CINEMA 4D™

MODELING • ANIMATION • RENDERING

XL

RELEASE 6

Reference Manual

CINEMA 4D™ XL

Reference Manual

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MAXON Computer
GmbH Max-Planck-Str. 20
D-61381
Friedrichsdorf
Germany

or for North and South America to:

MAXON Computer Inc.
566 St. Charles Drive, Suite 2
Thousand Oaks, CA 91360
USA

We also shall be glad to provide you with the address of your nearest supplier.

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Conny Herbst, Ulrike Kurz, Beate Losch

Preface

Manuals typically open by congratulating you on your superb choice of purchase, praising you for your infinite wisdom and good taste. Let us not be accused of breaking with tradition.

Congratulations! We are delighted you have chosen CINEMA 4D XL and we wish you every success with the program. Before we leave you to sip your champagne, please allow us to indulge in a little after-purchase speech.

Computer graphics has always been about passion. Those who are employed in this field are not, by and large, in it for the money, but are there to have fun too, to marry the financial needs of daily life together with the passion that is CG. It is with this same drive and enthusiasm that we have continued to develop CINEMA 4D for over 10 years. Throughout these years, listening to our customers has been at the very heart of our software development.

After all, the success of the program depends on you. Over 7,000 of your ideas and suggestions were evaluated for this version. Of these suggestions, almost all those that were made more than three times have been implemented, and the result is before you now.

We ask you, our valued customer, to submit yet more requests to us - we want to know what you need. You can send us your requests using the suggestion form on our website (www.maxon.net). Please continue to send us your ideas so that CINEMA 4D can remain *your* software.

We receive continual proof that listening to our customers works. Versions 4 and 5 alone received over 40 international awards, rave reviews and distinctions between September 1996 and December 1999. We intend to continue this wonderful tradition.

Much has changed since CINEMA 4D first saw the light of day in 1989. In the early days, many of our customers were ambitious computer enthusiasts creating animation in their spare time. Today our customers are mostly professional, almost exclusively so with the XL edition.

With the professional market comes added responsibility, so it is imperative that we supply you with the tools that help you most.

Two features, above all others, matter to professionals: stability and speed. You need a tool that you can rely on 100% to deliver these features, especially when tackling time-critical projects.

You need other features too, of course. The modeling tools have been enhanced greatly, the animation functions are cutting-edge (regardless of price-range) and the render quality has always been of the highest standard.

Now for some advice: please do yourself a big favour and read the manual (ignore anyone who tells you they never read manuals). We have placed great emphasis on making CINEMA 4D intuitive to use, but the sheer range of functionality makes it impossible for you to figure out everything for yourself. This manual documents all the functions in depth and includes many illuminating examples.

The one thing we cannot give you, of course, is ideas.

However, the Internet can help you here. For some time now the Internet has been home to a thriving international community of CINEMA 4D users. There are many discussion forums, where questions beyond the scope of technical support are answered promptly and efficiently by other users - more often than not you will receive several replies. You can also find tips, tricks, on-line tutorials, galleries, plug-ins and much more besides on the Internet. You can link to these sites from our homepage: www.maxon.net.

Enough of this preface - we hope you will enjoy using CINEMA 4D - now let's get down to work!

Michael Giebel, Friedrichsdorf, March 2000.

CINEMA 4D

MODELING • ANIMATION • RENDERING

1. Getting to Know

1 Getting to Know CINEMA 4D

Launching

There are several ways to start CINEMA 4D:

- Double-click on the program icon.
- Double-click on a scene file.
- Use the Start menu (Windows).

Alternatively, you can drag-and-drop one or more CINEMA 4D files from Explorer (Windows) or Finder (Macintosh) on to the CINEMA 4D application icon or directly into the program.

Template.c4d

If the CINEMA 4D root folder contains a scene named 'Template.c4d', this is loaded during startup and all the settings defined there become effective.

Quitting

File > Quit quits the program. If any unsaved changes are detected in the editor, a dialog asks you if you wish to save these before quitting.

Clicking on **Cancel** in this dialog returns you to the program.

Note

The layout can be saved automatically each time you quit the program - activate Save Layout at Program End on the General page of the General Settings.

Mouse Techniques

CINEMA 4D offers enhanced mouse functionality. The features that go beyond conventional mouse control are:

- You can simulate the right mouse button on the Macintosh with the Ctrl key held down. Alternatively, use a two-button mouse with the appropriate driver.
- If you wish to drag an object on to a window displayed as a tab but the window is concealed, drag and hold the object over the window's tab. After a short delay, the window will be activated and you can drop the object on the target.
- If you are using a wheel mouse, you can use the wheel to scroll sliders (such as a material's color and brightness sliders or the time slider). You can also use the wheel to increment/decrement numbers in numerical text boxes.

Hotkeys 1 to 7

You can use the following hotkeys in the view panel:

1	move camera
2	scale camera
3	rotate camera
4	move object
5	scale object
6	rotate object
7	scale model

The GUI

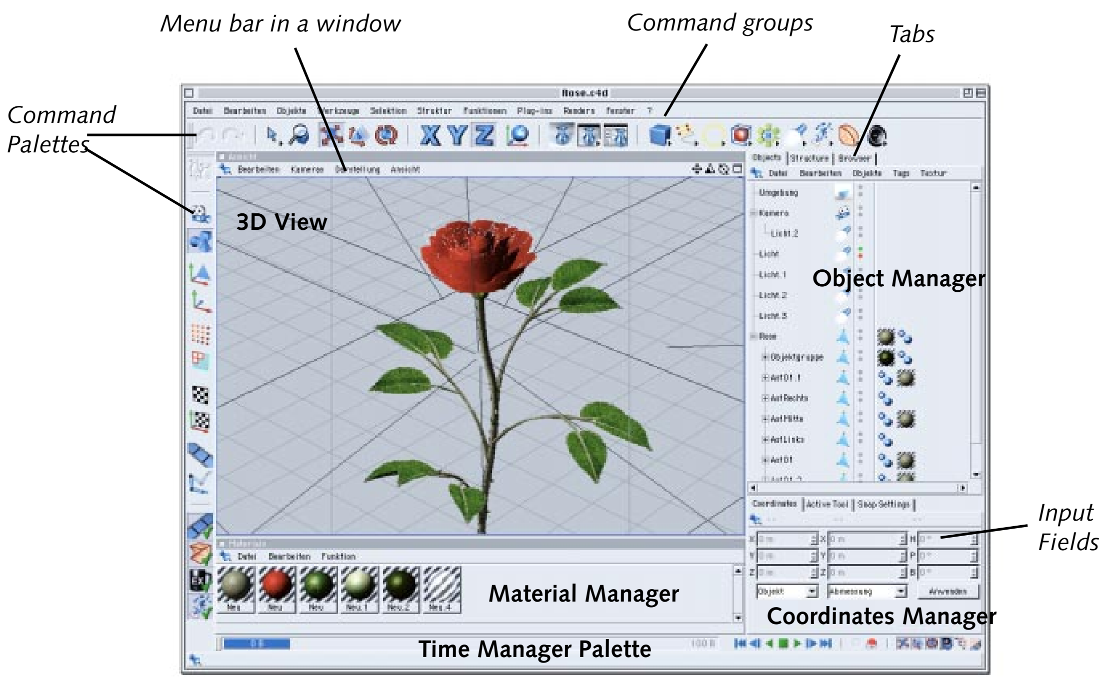
The CINEMA 4D GUI offers features far in advance of the standard Windows/Macintosh GUI. For example, you may dock all windows into the main window.

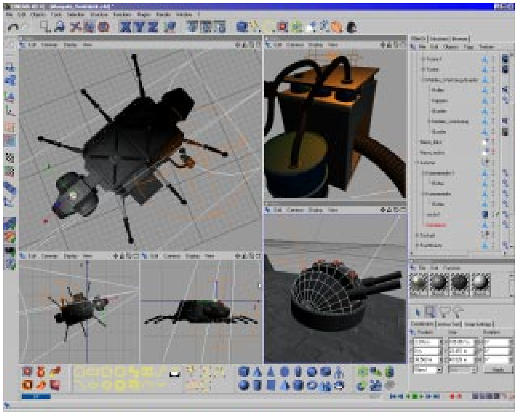
When a docked window is moved, the surrounding windows adapt so that no overlapping occurs. Each window has its own menu bar. Windows can also be displayed as tabs and grouped together to conserve display space.

The GUI is freely configurable. You can create your own icon palettes (including folded icons) and you can even edit the menus.

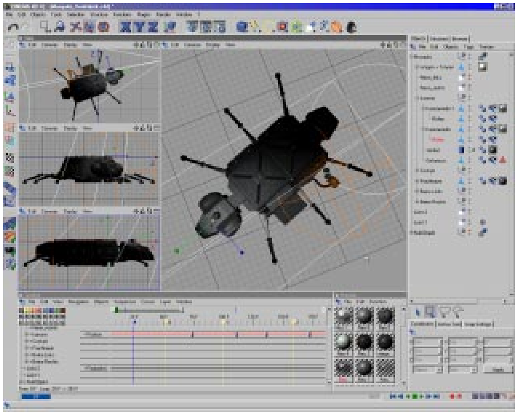
You can define various layouts and switch between them at will. For example, you may find it helpful to create a layout for modeling, a layout for texturing and a layout for animation.

A further powerful feature is that plug-ins can be integrated into the GUI and make use its features.

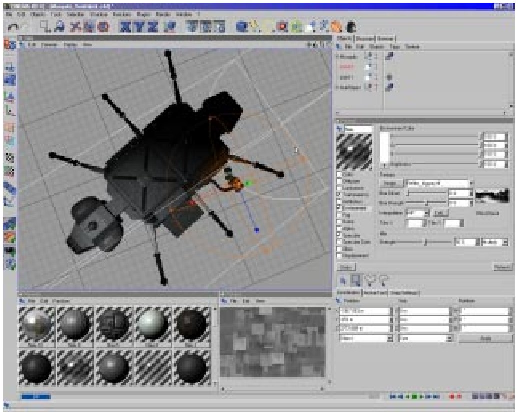




Example modeling layout



Example animation layout



Example texturing layout

A Quick Tour

In this section we take a look at the individual program elements that appear on the screen the first time you launch CINEMA 4D. This is merely a quick tour - the detailed descriptions come later in the corresponding chapters.

Managers

Managers are the main program elements in CINEMA 4D. Each manager has its own window and runs parallel to the other managers. This means that each manager can operate independently (so that it is *multithreaded*) - something of a rarity for application software. For example, you can render an animation in the picture viewer while you work in the editor!

Although the managers operate independently, each manager reacts immediately to changes made in other managers that affect it. For example, if you move an object in the editor, the corresponding values in the Coordinates Manager change.

Windows

Each manager has its own window. A window can be placed freely or it can be *docked* into CINEMA 4D's main window.

In the default layout, almost all the managers are docked. If you change the size of a docked window, the surrounding windows are adjusted automatically to avoid an overlap.

If you wish to undock a window from the group, click on its pin icon and select **Undock**. To re-dock the window, drag-and-drop its pin icon onto the main window. A black line will indicate the insertion position.

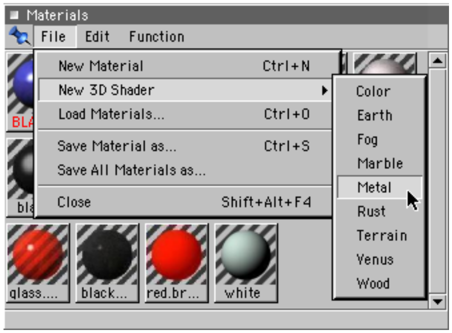
To change a window's size, first move the mouse pointer to its border. The pointer will change into a double arrow to indicate the direction (either vertical or horizontal) in which you can drag the border. Drag the window as required. The other windows in the group will adapt to the change.

Menu Bars

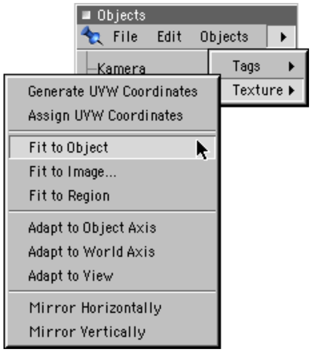
Each manager has its own menu bar.

Menu bars have the following features:

- Submenus.
- Commands that cannot be selected are grayed out.
- Activated options are indicated with a tick.
- All shortcuts, including those you have allocated yourself, are displayed.



If there is insufficient space to display the entire menu bar, a black triangle appears. If you click on the triangle, the other menu entries appear on a popup menu.



Command Palettes

There are two command palettes (aka icon palettes) in the default layout to house the most frequently used commands.

Some of the icons have a small black triangle to their lower right. This indicates a folded group. If you click and hold down the left mouse button on the icon, hidden icons appear. Folded groups take up minimal space and are a convenient way to group similar commands. The visible icon is usually the last command that you used. For more information on command palettes see Command Palettes, page 34.

Tabs

You can display windows and command palettes as tabs. For example, the Object Manager, Structure Manager and Browser are displayed as tabs in the default layout. This saves display space and allows you to reach a manager or command palette quickly.

If there is insufficient display space for all the tabs, one of the tabs will be *torn*. You can use the small arrow icons to the top right of the window to scroll through the tabs.

For more information on tabs see Tabs, page 33.

For details on the individual program managers, please see the corresponding chapters.

Context Menus

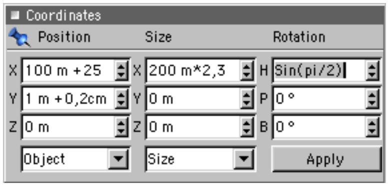
CINEMA 4D supports context menus. To activate a context menu, press the right mouse button (or Command-click for the Macintosh).

Input Fields

Input fields with two small arrows (one pointing up, the other pointing down) offer the following features:

- Click on an arrow to increment or decrement the value by one.
- If you click on an arrow and move the mouse up/down, the value increases or decreases rapidly.
- The wheel mouse is supported - position the mouse pointer in a box with a numerical value, then move the wheel to increase/decrease the value.

CINEMA 4D has a built-in expression evaluator which enables you to include mathematical operators in numerical boxes. See Appendix 1.



Perspective View

The perspective view is the heart of the program. This is where the 3D models are constructed (modelled) and animated.

Object Manager

The Object Manager contains all the scene elements (objects). Objects can be grouped hierarchically. For example, a leaf will be the child of a branch, which in turn is the child of the trunk while the tree is the main (root) object.

An object can be selected by clicking on its name in the Object Manager. This activates the object in the view panel, from where it can be moved and so on. You can use *tags* to allocate certain properties to objects in the Object Manager, such as color, texture and complex animation behaviour.

Material Manager

The Material Manager contains all the materials used in the scene. A double-click on a material opens its dialog so that it can be edited. You can apply a material by dropping it on to an object.

Browser

In the default layout, the Browser is displayed as a tab. The Browser is a library for all files that can be read by CINEMA 4D. You can drag-and-drop files from the Browser on to other managers to have them displayed there. For example, if you drag a scene on to the view panel, the scene is loaded; if you drag a scene on to the Material Manager, the scene's materials are loaded.

Coordinates Manager

You can use the Coordinates Manager for precision modeling or manipulation. For example, rather than scale an object in the view panel, you can enter the exact size in the Coordinates Manager. As with all numerical boxes, you may use mathematical operators too.

Time Manager Palette

Users of previous versions of CINEMA 4D will recognise this as the old time manager. It offers rudimentary, easy-to-use animation controls. For example, you can use the record button to record the position, size and direction of 3D objects.

The Time Line, which is the centre of animation control, is not open in the default layout. See page 547.

Active Tool Manager

This manager shows the settings for the active tool - the settings vary according to the tool. For a detailed description of the options, see the relevant tools chapter.

Snap Settings

Lots of different snap settings are supported. For example, you can snap to the grid or snap to other elements. For more information on snap settings see page 383.

CINEMA 4D

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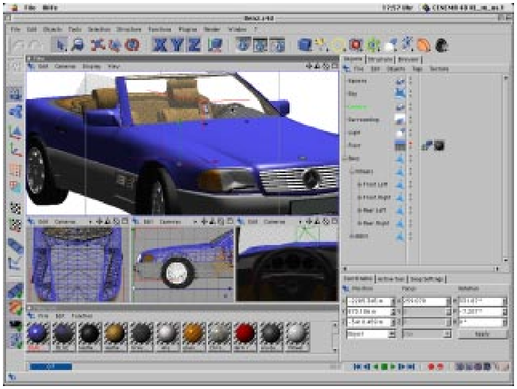
2. View Menu

2 View Menu

View Panels

You can open as many view panels as you like. Each view panel has its own display settings.



A view panel can show up to four views simultaneously. Each of these views has its own display settings.

View Icons

There are four icons at the top right of each view. The right-most icon toggles the active view (see Toggle Active View, page 24). The remaining icons move, zoom and rotate the camera (click-drag on the icon you require to see the effect).

Edit

Undo View/Redo View

Each view has its own **Undo View/Redo View** functions (the **Undo/Redo** functions of the main window do not affect editor cameras).

Note

The shortcut for Undo View is Ctrl+Shift+Z. For Redo View, use Ctrl+Shift+Y.

Frame

Frame Selected Elements

The camera will move so that the selected elements (e.g. objects, polygons) fill the view and are centred.

Frame Active Object

The camera will move so that the active object fills the view and is centred.

Frame Scene Without Camera/Light

The camera will move so that all objects (bar lights and cameras) fill the active view and are centred.

Frame Scene

The camera will move so that all objects, including lights and cameras, fill the active view and are centred.

Frame Default

This function resets the view to its default values.

Use as Render View

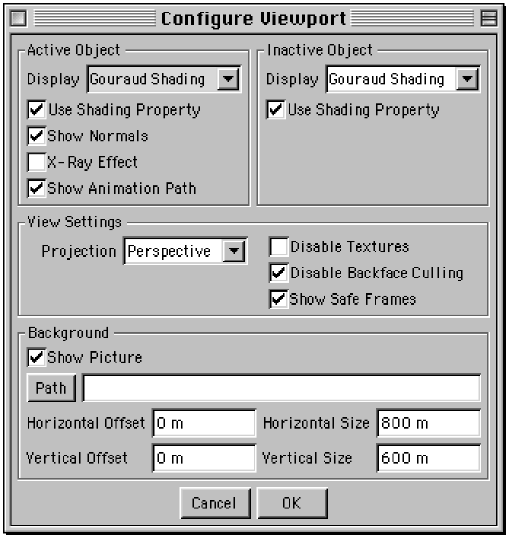
If this option is activated, the active camera of the active view is used for the rendering in the Picture Viewer.

Redraw

This function redraws the scene. This is useful when CINEMA 4D has been unable to complete the editor picture automatically. This may happen, for example, when you call functions in quick succession.

Configure

If you select **Configure**, the view's configuration dialog will open.



Active Object

Display

Display sets the display mode (e.g. Gouraud shading, wireframe) for the active object, although see **Use Shading Property** below.

Use Shading Property

If this option is activated, the active object will use the display mode defined in its display tag instead of the setting defined in this dialog.

Show Normals

If you enable this option, surface normals will be shown when you select polygons. The normals appear as small auxiliary lines which are perpendicular to their surface. By convention, the direction of a normal represents the direction of its surface. For example, *backface culling* checks the direction of each normal to determine whether its surface should be drawn - if the normal points away from the camera, the surface is not drawn (the surface is assumed to point away from the camera, just like its normal).

X-Ray Effect

To activate the X-ray mode, select this function. If the active object is a polygon object, it will become semi-transparent so that you can see its concealed points and edges.

Show Animation Path

If this option is selected, the active object's animation path will appear in the editor in the form of a yellow curve. You may edit the animation path in the same way you would edit a spline - e.g. you can drag spline points to new positions and edit the tangents. This enables you to edit the animation path without editing the keys themselves.

Inactive Object

Display

Display sets the display mode (e.g. Gouraud shading, wireframe) for the inactive objects in the scene.

Use Shading Property

If this option is activated, the inactive objects will use the display mode defined in their display tags instead of the setting defined in this dialog.

View Settings

Projection

You can use this setting to change the projection type (e.g. to Perspective, Bird, Dimetric).

Disable Textures

Select this option if you wish to switch off realtime texture mapping.

Disable Backface Culling

You can select this option to switch off backface culling.

Note

Backface culling merely hides an object's concealed points and edges. For example, if you are using the wireframe display mode, you can still see an object when it is behind another object.

Show Safe Frames

This activates the safe frames (Render Safe, Action Safe, Title Safe), although they must be activated in the General Settings as well in order for them to be displayed.

Show Picture

If you wish to place a background picture in a planar view (e.g. front, top, right), click on the **Path** box and use the dialog that opens to locate the picture. Next, activate the **Show Picture** option. You can use the horizontal and vertical offset and size boxes to move and scale the background picture freely. This background picture is a modeling aid - it is not intended for rendering. You can place a different picture in each planar view.

Cameras

Each view has its own camera. The editor camera is used by default, but you may create and use your own cameras via the Object Manager.

Scene Cameras

You may activate your own camera (see page 188) by selecting it from this list.

Link Active Object

If you select this function, you will view the scene from the origin of the active object. This can be any type of object, even a light source. However, if the object has surfaces, the view may be obscured!

Editor Camera

This function activates the editor camera.

Projection

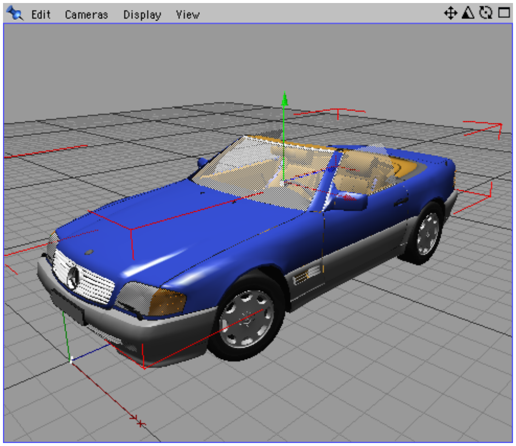
You can choose from over a dozen projection modes. A detailed technical explanation for each projection type is beyond the scope of this manual. However, the pictures highlight the key differences visually.

Warning!

The camera position may alter when you change the projection mode. You can avoid this by selecting the view (e.g. View 3) from the View menu.

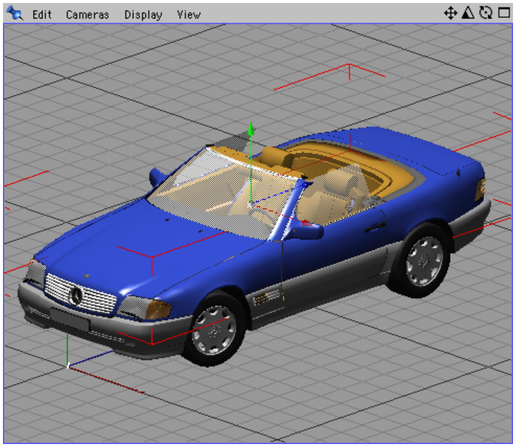
Perspective

This is the default projection mode for the view panel. It operates in a similar fashion to a real camera.



Parallel

With parallel projection, the vanishing point is infinitely distant. As a result, the picture appears to have no vanishing point and all lines are parallel.



Left

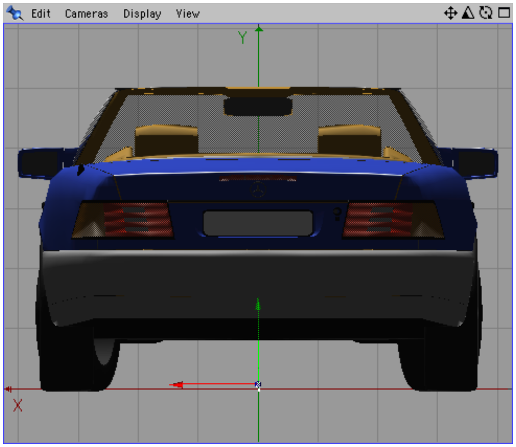
This function selects the YZ (left) view.

Right

This function selects the ZY (right) view.

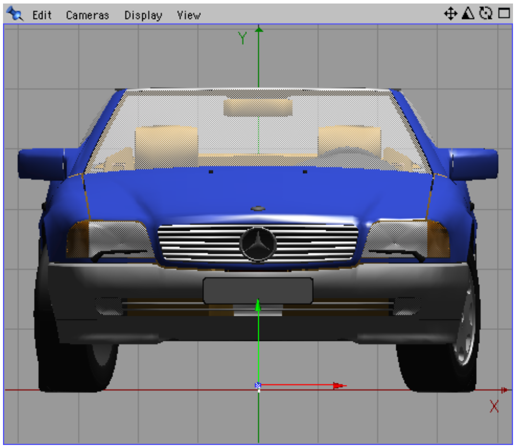
Back

This function selects the YX (back) view.



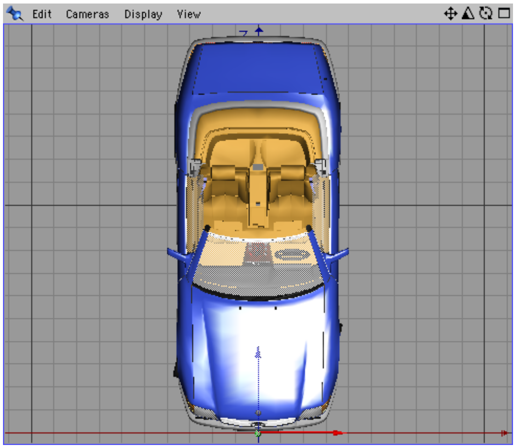
Front

This function selects the XY (front) view.



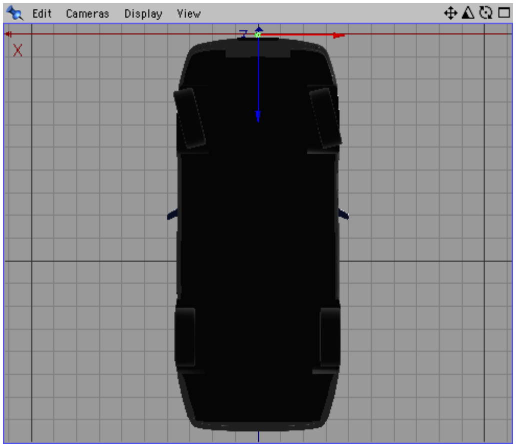
Top

This function selects the XZ (top) view.



Bottom

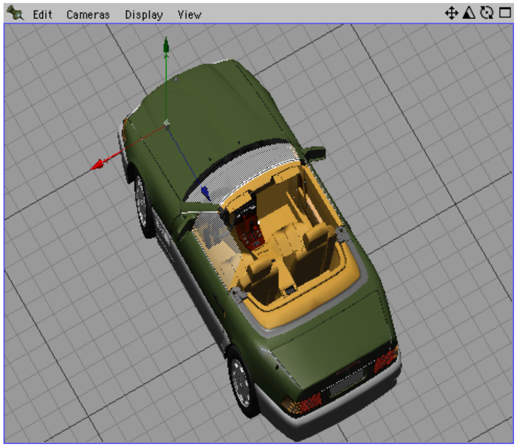
This function selects the ZX (bottom) view.



The following projection types all use parallel projection. They differ in the format and/or viewing angle.

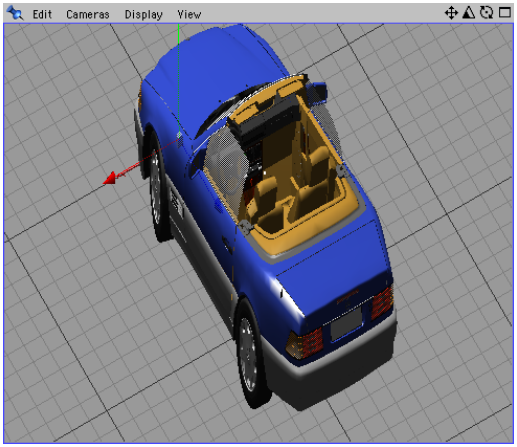
Military, Frog and Bird projection share the same viewing angle but use different formats...

Military



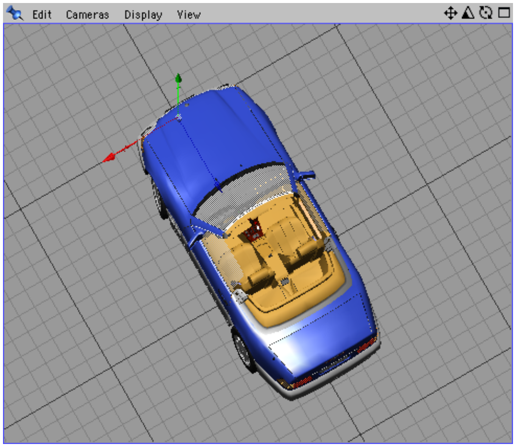
X:Y:Z = 1:1:1

Frog



X:Y:Z = 1:2:1

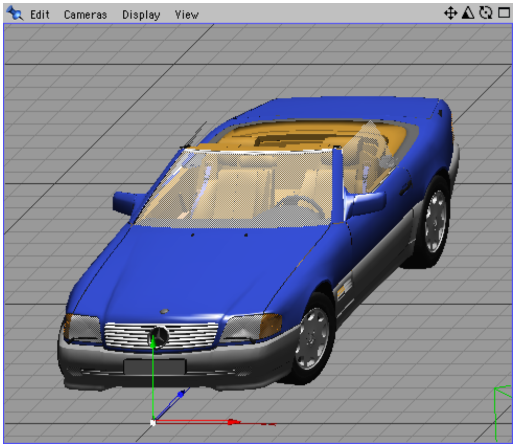
Bird



X:Y:Z = 1:0,5:1

Gentleman

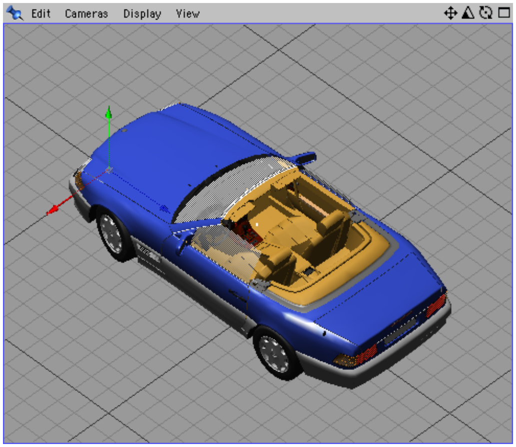
This is a popular choice for architecture.



X:Y:Z = 1:1:0,5

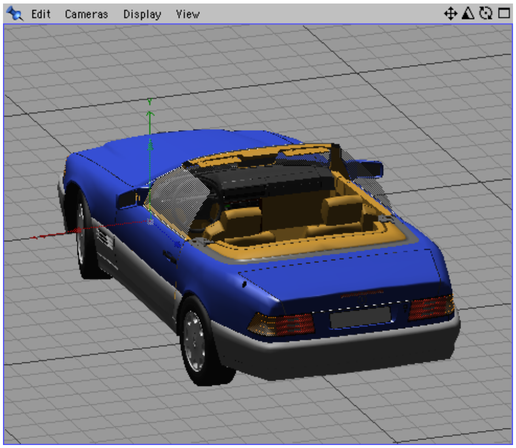
Isometric

This is a popular choice for technical subjects (e.g. machinery). The X:Y:Z format is 1:1:1.



Dimetric

This is similar to Isometric, but with an X:Y:Z format of 1:1:0.5.



Display

This sub-menu lists display options such as the shading mode. You can, in addition, activate realtime antialiasing from the Window tab of the General Settings - provided that you are using an OpenGL card which supports this feature.

Level Of Detail

Choose from **Low**, **Medium** or **High**. The setting affects the amount of detail shown on each object for the selected display type; the lower the detail, the faster the display.

Gouraud Shading

Gouraud shading offers the highest quality display mode in the editor. All objects are shaded with smoothing and light sources are evaluated for the shading.

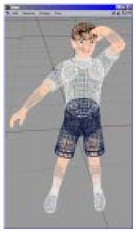
The redraw rate is affected most by the processor speed and graphics card speed. If the display becomes too slow, try reducing the view size.

Quick Shading

Quick shading is almost identical to Gouraud shading (see above). The only difference is that the auto light (see page 424) is used to calculate the shading values - all lights in the scene itself are ignored. This can lead to a faster redraw rate, since only a single light source (the auto light) is evaluated.

Wireframe

If this mode is selected, objects are displayed as lines. This can be particularly effective for an overview of complex scenes, especially when used with backface culling (see page 21). This mode is drawn very quickly.



Isoparms

This mode displays isoparm lines for those objects which make use of them (e.g. NURBS objects). Other objects, such as polygon objects, will be displayed in wireframe.

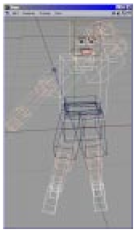
The isoparm display mode is very fast and is particularly suited to complex scenes.

Shaded Box

This mode displays each object as a shaded box. Each box has the same dimensions as the object it represents. This mode is drawn very quickly, even with complex scenes. It can be useful for character animation or for navigation in large scenes.

Box

This mode displays each object as a wireframe box. Each wireframe box has the same dimensions as the object it represents. This mode is exceptionally fast, making it suitable for the most demanding scenes.



Skeleton

This is the fastest display mode of all, but it is only suited to hierarchical structures. Each object origin is shown as a small dot and these dots are connected with lines according to the hierarchy. This mode is particularly useful for character animation, not only for its speed, but also because it removes all non-critical lines to expose the all-important skeleton.

Use Shading Property

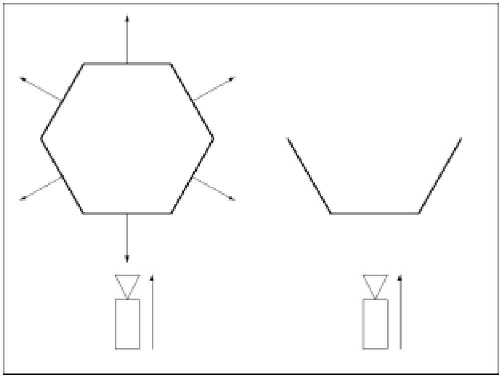
If this option is activated, objects will use the display mode defined in their display tags instead of the general display setting. Objects that do not have a display tag will continue to use the general setting.

Backface Culling

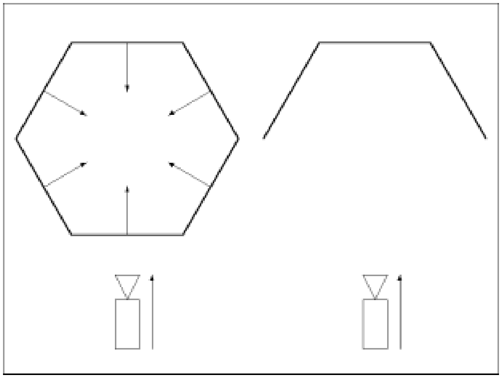
If you activate backface culling, backfaces are not drawn in the editor. This can speed up the display as well as hide concealed surfaces.

A backface is a surface which points away from the camera. CINEMA 4D can tell in which direction a surface points by examining its surface normal.

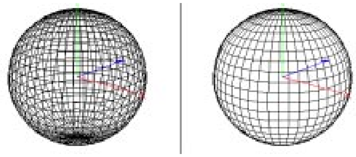
If the surface normal points towards the camera, the surface is a frontface. If the surface normal points away from the camera, the surface is a backface and is not drawn if this option is activated. The following picture demonstrates the backface principle:



By convention, the normals should point outwards from their surfaces. If your object has normals that point inwards on the object, display errors may arise. In this case, reverse the normals (see Structure Manager, page 379).



The following picture shows how backface culling hides concealed surfaces (backfaces). The object on the left does not use backface culling, the object on the right does.



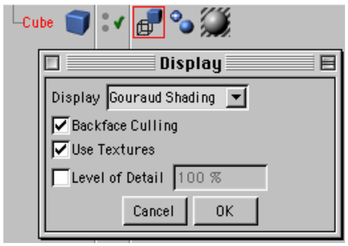
Textures

CINEMA 4D's realtime texture mapping (RTTM) enables you to see textures in the view panel in realtime - even without an OpenGL card! To activate RTTM mode for a particular view, select the **Textures** option from its **Display** menu. The textures will only be visible with Gouraud shading or quick shading.

RTTM can display the following material properties:

- Color textures
- Highlights
- Bump map
- Alpha channel
- Transparency

You can use a display tag in the Object Manager to activate or deactivate RTTM for each object (**File > New Tag > Display Tag**).



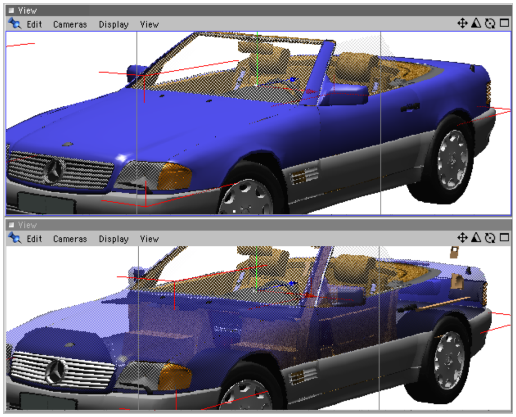
Activating and deactivating RTTM

RTTM is an approximation of the rendered result. RTTM may, under circumstances, differ substantially from the final result, especially for large surfaces which extend towards the horizon.

X-Ray

To activate the X-ray mode, select this function. If the active object is a polygon object, it will become semi-transparent so that you can see its concealed points and edges.

This is particularly helpful in polygon-based modeling, since it enables you to see concealed surfaces in the Gouraud shading and quick shading modes.



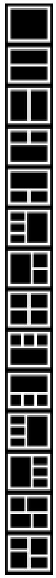
View

Each view panel can have up to four views. Each of these views may have its own:

- camera
- projection type
- display mode

View arrangement

You can choose a single-view mode or all-views mode. The arrangements on offer are:



Single-View
2 Views Stacked
2 Views Side by Side
3 Views Top Split
3 Views Bottom Split
3 Views Left Split
3 Views Right Split
4 Views
4 Views Top Split
4 Views Bottom Split
4 Views Left Split
4 Views Right Split
4 Views Stacked
4 Views Side by Side

Each view may have its own camera, projection type and display mode.

Note

These settings are saved automatically when you save the document.

Toggle Active View

This option toggles between the single-view mode and the all-views mode. When toggling from all-views to single-view, select the option from the target view (the view that you wish to see next).

View 1 - View 4/All Views

Here you can switch between the single-views and the all-view mode.

You can change each view's projection type via its **Cameras** menu. The default projections are:

View 1	F1	perspective
View 2	F2	top
View 3	F3	right
View 4	F4	front
All Views	F5	all views

CINEMA 4D

MODELING • ANIMATION • RENDERING

3. Configuration

3 Configuration

If you have upgraded from version 5 of CINEMA 4D, you will know that many things have changed in version 6. Hundreds of new functions have been added and many of the version 5 functions have been enhanced.

We have taken great care during the entire development stage to ensure that CINEMA 4D remains easy to use despite this great increase in functionality.

One of the many new features is enhanced configuration power, the downside of which is that there are many more settings. However, there is no enormous Options menu or gargantuan Settings dialog for you to wade through every time you want to change something. Instead, we have placed the options where they most make sense. Not only does this hide their sheer number from you, they are also easier to find as a result.

This chapter provides you with an overview of the settings. There is also a detailed description for each setting or a reference to another chapter (some settings are best explained in other chapters, e.g. the render settings are documented in the Render Menu chapter).

Overview

The Configuration Dialogs

CINEMA 4D's configuration dialogs are listed below. In each case we tell you where you can find the dialog and what, in general terms, the dialog controls.

General Settings

These are global settings that apply to the program as a whole. For example, you can use these settings to change the colours used in the editor window. The settings apply to all open documents.

The general settings can be accessed from the Edit menu of the main window. They will be saved when you quit CINEMA 4D.

The general settings are described in detail later in this chapter. See page 42.

Project Settings

These are local settings that apply to the active project only (the active project is the one that is currently shown in the main window). For example, you can use these settings to change the frame rate of the animation.

The project settings can be accessed from the Edit menu of the main window. You can also call the project settings from the menu of the same name in the Time Line. Both items open the same dialog. The project settings are saved when you save the scene.

The project settings are described in detail later in this chapter. See page 42.

Viewport Settings

These are local settings that configure the viewport for the active scene. For example, you can use these settings to determine the shading mode for active objects and inactive objects.

The viewport settings can be accessed from the Edit menu of each viewport (select **Configure**). They are saved when you save the scene.

The viewport settings are described under Configure, page 14.

Render Settings

These are local settings that affect the output of the active scene. For example, you can use these settings to switch shadows on or off.

The render settings can be accessed from the Render menu of the main window. They are saved when you save the scene.

These settings are described in detail in Render Settings, page 407.

Import/Export Settings

These are global settings that affect the importing and exporting of files. For example, you can use these settings to scale objects that are imported in 3DS format.

The import/export settings can be accessed from the File menu of the main window. They are saved when you quit CINEMA 4D.

The import/export settings are described in detail on page 74.

Browser Settings

These are global settings that relate to the display of thumbnails in the Browser. For example, you can use these settings to determine which file formats are shown.

The Browser settings can be accessed from the Edit menu of the Browser. They are saved when you save the scene. However, you can prevent the Browser from loading the settings by deactivating the **Load Manager Settings** option in the general settings.

The browser settings are described in detail on page 64.

Snap Settings

These are global settings which you can use to specify the snap behaviour. For example, you can use these settings to snap to points.

The snap settings can be accessed from the Window menu of the main window. They are saved when you save the scene.

The snap settings are described in detail on page 381.

The Configuration Managers

Command Manager

You can use this manager to edit the existing palettes, create your own palettes or define new shortcuts.

You can access the Command Manager from the Window menu of the main window. The settings are saved when you quit CINEMA 4D.

The Command Manager is described in detail later in this chapter. See page 38.

Note

The shortcuts will be saved when you quit CINEMA 4D.

Menu Manager

You can use this manager to create your own menu structure for each manager.

You can access the Menu Manager from the Window menu of the main window. The settings are saved when you click on the **Save All Changes** button in the Menu Manager dialog. They are also saved when you quit CINEMA 4D.

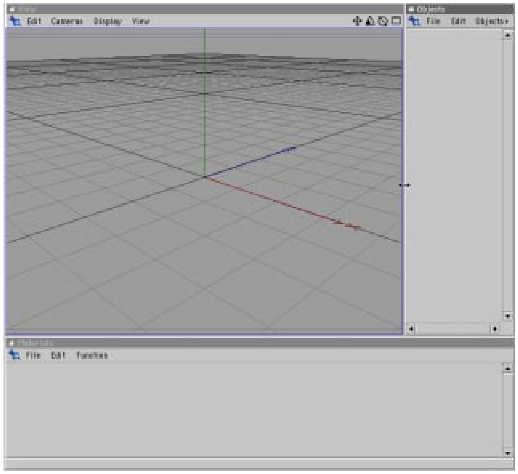
The Menu Manager is described in detail later in this chapter. See page 40.

Other Settings

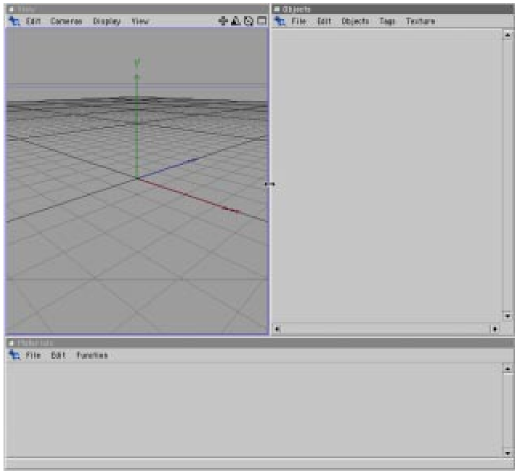
There are many settings in addition to those mentioned above. For example, you can select the time curve mode in the Time Line.

These settings are always saved in the scene file. However, you can prevent them from being loaded into the managers by deselecting the **Load Manager Settings** option in the general settings.

Each setting is described in detail in the chapter for the corresponding manager.



Before moving the edge of the window



After moving the edge of the window

Graphical User Interface

The Main Window

The main window in where the managers and command palettes meet each other. If the size of the main window or a docked window is changed, all the other windows in the group adapt to the change. The main window is simply a group of windows and palettes. You can create your own group to suit your needs (see Undocking below).

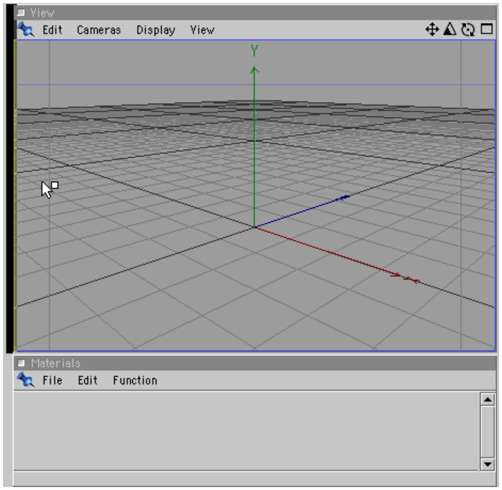
Changing The Size Of Windows

To change the width or height of a window, first move the mouse to a window border. The mouse pointer will change into a double arrow to indicate the direction (either vertical or horizontal) in which you can drag the border. Drag the window as required. The other windows in the group will adapt to the change.

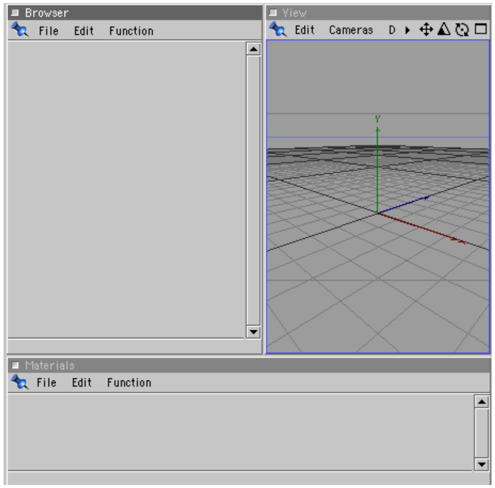
Changing The Window Order

To change the window order, drag the pin icon using the mouse. A dark line will appear to indicate the point at which insertion will take place.

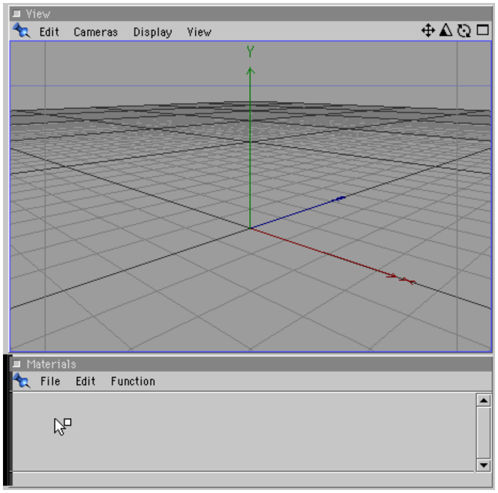
The following picture-pairs demonstrate just a few of the layouts that are possible. For each pair, the picture to the left shows the state before the movement, while the picture to the right shows the state after the movement.



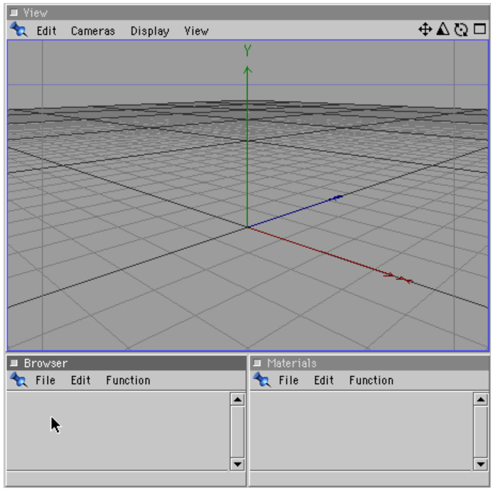
Before



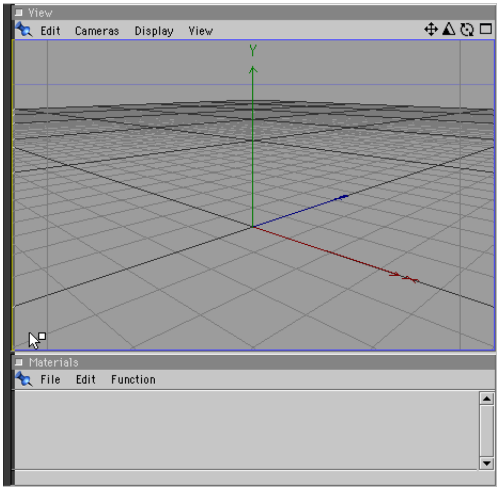
After



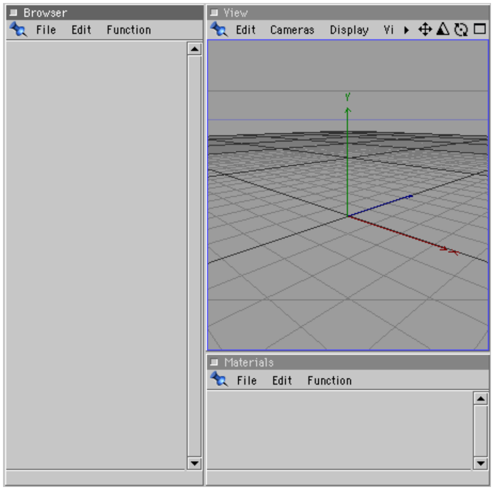
Before



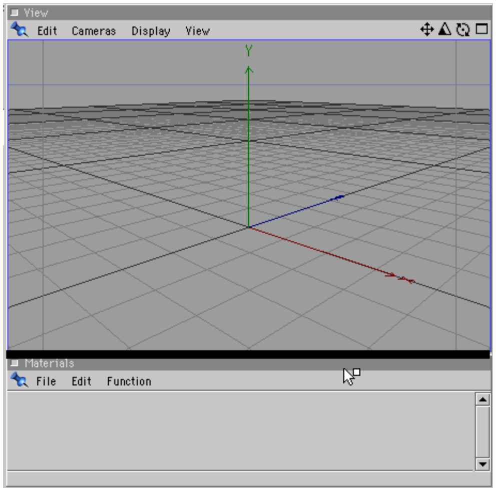
After



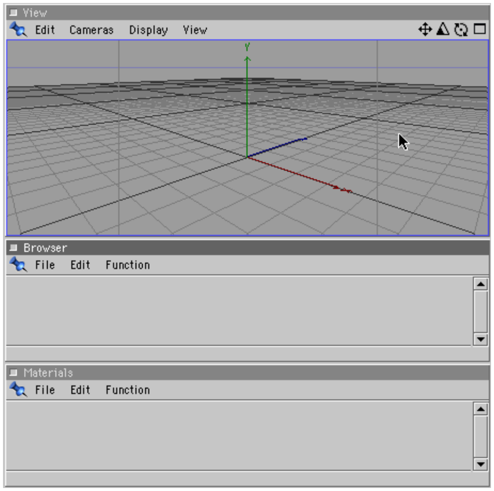
Before



After



Before



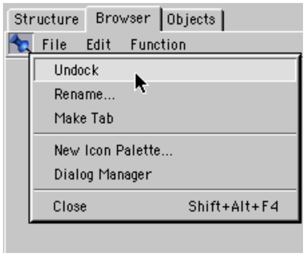
After

Note

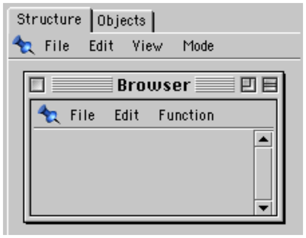
You can load a previously saved layout or revert to the default layout at any time. See Working With Layouts, page 56.

Undocking

You can undock a window to separate it from a group. To do this, click on the pin icon and select **Undock** from the menu. The window is removed from the group and becomes a separate window.



Click on Undock



Undocked window

Note

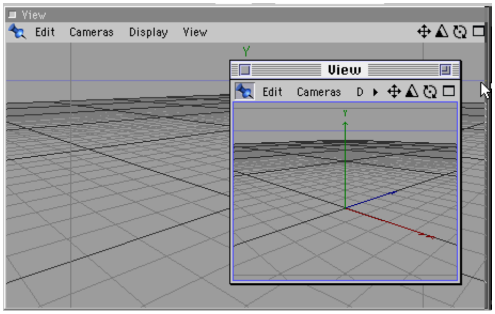
You can insert a window or a command palette into an undocked window to create a new group. This is particularly useful if you are using more than one monitor.

Undocked windows are fully functional, although you do lose the advantage of automatic justification.

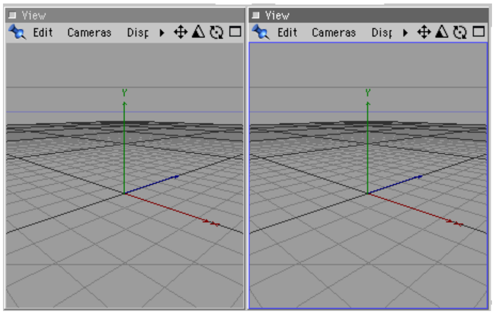
Docking

You can dock a new window (new windows are undocked by default) into a group at any time. To do this, click on the pin for the new window and drag it to the required position in the docking window. A dark line will indicate the insertion position.

Try adding a second 3D view for practice: Select **Window > New View Panel** in the main window. Drag the pin for the new window and drop it wherever you like, e.g. between the Object Manager and the Coordinates Manager (check that you can see the dark line before you release the mouse). You can remove the window by undocking it and then closing it (click on the pin to select the **Undock** and **Close** commands).



New view, still undocked



Here the new view is docked

Rename

This function in the pin's menu allows you to rename the window or command palette. The name of a command palette is visible in the interface only when it is defined as a tab.

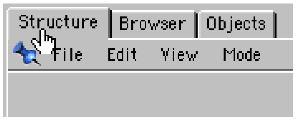
Tabs

Creating Tabs

You can display a window or command palette as a tab. To create the tab, click on the pin icon and select **Make Tab**.

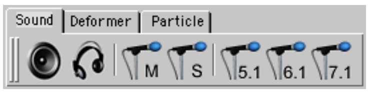
Grouping Tabs

You can remove a tab from one group and insert it into another group (the *target* group). To do this, drag the tab's pin and drop in on to a tab or pin in the target group. The mouse pointer will change into a hand to indicate when the insertion is possible.



If you drop the tab on to a pin, it will be inserted after the tab that the pin belongs to. If you drop the tab on to a tab, it will be inserted before it provided that the hand icon is released on the left half of the tab; otherwise, it will be inserted after the tab.

Do not forget about the command palettes - they make great tabs too!

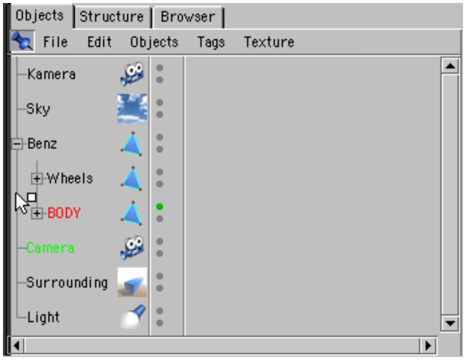


Note

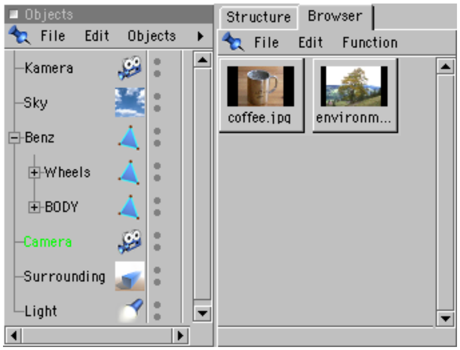
If you drop a pin on to another pin (the target), both will become tabs, even if the target was not a tab.

Converting Tabs Into Windows

You can convert a window defined as a tab into a freestanding window. To do this, drag the tab's pin slightly to the left and release the mouse button.



Here the Object Manager gets undocked



The undocked Object Manager

Command Palettes

A command palette can contain any command that can be selected from a menu. The command palette can show the commands as icons, text or as both icons and text.

Command palettes help you reach important commands quickly. You can edit the default palettes and create completely new palettes. You can dock new palettes into the layout.

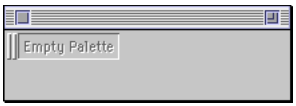
Note

An undocked palette is a window in its own right. For example, it can contain several command palettes and windows. This is particularly useful if you are using more than one monitor.

Creating A New Command Palette

To create a new (empty) command palette, either:

- select **Window > Layout > New Icon Palette** (main window)
- click on any pin icon and select **New Icon Palette** from the pin's menu
- click the right mouse button within an existing command palette (e.g. the default palette to the left of the main window) and select **New Icon Palette** from the context menu

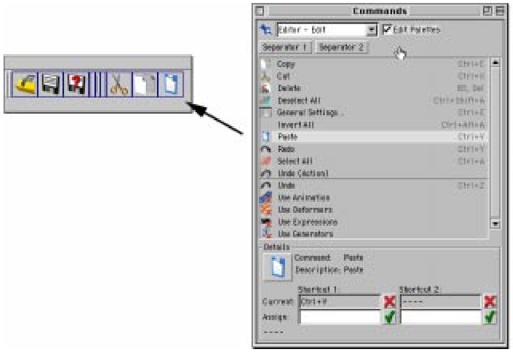


New command palette, still empty

There are two ways to add commands to the command palette. You can either drag-and-drop commands from an existing palette (e.g. the default palette to the left of the main window) or you can drag-and-drop commands from the Command Manager (choose **Window > Command Manager**).

You must activate the **Edit Palettes** option in the Command Manager before you can add commands. Once the **Edit Palettes** option is selected, drop the first command on to the empty palette box of the new command palette. When you drag-and-drop further commands on to the palette, a dark line will appear to demonstrate where the command will be inserted. To open the context menu for the command palette, position the mouse pointer on an icon and click the right mouse button.

The Command Manager is described in detail later in this chapter.



This is the way that a command is added to the new palette

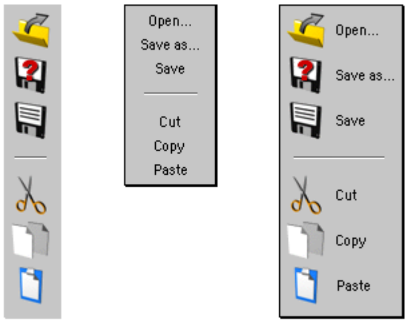
Changing The Sequence

To move a command to a different location in the palette, drag-and-drop the command to the new position (a dark line will indicate the insertion position).

Icons / Text

You can reach these two settings via the command palette's context menu (position the mouse pointer over a command and click the right mouse button).

If the Icons option is selected, icons will be shown for the commands. If the Text option is selected, text will be shown for the commands. If both options are selected, icons and text are shown for the commands.



Different combinations of command palettes

Vertical

You can reach this setting via the command palette's context menu (position the mouse pointer over a command and click the right mouse button).

If this setting is activated, text will be displayed below each icon instead of to the right (provided that Icons and Text are also activated).

Command Alignment (Horizontal vs Vertical)

You can reach this setting via the command palette's context menu (position the mouse pointer over a command and click the right mouse button).

Select Transpose to toggle the alignment of the commands between vertical and horizontal alignment.

Rows / Columns

You can reach this setting via the command palette's context menu (position the mouse pointer over a command and click the right mouse button).

The value you set here defines the number of rows or columns for commands. Think of this as the number of lines. For example, if you have 20 commands, setting this value to 2 will create 2 lines with 10 commands in each line. A value of 3 would create three lines (this time with 7 commands in the first two lines and 6 commands in the final line).

If you are using vertical command alignment, this setting refers to the number of columns. If you are using horizontal command alignment, this setting refers to the number of rows.

Alignment in rows or columns

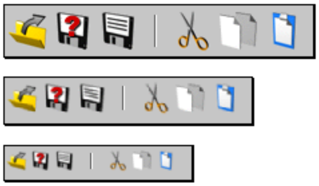
Icon Size

You can reach this setting via the command palette's context menu (position the mouse pointer over a command and click the right mouse button).

You can use this setting to change the size of the command icons. The sizes you can choose from are:

Large	32 by 32 pixels
Medium	24 by 24 pixels
Small	16 by 16 pixels
Original	original icon size (see below)

The original icon sizes are defined in the icon resource file ('Resource/icons/c4d_icons.res'). The original sizes usually correspond to Large icons.



The different icon sizes

Note

If an icon is displayed at a different pixel size to its original size, it must be resampled. This may lead to a visible loss in picture quality.

Creating Folded Palettes

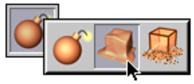
You can group commands to form a *folded* palette. To do this, ensure that the Edit Palettes option is active, then position the mouse pointer over a command and click the right mouse button to open the context menu. Choose Fold Palette.

Now, only one command is visible. This is called the *visible command*. The little arrow towards the bottom right of the icon indicates that it contains a folded menu.

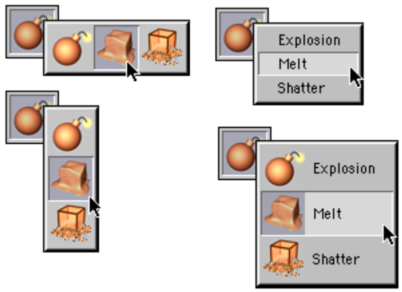
Next, deactivate the Edit Palettes option. Click and hold down the left mouse button on the visible command. The folded palette appears.

You can either release the mouse button and then click on the required hidden command, or you can move the mouse pointer over the required command before you release the mouse button. Note that the visible command is also a hidden command.

If the Lock Icon command of the context menu is not selected, the visible icon will always be the last command that you selected. For example, if the visible command is Cube and you select the hidden Cone command to insert a cone in the scene, the cone will become the visible command.

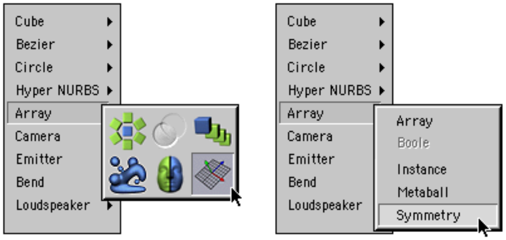


The order of the commands in the folded palette corresponds to their order before they were folded. You should arrange the commands before you fold them.



You can drag-and-drop a visible command on to another palette. This enables you to use several folded groups within the same palette. To create a palette with several folded command groups: Create two empty command palettes. Use the first palette to create a folded command group, then drag-and-drop the folded commands (i.e. the visible command) on to the second palette. Next, create the second folded group in the first palette, then drag-and-drop it on to the second palette, and so on. Once the process is complete, close the redundant palette.

You can also use text-only display with folded palettes.



Unfolding icons

You can unfold a folded group of commands into a palette of individual commands. To do this, select **Unfold** from the context menu (click the right mouse button on the visible command).

This command can be selected only when the **Edit Palettes** option is active.

Lock Icon

If this command of the context menu is not activated, the visible command for a folded group of commands will always be the last command that you selected. For example, if the visible command is Cube and you select the hidden Cone command to insert a cone in the scene, the cone will become the visible command.

If this command is activated, the current visible icon will be locked, meaning that no matter which tools you go on to use from the folded palette the visible command remains the same.

This command can be selected only when the **Edit Palettes** option is active.

Delete Command

You can delete a command from the palette. To do this, move the mouse pointer over the command that you wish to delete, then hold down the right mouse button and select **Delete Command** from the context menu.

This command can be selected only when the **Edit Palettes** option is active.

Edit Palettes

You must activate the **Edit Palettes** command before you can make changes to palettes. You can reach this setting via the context menu (right mouse button over a command) or via the Command Manager (**Windows > Command Manager** in the main window).

Save / Load Palette

You can save a palette using the **Save Palette** command of the context menu (right mouse button over a command). The file will be appended with '.p4d'. You can load a palette with the command **Load Palette**, which you can also select from the context menu.

If you save a palette in the 'prefs' folder, it will be listed in the **Window > Layout** menu (main window). To load it, select the palette from the list.

Note

The palettes will be saved automatically when you save the layout. To save the layout, choose

Save Layout As or Save Default Layout from the Window > Layout menu (main window).

Save Palette is more convenient if you are defining complex command palettes or transferring palettes between layouts.

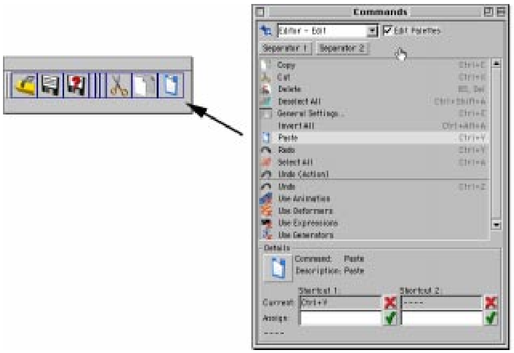
The Command Manager

The Command Manager contains lists of all the commands in CINEMA 4D. You can use this manager to drag-and-drop commands in order to create your own command palettes or submenus (see The Menu Manager, page 40). You can also use the Command Manager to define short-cuts.

Inserting Commands In Palettes

First, select the **Edit Palettes** option. Next, drag-and-drop commands on to the palette. A dark line will indicate where a command will be inserted.

You can also drag-and-drop separators on to palettes to visually separate commands into logical groups. **Separator 1** is a line, **Separator 2** is a space. Simply drag-and-drop these separators on to the palette. Again, a dark line will appear to indicate the insertion point.



This is how you add separators to the new command palette

You can use the popup menu to the right of the pin to select which command category is displayed in the list. Each category refers to a particular menu or manager.

You will notice that some commands do not have icons. This is because these commands were difficult to represent as icons and we did not wish to cause undue stress to Joern, the icon designer.

Note

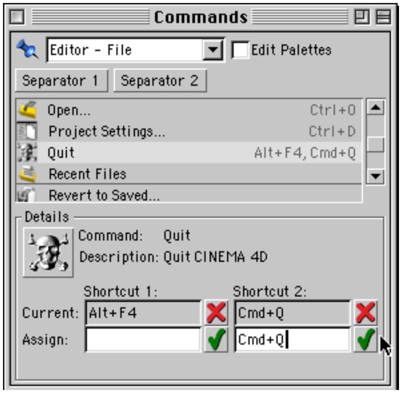
The icons were rendered in CINEMA 4D.

Allocating Shortcuts

You can allocate a shortcut to any command so that you can press a simple key sequence to call the command rather than select it via a menu or palette.

For example, if you press Ctrl-B, the render settings dialog will open. You use the Command Manager to allocate the shortcuts. You can also use the Command Manager to define a second shortcut for the same command.

This can be useful when two keys are logical alternatives for a particular command. For example, the delete and backspace keys are both shortcuts for the **Delete** command. The second shortcut is also useful for standard commands which have different shortcuts under Windows and Mac OS.



To create a shortcut:

Select the command from the list in the Command Manager by clicking on it with the left mouse button.

Next, click on the first text box to the right of **Assign:**. Press the key combination that you wish to assign to the command.

Click on the green tick to the right of the text box to activate it. The short-cut will appear in the **Current:** box. To remove the shortcut, click on the red cross icon.

Valid shortcuts are:

- a single key
- a key + Ctrl
- a key + Shift
- a key + Ctrl and Shift

Note

Some keys are reserved and cannot be allocated as shortcuts (e.g. left arrow, right arrow).

CINEMA 4D's *hotkeys* are extremely useful. For example, if you hold down the 1 key you can move the camera, no matter which tool is active. The hotkeys come at a price - you cannot use them with shortcuts, even if you combine them with Ctrl and/or Shift.

If a shortcut has already been allocated, the command that uses the shortcut will be displayed below the text boxes. You should remove the shortcut before reallocating it (to remove the shortcut, select the command that it is currently allocated too, then click on the red cross icon).

It is not possible to predict the effect of pressing a shortcut that is applied to more than one command.

Note

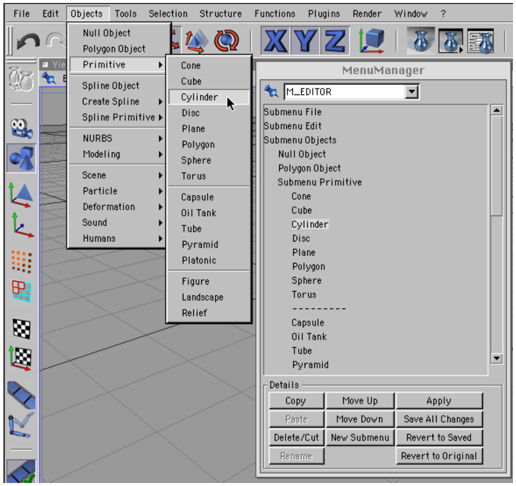
The shortcuts are saved in the layout.

Warning!

Do not attempt to allocate shortcuts that are used by OS commands, e.g. Ctrl-Alt-Del (Windows).

The Menu Manager

You can use the Menu Manager to edit submenus and popup menus. You can also create your own submenus.



The menus in the Command Manager and how they 'look' in the program

The Menu Manager and the Command Manager allow you to configure your very own CINEMA 4D interface, fine-tuned to the way you like to work.

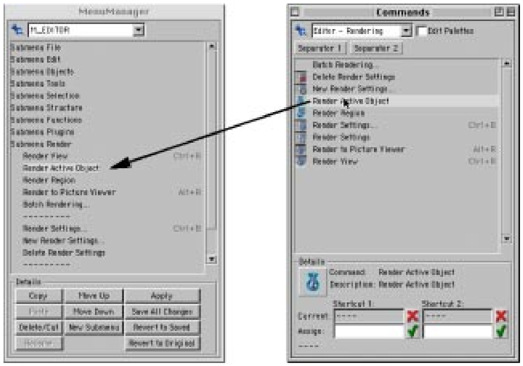
The Menus

CINEMA 4D has more than 25 menus and popup menus. Use the popup menu at the top of the manager to determine which menu is shown in the list.

Submenus are prefixed with Submenu. To open or close a submenu, double-click on it.

Inserting Commands

The Command Manager contains lists of all the CINEMA 4D commands. You can drag-and-drop commands from the Command Manager into the Menu Manager.



The mouse pointer will change form to indicate the insertion mode.

Copy, Delete / Cut, Paste

You can use these commands to copy, delete or paste the selected command.

Move Up, Move Down

You can use these commands to move the selected menu entry one position up or one position down the list.

New Submenu

This will insert a new submenu above the selected entry. You can add commands or even further submenus to the submenu.

Rename

You can use this command to rename a submenu that you created.

You cannot rename the standard menus and commands.

Apply

The changes will be applied. You can test them immediately.

Save All Changes

All menu changes will be saved.

Revert to Saved

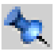
Discards all settings and reverts to the last menu definition that was saved.

Revert to Original

Reactivates the standard menu settings, which are permanently stored in the program (factory settings).

The Pin Menu

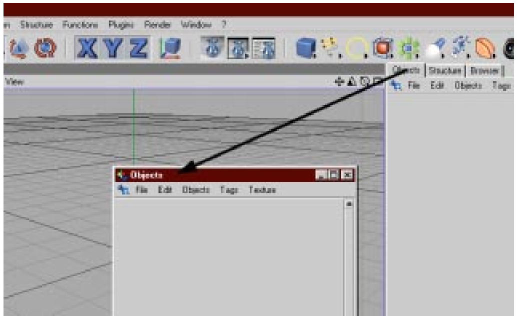
Each manager has a pin icon towards its top left corner.



Earlier in this chapter we explained how the pin is used to combine and arrange managers (see Graphical User Interface, page 29). The pin also has a menu, the functions of which are described below.

Undock

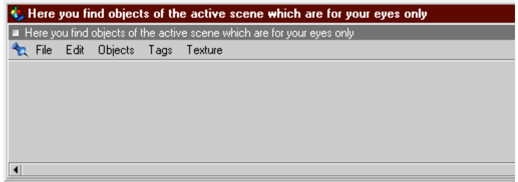
This function removes the current manager from the main window. The manager will be displayed in its own window.



Undock a tab to open a manager in a floating window

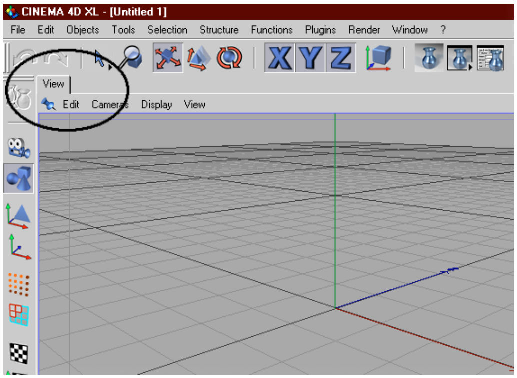
Rename

You can use this function to rename a window or a tab.



Make Tab

This function creates a tab for the active window/active manager.



New Icon Palette

This function creates an empty command palette. You can use the Command Manager (see above) to add commands to the palette.

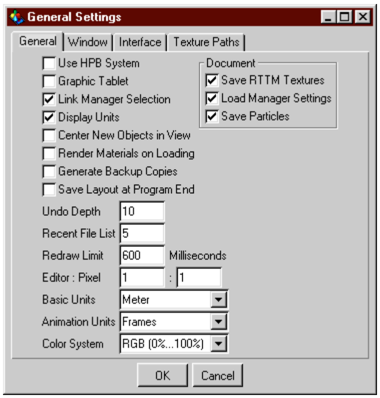
Close

This function closes the manager. To open the manager again, select it from the Window menu of the main window.

General Settings

These settings enable you to change the editor's appearance as well as influence the operation of functions. You can access this dialog from the Edit menu of the main window.

General



Use HPB System

You may find this option useful if you are an experienced animator. If this option is not selected, the active object will rotate about its local axes or the world axes when you use the mouse. However, when you play back the animation, the object may not rotate as planned. This is because CINEMA 4D records all rotation using the HPB system (see World System, page 311).

If, on the other hand, you activate this option, the active object will rotate about the HPB angles when you use the mouse. In other words, you will rotate the object using the heading, pitch and bank of the object's *parent* system. Only experienced animators should use this option, since it requires a great deal of abstract thought.

Graphics Tablet

If you experience problems when using a graphics tablet with CINEMA 4D, activate this option.

Link Manager Selection

If this option is activated, the Object Manager and the Time Line are linked. The objects you select in the one manager will be selected in the other manager as well.

Note

Object hierarchies will not be opened automatically in the other manager.

Display Units

Values are displayed together with their unit of measurement by default.

If this option if deactivated, the unit of measurement will not be displayed.

Center New Objects In View

CINEMA 4D creates all new objects at the origin of the world coordinate system by default. If the origin is not visible in the view, a newly created object may be out of sight.

If this option is activated, new objects will appear in the centre of the active view.

Render Materials On Loading

When you save a scene, the material preview pictures are saved as well. When a scene is loaded, these pictures will be used and displayed. However, if you load a foreign 3D data format, only the base colours of the materials will be shown.

If this option is activated, CINEMA 4D will create new preview pictures each time a scene is loaded. By necessity, this will slightly slow down the loading process.

Generate Backup Copies

When you save a scene with a filename that already exists in the destination folder, the original scene will be overwritten by default.

If this option is activated, CINEMA 4D will rename the original file before the new file is created. The original file is appended with '.bak'.

For example, 'Design.c4d' will become 'Design.bak'. If 'Design.bak' already exists, it will be overwritten.

Save Layout At Program End

If this option is activated, the current layout will be saved when you quit CINEMA 4D. When you next start the program, the layout will be in the same state that you left it in.

This may possibly lead to unwelcome effects. For example, perhaps your usual layout is biased towards modeling. You decide to create a layout specifically for animation (e.g. the Time Line is open). You save the animation layout under its own name and quit the program. If this option is activated, the animation layout will overwrite your usual layout.

Note

Always save a new layout using a unique name, even if you intend for it to be your normal layout. To save the layout, choose Window > Layout > Save Layout As.

Save RTTM Textures

If you have activated realtime texture mapping (RTTM), small *editor textures* will be created so that you can see textures in the editor.

These editor textures take a while to create and they must be created each time you load the scene.

However, if **Save RTTM Textures** is activated, the editor textures will be saved in the scene file. This speeds up the loading process, but the file size will increase as a result.

Load Manager Settings

We mentioned in the Other Settings section of the overview that each manager also contains settings that are not represented in the settings dialog (e.g. the active mode for time curves).

You have the option either to load these settings when you load the scene or to use the current settings.

If the option is activated, the settings that were last used in the saved scene will be activated in the corresponding managers.

Note

These settings are always saved in the scene file. Whether or not you use them is another matter.

Save Particles

Imagine that you have saved a scene containing particles with the time slider beyond frame 0.

When you next load the scene, the particle streams must be generated afresh. This can slow down the loading process and it must be performed each time you load the scene.

If this option is activated, the current particle data will be saved in the file. This reduces the loading time, but the file size will increase as a result.

Undo Depth

You can use this value to determine the maximum number of editing steps that can be undone consecutively. (See Undo/Redo, page 85 for further details.)

Recent File List

You can use this value to determine the number of recent files that are listed in the File menu (see page 71).

Redraw Limit ... Milliseconds

Sometimes it is not possible to move an object smoothly in the editor with full shading due to hardware limitations such as processor speed.

CINEMA 4D uses an ingenious system that estimates the time required for a redraw. If the estimated time exceeds the redraw limit specified here, a faster display mode will be used automatically. For example, **Quick Shading** will be reduced to **Wireframe**. If the wireframe mode is still to slow, **Box** will be used instead.

This process enables you to work smoothly in the editor. You can configure the threshold value to suit your needs. The default value of 600 milliseconds means that a minimum of three pictures per second will be drawn.

If you do not want a faster display mode to be used, set the redraw limit to a very high value (e.g. 10000 milliseconds).

Editor : Pixel

These values specify the ratio of a pixel's on-screen width to its on-screen height. The pixel ratio for most monitors is 1:1.

However, some display media use a pixel ratio other than 1:1. This will lead to distortion unless the pixel ratio is adjusted accordingly. For example, circles will appear to be ellipses.

If you need to calculate the pixel ratio manually, expand the editor window so that it fills the entire screen. Select the side view and create a cube. Measure the width and height of the cube with a ruler and enter values in the corresponding boxes.

Basic Units

Here you determine the basic unit of measurement in CINEMA 4D. You can choose from pixels, kilometres, metres, centimetres, millimetres, micrometres, nanometres, miles, yards, feet and inches.

For example, if you select **Centimetre** as the basic units, all position values will be stated in cm. Note that if you change units the numerical values will not be converted.

However, you can enter values in different units. For example, if the basic units are cm and you type '5 km' into a dialog, the value will be converted to 500000 cm.

If you set the basic units to **Pixel**, the unit of measurement will not be specified. It is then up to you to decide how to interpret the values.

You can use the following abbreviations for units when entering values:

Pixel	no units specified
Kilometres	km
Metres	m
Centimetres	cm
Millimetres	mm
Micrometres	um
Nanometres	nm
Miles	mi
Yards	yd
Feet	ft
Inches	in

Animation Units

Here you can specify the time units used for animation. You can choose from frames, seconds and SMPTE time codes.

SMPTE time codes use the format: Min:Sec:Frame. For example, *3:20:14* refers to the time *3 minutes, 20 seconds, 15th frame*. The last value in the time code specifies the frame number of the current second (starting at frame zero). For example, if you are using a frame rate of 25 fps, the frame value can range from 0 to 24.

You do not have to specify the minutes value when entering SMPTE time codes (e.g. 15:14). In this case, the first value specifies the seconds and the second value specifies the frame number.

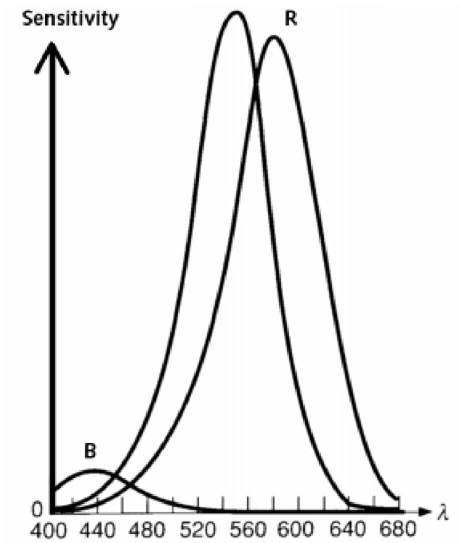
You can use the following abbreviations when entering time values:

Frames	F
Seconds	S
SMPTE	min:sec:frame

Color System

You can choose between the RGB model and the HSV model. You can also choose whether the values should be specified as a percentage, or in steps ranging from 0 to 255, or in steps ranging from 0 to 65535.

A good choice of colours is essential for consistent photorealistic results. Photorealism is often a yardstick for programs such as CINEMA 4D.



The human eye can see several hundred thousand colours in the spectral range between 400 nm (blue) and 700 nm (red). This color sensitivity is the result of many thousands of receptors on the retina. Not all of these are equally sensitive, and not all are sensitive to the same range of wavelengths.

Some of the receptors are particularly sensitive within the blue range, around 440 nm; others are far more sensitive in other ranges, while yet others are particularly receptive in the green range, around 540 or 580 nm.

The eye therefore has three different types of receptors for the primary colours red, green and blue. The spectral sensitivity and overlapping of the sensitive ranges make characterisation of colours extremely difficult.

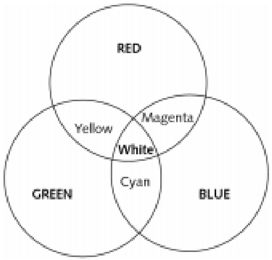
The color which the human eye perceives as white does not contain equal parts of red, green and blue light—this would be called *chromatic*—but must, in accordance with the overlapping sensitivity ranges, be made up of varying proportions of these colours. Only then does the eye see white. This is what we call *achromatic* light.

Typical output devices for color are printers, imagesetters and computer screens. The first two use the subtractive method of color mixing (CMY) and will not be part of our discussion here. Most important for CINEMA 4D is the additive method of color mixing, which is the one used for representing colours on monitors. CINEMA 4D characterises all colours by using three numerical values.

Two different color models are used, which you can easily toggle between. Probably the best known model is RGB, which is used by most graphics applications because it is best suited to the hardware components for image and color output. The most commonly used output device is the computer screen, which has a grid consisting of fine dots, made up from a red, a green and a blue point. These points can be addressed by an electron beam. By aiming the beam at not just one color dot, but for example the red and the green, the added color value is yellow.

The color pigments for the screen dots have been selected in such a way that when equal parts are added they result in a white which comes closest to what the human eye perceives as a pure white.

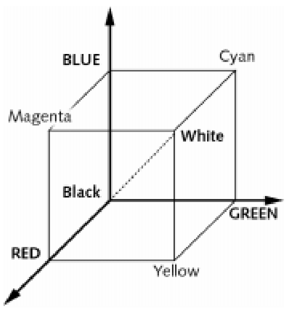
By beaming different intensities at the three dots it is possible not only to generate the eight basic colours (black, red, green, yellow, blue, magenta, cyan and white) which are the result of mixing the three primary colours, but many, many mixed colours.



The number of colours possible is determined by the number of gradations in the intensity of the electron beam.

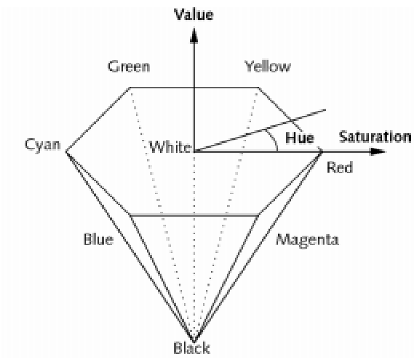
Using four gradations per primary color results in 4 x 4 x 4 = 64 colours. The standard is 256 gradations per primary color, which gives 256 x 256 x 256 = 16,777,216 colours.

These colours can be represented in a three-dimensional coordinate system.



The coordinate axes are formed by the three primary colours. Black is at the origin. Mixed colours between red and green form the base plane. Moving upward, more and more blue gets mixed in, until white is reached at the front corner of the cube. All white shades lie on the line connecting the origin with this corner.

Less technical, and therefore better suited for painters and artists, is the HSV model. H is the hue, S the saturation, V the color value. The illustration below shows what these mean.



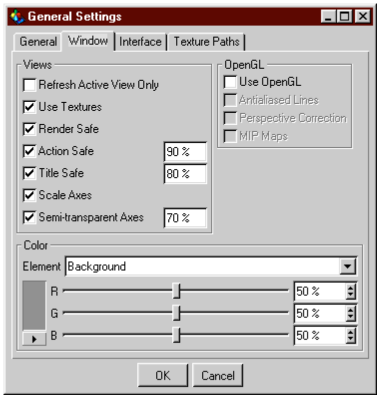
The six basic colours (red, yellow, green, cyan, blue, magenta) form a hexagon around the color white, together with the color black. The hue is the angle: starting with 0° for red, through 180° for cyan, to 270° for magenta. The saturation (S) is always measured radially towards the outside. On the inside, along the black/white axes, it has the value 0.0, outside, at the edge of the hexagon, it is 1.0. The greater the saturation, the more intensive the hue.

The value (V) is measured in the direction of the black/white axis. At the height of white it has the value 1.0; going downwards it decreases until it reaches the value 0.0 for black. The color value is used for darkening the hue.

Let's summarise this:

- Pure color pigments sit at the edge of the hexagon: V = 1.0 and S = 1.0.
- To add white, reduce the saturation.
- To add black, decrease the color value.

Window



Refresh Active View Only

CINEMA 4D refreshes all views simultaneously by default. If you are working with a complex scene using a high level of shading (e.g. Gouraud Shading with RTTM mode activated), the editor soon becomes sluggish.

If this option is activated, only the window in which you carry out an action will be redrawn in realtime. The other views will only be refreshed once the action has been completed (e.g. when you release the mouse button having dragged an object to a new position).

Use Textures

This option defines whether textures are displayed when the Gouraud Shading mode is activated. This setting is applied globally, i.e. it affects all views.

You can define this option separately for each view via the viewport settings (see Configure, page 14), which apply to the active view only.

Note

You can work more smoothly in the editor if you deactivate this option.

Render Safe

If this option is activated, the boundaries of the film format (see page 414) will be shown in the editor window.

Note

You can set this option separately for each view via the viewport settings (see Configure, page 14), which apply to the active view only.

Action Safe

If this option is activated, a frame will appear in the editor window. You can adjust the size of the frame by entering a new percentage value in the box to the right. The percentage is based on the film format that is selected in the render settings (see Render Settings, page 407 and Render Safe above).

Action Safe marks out a region in which it is safe for action to occur so that it will be in full view when played back on the target medium (monitor, TV screen, cinema screen).

You will have noticed that almost all cinema screens have curtains at the sides. The curtains can be pulled closer together or pulled further apart in order to accommodate the film that is being played. Even conventional TV screens do not always display the entire picture.

Note

You can set this option separately for each view via the viewport settings (see Configure, page 14), which apply to the active view only.

Title Safe

If this option is activated, a frame will appear in the editor window. You can adjust the size of the frame by entering a new percentage value in the box to the right. The percentage is based on the film format that is selected in the render settings (see page 407 and Render Safe above).

Title Safe marks out a region in which it is safe to place opening credits, final credits and other text information so that there is a minimum of distortion when it is played back on the target medium.

Many television sets have a dome-shaped picture-tube, the curvature of which increases towards the edges. Pictures displayed on such a surface will experience the most distortion towards the edges. This distortion becomes particularly noticeable with text such as film titles.

Note

You can set this option separately for each view via the viewport settings (see Configure, page 14), which apply to the active view only.

Scale Axes

If this option is activated, an object's axes will be scaled whenever you scale the object itself.

You may find, however, that relatively large or relatively small axes make it difficult to perform quick actions (move, scale, rotate) by dragging on a particular axis.

If this option is deactivated, the object axes retain their size when the object is scaled.

Semi-Transparent Axes

If this option is activated, the object axes will be semi-transparent. You can enter the strength of the transparency in the box to the right.

If this option is deactivated, the object axes will be displayed at full brightness.

OpenGL

If the **Use OpenGL** option is activated, CINEMA 4D will use its built-in OpenGL routines. You will be able to select further options provided that they are supported by your OpenGL implementation (see the documentation for your card/software).

If this option is deactivated, OpenGL support is turned off and CINEMA 4D will use its internal shading routines instead.

Note

OpenGL can be installed on your computer as hardware or software. As a general rule, software-only implementations are much slower than their hardware counterparts.

Warning!

The OpenGL support has no effect on rendering speed. It affects editor shading only.

Antialiased Lines

If this option is activated, lines will be smoothed (antialiased) by the OpenGL implementation provided that it supports this mode.

Perspective Correction

If this option is activated, the OpenGL implementation will correct the perspective of editor textures. This will enhance the quality of the display, although it can also slow down shading. You can only use this option if it is supported by your OpenGL implementation.

MIP Maps

If this option is activated, the OpenGL implementation will use MIP maps for texturing in the editor. You can only use this option if it is supported by your OpenGL implementation.

For more details on MIP mapping, see page 485.

A Few Words On Acceleration

Many of us know that 3D computer games can be enhanced dramatically by using a 3D accelerator card. With this knowledge in mind, many users anticipate massive gains with professional software too. The reality is somewhat slower and the user is disappointed more often than not.

Simple graphics cards soon fall by the wayside because they do not have enough graphics memory to display complex objects in a reasonably large editor window. A screen that is 1000 by 1000 pixels in size with 24-bit color requires about 4MB of memory. Double this figure to allow for screen buffering. If you also take the depth buffer into account, the memory required is about 10MB. If insufficient graphics memory is available, the screen size must be reduced. (Our calculation doesn't even take editor textures into account!)

Even if your card has sufficient memory, there are other factors to consider:

3D objects are drawn on the screen as filled triangles. There are two main stages involved. First, CINEMA 4D must calculate the triangles. Next, the triangles must be drawn. If no 3D accelerator card is present, CINEMA 4D will draw the triangles itself using the CPU. The ratio of the time required to calculate the triangles to the time required to draw the triangles is about 1:1. Even if a 3D graphics card takes over the second stage (drawing the triangles), CINEMA 4D must still use the CPU to first calculate the triangles.

For example, if a graphics card can draw triangles five times more quickly than CINEMA 4D, the overall increase in shading speed is only 40%, not the 500% that you may have hoped for.

The assumed ratio of 1:1 depends on other factors:

1. Window size

   If you increase the size of the editor window, the time required by the 3D card barely increases (provided that the card has sufficient memory). The CPU, on the other hand, is slowed down to a far greater degree. For example, increasing the window size from 640 by 480 to 1280 by 960 will triple the time required by the CPU. As a result, the total shading time is doubled (3:1 instead of 1:1).

2. Number of polygons to be drawn

   If a scene contains many polygons in a small area, CINEMA 4D can often draw them more quickly than the 3D card.

The Role Of The Cpu

If you are not using a 3D graphics card, the display speed increases linearly with CPU speed. If you double the CPU speed, the display speed doubles as well.

If you double the CPU speed when a 3D card is already in use, the CPU accelerates the calculation of the triangles, but not the drawing of them. In this case, the display speed increases by a factor of 1.5 — the faster the CPU, the less difference (as a percentage) a 3D graphics card makes.

CINEMA 4D And Other Programs

Some other 3D programs experience a more noticeable acceleration with 3D cards. The reason for this is quite simple. Such programs are naturally slow, whereas CINEMA 4D is already highly optimised for speed.

CINEMA 4D is exceptionally fast, even before you activate OpenGL.

Important

Just because a 3D graphics card is used for shading, this does not mean that shading will be equally fast in all programs. The triangles must still be calculated by the program itself, and this is where CINEMA 4D excels. The result is that, even though the same 3D card is used, CINEMA 4D has faster shading than many other 3D programs.

Why CINEMA 4D Sometimes Puts A Graphics Card In The Shade

The concept that makes this possible is *adaptive shading* (aka *adaptive blitting*). This means that CINEMA 4D will only redraw those parts of the screen that have actually changed. OpenGL, on the other hand, does a complete redraw every time. The result is that CINEMA 4D sometimes out-performs 3D cards. We told you that CINEMA 4D is exceptionally fast!

Outlook

Until OpenGL is expanded to include adaptive technology, a faster processor is probably more effective than a 3D card.

A Word Of Caution!

Our testers have noticed that some 3D cards switch off their OpenGL support beyond certain resolutions and color depths. Some cards only support OpenGL up to 1024 by 768 pixels and 24-bits. Some even give up on OpenGL beyond 800 by 600 and 65535 colours. Perhaps the most alarming aspect is that in all cases the OpenGL was deactivated silently, leaving the user in the dark.

A Second Word Of Caution!

Acceleration is not always supported on multi-monitor systems (particularly under Windows 9x). Be sure to ask about any such OpenGL limitations before purchasing a multi-monitor system.

Color

Here you can define the colours used in the editor. Select the element that you wish to change from the popup box and change its color using the sliders or the system color dialog.

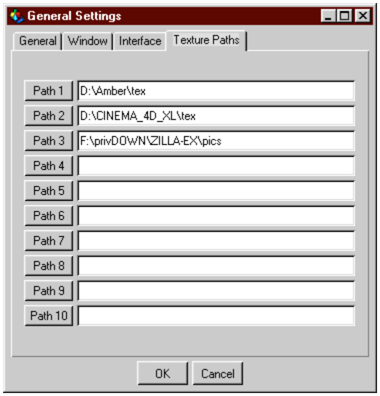
You will see either three color sliders or a color table depending on the **Color System** setting on the General page. The default setting is the RGB model with values specified as percentages.

A fourth slider enables you to change the brightness of the color. If you are using the HSV system, the brightness slider is redundant (it has the same meaning as the V slider).

The resultant color is shown to the left of the sliders. If you click on this color box, the system color dialog will open.

If you click on the little triangle just below the color box, a hidden menu appears. You can use this menu to change the color model or switch over to the color table. This setting will be retained for as long as the dialog is open. As soon as you close the dialog, the setting on the general page will be used.

Texture Paths



CINEMA 4D searches for textures and animation files in the following locations:

1. in the same folder as the scene
2. in the 'Tex' folder of the scene folder
3. in the 'Tex' folder of the CINEMA 4D folder

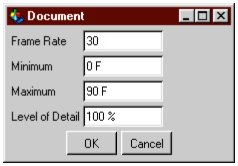
If a texture cannot be found in any of the folders above, you can add the texture's folder to the alternative paths. You can specify up to 10 alternative paths. Each alternative path is searched recursively, i.e. their sub-folders will be searched too. If a texture still cannot be located after searching the alternative paths, CINEMA 4D will report a texture error.

You can type the path name directly into a text box. Alternatively, click on a text box and guide the dialog that opens to the folder in question.

Once you have located the folder, click on Open (Windows) or the box at the bottom of the dialog that contains the name of the folder (Mac OS). The path will be added to the text box of the settings.

Project Settings

These settings refer to the active scene. You can access these settings from the Edit menu of the main window. You can also access them from the menu of the same name in the Time Line.



Frame Rate

You can use this value to define the frame rate for the animation project. CINEMA 4D uses this value to calculate all animation data.

Note

You can also set a frame rate in the render settings (see page 407). However, the frame rate in the render settings is not used to recalculate the animation data. If the two frame rates differ, frames may be dropped or duplicated in the animation, leading to a reduction in animation quality.

Minimum

This defines the starting frame for animation tracks in the Time Line. You can enter a negative value is you wish. For example, you may find it useful to start generating particles before frame 0 so that the particle stream is already in position by frame 0.

This value is decreased automatically when you drag a sequence past its boundary in the Time Line (see page 556).

Maximum

This defines the last frame for animation tracks in the Time Line. This value is increased automatically when you drag a sequence past its boundary in the Time Line.

Level of Detail

This value influences the display of all objects in the active scene that support a reduction in detail, such as metaballs, primitives and NURBS.

However, any objects that have their own level of detail setting (see page 454) will continue to use their setting.

If the value is set to 100%, the objects will be displayed in full detail.

If the value is set to 50%, the objects will be displayed with only half of their usual detail (subdivision).

Note

This value affects the setting of the same name in the Display menu of the view window.

CINEMA 4D

MODELING • ANIMATION • RENDERING

4. Workflow

4 Workflow

Introduction

You are unlikely to find the term *workflow* in your dictionary. Nor are you likely to find *raytracing* listed, yet CINEMA 4D has been raytracing for over ten years now! We define *Workflow* to mean the performance of all the steps involved in achieving a task. If you can improve your workflow (i.e. go about things in a more efficient way), you can work more quickly as a result.

The purpose of this chapter is to raise your awareness of workflow issues.

Here To Help

There are many features in CINEMA 4D that can help improve your workflow. We list just a few of the features below:

- If you need to move, zoom or rotate a camera, use the icons at the top right of the view (drag the right mouse button on the icon you require). The fourth, right-most icon toggles the active view between single-view and all-views (see Toggle Active View, page 24).
- Define short-cuts for the functions you use the most. Also, create an icon palette and fill it with the functions. In this way, you can reach high-frequency functions more quickly.
- Many commands can be performed with a quick drag-and-drop rather than a trek through the menus. For example, to allocate a material, drag it from the Material Manager and drop it on to an object in the Object Manager or view window.
- What if the Object Manager is not the active tab (see page 33) when you drag-and-drop a material from the Material Manager? Simply drag the material on to the Object Manager's tab. After a short delay, the Object Manager will become the active tab and you can drop the material on to the required object.
- Many primitives have handles - e.g. to control the fillet radius. You can drag these handles to change the values interactively in the editor rather than enter values in the object's dialog.
- If you need to move several keys or sequences in the Time Line, select them all and then move (or copy) them in one go rather than individually.
- You can construct a spline by creating its points one by one. Alternatively, draw the spline and its points will be created automatically (see Freehand, page 136).
- There is no need to lock axes in order to move, scale or rotate an object in one direction only. There is a small arrow, cube or sphere at the end of each object axis (the exact form depends on the active tool). Click on the arrow/cube/sphere for the required axis and drag. Note that you can use this method to move/scale/rotate selected points and polygons as well as objects!
- When you need to select several adjacent points or polygons, do not click on them one by one. Instead, use the Live Selection tool and *paint* over the points/polygons to select them.

The text above covers only a few of the ways in which you can improve your workflow. Be sure to read the entire manual at the earliest opportunity, since many other workflow tips are described along the way.

Here's a picture, just to spice up this rather dry text!

The Joust – © 2000 by Happy Ship

Working With Layouts

CINEMA 4D has a wealth of configuration possibilities. For example, you can define your own short-cuts, create your own layouts, set your own defaults and configure the Browser for a specific project.

The allocation of short-cuts is described in detail in Allocating Shortcuts, page 38. The Browser and default values are described later in this chapter. First, we consider working with layouts.

The golden rule for improving your workflow is to do it in stages. Make little changes at a time, then once they have become second nature, make further changes. If you attempt too much to soon, you may worsen your workflow! Begin with just a few (e.g. five) short-cuts. Once these short-cuts have become instinct, create and learn to use a few more short-cuts.

What's the big deal about being able to create your own layout?

Well, we admit that we are not omniscient - in particular, we cannot know your preferred way to work. For example, do you prefer icons or text in the command palettes? Should the Material Manager be open or do you prefer the Time Line in its place?

Of course, we could activate everything, but this would help no-one. The sheer number of windows, icons, menus, functions and options would almost make your monitor sag. Anyone new to 3D would run a mile. As for workflow...

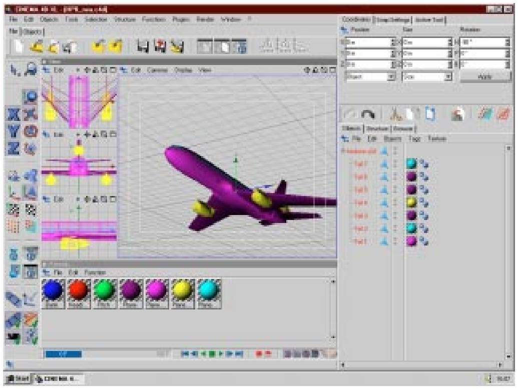
What is far more important is that you and your colleagues can create and use your very own layout settings. You will not have to deal with the seemingly bizarre changes a colleague has made to the layout, and vice versa. Anyone who has used a colleague's computer will know what we're getting at. ("Which folder did she say the word processor was in? I need to get home some time tonight...").

Not only are layouts good for office harmony, you can also create several layouts for your own use. For example, you may find it useful to create a layout specifically for modeling Structure Manager and Material Manager open) and a different layout for animation Time Line and animation command palette open).

Start by using the default layout. As time passes by, keep track of which commands you use the most.

Is your mouse getting too much exercise? Is it constantly darting between a command on the bottom left and a command on the top right of your 21-inch, 1600x1200 res. monitor? If so, alter the layout! Put the commands next to each other, within easy reach.

Let's break off from the text for a moment. Take a look at one personal layout below:



Previously, we learnt how to use layouts. In the following, we take a look at the functions for layout management. You can reach all of these functions from the main menu bar under **Window > Layout**.

Load Layout

You can use this function to load a previously saved layout. Use the system dialog that opens to choose the layout file (with a '.L4D' extension).

Reset Layout

This function resets the layout to the factory settings. Use this function if you get in a muddle!

It is also very helpful if you reset the layout before contacting technical support. In that way, you and the technician will be using the same layout - it will be easier to help you locate the problem.

Note

Remember to save the layout if necessary before you reset it! You can save the layout with Save Layout As (see below).

Save Default Layout

This function saves the current layout in a special file. The next time you launch CINEMA 4D, the layout will load automatically as the new default.

Note

There is an option in the General Settings (Save Layout At Program End, page 43) that, when activated, will save the layout each time you quit the program.

Save Layout As

You can use this command to save the current layout. This enables you save several layouts, e.g. one for modeling, one for animation.

Layout files are given the extension '.L4D' automatically.

Further Menu Items

The **Window > Layout** submenu also lists all the layout files (extension '.L4D') in CINEMA 4D's 'prefs' folder. To load a layout, select one from the list.

The Browser

A file catalog in the Browser

Working with the Browser

Introduction

Using the Browser, you can take a *snapshot* of all files produced by or used in CINEMA 4D scenes. Many of these files can be viewed as thumbnails. So, for example, before loading a texture image into your scene you can view it, and any other possible textures you may need, directly within the Browser.

More accurately, using the Browser you can capture scenes, materials, textures, pictures, animations, sound, time curves and even C.O.F.F.E.E. programs (those files ending with the extension COF and COB e.g. UNDO.COF). A full list of all CINEMA 4D supported file formats can be found in Appendix 3. This list is extended further through the picture and animation formats available when you have installed QuickTime on your system.

Note

The Browser will only recognize a movie file if its corresponding codec is installed on the system.

When used correctly the Browser is a very powerful control center and manager for your 3D objects.

It makes sense to organize your scene information into various image catalogs (e.g. one for sunsets, one for floor tiles, one for the scenes of a large movie project...). You can then add notes to these archived files; these notes will aid in future archive searches. Using a search with certain criteria you could, for example, search for all of those files that are copyright free and are able to be distributed freely.

While working on a project you can load each of the required catalogs into the Browser, e.g. select suitable materials and load these directly into the scene. We will see how this works further on in this chapter. First, we need to create a catalog.

Creating A Catalog

- To start with, scan a directory for all CINEMA 4D files.

From the File menu, select **Import Directory**. From the dialog you can choose your desired folder. For these first practice steps the 'Tex' or the 'Sample' directories in the root of CINEMA 4D are recommended.

You may also limit the search to certain file types, perhaps only pictures or scenes. These criteria (and more options) can be defined in the Browser preferences.

- During the search the Browser automatically creates small preview pictures (slides). These give you a good idea of the actual appearance of a picture or a scene.

Tip

If the file read by the Browser contains only one single material (and nothing else, absolutely nothing at all different), then the Browser will display only material pictures as in the Material Manager (see Material Manager, page 475), In all other cases the raytracer renders a picture of the current view. (See also Save Material As on page 477.)

- Once the Browser has finished cataloging the data you are free to add personal notes, comments, copyright notices and similar things to the individual files.

Select a slide (click on it so that it is framed red) and choose **Info** from the Function menu. Enter your own text into the large field. Close the dialog with OK.

Now move your mouse pointer over the slide that you have added comments to and wait. After a short time the text appears under your mouse pointer.

- Finally save your whole database as a catalog file with a meaningful name.

Choose **Save Catalog As** from the File menu. Again the system dialog appears. Enter a sensible name, such as Test, and the file Test.cat will be created in the selected directory. This catalog can then be loaded into the Browser.

So far, we have seen the basic use of the Browser. The full potential of the Browser will become much clearer when it is used in combination with the various CINEMA 4D Managers. Depending on where you drag a thumbnail slide, you may create new materials, load scenes, view animations etc.

Simply click on a thumbnail and keep the (left) mouse button held down. Move the mouse pointer over a Manager and release the button. This technique is known as *Drag-and-drop*.

You may, of course, select several separate slides. Keep the Shift key pressed as you select your required slides. All selected slides are framed in red.

Drag-and-Drop With The Browser

Pictures, Animations

- Pictures, animations in the Material Manager:

Creates a new material, containing the image, or animation, as a color texture.

- Picture, animation on an object in the Editor:

Creates a new material, as above, but assigns this material directly to the selected object.

- Picture, animation on an object in the Object Manager:

Creates a new material, as above, using the picture or animation as the color channel but assigns this directly to the selected object.

- Picture on the Picture Manager:

The picture is displayed in the Picture Manager window.

Tip

The texture must be located in the CINEMA 4D search path, otherwise the preview image *remains black in the Material Manager (see Material Manager, page 475).*

Scenes

- Scene on the Material Manager:

  All materials (if applicable) belonging to the scene are imported to the materials list of the current scene.

- Scene on the Editor Window:

  The selected scene is loaded.

- Scene on the Object Manager:

  The selected scene is imported into the current scene.

Materials

- Material on the Material Manager:

  The material is imported into the material list of the current scene.

- Material on an object in the Editor:

  The material is added to the material list and assigned immediately to the selected object.

- Material on an object in the Object Manager:

  The material is imported into the material list and assigned immediately to the selected object in the Object Manager.

Tip

If a texture that you use in the CINEMA 4D Browser is located outside of the search path, the program asks whether you want to copy the file to the same location as the scene. This allows CINEMA 4D to find textures automatically without user intervention.

If you have not yet assigned a name (and therefore a location) to your scene, textures are saved to the CINEMA 4D startup folder.

Sounds

- Sound on an object in the Time Line:

  If you drag a sound slide onto an object in the Time Line, a sound track with the associated sound sequence is created automatically and the WAV file is loaded into this sequence.

- Sound on sound track in the Time Line:

  If you drag a sound slide onto an already existing sound sequence in the Time Line, the WAV file is loaded into this sequence. The existing sound is replaced by the new one.

- Sound in the Picture Manager

  If you drag a sound slide into this window, the wave pattern of the WAV file is displayed in detail.

Time Curves

- Time Curve on a sequence in the Time Line:

  The Time Curve is overlaid on the selected sequence. Any time curve that already exists in the Time Line is replaced by the new one. More detail on the handling of time curves can be found in Time Control, page 594.

Tip

Drag-and-drop with C.O.F.F.E.E. programs will have no effect.

Further Browser Functions

- Double-clicking on a picture file (usually a texture) opens the Picture Manager and displays the picture.
- Double-clicking on an animation file calls up the animation player of your system and plays the animation.

- Double-clicking on a sound file calls up the sound player of your system and plays the WAV file.
- Double-clicking a scene file loads it into the editor.
- Double-clicking on a material imports and adds it to the current scene and the Material Manager.
- Double-clicking on a C.O.F.F.E.E. program opens your system's default text editor (the default under Windows is NotePAD and under Mac OS is SimpleText) and loads the program, ready for editing.

Tip

Double-clicking on time curves has no effect.

- Right-clicking on a preview picture will open a context menu from which you can access information about the selected slide and this allows you to use the Search dialog.

Tip

To open the context menu on the Macintosh, hold down the Command key while you click the mouse button.

The Drawing Pin

Using this menu you can alter the layout of CINEMA 4D to your own requirements. Further details are in The Pin Menu, page 41.

File Menu

New Catalog

Creates a new, empty catalog. Any existing catalog in the Browser will be replaced with the new one.

Open Catalog

Loads a previously saved catalog into the Browser.

Import File

Loads and adds a file (scene, picture, material...) to the current catalog. A preview picture is generated.

Import Directory

Loads and adds the contents of a directory to the current catalog. Depending on how the preferences are set up, subfolders will be searched or ignored.

Tip

It is advisable not to list the complete contents of a CD-ROM unless your computer has lots of memory. A quick calculation backs this up: a small thumbnail picture with a size of 80x60 pixels and a color depth of 24 bits needs around 15KB of memory. So 1,000 images on a CD would require a minimum 16MB of memory. And don't forget the extra few megabytes for the actual display of these images within the Browser!

In such cases it is simple to create a number of smaller catalogs, which are easier to manage.

Save Catalog

Saves the current catalog. The catalog is saved using the name given in the Save Catalog As dialog. This name also appears in the Browser title bar.

If your catalog is still yet to be named (in which case the Browser title bar will show Untitled), the Save command acts in the same way as Save Catalog As (see below).

Save Catalog As

Save Catalog As always opens the File selector. The name you enter here will appear in the title bar of the Browser window.

CINEMA 4D always adds the extension '.cat' to the catalog filename.

Making Catalog Paths Relative

Normally, when storing a preview image in a catalog, the exact location is also saved. This is essential when using the drag-and-drop technique to pass objects over to CINEMA 4D for processing.

However, should you move, for example, a texture directory from your own system to the company's network server, the location of the files is no longer the same as that of the saved catalog. Therefore the Browser will not find the required files.

A similar situation may arise when you compile a catalog for a CD-ROM collection (textures, objects, scenes etc.). These collections would normally be created locally on a computer, using the computer's local path definitions and drive IDs (e.g. the drive could be D:\, or even X:\ under Windows, or possibly 2184: or 1601 under Mac OS). This system would be unusable for catalogs, as the Browser would look for the various devices and paths of the computer, rather than the CD-ROM.

The solution to this is to use Relative Paths. This option ensures that paths are not stored as complete path names, but instead as relative paths, starting from the catalog folder. Here, the location path of files is still used, but you are free to define where the system is to begin its search. This anchor directory can be anywhere on a hard disk or CD-ROM. But, starting from that anchor directory, and moving down, the same path hierarchy as that of the catalog directory must exist.

Here's an example of anchor directories. Let us imagine that you want to list your winter background pictures. These are located on the system hard drive in the following directory tree:

Disk1/Texture/Backgrounds/Winter/...

So we define Texture as the anchor directory, the relative path then reads:

Backgrounds/Winter/...

This (sub-) directory hierarchy can be now moved to any other location e.g. to the company server:

Server7/C4D/Resources/Tex/
Backgrounds/Winter/...

The new anchor directory is now Tex. Starting from this location, the hierarchy sub-items now have the same path as before. To ensure that the Browser finds the required files requires one rule; the Browser catalog must always be in the anchor directory. In the above example the catalog would have been created in Texture and later copied to Tex.

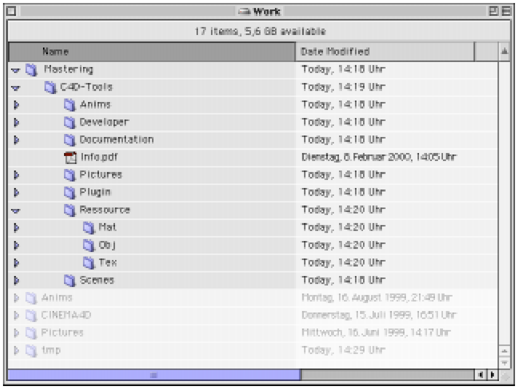
Let's see a more practical example:

You need to collect together and write all of your textures, materials, objects and finished pictures, and all other useful items, to a CD.

Firstly, a relevant catalog for the files is created. It is to contain all textures, objects and materials. In addition the catalog will be located in the root directory of the CD, so that you can view and archive it directly.

You now create the entire archive on your computer. On most systems you will have a reserved hard drive partition which was defined for such CD-ROM production. Only rarely should you require more than the 650MB limit of a CD-ROM for this work area.

A possible CD structure for your hard drive might look like the following illustration.



The CD-ROM structure in the Mastering folder

So this is how the structure could look. You have created and filled the folders with the relevant contents. As we are just concerned with browsing from here, only the three directories Mat, Obj, and Tex are of any interest to us. Or have we forgotten an important directory?

Of course ... we need to know where the anchor directory is located.

Let's look more closely. The CD will be called C4D Tools. Thus the directory of the same name within the mastering partition forms the anchor. This is also where the catalog is to be located, making it easily accessible. So, proceed as follows:

1. Start CINEMA 4D and open the Browser.
2. Open **File > Preferences**.

   Check the option **Recurse Folders** in the dialog (see above) as well as **Pictures**, **Movies** and **Scenes** (and, depending on personal preference, from the drop-down menu to the right of Scenes choose **Raytracer**, which will cause a delay in catalog creation, **Gouraud Shading** or **Wireframe**).
3. Select **File > New Catalog**.
4. Now each directory is added.

   Select **File > Import Directory**. In the dialog select, for example, the directory Mat. The catalog and the preview pictures are created. Use the **Import Directory** function twice more for the directories Obj and Tex.
5. Now Select **File > Save Catalog As**.

   In the system dialog define 'Disk3:Mastering:C4D Tools' as the location and, say, 'C4D Tools.cat' as the name. This is the most crucial (and also most difficult) step. Now (and only now) does the Browser know where it has to create relative paths.
6. Open the menu command **File > Make Catalog Relative...**, so that the Browser converts all information into relative paths.
7. Save the catalog with **File > Save Catalog**.

You are now ready to master the CD.

To summarize:

If **Make Catalog Relative...** is enabled, then complete paths are no longer saved, instead only the relative paths, starting from the catalog folder are used. From this location the current catalog directory and its sub-directories are scanned.

Tip

This method only works if you have named the catalog and assigned the path with the Save Catalog As command (see above) prior to searching the catalog.

Close

This command closes the Browser. The current catalog is removed from memory.

Edit Menu

Delete

Removes all selected pictures from the catalog. The originals on the system disk remain unaffected.

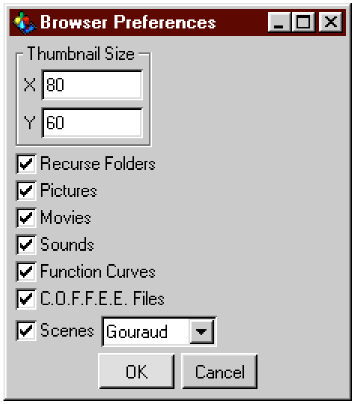
Select All

Selects all the preview pictures of the current catalog.

Deselect All

Deselects all the preview pictures of the current catalog.

Preferences



Thumbnail Size

This allows you to adjust (in pixels) the size of the preview images in the Browser. The changes are immediate, although actual recalculation does not occur until later. The images are simply scaled up or down.

The new calculation of all pictures is achieved by the use of **Render All** from the Function menu (see below).

Recurse Folders

If this option is checked, sub-directories are also scanned for scene elements and displayed in the Browser.

Pictures

If this option is active, pictures are displayed in the Browser. All image formats unknown to CINEMA 4D are ignored.

Movies

If this option is checked, animations are displayed in the Browser. All animation formats unknown to CINEMA 4D are ignored.

Sounds

If this option is active, the waveforms of the sound files are displayed in the Browser. All sound formats unknown to CINEMA 4D are ignored.

Function Curves

If this option is activated, function curves are displayed in the Browser.

C.O.F.F.E.E. Files

If this option is activated, C.O.F.F.E.E. files are displayed in the Browser.

Scenes

If this option is activated, scenes are shown in the Browser. All scene formats that are not recognized by CINEMA 4D are ignored.

You can use the popup menu to the right of this option to determine whether scenes are shaded in Wireframe or Gouraud or rendered with the Raytracer. If **Raytracer** is selected, shadows and refraction are not rendered and only the floor and sky can be reflected. However, each scene is antialiased.

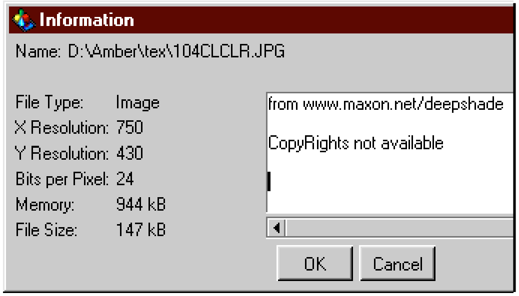
Function Menu

Render All

Recalculates all preview pictures that exist in the catalog.

This is necessary, for example, if you change the picture size in the preferences or add or change files in the directories. You can cancel the new calculation at any time with the ESC key.

Information



Opens an information window for the current preview and displays information, including the complete path, picture resolution and color depth.

Tip
This command is also accessible from within the context menu (right-click).

You may be surprised, when you are using relatively small textures in a scene, if the computer alerts you to a lack of memory. It's very easy to forget that images, and especially animations, often need considerably more memory than their file size suggests.

For example a compressed JPEG picture, which on disk is just one megabyte in size, can quite often need 10 or more megabytes of memory to display. Using several such compressed files in the Browser, the existing memory of your computer melts like ice cream in a desert!

Using the information window of the Browser, you can easily monitor the relevant values (file size and actual memory requirement) and avoid unpleasant surprises while working on a project.

On the right-hand side of the information window is an area where you can enter your own comments e.g. copyright notes, latest changes etc.

These comments may run to many lines and up to 255 characters. A comment can be displayed from within the Browser itself. To do this, simply leave the mouse pointer over a preview picture for a couple of seconds. As with command palettes (see Command Palettes, page 34), an information box will open under the mouse pointer.

To begin a new text line, simply press the Enter or Return key. This method means that this dialog window must be closed with the mouse by clicking on OK or Cancel.

Tip

The contents of the comment field can also be searched (see below). The Browser thus effectively becomes a small picture database.

Tip

If the Browser finds a text file with the name Readme.txt when scanning a directory, its contents will be automatically transferred to the information dialog of each thumbnail picture of the folder, space permitting.

Search For

Scans the name and/or comment fields of the current database of the Browser for the text entered.

Tip

This command is also accessible from within the context menu (right-click).

You may use the Browser to scan for filenames and/or comments. Simply choose the criteria by checking the relevant box and enter the text or value you wish to search for in the field to the right. All thumbnails that match the find will be outlined in the catalog.

Sort By

Use the sub-entries of this menu to define the sort sequence of the current catalog in the Browser.

Alternatively you may sort according to filename or file size. Items are always sorted in ascending order, i.e. the list starts with the smallest images and ends with the largest.

Initialisation Files

CINEMA 4D loads several initialisation files during startup. The content of these files is integrated into the layout.

Template.c4d

During startup, CINEMA 4D checks its root folder for a file called ‘Template.c4d’. If the file is present, its settings are loaded and are used as default values.

This can be very effective if you keep using the same scene-specific settings (e.g. several different render settings or the same frame rate).

For an overview of all the settings which are saved with the scene file, see Overview, page 27.

New.c4d

When you create a new file (main menu **File > New**), CINEMA 4D checks its root folder for a file called 'New.c4d'. If the file is present, its settings are loaded and are used as default values.

For example, to change the default frame rate to 25 frames per second, create a new file, change the value in the document settings and, if required, the value in the render settings and save the file in CINEMA 4D's root folder with the name 'New' (CINEMA 4D will append the extension automatically).

Template.cat

During startup, CINEMA 4D checks its root folder for a file called 'Template.cat'. If the file is present, it is loaded into the Browser automatically.

This can be useful, for example, when you are working on a large project and wish to have all the associated textures and/or scenes available immediately after startup. In this case, create a catalog which shows all the required files. Then, save the catalog in CINEMA 4D's root folder with the name 'Template' (CINEMA 4D will append '.CAT' automatically). The Browser will contain the catalog the next time you launch CINEMA 4D.

For more information on the Browser, see page 58.

Note

If the template catalog is very large (lots of preview pictures), expect a short delay during startup.

Template.l4d

During startup, CINEMA 4D checks its root folder for a file called 'Template.l4d'. If the file is present, it is loaded and used as the active layout.

You can create this file in one of two ways:

1. Activate the corresponding option in the General Settings (see page 42). The template layout will be created automatically when you quit CINEMA 4D — *each* time you quit, for as long as the option is activated!
2. Create the template layout manually using the function **Window > Layout > Create Default Layout** (main menu).

CINEMA 4D

MODELING • ANIMATION • RENDERING

5. File Menu

5 File Menu

Introduction

There are several ways of starting CINEMA 4D:

1. Double-click on the program icon.
2. Double-click on a scene file.

You can also drag one or more CINEMA 4D files in the Explorer (Windows) or the Finder (Macintosh) on to the CINEMA 4D icon (drag-and-drop).

The File 'New.c4d'

In the CINEMA 4D startup folder you will find a scene with the name 'New.c4d'; this is always loaded into CINEMA 4D (complete with the settings associated with it) when you create a new file. Thus, CINEMA 4D does not use a separate preferences file.

In order to change, say, the animation rate to 15 frames per second, you create a new file, change the values in **Edit > Project Settings** and save the file, as 'New.c4d', into the CINEMA 4D startup folder.

The File 'Template.c4d'

In the CINEMA 4D startup folder, there is also a scene with the name 'Template.c4d'; this is loaded, together with its associated preferences, automatically when CINEMA 4D is launched (and only then, in contrast to 'New.c4d'), allowing preferences to be set at startup.

New

This command opens a new document and makes it the active (current) document. All icons that are selected from the toolbar, and commands from any of the menus or managers then refer to this new document.

Until you save the new document and give it a name, the title bar of the document window will show 'Untitled'.

If you have several documents open you can switch quickly between them using the Window menu of the main menu bar.

Open

This command loads a file (a scene, a material, etc.) from a storage device (such as a hard disk) into memory and opens it in a new document window. If the current document window is empty, this is used instead.

The following formats are understood by CINEMA 4D:

- CINEMA 4D scenes ('.C4D'), catalogs ('.CAT'), preferences ('.PRF')
- DXF to AutoCAD R12

- QuickDraw 3D ('.3DM') (binary only, not ASCII)
- VRML V1 and V2 ('.WRL')
- 3D studio R4 ('.3DS') (including materials, light sources, textures and animations)
- Wavefront ('.OBJ')
- LightWave ('.LWO', '.LWS') (including scene descriptions, light sources, textures and animations)
- DEM scenery files ('.DEM')
- Illustrator paths as polygons ('.AI', '.ART', '.EPS')

Recognition of these formats is automatic. Filename extensions (Windows) are superfluous, as are types and creators (Macintosh).

You can also use this command to view images, play animations or load other settings. If you open a QuickTime movie or an AVI animation, this will launch the default system movie player.

Alternatively, you can also open a new file by dragging it and dropping it into the Editor window.

Import

This command lets you add scenes, objects, materials etc. into the active document.

Revert to Saved

This command will load the last saved version from disk. Before this happens, a dialog appears asking for confirmation. You will lose any changes that were made to the current document after it was last saved.

Close

Closes the active document. If it contains any unsaved changes, a dialog appears asking if you want to save the scene before closing it.

Close All

Closes all open documents. If any documents contains unsaved changes, a dialog appears asking if you want to save the scene before closing it.

Save

This command saves your document without first opening the file selector. The scene is saved using the name chosen when you selected the **Save As** command (i.e. the name that appears in the title bar). If this is the first time you are saving a new document and it does not have a name yet, then the **Save** command behaves just like **Save As**.

Save As

Save As always displays the file selector. The filename you enter here will be displayed in the title bar of the document window. CINEMA 4D automatically appends the appropriate extension ('.c4d' for scenes) to the filename.

Save All

This function saves all open documents. If a scene has not yet been saved (and therefore is untitled), the appropriate system file selector appears for you to choose a name and path.

Save Project

Transferring scenes from one computer to another is always particularly challenging for a project leader. When the question of missing textures for materials arises, you know that these can be found automatically in your own local search path (**Edit > General Settings > Paths**).

CINEMA 4D helps you build complete scenes.

Selecting this command opens the usual system file selector for saving files. Choose a folder here and enter a name. CINEMA 4D creates a new folder in the specified path and saves the scene there. In addition, it creates a sub folder, named Tex, into which it copies all the pictures and textures necessary for rendering the scene.

There is now nothing to stop you moving the project to another system.

Export

A scene can also be exported to a foreign file format for subsequent work in other 3D software. The filetypes described below are available. CINEMA 4D automatically adds the relevant file extension to the file.

In principle each 3D program works differently. Therefore it is not always possible to convert all information within a scene. Further, the result will always differ according to the materials and lighting used; so a manual re-working may often be necessary.

3D Studio R4 (.3DS)

Common data format under DOS/Windows. 3D Studio is the predecessor of 3D Studio MAX. The last freely available file format is release 4 and the MAX data format is not accessible to other manufacturers.

In principle the MAX format is not generally readable since MAX (like CINEMA 4D) uses parametric objects, which are useless without their associated specific algorithm. For example a teapot is not saved with points and surfaces, but only with the dimensions and the subdivision rate. For re-creating the surfaces (to display the teapot on the screen) one needs to know the internal routines of MAX.

Therefore, because of this, there is also no external conversion tool for the MAX format.

Direct3D / DirectX (X)

Direct3D is a Microsoft specific 3D format, which is used by Windows 95/NT (provided DirectX is installed). This export module is particularly useful to game developers.

DXF (DXF)

The standard exchange format for graphics files.

CINEMA 4D splines are generally written as POLYLINEs, independent of the surface settings for polygons.

QuickDraw 3D (3DM)

The standard format for three-dimensional graphics on the Apple Macintosh.

VRML 1 (WRL)

The Virtual Reality Modeling Language enables you to produce platform-independent three-dimensional representation of objects and scenes on the Internet. It has also proved useful as an exchange format for CAD programs, since it contains more file information than the often-used DXF format.

VRML 2 (WRL)

Version 2 of the standard format for three-dimensional graphics files on the Internet enables you to display animation sequences. The advantages for data exchange with CAD software mentioned above also apply to VRML 2.

Wavefront (OBJ)

A common 3D data format in the UNIX world, developed by Alias.

Import / Export Settings

3D Studio R4

Factor

This is for specifying whether and to what degree 3D Studio files are scaled when they are loaded and saved.

Adapt Textures

3D Studio does not support as many graphics file formats for textures etc. as CINEMA 4D. Its main format is TIFF.

If you enable this option, all texture filename extensions are changed to that which you have specified (for example ‘frame.jpg’ becomes ‘frame.tif’).

However, you will still have to do the actual conversion of the images yourself. This is very simple if you use one of the graphics programs that are provided with the package (PaintShop Pro or Graphics Converter).

Direct3D/DirectX

Factor

This is the scaling factor for saving the scene in this format. When exported, the scene is reduced by this factor.

Format

Direct3D is a text format. To facilitate manual editing of the file, this option formats the whole file automatically. This increases the file size somewhat.

Save Templates

When enabled, the template header is written to the file.

Export Textures

When enabled, all texture information is saved for all objects. This includes creating UV coordinates for each object.

Adapt Textures

DirectX uses mainly the ‘ppm’ (Portable-Pixel-Map) graphics format, but also ‘.bmp’ (Windows-Bitmap). CINEMA 4D does not recognise the former, which means that textures need to be converted.

This can easily be done using the graphics programs PaintShop Pro or Graphics Converter, which are provided in the package. But what about adapting the names?

If you enable this option, all texture filename extensions of scene materials are automatically changed when they are imported (so that ‘image.jpg’ becomes ‘image.ppm’). This has the benefit that you do not need to check for each material and for each attribute whether a change of name is required.

Note

This really does only change the name. You still need to convert the image!

Note that DirectX can only process graphics measuring 2n pixel (textures need to be 2x2, 4x4, 8x8, 16x16, 32x32, 64x64, 128x128, 256x256, …).

Save Normals

If this option is enabled, normal vectors are created for all surfaces. If not, calculating the normals is left to Direct3D.

Generate Mesh

Direct3D works with two types of models; Frame and Mesh.

Frames, as with CINEMA 4D, consist of objects arranged in a hierarchical structure. Objects remain encapsulated.

In a mesh, on the other hand, all objects are on the same level. The hierarchy disappears.

DXF

CINEMA 4D can work with DXF files of all versions. It can correctly interpret the following elements: SOLID, 3DFACE, LINE, POLYLINE, CIRCLE, ARC, POINT and TRACE. All three-dimensional data is read in accurately.

All documented POLYLINE combinations as well as height and elevation data are supported. The same is true of element coordinate systems, layer names and various line thicknesses.

Factor

This specifies whether and to what extent DXF files are scaled during loading and saving.

Circle

This determines the number of polygon segments that are used for subdividing circle segments.

Frozen Layers

Enable this option if you want to convert frozen layers of a DXF file when loading. Many CAD programs offer the option of freezing (i.e. hiding) temporary or unused layers.

2D Elements

This specifies whether or not two-dimensional DXF elements should be converted when loading a file.

Align Normals

CINEMA 4D assumes that all surfaces of an object are uniformly aligned. This is not necessarily the case with DXF files.

If adjacent surfaces are differently aligned, their normal vectors point in a different direction. During rendering, this can result in undesirable color *jumps*. CINEMA 4D uses this option to re-align all adjacent surfaces in the same direction.

Triangulate Polygons

DXF files may contain three-dimensional polygons. CINEMA 4D can triangulate these if this option is enabled. This means that the inscribed surface is generated as a 3D object. This is useful in most cases, and it is therefore the default setting.

Unless the option is disabled, polygon lines are converted as such, which is useful for further processing in CINEMA 4D.

Layer

DXF files often consist of a great number of small elements. When this option is enabled, CINEMA 4D attempts during a load to combine elements of the same color (**Connect by Color**) or of the same layer (**Connect by Layer**). If you wish to prevent this, use **Don't Connect**.

Export

The DXF standard offers several options for saving an object. Here you can choose the type into which the object is converted when being saved. The choices are **Polyline**, **Solid** and **3DFace**.

DEM

DEM files are used in geography and are often used for the description of landscapes. This format can be imported only.

Factor

Use this to determine whether and how much DEM files are scaled when they are loaded.

Illustrator

If you want a high-quality 2D vector graphic (e.g. a company logo) to be three-dimensional, then import it in the Illustrator format.

Also vector graphics from other programs, such as Macromedia's FreeHand or CorelDraw, can be imported if they were saved in Illustrator format.

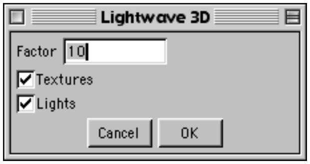
Please also read about how to export files in the relevant product manuals.

Factor

Use this to determine whether and how much Illustrator files are scaled when they are loaded.

LightWave

When you load a file in LightWave format, not only are the object geometries copied over, but also complete scene descriptions, texture maps, animation sequences, even the full bones information.



Factor

This specifies whether and to what extent LightWave files are scaled during loading and saving. The default value is 100, since LightWave uses a smaller construction scale than CINEMA 4D.

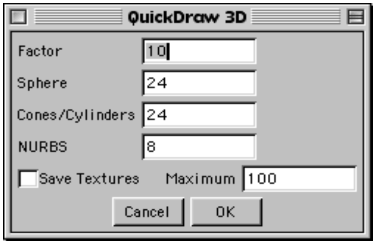
Textures

This lets you decide whether CINEMA 4D should import a LightWave object's texture information.

Lights

This lets you decide whether CINEMA 4D should import a LightWave object's light source information.

QuickDraw 3D



Factor

Use this to determine whether and how much QuickDraw 3D files are scaled when they are loaded.

Sphere

Use this to specify whether and to what extent QuickDraw 3D spheres are triangulated during loading.

Cone/Cylinders

Use this to specify whether and to what extent QuickDraw 3D cones and cylinders are triangulated during loading.

NURBS

Use this to specify whether and to what extent QuickDraw 3D NURBS are triangulated during loading.

Save Textures

If this option is enabled, all objects are saved with their textures (including any UV coordinates).

If this option is disabled, objects are saved with their color information only (i.e. without textures).

Maximum

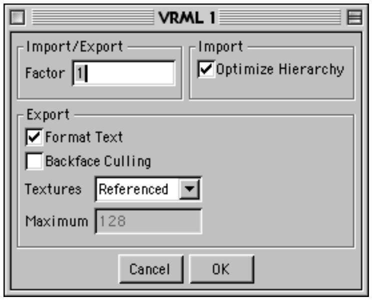
CINEMA 4D allows you to use any size of texture—provided of course that you have plenty of memory. However, when viewing a scene it can be irritating to wait for textures which are very large to load.

This option lets you restrict the size of QuickDraw 3D files. The material images are scaled to the specified value (in pixels); the proportions remain intact.

Note

If imported QuickDraw 3D models contain textures you have the option when loading them to either ignore them or to save them separately.

VRML 1



Factor

This is for specifying whether and to what degree VRML files are scaled when they are loaded and saved.

Optimize Hierarchy

If **Optimize Hierarchy** is selected, the scene structure will be optimized once the VRML1 file has been loaded. Superfluous dummy objects will be removed and the object hierarchy will be optimized. This creates a clearer overview, helping you to work more quickly.

Format Text

VRML is a text format. To facilitate manual editing of the file, this option carries out automatic formatting on the entire text file during export.

Backface Culling

This option enables an attribute on all exported objects which switches off drawing of the non-visible sides of all objects in the www browser. This gives a much faster display.

Textures

This menu specifies the action CINEMA 4D is to take when exporting textures.

None ignores the textures and saves only color information.

Referenced means objects are saved with the paths to the textures.

With File saves all textures directly in the VRML file (so-called *inline* textures). Any UV coordinates are also saved.

Maximum

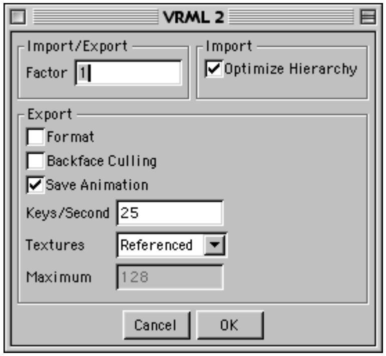
CINEMA 4D allows you to use any size of texture—provided of course you have plenty of memory. However, when viewing a scene it can be irritating to wait for textures which are very large to load.

This option lets you restrict the size of VRML files. The material images are scaled to the specified value (in pixels); the proportions remain intact.

Note

If imported VRML models contain textures you have the option when loading them to either ignore them or to save them separately.

VRML 2



Factor

This is for specifying whether and to what degree VRML files are scaled when they are loaded and saved.

Optimize Hierarchy

If **Optimize Hierarchy** is selected, the scene structure will be optimized once the VRML2 file has been loaded. Superfluous dummy objects will be removed and the object hierarchy will be optimized. This creates a clearer overview, helping you to work more quickly.

Format Text

VRML2 is a text format. To facilitate manual editing of the file, this option carries out automatic formatting on the entire text file during export.

Backface Culling

This option enables an attribute on all exported objects which disables the drawing of the non-visible sides of all objects in the web browser. This gives a much faster display.

Save Animation

With this option enabled, it is possible to export animation sequences into VRML2 format.

Keys/Second

When animation export is enabled you choose the frequency with which the keys are being written.

Since VRML2 has only linear interpolation available you can increase the precision of the export by setting this value higher (expect a proportional increase in the file size).

Sensible values are in the range 5 to 25. More keys than frames per second does not seem particularly useful!

Textures

This menu specifies the action CINEMA 4D is to take when exporting textures.

None ignores the textures and saves only color information.

Referenced means objects are saved with the paths to the textures.

With File saves all textures directly in the VRML file (so-called Inline textures).

Any UV coordinates are also saved.

Maximum

VRML-2 provides two options for making textures available to their objects:

The first option is identical to the one used in CINEMA 4D; a reference to the texture file is saved along with the VRML scene. If you want to go with this option, specify the value 0.

The second option integrates the graphics data directly into the VRML-2 file.

Since the texture is written uncompressed, in text format, a texture of 1000x1000 pixels quickly reaches a file size of 4MB. If you wish to avoid having such large files, you can specify a value (larger than 0), to restrict the size of textures. The materials are then scaled to that value (in pixels). The proportions remain intact.

If you have a texture of 800x600 pixels and you set a maximum value of 100, the texture is proportionally scaled down to a size of 100x75 pixels before being saved.

Note

If imported VRML models contain textures you have the option when loading them to either ignore them or to save them separately.

Wavefront

Factor

This specifies whether and to what extent Wavefront files are scaled during loading and saving.

Recent Files

CINEMA 4D remembers the files opened last and lists them in this sub-menu for quick access. You can define the maximum number of remembered files in **Edit > General Settings**.

CINEMA 4D

MODELING • ANIMATION • RENDERING

6. Edit Menu

6 Edit Menu

General

The Edit menu contains some of the most important and most frequently used functions (like Undo) in the entire CINEMA 4D program. We often take these functions for granted, but we would soon be lost without them. These functions are of such fundamental importance that you will find them in almost all managers (within a local Edit menu).

As we work through this chapter we will present you with a little theory. For example, we will explain how the internal buffers work and we will unravel the inner workings of the drawing pipeline. Please avoid any natural instinct to skip over the theory; it is very relevant to your everyday work because it helps you to understand and predict CINEMA 4D's behavior.

Also, it helps you to solve problems. Little is more frustrating than knowing you are doing something wrong but not knowing what it is. Here is your chance to be well-prepared!

Undo

This function will reverse the last change (action) that you made, restoring the scene to its previous state. If, for example, you move an object by accident, **Undo** will put the object back into position. **Undo** can also reverse complex editing actions such as **Crumple**.

You can select **Undo** repeatedly to continually reverse actions. By default, you can undo a maximum of 10 changes. We refer to the number of actions that you can reverse as *the undo depth*.

You can set the undo depth in the program settings (see General Settings, page 42).

Redo

Redo will restore the last action that was undone (see **Undo**, above). You can select **Redo** repeatedly to continue restoring the actions.

You can traverse the recent development stages of your scene by using **Undo** to move backwards and **Redo** to move forwards.

Naturally, the number of steps you can redo cannot possibly be greater than the number of actions you have undone. Therefore, there is no separate setting for the redo depth in the program settings.

Undo (Action)

This function differs from the conventional undo command in that it ignores selection actions. Undo (No Select) will reverse the last action that did not involve selection.

Why would you want to ignore selection actions?

Imagine that you increased the size of an object and then you used 10 selection actions to select points in various locations. Suddenly, you decide that the object is too big and you want to restore it to its original size. This would require you to call the conventional undo command 11 times (you must undo the 10 selection actions and then finally the scale action). If, however, you use Undo (No Select), it skips over the selection actions and reverses the scale action in one go.

Let's look at a few examples (*A* stands for a normal reversible action, e.g. *Move*; *S* stands for a reversible selection action):

Example 1

You've been editing for a while. The undo buffer contains the following sequence.

A S A S A A A S S S S

i.e. the buffer starts with a normal action, which is followed by a selection action, which is followed by a normal action, and so on. There are four consecutive selection actions at the end of the buffer. The final, most-recent, selection action is right-most and represents the current state of the undo buffer.

If we call the normal undo function, the resulting buffer is:

A S A S A A A S S S

Only the final selection has been removed - there are still three selection actions at the end of the buffer.

However, if we use the Undo (No Select) function instead of the normal undo we get:

A S A S A A

Can you see how it works? The first normal action has been removed as well as all the selections that happened to be in front of it.

Example 2

In this example the undo buffer contains selection actions only:

S S S S

The final, most-recent, selection action is right-most and represents the current state of the undo buffer. If we call the normal undo function, the resulting buffer is:

S S S

If, however, we use the Undo (No Select) function instead of the normal undo, we get:

S S S S

Nothing has been undone. Why?

The buffer contains selection actions only - there are no normal actions. Undo (No Select) reverts the scene to its state prior to the last normal action. So if there are no normal actions at all in the buffer, the buffer remains unchanged.

Notes On Undo/Redo

The Undo Buffer

When you perform an action in CINEMA 4D, information about that action is written to an area of memory referred to as *the undo buffer*. The **Undo** and **Redo** functions use the information in the undo buffer to revert the scene to a previous state.

An example

Imagine that you create an object and then change its scale to (400/400/400) units. Next, you move the object to coordinates (100/-300/0).

The undo buffer would then contain the following action history:

1. Create object at position (0/0/0)
2. Scale object to (400/400/400) units
3. Move object to position (100/–300/0)

The buffer's current state is step 3, the move action. If you call the **Undo** function, CINEMA 4D will undo the current state (move), then set the current state to step 2 (scale).

If you call the **Undo** function again, the scale action is undone and the current state is set to step 1 (create).

What particularly interests us here is that throughout the process the buffer content itself is not altered - nothing is deleted. As a result, you can restore the undone actions with the **Redo** function.

You can use **Undo** to move backwards through the undo buffer. **Redo** will advance you through the buffer.

Recall that nothing is deleted from the buffer. There must, however, be some constraint on the size of the buffer to prevent it taking up too much memory. This is the purpose of **Undo Depth** in the general settings - it specifies the maximum number of actions that can be undone (see Undo Depth, page 44).

Note

Some functions, such as Save and General Settings, are not recorded in the undo buffer and subsequently cannot be undone.

The Three Undos

CINEMA 4D has three types of undo.

Normal Undo/Redo

CINEMA 4D has *multiple-undo*, which means that a single undo can reverse multiple actions that logically belong together. Confused? Here's the explanation:

Imagine you have 10 objects in the Object Manager, then you use the **Group Objects** command to place them into a group. Internally, 12 actions are required: first a new (null) object is created, then 10 transfer actions place the objects into the null object, finally the null object is activated. CINEMA 4D's intelligent undo recognizes that these 12 actions belong together and it will treat them as though they were one action, i.e. you can undo all 12 actions with a single undo command.

Not only does CINEMA 4D have multiple undo, it also differentiates between memory-intensive actions and non-memory-intensive actions.

Examples of memory-intensive actions include the deletion of an object and the movement of an object's points. Non-memory-intensive actions include the activation of an object and the renaming of an object.

Non-memory-intensive actions can be recalled 10 times more than the **Undo Depth** value in the general settings.

For example, with an undo depth of 12 you can undo either 12 delete object actions or 120 activate object actions. You can also mix both types of action, e.g. you can undo 6 delete object actions and 60 select object actions.

Undo View / Redo View

These two functions are located on the Edit menu of the View window and they operate exclusively on the editor camera. They will not affect camera objects.

You can undo a maximum of 500 editor camera changes.

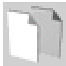
Undo (No Select)

We explored this third type of undo earlier in the chapter. It is particularly useful when modeling, since it ignores selections. **Undo (No Select)** uses the same undo buffer as the normal undo.

Cut

This function deletes the active object or active element from the current scene and copies it (including its materials and animation data) to the clipboard. The object can be copied back from the clipboard with the **Paste** function (see below).

Copy



The **Copy** function copies the active object or element (including its materials and animation data) to the clipboard. The object can be copied from the clipboard to the active scene with the **Paste** function (see below). You can paste repeatedly to create additional copies.

Note

You can copy and paste objects using drag-and-drop in the Object Manager. Keep the Ctrl key held down while you grab the object's name with the mouse and drop it elsewhere within the Object Manager. The first copy takes the name of the original and appends '.1'. The first copy of 'Apple' will be called 'Apple.1', the second copy will be called 'Apple.2' and so on.

Paste

This function inserts the contents of the clipboard (i.e. the last object that was cut or copied there) into the active scene.

Note

You can cut and paste between scenes - use the copy command in the source scene, then activate the target scene and select the paste command.

The names of the inserted objects are appended with numbers to differentiate them from the original ('Name.1', 'Name.2', etc.).

The trio Cut, Copy and Paste are found in almost all programs. Sometimes they are referred to collectively as cut-copy-paste, prompting instructions such as "Remove the item with cut-copy-paste". Only Cut removes the item - this has nothing to do with Copy and Paste.

Delete

This function deletes the active object or element from the current scene without copying it to the clipboard (see below).

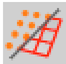
The Clipboard

When you use the **Cut** or **Copy** commands, the active object or element is copied into a structure in memory known as the *clipboard*. When you select the **Paste** command, the data in the clipboard is inserted into the current scene. For example, to copy an object from one scene to another scene; open both scenes, activate the scene that contains the object, copy the object, activate the other scene and then paste.

The clipboard can hold only one data element at a time. If you want to copy several objects, group the objects first, then copy the group.

The size of the clipboard is determined by the size of the data stored there. If, for example, you copy an 18MB object, the clipboard will use 18MB of memory. Naturally, you may want to purge the clipboard (e.g. before you render) to free up memory. You can purge the clipboard by cutting a null object (see Null Object, page 97) - the null object wastes only a few bytes.

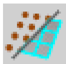
Select All



This function selects all the objects in the scene. If it is not possible to select all the objects directly, the objects will be placed in a group and the group will be selected.

If the Points tool is active (see Points, page 302) when you call **Select All**, all the points of the active object will be selected. Similarly, if the Polygon tool is active, all the polygons of the active object will be selected.

Deselect All



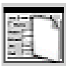
This function deselects all the active objects or elements.If the Points tool (see Points, page 302) is active when you invoke **Deselect All**, all the points of the active object will be deselected. Similarly, if the Polygon tool is active, all the polygons of the active object will be deselected.

General Settings

The general settings allow you to change the way CINEMA 4D operates and the way the program looks.

The numerous options are explained in detail in General Settings, page 42.

Render Settings



The render settings let you change the way CINEMA 4D renders the active scene.

The various options are explained in detail in Render Settings, page 407.

If you want to change the default render settings, open a new scene, change the settings to their new defaults, then save the scene in the CINEMA 4D root directory as 'template.c4d' or 'new.c4d'. CINEMA 4D will use these render settings each time you open a new scene. For more details see Initialisation Files, page 66.

The Drawing Pipeline

Introduction

One of CINEMA 4D's strongest features is its realtime preview. One problem faced by this preview is that sometimes it is possible to interpret the data in more than one way.

For example, imagine that you deform an object using an FFD (see FFD, page 270). Then you animate the object's position.

But what exactly is moved? The original object (which, although not used directly for the display, still exists), or the deformed object?

You want the deformed object to be moved, of course, in which case the animation must be evaluated before the deformation.

Let's take a second example. This time you have an object that is animated from point A to point B; yet at the same time you have given it an expression (see New Expression, page 462) that tells it to move to point C.

The object cannot be in both places at the same time, so who wins?

The winner is the one which is evaluated last of all - if the expression is evaluated first, the animation overwrites the expression and the object lands up at point B; if the animation is evaluated first, the expression overwrites it and the object ends up at point C.

The evaluation order is critical to object construction as well. Imagine that you bend a spline using a bend deformation. Next, you add an Extrude NURBS to extrude the spline. There are now two possibilities that generate very different results:

1 the spline is bent; the bent spline is extruded

2 the spline is extruded; the extruded object is bent.

These problems should make it clear that the evaluation order is critical in determining exactly what we see on the screen. There must be a set order in which the data is evaluated.

Since the data must be evaluated in order, we refer to this as a *pipeline* (it is as though the data is forced to pass through a pipe one element at a time). The order of evaluation determines what is drawn on the screen, therefore we refer to the entire evaluation process as the *drawing pipeline*.

Once you understand the principles of the drawing pipeline you will be able to predict results and solve related problems!

Elements Of The Drawing Pipeline

In this section we take a closer look at each data type that can pass though the drawing pipeline. In each case we will explain the order in which elements of the same data type are evaluated.

Animation

Animation refers to any data that is stored in the Time Line (see Time Line, page 547).

Comment

Although expressions can animate an object, they are treated as a separate data type.

Evaluation Order

Tracks are evaluated from bottom to top in the Time Line, beginning with parent objects. The child objects (sub-objects) are then evaluated according to the hierarchy tree; to see this tree in the Object Manager (see Expand Object Group, page 466), open the entire structure for a complex object group.

The objects are evaluated from top to bottom in the order you see here.

What happens if you have allocated two different position tracks (e.g. one from A to B, the other from A to C) to the same object?

The track which is topmost in the Time Line will be evaluated last of all and will overwrite the previous movement. So, if track A-to-B is above track A-to-C in the Time Line, the object will move from A to B.

Expressions

An *expression* is a behavioral property that can be added to an object. It gives instructions to the object. Expressions use C.O.F.F.E.E., CINEMA 4D's built-in programming language, and thereby have access to all of an object's parameters.

An expression could, for example, simulate muscle bulge by controlling the strength of a displacement texture according to the angle between the upper and lower arm of a figure. Another example might be to change the texture color used by a house according to the state of a sun object.

Evaluation Order

Expressions are evaluated from left to right as they appear in the Object Manager.

First the parent object is evaluated, then the order continues along the hierarchy tree; to see this tree, open the entire structure for a complex object group in the Object Manager (see Expand Object Group, page 466).

The objects are evaluated from top to bottom in the order you see here.

Generators

Generators are objects that create temporary hierarchical structures.

For example, a NURBS object generates a temporary polygon object for display purposes. You can convert the temporary object into a real object if required. See Current State To Object, page 393.

Generators include NURBS objects, the particle system, the array, the symmetry object, polygon primitives, spline primitives, instances, metaballs and so on.

Evaluation Order

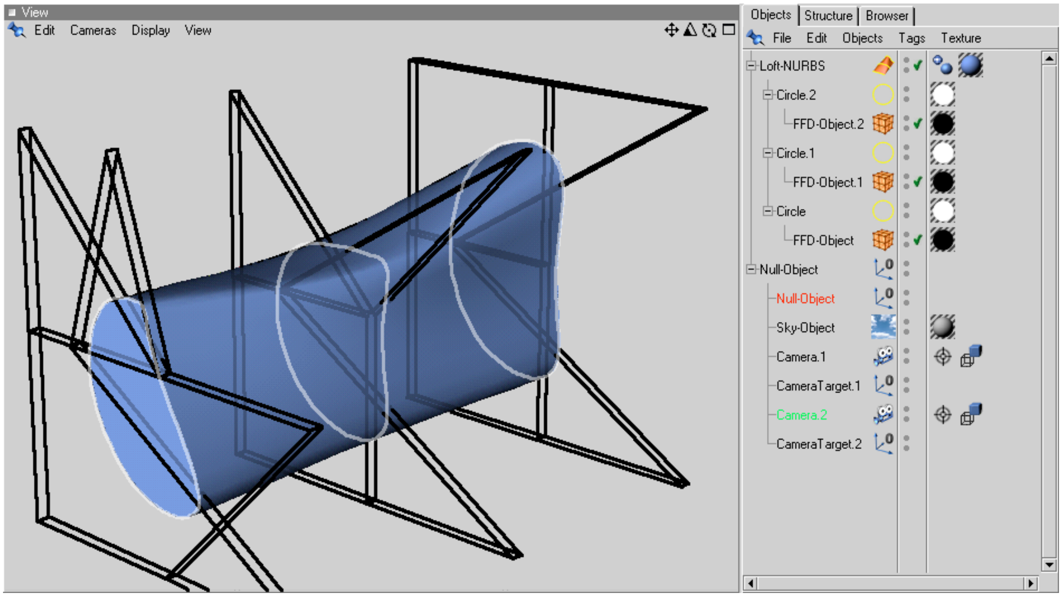
Generators are evaluated starting with the sub-objects, then evaluation moves up the hierarchy tree; to see this tree, open the entire structure for a complex object group in the Object Manager (see Expand Object Group, page 466). The objects are evaluated from top to bottom in the order you see here.

Deformations

Deformers are the functions listed in the **Objects > Deformation** menu and include Explosion, FFD, Bone and Magnet.

A deformer deforms the (single) object that it is applied to. The deformation is applied to a virtual copy of the source object so that the original geometry is preserved and can always be restored.

The main difference between expressions and deformers is that expressions are processed before the (virtual) copy is created, whereas deformers are processed after the copy is created.



Evaluation Order

Deformers are evaluated starting with the sub-objects, then evaluation moves up the hierarchy tree; to see this tree, open the entire structure for a complex object group in the Object Manager (see Expand Object Group, page 466).

The objects are evaluated from top to bottom in the order you see here.

Here is an example to explain why the evaluation order for deformers and generators begins at the sub-object level:

A loft NURBS (Loft NURBS, page 170) creates a temporary polygon object for display purposes - it is a generator. Imagine that the splines which describe the Loft NURBS are themselves deformed by several FFD objects (deformers). The hierarchy tree might look as in the illustration opposite.

It is only possible for the FFDs (sub-objects of the splines) to deform the splines before they are used by the NURBS object if the evaluation order is from the bottom of the hierarchy tree to the top.

The Display Order

We have addressed the order in which elements of the same data type are evaluated, but what is the evaluation order for elements of differing type? Again, the display pipeline works to a strict order:

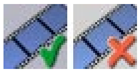
- First, all animation data is evaluated.
- Next, the expressions are evaluated.
- Finally, and with top priority, the generators and deformers are evaluated.

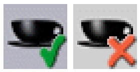
It is a good idea to remember this sequence.

The drawing pipeline is evaluated each time you perform a new action in CINEMA 4D. This apparent overhead makes it possible, for example, to apply a *target expression* to an object, then see it move automatically as you move the target object around in the editor.

You are able to work with objects live - there is no need to move the time slider or play back the animation to update the scene. This is particularly useful with inverse kinematics (see Inverse Kinematics, page 308) since you can work with interactive (live) targets.

Use Animation
Use Expressions
Use Generators
Use Deformers

 Use Animation

 Use Expressions

 Use Generators

 Use Deformers

These four functions turn on or off specific elements of the drawing pipeline. If an element is turned off, its data will no longer be evaluated in the editor. If, for example, you turn off deformers, all objects will appear in their undeformed state.

Example

If you have allocated a target expression to an object and if **Use Expressions** is selected, you will be unable to rotate the object freely (you can rotate it about the Z axis, but you cannot rotate it away from the target).

This is because CINEMA 4D evaluates the movement but immediately overwrites it with the expression. Remember that the drawing pipeline is updated each time you make a change.

Let's take another example.

If you have created a simple position animation (movement from A to B) using keyframing (see page 552), you will be unable to move the object away from its path - it hops back immediately.

If you want the object to pass through point C on its journey from A to B, deselect **Use Animation**, move the object accordingly, record the new key for point C, then reselect **Use Animation**.

Tip

Should you encounter unexpected results in CINEMA 4D, check the drawing pipeline first.

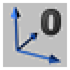
CINEMA 4D

MODELING • ANIMATION • RENDERING

7. Objects Menu

7 Objects Menu

Null Object



With the null object one could say it's a "I cannot do anything, I'm nothing" object. And that's right ... almost.

If you call this function, CINEMA 4D creates only an empty axis system in the 3D space. The object contains neither points nor surfaces and cannot be edited in the normal way.

So why use a null object?

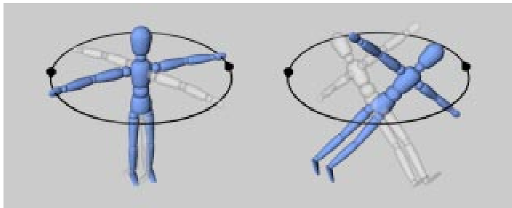
Well, the null object can have other objects placed within it. So it is useful for grouping matching elements of a scene. Null objects are also created by an automatic grouping in the Object Manager (Group Objects, page 466).

A further possible application is as a handle in IK chains (see Inverse Kinematics, page 308). Here you create a null object as the last part of an IK chain. Then use this empty object, instead of the other real objects in the chain, to move the inverse kinematics (manually or within an animation).

The advantage? Well, normally if you move, say, the hand at the end of an arm of a figure by IK, the hand itself remains rigid. This is avoided by the use of such a dummy object at the end of the chain.

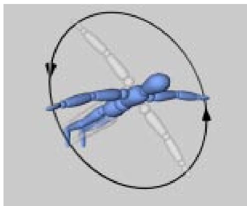
Let's not forget one of the most frequently used applications of the null object; its use as a dummy object for accurate rotation of previously rotated objects.

As long as the axes of an object lie parallel to those of its parent system (with newly created objects the parent is the world coordinates system), an object rotates around its Y axis (a heading rotation). However, if the object, or its local object coordinate system, is already rotated (so that its axes are not parallel to those of its parent), the result often astonishes even the most experienced 3D designers.



Left: rotation with parallel axes systems, Right: with an already rotated object system (in each case the final rotation is through 90°)

The use of a null object gives the desired result. Here the null object and the object which is to be rotated lie on top of each other. The axes of the two objects have the same direction and - quite importantly! - the object in question is within the hierarchy of the null object.



Correct rotation behavior through the use of a null object

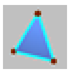
In addition, some actions that rely on a particular orientation of an object in 3D space (such as the duplicating of objects) profit from the use of a parental null object.

You can read more on this topic in Rotation, page 297 and in Duplicate, page 394.

Animations with particles represent a further problem that null objects can help with (see also Particle System, page 244 and Particle Animation examples, page 255). Let's assume you move an object from A to B, record this as a position track for the object, and then place it in an emitter. What happens? The objects simply fly from the emitter, as if they had never heard of the phrase 'position animation'.

The solution is to use a null object. Put the animated object into the null object and then the null object into the emitter. The result is that, as you intended, all emitted particles follow the position track you defined.

Polygon Object



This creates an empty polygon object. Initially, it is recognizable on the screen only by its origin and its axes.

You can later fill this object with points and surfaces (polygons). You can read more on this in Add Points on page 356, Create Polygon on page 364, and Import ASCII Data on page 607.

As an alternative to the null object (see above), the polygon object can also be used for grouping other objects.

Tip

Do not confuse the polygon object with the spline object (see below). Both are initially empty containers; however the former can accept only polygon vertices (and surfaces) while the latter accepts only spline vertices (and splines).

Primitives

General

All primitives within this menu are *parametric*, i.e. they are created from mathematical formulae using a number of pre-set values. A consequence of this is that such an object is initially simply a mathematical abstraction and is not editable. In plain language this means that such objects do not possess any points or surfaces which you could manipulate.

To deform one of these primitives, say with the magnet tool (Magnet, page 373), it must first be converted into polygons with the **Make Editable** command (see Make Editable, page 356).

On the plus side, parametric means that, at any time, you can change the parameter values of an object (e.g. height, radius, etc.). This allows you to play with the different parameters of an object in order to get a feeling for how it looks, behaves, etc.

However you choose a new object primitive, first of all the relevant primitive is created in the scene. The properties of such an object are reachable within the Object Manager in the parameter dialog; double-click on the object icon to reach this dialog (see Edit Object, page 466).

Alternatively you can double-click on the object itself within the editor.

Often within these parameter dialogs you will see a check box for **Segments**; this allows you to define the level of refinement of the particular surface or solid. This is useful if you are going to extend the object, perhaps to build further, more complex, objects.

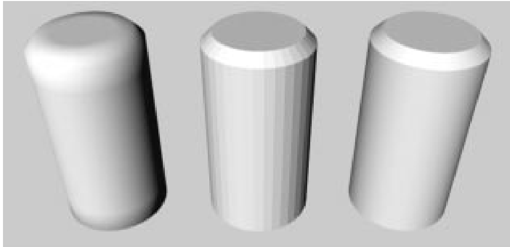
Consider a cylinder, out of which you would like to form a curved rod. If this possesses only one segment in the longitudinal direction, no intermediate points exist between the beginning and the end and therefore it becomes impossible to bend the object in this direction. The higher the number of segments, the more smoothly the object can be bent.

In addition, most objects are created with their Smoothing property set (see Smoothing Tag, page 455).

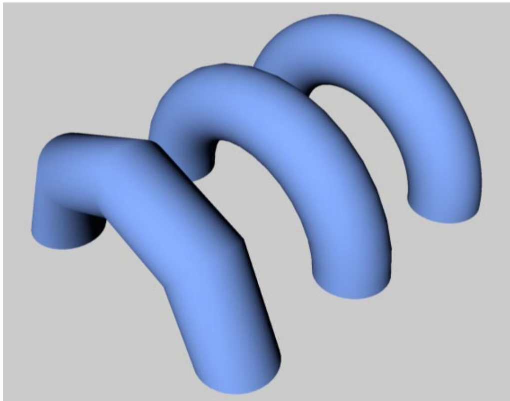
With smoothing assigned to an object it is displayed using chamfers and this can, occasionally, lead to unpleasant results.

In such a case you can delete the smoothing property (but you will probably then need to increase the segmentation), or change the smoothing angle in the smoothing dialog until you achieve the desired result. You may often need to juggle segmentation and smoothing to achieve a balance between quality and speed.

In the following illustration, the cylinder on the left has smoothing turned on, in the center smoothing is tuned off and on the right is the optimized result.



In the lower illustration is a curved cylinder, on the left with 4 segments, in the center with 16 segments and to the right with 72 segments. You can see how the increase in the segmentation affects the softness of the deformed object.



You should always try to create an object with as regular a segmentation as possible; this will help the smoothing algorithm.

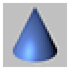
A parameter common to all the primitives is **Orientation**; this lets you change how the object lies in the 3D space. Thus you can quickly move your object to lie in another direction. Notice that the actual geometry is affected by an orientation change, not the object axis system.

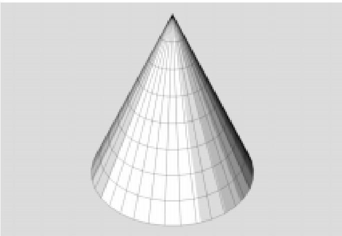
Interactive handles represent another way of changing the object's parameters; these are displayed as small orange points. If you click on one of these points, keep the mouse button pressed and move the mouse in any direction, the object changes its shape immediately; radii become larger, lengths smaller, etc.

New objects are created either centred at the world origin or centred within the editor view; this behavior is changed within the General Settings (see General Settings, page 42).

In the following sections we will describe, in sequence, each primitive. In each case we will describe the options in the parameter dialog first and then explain the behavior of the object handles.

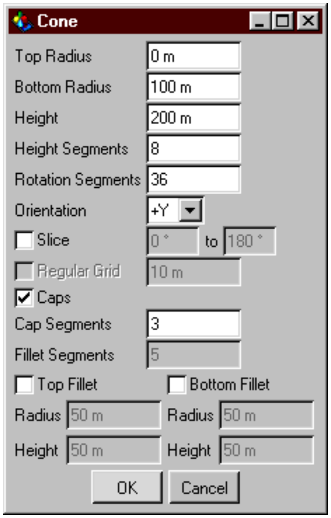
Cone





This function creates a cone, whose base lies in the XZ plane (but see below). With its various options this object is substantially more flexible than it appears at first sight.

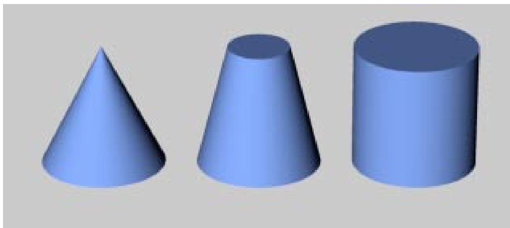
You want to create a water drop? Or perhaps you need objects that are often used in production technology, like splined cones and cylinders (see Oil Tank, page 114). No problem - you'll find these objects, among many others, in the examples below.



The Cone parameter dialog

Top Radius, Bottom Radius

These values define the upper and lower radii of the cone. The top radius is, by default, zero i.e. the object possesses a point here (see illustration below, left). If this value is set higher than zero, a truncated cone will be formed (below center). If the top radius is equal to the bottom radius, you will get a cylinder (below right).



Different cone radii

Height

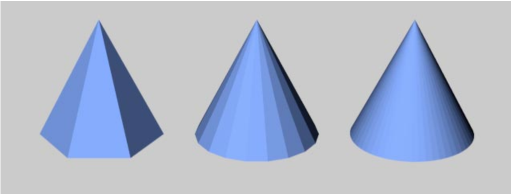
This value defines the overall height of the cone.

Height Segments

Defines the number of subdivisions of the object in the Y direction.

Rotation Segments

Defines the number of subdivisions of the object along its length. The larger this value, the more round the cone will appear.



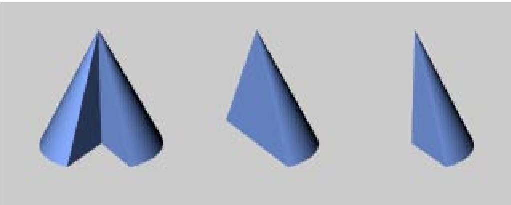
Cone with different subdivisions

Orientation

Choose a value from this popup menu to set the cone's initial position in space. Using this you can turn the cone on its axis very simply and, above all, quickly.

Slice

Use this to slice up the cone. Think of an ice cream bombe (well, why not), from which you cut out a slice; the planes of section of the remaining object are closed.



Different cone cutouts

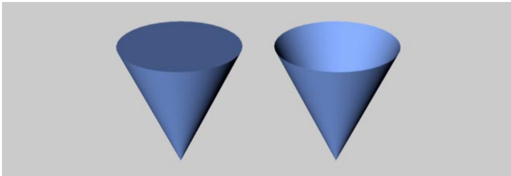
Regular Grid

The Regular Grid option will be available if, and only if, you have chosen to Slice the object. By checking this option and entering a value alongside the check box you can control the subdivisions within the plane of section of the sliced object. Small values produce a fine subdivision while larger values result in a coarse structure.

This subdividing only affects the *face* (the plane of section) of the slice. You will only need to use this option if you intend to process the object further after slicing it.

Caps

With the option you can choose whether the cone is capped on its top and base. If this option is not checked, you're creating something like a coffee filter.



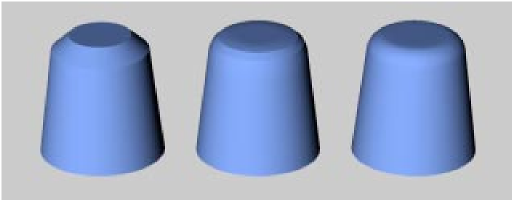
On the left is a cone, on the right is one without caps

Cap Segments

This sets the number of subdivisions of the caps in a radial direction. The subdivision along the circumference of the caps is set from the value defined in **Rotation Segments** (see above).

Fillet Segments

If you have chosen to fillet the top or bottom of your cone, you can define the degree of filleting or chamfering here. The larger the value, the finer (or rounder) the fillet becomes. To achieve a single chamfer, set the number of fillet segments to 1. Below is a truncated cone whose upper extent has been filleted. To the left is a chamfer, in the center a rough fillet and, on the right, a fine fillet.



On the left a fillet of 1 segment (a chamfer), in the center 3 fillet segments, on the right 10 fillet segments

Top Fillet, Bottom Fillet

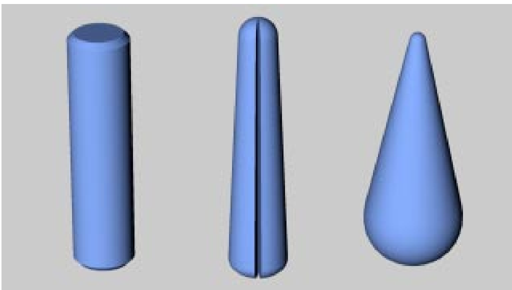
Check these according to where you want to apply the fillet/chamfer.

Radius, Height

These values define the shape of the rounding that is applied when filleting. If both values are identical, the roundness is circular; if the values are different, the roundness is elliptical.

The value for the radius here can be set up to the value of the radius of the relevant part of the cone; the value for the height can be set up to the value of half the cone height.

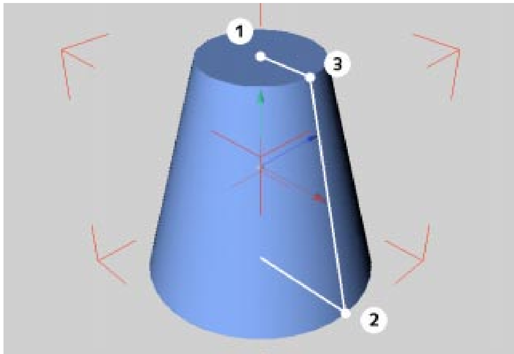
In the following illustration are some examples of what one can create using the cone primitive.



Different "cones"

Interactive editing

The cone has, initially, three handles - handle 1 (for the upper radius; initially zero) and handle 3 (for the height) lie one above the other.



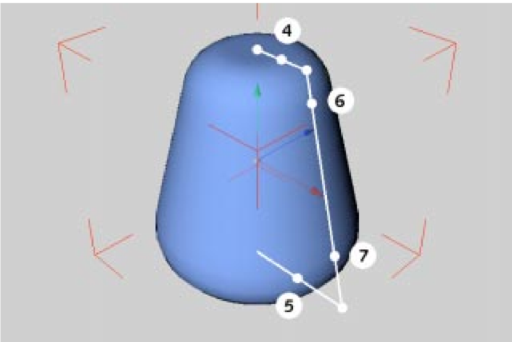
The handles of the cone primitive

If you drag handle 1 you change the upper radius. If you drag handle 2 you change the lower radius. If you drag handle 3 you change the cone height.

Tip

You will see that, for the height of the cone and for the upper truncated cone radius, two handles lie one above the other. Using the mouse alone you can select and use the top handle; hold down the Shift key and drag the mouse to get the handle underneath.

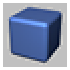
If you switch on the Fillet option in the parameter dialog (see above), two further handles appear for controlling the upper and the lower rounding.

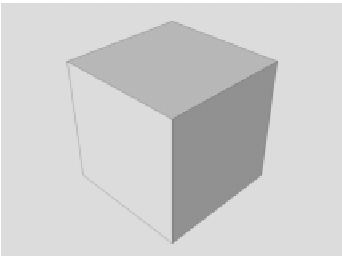


Additional handles of the cone primitive

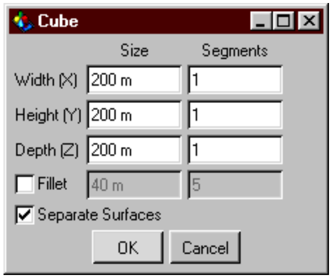
If you drag handles 4 or 5 you change the width of the fillet. If you drag handles 6 or 7 you change the height of the fillet up or down.

Cube





This function creates, by default, a cube whose sides are parallel to the coordinate axes of the world system. By adjusting the various options, many arbitrary cuboids, optionally with rounded edges, can be created.



The Cube's parameter dialog

Size — Width (X), Height (Y), Depth (Z)

The values for width, height and depth define the size of the object. If all three are identical it's a cube, in all other cases a cuboid.

Segments — Width (X), Height (Y), Depth (Z)

These values for width, height and depth reflect how finely the particular side of the object is subdivided.

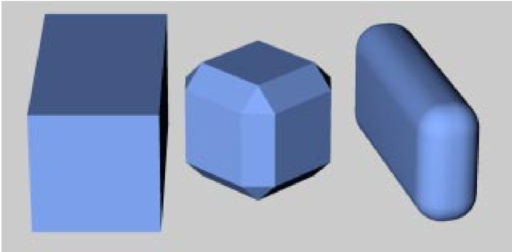
You must consider the segmentation if you intend to edit the primitive with other tools. The finer the subdivision, the softer later deformations will appear.

In particular you should subdivide an object quite finely before using boolean operations on it - generally, though, only subdivide when necessary.

Fillet — Size, Segments

With this option you can apply an even roundness to all the cuboid's edges, i.e. apply a fillet. **Fillet Size** is the radius of the curvature, while **Fillet Segments** defines how finely the fillet will appear.

The more segments you specify, the rounder the object's edges will be. If you want to create a chamfer, instead of a rounded, filleted edge, set this value to 1.



Different cube shapes

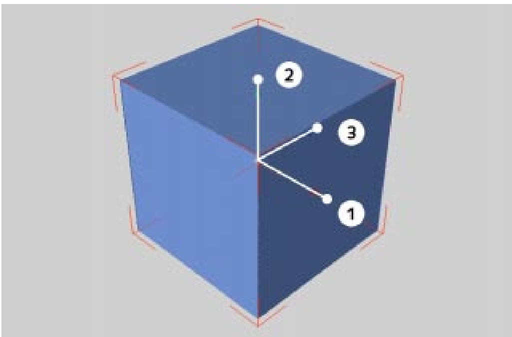
The radius of the fillet cannot be larger than half of the value of the smallest of the cuboid's dimensions. If your cuboid possesses, say, a width of 100 units and a height and depth of 300 units each, a maximum of 50 can be chosen for the fillet radius.

Separate Surfaces

If you select this option then, during a later transformation of the parameter object into a polygon object, a separate object will be created for each side of the cuboid and all will be combined into a group. This is useful if you want to be able to process elements of the cuboid separately.

Interactive editing

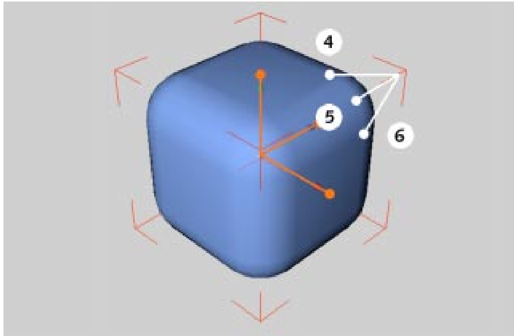
The cube has three handles.



The handles of the cube primitive

If you drag handle 1 you change the width (X). If you drag 2 you change the height (Y). If you drag 3 you change the depth (Z).

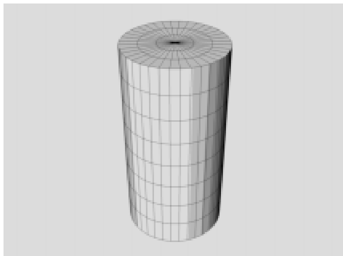
If you switch on **Fillet** in the parameter dialog (see above), three further handles appear.



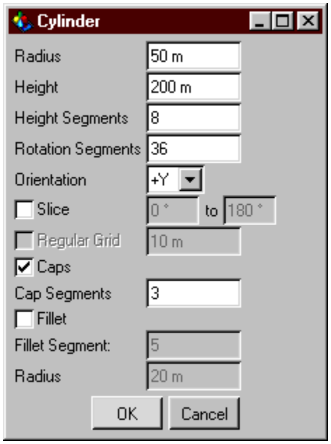
Additional handles of the cube primitive

Drag handles 4, 5 or 6 to change the fillet radius.

Cylinder



This function creates a cylinder, whose ends (caps) are aligned parallel to the XZ plane.



The Cylinder's parameter dialog

Radius, Height

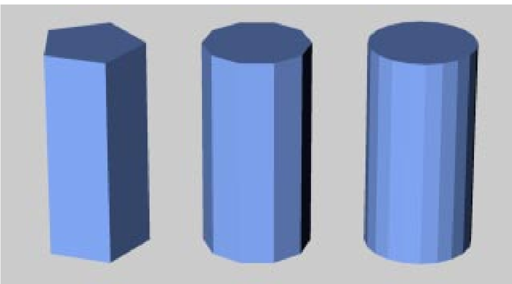
These values define the basic dimensions of the cylinder.

Height Segments

Changes the number of subdivisions of the object in the Y direction.

Rotation Segments

This defines the number of subdivisions of the object along its circumference. The larger this value, the smoother the cylinder will appear.



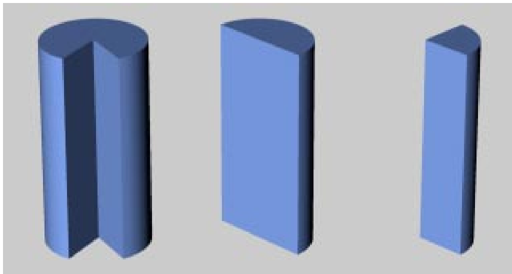
Cylinder with different subdivisions

Orientation

Choose a value from this popup menu to set the cylinder's initial position in space. Using this you can turn it on its axis very simply and, above all, quickly.

Slice

By entering a value for **Slice** you can remove parts of the cylinder. Think of a cake, from which you've cut a piece. The planes of section of the remaining object are closed. Here are some different cylinder cutouts.



Different cylinder cutouts

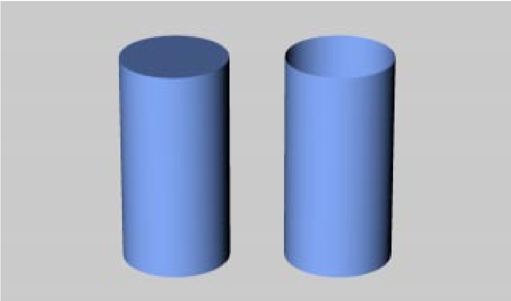
Regular Grid

The Regular Grid option will be available if, and only if, you have chosen to Slice the object. By checking this option and entering a value alongside the check box you can control the subdivisions within the plane of section of the sliced object. Small values produce a fine subdivision while larger values result in a coarse structure.

This subdividing only affects the *face* (the plane of section) of the slice. You will only need to use this option if you intend to process the object further after slicing it.

Caps

Use this option to give the cylinder caps both of its ends, or leave it unchecked for a hollow cylinder.



A cylinder on the left with and, on the right, without caps

Cap Segments

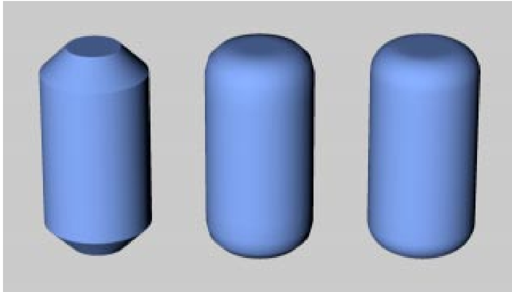
This value defines the number of subdivisions of the caps in a radial direction. The subdivision along a cap's circumference is as defined in **Rotation Segments** (see above).

Fillet, Radius

Assuming that the cylinder has caps you can use this option to apply a fillet or chamfer to the join between the cylinder body and the caps. Enter the radius of the fillet.

Fillet Segments

With **Fillet** selected you can choose the degree of the roundness with this option. The higher the value the smoother the join will appear; enter a value of 1 to achieve a chamfer. In the picture is a cylinder whose upper cap was rounded. To the left is a chamfer, then a rough fillet and, on the right, a high-value, smooth fillet.

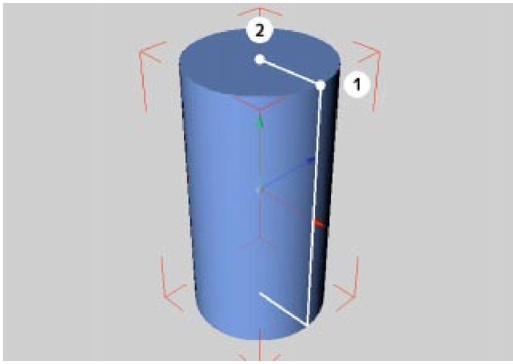


On the left a fillet segment of 1 (chamfer), center fillet segments set to 3, on the right 10

The roundness can be set as large as the cylinder radius — the caps will then appear to be hemispheres.

Interactive editing

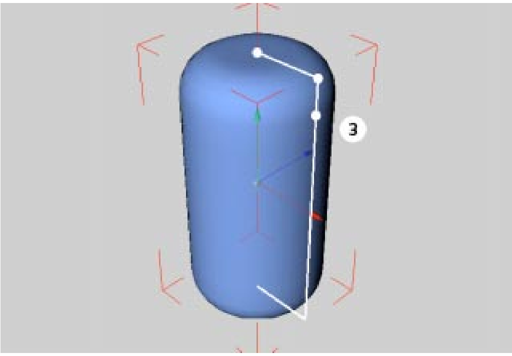
The cylinder has, initially, two handles.



The handles of the cylinder primitive

If you drag handle 1 you change the radius. If you drag handle 2 you change the height.

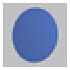
If you switch on **Fillet** in the parameter dialog (see above), a further handle appears.

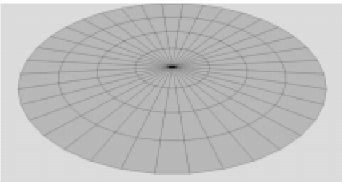


Additional handle of the cylinder primitive

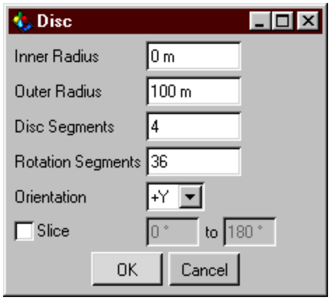
If you drag handle 3 you change the radius of the cap fillet.

Disc





This creates a circular disc in the XZ plane.



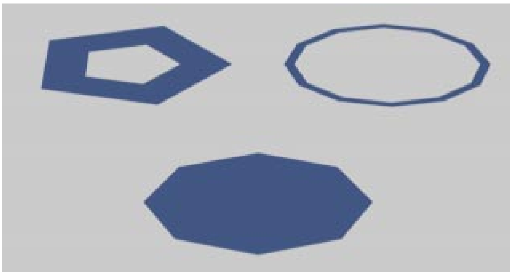
The Disc's parameter dialog

Inner Radius, Outer Radius

The value for the outer radius defines the overall size of the disc. A value for the inner radius of greater to zero, generates a perforated disc. Naturally, the inner radius cannot be larger than the outer radius.

Disc Segments, Rotation Segments

Disc Segments gives the radial subdivision, **Rotation Segments** the subdivision along the circumference of the disc.



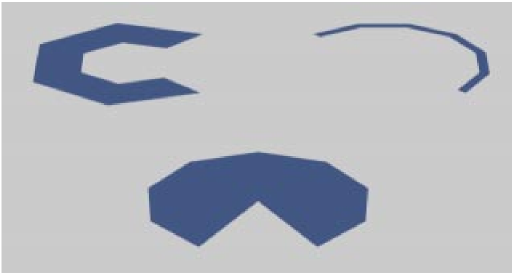
Discs with different subdivisions

Orientation

Choose a value from this popup menu to set the disc's initial position in space. Using this you can turn it on its axis very simply and, above all, quickly.

Slice

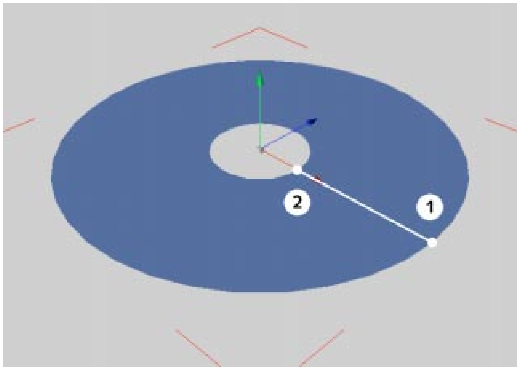
Check this option and enter a value in order to cut chunks out of the disc, like slices from a cake. In the following illustration are some different disc cutouts.



Different disc cutouts

Interactive editing

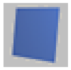
The disc has two handles.

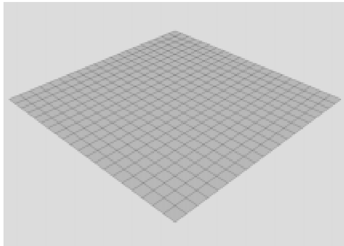


The handles of the disk primitive

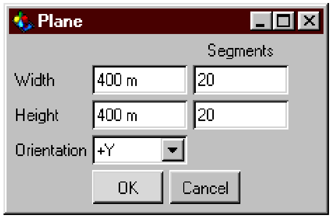
If you drag handle 1 you change the outer radius. If you drag handle 2 you change the inner radius.

Plane





This creates a quadrangle in the XZ plane, which is divided into further quadrangle surfaces.



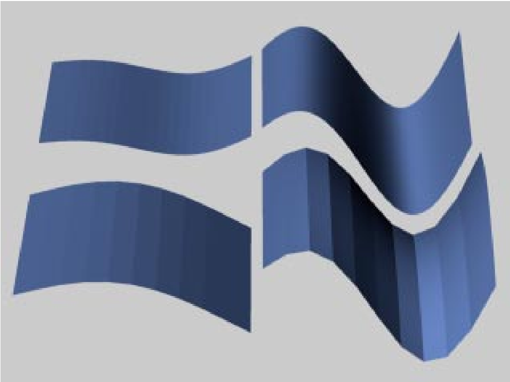
The Plane's parameter dialog

Width, Height

Defines the size of the plane.

Segments

For each dimension of the plane you can separately adjust the level of subdivision. This is important for subsequent modeling. The finer the subdivision, the more smoothly you will be able to apply tools such as the magnet (see Magent, page 373).



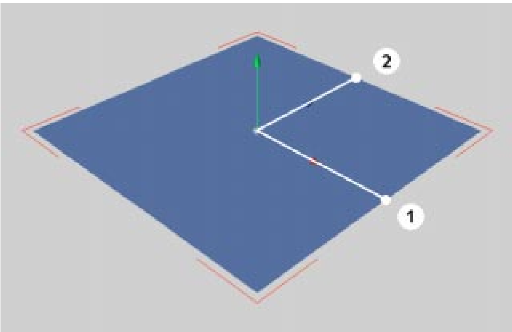
Differently subdivided, deformed planes

Orientation

Choose a value from this popup menu to set the plane's initial position in space. Using this you can turn it on its axis very simply and, above all, quickly.

Interactive editing

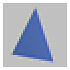
The plane has two handles.

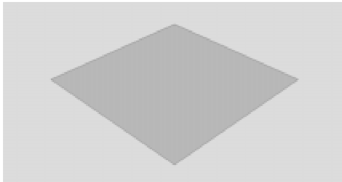


The handles of the plane primitive

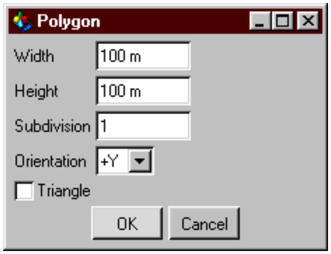
If you drag handle 1 you change the width. If you drag handle 2 you change the height.

Polygon





This creates probably the most elementary object used in computer graphics, an individual, triangular or rectangular polygon in the XZ plane.



The Polygon's parameter dialog

Width, Height

Define the size of the polygon.

Subdivision

Allows you to change the degree of subdivision of the object.

Orientation

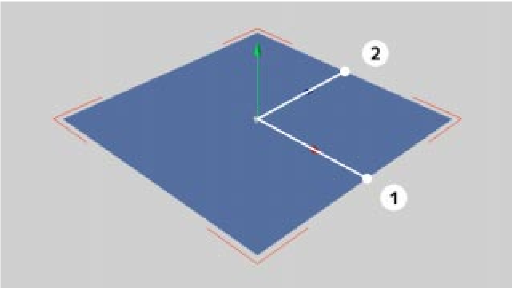
Choose a value from this popup menu to set the polygon's initial position in space. Using this you can turn it on its axis very simply and, above all, quickly.

Triangle

Check this option to create the polygon from triangular shapes, as opposed to rectangular ones. This option is set by default.

Interactive editing

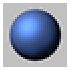
The polygon has two handles.

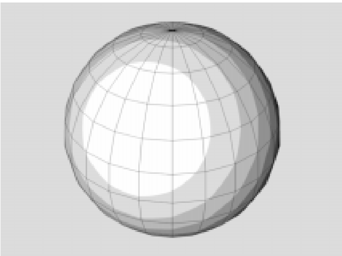


The handles of the polygon primitive

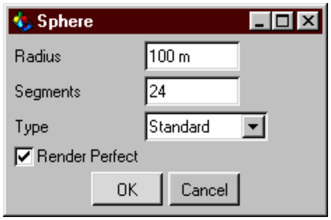
If you drag handle 1 you change the width. If you drag handle 2 you change the height.

Sphere





This function creates a sphere, composed of triangles and squares. Spheres will come into their own when used with Metaballs (see Metaball, page 185).



The Sphere's parameter dialog

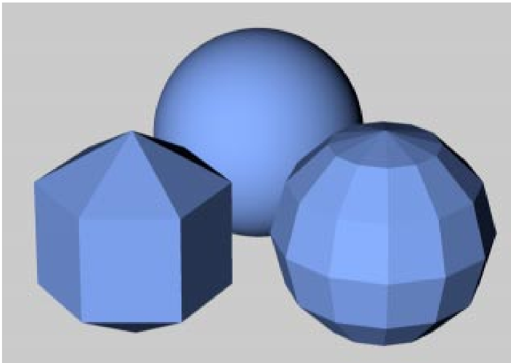
Radius

Use this to define the size of the sphere.

Segments

Defines the degree of the subdivision of the sphere. The sphere is divided along its latitude and longitude.

However, until you convert a sphere into a polygon object with **Make Editable** a sphere is always generated by calculation, no matter how much you subdivide it.



On the left a sphere primitive divided into six segments, on the right the same object, this time converted to a polygon.

Render Perfect

If you choose this option, a *perfect* sphere is generated by the maths (if the sphere was not already distorted or deformed).

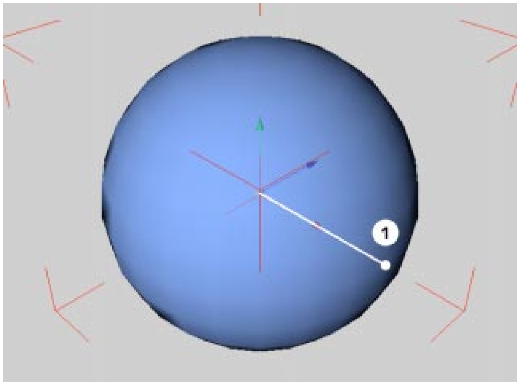
This type of sphere has the advantage that it looks great, since it is truly round and smooth. In addition it can be rendered more quickly than a sphere built from surfaces.

Type

With this popup menu you choose of which surfaces, and in which arrangement, a sphere is to be composed. With Standard the sphere surface is made up of triangles and squares, Hexahedron uses only squares and Icosahedron only triangles.

Interactive editing

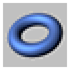
The sphere has one handle.

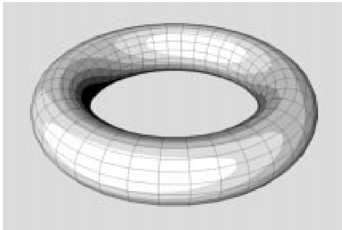


The handles of the sphere primitive

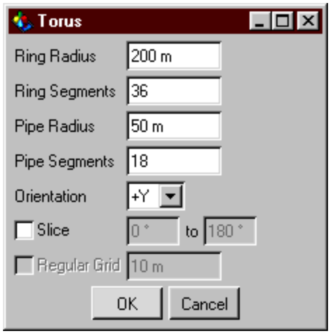
If you drag handle 1 you change the radius.

Torus





This function creates, by default, a torus (solid ring, like a bent pipe) in the XZ plane.



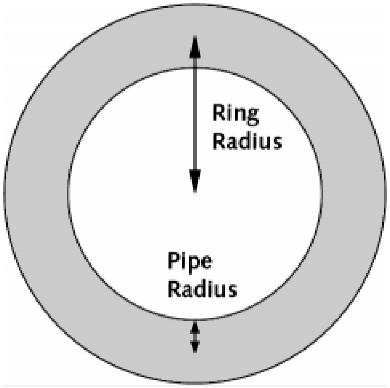
The Torus's parameter dialog

Ring Radius, Ring Segments

With these values you define the size and the subdivision of the ring. The ring is a notional circle running round the center of the pipe.

Pipe Radius, Pipe Segments

Specify the size and the subdivision level of the pipe. The pipe radius cannot be larger than the ring radius.

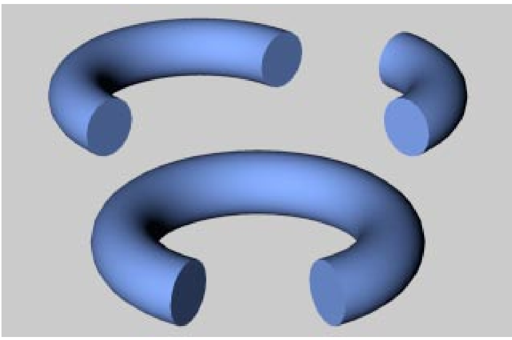


Orientation

Choose a value from this popup menu to set the torus's initial position in space. Using this you can turn it on its axis very simply and, above all, quickly.

Slice

Check this box and select a value to obtain a portion of the torus. The planes of section of the cutout object are closed. In the following illustration are some different cutouts.



Different torus cutouts

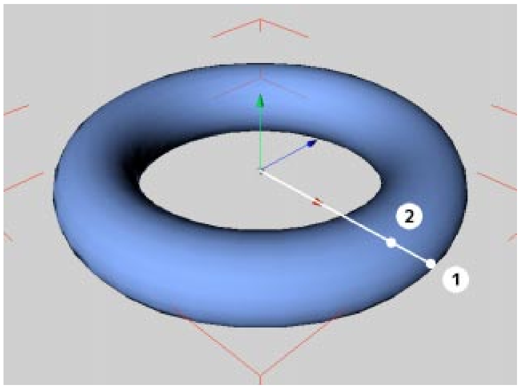
Regular Grid

The Regular Grid option will be available if, and only if, you have chosen to Slice the object. By checking this option and entering a value alongside the check box you can control the subdivisions within the plane of section of the sliced object. Small values produce a fine subdivision while larger values result in a coarse structure.

This subdividing only affects the *face* (the plane of section) of the slice. You will only need to use this option if you intend to process the object further after slicing it.

Interactive editing

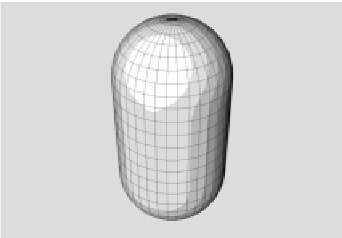
The torus has two handles.



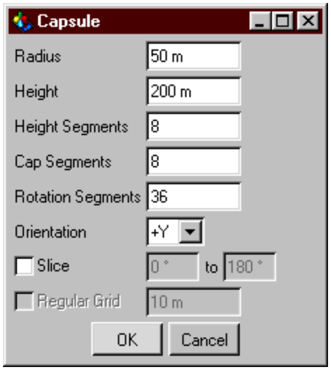
The handles of the torus primitive

If you drag handle 1 you change the ring radius. If you drag handle 2 you change the pipe radius.

Capsule



This function creates, along the y axis, a cylinder with hemispherical caps. From this, you can quickly create a myriad of pill shaped objects.



The Capsule's parameter dialog

Radius

This value defines the half-thickness of the object. The cap radius is automatically generated from this value.

Height

Use this to choose the overall height (the cylinder plus the caps) of the capsule.

Height Segments

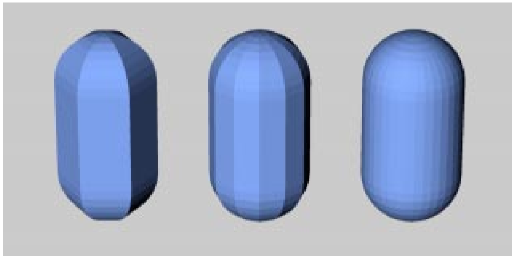
This gives the number of subdivisions of the capsule in the Y direction.

Cap Segments

Defines the number of subdivisions of the cap in a radial direction. The subdivision along the cap's circumference is given by **Rotation Segments** (see below).

Rotation Segments

The number of subdivisions of the capsule around its circumference. The larger this value, the rounder the cap appears.



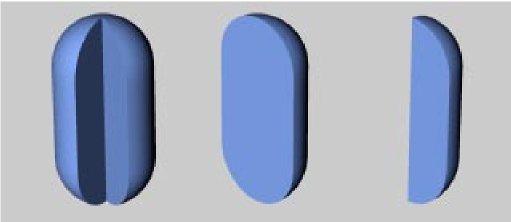
Capsules with different segment values

Orientation

Choose a value from this popup menu to set the capsule's initial position in space. Using this you can turn it on its axis very simply and, above all, quickly.

Slice

Select and enter values to remove part of the capsule. The planes of section of the resulting object are closed. Here are some different capsule cutouts.



Different capsule cutouts

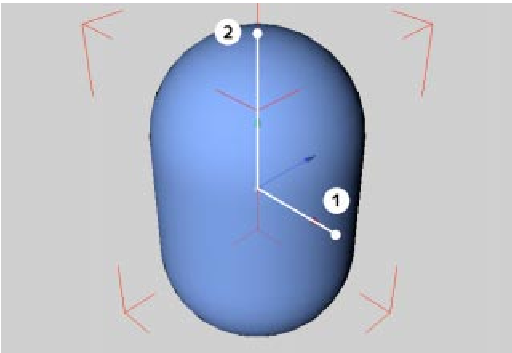
Regular Grid

The Regular Grid option will be available if, and only if, you have chosen to Slice the object. By checking this option and entering a value alongside the check box you can control the subdivisions within the plane of section of the sliced object. Small values produce a fine subdivision while larger values result in a coarse structure.

This subdividing only affects the *face* (the plane of section) of the slice. You will only need to use this option if you intend to process the object further after slicing it.

Interactive Editing

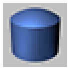
The capsule has two handles.

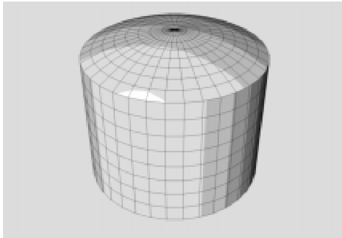


The handles of the capsule primitive

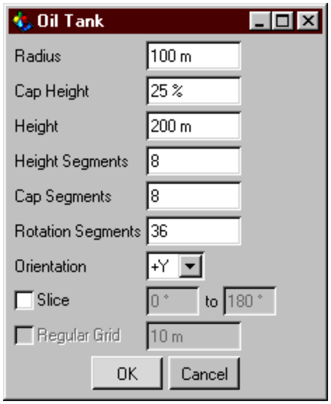
If you drag handle 1 you change the radius. If you drag handle 2 you change the height.

Oil Tank





This creates a cylinder along the Y axis with curved caps. By adjusting the parameters many different objects can be made, such as the location pins or rivets frequently used in the car industry.



The Oil Tank's parameter dialog

Radius

Defines the half-thickness of the object.

Cap Height

The cap height is defined as a percentage of the radius of the oil tank. 100% will give a hemispherical cap (a capsule, assuming the length is sufficient compared to the radius), 0% means no curvature (a cylinder).

In contrast to the cone or the capsule, the transition from the cylinder barrel to the cap is always sharp; the exception being if you have chosen 100% for this parameter.

Height

This is the overall length (the body plus the caps) of the oil tank.

Height Segments

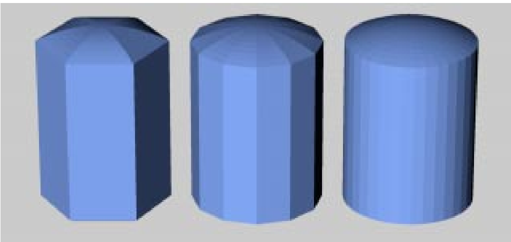
This value defines the number of subdivisions of the object in the Y direction.

Cap Segments

This is the subdivision level of the caps in a radial direction.

Rotation Segments

The number of subdivisions of the oil tank around its circumference. The larger this value, the rounder the oil tank appears.



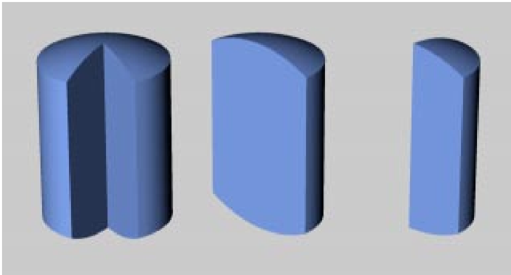
Oil tanks with different segment values

Orientation

Choose a value from this popup menu to set the oil tank's initial position in space. Using this you can turn it on its axis very simply and, above all, quickly.

Slice

Use this to get just a portion of the oil tank. Here are some different oil tank cutouts.



Different oil tank cutouts

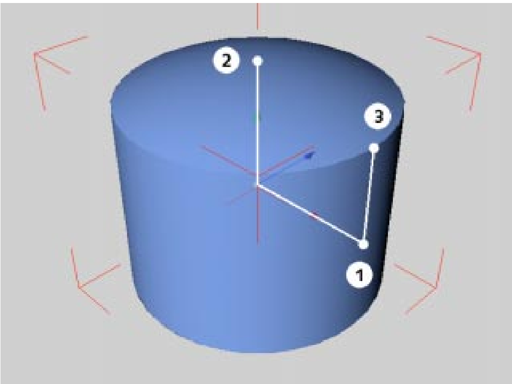
Regular Grid

The Regular Grid option will be available if, and only if, you have chosen to Slice the object. By checking this option and entering a value alongside the check box you can control the subdivisions within the plane of section of the sliced object. Small values produce a fine subdivision while larger values result in a coarse structure.

This subdividing only affects the *face* (the plane of section) of the slice. You will only need to use this option if you intend to process the object further after slicing it.

Interactive Editing

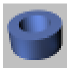
The oil tank has three handles.

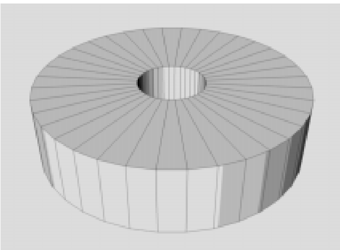


The handles of the oil tank primitive

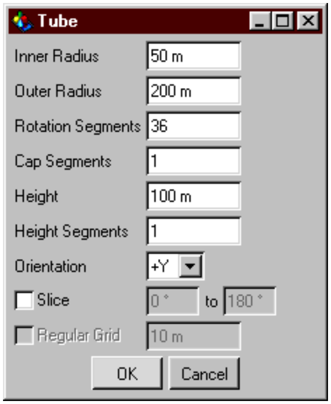
If you drag handle 1 you change the radius. If you drag handle 2 you change the height of the oil tank. If you drag handle 3 you change the height of the caps.

Tube





This function creates a hollow cylinder, with walls of various thicknesses, whose ends are aligned parallel to the XZ plane.



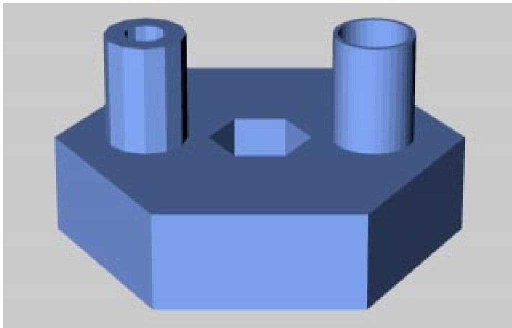
The Tube's parameter dialog

Inner Radius, Outer Radius

Change these values the values to change the size and the wall thickness of the tube.

Rotation Segments

This is the number of subdivisions of the tube around its circumference. A large value means a smoother tube with more faces.



Tubes with different segment values

Cap Segments

Defines the number of subdivisions of the cap in a radial direction. The subdivision along the cap's circumference is given by **Rotation Segments** (see above).

Height

The length of the tube.

Height Segments

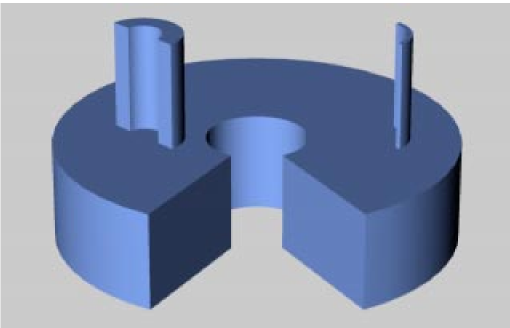
This is the number of subdivisions of the tube in the Y direction.

Orientation

Choose a value from this popup menu to set the tube's initial position in space. Using this you can turn it on its axis very simply and, above all, quickly.

Slice

Use this parameter to cut a section out of the tube; check the box and choose sensible values for the angles of the cutout. Below are some different tubing cutouts.



Different tubing cutouts

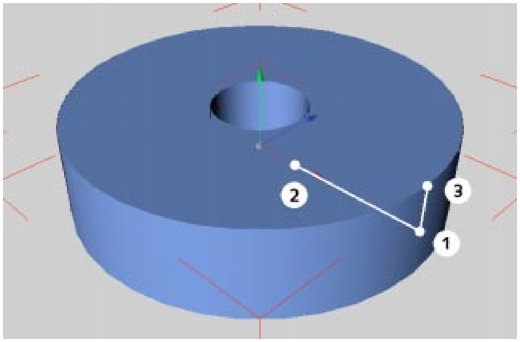
Regular Grid

The Regular Grid option will be available if, and only if, you have chosen to Slice the object. By checking this option and entering a value alongside the check box you can control the subdivisions within the plane of section of the sliced object. Small values produce a fine subdivision while larger values result in a coarse structure.

This subdividing only affects the *face* (the plane of section) of the slice. You will only need to use this option if you intend to process the object further after slicing it.

Interactive Editing

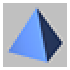
The tube has three handles.

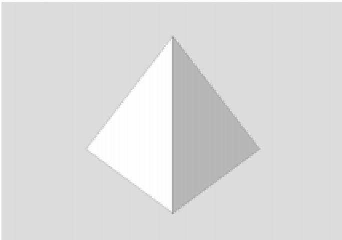


The handles of the tube primitive

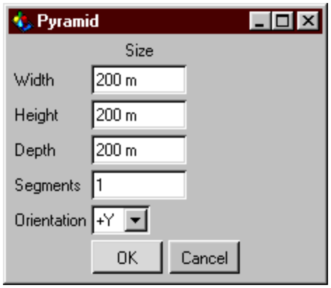
If you drag handle 1 you change the outer radius. If you drag handle 2 you change the inner radius. If you drag handle 3 you change the height (the tube length).

Pyramid





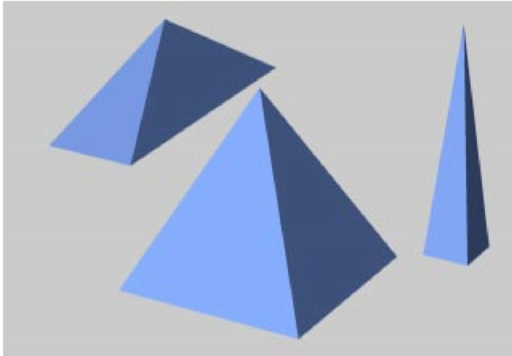
This function creates a 4-sided (5, if you count the base!) pyramid. By default the base of the pyramid is parallel to the XZ plane of the world coordinate system. In principle this object corresponds to a cone with 4 rotation segments (see above) but its quicker to make a pyramid with this primitive.



The Pyramid's parameter dialog

Width (X), Height (Y), Depth (Z)

These values give the dimensions of the object.



Different pyramids

Segments

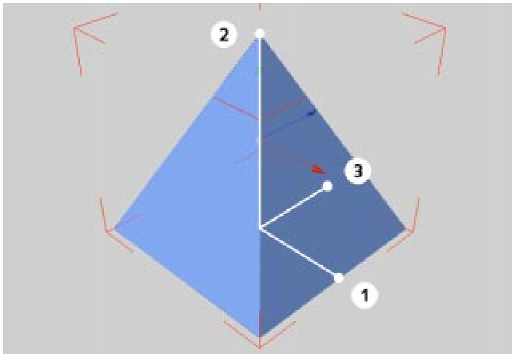
This is the number of subdivisions applied to all surfaces.

Orientation

Choose a value from this popup menu to set the pyramid's initial position in space. Using this you can turn it on its axis very simply and, above all, quickly.

Interactive editing

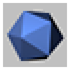
The pyramid has three handles.

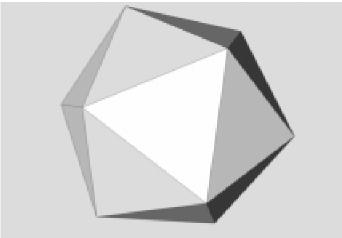


The handles of the pyramid primitive

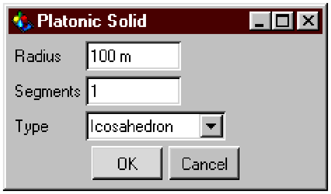
If you drag handle 1 you change the width (X). If you drag 2 you change the height (Y). If you drag 3 you change the depth (Z).

Platonic Objects





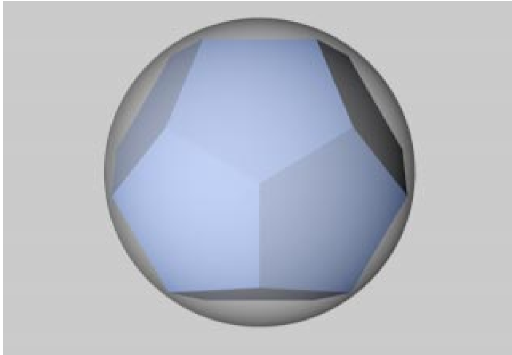
This function creates many different Platonic primitives.



The Platonic parameter dialog

Radius

This value gives the size of the circumscribing sphere into which the object is placed. All points of the object touch the surface of this sphere.



Platonic objects placed into the circumscribing sphere

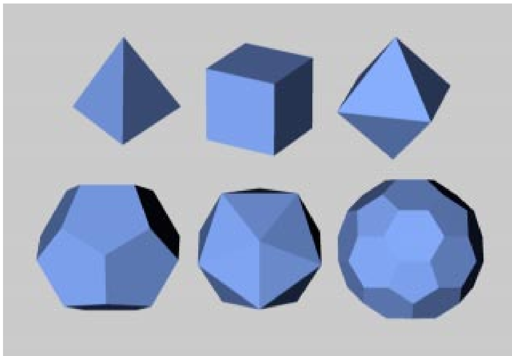
Segments

The number of subdivisions applied to all surfaces.

Type

Here you can choose from a list of pre-defined platonic objects. In addition to the many standard objects that Plato would have recognized is the football-like C60-Buckyball.

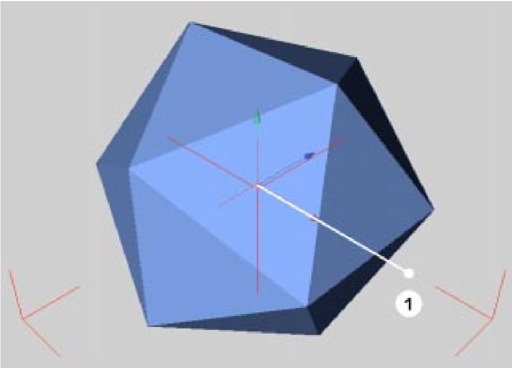
The following illustration shows the different objects.



Tetrahedron, Hexahedron, Octahedron, Dodecahedron, Icosahedron and C60-Buckyball

Interactive editing

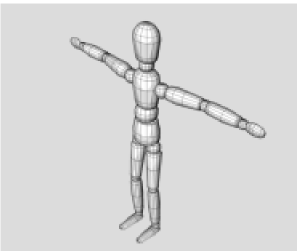
The Platonic objects have one handle.



The handles of the Platonic primitives

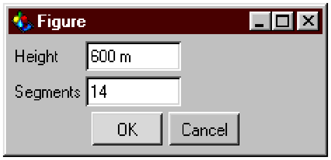
If you drag handle 1 you change the radius.

Figure



This function creates a animation-ready figure. All hierarchies are already defined and can be used, for example, with the Inverse Kinematics function (see Inverse Kinematics, page 308). In addition, most joints possess pre-defined angle restrictions for movement (see IK Tag, page 460).

So where is the hierarchical structure? Well, the hierarchy will appear in the Object Manager only when you convert the figure to polygons i.e. make it editable (see Make Editable, page 356).



The Figure's parameter dialog

Height

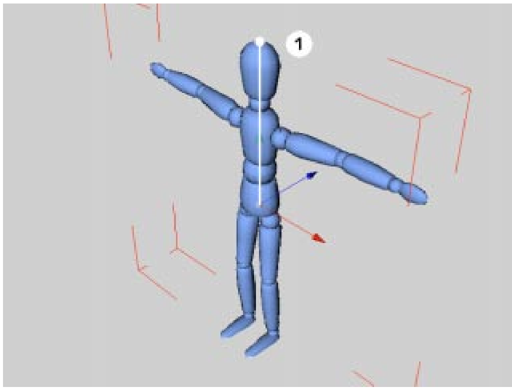
This gives the overall height of the figure. All the body elements are changed (scaled) accordingly.

Segments

The value defines the number of subdivisions of all the surfaces of all the sub-objects of the figure.

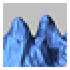
Interactive editing

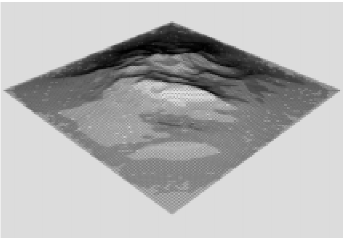
The figure has one handle. If you drag it you change the height (size).



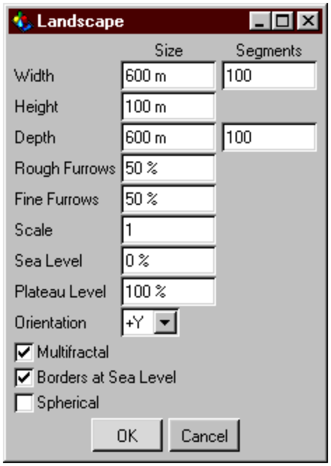
The handles of the figure primitive

Landscape





With one press of a button, this function produces, in the XZ plane, craggy mountains or gently rolling countryside. More accurately, it creates an irregularly-formed object using fractal principles. The parameters allow versatile control of the landscape appearance.



The Landscape's parameter dialog

Width (X), Height (Y), Depth (Z)

With these values you change the size of the landscape.

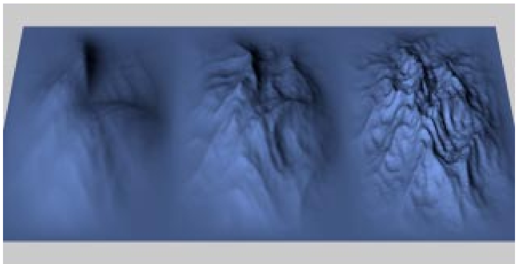
Segments

The value defines the number of subdivisions of the surface, in width and depth. The larger the number of segments, the finer the structure.

Landscapes with different subdivisions (on the left 10, in the center 50, on the right 100)

Rough Furrows, Fine Furrows

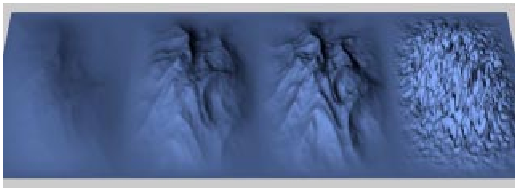
Change the cragginess of the landscape with these values. Low values result in gentle hills, high values rough mountains. In the following illustrations the rough furrows value is increased from left to right and the fine furrows value is increased from top to bottom.



Different landscapes (from left to right, 0%, 50%, 100%)

Scale

This controls the height of the fissures in the landscape. Large values result in deep valleys, small values give flatter landscapes.



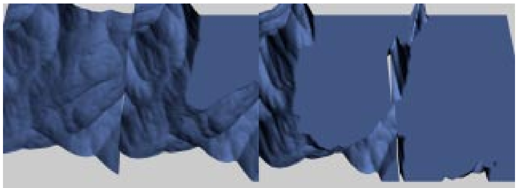
Different scaling (from left to the right 0.1, 1, 1.5, 10)

Sea Level

This sets the height of the water. The higher the value, the further the landscape slips into the sea. With 100% Sea Level you have re-created Atlantis — and you see a simple plane.

Different sea levels (from left to the right 0%, 25%, 50%, 75%)

If you switch off **Borders At Sea Level** (see below), you will see a rather different result. After being truncated at sea level the landscape is then lifted again to its full height, i.e. the parts rising from the water become steeper.



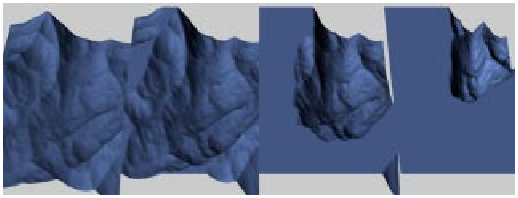
Water levels with borders not at sea level (from left to the right 0%, 25%, 50%, 75%)

Plateau Level

The value works in an inverse way to sea level. Instead of being cut off from the bottom, the landscape is truncated from the top, creating flattened mountain tops. If the plateau level is set to 0%, a plane will result. If you switch off **Borders At Sea Level** then, after truncation, the landscape is lifted again to full height, i.e. the mountains become steeper.

Plateau with borders at sea level (100%, 75%, 50%, 25%)

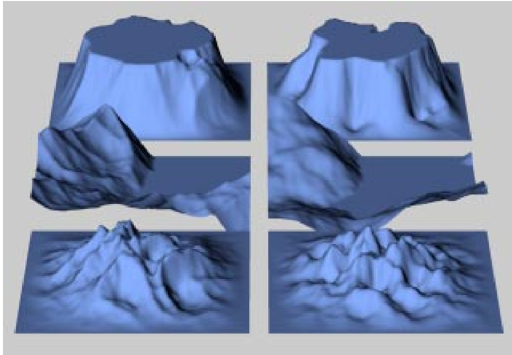
If you switch off **Borders At Sea Level** (see below), you will see a rather different result.



Plateau with borders not at sea level (100%, 75%, 50%, 25%)

Multifractal

If you turn off this option, CINEMA 4D will use a different algorithm for the generation of the landscape. Usually, more natural scenes are generated with multi-fractal enabled but it's up to you.



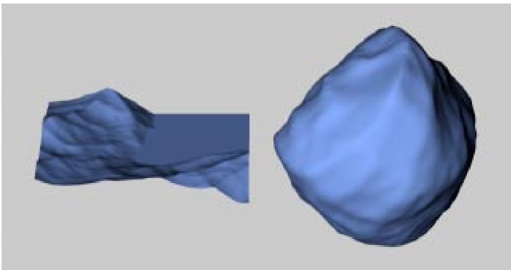
Landscapes left with multifractal on

Borders At Sea Level

This affects how the landscape changes where it meets the sea. With this option turned on, CINEMA 4D attempts to soften, or flatten, the landscape-to-sea transition. This option is not available if you have enabled **Spherical** (see below).

Spherical

Select this option if you want to wrap your landscape on to a sphere. The radius of this sphere is defined by half the width value, the height of the landscape above the surface of the sphere is taken from the height value (see above).



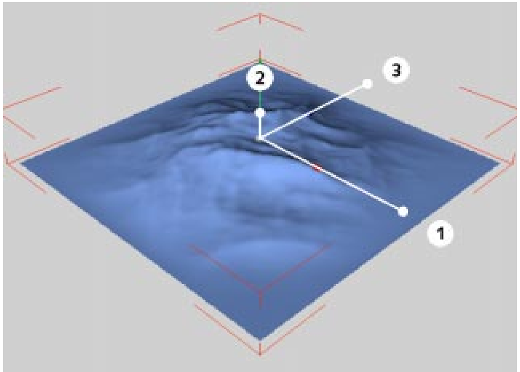
A plane landscape (left), wrapped on to a sphere (right)

Orientation

Choose a value from this popup menu to set the landscape's initial position in space. Using this you can turn it on its axis very simply and, above all, quickly.

Interactive editing

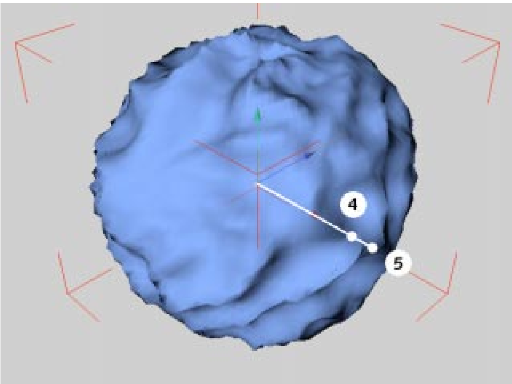
The landscape has, initially, three handles.



The handles of the landscape primitive

If you drag handle 1 you change the width (X). If you drag 2 you change the height (Y). If you drag 3 you change the depth (Z).

If you switch on **Spherical**, only two handles appear.

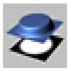


Alternative handles of the landscape primitive

If you drag handle 4 you change the radius of the sphere, around which the landscape is wrapped (half the width).

If you drag handle 5 you change the height of the mountains (height).

Relief

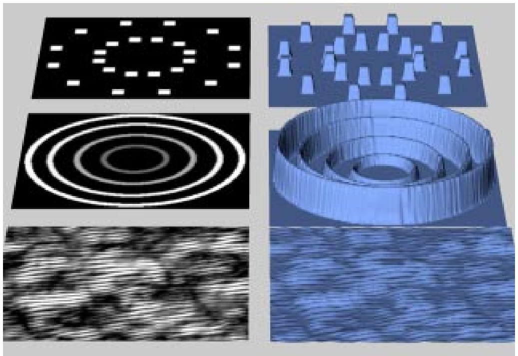


This function creates an object in the XZ plane that is similar to a landscape (page 121). However, in this case no fractal function is used to generate the scene, but rather a picture or image.

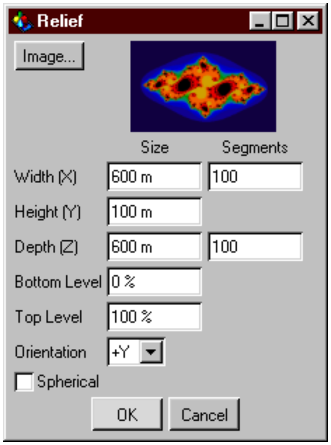
The relief map interprets the different greyscales within the chosen image as altitude values. If you choose a color image, the greyscale is formed from the average value of the red, green and blue values of the bitmap picture. The brighter a pixel of the image is, the higher its elevation within the landscape; the darker a pixel is, the more deeply it lies within the scene. So, darkness defines valleys, brightness, mountains.

Since it can be hard, initially, to see how a coloured image will convert to greyscales, we recommend using monochrome images until you are more experienced with using relief maps.

In the following examples you can see, on the left, the image used and, on the right, the subsequent relief created by CINEMA 4D.



Patterns (left) for different reliefs (right)



The Relief's parameter dialog

Image

Click the button and a file selector opens, from which you select the desired image file to be applied to the relief. Select a file which has a format that CINEMA 4D understands (see Appendix 3).

Note

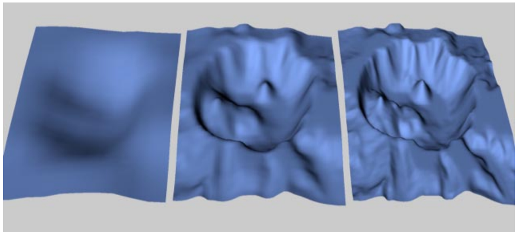
A CINEMA 4D shader (see The Shaders, page 508) cannot be used as an image file.

Width (X), Height (Y), Depth (Z)

These values define the size of the relief.

Segments

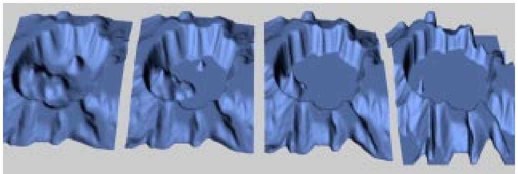
The value defines the number of subdivisions of the surface, in width and depth. The larger the number of segments, the finer the structure.



Reliefs of different subdivisions (on the left 10, centre 50, on the right 100)

Bottom Level

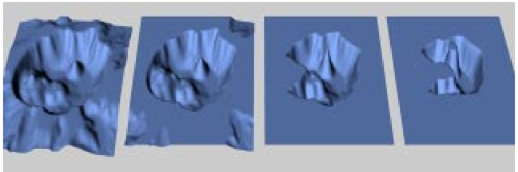
This defines the height of the notional water. The higher this value, the further the landscape slips into the sea. With 100% the entire landscape is flooded and disappears — a simple plane results.



Different bottom levels (0%, 25%, 50%, 75%)

Top Level

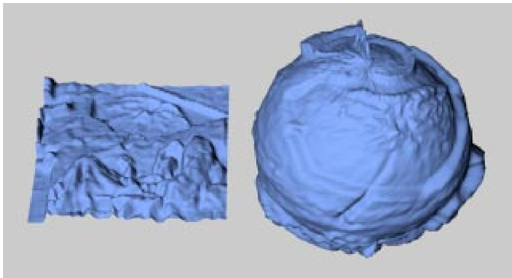
The value works in an inverse way to bottom level. Instead of being cut off from the bottom, the landscape is truncated from the top, creating flattened mountain tops. If the top level is set to 0%, a plane will result.



Different top levels (100%, 75%, 50%, 25%)

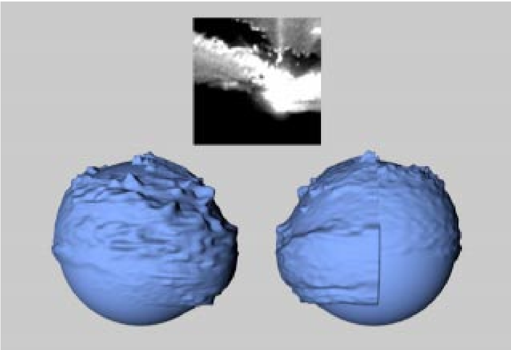
Spherical

Select this option if you want to wrap your relief on to a sphere. The radius of this sphere is defined by half the width value, the height of the relief above the surface of the sphere is taken from the height value (see above).



An even relief (left) wound on a sphere (right)

A general problem of this wrapping operation is that, depending on the image used, you may get discrepancies at the edge of the relief, especially if you use a non-tileable texture (see Tiled Textures, page 537). The illustration below shows the problem quite well. You must choose your images carefully and be prepared to experiment.



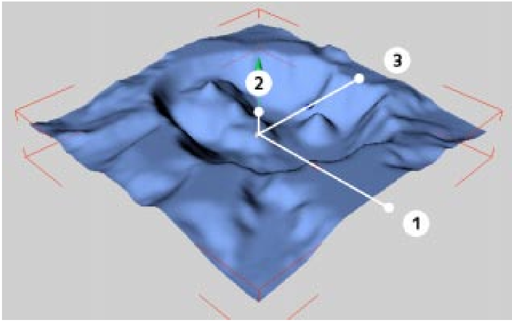
The image used (top), the sphere relief from the front (left) and from the rear (right)

Orientation

Choose a value from this popup menu to set the relief map's initial position in space. Using this you can turn it on its axis very simply and, above all, quickly.

Interactive editing

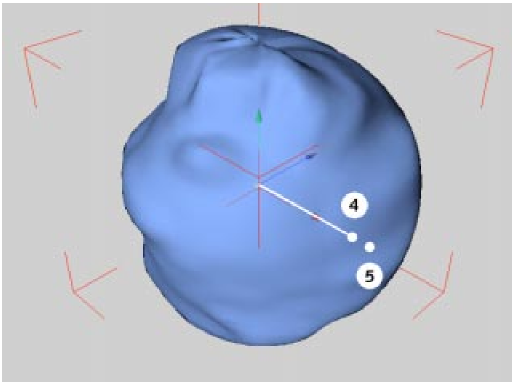
The relief has, initially, three handles.



The handles of the relief primitive

If you drag handle 1 you change the width (X). If you drag 2 you change the height (Y). If you drag 3 you change the depth (Z).

If you switch on **Spherical**, only two handles appear.

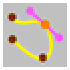


Alternative handles for the relief primitive

If you drag handle 4 you change the radius of the sphere, around which the relief is wrapped (half the width).

If you drag handle 5 you change the height of the elevation (height).

Spline Object



This function creates an empty spline object. Like the Polygon object, it is only recognizable on screen by its origin and axes.

You can use this object for the construction of your own splines.

Spline Basics

Curves

Splines are primarily a sequence of vertices, connected by lines, lying in 3D space. The shape of these connecting lines (straight or curved) defines the so-called *interpolation*.

Apart from the direct connection of the vertices over straight, rigid lines, there are other kinds of splines that use an interpolation method whereby the lines between the vertices are curved instead of straight. Such splines have a soft leading edge without sharp corners.

The spline itself is infinitely thin. We add some thickness to splines to help you visualize them better in the editor window. However, you should realise that you will never see a spline when rendered with the raytracer.

The spline's line has no three-dimensional depth, even though it occupies the 3D space. However, many complex 3D objects, among other things, can be constructed out of these curves in seconds.

After the spline is created it can be pulled along its depth in order to make tube-like objects.

You can also rotate a spline around an axis and make circular objects (e.g. a wineglass). Or you can construct a skin over several splines, with the finished object simulating the contours on a map. More of these spline-modeling capabilities are discussed in NURBS, page 165.

But the production of 3D objects is not the only use of object splines. Object groups can be assigned to splines, or they can be used for defining movement paths for the animation of other objects.

Segments

A spline is made from several partial curves, or *segments*. If, for example, you create some text (see Text, page 148), you will see that only one object is created, even though you typed several letters. The text object now actually consists of several outlines, at least one outline for each letter.

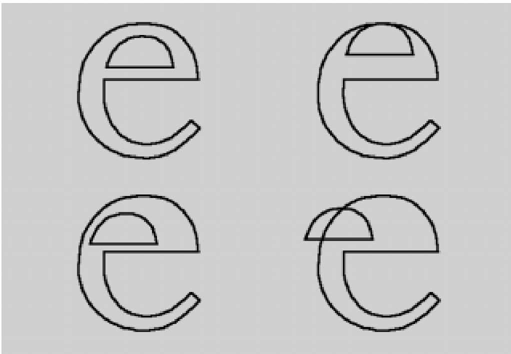
Take for example the letter sequence in the word 'Test'.

The word consists of four letters; that makes four separate segments. However, another, fifth, segment is also present; the inside of the 'e' is a further spline segment.

If this type of element is later extruded into a 3D object, CINEMA 4D will automatically punch out a hole that is the same size and shape of the internal segment of the 'e'.

A spline converted to a 3D object with holes automatically created

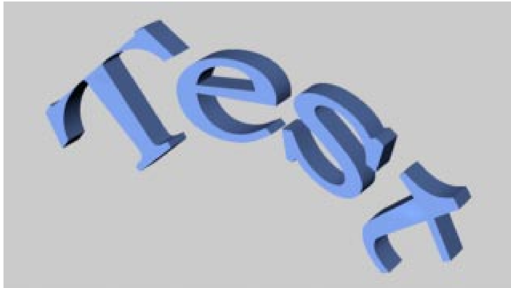
Holes are formed only if a spline lies completely inside another spline and both form closed curves. If two segments overlap in any way, no 3D object can be formed. If you nonetheless try, then the results may well be strange.



On the left is a correct arrangement of splines and on the right we see spline segments arranged in an incorrect order.

A spline object can be composed of any number of segments. However all segments of a spline must have the same settings, e.g. they should be either all open or all closed and all have the same kind of interpolation.

So, what is the advantage of a spline with many segments and many separate spline objects? As long as the element is present as a complete, individual object then all of its points can be modified and edited at the same time. Let's return to the text example above. Before you convert the spline to a 3D object you can bend it e.g. with a deformation object (see Deformation, page 256). The tool affects all vertices of all segments equally. Therefore the spline is deformed evenly, as a whole.



Before extruding, a spline with several segments is modified

If we have nothing but individual, separate spline objects, then even simple deforming becomes very difficult, if not impossible. As you can see, Splines are an extremely important part of CINEMA 4D.

<u>Tip</u>

Do not confuse the Polygon object with the Spline object. Although both are essentially just empty containers, the former deals with polygon vertices only while the latter works with spline vertices (and splines).

To create a new spline curve

Create an empty spline.

Change to the Edit Points tool (**Tools > Points**).

Create each of the consecutive vertices of the curve. For this point creation, keep the Ctrl key pressed and click with the mouse in the editor window.

The first point defines the start of the spline. Each consecutive click, if clicked further away than the last point created, will add to the spline.

If you Ctrl-click between two previously created points on the curve then the new point will be positioned on the spline between these two existing points.

If you hold down the Shift and Ctrl keys together while clicking, the new point is created at the beginning of the spline (giving a new starting point).

If you click on the starting point, no new vertex will be created, but the spline will be closed (see below).

The spline is always created in the view of the active editor window. If the active window displays, for example, the front view, then the created spline appears in the XY plane, with the plan view in the XZ plane. If you have activated one of the 3D views (e.g. isometric or central perspective), the spline is drawn principally in the XZ plane (plan view).

For some operations, such as the aligning of objects along a spline, (see Arrange, page 391) or the movement of objects along a given curve (see Align To Spline, page 564) the *direction* of the spline (where it begins and ends) is important. To this end, the spline is color-coded.

By default, from the first vertex, the starting point, and moving outwards, the curve is coloured from red to orange to yellow (the end point). The colours of the start and end points can be changed within the preferences.

The colours chosen are then changed, in a graduated fashion, between the two points. This coloured display is visible only when the Edit Points tool is active.

To create a new spline segment

Create a spline as described above.

Add a new point that will be the start point of a new segment (though still connected to the last point of the previous segment for now).

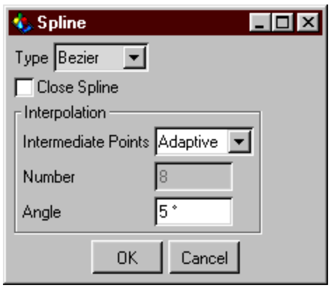
Select **Structure > Edit Spline > Break Segment**. The connection to the previous segment is now broken.

Add further vertices. All new vertices now belong to the new segment.

Depending upon your needs, you can create further segments.

If you wish the start point of a new segment to lie in the same position as the end point of the previous segment, select the snap function in step 2 (see Snap Settings, page 383) , thus setting the new segment starting point as desired.

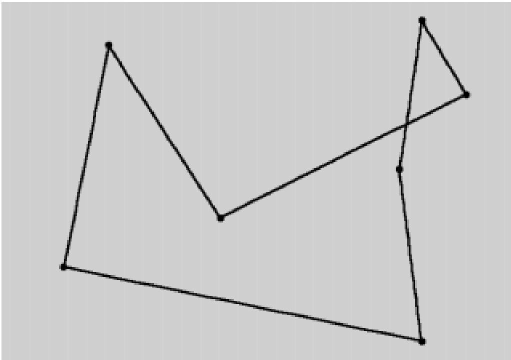
If a spline consists of several segments, then new vertices are always created from the active vertex. If no vertices are active, then new vertices are generated at the last-created segment. If several vertices at different segments are active, new vertices are always generated at the first-created segment.



The Spline's parameter dialog

Type > Linear

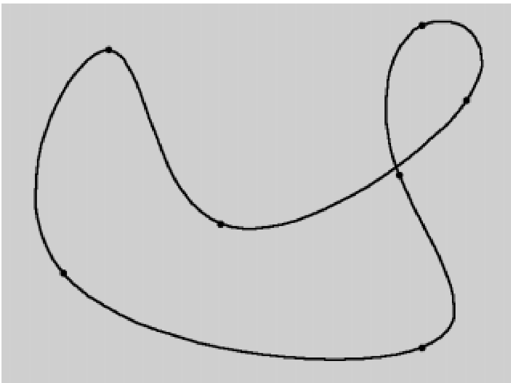
This simplest of all the spline types connects the vertices, which define the polygon, with straight, directly connected lines.



You can use these splines to create angular objects or to simulate jerky, sharp angular movements in animation.

Type > Cubic

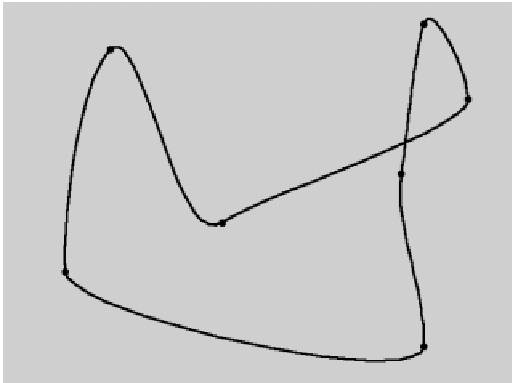
This kind of spline has a soft curve between the vertices. The interpolated curve always passes accurately through the vertices.



Considering the two points at the top right diagram above you can see that the curve extends further to the above right than is actually necessary. This behavior is called *overshooting*, and it often appears with closed curvatures. This becomes clearer when you compare this section of the curve with the same section of the Akima curve interpolation.

Type > Akima

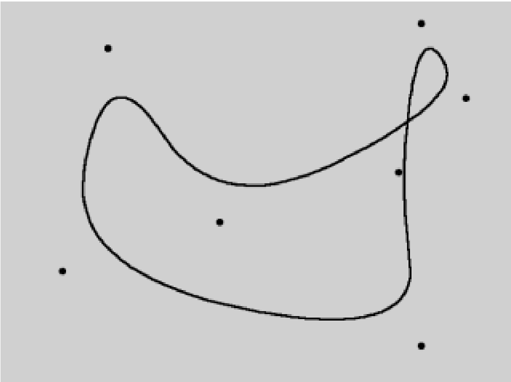
This spline type also creates a soft curve between the vertices. The interpolated curve always passes accurately through the vertices. Overshooting does not happen with this type of curve.



Akima interpolation adheres very closely to the path of the curve given by the vertices but, because of this, it can sometimes appear somewhat hard. If this happens you should use Cubic interpolation.

Type > B-Spline

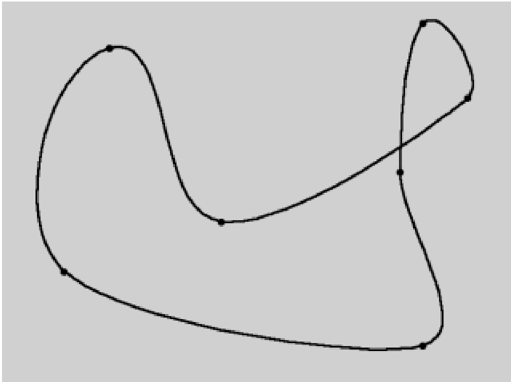
This kind of spline also creates a soft curve between the vertices. The curve however does not use an interpolation method that passes directly through the vertices.



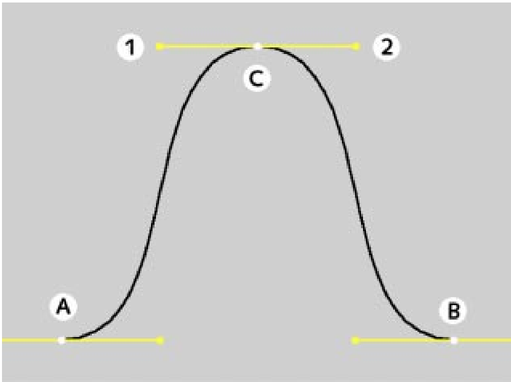
This produces a very smooth curve. The vertices control only the approximate path of the curve. Distant points have less influence on the curve than those lying closer together.

Type > Bézier

This spline type creates a soft curve path between the vertices, which can be controlled very precisely. The interpolated curve always passes accurately through the vertices. Overshoot does not happen.

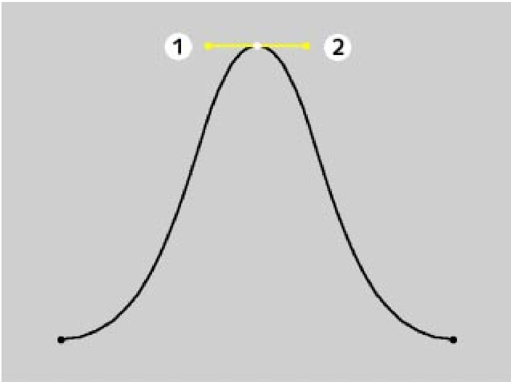


If you activate a vertex of the spline (i.e. by clicking on it), additional control points at the tangents to the curve become visible.

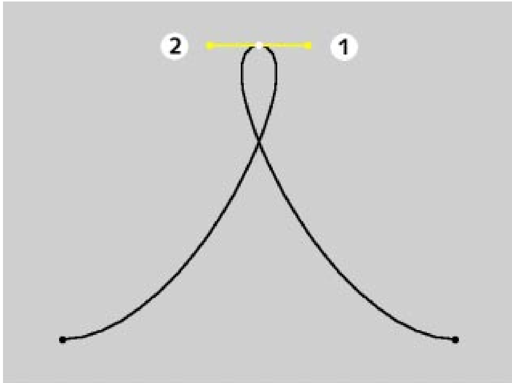


Changing the direction of the tangent handles controls the direction of the curve at each vertex. To do this, click on a tangent end point and drag it with the mouse.

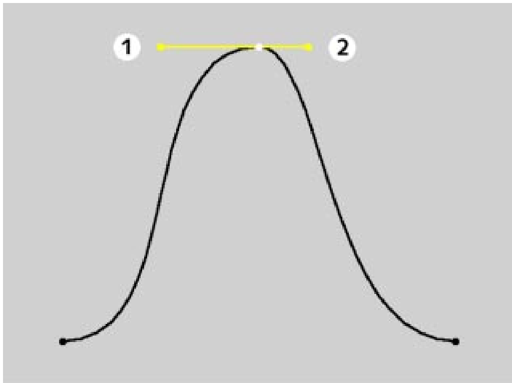
By adjusting the length of these tangent handles you can control the strength of the curvature. Drag the tangent end point towards the vertex point and observe the symmetrical movement of the opposite handle.



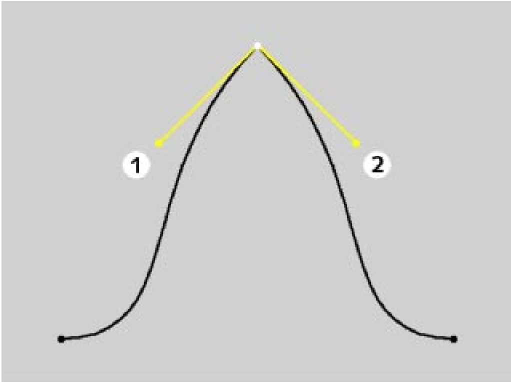
In the above illustrations all tangents lie horizontally. Now the tangent of the upper point was rotated 180°, i.e. the left tangent end point lies now on the right, the right on the left. You can see the result in the following illustration.



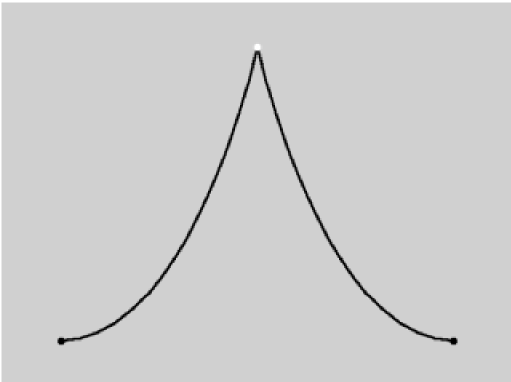
You can define the lengths of the tangents separately from each other; keep the Shift key pressed as you click and drag a tangent end point. See the following example:



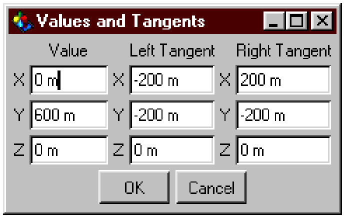
You may set different tangent directions on the right and on the left of the vertex. With this approach you can make the otherwise smooth path of a curve produce sharp corners and peaks, if required. To do this hold the Shift key down, click on a tangent end point and move it with the mouse.



If the tangents of two neighbouring points have zero length, the segment that runs between the vertices will be linear. Thus, you can mix linear segments with curved spline shapes.



If you double-click on a Bézier vertex, a dialog opens that allows you to accurately enter both the position of the vertex (in world coordinates) and the position of the tangent end points (relative to the vertex) numerically.

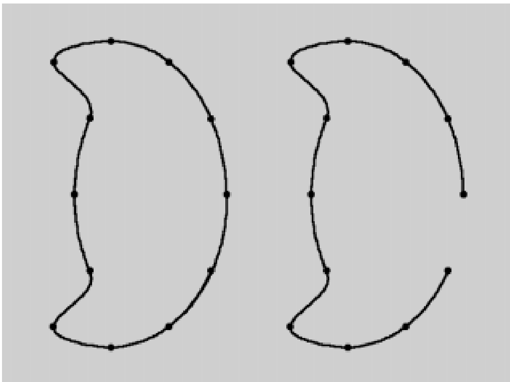


In comparison to the other spline types available, Bézier splines are the most functional, offering the most user control. Therefore CINEMA 4D uses Bézier splines for its animation system.

Close Spline

Each polygon can be closed or open. If a polygon is closed, the start and end points are connected.

Although you may assume that closing a polygon (and interconnecting the start and end points) or simply positioning the start and end points together will have the same end result, there is a big difference. In the first case the transition from the start to the end point is soft, in the second case it is abrupt.



On the left an open spline and on the right a closed spline

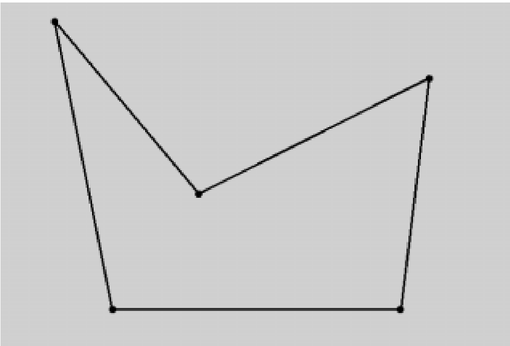
You can close the spline automatically when creating it by clicking on the start point as last action (keeping the Ctrl key pressed).

Interpolation

Here you can define how the spline is to be subdivided during your tweaking and modification. Even after you select the Interpolation type from the menu for the Intermediate Points, you can still make more changes.

Interpolation > None

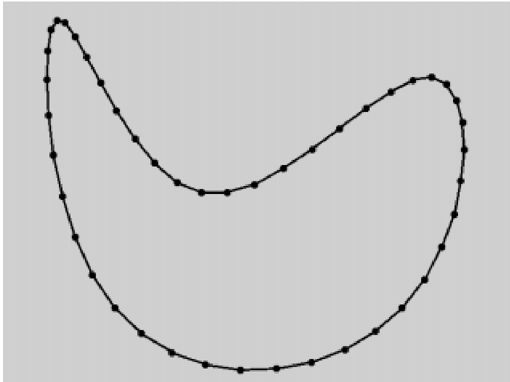
This method of interpolation uses the vertices of the splines directly and connects them with straight, rigid lines, using no additional intermediate points.



With None you cannot enter values for the **Number** or **Angle** fields.

Interpolation > Natural

This interpolation type subdivides the spline with the number of points given in the **Number** field. The points follow the natural course of the spline i.e. they are positioned closer together at the vertices and further apart when in-between the vertices.

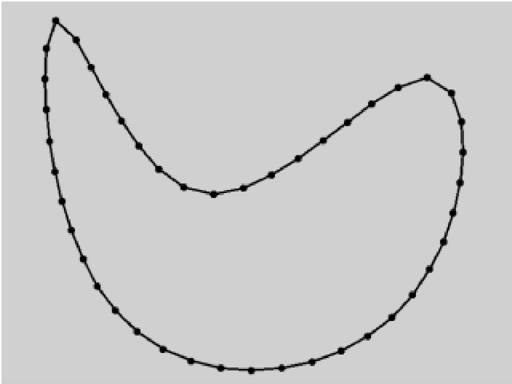


The resulting curve points do not necessarily pass through the vertices. If the spline consists of several segments then the value in the **Number** field is applied to each segment.

Natural interpolation does not allow you to enter values in the **Angle** edit field.

Interpolation > Uniform

This type of interpolation also subdivides the spline using a number of intermediate points given by **Number** but the points are positioned at an exact equal distance from each other. The points from this resulting curve do not necessarily pass through the vertices.



If a spline has several segments, then the value of the field applies to each segment. This type of interpolation also subdivides the spline using a number of intermediate points given by **Number** but the points are positioned at an exact equal distance from each other. The points from this resulting curve do not necessarily pass through the vertices.

As with the Natural method, you cannot enter values in the **Angle** edit field.

Note

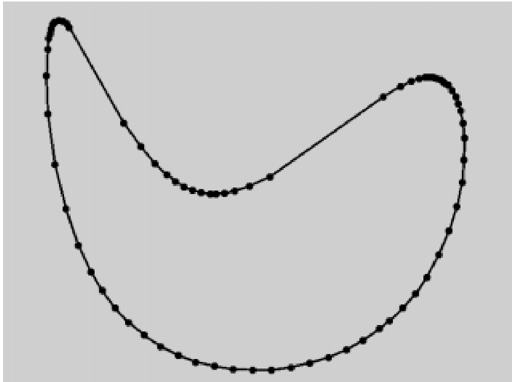
*For Natural and Uniform interpolation the number of intermediate points is calculated by the formula (number of vertices + 1) * Number.*

*So an open spline with four vertices and a Number of 2 will contain (4+1)*2=10 intermediate points.*

*If the spline is then closed, a further (virtual) vertex is added; then the number of intermediate points will be (5+1)*2=12. This ensures that a spline is not more roughly divided when you close it.*

Interpolation > Adaptive

This interpolation type sets intermediate points whenever the angle deviation of the curve is larger than the value for given in **Angle**. The resulting curve has points that pass accurately through the vertices.



If a spline has several segments, then the value of **Angle** will apply to each segment.

The Adaptive method gives the best results in rendering and, as such, is set as the default interpolation method.

Like the preceding methods, you cannot enter values in the **Number** field.

Create Spline (Curves)

Using the spline object (see above) you will quickly create new splines from scratch. However, for some shapes this approach can be clumsy and unnecessary.

For this reason CINEMA 4D includes spline-curves. These are interactive tools which will remain active until you select another tool (e.g. Move). You can thus create any number of these splines without the need to select the command each time.

Spline curves are always created in the active view. If this is, say, the plan view, the newly created curve will lie in the XZ plane.

Freehand

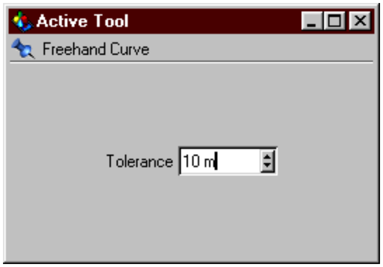
With this function you can actually draw curves directly in the editor window.

Select the Freehand tool. Then click in the editor window and keep the mouse button pressed. A small crosshair appears and you can then draw the Freehand curve for as long as the mouse button is held down.

Releasing the mouse button will end the Freehand spline creation and the finished spline will appear. You can imagine how useful this function will be when tracing patterns with a graphic tablet.

If the start and end positions of the finished curve are positioned close together, the curve is automatically closed. If you work in central perspective with the Freehand tool, the spline is created on a plane perpendicular to the line of view.

More adjustment and control for this tool is available in the Active Tool window.

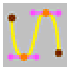


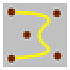
The Active Tool dialog

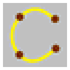
Tolerance

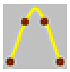
This value defines how accurately the spline curve will follow your mouse movements. The higher the value for **Tolerance**, the more rounded the spline will be and the fewer vertices will be generated.

Bézier, B-Spline, Cubic, Akima

 Bézier Spline

 B-Spline

 Cubic Spline

 Akima Spline

Using this function you can create the exact type of curve you require. The difference between these curves is described in detail in Spline Basics, page 127.

Select the desired type of curve and the point editing mode is automatically switched on. Now create the vertices of your spline curve in the editor window.

By right-clicking away from the vertices in the editor window, the finished spline will appear. Clicking on the starting point (with the left button) again will show the finished spline and also close it. After the finished spline appears, you are left in point editing mode, ready to tweak and modify your curve spline.

If you work in the central perspective view, the spline is created in the XZ plane. Then it is not possible to set vertices above the horizon.

Spline Primitives

General

We have already seen how to create new curve paths (splines) from scratch. However, since the creation of such splines can be a somewhat lengthy and cumbersome process, CINEMA 4D gives you a generous number of pre-defined curves.

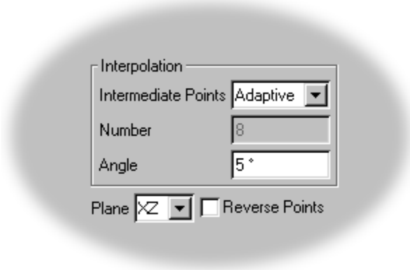
Add to that the possibility of converting vector based artwork files from other programs (see Vectorizer below) and adding graphic characters (see Text below) and you can see that you have a large range of spline primitives at your disposal.

All of these spline primitives are parameterized. This means that the spline is merely the graphical representation of a mathematical formula built from any number of pre-set values. As a result, this mathematical formula initially has no properties to edit within the 3D window. It has no vertices to manipulate.

To adjust the vertices with the point editing tool (see Points, page 302), for example, requires you to first convert the spline to a non-parameterized, editable object using the **Tools > Options > Make Editable** command (see Make Editable, page 356). However, you are free to modify the spline primitive with a deformation object (see Deformation, page 256) without such a prior conversion.

In addition to this, you may change all the preset parameters of such an object (e.g. height, radius, etc.) at any time. Have a play with the different parameter values of an object to get a feel of what is possible (just double-click on the property icon in the Object Manager). Start by changing just single values so you can observe the changes more clearly. Enter large values, and then try smaller ones.

When creating a new spline object from the Object menu, the actual spline primitive will appear in the editor window. The properties of this object - editable within its parameter dialog - are accessible through the Object Manager. Simply double-click on the object icon (see Edit Object, page 466).



Identical parameters for all spline primitives.

Interpolation

Interpolation defines exactly how finely the vertices of a spline will be positioned. The various choices are described on page 134.

These adjustments affect only the generators (e.g. NURBS - see NURBS Objects, page 165) or those objects converted into a polygon object (see Make Editable, page 356).

If None is chosen for the method of interpolation, no additional vertices are created. The direct vertices of the spine are used, with no extra intermediate points added.

If the Natural method is used, the spline is divided according to the number of points entered into the **Number** field. These points follow the natural path of the spline, i.e. they lie closer together between the vertices, and do not necessarily go through them.

Using Uniform for interpolation divides the spline in such a way that, once again, the number of points entered in the **Number** field is used. The points lie apart at an equal distance and do not necessarily go through the vertices.

You can calculate the exact number of points for natural and uniform interpolation as follows:

points = (number of vertices + 1) * Number

For example, an open spline with four vertices and a **Number** of 2 creates a total of (4+1)*2 = 10 points.

If you close the spline, a further (virtual) vertex is used. In this case, (5+1)*2 = 12 points are used. The virtual vertex prevents the spline from becoming too coarse.

The Adaptive interpolation method creates additional intermediate points whenever the angle deviation of the spline is larger than the value indicated by Angle. This results in smooth and accurate curves.

Plane

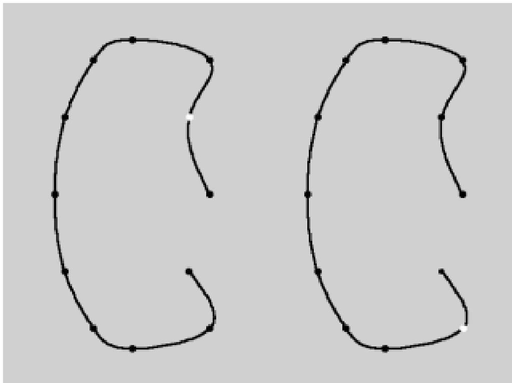
From within the **Plane** popup menu you may define in which of the three planes (XY, XZ, ZY) the spline primitive is to lie. By default the created spline is always positioned so that it is visible in the current active view. This means that if the spline is created in the XZ (top) or XY (front) view, then the spline will seen, for example, as facing towards the XY plane in the perspective view.

In all of the following examples the spline primitive has been created in the frontal view, or the XY plane.

Reverse Points

Using this option, the points (but not the spline) are reversed.

Reversing the points of the spline primitive not only has an effect after the conversion into an editable spline curve. The reversal of points will also affect operations such as **Tools > Options > Arrange**.

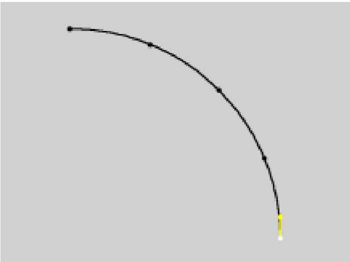


On the left is a spline, on the right the same spline with a reversed point order (the second spline vertex point is marked).

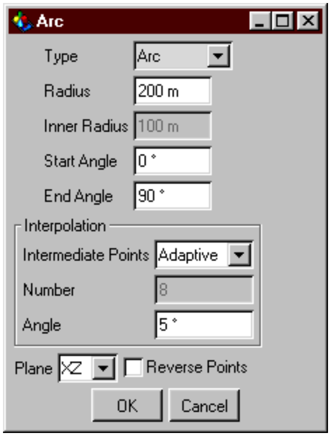
In the following sections we will detail each spline primitive and the individual options within its parameter dialog.

As we have already described, splines are a preliminary stage within the production of three-dimensional objects. In later chapters we will see how splines can be used.

Arc



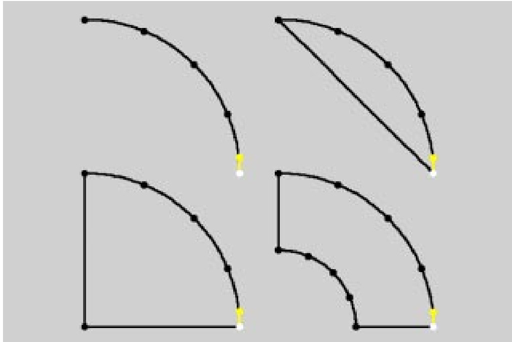
This function creates arc elements.



The Arc's parameter dialog

Type

With this option you choose the circle element to be used in your arc. Select from Arc, Sector, Segment and Ring.



Arc, Sector, Segment and Ring.

Radius

Defines the circle radius, from which the circular element is to be created.

Inner Radius

If you selected the Type Ring, this will be the inner radius of the ring.

Start Angle, End Angle

Using these two values you can define the start and end point of the circle element. 0° defines the value as the positive X-axis, 90° the positive Y-axis, 180° the negative X-axis etc. These examples assume you are working in the XY plane, as mentioned earlier.

Interpolation

As mentioned earlier, this function defines how the points of a spline are produced. These choices are described in detail on page 134.

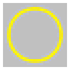
Plane

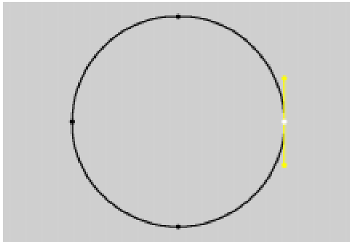
With this popup menu you choose in which of the three planes (XY, XZ, ZY) the spline primitive is created.

Reverse Points

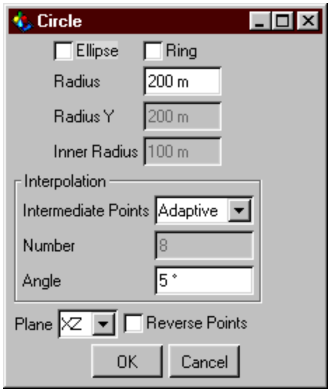
Checking this option will reverse the point order of the spline.

Circle





This function creates circles, rings, ellipses and ellipse rings. It is also suitable for the creation of hoses or tubes using NURBS objects (see NURBS Objects, page 165).



The Circle's parameter dialog

Circle, Radius

By default the Circle function creates a circle with a radius of **Radius**.

Ring, Inner Radius

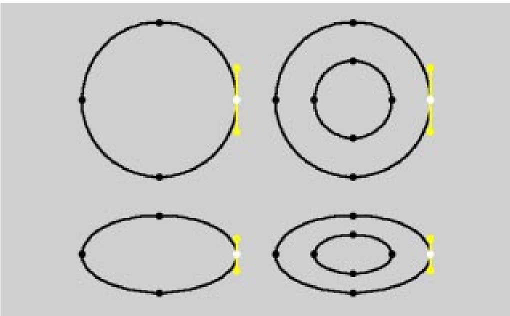
If the **Ring** option is checked, either circular rings or ellipse rings are created. Here the internal radius of the ring is given by **Inner Radius**. For ellipse rings this value is the internal radius along the ellipse's x-axis. The inner length along the y-axis is automatically calculated from the outer ellipse's dimensions.

Ellipse, Radius, Radius Y

If the **Ellipse** option is activated, both **Radius** and **Radius Y** will affect the shape, with **Radius Y** defining the length of the ellipse along the Z axis.

Ring, Inner Radius

Activating both **Ellipse** and **Ring** will result in ellipse rings. Here the internal radius of the ring is given by **Inner Radius**. For ellipse rings this value is the internal radius along the ellipse's X axis. The inner length along the Y axis is automatically calculated from the outer ellipse's dimensions.



Circle, Ellipse, Ring, Ellipse Ring.

Interpolation

As mentioned earlier, this function defines how the points of a spline are produced. These choices are described in detail on page 134.

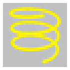
Plane

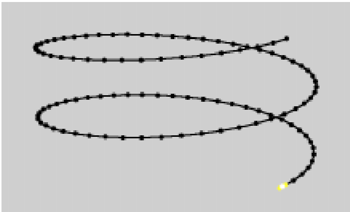
With this popup menu you choose in which of the three planes (XY, XZ, ZY) the spline primitive is created.

Reverse Points

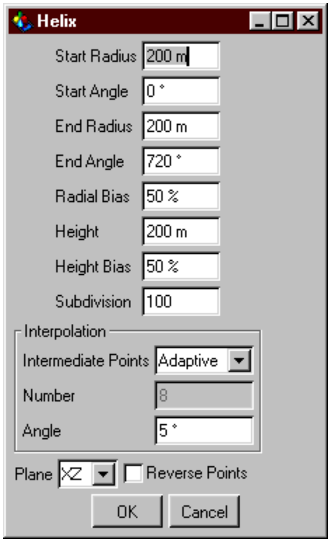
Check this option to reverse the spline's points (but not the spline itself).

Helix





This function creates a spiral-shaped wound helix.



The Helix's parameter dialog

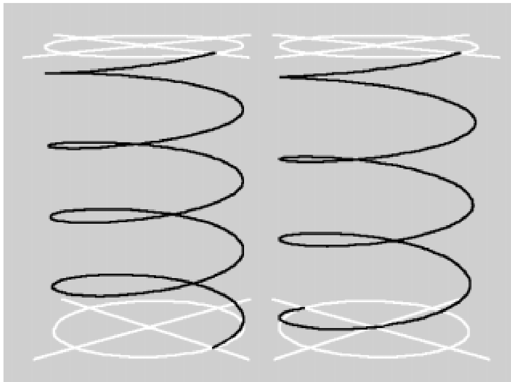
Start Angle, End Angle

These values specify the start and end points of the helix. 0° here designates that the relevant point is on the positive X axis, 90° the positive Z axis, 180° the negative X axis, etc.

E.g. if the start angle is 0° and the end angle 720°, the helix makes two complete revolutions. If the helix begins at 180°, there will be only 1.5 revolutions.

<u>Tip</u>

*You can use calculations in the value fields. In the above example you may enter 4*360 instead of 1440. (You can find out more about this in Coordinates Manager, page 449 and in Appendix 1.) For the mathematicians out there: the number of spiral threads results from the formula: (End Angle – Start Angle) / 360°*



On the left a helix with 4 revolutions, on the right a helix with 3.5 revolutions

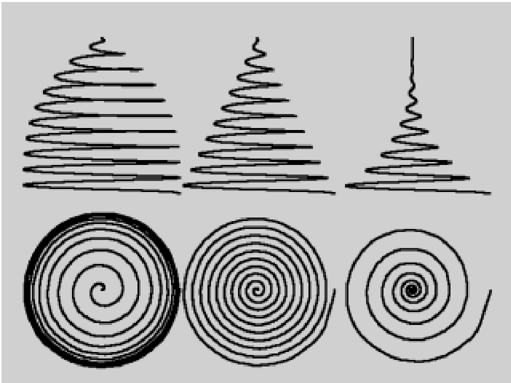
Height

This value defines the vertical height of the helix, in the Y direction. The pitch of the screw results from the formula: *Height / ((End Angle – Start Angle) / 360°*.

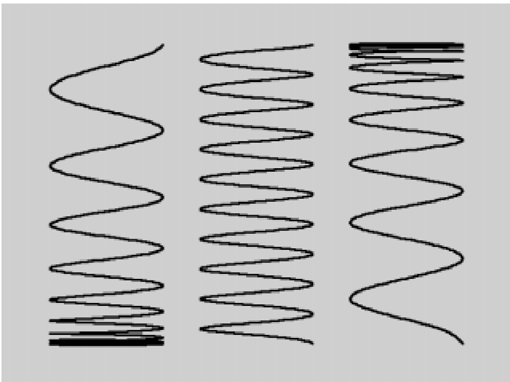
Radial Bias, Height Bias

The bias values indicate the speed with which the end values of the helix are to conclude. The radial bias defines the speed of the horizontal growth, while the height bias determines the vertical growth.

To make this clearer, let's see some examples.



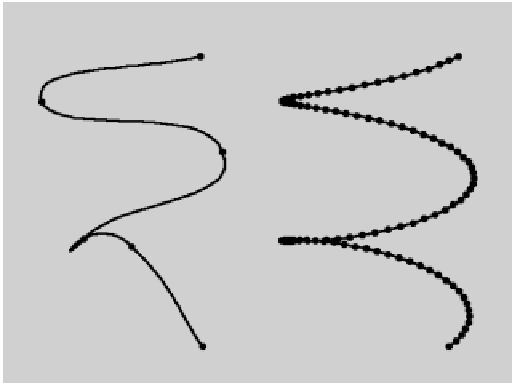
Three spirals with ten spiral threads and an end radius of 0; radial bias on the left is at 10%, center 50%, and on the right of 90%.



Three spirals with ten spiral threads; height bias on the left is 10%, center 50%, on the right of 90%.

Subdivision

The creation of a helix is based on a formula. The smoothness of this formula is defined with Subdivision (see also Cubic Interpolation, page 161).



On the left is a helix with five subdivisions, on the right the same helix with 100 subdivisions.

Interpolation

As mentioned earlier, this function defines how the points of the helical spline are produced. These choices are described in detail on page 134.

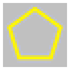
Plane

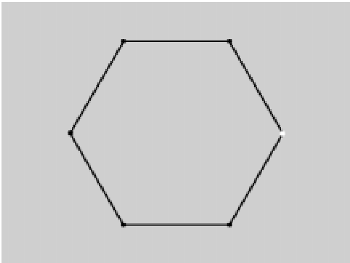
With this popup menu you choose in which of the three planes (XY, XZ, ZY) the helix is created.

Reverse Points

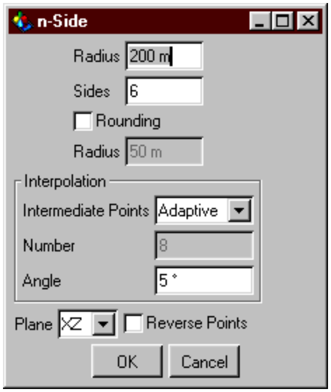
Check this option to reverse the spline's points (but not the spline itself).

n-Side





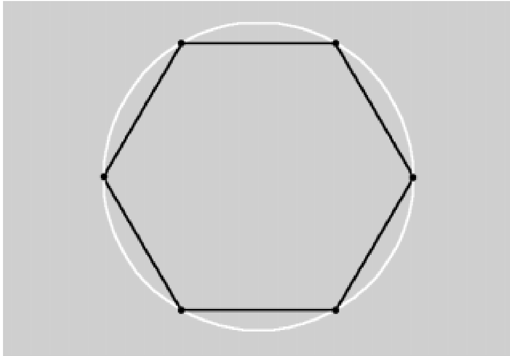
This command creates a regular, angular, closed spline. It is also suitable for, among other things, creating hoses and tubes with the Loft NURBS function (see Loft NURBS, page 170).



The n-Side's parameter dialog

Radius

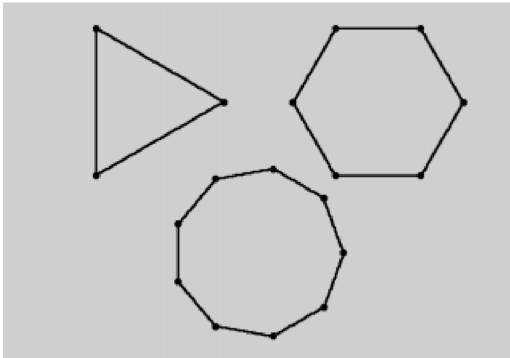
The n-Side object is created within a bounding circle. The Radius defines the size of this initial shape.



The n-Side created within its bounding circle.

Sides

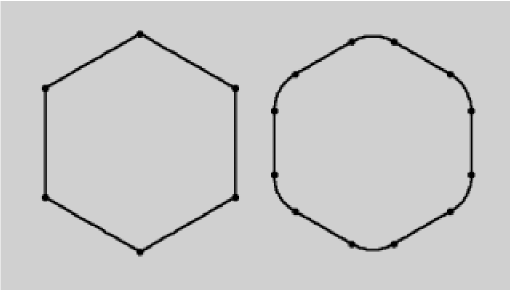
This value defines how many sides the n-Side spline will have.



Variation with 3, 6 and 9 sides.

Rounding, Radius

Enabling this will round off the corner angles of the shape according to the **Rounding Radius** value, creating a quasi N-Round spline.



On the left we see a regular n-Side spline, on the right the rounded version.

Interpolation

As mentioned earlier, this function defines how the points of the spline are produced. These choices are described in detail on page 134.

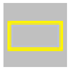
Plane

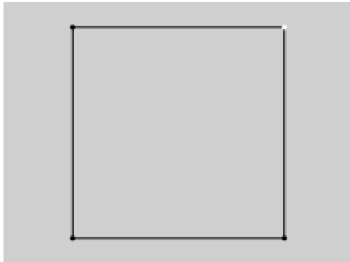
With this popup menu you choose in which of the three planes (XY, XZ, ZY) the spline is created.

Reverse Points

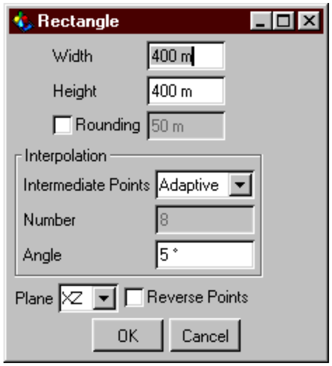
Check this option to reverse the spline's points (but not the spline itself).

Rectangle





This function creates a rectangle.



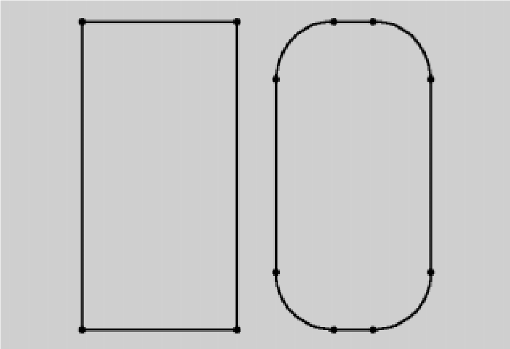
The Rectangle's parameter dialog

Width, Height

These values define the size of the spline primitive. By default both width and height are equal and a square is thus created.

Rounding

Enabling this will round all corners by the **Radius** angle.



On the left a standard rectangle, on the right the rounded version.

Interpolation

As mentioned earlier, this function defines how the points of the rectangle are produced. These choices are described in detail on page 134.

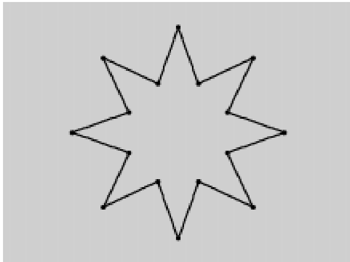
Plane

With this popup menu you choose in which of the three planes (XY, XZ, ZY) the rectangle is created.

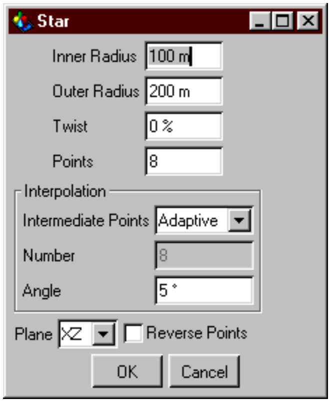
Reverse Points

Check this option to reverse the rectangle's points (but not the rectangle itself).

Star



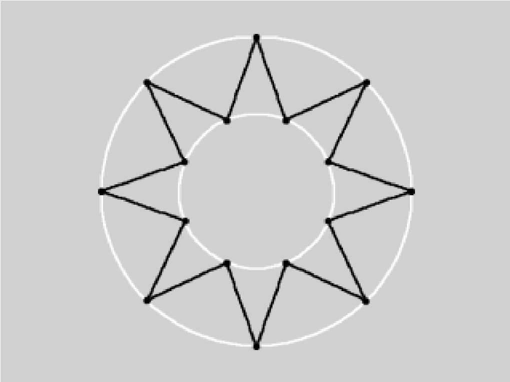
This function creates a star.



The Star's parameter dialog

Inner Radius, Outer Radius

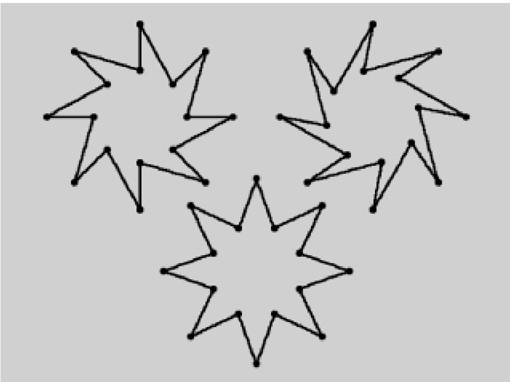
The points of the star are based around two circles, the sizes of which are defined by the **Inner Radius** and the **Outer Radius**.



A star, based around two circles.

Twist

Use this to twist the points of the star around its own shape. This makes saw blade shapes very easy to construct. The values can be between –100% and +100%. A value of 0% represents its base, star-like position.



The Twist value on the left is –50%, the centre 0% and on the right it is 75%.

Points

This value defines the number of points of the star.

Interpolation

As mentioned earlier, this function defines how the points of the star are produced. These choices are described in detail on page 134.

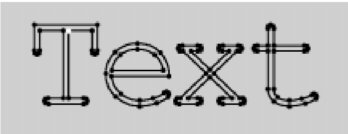
Plane

With this popup menu you choose in which of the three planes (XY, XZ, ZY) the star is created.

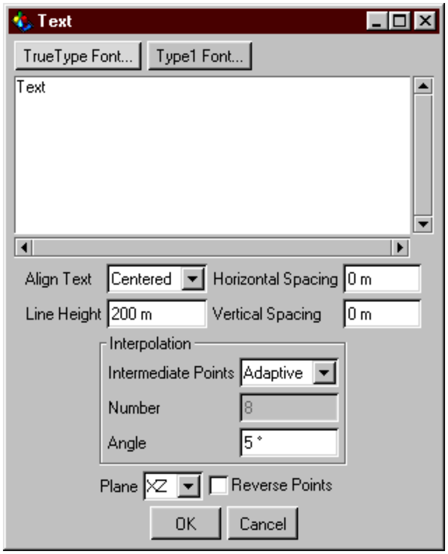
Reverse Points

Check this option to reverse the star's points (but not the star itself).

Text



With this function you can add letters, characters and any other piece of text. Simply choose a font and type your required text into the field within the dialog.



The Text parameter dialog

TrueType Font, Type1 Font

In CINEMA 4D you can choose between TrueType or PostScript Type 1 fonts by clicking on the appropriate button. With TrueType fonts, a font selector window will open, allowing you to choose a character set. With PostScript fonts, a standard file selector window opens, from which you can locate and load any desired PostScript font.

CINEMA 4D works with the so-called PFB (PostScript Font Binary) format of Type 1 fonts. These can usually be found in the directory C:\PSFonts. The information in the PFM (PostScript Font Metrics) files is not considered.

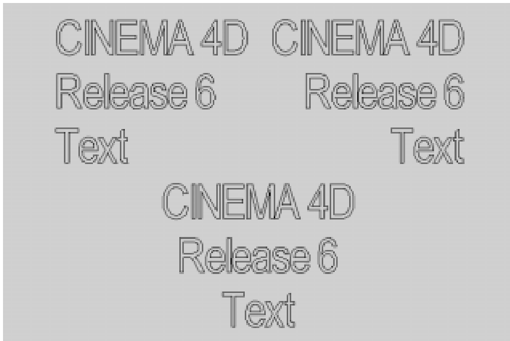
Under Mac OS you will usually find all your fonts (TrueType and PostScript) in the 'System Folder:Fonts' folder.

Text Edit Field

Enter your text into the large text field. You can enter several lines of text, pressing Return will begin a new line. To end the text input, press **OK**.

Align Text

With the **Align Text** popup menu you may adjust the alignment of the text object, either Left aligned, Centered or Right aligned.



Left justified text, centred text and right-justified text

Horizontal Spacing

With this function you can insert additional space between the characters inside a piece of text.

Vertical Spacing

Use this to insert additional space between the actual lines of text.

Line Height

This value defines the height of the characters in world units. The line height is based around the object's center of origin and includes any additional text spacing/leading.

Notes

CINEMA 4D generates text objects as connected splines. After they are created, you may add depth to these objects using Extrude NURBS. Simply create an Extrude NURBS object (see Extrude NURBS, page 166), then drag the created text spline, within the Object Manager, into the NURBS Object.

Various 3D text characters

As you can see, not only character fonts can be used but symbols too.

Some fonts are poorly designed and will have noticeable overlapping edges. CINEMA 4D cannot improve these faults. Always use high quality fonts for the best results.

You can get a good result with 3D fonts by using the Bevel command on a font object and restricting the angle limit to approx. 20° (see Bevel, page 358).

Tip

Kerning information is not evaluated by CINEMA 4D. Therefore to shift individual text letters accurately, proceed as follows:

– Convert the spline primitive with the function **Tools > Options > Make Editable** (see Make Editable, page 356).
– Activate the Points mode (see Points, page 302).
– Activate a vertex of the desired character (by clicking it).
– Choose **Selection > Select Connected** (see Select Connected, page 323). All points in this character object are now selected.
– Activate the Move tool (see Move, page 295) and you can move the entire character.

Alternatively, you may create individual text objects.

Caution

The text objects you create are created for multi-platform use, i.e. you may take a scene containing text spline objects over to another platform (e.g from a Macintosh to a Windows-based PC). However, if the original font does not exist on the target computer, the spline outline is lost as soon as changes are made to the object. If you suspect that the target machine may not recognise any particular character(s), you will *first have to convert the spline primitive to a polygon object (see Make Editable, page 356).*

Interpolation

As mentioned earlier, this function defines how the points of the text are produced. These choices are described in detail on page 134.

Plane

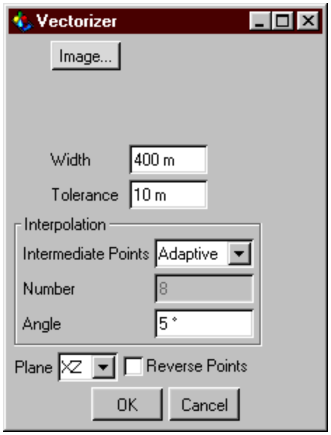
With this popup menu you choose in which of the three planes (XY, XZ, ZY) the text is created.

Reverse Points

Check this option to reverse the text's points (but not the text itself).

Vectorizer

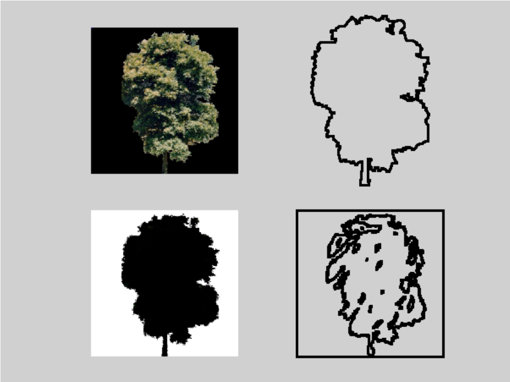
Behind this object hides a very powerful conversion tool. Using Vectorizer allows you to create spline outlines from bitmap pictures.



The Vectorizer's parameter dialog

Image

Click on the **Image** button to open a file selector. From here you can load the image that you wish to convert to splines. CINEMA 4D shaders cannot be used. It is important to remember that only pure black (RGB 0/0/0) is interpreted as a solid background. All other colours will be bordered with a line. The larger the source image, the better the results will be.



Converting an image (color image with black background and black image with white background)

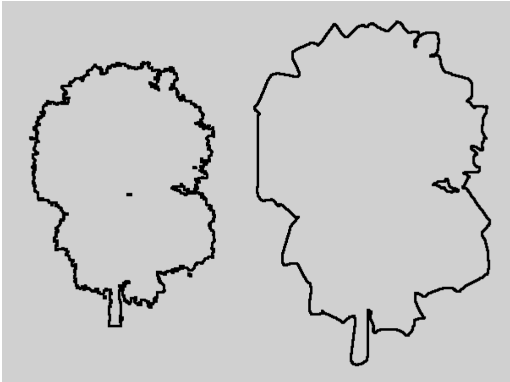
Effect of the image size on the result (512x512 and 1024x1024 pixels)

Width

This parameter defines the size in the X direction. The height (Y direction) results automatically from the aspect ratio of the image.

Tolerance

This defines the smoothing of the conversion. The higher the value, the smoother the contour appears. However, more and more detail will also be lost. The smaller the value, the more detail of the original picture will appear in the result. This, however, can lead to the spline showing staircase-like jaggies at its edges.



Different tolerance values lead to different precision results

Interpolation

As mentioned earlier, this function defines how the points of a spline are produced. These choices are described in detail on page 134.

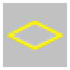
Plane

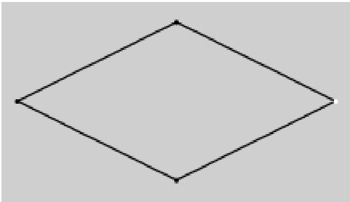
With this popup menu you choose in which of the three planes (XY, XZ, ZY) the spline primitive is created.

Reverse Points

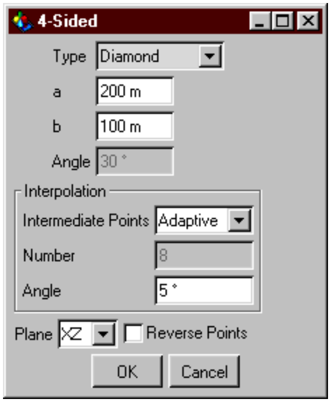
Check this option to reverse the spline's points (but not the spline itself).

4-Sided





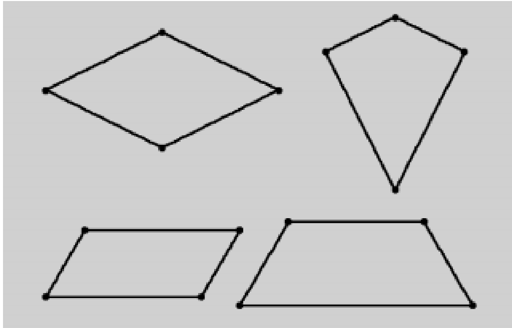
This command creates various 4-sided primitives such as trapeziums or parallelograms.



The 4-Sided's parameter dialog

Type

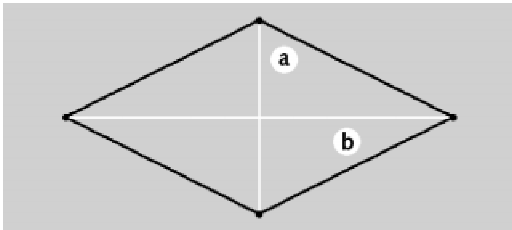
Select the desired 4-Sided object from the **Type** menu. You can choose between a Diamond, a Kite, a Parallelogram or a Trapezium.



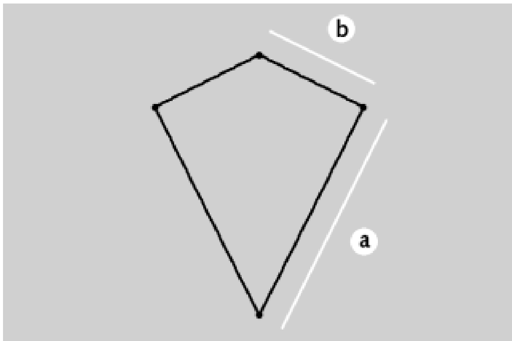
The various 4-Sided objects (Diamond, Kite, Parallelogram and Trapezium).

a, b, Angle

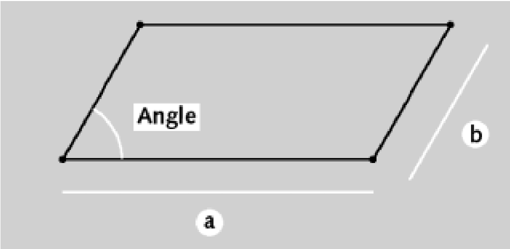
Depending on your choice of 4-Sided object, these values have different meanings. The following illustrations show these:



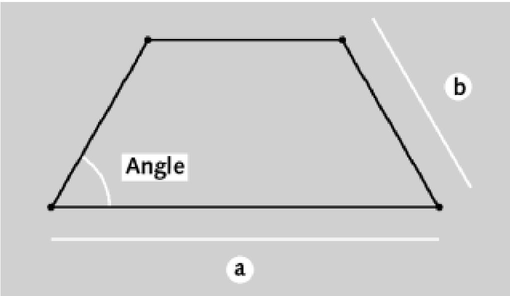
The parameters a and b for the diamond object



The parameters a and b for the kite object



The parameters a, b and angle for the parallelogram object



The parameters a, b and angle for the trapezium object

Interpolation

As mentioned earlier, this function defines how the points of the spline are produced. These choices are described in detail on page 134.

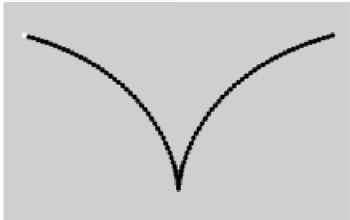
Plane

With this popup menu you choose in which of the three planes (XY, XZ, ZY) the spline is created.

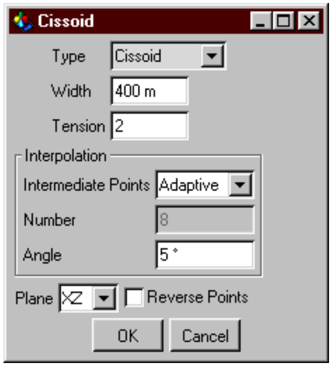
Reverse Points

Check this option to reverse the spline's points (but not the spline itself).

Cissoid



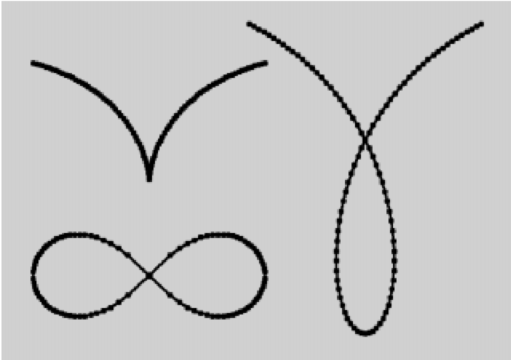
Creates various mathematical curves.



The Cissoid's parameter dialog

Type

This defines the type of curve created. You can choose between the Cissoid, the Lemniscate and the Strophoid. The Lemniscate results from a special calculation, using a technique known as Cassini curves.



Cissoid, Lemniscate and Strophoid.

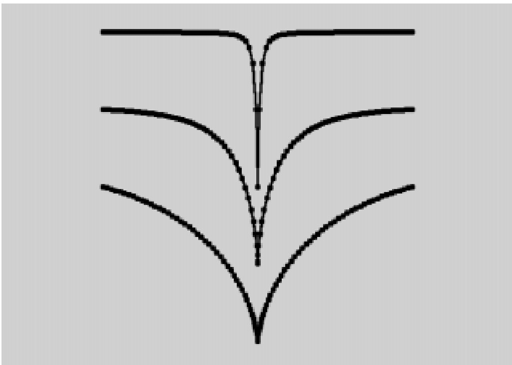
Width

This value defines the overall size of the curve.

Tension

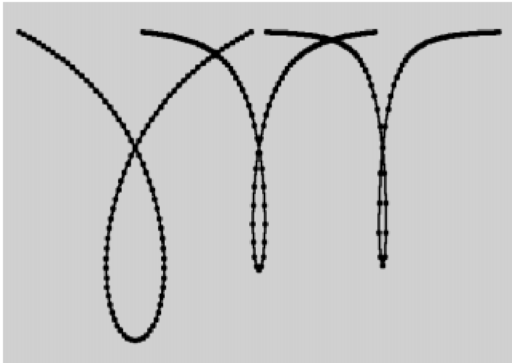
This will only affect the Cissoid and Strophoid objects.

With the Cissoid, the larger the value you enter, the more the two arcs are pulled together on both the left and the right of the axis of symmetry.



Various Cissoid objects with the tension values of 2, 6 and 50

Increasing the **Tension** value on the Strophoid object has a similar effect to when used on the Cissoid. The arcs are pulled up further as the value is increased. The loop also becomes narrower.



Various Strophoids with tension values of 2, 6 and 10

Interpolation

As mentioned earlier, this function defines how the points of the spline are produced. These choices are described in detail on page 134.

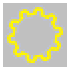
Plane

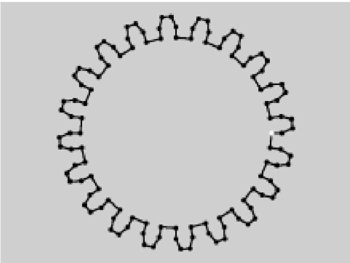
With this popup menu you choose in which of the three planes (XY, XZ, ZY) the spline is created.

Reverse Points

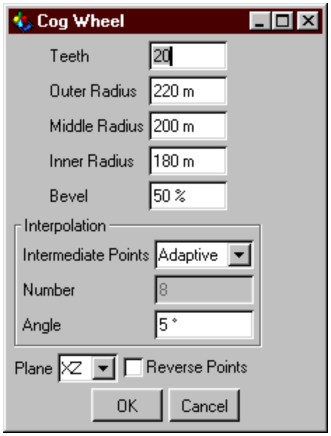
Check this option to reverse the spline's points (but not the spline itself).

Cog Wheel





This function creates a cog wheel, no surprises there.



The Cog Wheel's parameter dialog

Teeth

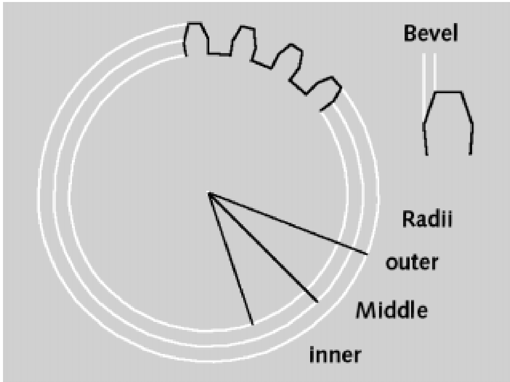
Enter the number of teeth of the cog wheel here.

Outer Radius, Middle Radius, Inner Radius

The overall size of the cog wheel is defined by **Outer Radius**, while the depth of the teeth results from the value for **Inner Radius**.

For the mathematicians: *Depth of teeth = (outer radius – inner radius) / 2*.

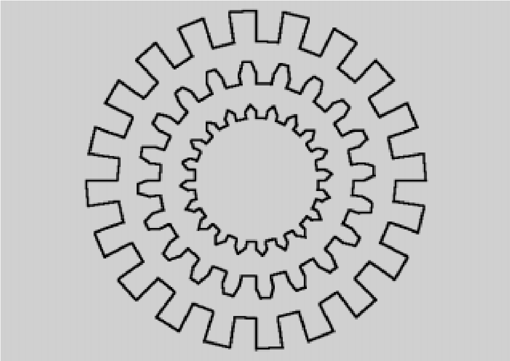
The third value, **Middle Radius**, gives the height at which any bevel will start to take effect (see Bevel below). The following illustration clarifies the connection between the three values.



The three radii of a cog wheel.

Bevel

As already mentioned, in addition to an inner and outer radius that define their depth, the teeth have another value, **Bevel** which can be used to create different degrees of sharpness. This is entered as a percentage and starts from 0% = no bevel up to 100% = maximum value (pointed teeth). The bevel starts to take effect from **Middle Radius**.



Various bevel values from 0%, 50% and 100% (left to right)

Interpolation

This function defines the partitioning of the points of a spline. These choices are described in detail on page 134.

Plane

With this popup menu you define in which of the three planes (XY, XZ, ZY) the spline primitive is created.

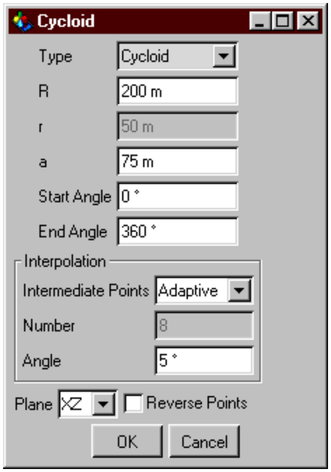
Reverse Points

Using this option, the points of the spline are reversed.

Cycloid

This creates a sort of rolling curve. This curve is described by a point located on the circumference of a circle as the circle rolls along a straight line. (This point can also be located inside or outside the circle.)

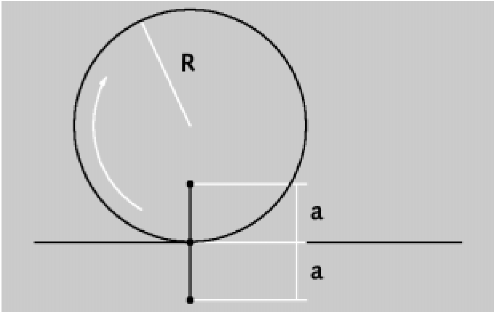
Cycloids, epicycloids and hypocycloids are particularly suited to rotating types of movement, e.g. for walk movements, gear mechanisms and planetary orbits.



The Cycloid's parameter dialog

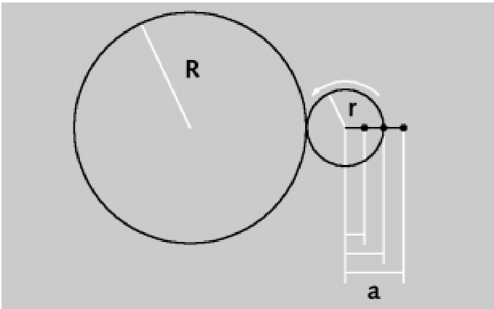
Type

With this option you choose the kind of rolling effect you want the curve to adopt. The basic Cycloid is the rotating curve of a circle (radius r) along a straight line.



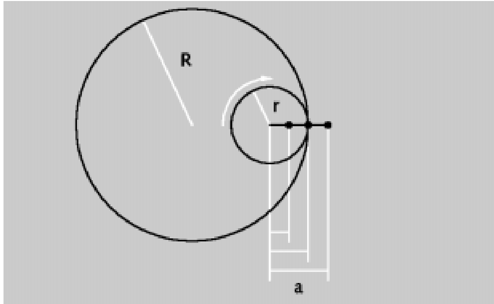
Parameters of a basic cycloid object

The Epicycloid is the rotating curve of a circle (radius r), which moves outside of a second (usually) larger circle (radius R).



Parameters of an epicycloid object

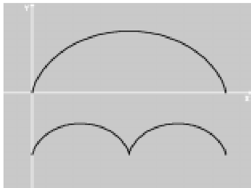
The Hypocycloid is the rotating curve of a circle (radius r), which moves inside a second (usually) larger circle (radius R).



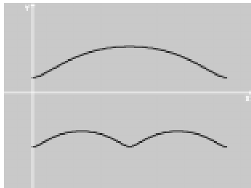
Parameters of a hypocycloid.

R, r, a

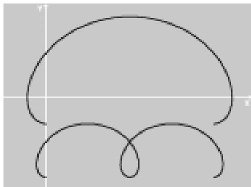
With the basic cycloid (a = r), the observed point P (that the curve forms) is on the radius of the circle. With the shortened (curtate) cycloid (a < r) it is inside the circle radius and with the extended (prolate) cycloid (a > r) it is outside.



r = 2, a = 2



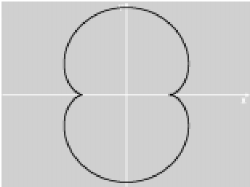
r = 2, a = 1



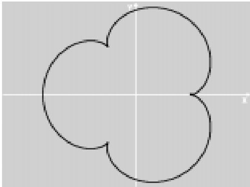
r = 2, a = 4

With the basic Epicycloid, the observed point P (that forms the curve) is on the radius of the inner circle (a = r). With the shortened Epicycloid it is on the inside of the inner circle (a < r) and with the extended Epicycloid it is outside (a > r).

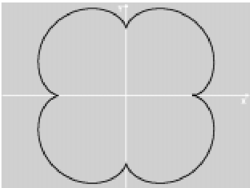
In the following illustrations you can see some of the possible curves. Below each illustration are the chosen values.



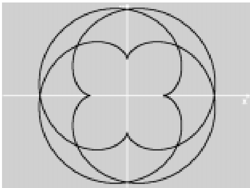
R = 4, r = 2, a = 2



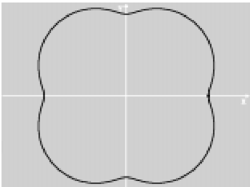
R = 3, r = 1, a = 1



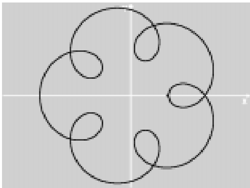
R = 4, r = 1, a = 1



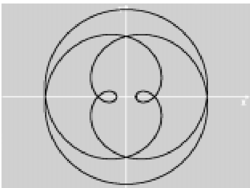
R = 4, r = 3, a = 3



R = 8, r = 2, a = 1

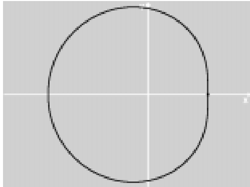


R = 10, r = 2, a = 5

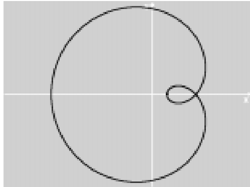


R = 2, r = 3, a = 4

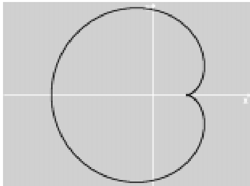
Special cases arise when the radii of both circles are equal (known as Pascal's curve). If, in addition, point P is on the radius of the outer circle (a=r), the result is known as a Cardioid. (See the ullustrations below.)



R = 2, r = 2, a = 1



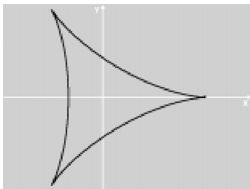
R = 2, r = 2, a = 3



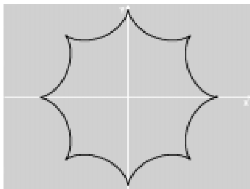
R = 2, r = 2, a = 2 – Cardioid

With the basic Hypocycloid, the observed point P (that forms the curve) is on the radius of the inner circle (a = r). With the shortened Hypocycloid it is located inside the inner circle (a < r) and with the extended Hypocycloid it is outside (a > r). If the radius of the outer circle is exactly four times the size of the inner circle, the result is an Astroid.

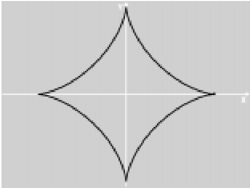
In the following illustrations you can see some of the possible curves available. Under each illustration are the chosen values.



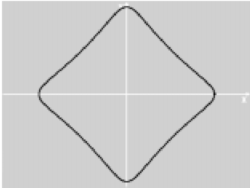
R = 6, r = 2, a = 2



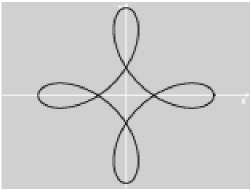
R = 8, r = 1, a = 1



R = 8, r = 2, a = 2 – Astroid



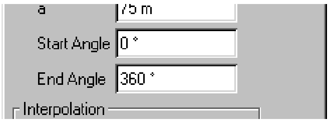
R = 8, r = 2, a = 1



R = 12, r = 3, a = 6

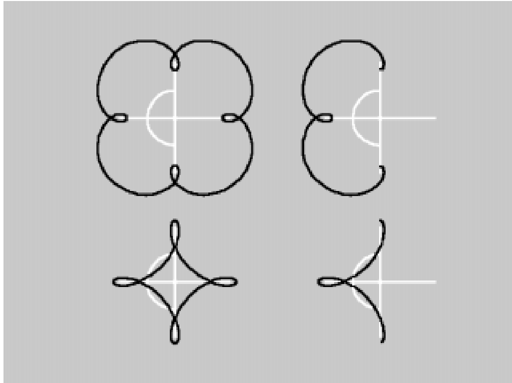
Start Angle, End Angle

These values define the start and end positions of the rolling circle. There is a small, but crucial, difference between the Cycloid, Hypocycloid and Epicycloid values.



For Cycloid you simply define the values for the start angle and the end angle of the rotating circle.

With Epicycloid and Hypocycloid you define the values for the start and end points on the fixed circle. Although the rotating circle still begins at 0°, you can view these angles as the range over which the rotating curve becomes visible.



Angle range on the left is 0 – 360°, on the right it is 90 – 270°

Interpolation

This function defines the partitioning of the points of a spline. These choices are described in detail on page 134.

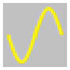
Plane

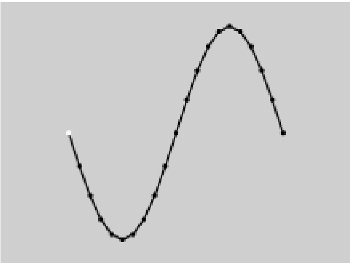
With this popup menu you define in which of the three planes (XY, XZ, ZY) the spline primitive is created.

Reverse Points

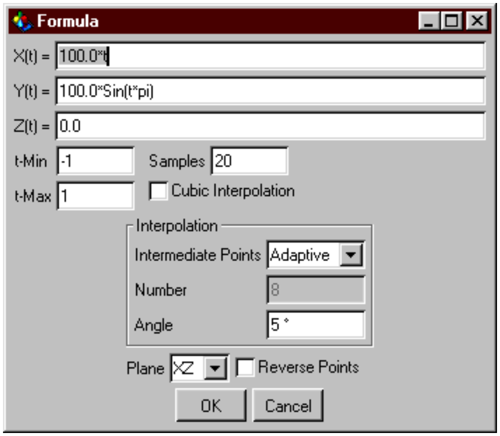
Using this option, the points of the spline are reversed.

Formula





This function creates a geometric curve based on a mathematical formula. A list of all CINEMA 4D's built-in functions, operators and constants can be found in Appendix 1.



The Formula parameter dialog

X(t), Y(t), Z(t)

Enter a mathematical function, with dependant variable t, for each of these directions.

t–Min, t–Max

Specify the definition range here.

Samples

Using this value you can define how many vertices between **t–Min** and **t–Max** are to be created. The value you enter will specify how many times a spline will be divided (note: it will always calculate one vertex more than the value you input).

In the following illustration is a standard sine wave with a definition range of –1 to +1. Below that we see the same function but this time with a range of –2 to +2. Both times the number of steps was set to 10.

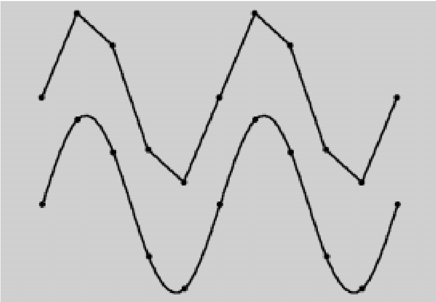

The same curve using various ranges for t.

As you increase the range of values that t can take, it may be necessary to increase the **Samples** size in order to retain a smooth curve (if desired).

Cubic Interpolation

Enable this option to keep down the number of vertices. Using cubic interpolation will add additional intermediate values between two vertices, effectively calculated according to the chosen interpolation (see below).

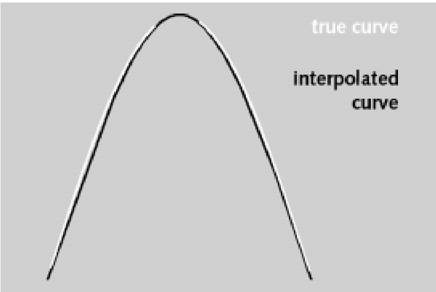
In the illustration below you can again see our rough sine wave (top), and underneath with Interpolation activated.



Effect of cubic interpolation.

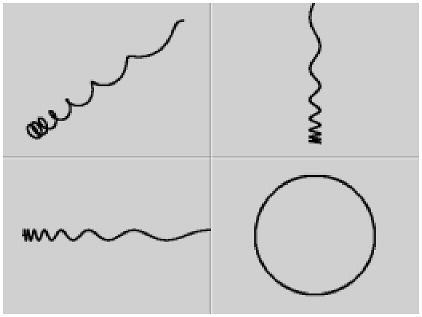
What interpolation means exactly and the implications that it has here for the shape of the curves are beyond the scope of this manual; there are many good mathematics books on this subject, should you wish to know more.

In the illustration below you can see the differences between interpolated and non-interpolated (true) examples of the curve.

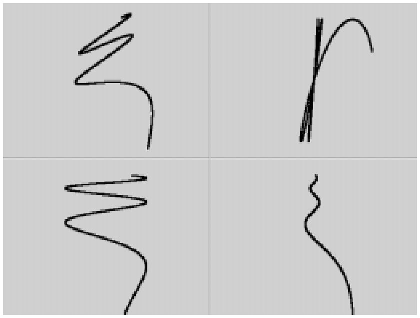


The true and interpolated curves for comparison.

Examples



*X(t) = 100 * cos(pi*t)* *Y(t) = 100 * sin(pi*t)*
*Z(t) = 100 * exp(0.25*t)* *t = 0 … 15*



*X(t) = 100 * sin(t) / t* *Y(t) = 100 * log(t)*
*Z(t) = 100 * sin(t) t = 0.5 … 15*

Interpolation

This function defines the partitioning of the points of a spline. (Described in detail on page 134.)

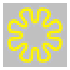
Plane

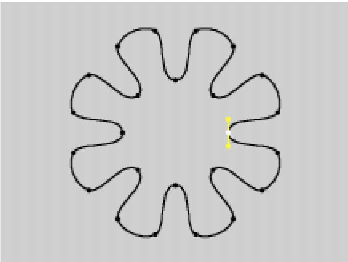
With this popup menu you define in which of the three planes (XY, XZ, ZY) the spline primitive is created.

Reverse Points

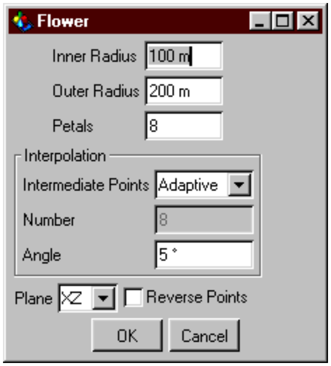
Using this option, the points of the spline are reversed.

Flower





This function creates a flower-shaped object.



The Flower's parameter dialog

Inner Radius, Outer Radius

The inner radius defines the size of the inner area, whence the petals begin to grow. The petals then extend from the inner radius to the outer radius.

Petals

This value gives the total number of flower petals.

Interpolation

This function defines the partitioning of the points of a spline. These choices are described on page 134.

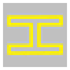
Plane

With this popup menu you define which of the three planes (XY, XZ, ZY) the spline primitive is created in.

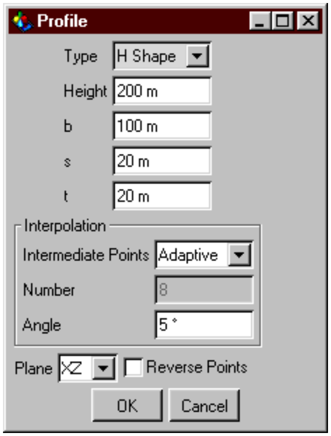
Reverse Points

Using this option, the points of the spline are reversed.

Profile



This function creates various profile shapes.



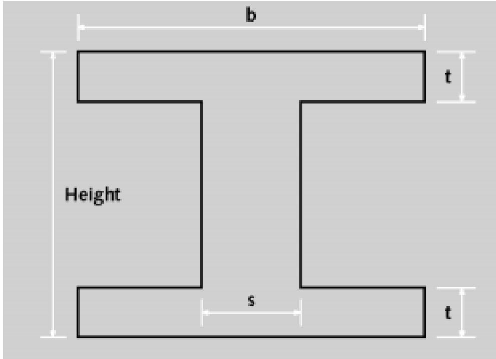
The Profile's parameter dialog

Type

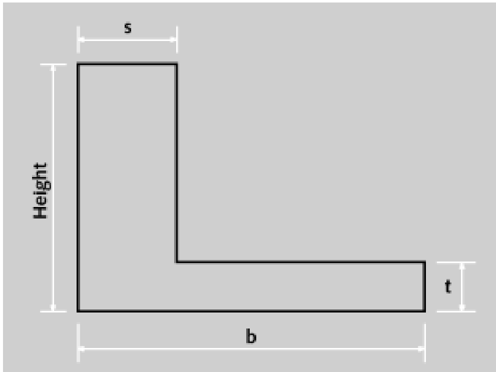
Here you choose the profile shape.

Height, b, s, t

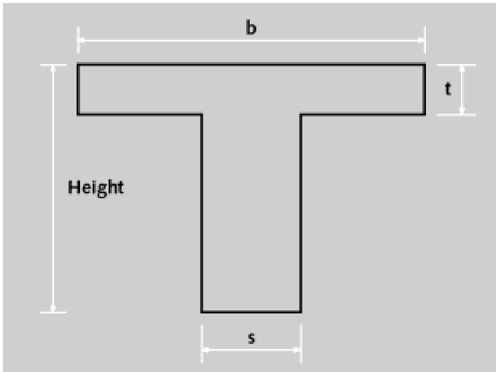
The relevance of the individual parameters can be seen in the following illustrations.



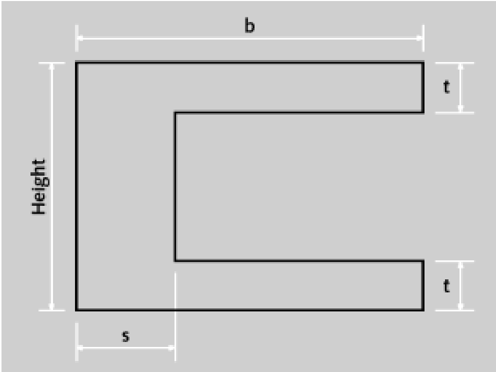
The parameters of the H-profile.



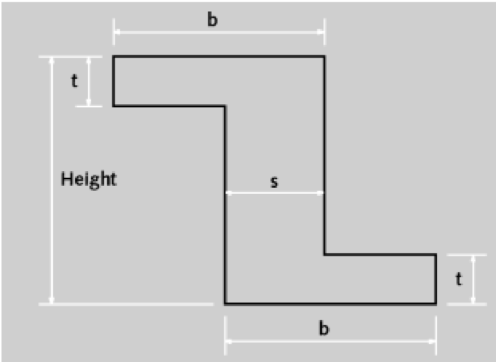
The parameters of the L-profile.



The parameters of the T-profile.



The parameters of the U-profile.



The parameters of the Z-profile.

Interpolation

This function defines the partitioning of the points of the profile. These choices are described in detail on page 134.

Plane

With this popup menu you define in which of the three planes (XY, XZ, ZY) the spline primitive is created.

Reverse Points

Using this option, the points of the spline are reversed.

NURBS Objects

NURBS objects are *generators*, meaning that they use other objects to generate a new geometry. The Hyper NURBS object uses polygon objects or primitive objects. The Extrude NURBS, Lathe NURBS, Loft NURBS and Sweep NURBS use spline objects. The exception to the rule is the Bézier NURBS, which we shall examine later in this chapter.

All NURBS objects are interactive, which means that as you change the source object(s), the NURBS object changes automatically. This gives you powerful interactive modeling.

NURBS objects have neither polygons nor points. If you wish to edit a NURBS object in specific regions, you must first convert it into a polygon object with the menu command **Structure > Make Editable**.

Hyper NURBS

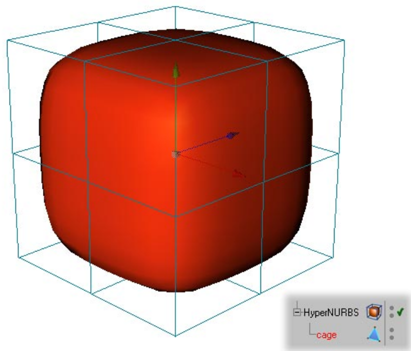
The Hyper NURBS object uses an algorithm to subdivide and round the object interactively - a process termed *subdivision surfaces*. This is an extremely quick and simple way to create organic forms.

First you create a simple cube and convert it into a polygon object (see Make Editable, page 356). Then you can use tools from the structure menu to extrude surfaces, bevel, knife and so on to create a complicated mesh with great ease.

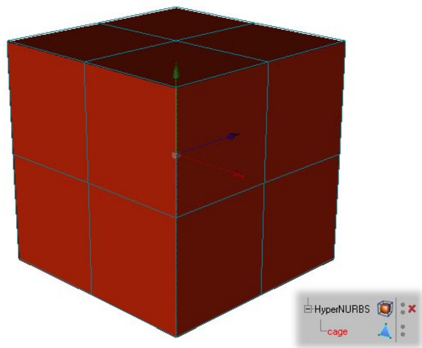
You can learn much more about Hyper NURBS in the Hyper NURBS Modeling tutorial in the Tutorials manual.

In principle you can use any type of object with Hyper NURBS, including polygon objects.

The source object (*cage*) must be a sub-object of the Hyper NURBS object.

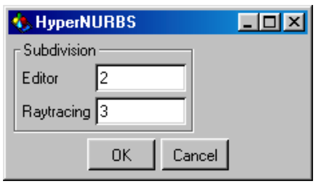


Both the Hyper NURBS object and the cage object are visible



Only the cage object is visible

Double-click the Hyper NURBS icon in the Object Manager to change the appearance of the Hyper NURBS.

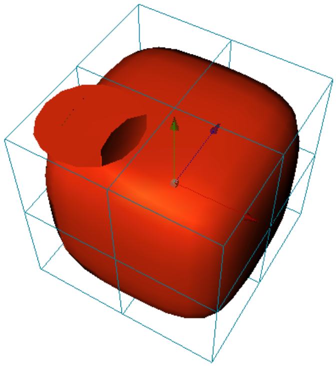


You can use the dialog to specify the subdivision level for shading in the editor and for raytracing. Normally the value you use for raytracing will be equal to or greater than the resolution for the editor. The higher you set the resolution, the smoother the object becomes, but also the more memory it uses and more slowly it renders.

Basic Advice On Hyper NURBS Modeling

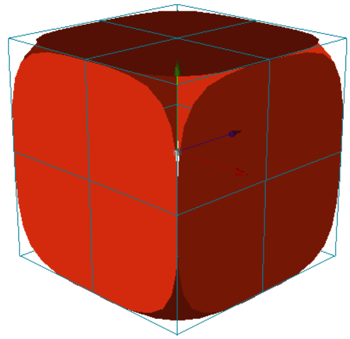
Here is some general advice on what to avoid when Hyper NURBS modeling.

- A polygon can only have one neighbour on an edge, otherwise the surface will tear. Sometimes it is possible to repair a torn surface with the menu command Structure > Optimize.

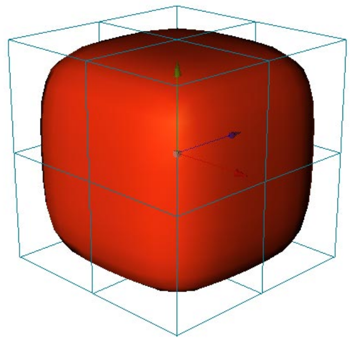


Here two polygons overlap each other on the left side of the object - as a result, the polygon on the right has more than one neighbour and the surface tears

- Only connected polygons are rounded. To check which polygons are connected, select a surface, then use Selection > Select Connected. If you want to connect overlapping polygons, use the Structure > Optimize command.



The sides of the cube are not connected to each other



This cube, on the other hand, is 'one piece'

- Try to work with rectangles rather than triangles, as they produce higher quality mesh.

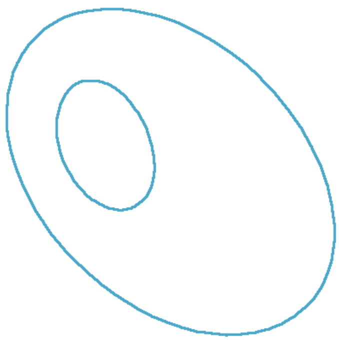
Extrude NURBS

The Extrude NURBS object extrudes a spline to create an object with depth. The extruded object appears as soon as you *drop* the spline into the Extrude NURBS in the Object Manager.

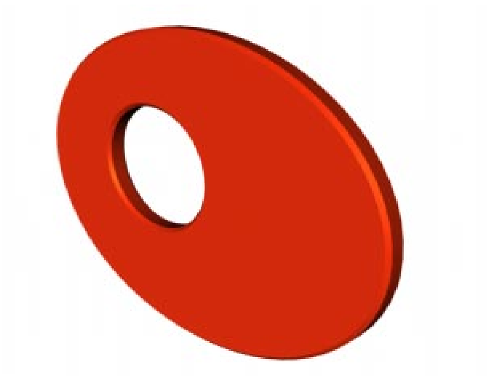
You can also use splines to cut out holes. If, for example, a single spline object has two segments (an outer circle and an inner circle), the inner circle will be interpreted as a hole. CINEMA 4D detects *hole splines* automatically. Even a hole within a hole is possible and the order of the segments is of no importance.

Note

All segments must be contained within a single spline object - additional splines will be ignored. To connect the splines, group them together then select Functions > Connect.

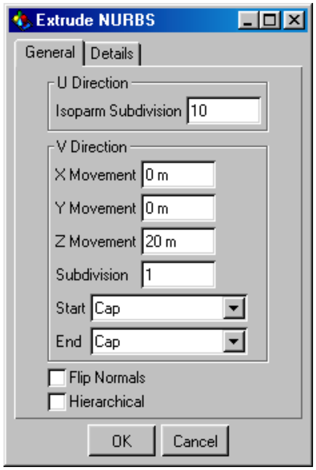


Hole spline



Hole spline in the Extrude NURBS object

If you click on the Extrude NURBS icon in the Object Manager the following dialog appears:



General Tab

Isoparm Subdivision

This defines the number of isoparms used to display the Extrude NURBS when the isoparm display mode is active (Isoparms, page 20).

X/Y/Z Movement

Here you can enter the extrusion distance along the X, Y and Z axes (based on the local axis system of the NURBS object).

Subdivision

This setting defines the number of subdivisions along the extrusion axis.

Start/End, Caps and/or Rounding

You can use these two popup menus to add caps and/or rounding to the start and end of the Extrude NURBS. See Details Tab, page 179.

Flip Normals

This option flips (i.e. reverses the direction of) the normals of the Extrude NURBS.

Usually, CINEMA 4D will point the normals in the *correct* direction. However, with open contours it is not possible for CINEMA 4D to know which way they should point. In this case you can control the direction of the normals either by changing the direction of the spline or by using the **Flip Normals** option.

This option does not effect the caps, since their normals are always calculated correctly.

A profile spline

Lathe NURBS

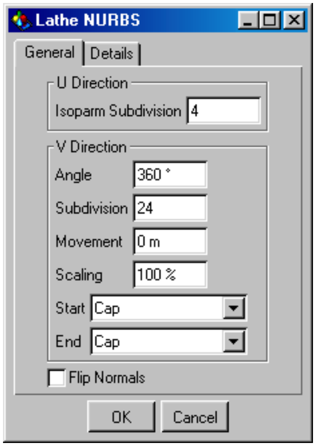
The Lathe NURBS rotates a spline about the Y axis to generate a surface of revolution, e.g. you can create a wine glass from a simple profile.

The lathed object appears as soon as you *drop* the spline into the Lathe NURBS in the Object Manager.

Usually the profile should lie on the XY plane (because it will be rotated about the Y axis).

The result - a wineglass

If you click on the Lathe NURBS icon in the Object Manager the following dialog appears:



General Tab

Isoparm Subdivision

This defines the number of isoparms used to display the Lathe NURBS when the isoparm display mode is active (Isoparms, page 20).

Angle

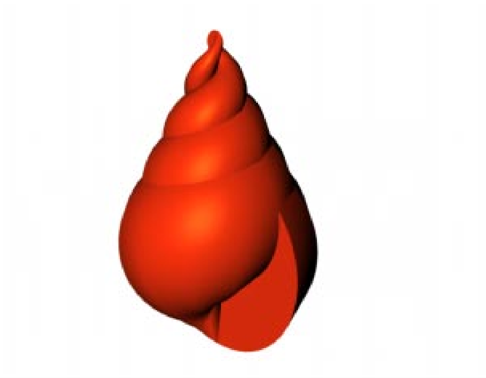
Here you define the angle through which the spline is to be rotated. 360° is one complete revolution.

Subdivision

This defines the number of subdivisions along the rotation.

Movement

If you enter 0 for the movement, the spline rotates on a circle. With any other value, it moves around a helix, enabling you to create shapes such as threads and screws. A large angle value is required for several threads.



Scaling

As you can see in the example above, **Scaling** determines the final scale of the spline.

Start/End, Caps and/or Rounding

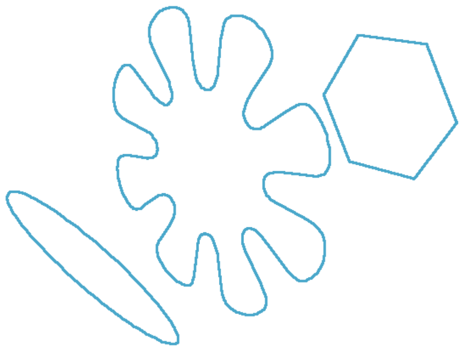
You can use these two popup menus to add caps and/or rounding to the start and end of the Lathe NURBS. See Details Tab, page 179.

Flip Normals

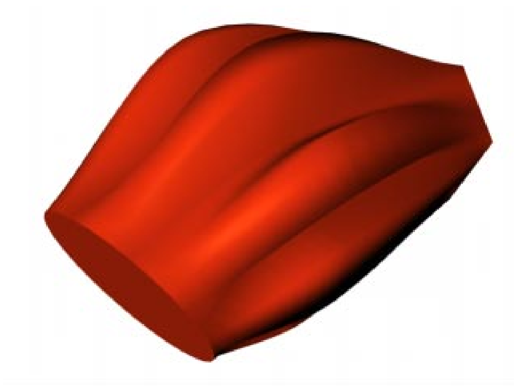
This flips (reverses the direction of) the normals of the Lathe NURBS. CINEMA 4D will point the normals in the *correct* direction, however, with open contours it is not possible to know which way they should point. In this case you can control the direction of the normals either by changing the direction of the spline or by using the **Flip Normals** option. This option does not effect the caps, since their normals are always calculated correctly.

Loft NURBS

The Loft NURBS stretches a skin over two or more splines (although see the Note below). The order of the splines in the Loft NURBS determines the sequence in which they are connected.



The original splines

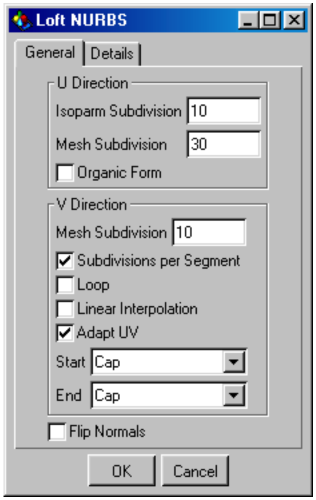


The splines in the Loft NURBS

Note

You can use a single spline with a Loft NURBS to create a surface.

If you click on the Loft NURBS icon in the Object Manager the following dialog appears:



General Tab

Isoparm Subdivision

This defines the number of isoparms used to display the Loft NURBS when the isoparm display mode is active (Isoparms, page 20).

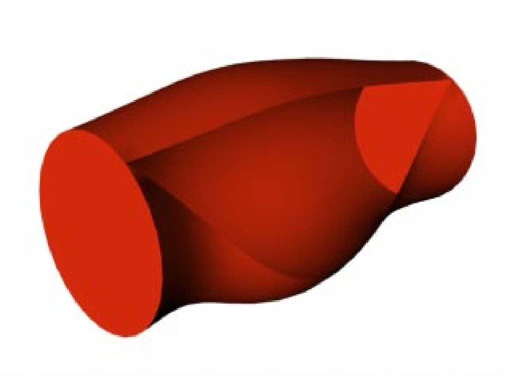
Mesh Subdivision

This gives the number of subdivisions in the U direction.

Note

If you are using 'open' splines, the number of subdivisions generated matches the Mesh Subdivision value exactly. However, if you are using 'closed' splines, the first subdivision coincides with the last division, generating one *subdivision less than the Mesh Subdivision value.*

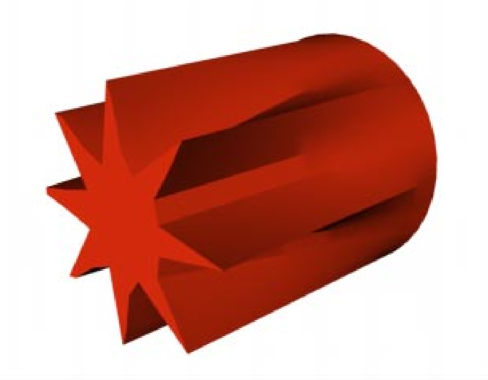
You can use both open and closed splines within the same Loft NURBS object.



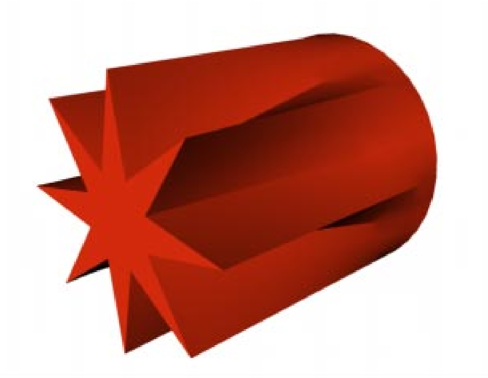
Two closed splines with an open spline in between

Organic Form

If this option is not selected, the Loft NURBS lines pass directly though the spline points and the distances between the lines adapt to the spline points, resulting in a very tight form. If the option is activated, the Loft NURBS lines no longer pass through the spline points exactly, but maintain equal parametric distance to each other, creating a looser, more organic form.



Organic Form selected



Organic Form not selected

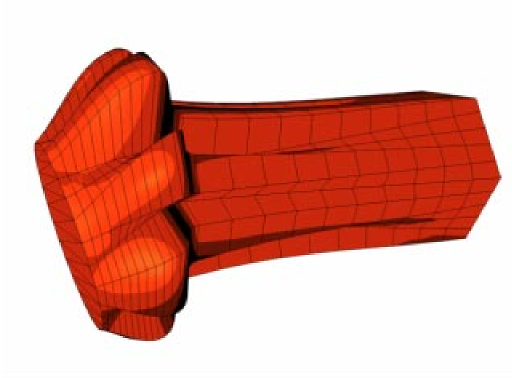
Mesh Subdivision (V Direction)

This defines the number of subdivisions created in the V direction.

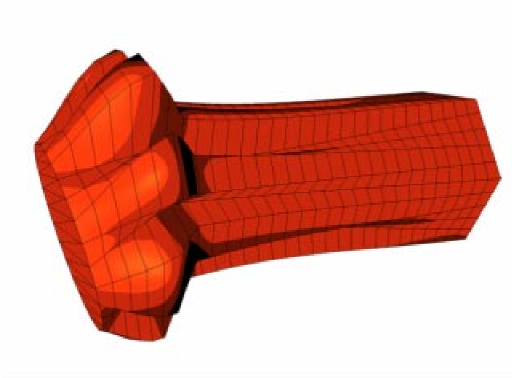
Subdivisions Per Segment

You can use this option to choose whether the mesh subdivision is divided evenly over the entire length of the object or evenly per segment (a segment is the section between one spline and the next). Activating this option gives you more control over the object's appearance when splines are close to each other.

If the option is not selected the number of resultant subdivisions per segment is calculated using the average distance of the segments. This may be unsuitable for animation, but it generates more regular objects with modeling.



Subdivisions Per Segment selected



Subdivisions Per Segment not selected

Loop

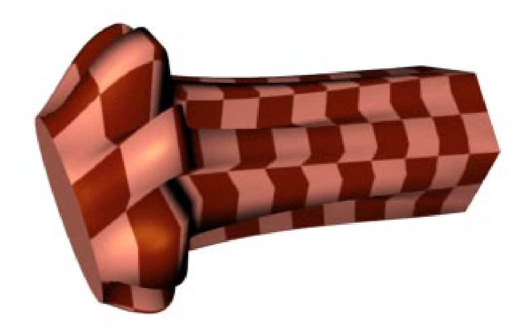
If the **Loop** option is active the first spline is connected to the last spline in the V direction.

Linear Interpolation

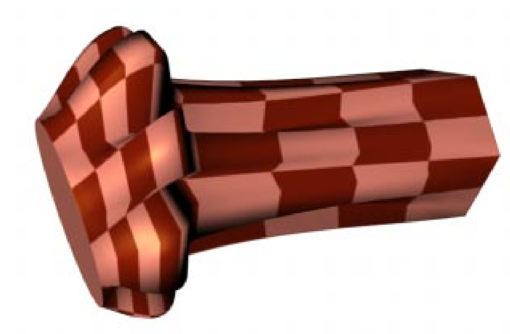
You should select this option for a linear interpolation between the splines; otherwise the interpolation is soft.

Adapt UV

Adapt UV is similar to **Subdivisions Per Segment** - but refers to the texture instead. The texture must use UVW mapping (see UVW Mapping, page 531) for this option to have an effect. It is independent of the **Subdivisions Per Segment** option. The texture is projected either per segment (selected) or evenly over the entire object (not selected).



Adapt UV selected



Adapt UV not selected

Start/End, Caps and/or Rounding

You can use these two popup menus to add caps and/or rounding to the start and end of the Loft NURBS. See Details Tab, page 179.

Flip Normals

This option flips (i.e. reverses the direction of) the normals of the Loft NURBS. Usually, CINEMA 4D will point the normals in the *correct* direction.

However, with open contours it is not possible for CINEMA 4D to know which way they should point. In this case you can control the direction of the normals either by changing the direction of the spline or by using the **Flip Normals** option.

This option does not effect the caps, since their normals are always calculated correctly.

Sweep NURBS

The Sweep NURBS requires either two splines or three splines. The first spline, the *contour* spline, defines the cross section and is swept along the second spline, called the *path*, to create the object.

The optional third spline (termed a *rail* spline) can be used to modify the scale of the contour spline over the length of the object.

Note

The contour spline should lie on the local XY plane.

You can use splines with multiple segments, e.g. you can sweep an entire word along the path!

This logo was swept parallel along two path splines (the final scale is 30%)

The contour spline is swept along the path in the direction of its (the contour's) Z axis. If you are using a planar (two-dimensional) path spline, there are no further considerations. However, the behaviour of the sweep is a little more complicated with a non-planar (three-dimensional) path.

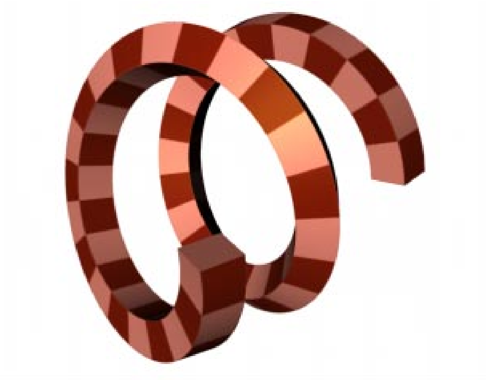
If **Banking** is activated the following rules apply; the contour spline is rotated at the start of the path spline so that its X axis is parallel to the average plane of the path spline. The contour is still placed with its Z axis tangential to the path spline. All subsequent contours are placed in such a way that the angle change from start to finish is kept to a minimum. If necessary, the contour is also given a rotation so that the start and end contours meet with closed path splines.

Banking allows you to use arbitrary 3D paths. However, it is not suitable for a precise sweep since the contours may break up, depending on the path.

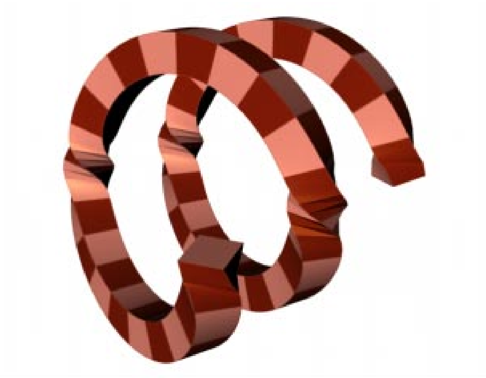
If the **Banking** option is not activated the following applies; the contour spline is rotated for each subdivision so that on the one hand its Z axis is always tangential to the path spline and on the other hand its X axis is parallel to the XZ plane of the path spline. You can use this XZ plane to control the sweep, although you do lose the ability to model *loopings*, since the contour flips over when the path runs vertical.

Finally, there is another, much more powerful functionality; you can use a *rail* spline to control the direction and/or scale of the contour as it runs along the path.

The path spline controls the positioning of the subdivisions. Adaptive spline interpolation is a good choice for modeling since it generates a relatively low number of surfaces. Uniform spline interpolation, on the other hand, is the better choice for animation since the subdivisions will be a uniform distance apart.



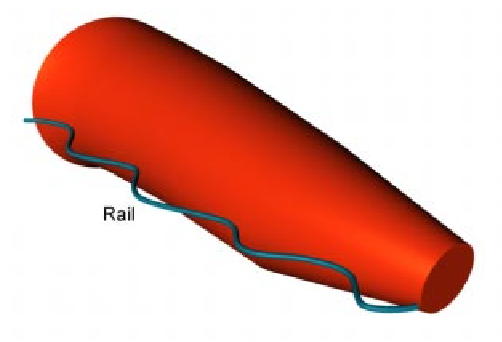
Banking selected



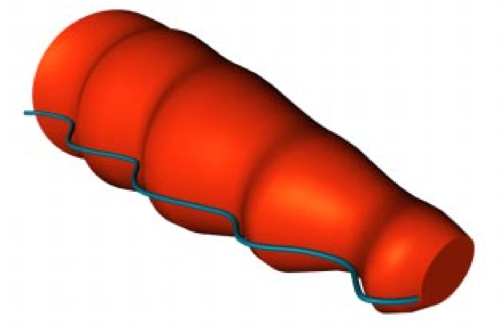
Banking not selected

Note

A common mistake when using rail splines is to use a path spline with adaptive interpolation. This can generate insufficient subdivision for the rail to work properly - a higher resolution is required. You can solve the problem by setting the path's interpolation to Natural.



Adaptive path spline

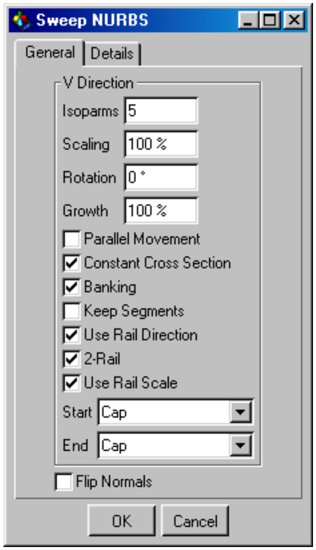


Natural path spline

Note

For more details on spline interpolation see Spline Basics, page 127.

If you click on the Sweep NURBS icon in the Object Manager the following dialog appears:



General Tab

Isoparm Subdivision

This defines the number of isoparms used to display the Sweep NURBS when the isoparm display mode is active (Isoparms, page 20).

Scaling

This gives the size of the contour at the end of the path. The contour is 100% at the start of the path and the size is interpolated in between.

Rotation

This defines the rotation about the Z axis that the contour has passed through by the time it reaches the end of the path.

Growth

This setting defines the size of the sweep itself. 100% means that the contour spline is swept along the entire path. If you are using a closed path, you can set caps when the growth is less than 100% (although you cannot select rounding).

Note

You can animate the growth using the parameter track in the Time Line.

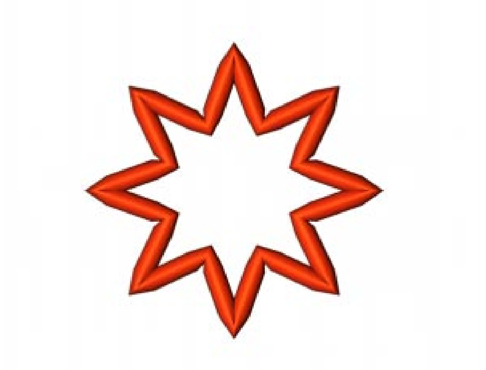
For example, you can gradually write a word by using a circle spline (e.g. radius 4, XY plane) as the contour and a spline in the shape of the handwriting as the path. Next, set two keyframes for the growth parameter - done!

Parallel Movement

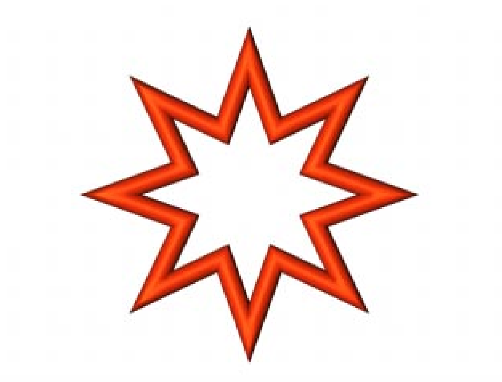
If this option is active the contour is swept in a parallel manner (i.e. it is not rotated at all).

Constant Cross Section

This option is selected by default. It is ignored if a rail path is used. It causes the contour spline to be scaled at hard edges in order to maintain a constant thickness throughout the sweep. The star-shaped path below illustrates the effect:



Constant Cross Section not selected



Constant Cross Section selected

Banking

If **Banking** is selected, the contour spline will lean into the curves of the path spline (CINEMA 4D will calculate the banking by considering the curvature of the path). The initial banking angle is set to the average plane of the path spline, which is calculated from the position of the path's spline points. The banking angle must be chosen at random for straight lines since they cannot have a plane. In this case, we recommend that you turn off banking. Then, the contour will run parallel to the path spline's XZ plane.

Keep Segments

This setting is only used if you have changed the value for **Growth**. Its effect is, by and large, only noticeable with animated growth. If the option is not selected, the animated growth is smooth. However, if you select **Keep Segments**, the sweep grows segment by segment. The positions of the segments themselves are determined by the path spline's interpolation settings. An adaptive path spline will usually lead to a jerky growth animation if **Keep Segments** is selected.

Use Rail Direction

If this option is selected the rail spline will influence the rotation of the contour spline about its Z axis.

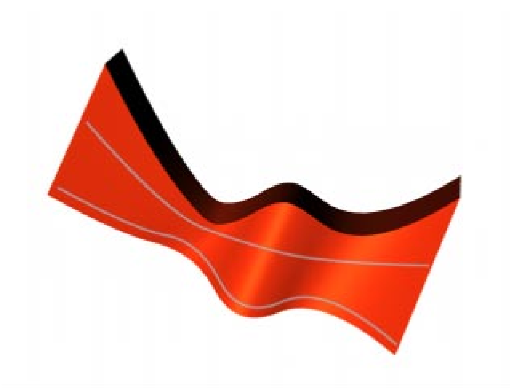
Use Rail Direction selected

Use Rail Direction not selected

2-Rail

If this option is selected the contour spline will be positioned between the path and rail; otherwise the rail controls the rotation of the contour about its Z axis (provided that the **Use Rail Direction** option is selected).

2-Rail selected



2-Rail not selected

Use Rail Scale

If this option is selected, the rail spline can be used to alter the scale of the contour along the path. Note that the **Constant Cross Section** option will be deactivated when you use this option (since they are contradictory).

Start/End, Caps and/or Rounding

You can use these two popup menus to add caps and/or rounding to the start and end of the Sweep NURBS. See Details Tab, page 179.

Flip Normals

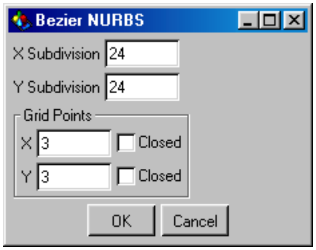
This option flips (i.e. reverses the direction of) the normals of the Sweep NURBS. Usually, CINEMA 4D will point the normals in the *correct* direction. However, with open contours it is not possible for CINEMA 4D to know which way they should point. In this case you can control the direction of the normals either by changing the direction of the spline or by using the **Flip Normals** option. This option does not effect the caps, since their normals are always calculated correctly.

Bézier NURBS

The Bézier NURBS differs from the other NURBS in the sense that it does not require any objects. Bézier NURBS stretch a surface over Bézier curves in the X and Y direction. The control points for these curves pull on the surface like little magnets (apart from the edge points, to which the surface is *fixed*).

Bézier NURBS are perfect for smooth, curvy surfaces such as car wings, nose-cones and sails.

If you click on the Bézier NURBS icon in the Object Manager the following dialog appears:



X/Y Subdivisions

These settings define the number of subdivisions in the X and Y directions.

X,Y (Grid Points)

Here you can enter the number of control points in the X and Y directions. The more points you set, the more control you have over the surface.

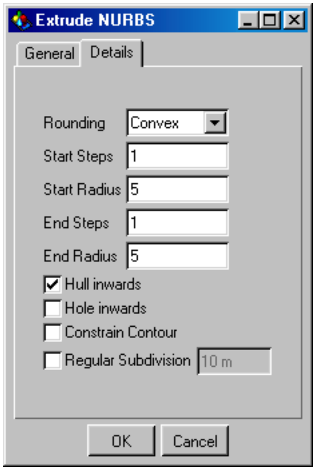
Closed

You can use these settings to close the surface in the X and/or Y direction.

Note

If you change the subdivision settings the Bézier NURBS is 'reset' to its starting state. Therefore ensure you have enough subdivisions before you start modeling in earnest.

Details Tab

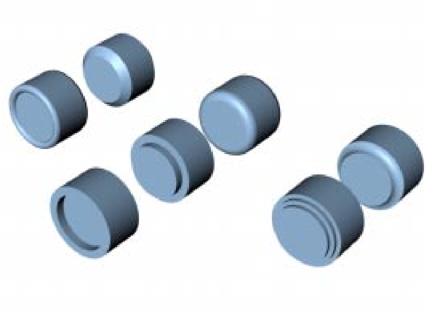


You can use the details tab for the Extrude, Lathe, Loft and Sweep NURBS in order to change the rounding at the start and end of the object.

The General tab allows you to specify caps and/or rounding separately for the start and end of the NURBS object. If you set Cap And Rounding for **Start** or **End**, you can set the following options on the Details tab:

Rounding

You can choose the shape of the rounding using the popup menu. The following picture demonstrates all the rounding types:



From back to front and from left to right: Linear, Convex, Concave, Half Circle, 1 Step, 2 Steps and Engraved

Start Steps

Here you enter the number of subdivisions for the rounding at the start of the object.

Start Radius

This determines the radius of the rounding at the start of the object.

End Steps

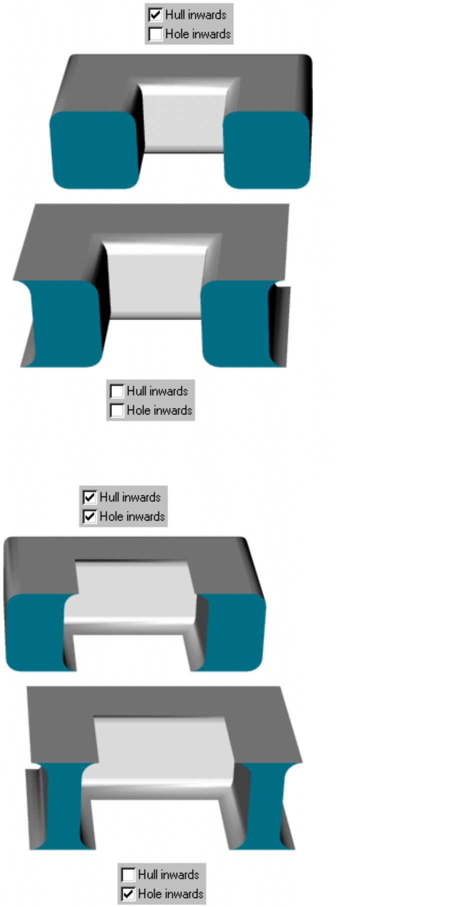
This is the number of subdivisions for the rounding at the end of the object.

End Radius

This determines the radius of the rounding at the end of the object.

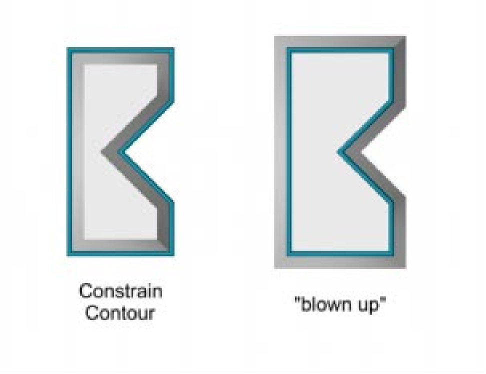
Hull Inwards/Hole Inwards

The examples below demonstrate rounding inwards and rounding outwards. **Hole Inwards** refers to hole segments - it is ignored if your spline has no hole segments.



Constrain Contour

This setting determines whether the object's dimensions are preserved or whether the object should be *inflated* by the rounding. Here are some examples:

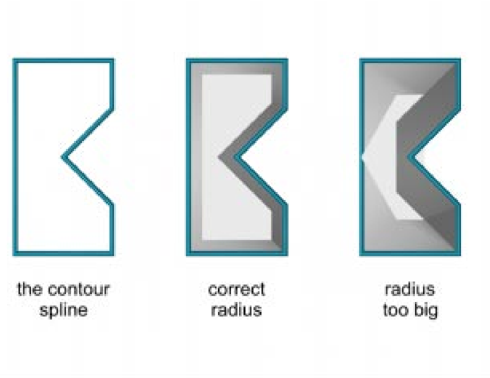


The thick line represents the initial spline

Note

You need to take a little care when rounding with the Constrain Contour option selected. The pictures below demonstrate this issue. The top picture shows the initial contour. Rounding the contour with a small radius produces the desired result (middle picture). The final picture shows what happens if the rounding is set too high. CINEMA 4D cannot detect inappropriate settings for you in this case. It is up to you to use a sensible rounding radius.

Rounding objects by *inflating* them always works, although it does increase the size of the hull.



The initial contour, the correct radius and radius too large

Regular Subdivision

If this option is active the surface will not be built out of long triangles but out of regularly spaced quadrangles whose size you can enter in the text box to the right of **Regular Subdivision**.

Initially there appears to be no difference at all between the selected and deselected option when you render or shade. However, if you turn off the option and deform the spline so that it is no longer planar, artefacts will appear on the surface. The long triangles are now visible.

You can reduce the artefacts by activating the option. Triangles will still be created at the edge. To reduce the number of triangles decrease the size of the quadrangles.

This option is particularly useful if you intend to use deformation objects.

Different materials for the hull, caps and rounding

You can apply different materials to the hull, caps and rounding. You can convert the object into polygons with **Structure > Make Editable**, or you can use the so-called *invisible* selections (see below). For example, you can use the Extrude NURBS to create marble letters with a golden rounded or bevelled edge.

Note

You can use existing 'invisible' selections for the caps and rounding of a NURBS object.

For example, you can apply a material to the start cap by using the **Restrict To Selection** function (see page 542). You should type in 'C1' to apply the material to the start cap (please use a capital C). The possibilities are:

C1 = Start Cap (Cap 1)

C2 = End Cap (Cap 2)

R1 = Start Rounding (Rounding 1)

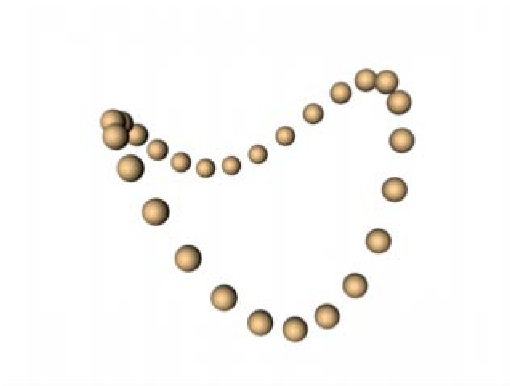
R2 = End Rounding (Rounding 2)

Modeling

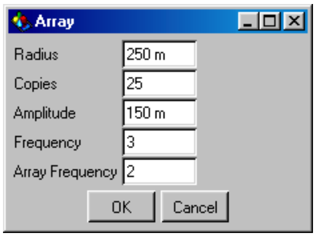
Array

The array object creates copies of an object and arranges them in a spherical form and in a wave form. The wave (amplitude) is animated.

The simplest way to understand the Array object is to see it in action. Open the 'Array.c4d' scene, which you can find on the CINEMA 4D CD. Play back the animation in the editor for a demonstration.



The original object (in this case the small sphere) must be a child of the array. The copies are placed around the array object's origin. Double-click on the array icon in the Object Manager to open the following dialog:



Array

Radius	250 m
Copies	25
Amplitude	150 m
Frequency	3
Array Frequency	2

OK Cancel

Radius

This value defines the distance of the objects in the array (in this case, the spheres) from the array object's origin.

Copies

Copies defines the number of copies of the original object. Note that the original object remains visible, so the total number of objects in the array equals this value plus one.

Amplitude

This specifies the maximum movement in the Y direction.

Frequency

You can use this setting to determine the wave velocity.

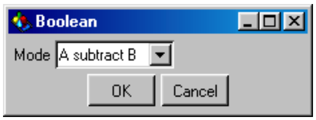
Array Frequency

The Array Frequency defines the number of waves.

Boolean

The Boolean object performs realtime Boolean operations on primitives or polygons. This means that you can see the result in the editor the moment you make the two objects children of the Boolean object (try two spheres for testing). The default Boolean mode is *A subtract B*.

Double-click on the Boolean icon in the Object Manager to open the following dialog:

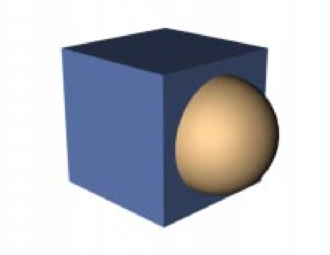


Mode

You have four Boolean modes to choose from. Each mode is explained below with the help of a picture:

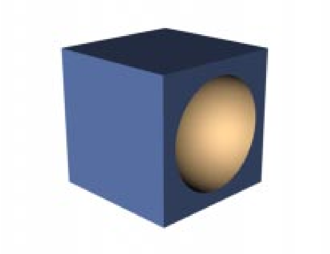
A union B

Object A is merged with object B:



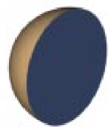
A subtract B

Object B is subtracted from object A:



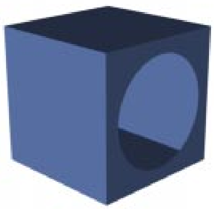
A intersect B

The volume of intersection is shown:



A without B

This is similar to *A subtract B*, but it is not a genuine Boolean operation. It cuts holes in object A, but it does not cap the holes:



Note

If you need to make a 'cleaner' cut (i.e. if you can see defects), increase the number of subdivisions for the objects.

Instance

An instance object is a special duplicate of an object that does not have its own geometry. As a result, instances require far less memory than conventional duplicates, but the advantages do not end there.

Imagine that you have created a street scene with over 40 street lamps using conventional duplicates rather than instances. You decide that the lamp illumination is too bright - what now?

Well, you can double-click on a light source icon, adjust its brightness, click on OK and then repeat the process 39 times for the other lamps. You'll spend some of the most boring minutes of your life making these changes. Once you're done, you render the scene and guess what? Yes, those lights are far too yellow. "Uh-oh, that's another 40 light dialogs to edit..."

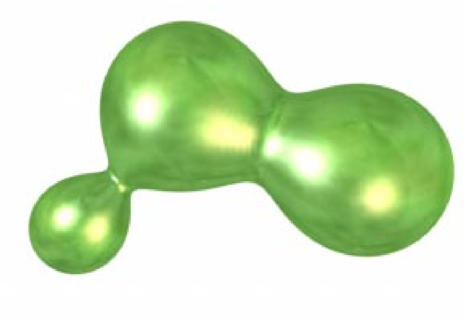
You can spare yourself this headache simply by using instances rather than normal duplicates - even a complex hierarchy can be instanced.

If the street scene contains instances rather than normal duplicates, you can change the original street lamp and all the instances will change as well. You may even edit the original with the modeling tools and the instances will follow suit. Material properties are adopted as well. Only the position, scale and rotation are independent of the original.

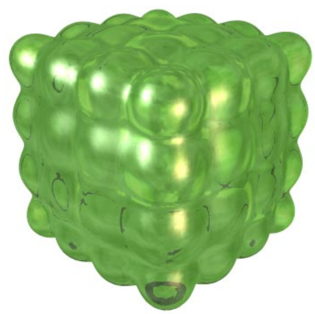
To create an instance of an object, select the object in the Object Manager and choose **Instance** from the **Objects > Modeling** menu. The dialog for the instance will not open, since the name of the original is recorded in the dialog's name box automatically. If no object was selected in the Object Manager at the time of the call, the name box remains empty. To enter a name manually, double-click on the Instance icon in the Object Manager. A dialog opens so that you can type in the name of the original object.

Metaball

Think of the metaball object as an elastic skin that can be stretched over spheres, splines and points. The skin will become active the moment you make such an object a child of the metaball object (drag-and-drop in the Object Manager). If you move any of the child objects, the skin behaves like a sticky, blobby mass!

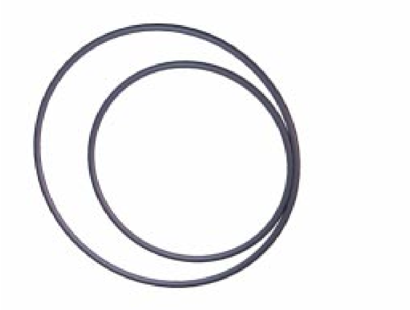


Sticky, blobby mass is not the technical term, however. Technically, it is referred to as the *hull*. The metaball object works exclusively with parametric spheres, splines (all types) and polygon objects. In the case of polygon objects, each point is interpreted as a sphere.



Polygon cube (3x3x3 segments) in a metaball object

Splines have a special feature - you may use a second spline to control the hull thickness. This second spline must be a child of the first spline and it must also be of the same type (why not copy the first spline as your starting point?).



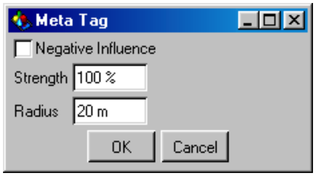
The original circles

The circles in the metaball object

You can even use a particle emitter with a metaball object! See page 255 for a tutorial of particle animation with metaballs.

Double-click on the metaball icon (Object Manager)...

...to open a dialog containing the following settings:



Hull

This defines how tightly the hull is applied. Higher values mean that the hull is wrapped more tightly around the objects.

Editor Subdivision

This defines the number of subdivisions that are displayed in the editor.

The subdivision is specified in distance units. This means that you should *lower* the value to increase the number of subdivisions and mesh-smoothness. Increasing the value will reduce the number of subdivisions.

It makes sense to use a high value here (e.g. 40), otherwise the redraw rate may slow down noticeably.

Render Subdivision

This defines the number of subdivisions that are rendered.

The subdivision is specified in distance units. This means that you should *lower* the value to increase the number of subdivisions and mesh-smoothness. Increasing the value will reduce the number of subdivisions.

You should choose a low setting here (e.g. 5), so that the surface is rendered smoothly.

You can assign a *metaball tag* to child objects of the metaball for further control - select the child object that you wish to *fine-tune* and choose **File > New Tag > Metaball Tag** in the Object Manager.

The tag gives you access to the following settings:

Negative Influence

Normally, objects attract the metaball hull and make it expand. However, if you activate this option, the object will repel the hull and cause it to shrink.

Strength

You can use **Strength** to define how strongly the object affects the hull relative to the other objects.

Radius

This value determines the radius used by the object to affect the hull.

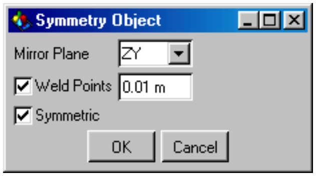
Symmetry

The symmetry object is particularly useful for polygon modeling. Imagine that you are modeling a face. Isn't it a real pain to have to model two ears and two eyes? Why not model just one eye and one ear and have them reflected to the other side of the face? Then adjust slightly for that authentic Van Gogh look! The symmetry object allows you to do precisely that.

When using the symmetry object in this way, you should model only half of the object. Let's try something simple: create a sphere, convert it into polygons with **Structure > Make Editable**, go into points mode and delete the right half of the points in the front view (select the points using the Rectangle Selection tool). Create a symmetry object and make the *sphere* a child object.

The sphere is restored to its former glory. Note that only the left-hand side has points - the right-hand side is, after all, just a reflection. See what happens if you, say, use the magnet to pull some of the points on the left-hand side.

Useful, don't you think? We're not done yet, though - double-click on the symmetry icon in the Object Manager to open a dialog containing the following options:



Mirror Plane

This determines the plane which is used as the mirror. ZY is the default since it is used for objects with vertical symmetry (e.g. a face) in the front view.

Weld Points

If this option is selected, points at the mirror's edge are welded automatically - two points become one. This joins your object smoothly, avoiding a seam along the middle. You can enter the maximum weld radius in the box to the right of the option. Points that are within this distance to each other will be welded together.

Symmetric

If this option is not selected, any point that is slightly off the mirror axis will be mirrored to the other side and the resultant point will not be on the mirror axis. If you activate **Symmetric**, the resultant point will be placed exactly on the mirror axis.

Construction Plane

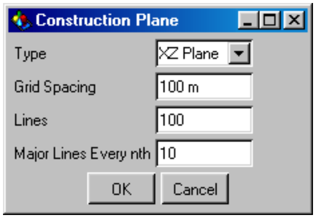
The world grid is the default construction plane. The disadvantage of the world grid is that it cannot be moved or rotated. When you create a construction plane, the world grid is switched off.

The construction plane is an aid to object placement. You can place objects, splines and points onto the construction plane. For example, you can move and rotate the construction plane so that you can place tiles straight onto a slanted roof.

So that objects, points, surfaces etc. come to rest on the construction plane, activate the corresponding options in the Snap Settings (see page 383).

For example, if you activate spline snapping and draw the spline in the perspective view, it will be drawn straight onto the construction plane. Note that the mouse pointer must remain below the horizon line in the process.

Double-click on the construction plane icon in the Object Manager to open a dialog with the following settings:



Type

The construction plane can be in the local XY, ZY or XZ plane.

Grid Spacing

This defines the distance between grid lines.

Lines

You can use this to set the number of grid lines in both directions. 100 is the default setting. Enter a higher number if you need to increase the size of the construction plane.

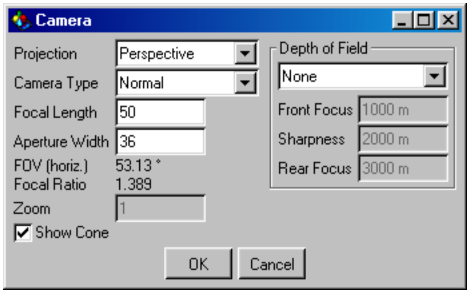
Major Lines Every nth

Major lines are darker than normal lines. Use this setting to determine the number of normal lines per major line.

Scene Objects

Scene Objects include cameras, lights and other objects which provide you with control over the final appearance of your scene.

Camera



In addition to the default camera within the Editor, you may add as many additional cameras as you need. Each camera can view your scene from a different perspective.

When creating a new camera, the default position and focal length values are taken from the current 3D view.

When placing and aligning a camera, CINEMA 4D uses the camera coordinate system. This system behaves in such a way that the X and Y axes define the focal or film plane, and the Z axis indicates the direction that the camera is pointing and displays this view in the Editor.

In the editor, the camera is shown as a cube with two spools of film and a lens:

Additional camera parameters are described below.

Attach camera

After creating a camera, the view is not initially switched to the new camera. You can move the camera in the editor windows and see your adjustments to the camera in the scene.

In order to view using your new camera you must activate the view by selecting **Attach Camera** from the menu of the appropriate editor window. Now the editor window will show the new camera view.

Note

With more than one camera in a scene, you may assign each of the respective camera views to your main editor window and very easily switch between different cameras and their views in this editor. Alternatively you can open and attach an individual editor window for each camera object and its view. Then you may control all the scene's cameras at the same time.

Detach camera

To cancel the view from a selected camera, detach it using this command. This removes the view connection from a camera and shifts back to the editor camera view.

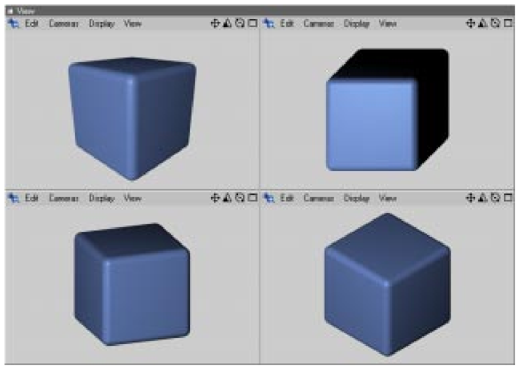
Note

Camera objects are not only used as cameras. You can also use a camera to help you align your scene elements and objects. This would make sense with a spotlight for instance *(see page 197)* *when, like camera objects, the Z-axis is used as the line of sight.*

To show all objects in a scene, CINEMA 4D displays them using a central perspective projection. By default, objects are shown from the viewpoint of this virtual camera.

Alternatively you can select from a variety of other types of projection (e.g dimetric or isometric views, which are commonly used in technical applications).

Some examples follow: top left; central perspective, top right; gentleman projection, bottom left; dimetric and bottom right; isometric.



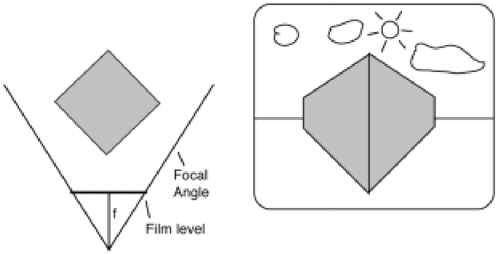
Focal Length

The CINEMA 4D cameras, like their real world counterparts, use a lens system. You are free to choose from different lenses and to specify the focal length.

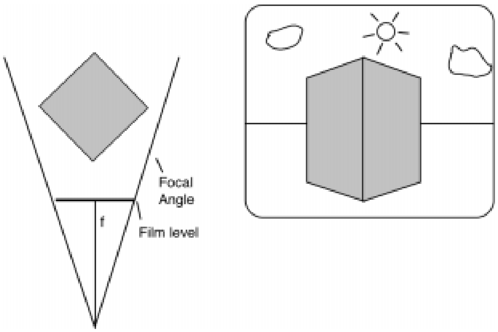
Note

The camera model used in computer graphic programs corresponds to a pinhole camera with infinite sharpness. Therefore CG focal length is *to be understood only as a simulation and corresponds in no way to a physical model.*

Short focal lengths give a wide-angle view and are ideal for a good overview of the whole scene. They do, however, distort objects in the scene - a particularly striking effect is that of a very short focal length such as a fisheye lens.



Large focal lengths correspond to a telephoto lens, they display a very small area of the scene since they can capture only a small spatial angle.



This is compensated by the fact that you can capture far more detail with hardly any distortion. With an extremely high value used as a focal length, the perspective depth is lost completely as the perspective projection changes into a parallel projection.

Lens	Focal length
Fisheye	20 mm
Extra wide angle	25 mm
Wide angle	35 mm
Normal	50 mm
Portrait	85 mm
Telephoto	200 mm
Super Telephoto	1000 mm

Depth of Field

CINEMA 4D will also let you simulate the quality of the lens system, blurring with an increased aperture, which is known as Depth of Field.

Depth of Field lets you specify which part of a picture will be out of focus. You have a choice of **Front** or **Back**, depending on whether you require the objects at the front or the back to be displayed clearly.

You can also choose to have the central range in focus, in which case both the front and back of the scene will be out of focus. Selecting **None** will leave the settings unchanged and will display all objects in focus.

If you use depth of field in your scene, the following options will let you define the effect more precisely. Depending on the settings, not all options may be available to you.

Sharpness

Defines the distance from the camera at which the picture will be perfectly sharp. Depending on the **Depth of Field** values, the sharpness will decrease towards the front or the rear.

Front/Rear Focus

Determines the distance from the camera to the front and to the rear of the scene where objects will become completely out of focus.

Note

The contrast of the greyscale depth channel is controlled by the sharpness settings of the camera. You will get optimum contrast if Front Focus is set to immediately before the first object of the scene and Rear Focus set to immediately after the last object. The easiest way to control these values is to interactively adjust the camera's handles in the editor (see below - Interactive control of the camera).

Note

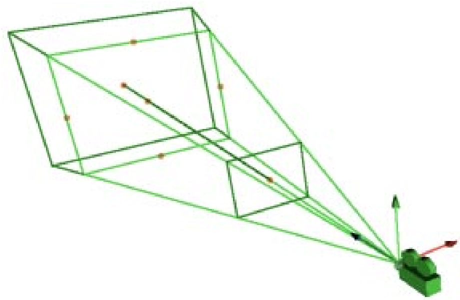
Remember that depth of field will appear less obvious at high resolutions.

Interactive control of the camera and its parameters

Cameras will be frequently used, so ease of use is important. To make things simple, you can adjust the camera parameters without having to open the dialog. Instead use the adjustable handles in the editor window. Follow this example to see how:

1. Create a new, empty document.
2. Create a camera object and set the Depth of Field Front and Rear values to 500 and 2000 respectively.
3. Now take a look at the camera object in the editor window.

Select the menu option **View > Frame Scene**. Zoom out until you can see the camera object completely. The camera symbol is now relatively small, similar to this illustration (you might want to switch to a 4T-view for a better view of the scene):



We will now describe the process in more detail.

A green line runs from the camera origin, ending in a single orange point. This is the target point of the camera. You can grab this point with the mouse, move it and align it to other objects, thereby rotating the camera around its origin.

At the same height as the target point there is a 4-sided plane with grab points. This is the focal length plane. At the center point of each side of this plane is an orange handle. These handles allow you to change the focal length interactively.

Switch to the 4-T view, activate the camera object and adjust the focal length. You can see the adjustments in real time in the editor.

There are two further, optional, planes that run parallel to the focal length plane, one in front and one at the back. These two planes (or just one of them) are only available if you select **Depth of Field**. At the center of each plane you will see another orange handle. Use this handle to shift the Depth of Field plane interactively along the Z-axis of the camera. Again, you can see these real time adjustments in the editor.

You may also adjust the focal range i.e. the area that is shown in focus.

By holding down the Shift key while dragging the handles you will see that the entire plane, rather than just the focal length, can be moved along the Z-axis.

As you see, interactive control of the camera is very easy.

As mentioned earlier, you may create as many cameras in CINEMA 4D as you wish. Bear in mind though that, for the actual rendering, the active camera is always used unless you switch cameras within an animation.

Moving between several camera views during an animation is explained in Stage Object, page 240. With the Stage object you have access to the controls of all cameras (and light sources, environment objects etc.).

Target Camera

A camera with a target is, in principle, no different from the camera described above. However, when you choose a target camera, an align-to-animation track is automatically created within the Time Line.

In addition, a target object - a null object, to which the camera is aligned - is created. As you would expect, everything is interactive; if you move the camera in the editor, it stays aligned to the target object and, conversely, if you move the target object, the camera follows it.

Light

General Information

Standard Lighting

When building a new scene in CINEMA 4D, a standard default light is automatically assigned to the scene's properties. This default light is positioned to the left of your initial perspective view.

Note

If you require your animation to fade out at its conclusion you may experience problems with the default light switching itself back on as your scene reaches total darkness. This happens when CINEMA 4D detects that you have no lights set to above 0%; it then obligingly adds a default light. To prevent this happening, switch off the Auto Light in the Render Settings > Options tab.

If you wish to change the default lighting setup for all future scenes, build a new scene that contains only the lights that you require for your default lighting and save this scene as 'new.c4d'. This setup will then be opened automatically each time you start a new CINEMA 4D scene.

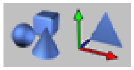
Note

All other CINEMA 4D scene/environment attributes (Sky, Floor, Environment etc.) can be added to your default scene setup in this way.

Displaying Lights In The Editor

The lighting within a scene can be easily previewed by turning on the Gouraud shading option. This option will update your lighting in real-time, even adjusting the lighting and updating your scene as you move the lights around.

If your scene is complicated and updates too slowly when moving your light with the Object Tool, adjust your light's position with the Model Tool icon.



the Object tool and the Model tool

Name your light in the Object Manager by double-clicking on its name.

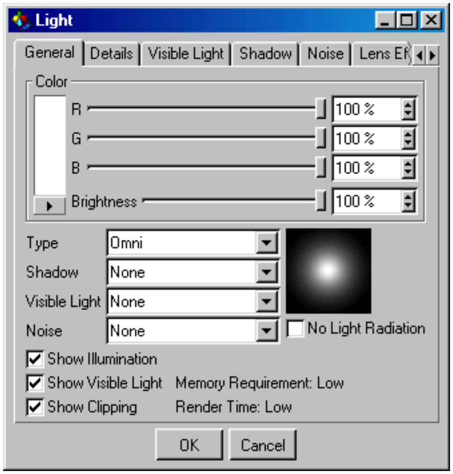
To change the properties of your light, double-click on its icon in the Object Manager.

This opens the light dialog.

The Light Dialog

This dialog provides the details of each light source in your scene.

General Tab



Many of the light attributes that you select here (such as **Noise**) have their own tab on which you can give more detail of the particular feature. We will give an overview of these features here; more detail can then be found in the section on the relevant tab, later in this chapter.

Color

You can adjust the color of each of your lights using the slider controls and the text input fields for each color element (R,G,B). You may change the color system (perhaps to HSV 0...255) using the popup menu below the color box.

The brightness of each light is independent of the light's color and can be controlled with the bottom slider (Brightness). By adjusting brightness values with the slider control you can simulate any type of light from the small glow of a candle to the extreme brightness of sunlight.

In most cases the maximum slider value of 100% will suffice, but in extreme cases a value of up to 1000% can be manually typed into the adjacent text field.

It is also possible to use the color sliders to achieve *negative lighting* effects, which is discussed in detail below.

Type

You may change the type of light with this selector. Detailed explanations of each light type are given later in this chapter.

Shadow

Using this selector you may choose to have various shadows generated by your light source, or no shadows at all. Detailed explanations of the different shadow types are given in the Shadow tab section of this chapter.

Select **None** if your light is to cast no shadow. This is a very helpful option in a scene with many lights, allowing you to turn on shadow-casting for the main lights only. Any real world photographer will envy you this option and its possibilities.

Visible Light

With this popup you can adjust the visibilty of the light in your rendered scene.

In nature, light normally becomes visible only if small particles such as dust, insects, smoke or fog are present in the air. For example, if a car headlight shines in fog, you will see its cone of light quite distinctly. Detailed explanations of these various types of visibility are given later, in the Visible Light section of this chapter.

Noise

With this option you can make your lights exhibit irregularities in the visible light or on the surface lit by the light.

Some sensational effects, such as animated fog or sun flares, can be achieved using this feature without needing to resort to the use of possibly time consuming volume shaders. Note though that lights with this noise effect do have a small price to pay in rendering time, as any light using the Noise feature is slower to calculate than those without.

No Light Radiation

If you need to see just the visible light and/or its lens effects without the light source actually casting light onto your objects, activate this option. Should you need your light sources for special effects (such as the particles emitted by a jet engine) check this box, otherwise your render times will rise.

Show Illumination

Selecting this option will show a wireframe approximation of the light's illumination range in the editor window. This range can then be adjusted by dragging the handles on the wireframe representation.

Show Visible Light

Selecting this option will show an approximation of the light's visible range, not to be confused with the aforementioned *illumination range*, in the editor window. It may become confusing if both indicators are turned on in the editor window. For this reason, this option is turned off by default. Again, this range can be interactively adjusted with its handles.

Show Clipping

Selecting this option shows an approximation of the selected light's clipping range (restriction of the light range - see later) in the editor window and can also be interactively adjusted with the wireframe's handles.

Memory

This indicator shows the amount of memory needed for the selected light sources in your scene.

Here is an overview of the memory requirements for light sources:

- Hard shadows/Area shadows need memory intensive raytracing calculations.

  As more objects are added to a reflection/ refraction dependent scene, additional memor y will be r equired.

- a Soft-shadowed visible light will need a Shadow Map of at least 250KB X-r esolution * 250KB Y-resolution

- Omni light sources require six times as much memory for their shadow maps.
- When used in combination with textured transparencies (Light Maps), up to twenty times more memory can be needed.

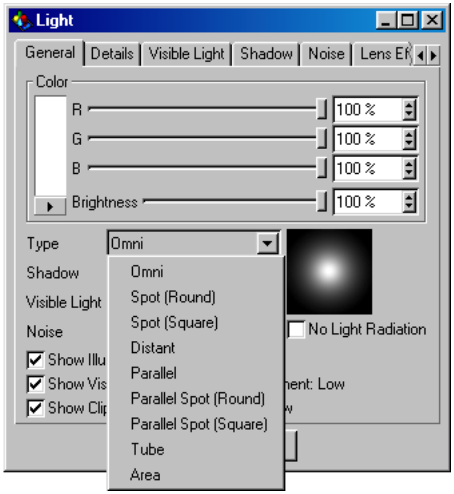
Render Time

This indicator gives an approximate render time for the selected light source.

Here is a short overview of lighting render times.

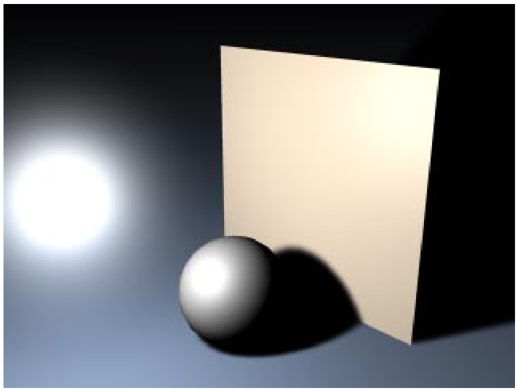
- Soft shadows are calculated much more quickly than Hard shadows, Hard shadows being much faster to calculate than Area shadows.
- Making a light visible in a rendered scene adds a negligible amount to its render time. Using a Volumetric light increases render time, sometimes substantially, in relation to the Sample Distance.
- Noise adds to render time, with Hard and Soft Turbulence requiring more calculations than basic Noise, while Wavy Turbulence roughly doubles rendering time over that of standard Noise.
- Using a high sample radius will increase the render time of soft shadows.
- Tube light and Area light sources also increase render time, although not to the same extent as the processor intensive Volumetric light.

Light Source Types



Omni

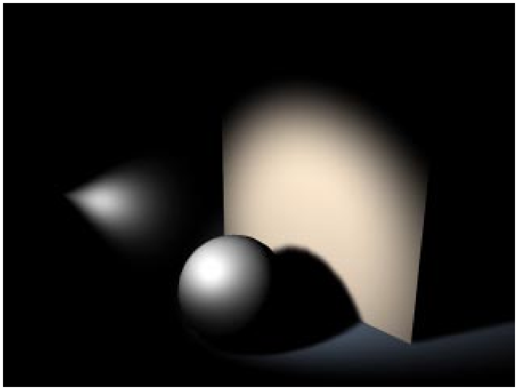
An Omni light source acts like a real life light bulb - casting its rays in all directions.



Placing an Omni light into the center of your scene will illuminate your scene evenly.

Spot (round/square)

Spotlights cast their rays in just one direction, which is along the Z axis by default. Once created, they can be easily moved and rotated to light individual objects and certain areas of a scene. The spotlight source can project a round or a square cone of light.

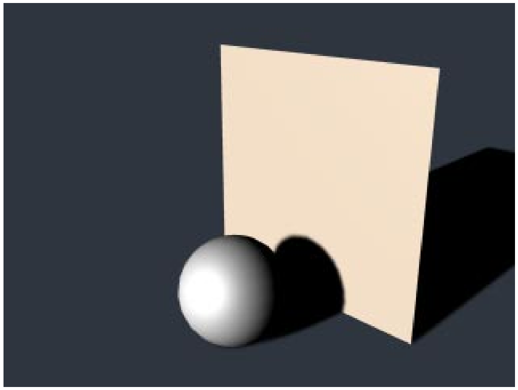


Square light cones are ideal for, amongst other things, the simulation of projectors which require a square picture to be cast onto a wall.

Some typical examples of round spotlights are car headlights, torches etc.

Distant

The Distant light type is so called because it mimics the light that is cast from an infinite distance. Using a Distant light would, for example, evenly illuminate the whole of a floor object in all directions.



Since a Distant light is infinite, the light has no actual origin. Thus the exact placing of a Distant light, near or far, has no effect on your scene's objects. Only the actual direction in which the light is facing is important with this light source.

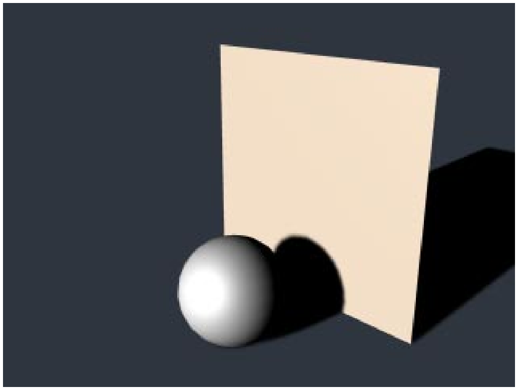
Distant light sources are very suitable for the simulation of sunlight.

Note

Owing to its characteristics, the distant light source itself cannot radiate visible light.

Parallel

Parallel lights resemble a very distant light source. Unlike the Distant light source however, the Parallel light has an origin and simulates a large, single axis *wall* of light.



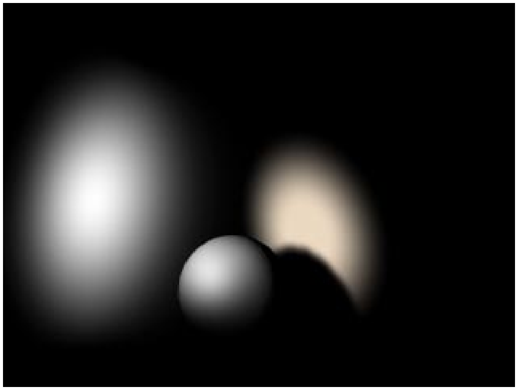
By default, all Parallel lights when created will radiate light rays along the Z-axis. These lights take the appearance of an infinitely large surface, radiating parallel light in a single direction; anything behind the point of origin will not be illuminated.

Note

Like the Distant light, Parallel lights cannot be rendered as a visible light.

Parallel spot (round/square)

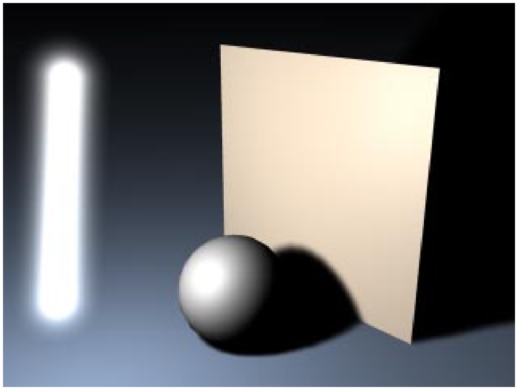
Parallel spotlights resemble the regular spotlight source object, but do not have light cones to define falloff or distance. Instead, light rays are cast along cylinders and/or bars.



The origin is important in defining which objects in a scene will be affected by this light. The radius of the spotlight can also be modified using the adjustment handles.

Tube

Tube lights do not have an exact point of origin, but a linear one. The Tube light is represented by a line, from which light is radiated in all directions. When used as a Visible light, this is a very quick and easy way to make neon tubes.



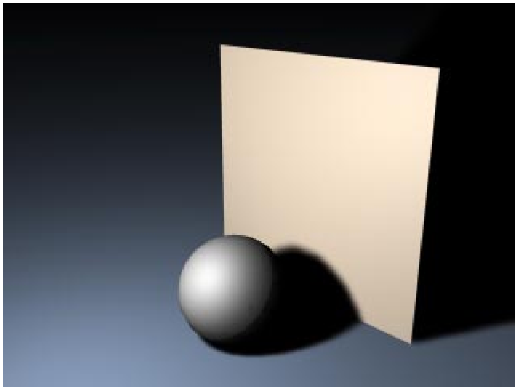
A classic example of the use of the Tube light is of course the laser sword.

Quick tip

Tube lights are a great way to produce long-drawn-out specular highlights.

Area

The light rays from an Area light expand from its origin outwards in all directions. A rectangular computer screen is a good example of such a light.



The resultant lighting and specular effects are somewhat different from those of an Omni light. Specular highlights are more angular and the surface illumination is richer. The closer the light source is to the object, the more apparent this becomes.

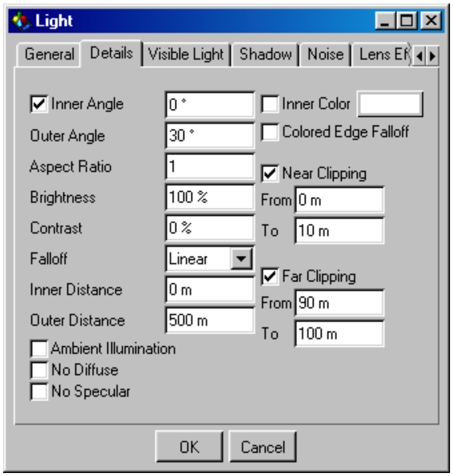
However, an Area light with a small radius that is placed far away in a scene will hardly seem to differ from an Omni light source.

An example lighting scene for area light sources can be found at the end of this chapter - Radiosity effects with area light sources.

Note

As with the Distant and Parallel lights, an Area light cannot be rendered as a visible light source.

Details Tab



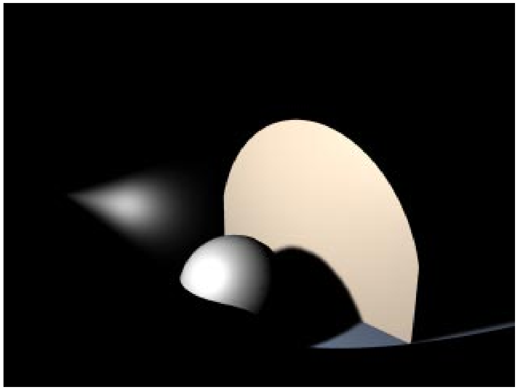
Using the Details tab, you can access the individual properties of each of your light sources.

Inner Angle

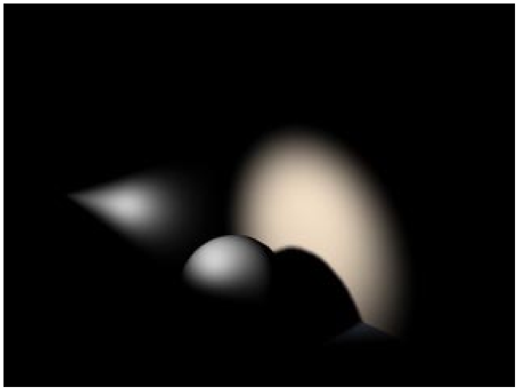
Depending on the type of light you use, this will adjust either the Inner Angle (for a standard Spotlight) or the Inner Radius (for a Parallel Spotlight) of the light.

Within the Inner Angle area, the luminosity value of the light source is 100%. From the Inner to the Outer Angle the luminosity value falls from 100% to 0%.

If you switch off the **Inner Angle**, the luminosity of the light source in the entire light cone amounts to 100%, resulting in a hard cone of light; the following picture shows this.



If the **Inner Angle** has a value of 0, the light source will have a soft transition spreading from the center of the light to the light's edge, as shown below.



Outer Angle

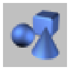
Adjusting this value will define how large the light will be in total. The **Outer Angle** value indicates the limits of the light source's luminosity.

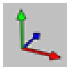
Aspect Ratio

This option allows you to stretch and shear the shape of the light's cone angle. The standard aspect ratio value is 1; increasing the value, for example, to 2 will double the light cone's height relative to its width. Similarly, decreasing the value to 0.5 will make the light cone only half as high as it is wide.

Note

This effect can also be achieved by scaling the axes of the light source using the Object tool and/or the Object Axis tool.

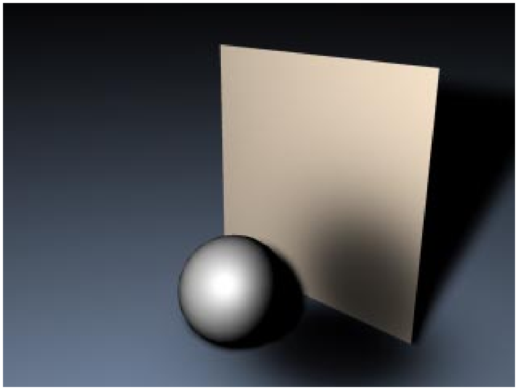
 Object Tool

 Object Axis Tool

Brightness

This value controls the overall brightness of the light source.

While this control may be seen as just a way of brightening/dimming your light source, it's also capable of another interesting, and very useful, effect. Using a negative value with this option results in *negative lighting*. The color of your light source (set in the General tab) is important here. That color will not be added to the scene where a negative light source is in effect. With this technique you can artificially darken and shade specific areas of your scene.



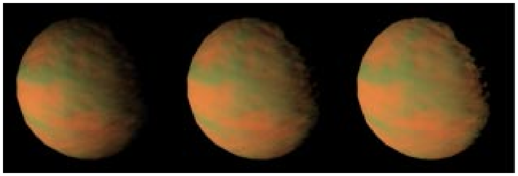
This type of lighting works even better when used with carefully constructed environment lighting and falloff ranges. A good understanding of environment lighting is needed for this and this is covered later in this chapter.

Contrast

The intensity of a light source on an object is not dependent on the distance of the light from the object (unless you explicitly adjust its falloff), but rather on the angle at which its rays hit the object.

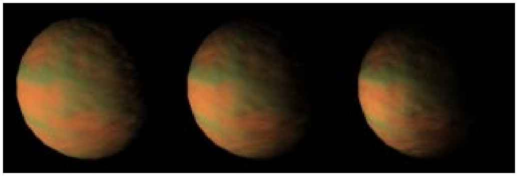
If a ray hits a surface at an angle of 90°, the surface is illuminated with the light's maximum intensity (taking any falloff into account). As this angle (called the *angle of incidence*) decreases, the strength of the illumination decreases as well. Therefore, in an average scene, a soft transition is normally seen on any lit surfaces. The **Contrast** value controls this transition.

In the illustration you can see a series of pictures of a planet, towards which a light is directed. You can easily see how little the planet's front and sides are lit using 0% contrast. The transition on this lit surface is not very soft; this surface contrast is not natural for planets. If you look at photographs of a planet you will see that the transition of its lit surface to its shadowed edge is hard - as illustrated further to the right in the series of pictures.



With the contrast control you can adjust how soft or hard you wish the lit surface transition to be.

If you need a special overly-soft look to your objects you may even enter negative values, here's an example:



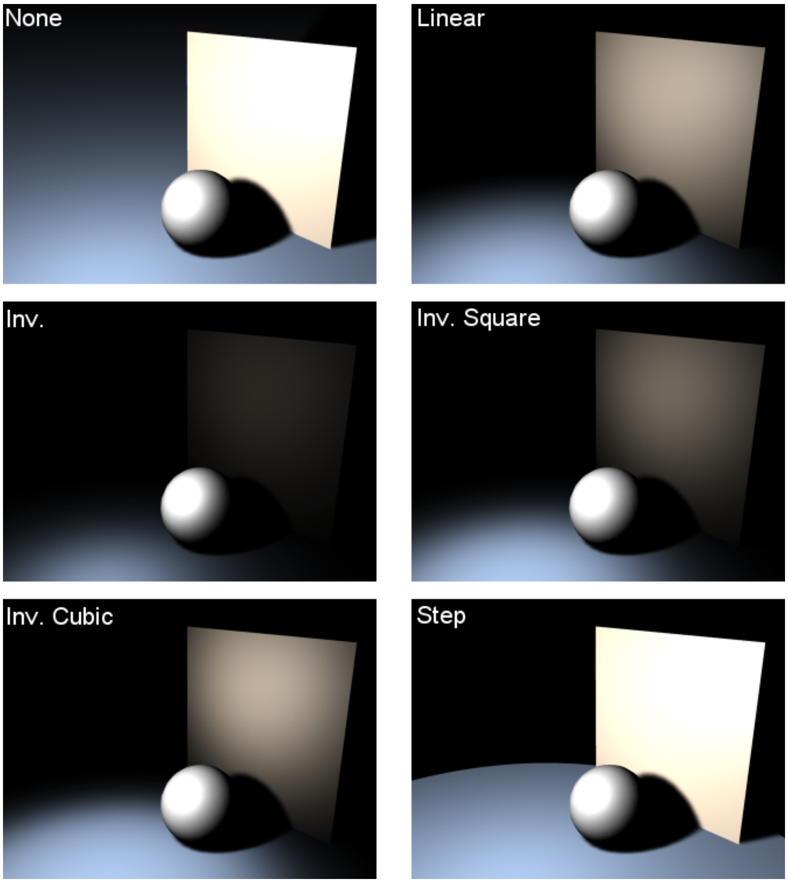
Inner Color

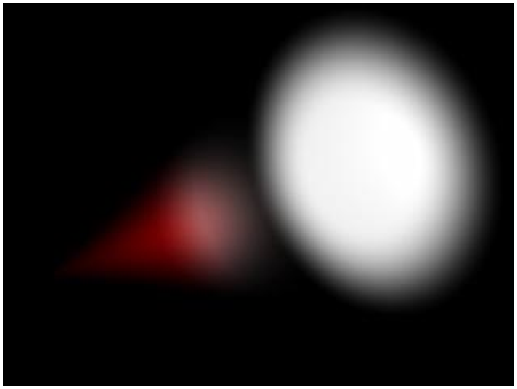
Independently of the light source's color, which was assigned in the General tab, you may assign another color to the internal range of the light.

When used, this Inner Color is the *core* color of the light source. Starting at 100% of its value, the Inner Color spreads outwards and gradually changes into the light source's General color. For the Inner Color to be used, the Falloff function (see below) must be activated.

The Inner Distance of the Fallof determines the expansion of the Inner Color. Click on the color chooser to select the color properties of your internal color.

In this illustration the light source is yellow and the Inner Color is red. The light shows a gradual progress of color change from red to yellow.

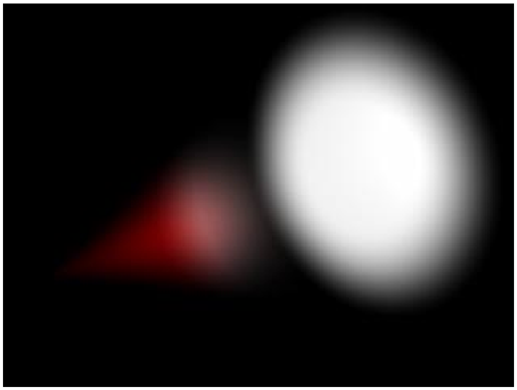




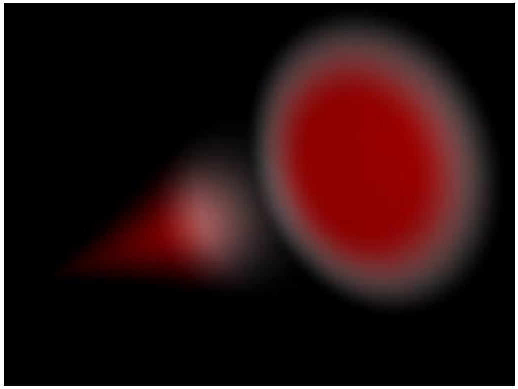
Colored Edge Falloff

This option is only available when using a spotlight with an **Inner Color** option selected. The normal behaviour of the inner color is to spread in a linear direction along only the Z-axis of the spotlight, from its origin to the light source's color (selected in the General tab).

If you select **Colored Edge Falloff**, however, the Inner Color will also radiate outwards from the Inner Angle through to the light source's general color.



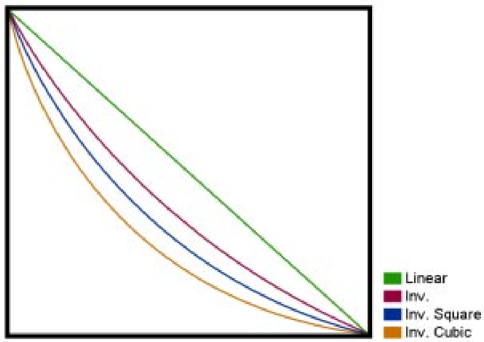
In this picture Colored Edge Falloff is deactivated.



Here Colored Edge Falloff is on – you can see the inner color in the center of the light cone.

Falloff

A normal virtual light source will illuminate its surrounding environment with a continuous, linear brightness. However, this is not how all lights work in reality; real light sources will have their luminosity absorbed. Just as in nature, CINEMA 4D light sources are able to have their luminosity reduced over any distance. To achieve this, several falloff functions are available and are displayed in the following table.



Inner Distance

Within the Inner Distance there is no falloff. Up to this point, the brightness of the light remains constant. Outside of this boundary is where the Inner Distance Falloff begins.

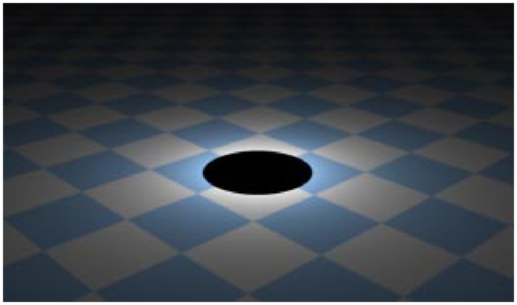
Outer Distance

The range between the Inner Distance and the Outer Distance is where the brightness of the source light changes from 100% to 0%. This **Outer Distance** value indicates the maximum range that will be illuminated by the source light.

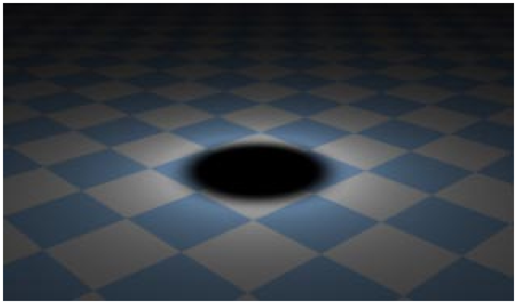
Near Clipping

You can use clipping to restrict the illumination and visible light (if present) radially with an Omni light and linearly with all other light types. This means your light source does not have to radiate light from its origin; the radiation may begin, for example, five meters from the light source's origin.

The two values used for this effect are **From** and **To** and signify, in metres, the distance for the clipping effect. The larger the difference in the two values, the softer the transition.



From = 90, To = 90



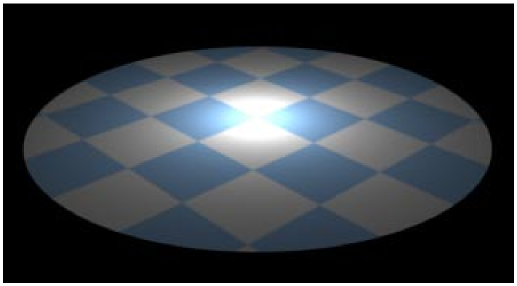
From = 90, To = 150

An example:

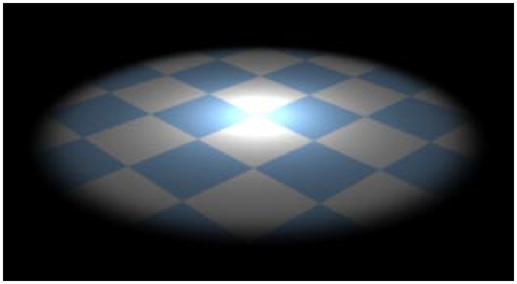
If values of 10m and 50m are used in the two fields, it means that there will be no illumination from the light source between 0 and 10 meters; from 10 metres the luminosity begins, reaching full luminosity at 50 metres.

Far Clipping

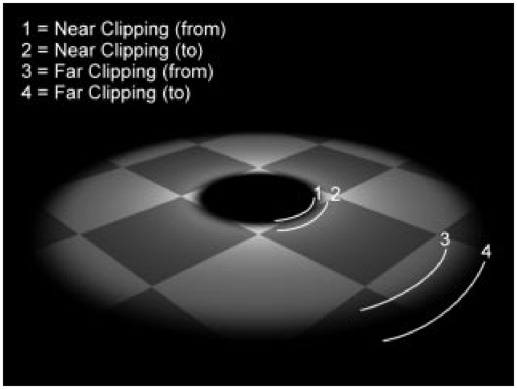
Far Clipping can be used to cut off your light source's illumination abruptly. To use Far Clipping, once again two values are needed. This time the **From** and **To** values denote where the cut off begins, and where the light source will fully vanish. Again, the larger the difference between these two values, the softer the transition. Examples of clipping with point and spotlights are shown below.



From = 300, To = 300



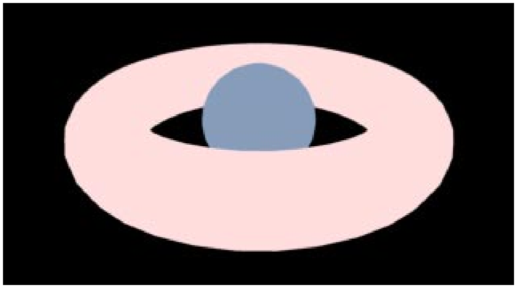
From = 220, To = 300



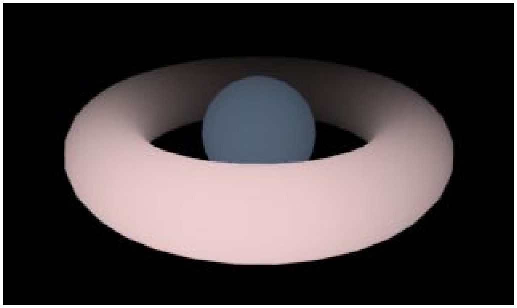
Schematic Display of the individual clipping ranges using the example of an Omni light source

Ambient Illumination

Normally the brightness of a surface is determined by the angle at which a ray of light hits it. The greater the angle between the ray and a tangent to the surface, the more the surface will be lit by the light. When **Ambient Illumination** is switched on, however, this physical law is waived. Here the angle does not matter. All surfaces are lit with the same intensity. Thus a much *flatter* look results. Only the material color is considered in the lighting calculations.



In this example picture, the light's **Falloff** was also activated.



With both **Ambient Illumination** and **Falloff** activated for the light source, you can lighten certain regions of your scene in a similar way to how you darken them with Negative Lighting, explained earlier.

No Diffuse

When **No Diffuse** is selected, the color properties of an object are ignored by the light source; only specular surfacing is produced by the light. This can be useful for some objects e.g. a golden signature, where you would like some specular glints, but no lightening of the color properties.

Writing with No Diffuse off

Writing with No Diffuse on

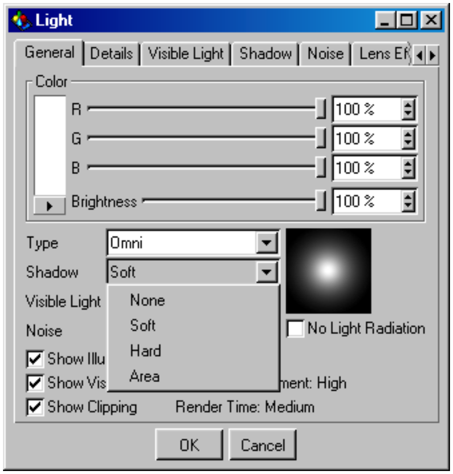
No Specular

When this option is selected, the light source produces no specular highlights on your scene's objects. Imagine you have a wineglass on a table with two or more light sources in the scene. Your wine glass may then show too many specular highlights, with the glass material looking too busy. To avoid this, turn on **No Specular** for some of your light sources.

This bottle is lit by two light sources, causing several highlights to develop.

In this picture, the **No Specular** option is activated for one of the light sources.

Shadow Types

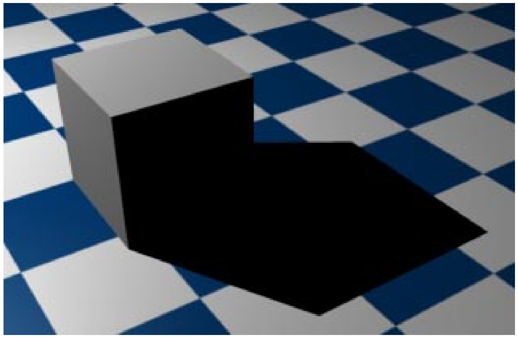


You can combine all light source types with all shadow types in CINEMA 4D. For example an area light can cast not only area shadows, but hard shadows as well. And a parallel light can easily cast soft shadows.

There are no restrictions to this mixing of lights and shadows, since the shadow is computed independently of the light source.

Hard shadow

Traditionally in raytracers, genuinely raytraced scenes contained hard shadows. As this technique needed to compute many more additional rays, this method increases the render time dramatically. Hard shadows, because of their abrupt, sharp appearance, are of particular interest for technical illustrations. However, in other more natural pictures they look rather unrealistic because such hard, sharp shadow borders are rarely found in real world environments.

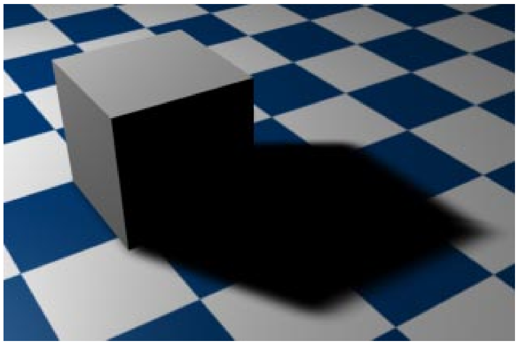


Soft shadow

In reality all objects - whether they are trees growing in the wild, or a vase in a room - are lit by several partial light sources. The result of this is a gradual transition of light to shadow.

This soft edge, or *umbra*, can be simulated in CINEMA 4D by using a so-called shadow map, the Soft shadow. A shadow map is a gray scale picture of the scene seen from the view of the light source. Contained in this are all the objects lit by the light source.

During the render calculation the renderer will determine exactly which objects will fall into this shadow of the light source.



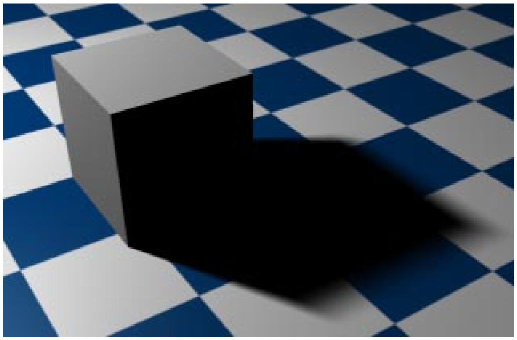
The major advantage of this method is the high computing speed and the soft shadow's natural appearance.

However, the one downside to soft shadows is the memory needed. Depending on the size of the shadow map, a great deal of additional memory may be needed. So be careful in your allocation of shadow maps or you may find your scenes wasting precious memory.

Area

Although Soft shadows are more natural than Hard shadows, they are still not perfectly natural. On careful examination you can see that the soft edge always has the same width.

In nature this does not happen; the nearer an object is to a surface on which it casts its shadows, the sharper this edge will be. Area shadows simulate this effect perfectly.



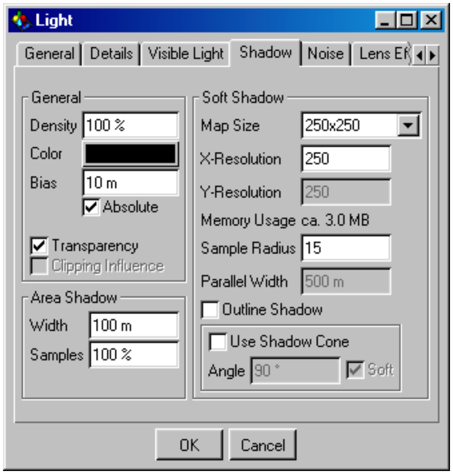
Take a look at the above illustration. Where the shadow borders on the sphere, it has a very hard look. As the shadow falls away from the sphere it becomes softer.

How does this work? Quite simply really; CINEMA 4D calculates the shadow at the origin of the light source outwards (for all lights, whether Omni, Spot or area). Only a hard shadow is computed at this point. The softer Area shadow is the result of a *virtual* Area light source, which simulates the overlay of several light sources. This provides the natural scattering of light.

However, as usual, this method comes with a price; high render times. The result, in many cases, does not justify the high render time, since the Soft shadow will often be sufficient. Carefully assigned Area shadows, however, can produce very impressive effects.

An example of a realistic shadow

Shadow Tab



This attributes tab is used for the fine-tuning of your scene's shadow maps.

Density

Adjusting this value will vary the intensity of your shadow. A value of 100% means the shadow has full intensity. With 50% your shadow will be half transparent, and at 0% the shadow is invisible.

Color

Here you can change the shadow's color. You may be asking yourself why you would ever need to do this. With a little thought, however, you may realise that in nature a shadow is hardly ever truly jet black. Coloring your shadow with a shade of brown, for example, could give a particular scene some natural, extra warmth.

Bias

Because of the particular principle involved in the calculation of shadow maps (shadows do not begin at the object's origin), you may at times find the need to adjust the shadow's position using the **Bias** value. Usually a value of 1m will suffice for most scenes. However, sometimes an adjustment may be necessary.

When zooming the camera in on extremely small objects, this distance between object and shadow will become apparent (see illustration 1). Entering a lower value can correct this error (see illustration 2). You may also at times have too small a **Bias** value (e.g. with very large objects), which can result in the object casting the shadow on to itself (see illustration 3). In a case like this, set the **Bias** value somewhat higher.

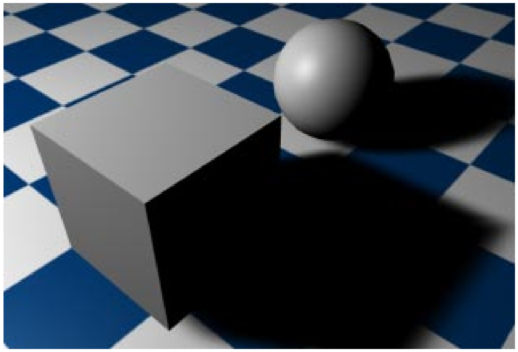


Illustration 1

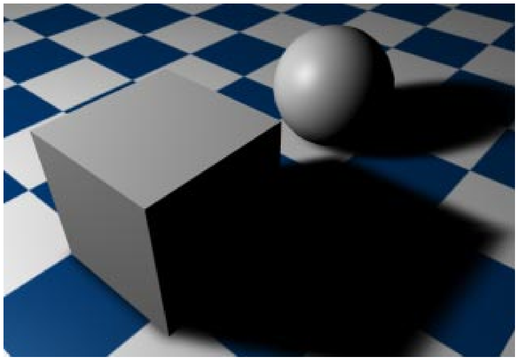


Illustration 2

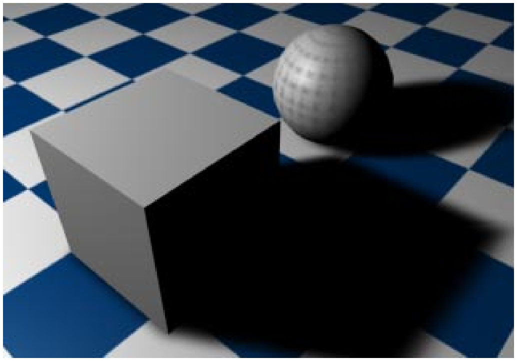


Illustration 3

Note

The smaller an object is and the more you zoom in on it with the camera, the smaller the Bias value must be set. This ensures no gap between object and shadow is visible. If the object is excessively large and unwanted self-shadowing occurs, raise the Bias value. Generally speaking, a value of 1m is adequate for all objects up to a size of 10000m.

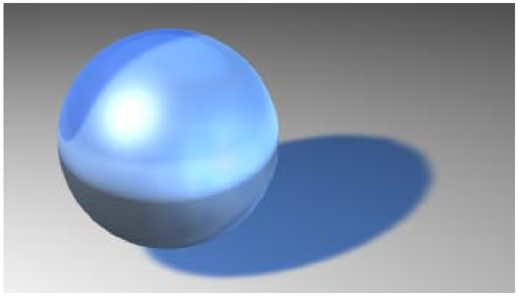
Absolute

You should leave this option activated. If you switch it off, the distance of the shadow from the object depends also on the distance of the light source from the object – so-called *relative bias*.

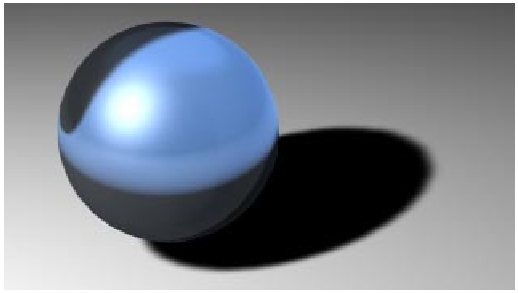
With relative bias, the further the light source is from the object, the further the shadow will be from the object. This behavior originated in version 5.x of CINEMA 4D and is present for backward compatibility (i.e. for the loading of old scenes).

Transparency

If you need your shadow maps to consider the transparent (or genlocking) properties of your objects, you should switch this option on. When activated, your shadows will take into account the transparent surfaces of your objects and render your shadows with the correct transparency. Transparencies can also be computed with all other shadow types.



The Transparency option is on



The Transparency option is off

Note

The calculation of transparent soft shadows uses lots of memory.

An Omni light source can sometimes use six times as much memory as a spotlight, as six shadow map calculations must be computed compared to the spotlight's single shadow map.

Clipping Influence

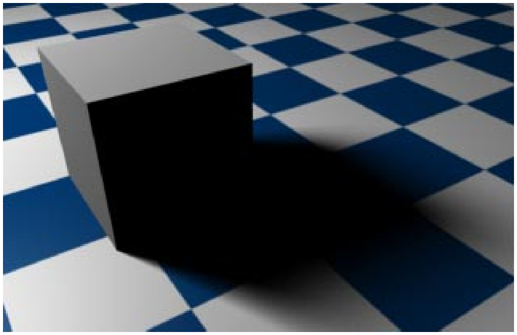
If you select this option, the clipping settings on the Details tab will be applied to shadow-casting as well.

Area Shadow

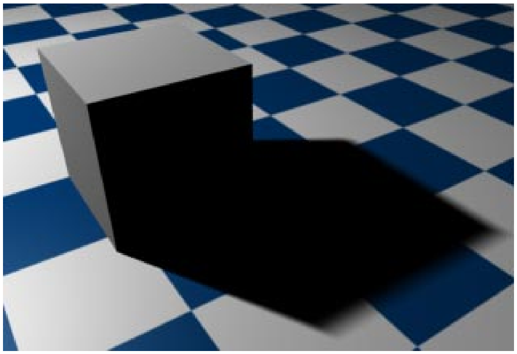
This value will set the parameter range for your Area shadow.

Width

As described above, the area shadow is produced by a *virtual* Area light source (independently of the actual light source). This **Width** value indicates the size of this surface. The larger you make this value, the more the light is scattered and the softer the shadow becomes. However, as the value is increased, so is the render time, sometimes substantially.



With large radius (300 m)



With small radius (50 m)

Samples

If you lower this value, the quality of the area shadow is reduced, but it is calculated more quickly.

Soft Shadow

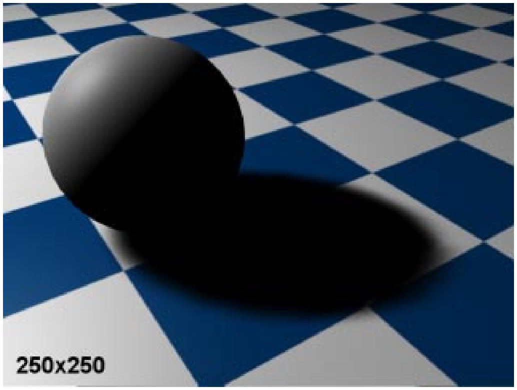
Use this for the finer details of your soft shadows.

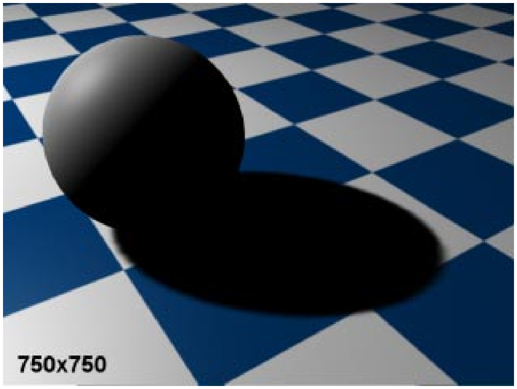
Map Size

When using soft shadows, CINEMA 4D initially *sees* the scene from the point of view of the light source and calculates the complete scene from this view. All objects *seen* in this view are interpreted as shadows for the scene. This results in Shadow Maps.

Map Size assigns memory for each shadow map. The smaller the memory assignment, the more pixelated the shadow will appear. This can result in a shadow map with a jagged, staircase-like appearance at its edges. The more memory used for the Map Size, the smoother the shadow and its edges, but the higher the memory usage.

By default, a standard size of 250x250 is used for Map Size. Shadow map size can increase to 1000x1000 if needed, but such extreme usage is rare and not recommended.





You can clearly see that, in order to keep your shadow sharp and smoothly defined, your shadow map will need to increase in size.

If you simply need to keep your shadow edge soft, you can increase the **Sample Radius** (see below). Again, this will increase render time.

Note

Rather than use a map with a doubled Map Size, you can achieve an equivalent soft edge by doubling the Sample Radius.

Sometimes when you have a small shadow map created by a very distant light source, a problem may appear with spherical objects casting rectangular shadows.

You can check this by viewing the scene through your light source. A light source, like any other scene object, can be defined as a camera view. To do this make sure your light source is selected and go to the **Function** menu of the object editor and select **Attach Camera**, or in the main editor window select **View > Attach Camera** or select the appropriate icon in the tool bar.

X-resolution

If the pre-set value of the map size is not giving you the desired result, you may optionally adjust the X-resolution manually. In general it is standard to set the manual X-resolution (width) to the same value as the Y-resolution (height)

Y-resolution

With a spotlight source, you can also provide a non-square shadow map by manually entering a value for the Y-resolution.

Memory Usage

CINEMA 4D automatically calculates the maximum memory use for the shadow map, which is shown here. This can help you in estimating exactly how much memory will be allocated for your light sources shadow map calculations in your scene.

Sample Radius

The sample radius determines the accuracy of the shadow map. The higher the sample radius, the more accurate the shadow is, at the expense of a higher render time. If, for some reason, you must use a small shadow map, selecting a higher **Sample Radius** value will improve the shadow quality. So you can trade off render time against memory usage.

Parallel Width

This setting will only be active for Distant and/or Parallel lights.

Here we meet a visible light setting known as a *light cube* (more accurately, a *light cuboid*). This light cube has its length/width dimensions set to the **Parallel Width** value, the depth (z-axis) of the light cube being infinite. Importantly, only objects within this cube can cast shadows.

This boundary for shadow-casting is a necessity since the scope of parallel/distant light sources is infinite. This value cannot dynamically adapt to your scene, as it is possible for other objects to *jump* into the shadow-casting area during an animation. Therefore, a fixed value is used, which is entered here.

Explanation

With soft shadows you can change the size of the shadow map. The lower this value, the more pixelated the shadow becomes. If the Parallel light cube boundary had a dynamic value, these pixels would appear to jump, since the shadow map would likewise vary dynamically in its size. In order to prevent this, a fixed value is used, and any such shadow jumps are eliminated.

Outline Shadow

Using this option will result in your shadow being seen as just a thin outline, instead of a full, darkened surface.

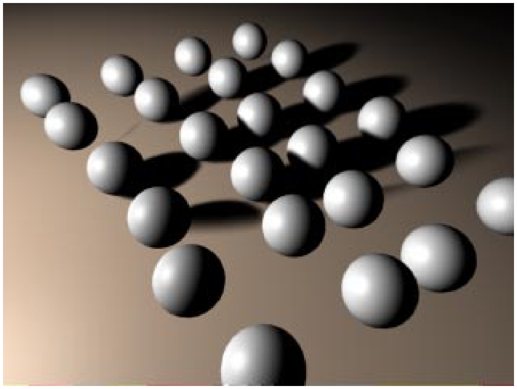
Note

With this option, it is recommended you use higher values for the shadow maps resolution and sample radius.

Use Shadow Cone

One of the main problems with Omni light sources is that six shadow maps must be computed in total, which can sometimes produce small artifacts at the shadow's edges. If the **Use Shadow Cone** option is activated, the shadow production is limited to a cone, thus generating s single (and artifactless) shadow map.

Additionally, producing these shadow maps only where necessary will result in the saving of lots of render time.



Soft

Activating this option will give the shadow cone a softer edge.

This option is used to ensure that any object which is only partially in the shadow cone area casts a soft, fading shadow.

Angle

This value changes the vertex angle of the Shadow Cone.

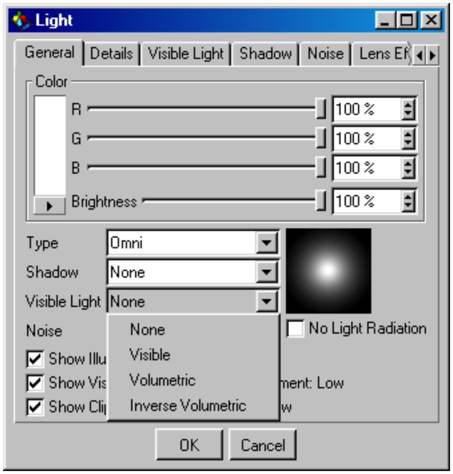
Types Of Visible Light

In CINEMA 4D all light sources and/or the light cone emitted can be made visible. This kind of effect can be seen for instance in a smoky room.

This effect is comparable to fog, which does not diminish light, but rather adds to its brightness.

With Visible Light you can produce the most stunning computer graphic effects. Headlights, glowing and shimmering lights, laser beams and atmospheric effects to name just a few.

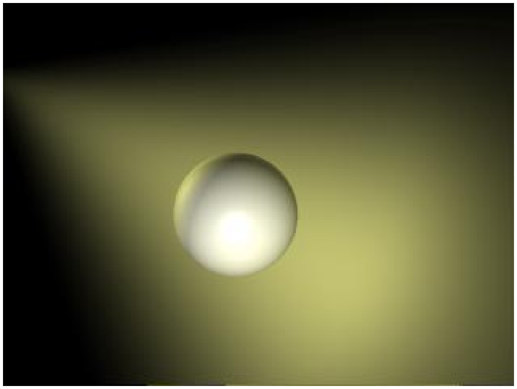
There follows a description of the various types of visible light, available from the Visible Light popup in the General tab.



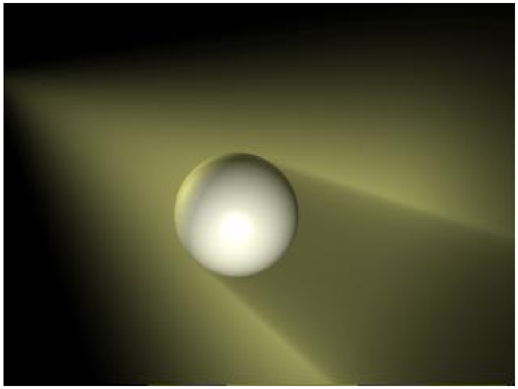
Visible

If the **Show Visible Light** option is activated (General tab), then the light source can penetrate all those atmospheric-like particles that are within the Visible Light's illumination area. So for example a visible light could be placed in the center of a planet's sphere to simulate an atmosphere.

The Visible Light option is of great importance to the particle system. Visible Lights (with **No Light Radiation** activated) lend themselves to a huge range of possible effects, e.g. nebula clouds, smoke, comet tails, fires and much more. You can learn more about these effects in Particle System on page 244.



A simple example of visible light



This is volumetric visible light; shadows can be cast within the light cone

Volumetric

If you have already played with the visible light settings, you will realise that a visible light pays no attention to objects which lie in its cone of light. The light rays penetrate objects unhindered, casting no shadow in the light's beam.

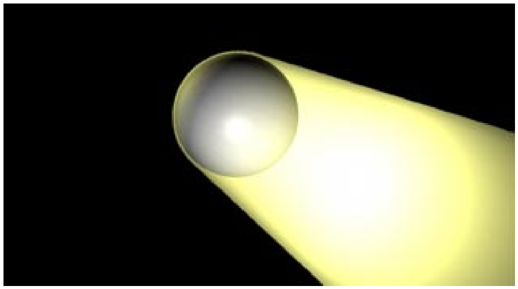
In order for a shadow to be cast by a visible light, Volumetric lighting must be added. **Visible Light > Volumetric** therefore must be selected in the General tab.

The parameters for the visible Volumetric light are taken from the light source's shadow map values; X-resolution, Y-resolution, Parallel Width and the Sample Radius. The algorithm for Volumetric light is based on the shadow map and needs these parameters. (These shadow map parameters are covered in more detail earlier in this chapter.)

Inverse Volumetric

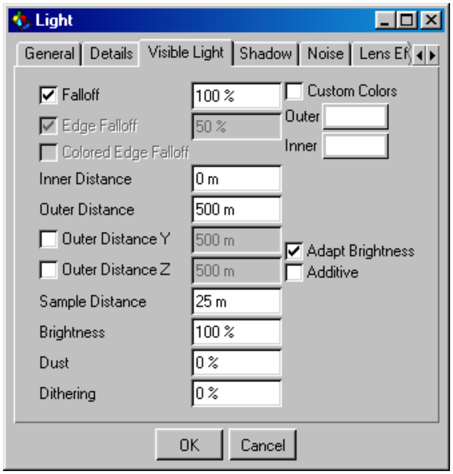
Using the Inverse Volumetric function has the interesting effect of inverting your volumetric light - that is, the light is visible where the light cone would normally be in shadow.

An explanation is in order. Imagine a company logo, behind which you have placed an Inverse Volumetric light source. This inverts the light's volumetric effect, giving the impression that the light is radiating from the logo itself. Using this feature, very interesting logo animations can be produced.



With inverse volumetric lighting, the light appears to emanate from the object

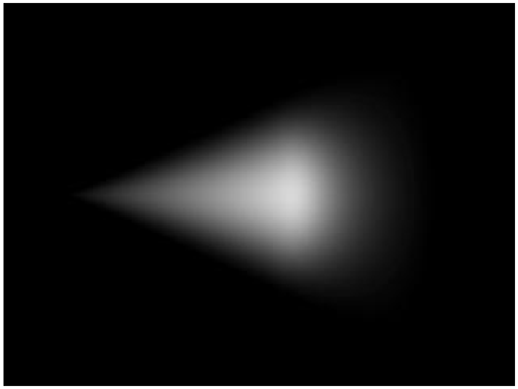
Visible Light Tab



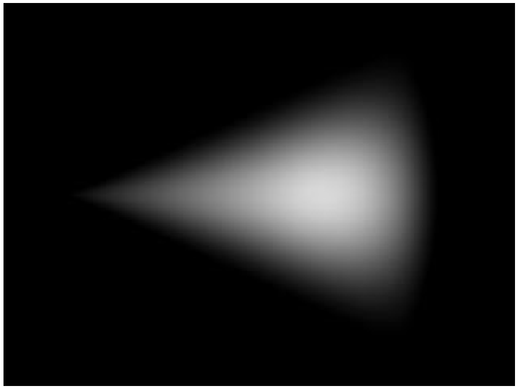
Falloff

This is the percentage reduction in the light's density. The axial falloff of the visible light is set to a standard 100%.

This means that from the origin of the light to its outer distance, the density of the visible light falls from 100% to 0%. So, if a value of 10% is entered, the outside edge will be at 90% visibility.



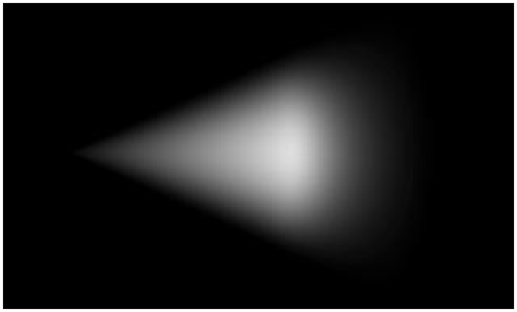
100% Falloff



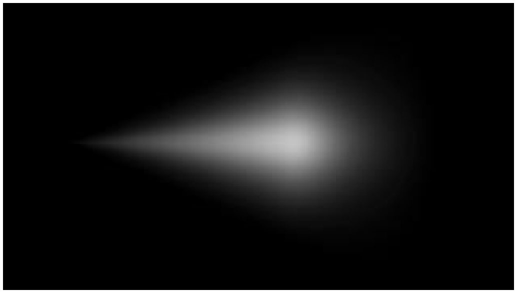
0% Falloff

Edge Falloff

Edge falloff is relevant only with Spotlight sources. The Edge Falloff determines how quickly the light's density decreases towards the edge of the light cone. If you enter a value of 0% (or leave the field inactive), you will produce a very hard visible light. A value of 100% gives a more gradual falloff from the inside of the light cone to its outer edge, until it reaches 0%.



0 % Edge Falloff



100 % Edge Falloff

Custom Colors

With this option you can assign your own colors to the visible light - independently of the actual color of the light source (General tab) and the inner color (Details tab).

Outer

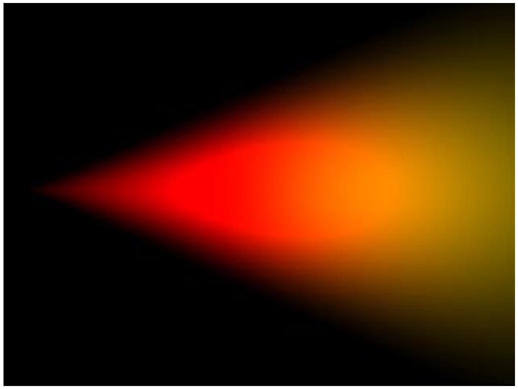
Use the color selector to define your light's outer color edge.

Inner

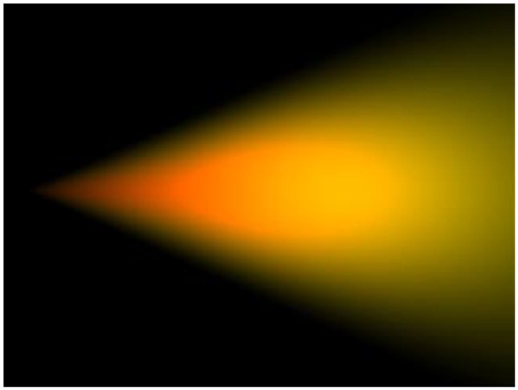
Use the color selector to define your light's inner color edge.

Colored Edge Falloff

This option is only available with Spotlight sources and works with your selected Custom Colors. Normally the Inner Color behaves in such a way that it travels along the Z-axis of the Spotlight source linearly to the Outer Color. However, selecting **Colored Edge Falloff** will cause the Inner Color to also spread outwards radially from the Inner Angle to meet the Outer Color.



In this picture Colored Edge Falloff is off



Here Colored Edge Falloff is on – you can see the inner color within the light cone

Inner Distance

Within this value, the density of the visible light is always a constant 100%. The falloff begins only outside of this distance.

Outer Distance

Between the Inner Distance and the Outer Distance the density of the visible light changes from 100% to 0%. This value thus gives the maximum visible range of the visible light.

Outer Distance Y

When using Omni light sources, you have the ability to set the falloff distance for both Y and Z axes. This option sets the distance of light falloff for the Y axis (or height).

Outer Distance Z

This option sets the value for the Omni light's falloff along the Z-axis (or width).

Sample Distance

The Sample Distance is only relevant for visible volumetric lights.

Adjusting this value defines how finely the visible light's volumetric shadow will be computed. Larger values lead to a somewhat rough (but swift) calculation, while smaller values lead to a much finer, but more time-consuming, result.

The value of this Sample Distance is measured in world units. This value thus determines how finely the shadows within a visible light will be sampled. Values will usually be from 1/10th to 1/1000th of the light source radius. By increasing the value your scene will render noticeably quicker but certain parts of your scene will be sampled very roughly, resulting in sampling artifacts. To reduce these sampling artifacts requires a reduction in your sampling value too. The smaller the value, however, the higher the cost in rendering time.

CINEMA 4D contains an integrated antialiasing technique for surface shine, ensuring even the roughest surfaces render smoothly, allowing you to set the **Sample Distance** value somewhat higher than without this feature.

General tips

If you wish to produce fine shafts of light, like that of light beams radiating through cracks or from behind stone columns, you need to set your sample distance relatively small. On the other hand, a light that is completely covered and allows no beams of light to break through may be sampled at a much higher value.

To clarify this, let us use a small example; the pumpkin in the picture has a radius of 150 units, the visible volumetric light a radius (outer distance) of 700 units.

above left
Sample Distance: 10 units
Render time: 105s
The pumpkin looks perfect.

above right
Sample Distance: 20 units
Render time: 60s
Here the rays emitting from the mouth and the right eye are showing the first signs of artifacts.

bottom left
Sample Distance: 40 units
Render time: 35s
You can clearly see now how the rays in the visible light are losing their fine edges.

bottom right
Sample Distance: 80 units
Render time: 23s
Forget it! The picture has been wrecked by artefacts.

So why is volumetric lighting so time-consuming for the renderer?

When a beam hits a light cone, it is not only the intensity of the light that needs to be computed. Additionally, for each part of the beam, the program needs to check for other objects within the light cone that might be casting shadows. So for every part of the beam of light, an extra raytracer ray needs to be initiated and emitted.

But as it is not possible to shrink segments in the fog below a certain length, an approximation has to be used; the length of the light cone is subdivided into equal parts.

Let’s say the raytracer ray hits the light cone and the distance between the entry and the exit points of the light cone is 1,000 units. So a sample distance of 50 units will mean that an intensity value and a shadow beam will have to be calculated 20 times (1000 divided by 50).

The shorter the sample distance, the longer the calculation is going to take. Even if you have only five subdivisions (so a sample distance of 200 in the above example) this will require a five-fold increase per raytracer ray and per contact with the light cone than without volumetric lighting. Using progressively finer subdivisions, the processing time involved will very quickly become astronomical.

Alas, this is an inherent problem with computer graphics which cannot be resolved or accelerated other than by throwing processor power at it.

So why can’t you input a fixed value for the number of samples?

Well, if the raytracer beam hits the light cone at its beginning, the distance between the entry and exit points might be, for example, 100 units. But if the beam hits the cone further from the light source, this distance might grow to

5,000 units or more. So if you used a fixed number of samples, at the narrow end of the cone a lot of unnecessary calculations would be made and later too few (which would result in ugly artefacts).

Tips

Volumetric lighting needs a lot of calculation time, therefore render such light sources only when it is absolutely necessary. If you choose to use a volumetric light as a particle (which is perfectly possible), then perhaps you should consider buying a second computer which you can leave to render that scene over a period of days.

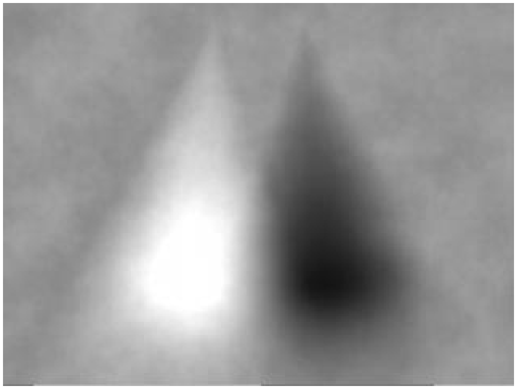
Most importantly, take care with your Sample Distance values. Finding a happy medium (small for fine detail, but as large as possible for reducing render time) is the key here.

Brightness

This value gives the brightness of the visible light source.

Dust

With this option you can determine the *darkness* of the light cone. With a **Dust** value of more than 0% Brightness is not added, but subtracted. To make sure you see the full effect of this, lower your light's brightness accordingly. The difference between a normal bright light and a dust-assigned light can be clearly seen in the following illustration. To the left is a bright, visible light. To the right a dark, dusty, somewhat sooty light.



In principle an accumulation of dust can be used in conjunction with particles for some amazing simulations of fire and smoke. More details on this can be found on page 244, Particle System.

Dithering

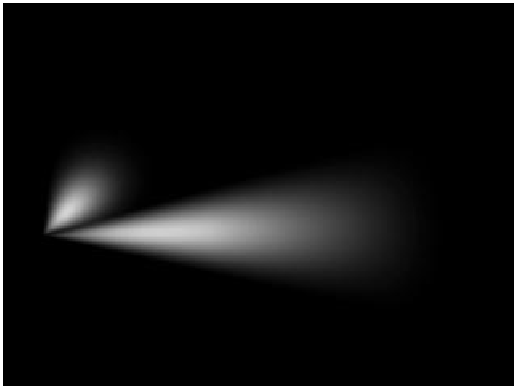
This produces irregularities in the visible light which, in certain cases, can help prevent unwanted *banding* (or *contouring*) in the visible light source.

Explanation

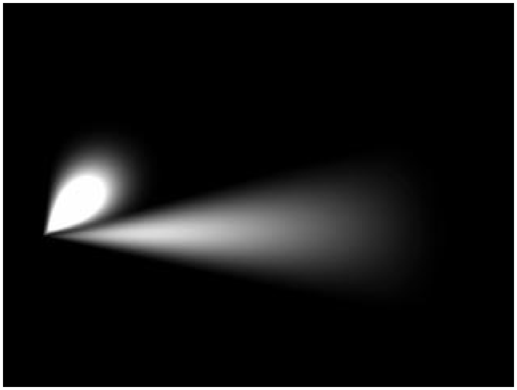
With certain light source combinations (e.g visible lights that overlap), you may find that the 24-bit picture depth of your output device is insufficient and it may display color gradients in large steps. This display problem is known as banding or contouring. To avoid this problem use the Dithering option to give your visible light a certain irregularity and help to smooth the color graduations.

Adapt Brightness

This option prevents a light beam from being over-exposed. The brightness is reduced until the over-exposed effect disappears.



Adapt Brightness off



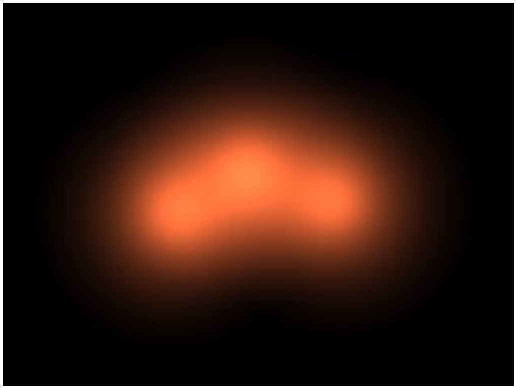
Adapt Brightness on

Additive

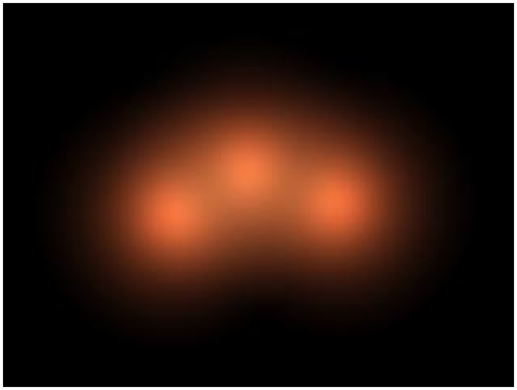
Select this option if you wish to mix the light beam additively with other light sources.

Note

Light sources in CINEMA 4D V5 were additive. This setting exists primarily for compatibility reasons. The light beam will look more realistic if this option is not selected.

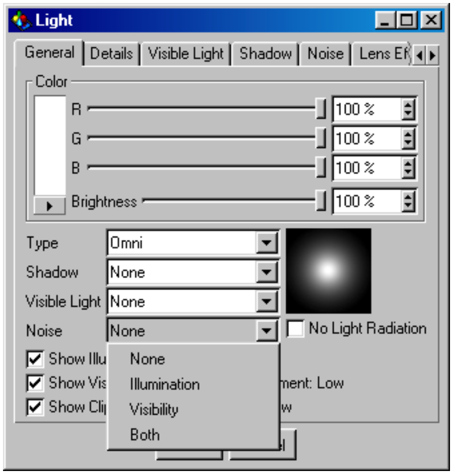


Additive on



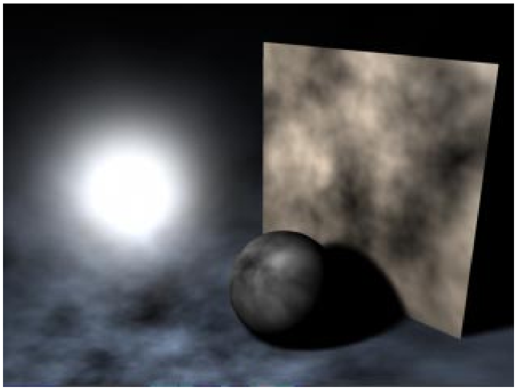
Additive off

Noise



Illumination (General tab)

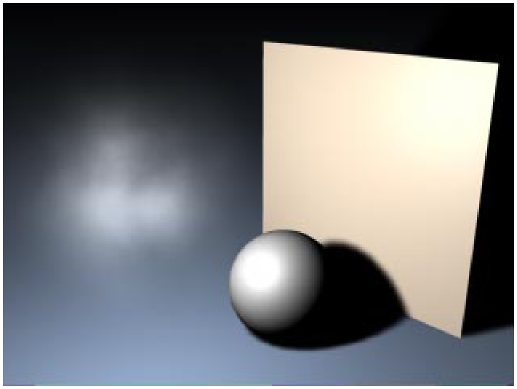
You can add animated irregularities to your light source in order to give it a realistic appearance.



A light's illuminated surface is very rarely evenly lit - particularly if dust or small particles are present.

Visibility (General tab)

This option adds irregularities not to your lit surface, but to the visible light itself.

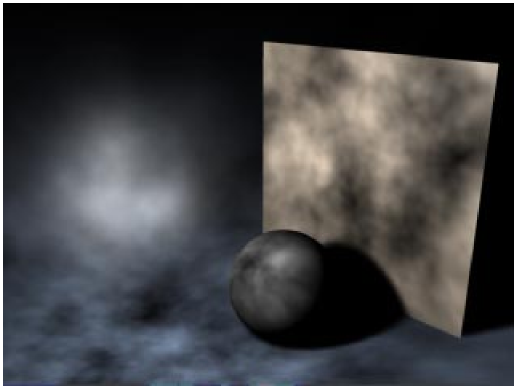


With this you can simulate for example the waving effect of fog, which is visible in the light cone.

Here is one example:

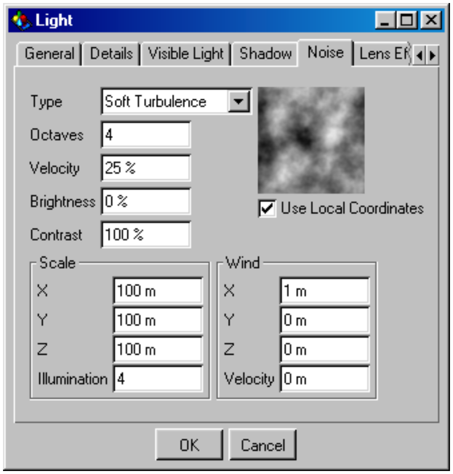
Using the Noise effect, you can produce very interesting effects, such as a supernova, simply by setting the internal and external colors of the visible light to yellow and red.

Both (General tab)



Using this option will ensure that both the basic light and any visible light are provided with noise irregularities.

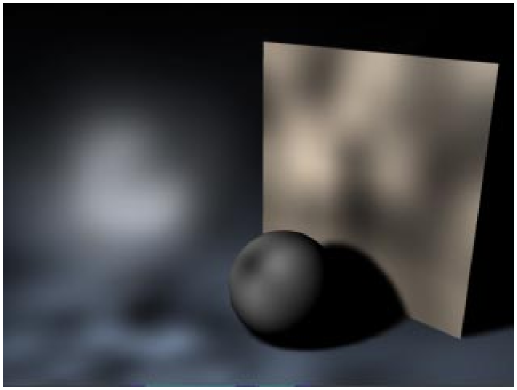
Noise Tab



Type

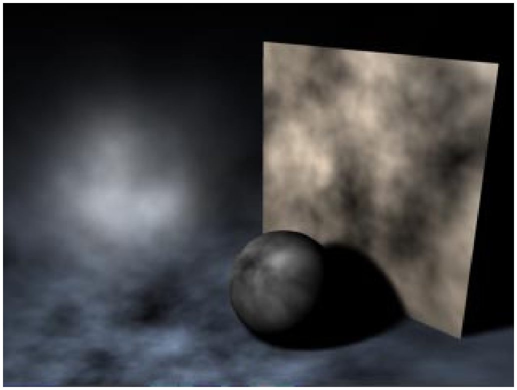
Select from four Noise types.

Simple Noise produces dark and bright areas.

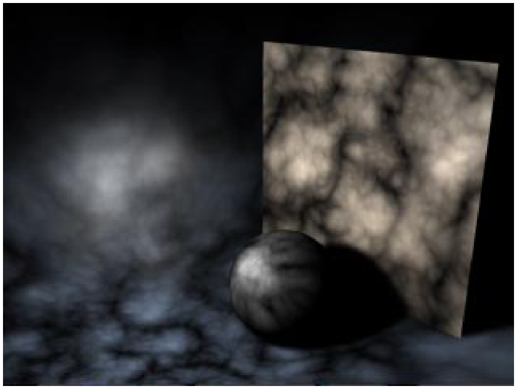


Then there are three types of turbulence that change the characteristics of the noise by adding cloud-like effects.

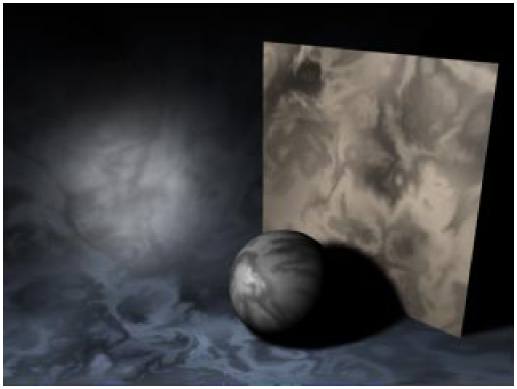
Soft Turbulence



Hard Turbulence



Wavy Turbulence



Octaves

(Only relevant for the Turbulence types above)

The **Octaves** value determines the graininess of the noise. The higher the value, the more *gritty* the appearance.

Velocity

Indicates the speed at which the irregularities will move.

Brightness

Using this you can raise the overall brightness of the irregularities. You may also enter negative percentages and reduce the brightness.

Contrast

Changing this will allow you to adjust the contrast of the noise. Higher values increase the contrast, lower values reduce it.

Use Local Coordinates

Selecting this option will ensure that the local coordinates of the light source are *nailed down*. If the light source is moved now, the turbulence/noise will move also. In normal use you should leave this option off, as dust and particles in the real world move due to the forces of nature, not because the light itself moves.

Scale

This value will determine the size of the irregularities in relation to the scene's absolute Cartesian coordinates. If the noise effect is too severe, try reducing this value.

Illumination

This is where you set the general intensity of the noise.

Wind

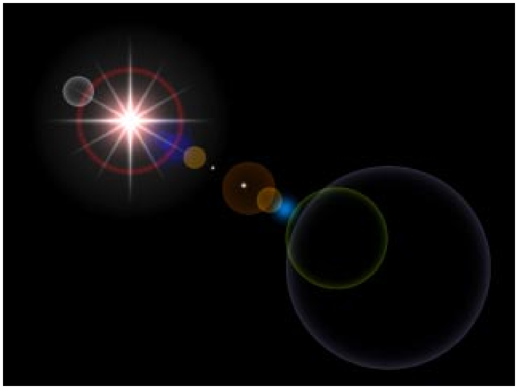
Here you can define the properties of any wind, which will add extra realism to your scene by appearing to blow the dust in specific directions.

The values of X, Y and Z give the vectors of the wind direction in absolute Cartesian coordinates (and/or local coordinates if this option is activated). Use the **Velocity** value to change the wind strength.

Lens Effects

CINEMA 4D is a powerful tool when it comes to producing the aberrations of real-world camera lens systems and film material.

Basic sunbeams are brought to life with a solar corona or a halo. A lens reflection of a low-quality camera lens can be easily simulated, as rainbow colored circles develop and run diagonally across the screen. A welcome *flaw* in an otherwise too perfect virtual world.



Just like the characteristics of other objects, the smallest details of these lens effects may be animated to give, for example, a rotating corona, or a lens flare turning from red to green.

You may remember in the General tab you had the option to turn off light radiation (**No Light Radiation**). If this option is chosen then the light source will no longer illuminate the scene, but all lens effects of the light will still be visible. This is handy for example in a scene in which your objects are illuminated to your exact requirements, and adding another light source for a lens flare will result in over-lighting the scene.

The parameters for these lens effects are many and varied and take up three separate tabs. But fear not, with a step-by-step approach you will soon be comfortable with all of the possible lens effects and their various options.

On the main Lens Effects tab you can define your basic effect, choosing both Reflexes and Glows separately from each other. Using the two tabs that follow you may fine tune the most minor details of the lens effect. To aid you in this, a preview window will constantly update the adjustments as you make them.

Tip

It's very easy to build yourself a light source library containing spectacular effects. You can produce many types of light sources with different effects that can then be saved as individual objects in the Object Manager. When you require one of these specific lights for your scene you may simply load it from your source light library.

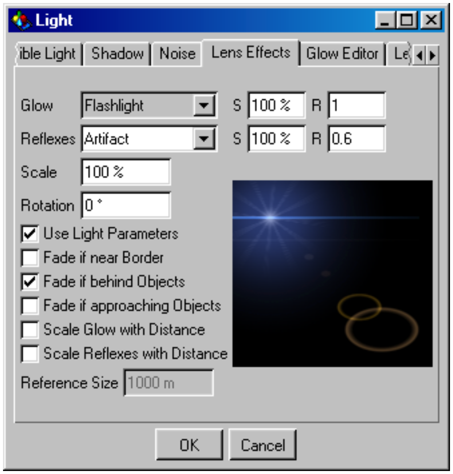
Note

Because of the way that Quicktime VR panoramas are calculated, lens effects cannot be displayed in them.

One more tip

Try not to overuse the light reflection effect; it can very soon become a distraction. Also remember that in the real world the cameraman will try his best to avoid them.

Lens Effects Tab



So to the details of the Lens Effects tab. From here you can quickly access a number of pre-defined glow and reflex examples. You can also change the basic properties of the lens aberration from here.

Glow

From this popup menu you can select, from a pre-defined library, the glow of the light source.

Reflexes

From this popup menu you can select, from a pre-defined library, the type of lens reflection.

You will find a detailed overview of all the effects at the end of this section.

Brightness S

Adjusting this value will change the global brightness of the glow or reflex. Smaller values will reduce the effect, values of 100% or more will strengthen it.

Aspect Ratio R

Change the global aspect ratio of both glows and reflexes with this value. At the default value of 1, both will appear circular. Smaller or greater values will give you a squeezed/stretched ellipse.

Scale

This value will adjust the size of the whole lens effect (rays, glows and reflexes). This saves you from adjusting each effect individually.

Rotation

Use this value to rotate the lens effect to any angle.

Use Light Parameters

When this option is activated, the light source properties defined in the General tab will also affect the glow/reflex effects. So if the light source color is red then the glow/reflex effect will also appear red.

Fade if near Border

Using this option will make the lens effect fade the nearer it is to the edge of the image. When at the center of the screen, the lens effect will have maximum intensity. This corresponds to a light's physical behaviour in the real world.

Fade if behind Objects

Using this option will determine whether light sources that lie behind objects are still to produce their effects or not.

Lens flares do not occur if light sources are behind objects, but glows or radiation can produce some rather nice effects.

Fade if approaching Objects

Normally, if a light source with a lens effect disappears behind an object, the effects are still at maximum strength until the light source origin is fully behind the object. With this option enabled, the effect's strength will gradually fade as the light source approaches the object.

Note

The gradual fading of the sun behind a planet, complete with atmosphere, is a good example of this effect.

Scale Glow with Distance

This option will scale the glow effect according to its distance from the camera. The further the distance from the camera, the smaller the effect will be.

Scale Reflexes with Distance

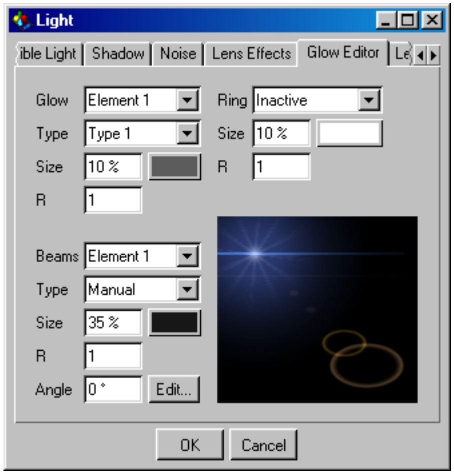
This option will scale the reflex effect according to the distance. The further the distance from the camera, the smaller the effect will be.

Reference Size

With this option you can adjust the distance value with which the glow and reflex effects are calculated. The smaller the value the more distant, thus smaller, the effect will appear. While increasing the value will make the effect appear closer, thus larger.

Normally lens reflexes have a constant size, no matter how far removed from the camera they are. If, however, you want to copy your favorite space movie and to let torpedoes fly under the camera, the lens reflexes and glows must become larger when the camera is closer to the torpedo.

Glow Editor



With this tab you can tweak the lens glow to your exact requirements. This dialog is divided into three parts, the Glow values (top left), the Halo/Ring (top right) and the Beam/Corona elements (bottom left). Of major importance is the preview window (bottom right) that updates your effect as you modify it.

Glow properties

- Glow

Select the required glow element from this menu of pre-defined light source glows, to change the overall shape of the light's glow.

- Type

Selecting a glow type from this pre-defined set will change how the glow's brightness is distributed.

- Size

Adjusting this value determines the size of the glow's element. The radius is shown as a percentage, where 100% is the distance from the center of the screen to the edge.

- R (aspect ratio)

Modifying this value allows you to change the aspect ratio of the glow. At its default size of 1 the glow will appear circular. Smaller or larger values will shrink/stretch the glow's aspect, making it a horizontal or vertical ellipse.

- Color

From this dialog (obtained by clicking the box to the right of **Size**) you can select the color of the surrounding outer glow.

Ring properties

Using these values will produce a ring, or halo, around the lens effect. Adjust this effect to your requirements by consulting the preview window (bottom right).

- Ring

From this drop-down menu you choose the halo type you require; **Inactive**, **Ring** or **Rainbow Ring**.

- Size

Adjust the size of the ring from here, the value being a percentage.

- R (aspect ratio)

Adjust the ring's aspect ratio with this value. Decreasing the default value of 1 will flatten the ring, while increasing it will stretch it into an ellipse.

- Color

Choose the color for the ring from this color picker.

With this dialog you can define the *Corona* of your lens effect - the rays of light that are cast in star-like fashion around the effect.

Change this effect until you see what you want in the preview window (bottom right).

Beam properties

Choose your preferred Beam/Corona from this pre-defined, drop-down set.

- Type

Choose the corona type from here. Depending on the chosen type, the pattern and number of beams cast will vary.

- Size

Use this value to determine the size of the element. The radius is indicated as a percentage, where 100% is the distance from the center of the screen to the edge.

- R (aspect ratio)

Adjust the aspect ratio of the corona with this value. At the default value of 1 it will appear circular. Smaller values will flatten the effect into a small horizontal ellipse, while increasing the value stretches it into a taller, vertical ellipse.

- Color

Choose a color for your corona from this color picker (click to the right of **Size**).

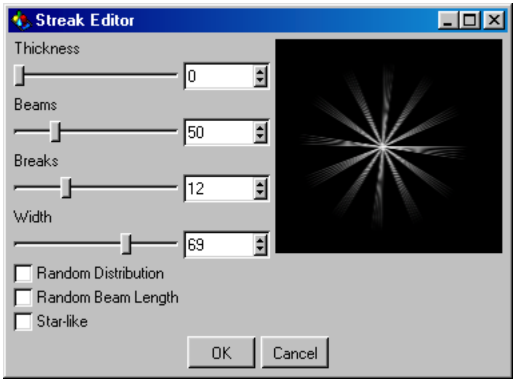
- Angle

To rotate the beams of your star/corona to any angle you want, enter a new value here.

- Edit

Still not satisfied? OK, there's more; click this **Edit** button.

The Streak Editor



This glow dialog lets you adjust the light that defines the appearance of the corona. These values are set with four sliders and three option fields. As usual, a preview window is updated constantly to let you see your changes.

- Thickness

Change this value to specify the width of the beam's rays. The smaller the value, the sharper the beam (or streak) appears.

- Beams

You can choose the number of beams produced by your corona effect here. Up to 200 beams can be produced by each light source.

- Breaks

With this option you can insert interruptions or breaks into your corona. These are added to the gaps which already exist between the beams.

- Width

Adjust the size of the above breaks with this value.

- Random Distribution

Activating this option ensures that the beams are arranged randomly, rather than in a symmetrical pattern.

- Random Beam Length

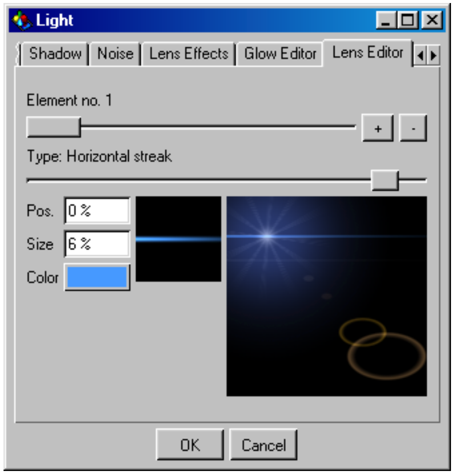
To ensure that all beams are not the same length, activate this option. All individual beams will then be different lengths.

- Star-like

Once activated, this option will arrange the beams in a more star-shaped pattern, thickening the beams towards the center.

This effect is particularly effective when used with a small number of thick beams.

Lens Editor Tab



The final light dialog concerns the creation and adjustment of the famous, often notorious, lens reflections (or lens flares) to your specific needs. Once again, all changes are shown in the preview window to the right.

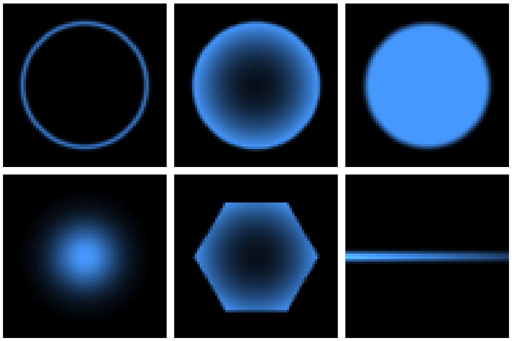
Element Number

Use this slider to select the reflection you wish to edit. You can add or remove extra reflections to/from the existing set by using the **+** and **-** buttons. A maximum of 40 reflections are at your disposal, enough to recreate any combination of light/lens flares or aberrations.

Type

Select the shape of your reflection with this slider. Only in the rarest case, if at all, should different reflection types be used in a scene. For example, apply only circular or only hexagonal types to the one scene. Remember, your scene is shot through one simulated real-world lens - these lens reflections depend upon that lens system, not on your existing scene lights.

Here are some examples:



Position or Pos

This value sets the positioning of the element on the screen. The axis on which all reflections lie travels through two points; the light source and the center of the screen (which is also the centre of the lens).

Here the following values apply.

0% = light source
50% = screen center
100% = 2* distance light source-center

Negative values place the reflections behind the light source.

Size

This value determines the size of the element. The radius is shown as a percentage, where 100% is the distance from the center of the screen to the edge.

Color

Select the color for the element.

Real World Glows, Halos and Reflexes

Glows

Glows are a type of over-exposure to light. When the light intensity is sufficient, this exposure *bloom* includes film grain in the areas surrounding a bright light, even though those areas are not illuminated at all.

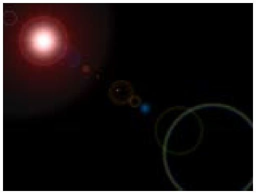
Halos

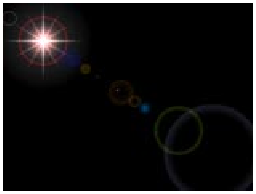
Halos are also caused by over-exposure, but with added color distortions caused by the diffraction of the film grain.

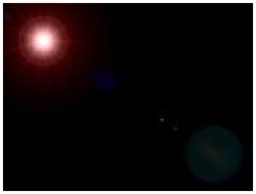
Reflexes

Lens reflections are caused by the focal image of poor quality lenses. The colored shape produced is an artifact of the lens surface, the shape resulting from the shape of the lens. Large apertures produce small reflections, small apertures produce larger ones.

Just in case you‘d forgotten: Each of the preceding options can, of course, be animated!

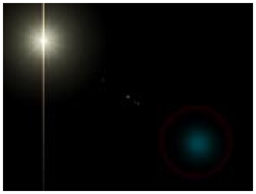

Default

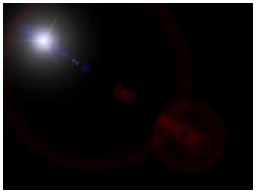

CINEMA 4D V4

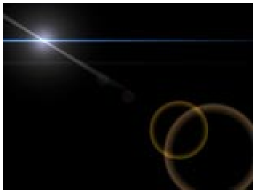

Wide angle

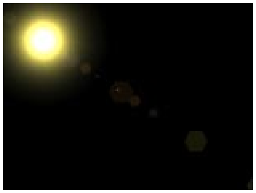

Zoom

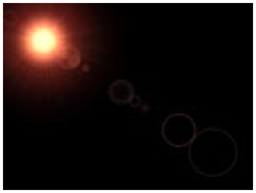

Hi-8

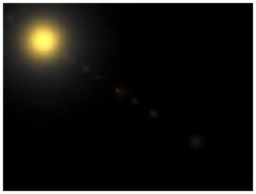

Camcorder

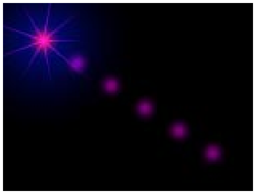

Floodlight


Artefact


Star 1


Star 2


Star 3


Violet

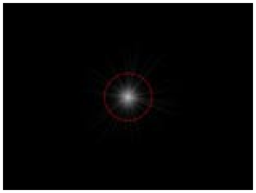

Flash 1

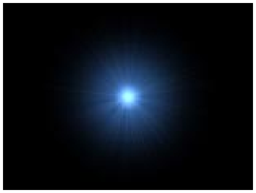

Flash 2

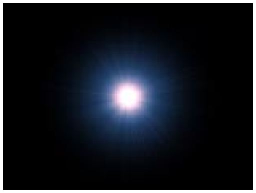

Flash 3

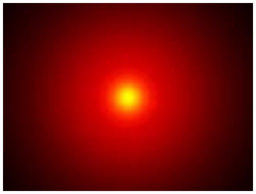

Sun 1

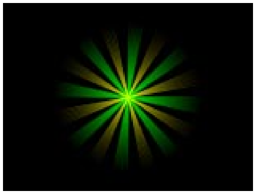

Sun 2


Grey

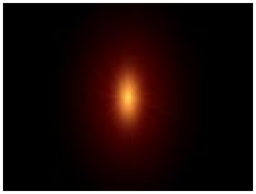

Blue 1


Blue 2


Red


Yellow-green 1


Yellow-green 2


Candle

Target Light

When you choose **Objects > Scene > Target Light**, a null object is created, containing a light source and another null object. The latter is the target object to which the light is tied at all times.

The light source can be any light type of your choosing and you simply move objects into the hierarchy of the target object for the light to become aligned to them.

You can edit the whole structure interactively within the editor so, if you move the light source, it stays aligned to the target object and, conversely, if you move the target object the target light follows it.

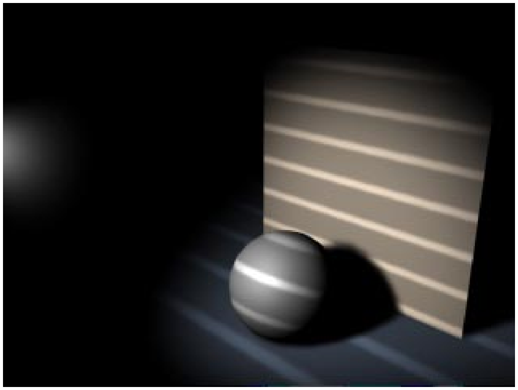
Texture Mapping

A Light Map is produced by assigning a material with a transparency map texture to a light source. The light's colored areas are then filtered by this texture and colored in exactly the same way as a slide projector will project a still picture.

You can assign as many light maps as you wish to each light object. Thus you are able to produce many complex picture effects with ease. For example, the striped-shadow effect of a venetian blind can be simulated, without the complicated and time-consuming shadow calculations normally associated with such an effect, simply by assigning a black-and-white striped light map to a light object.

Note

Lights do not take on the material properties of a parent object



You can find an example scene for light maps on the CINEMA 4D CD.

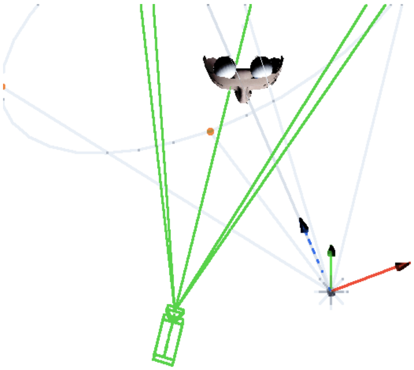
Lighting Examples

Three Point Lighting

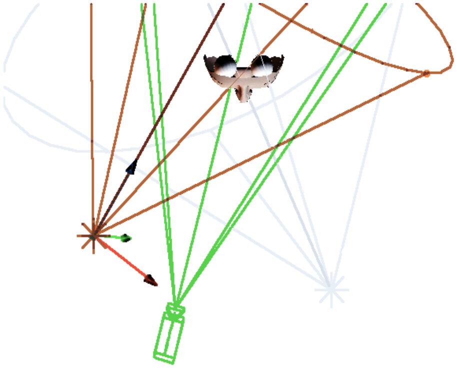
A simple and very common lighting principle is the three point lighting technique. This method is excellent for lighting individual objects correctly e.g. a character in a scene.

The object is illuminated by a main (*key*) light, a *fill* light and a third light from the rear, known as the *backlight*. Naturally all scenes and objects are unique and require individual setups, but this system is a good starting point for your scene's lighting properties.

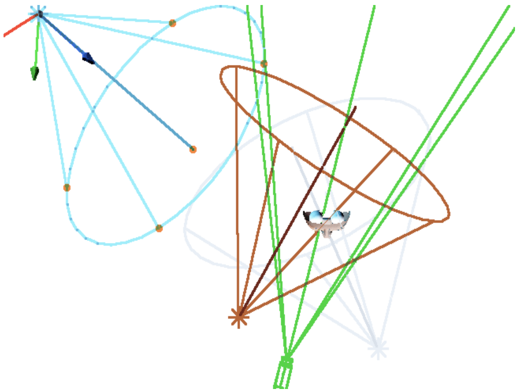
The first light is the main light of the scene (the key light) – often a white spotlight with a soft shadow and the brightest light of the three. This light is placed to the right of the camera and aligned to your object. The radius is then adjusted to illuminate the whole of the object.



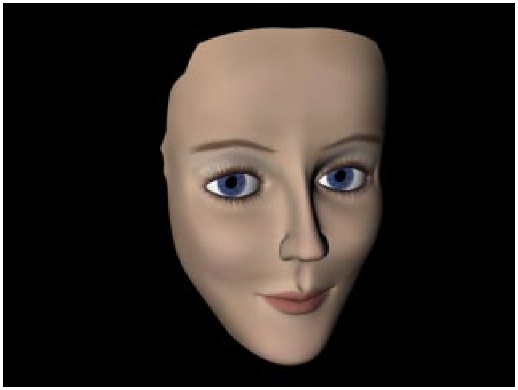
The second light is the fill light which complements the key light by illuminating the parts of the scene not reached by the key light. Changing this light to another color (e.g. yellow or red-brown) will make the scene appear softer and warmer. This fill light should be at roughly 50% brightness and placed to the left of the camera and key light.



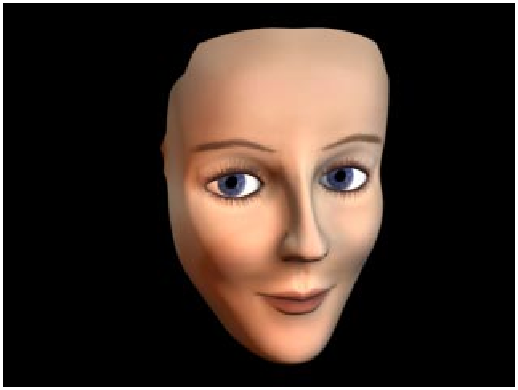
The third of these lights is the backlight. This spotlight provides lighting from the rear and above in order to emphasize the outline of your object against the background. Blue is a suitable color here, as cooler colors are seen by the human eye as somewhat more distant than warmer colors, thus giving more apparent depth to your scene.



Here is an image lit with simple, one-source lighting ...



Now here is the same image lit with carefully-designed three-point lighting ...



Note

Naturally the light sources do not have to be spotlights but the limited and more central spread of a spotlight's illumination means the objects won't become lost in a lighter, more evenly lit environment.

It is also preferable to have just one light (the key light) cast shadows. All three lights casting shadows can become confusing. One shadow-casting light is often more than sufficient.

Note that you should not place your light sources too close to your object, otherwise unwanted specularity may result. The further away the light source is from the object, the more evenly lit the object will be.

Radiosity Effect With Area Lights

Take a look at your environment when it is lit by bright sunlight.

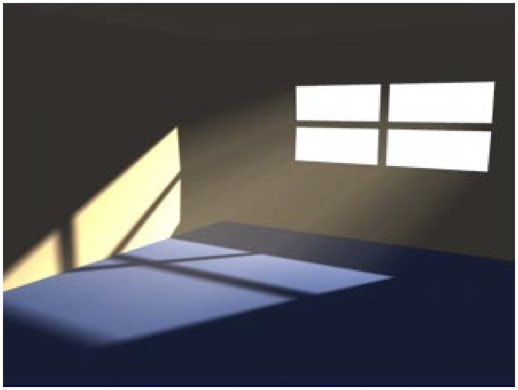
Where exactly does the light come from? It's impossible to pinpoint the source exactly. The lighting is even, the shadows are varied. The sunlight enters through the window and is then *bounced* from the walls. Each wall and object then becomes a sort of indirect light source. This effect is known as *Radiosity*.

There are specific programs which deal with this kind of *bouncing* light which use additional light rays, parallel to the normal raytraced rays. However, such calculations are extremely slow - approximately 50-100 times slower than normal raytracing.

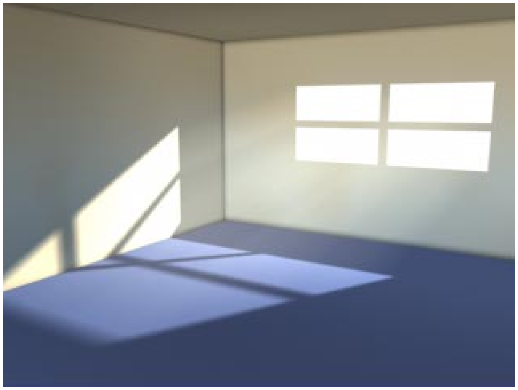
In CINEMA 4D you can simulate Radiosity with Area light sources. Although not as accurate as the aforementioned technique, the difference is hardly noticeable.

The basic principle of this Radiosity *workaround* is to assign a weak Area light source to each wall to simulate the reflected light of the wall.

In the example below you see an area without Area lights, just the light source for the sunlight through the window. To make the scene easier to view, the environment lighting (see Environment on page 241) was increased.

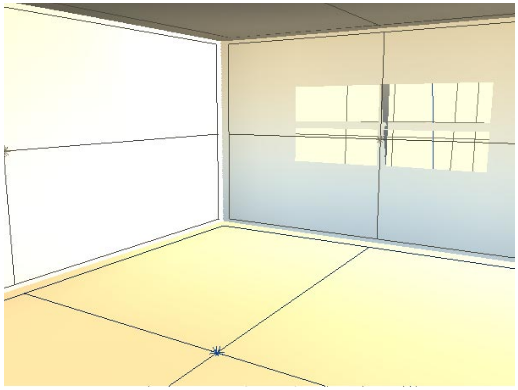


In the next picture each wall is assigned its own Area Light. The environment lighting is now 0% and the source of the sunlight reduced.



The floor is blue - therefore the area light source for the floor is also blue. One can easily see how the light is reflected by the blue floor onto the walls.

Here you see the structure of a typical scene. Familiarise yourself with it and note how the area lights are positioned. The walls are displayed in Gouraud Shading, the light sources as screens.



To illuminate this scene properly will need a certain amount of experimentation. Each light source needs its own individual brightness values tweaking to the correct amount.

When everything is carefully adjusted, however, results like this can be obtained:

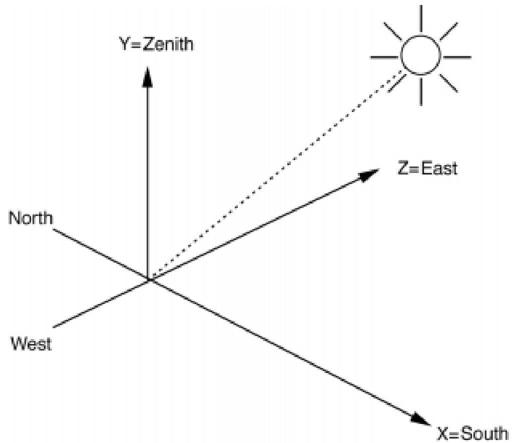
Sun Light

The sun light source is a special case of a light. It is a light source with the type of the light adjusted to Distant and the shadow to Hard. These settings cannot be changed.

Additionally, the sun light source contains an expression with which you can define the exact time of day, the date and the geographical latitude.

The sun is of particular interest to architects who often want a scene illuminated with a light that has the correct direction and color of the sun.

South is the X axis of the world coordinate system; the sun will always be here at 12 noon. East (sunrise) is therefore along the Z axis, West along the negative Z axis and North along the negative X axis.



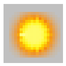
The sun light source is placed far away from the origin of the world coordinate system. Owing to its distant position, it radiates parallel light.

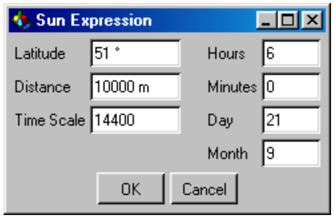
The sun shines only if it is over the horizon (day). For an animation of the sun you should therefore deactivate the automatic lighting (see Auto Light, page 424). Otherwise the scene, after the sun goes down, will be illuminated by the automatic lighting.

The color of the sun depends on the absorption spectrum of the mantle of air around the Earth and is normally yellowish during the day, shifting into the red spectral region as the sun nears the horizon.

The sun light is intended for users who want to simulate realistic colors and shades at different times of day, appropriate for landscape planning or house building.

Sun Expression Dialog





This dialog window appears when you double-click the icon for the sun light in the Object Manager

Latitude

Enter the geographical latitude of the desired location on the Earth's surface. That could be, for example, 51.3 for London, 40.5 for New York, 35.4 for Tokyo or 50.1 for Friedrichsdorf.

Distance

Here you enter the distance of the sun light source from the center of the world axes. The smaller this value, the smaller the circular arc on which the sun travels.

Time Scale

Here you determine how long the sun is to be in the sky, in CINEMA 4D. The world time (or real time) in seconds is divided by the factor you enter here.

A factor of 1 would mean that a CINEMA 4D second corresponds exactly to a world second. Half a day is exactly 43,200 seconds long so, in this case, the sun in CINEMA 4D would need actually 43,200 seconds to rise and set again.

Try this one - choose a factor of 1, check your watch and enter the current time, the current date and the geographical latitude of your location. Now choose **Play** in the Time Line. The CINEMA 4D sun should behave synchronously with the sun outside; you could sit all day in front of CINEMA 4D and watch the virtual sun!

That's too long? Then enter a factor of 43,200 - half a day now becomes just one second in the CINEMA 4D world.

Since the preset animation length in CINEMA 4D is exactly three seconds this factor is set, by default, to 14,400; thus the sun goes up and down again within three seconds.

Here's all you need to calculate the necessary factor:

43,200 / CINEMA 4D seconds = factor

Example:

Assume you want to make the sun go up and down again in CINEMA 4D over exactly ten seconds. According to the above formula we have:

43,200 real time seconds /
10 CINEMA 4D seconds = 4,320

Thus the factor which you must use, so that the sun rises and sets in ten seconds, is exactly 4,320.

Hours, Minutes, Day, Month

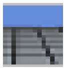
Enter the local time and date for which the position of the sun is to be calculated. Local summer time or other time zone corrections are not taken into account, so you must subtract one hour from the time during the summer months to obtain, for example, Central European Time.

Not only Light Sources can be used as a Sun

Since the sun uses an expression (see page 462), arbitrary objects can be used as a sun. By default, when you choose Sun Light from the **Objects > Scene** menu, a standard light source is used. However, you can drag (copy) the Sun expression to any object of your choice.

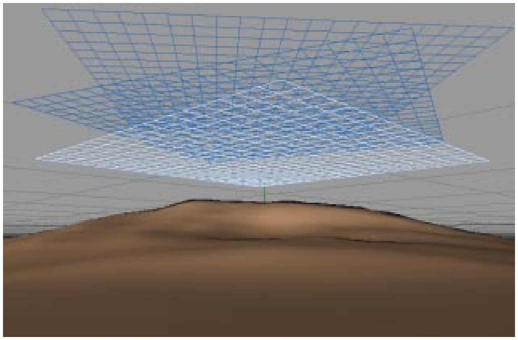
For example you could assign the sun to a null object, which you then move through the scene. Into this null object you can place, say, any light source as a sub-object. In that way you could prevent the automatic fading of the sun light at dusk. Also you could avoid hard shadows by simply setting soft shadows within this light sub-object. Or maybe you could place a sphere into this null object to simulate a moon.

Floor



This command creates a floor object. The floor always lies in the XZ plane of the world coordinate system, stretching to infinity in all directions.

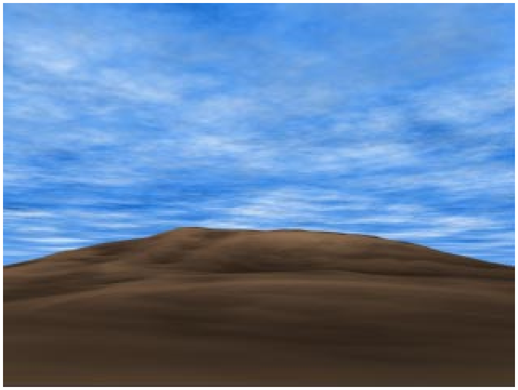
You may create as many floors as you need and use them all at the same time in CINEMA 4D. You could, for example, use multiple floors as pseudo skies on to which you can add cloud layers of differing transparency. In the following example four floors were used, one for the actual ground and three for the layers of cloud, each one situated higher than the other. If the cloud textures are also animated, an extremely realistic effect can be achieved.



As you may have realized, floors can be moved and rotated relative to each other. This feature can help you avoid cloud layers appearing identical, by avoiding repeating textures.

Sky

This command will create a sky object. In contrast to the Floor object, the Sky is an infinitely large sphere, whose center is the origin of the world coordinate system.



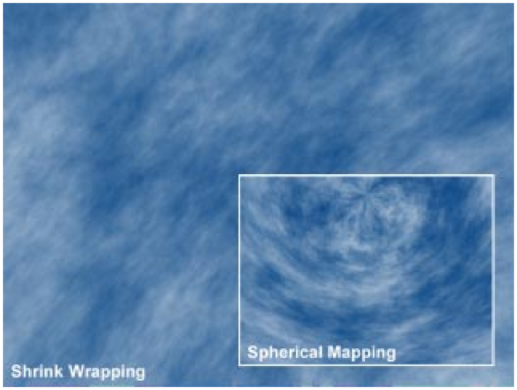
If you want to apply a texture (e.g the 2D cloud shader) to the sky, you should use Spherical or Cubic projection. If the clouds appear too large, increase the repetition of the texture's tiling and ensure you switch on **Seamless** (see Texture Mapping, page 538).

Do the clouds seem a little artificial? The possible reason for this is that the clouds have the same tiling in both the X and the Y direction. Adjusting the repetition of the tiling on the Y-axis, making them approximately twice as high as for the X-axis, ensures the clouds look somewhat *pulled* in their width and they appear nearer and more natural.

Alternatively, you can also use several floor objects for the simulation of cloud layers.

For the simulation of a starlit sky, the use of the cubic projection is recommended, as this will avoid unwanted distortions at the poles.

Aiming the camera directly up will display a problem - the cloud texture tends to gather at the zenith. You can fix this by assigning Shrink Wrapping (see page 534).



Note that, when rendering, only one sky object is taken into account. If you have several sky objects in your scene, you can control which sky is to be used in your scene by using the Stage object (see below).

Without a Stage object, the first sky object in the hierarchy is used when rendering the scene.

Note

With Environment Fog switched on, the sky object's visibility will be lost. How you create a sky to appear with Environment Fog is explained on page 241, Fog Tab.

Stage

The stage object behaves like the director in a film production. It determines when a camera, an environment, a background (and so on) are used within an animation.

So, for example, you can create many different cameras in your scene and then use the stage object to decide when to cut to a particular camera. An advantage of using several cameras and the stage object in this way is that you don't have to render enormous amounts of material from every conceivable perspective, only to use half in the final production. By already specifying the various camera cuts within the animation itself, you save a great deal of time and cost.

You can also use the stage object to *switch* between sky, foreground, background and environment objects.

You implement the Stage object as a parameter track in the Time Line (see page 574).

Environment

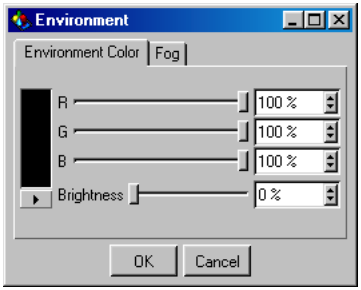
You can use the Environment object to define several global scene parameters.

Note

Only one environment object can be rendered. If you wish to change the environment during an animation, use the stage object with a parameter track.

Environment Color Tab

This is the color of the environment light. The environment light illuminates the scene evenly from all sides and is meant to simulate the background light of a daytime sky or the indirect lighting of a room light.



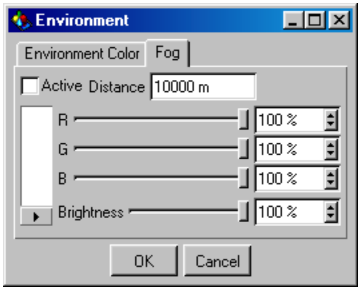
The brightness slider is set to 0% by default. If you wish to simulate environment light (aka *ambient light*), increase the value of the brightness slider to, say, 10% for architectural scenes. Be very careful when increasing the brightness, since it reduces the contrast in the scene - often, you can get better results by adding omni lights that do not cast shadows.

Note

Environment color can be useful for increasing the color contrast - for example, you can use it to introduce complementary colours into the scene. Perhaps you will set a dark blue to contrast with a warm yellow window glow as well as to simulate night. Or imagine a moonlit scene - you can enhance the bright yellow moonlight by using a dark purple environment.

Fog Tab

Use environment fog for atmospheric autumn images or underwater scenes.



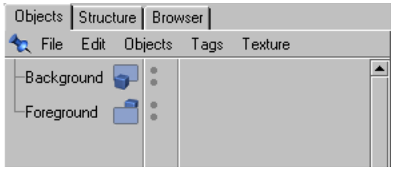
Environment fog fills the entire screen, stretching to infinity. Use this dialog to select the fog's color. **Distance** refers to the fog's intensity by specifying the distance over which a light beam will lose its intensity completely. As the light loses intensity, the fog color is added.

If, for example, you have entered a value of 500 for **Distance**, a light beam that starts off with 100% intensity will reduce to 20% after travelling 400 units; at the end of a further 100 units, the light will have faded out completely, giving way to the fog color. The shorter the distance, the thicker the fog.

Beams that penetrate the fog beyond the limit defined in **Distance** are absorbed completely by the fog color - if you enable environment fog, you cannot see a sky or a background image.

Foreground/Background

To render (or display in the Editor) a foreground or background image, you may assign a textured material to a foreground or background object, just as you would to any other object. For transparent areas, assign an Alpha (genlock) channel to the material (see page 500).



The foreground object could be a cockpit and instrument display, or simply a notice of copyright/authorship that you wish to appear prominently in the scene.

Taking the copyright example further, the color texture used for the material of the copyright message would be in the shape of the actual message text you wish to display. This texture must also be used in the Alpha channel property of the material. From here, you can use either the Alpha channel or clipping (eee page 500).

The background picture might be a landscape, into which your scene will fit.

For this you assign a material, with the required texture in its color channel, to the background object.

These images will be neither reflected by your scene's reflective objects nor lit in any way by the scene. Nor will they change with any change of camera settings.

The background image will show through transparent and refractive objects but will not change with altered camera settings.

You could compare it to a background layer generated by the Alpha Channel feature, on which the rendered image is then superimposed.

A CINEMA 4D object (the bridge) fits neatly into both a foreground and a background image (scene: Joachim Hoff)

Note

As soon as you have applied a texture to a background object, it will be displayed in the editor. If this display distracts you, you may turn it off by selecting the object in the Object Manager and choosing Objects > Object Display > Editor Off (see page 465).

Note

Any background picture (see page 14) is normally displayed in the perspective view only, so as not to distract you when working in the flat views. However, attaching the camera to the view in any editor window will make the background object appear in all view modes for that window. Any background picture already displayed will then be covered by the background object texture.

Foreground and background pictures can also be tiled. For this effect, use the texture geometry dialog (see page 525).

Foreground and background pictures are scaled to the film format during rendering (see Output Tab, page 414). Transparent sections of the background are ignored.

Animations and frame sequences can also be used for foreground and background pictures. In the case of a background object, these sequences will also be displayed in the editor.

Note

Only one foreground/background object can be rendered. If you wish to change the foreground/background during an animation, use the Stage object with a parameter track.

Particle System

Have you ever wanted to create a swarm of fish, a whole fleet of spaceships or the swirling smoke of a cigarette? CINEMA 4D's particle system will do all of this for you, and much more, in a very easy and intuitive way.

The heart of any particle system is the *emitter*, which ejects a stream of particles. These particles and their shapes can be modified by various parameters and controls to produce, amongst other effects, rotating, deflecting and decelerating particles.

It's a simple as this:

1. Create an emitter (**Objects > Particle > Emitter**)
2. Press Play in the Time Line window and view the default particle system in the editor window.
3. Drag an object into the emitter (a basic small sphere is suitable for now).

Good

In CINEMA 4D any object at all can become the particle. Not only simple spheres but also complex, grouped objects with hierarchies may be used (e.g. a jointed bird or a car).

Better

Even light sources can be used as particles. Together with the visible light function you can create fantastic fire or smoke effects very easily and particles can even cast lights and shadows.

Even better

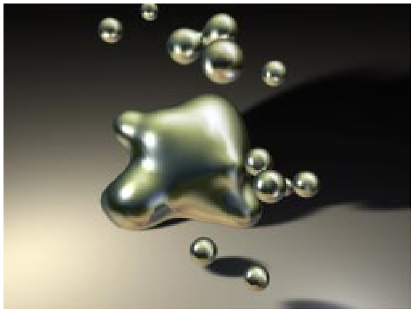
All objects in the emitter can be fully animated to create, for example, flying birds and swimming fish. Important: the animation of each object starts when the particle is emitted. This is done automatically. This helps give your swarm-like movements a more erratic, natural and much less uniform movement.

And there is yet more

Your particle stream can also contain mixed random particle objects (e.g. a variety of different birds). Simply drag the different objects into an emitter. These particles are then emitted in the same quantitative proportion.

And ...

You can also use a metaball. This can help you achieve otherwise difficult effects such as bubbling liquids.



Note

There are two mini-tutorials at the end of this chapter, one for light sources as particles, the other for metaballs as particles.

The particles now move in a straightforward fashion until they arrive within the range of a modifier. Then they are diverted, slowed, or rotated etc. These modifiers work, by default, in the z-direction of their coordinate system (e.g. the wind blows in this direction); if this is not the case, it will be explicitly pointed out in the text below. Modifiers can be embedded in other modifiers. Thus a turbulence modifier within a wind modifier results in very realistic smoke effects.

Almost all the properties of an emitter and the modifiers can be animated using a parameter track (see page 574). This can be used to simulate intermittent gusts of wind for instance.

Some good advice

If you would like to actually see the rendered particle animation within your lifetime :-) make sure you disable the light emission and shadow casting from any particle light sources. Hundreds of such particles are possible within a scene and, with the wrong options set, this will slow even the most powerful computer to a crawl.

Tip

Emitters themselves cannot be used as particles.

Bake Particles

Under certain conditions it may become necessary to use the *bake* function for particle streams. What does this mean?

Under normal conditions particle streams are rendered dynamically and sequentially, i.e. the position of a particle in next frame depends on its position in the previous one. But this can cause problems in two ways ...

First of all let's consider rendering within mixed networks. With the optionally available CINEMA 4D NET software, the rendering of an animation within a network can be distributed over several computers. For this type of network rendering a variety of different platforms can be combined, e.g. Power PC, AMD and Pentium processors. Since the floating-point units (FPU) of these processors work slightly differently, the sequential nature of the particle rendering can produce different results on the different platforms. The final output could be a non-continuous particle stream. *Baking* is the answer.

The second case occurs when using several independent particle systems in a scene. In principle all modifiers will always affect all particles of a scene, no matter what the source. If this is not what you require, you can remedy this problem by baking the particles.

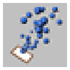
When baked, a particle stream will become frozen in its present condition, i.e. the position, rotation and size for each particle for each frame of the animation is fixed (also in the Time Line, although you won't notice it). All computers in a CINEMA 4D NET network will now render the particles correctly. Further modifiers may then be added after baking a particle stream and these will no longer affect the neighbouring particles.

As it is an object property rather than an object, the **Bake Particles** command is in the **Objects** menu of the Object Manager. It is referred to again in the Object Manager chapter on page 468.

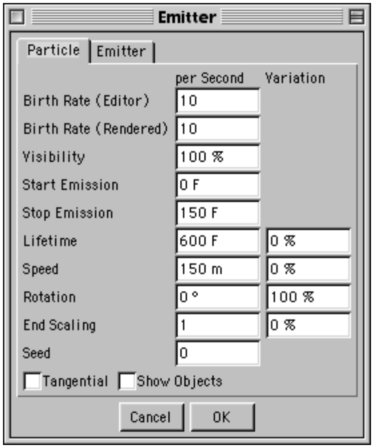
Tip

As you might expect, these extra particle options are not without a cost; high memory consumption. For each particle and for each animation frame the data, such as position, speed, situation, lifetime etc. must be saved. You can therefore quite easily build a scene that requires several megabytes of memory. You may check the memory consumption of the baked objects at any time with the function Object Manager > Objects > Information (see page 466).

Emitter



Particle Tab



Birth Rate (Editor)

Defines how many particles per second are to be created in the editor. The particles are emitted randomly from the entire surface of the emitter. This rate is also used when starting a calculation in the 3D window of the editor.

Birth Rate (Rendering)

Defines how many particles per second are to be created and rendered with the final calculated scene. The particles are emitted randomly from the surface of the emitter.

Visibility

Here you can enter how many of the particles should be visible. At first glance, this appears to offer no more than the birth rate settings.

However, on principle it is not possible to animate some of the parameters in the particle system, such as the birth rate settings. If you wish to vary the intensity of the particle stream over time, use **Visibility**. You can animate it via a parameter track in the Time Line (see page 574).

Start Emission / Stop Emission

You can use these values to define when (in frames) the particle emission should begin and end.

Lifetime

Gives the length of time a particle will be visible. So if flying sparks, for example, are set to be visible for 20 frames, the particles will disappear after this time. This value also controls the length of the animation sequence in the time line.

Variation adds a deviation factor to the **Lifetime** value; i.e. the individual particles can *live* for a longer or shorter time, according to the size of the **Variation** value.

Speed

Indicates the movement speed of the individual particles. The speed is shown in units per second (see **Edit > General Settings**). The larger the value, the longer the particle line displayed in the editor is.

Variation controls the deviation factor of the speed. A value of 100% can make the particles twice as fast, or twice as slow.

Tip

A speed of 0 is allowed. With this value set, the emitter leaves a particle trail behind itself when the emitter is moved. Negative values can also be used. The emitter will then emit the particle stream in the negative z-direction.

Rotation

Specifies the value at which the particles will revolve around a spatial axis.

Variation will add a deviation factor to the value.

End Scaling

Defines the final size of the particles relative to their starting size. A value of 0.5, for example, will shrink the particles to half of their initial size.

Variation (in the second column) defines a deviation factor for the scaling so that the particles are sometimes larger or smaller at the end of the animation.

Seed

Seed is used to create the pattern of the particle stream. If you copy an emitter, you will notice that both emitters generate exactly the same pattern. This may or may not matter depending on the nature of your scene. To ensure that each stream is unique, enter a different seed value for each emitter. For example, a seed value of 1 will create a completely different stream to a seed value of 0.

Tangential

The trajectory of the individual particles may be curved by selecting this option. If this option is activated, the Z-axis of the particles is aligned along the trajectory of the emitter; you would need this to simulate exhaust gases emitting from the engines of an aeroplane flying on a curve, say.

Tip

This option takes additional render time and should be disabled for objects with no direction (e.g. spheres or light sources).

Tip

You should only use one of the Rotation *or* Tangential *options at a time. For obvious reasons, these two are mutually exclusive.*

Show Objects

You can choose the way in which a particle is displayed.

If this option is deactivated, the particles are displayed in the editor as lines. The direction and length of each line indicates the direction of flight and the current speed of the respective particle - the longer the line, the faster the particle.

If this option is activated, the particles will be displayed in the editor as real objects. Please note that this display mode can slow down the redraw rate considerably, especially with complex objects.

Tip for Animations in the Editor

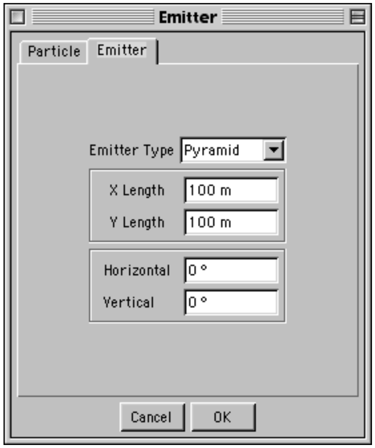
Particle effects will only be displayed accurately when played at a constant rate in the Time Line. If you go backwards in time or move more than one frame forward then strange things may happen on the screen.

These odd effects happen because the new position of a particle is calculated from the previous position. Therefore you should reset the time slider of the Time Line to the starting position whenever you place new modifiers in the particle stream.

When playing back you should also use the option Time Line > Navigation > Frame Rate > All Frames.

When the scene is finally rendered with the raytracer this does not matter, since the scene will then be calculated frame by frame from start to end.

Emitter Tab



Emitter Type

Indicates whether you want the particles to emit in either a cone shape or a pyramid shape.

X Length, Y Length

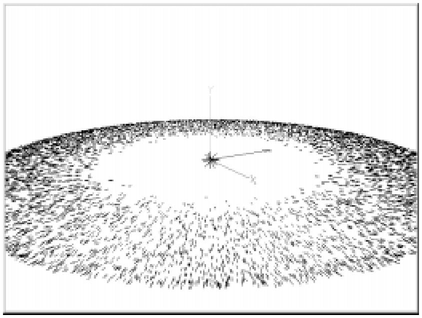
Indicates the size of the emitter.

Horizontal, Vertical

Sets the value of the emission angle of the particle stream. At a value of 0° the particles are emitted parallel to the Z-axis of the emitter, with a value of 180° the particles can exit in the XY plane of the emitter (Z=0).

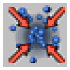
A radial emitter can be created with the following values:

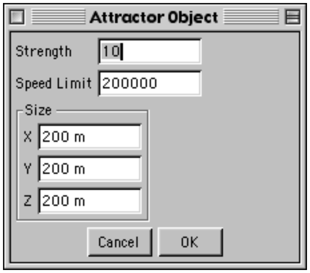
X-length = 0;	Horizontal = 360°
Y-length = 0;	Vertically = 0°



Modifiers

Attractor





The Attractor is a radially symmetrical gravitational force. With this modifier you can capture particles in a similar way that the sun captures individual planets. You can also create water whirls with this function.

Outside of the range of the Attractor, the particles will move in a linear fashion.

Strength

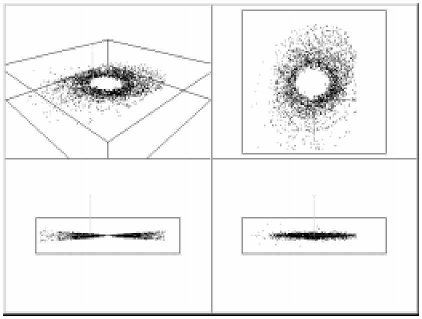
Indicates how strong the gravitational force will be. This value can also be negative, which produces a repulsion. So for example the different magnetic poles can be simulated.

Speed Limit

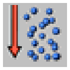
To prevent the particles travelling too quickly in a scene when using large values, you may define a speed limit with this function.

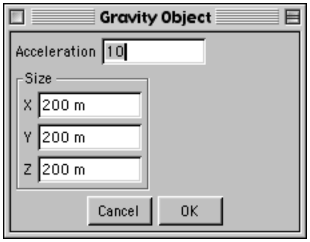
Size

Defines the spatial dimensions of the Attractor in all three directions.



Gravity





Gravity is familiar to us all, since the first time you ever dropped your buttered toast on the floor. The gravitational modifier will simulate this natural pull of the earth.

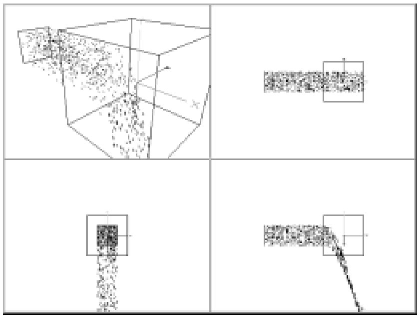
The gravitational force acts in the negative Y direction only (unlike the Attractor above). In the editor a small, downward pointing arrow indicates this.

Acceleration

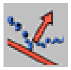
Defines the strength of the acceleration force.

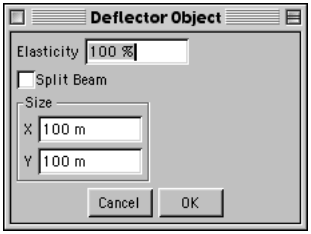
Size

Defines the spatial dimension of the gravity modifier in all three directions.



Deflector





A Deflector modifier is used to physically deflect particles. A realistically animated billiard table could quite easily be created with just five deflectors (one for the surface plus four cushions). The emitter creates just one particle (a sphere for the ball) which never leaves the table, rebounding nicely off the cushions.

Elasticity

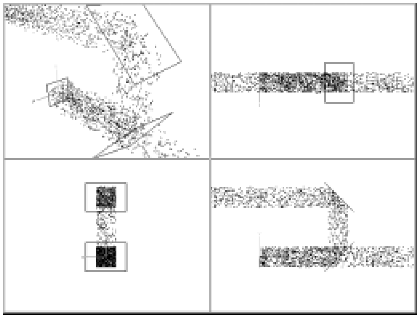
Indicates how *bouncy* the deflectors should be, i.e. the degree of rebound. With a value of 100%, the angle of exit is equal to that of the entry angle. The smaller the elasticity value, the more the particle's energy is absorbed by the deflector and the more the motion proceeds along the direction of the deflector.

Size

Defines the spatial dimensions of the deflector in X and Y directions.

Split Beam

Activating this option will divide the particle stream at the deflector. Half of the particles will be deflected, while the other half simply passes through unaffected, as if it were not there.

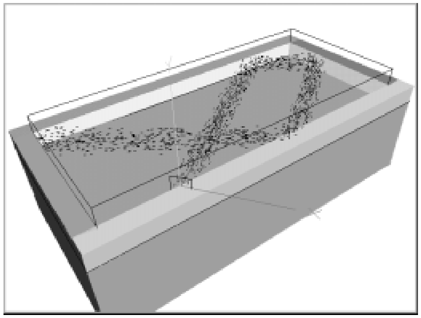


Note

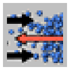
The calculation of the division only works with a fixed deflector and not with particles moving at high speed. Imagine a simple particle, moving at a high velocity of 200 units per frame. In the first frame it is 100 units in front of the deflector. However, in the next frame it has moved to 100 units behind the deflector. The deflector algorithm simply does not see the particle and has no chance to influence it. Obviously it is possible to define a larger influence radius for the deflector, but this would mean the particles would sometimes be influenced 100 units before reaching the deflector. This is a problem common to all particle simulations currently available.

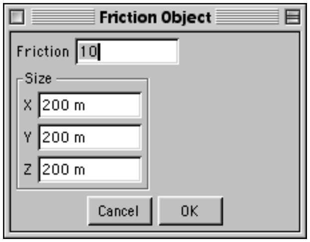
To a certain extent the use of the bake function may help here, by defining a higher Samples per Frame *rate, e.g. 10 samples per frame instead of only one. This will ensure that the entire animation and in particular those frames involving particle calculations are rendered with a higher time rate (in this case it would be 10 times higher). The deflector now has a chance of seeing, and thus influencing, the particle.*

Here is another example billiard table:



Friction





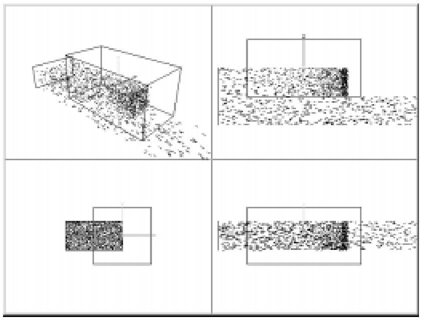
Friction reduces the speed of the particles, even bringing them to a complete standstill.

Friction

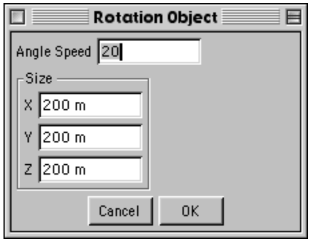
Gives the strength of the friction, thus affecting how the particles are slowed down. After leaving the modifier the particles continue moving at a constant (but reduced) speed. The friction coefficient can also use a negative value; in this case the particles accelerate.

Size

Defines the spatial dimensions of the friction modifier in all three directions.



Rotation



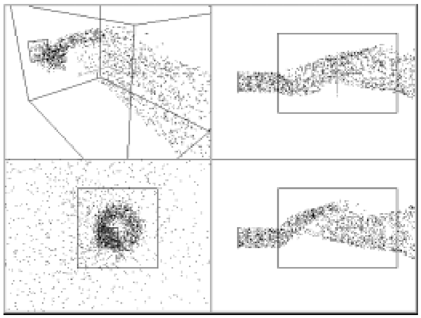
Rotation adds a tangential acceleration to the particle movement. This rotation occurs around the Z-axis. The radius is half the size of the smaller dimension of the modifier in the X and/or Y direction. Interesting effects can result if you place the modifier with its Z-axis parallel to the direction of the starting point of the particles. A spiral-shaped helical movement is then produced.

Angle Speed

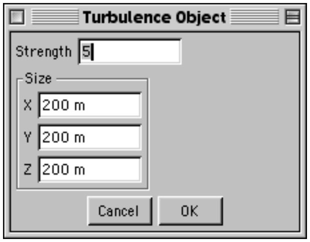
Gives the speed with which the particle stream is to be rotated around the Z-axis.

Size

Defines the spatial dimensions of the rotation modifier in all three directions.



Turbulence



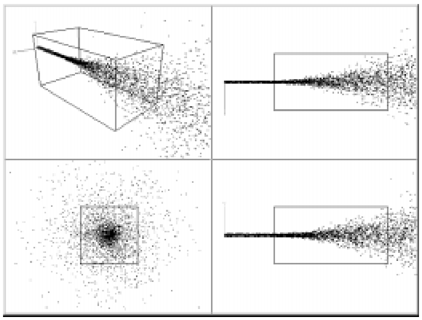
The Turbulence modifier will add a swirl effect to your particle stream. Interesting effects can be made with an elongated modifier as this would create a realistic, twisting smoke effect.

Strength

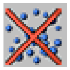
Indicates the strength of the Turbulence and thus how much the particle stream will be influenced.

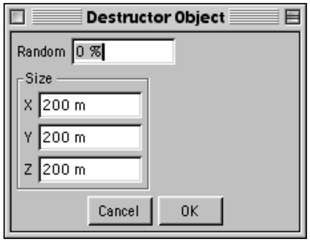
Size

Defines the spatial dimension of the turbulence modifier in all three directions.



Destructor





With the Destructor modifier you can destroy (i.e. remove) particles from the particle stream.

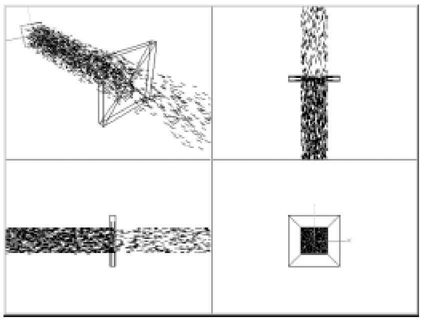
Random

Affects how many particles will *survive*.

0% =	All particles are destroyed.
x% =	x% of the particle stream remain.
100% =	All particles pass through the Destructor.

Size

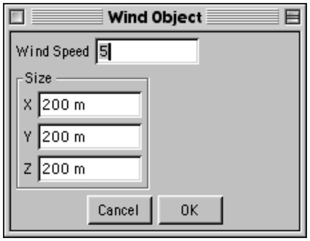
Defines the spatial dimension of the turbulence modifier in all three directions.



Important Note

So that the Destructor has a definite effect, i.e. that of destroying particles, it must have a minimum thickness that is greater than the length of run of a particular particle from one frame to the next. Otherwise a particle cannot be caught *and thus cannot be destroyed.*

Wind



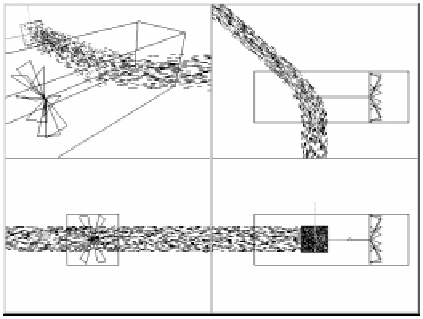
Wind diverts and disrupts the particle stream in a particular direction. The direction of the wind is displayed in the editor as a windmill-like (or fan-like) object with a small arrow showing the wind direction.

Wind Speed

Gives the strength of the wind and, thus, how much the particle stream will be diverted.

Size

Defines the spatial dimensions of the wind modifier in all three directions.



Tip

The wind modifier is represented by a cube with a fan-like object on one of the cube's faces. The fan shows the direction in which the wind is blowing (away from the face); the rotation rate of the fan is an indication of the wind strength.

Examples

Here, as promised at the beginning of the chapter, are two mini-tutorials for particle animation with light sources and metaballs. We hope you enjoy them.

Particle animation with light sources

We are going to create a comet tail in this tutorial. Real comet tails are up to 200 million kilometres in length, even though the core of ice and dust is 'only' a few kilometres in diameter. We will not be working to scale for this one :-)

Start by creating a light source with the parameters listed below. Only the values which you need to change are listed - please leave the other values set to their default. For more information on light sources, see page 193.

General tab

Color	R 100%, G 50 %, B 0%
Visible Light	Visible
No Light	Radiation activated

Visible Light tab

Outer Distance	10 m
Outer Distance Y	10 m
Outer Distance Z	20 m
Additive	activated

Next, create an emitter and change the following values (again, leave the values that are not listed set to their default):

Particle tab

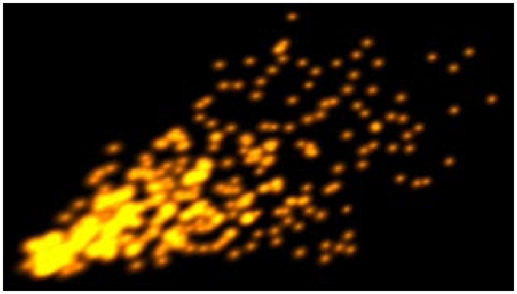
Speed Variation	50%

Emitter tab

X Length	30 m
Y Length	30 m
Horizontal	30°
Vertical	30°

Drag-and-drop the name of the light source onto the name of the emitter in the Object Manager. This will make the light source a child of the emitter. Move the time slider some way into the animation, then render the picture.

You could refine the tail by animating the light source parameters. For example, the particles could start with a yellow color, changing to orange then black over time. You could also add a particle modifier or two. The sky's the limit!



Let's see a second example - *meta-particles*!

Particle animation with metaballs

CINEMA 4D allows you to combine the properties of particles and metaballs. We explain the process below. As with the first mini-tutorial, we list only the values that you need to change. Please leave values that are not listed set to their default.

Create a metaball and change its values to:

Hull Value	70%
Editor Subdivision	15 m
Render Subdivision	5 m

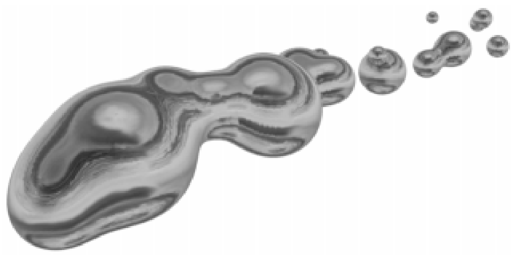
Next, create an emitter with the following values:

Particle tab

Birth Rate (Editor + Rendered)	15
Lifetime	100 F; Variation: 50%
Speed	500 m; Variation 50%
End Scaling	0; Variation 100%

Drag-and-drop the name of the emitter onto the name of the metaball in the Object Manager. This will make the emitter a child of the metaball. Note that, in this case, you do not need to make an object a child of the emitter.

Move the time slider some way into the animation, then render the picture. Please experiment with the settings - you can create some wonderful effects with this technique!



Note

You must render in the Picture Viewer (Render > Render to Picture Viewer) in order to see the 'smooth' version of the metaballs - this smooth version relates to the metaball's Render Subdivision value.

Deformation

The deformation objects deform the geometry of other objects. You can use *deformers* on primitive objects, NURBS objects, polygon objects and splines.

In the following, we call the object that is to be deformed the *recipient* object.

To have an effect, the deformer must either be on the same hierarchy level as the recipient or a direct child of the recipient.

You can use several deformers on the same recipient. Their order of evaluation is from top to bottom in the Object Manager. The evaluation order matters - a twist followed by a bend produces a different result to a bend followed by a twist!

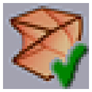
The deformer can only work with *what you give it*. For example, if you wish to twist the recipient smoothly, ensure that it has a sufficiently high number of segments/subdivisions along the twist axis.

All deformers apart from bones are activated automatically when you create them. If a deformer is activate, you will see the following icon in the Object Manager:

To deactivate the deformer, click on the green tick. The icon changes into a red cross:

A deformation object has no effect when it is deactivated.

There are two ways to activate or deactivate all deformers at once. You can either toggle the **Use Deformers** option from the **Edit** menu (main window) or you can use the drawing pipeline icon shown below. For information on the drawing pipeline, see page 90.



Turn on/off deformers in the drawing pipeline

To animate a deformer, use a parameter track in the Time Line (see page 574). For example, you can vary the strength of a wind deformation over time.

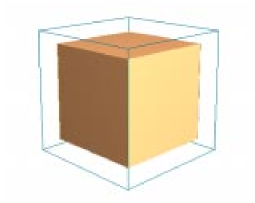
You can restrict a deformer's influence using vertex maps and polygon selections - see page 263 for an example with bones. You can learn how to make vertex maps on page 328, and polygon selections on page 322.

Very important note!

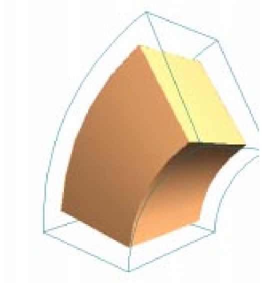
Activate UVW mapping before you deform objects. This will prevent textures from 'slipping'. See page 531 for more details on UVW mapping.

Bend

This deformer bends an object. The deformer has an orange handle on its top surface. Drag the handle to control the bend interactively in the editor.

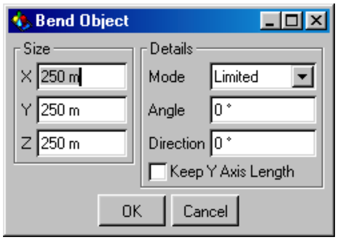


Cube with 5x5x5 segments



The same cube with a bend deformation

To open the dialog for the bend deformer, double-click on its icon in the Object Manager. The dialog contains the following settings:



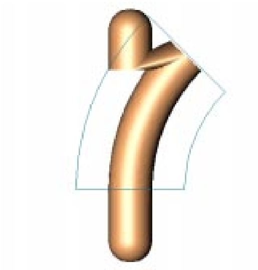
Size

You can use the X, Y and Z values to change the deformer's dimensions.

Mode

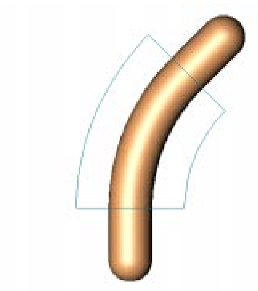
There are three modes for bend deformation.

Within Box



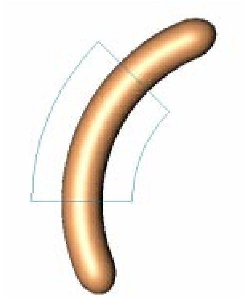
Surfaces within the cyan box are bent. Surfaces outside the box remain exactly where they are (they are unaffected).

Limited



The entire object is affected. Surfaces within the cyan box are bent and the other surfaces move and rotate if necessary to accommodate the bend.

Unlimited



The entire object is bent.

Angle

This value is the bend angle. To change this value interactively, drag the orange handle in the editor.

Direction

This value defines the direction of the bend. 0° corresponds to the deformer's local X axis.

Keep Y Axis Length

If you activate this option, the object will maintain its original length throughout the bend deformation.

Bone

Character animation, done well, makes jaws drop. However, there are a few pitfalls on the way to character animation par excellence.

One way to animate a character, for example, is to split it into separate objects and then apply inverse kinematics to each part. The major drawback with this method is that rigid, disconnected joints are not particularly lifelike. A way to solve this split-mesh problem is to use morphing or PLA (point level animation) instead. Although these techniques enable you to animate a single mesh, the process becomes very involved with even moderate complexity.

However, there is a more natural way to animate characters; bones. The idea is that you create a skeleton of bones for the character. Once the bones are in place, you then animate them with inverse kinematics to bring the character to life.

The *skin*, in this case the object surface, will stretch and contract according to the animation of the bones. One advantage of the bone technique is that the skeleton is completely independent of the character object's geometry, enabling you reuse the skeleton time and again with other objects.

You can use bones with all object types, including parametric objects, NURBS objects, polygon objects and splines - even other deformation objects can have bones.

Hyper NURBS and Bones

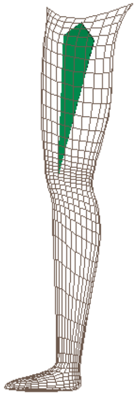
You can apply bones to a Hyper NURBS object (see page 165). There is no need to convert the Hyper NURBS object into a polygon object. Rather than work with a high-poly object, you can apply the bones directly to the low-poly cage of the Hyper NURBS. The bones will deform the cage, which in turn will deform the Hyper NURBS object. The object is smoothed *after* the deformation.

This method saves you the polygon errors, torn mesh and kinks that are associated with high-poly characters. You simply animate the cage and the result is a perfectly-formed, clean, kink-free Hyper NURBS object. In addition, it is much easier and more flexible to work with a low-poly object when using limited radii or even vertex maps.

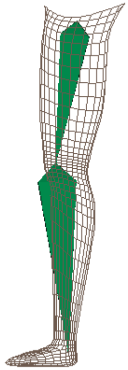
Laying out the bones hierarchy

In this section we are going to create a hierarchy for a Hyper NURBS leg. First we need the leg. We have included one for you on the CINEMA 4D CD. Load the Hyper NURBS leg. We need to create three bones; thigh, lower leg and foot. We shall start with the thigh bone, since it needs to be at the top of the bones' hierarchy (the bones' hierarchy will be created automatically, so it is important to start with the topmost bone).

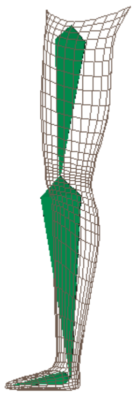
Create a bone object by selecting **Objects > Deformation > Bone**. Initially, the bone points in the direction of the Z axis. You can rotate the bone by dragging the little orange circle (*handle*) at the tip of the bone. Change into the side view and rotate the bone into the knee.



We are going to create the second bone (lower leg) by *pulling* it out of the thigh bone. Hold down the Ctrl key and drag out a new bone from the orange handle of the thigh bone. Let go of the mouse once the new handle reaches the ankle region of the leg. Change into the front view and check that the new bone really is in the middle of the lower leg. If necessary, adjust the direction of the new bone by dragging its handle. When a new bone is created in this way (pulled out from an existing, *parent* bone) it becomes a sub-object of the parent bone automatically.



We need just one more bone, the foot bone. Pull the foot bone out from the lower leg bone. Move into the top view and check that the bone is in the middle of the foot.



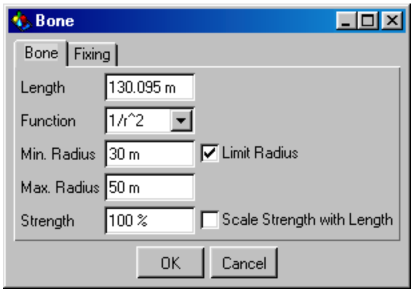
Note

The bone may spin around the Z axis when you pull on its handle. In this case you should rotate the bone about the Y axis of the world coordinate system using the Rotate tool, otherwise problems may occur later when the bone is animated.

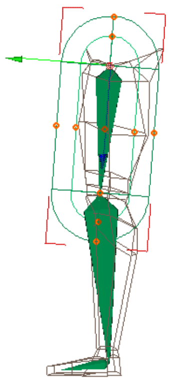
Using the Limit Radius option

It is important to restrict a bone's influence. For example, we do not want the thigh to be deformed when we move the foot bone. There are three ways to restrict the influence of bones - the first and most simple way is to use the **Limit Radius** option, which is explained on page 265.

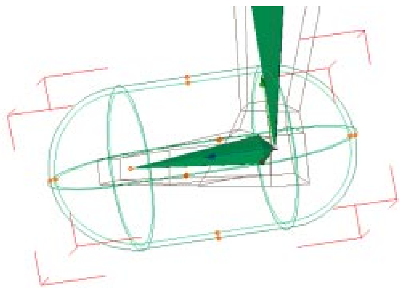
Double-click on the icon for the topmost bone (the thigh bone) in the Object Manager. Then, in the dialog that appears, select the **Limit Radius** function. Set **Min. Radius** and **Max. Radius** to, say, 30 and 50 - the exact values do not matter since we shall adjust them interactively in the editor. What is important is that you enter a value greater than 0 for **Min. Radius**, otherwise its handle will not appear in the editor. Click on OK to close the dialog. Now, limit the radii for the other two bones as well.



You should see two capsule-shaped cages in the editor surrounding whichever bone is selected. You can enlarge or scale down the cages by dragging their little orange handles. When using a Hyper NURBS object you can often set both radii to the same value, since the points of the Hyper NURBS cage are usually so far apart that a soft transition will occur automatically. If you would like to see the points of the Hyper NURBS object cage, take the cage out of the Hyper NURBS and change the display mode to wireframe - do not forget to put the cage back.

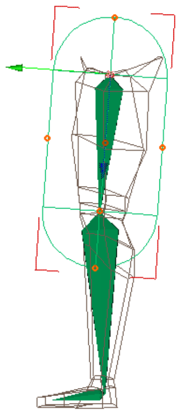


Select the foot bone. The radii for the foot should appear. Adjust the radii so that they enclose the foot completely.



Now adjust the radii for the lower leg bone until they enclose the entire lower leg and part of the foot. Next, adjust the radii for the thigh bone so that they enclose the entire thigh and part of the knee.

Slight overlaps are fine. What is important is that *all* parts of the leg are influenced by at least one bone, otherwise the leg will tear when the bones are animated.



Now we are ready to apply the bones, so drop the bones hierarchy onto the Hyper NURBS cage in the Object Manager.

Finally, we need to fix the bones; click once on the topmost bone in the Object Manager to select it, then choose **Objects > Fix Bones**. A requester appears, asking if sub-objects should be included (fixed). Click on OK.

The position in which the bones are fixed is their *starting position*. You can return the bones to their starting position at any time by selecting **Objects > Reset Bones** in the Object Manager. Resetting the bones deactivates their influence at the same time, i.e. they will no longer be fixed. You can fix the bones again in the usual way (**Objects > Fix Bones** in the Object Manager).

In this way you are able to change the starting position of the bones (move the bones to their new starting position before fixing them again).

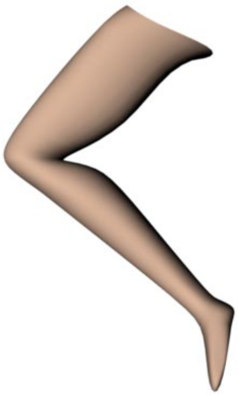
You can tell if a bone is active by its activation icon in the Object Manager:

Important

Bones are activated automatically when you fix them. However, just activating the bones will not fix them! You must fix the bones before activating them. Once you have fixed the bones, you can activate and deactivate them as required. You may be wondering what happens if you activate a bone before it is fixed. The answer is simple - the default fixing values of 0,0,0 will be used as the starting position and the object will be deformed accordingly (probably not a pretty sight!).

Try rotating the bones using the Rotate tool. If you notice that some parts of the leg are not moving properly, it is more than likely that you need to enlarge the radii for one or more of the bones. You can change the radii interactively even though the bones are fixed. Even if the leg is moving properly, try changing the radii to see how easy it is to adjust them in this way.

The bend at the knee isn't quite right. This is because the function is set too soft (see page 265). Change the **Function** value for the top bone to 1/r^10. There, perfect!



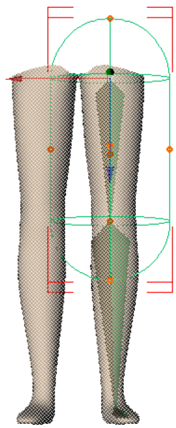
You can learn how to apply IK to the bones and animate the leg on page 309.

Restricting bones using polygon selections or vertex maps

In the preceding section we used the **Limit Radius** option to restrict a bone's influence. Bones can also be restricted using polygon selections or vertex maps. Exactly how you create polygon selections and vertex maps is beyond the scope of this section - instead, see pages 325 and 328. That section describes how you can allocate an *existing* selection or vertex map to a bone.

You can use polygon selections and vertex maps to restrict the effect of *any* type of deformation object (e.g. bend, bulge). The procedure is described in this chapter since restriction is used primarily with bones.

In the previous section we were able to restrict the bones in a leg quite effectively using radii. However, most conventional life-forms have at least two legs - as you can see in the picture below, the radii spill over onto the right leg, causing problems when animated.

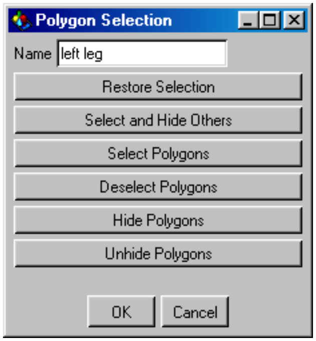


You can solve this problem by defining either a polygon selection or a vertex map for each leg. There is no need to define a restriction for each part of the leg - it is sufficient to restrict each leg as a whole.

For our example, a polygon selection per leg is adequate, since the points in the Hyper NURBS cage are spread out. If, on the other hand, you are using an object with a high point density, vertex maps are the better option in order to obtain a smooth transition at the edges of bones. In any case, the procedure for both methods is identical, i.e. the following description applies to vertex maps as well as polygon selections.

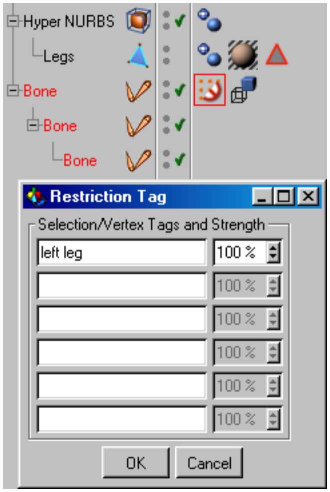
The polygon selection will restrict each leg as a whole. This means that we still need to use limited radii (see above) to further restrict each bone, e.g. so that the foot bone of the left leg will only influence the foot region of the left leg.

We can use our Hyper NURBS leg from the previous section. The bones already use the limited radii that we require. Mirror the surfaces of the leg (see page 375) to create a second leg. Now, select the surfaces of the leg which contains the bones, then choose **Selection > Set Selection**. Name the selection 'left leg'.



Now for the really important part - the allocation of the restriction tag to each bone.

In the Object Manager, select **File > New Tag > Restriction Tag**. The following window appears:



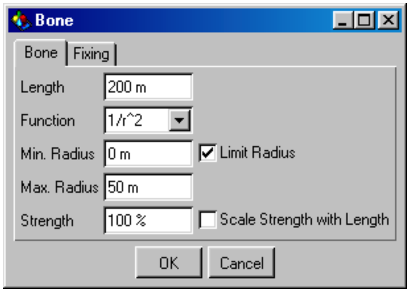
You can use this dialog to specify all the polygon selections and vertex maps that the bone should influence. The strength percentage allows you to weight the bone for each selection or vertex map. In our example, we use just one selection, *left leg*. Type 'left leg' into the first line of the dialog. You can leave its strength setting at 100%. Once you have clicked on OK, the following icon appears in the Object Manager, to the right of the bone:

Copy the restriction tag onto the other bones (drag-and-drop the restriction tag with the Ctrl key held down). This will ensure that the bones influence the *left leg* selection only.

The allocation procedure is identical for vertex maps. You can find an example of vertex map restriction on the CINEMA 4D CD.

The Bone Dialog

If you click on the bone icon in the Object Manager the following dialog opens:

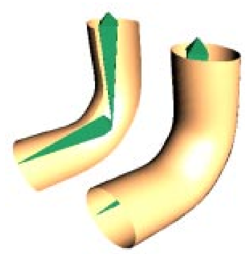


Length

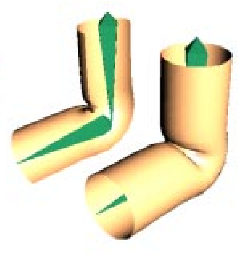
Here you enter the length of the bone. The length extends from the origin of the bone's coordinate system to the orange handle.

Function

The function defines how loose or tight the bend at the joints should be. The higher the power of 1/r, the greater the pull on the surrounding points, as shown in the examples:



Function 1/r^2



Function 1/r^10

The top picture demonstrates how the bend becomes tighter in the joint region with increasing power for the radius setting.

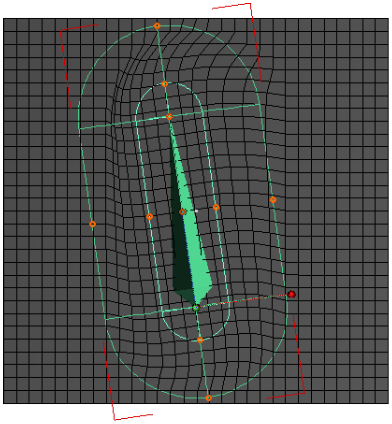
Lower settings are more suited to tube-like objects such as animated snakes; higher settings are more suited to the simulation of anatomical joints such as elbows.

The function must be defined in the bone at the top of the hierarchy (topmost in the Object Manager). This will define the function for all the bones in the hierarchy, regardless of the function value set in those bones.

Limit Radius, Min. Radius, Max. Radius

If the **Limit Radius** option is not selected, a bone will influence all the object's points. In order to prevent, say, the head moving when you move the little toe, you can use the **Limit Radius** option to restrict a bone's influence. **Min. Radius** defines the volume within which all points are transformed completely by the bone (1:1).

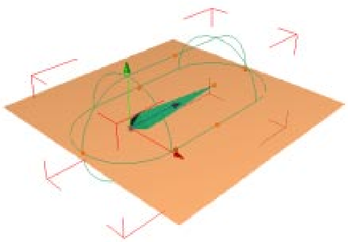
Points between the minimum and maximum radii are transformed softly, generating a smooth stretch. If both radii are equal, the points at the edge tear abruptly.



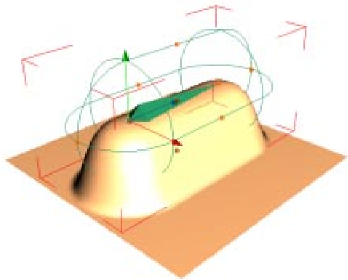
Bone with Limit Radius Min.: 35, Max.: 95

The pictures above and below show how, in view of the original horizontal position of the bone:

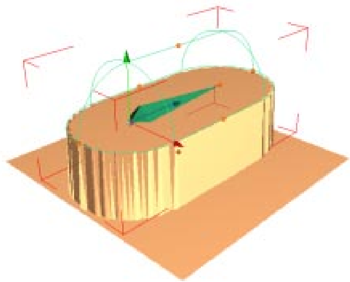
- the volume within the minimum radius is rotated but not distorted
- the volume between the minimum and maximum radius is rotated and distorted
- the volume outside the maximum radius is not influenced at all.



Starting object; plane with bone



Soft transition at the edge (Min. Radius = 0) - all points within Min. Radius are transformed softly



Hard edge (Min. Radius = Max. Radius) - All points within Max. Radius are transformed completely

Note

If you restrict the bones using the Limit Radius option the radii must, on principle, be restricted for all sub-bones too.

As a general rule, restrict all of the bones, or none at all.

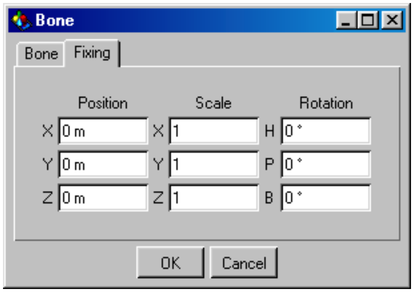
Strength

This lets you specify the influence that a bone exerts on a point in comparison to all other bones.

Scale Strength with Length

If the length of a bone is animated, it can be useful to change its strength proportionately. If you require this, activate this option.

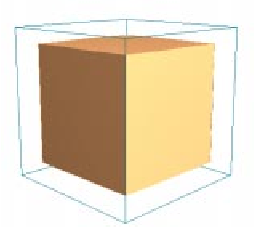
Fixing Page



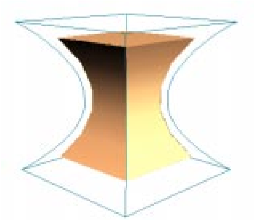
You can use this page among other things to define an irregular scale for a bone, e.g. to create irregular bone radii. Proceed with caution - the sub-systems will be distorted, which can lead to unexpected results (see page 305).

Bulge

This deformer makes an object bulge or contract. The deformer has an orange handle on its top surface. Drag the handle to control the bugle interactively in the editor.

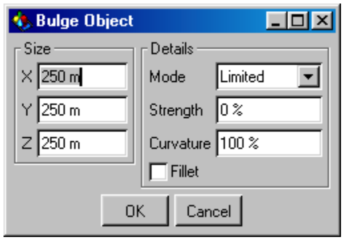


Cube with 5x5x5 segments



The same cube with a bulge deformation

To open the dialog for the bulge deformer, double-click on its icon in the Object Manager. The dialog contains the following settings:



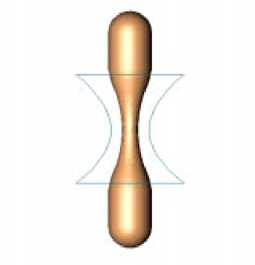
Size

You can use the X, Y and Z values to change the deformer's dimensions.

Mode

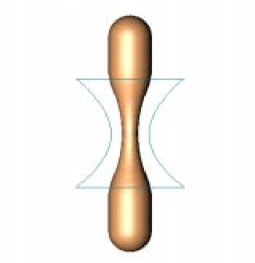
There are three modes for bulge deformation.

Within Box



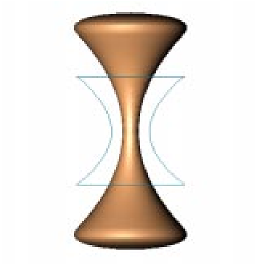
Surfaces within the cyan box bulge. Surfaces outside the box remain exactly where they are (they are unaffected).

Limited



The entire object is affected. Surfaces within the cyan box bulge and the other surfaces move and rotate if necessary to accommodate the bulge. In the example, the result is the same as **Within Box**. However, the effect differs when the bulge deformer is moved or rotated.

Unlimited



The entire object bulges.

Strength

This is the strength of the bulge. To change this value interactively, drag the orange handle in the editor.

Curvature

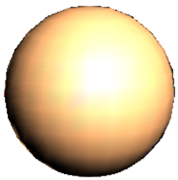
This value affects the curvature of the bulge. The higher its value, the more curvy the bulge.

Fillet

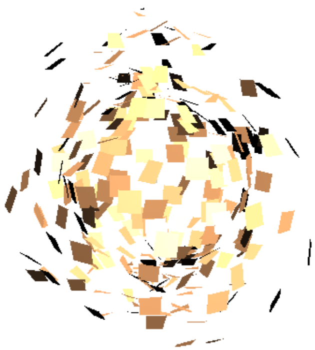
If you select this option, the deformation is softened near the top and bottom.

Explosion

The explosion deformer explodes an object into its constituent polygons. The recipient object explodes from the deformer's origin. Drag the orange handle to control the state of the explosion interactively in the editor. To animate the explosion, use a parameter track in the Time Line (see page 574). For a complete explosion, set **Strength** for the first key to 0% and **Strength** for the second key to 100%. You can reverse the explosion (an *implosion*) by swapping the keys around. Implosion is particularly useful for logo animation.



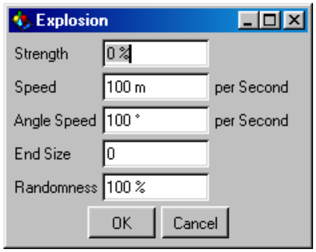
A normal sphere



The same sphere with an explosion deformation

To open the dialog for the explosion deformer, double-click on its icon in the Object Manager.

The dialog contains the following settings:



Strength

This value defines the state of the explosion. 0% is the start of the explosion, 100% is the end of the explosion. To change this value interactively, drag the orange handle in the editor.

Speed

This value defines the speed of the polygons during the explosion.

Angle Speed

This value defines the angle through which each polygon rotates during the entire explosion.

End Size

This value defines the relative size of each polygon at the end of the explosion. If the value is set to 1, the polygons will remain the same size throughout the explosion. If the value is set to 0, the polygons will disappear by the end of the explosion. If the value is 2, the polygons will double in size.

Randomness

This value defines the percentage by which the speed and angle speed may vary.

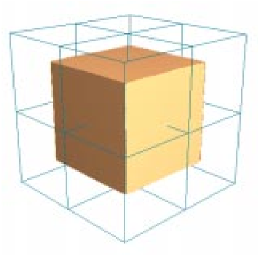
FFD

The FFD deforms objects freely using any number of grid points. Each grid point pulls on surfaces like a little magnet.

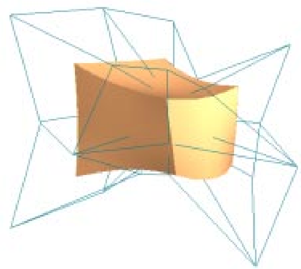
Note

In contrast to the other deformers, you must edit the FFD in point mode (there are no handles to move, only grid points to manipulate).

To animate an FFD deformer, use either morph targets or PLA (see Special Effects, page 566).

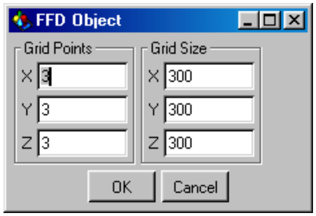


Cube with 5x5x5 segments



The same cube with an FFD deformation

To open the dialog for the FFD deformer, double-click on its icon in the Object Manager. The dialog contains the following settings:



Grid Points

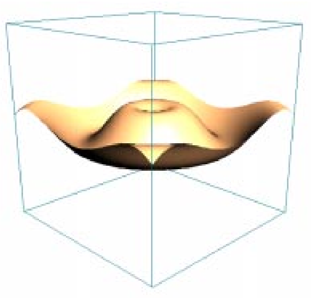
You can use the X, Y and Z values to define the number of grid points in the respective directions.

Grid Size

You can use the X, Y and Z values to change the deformer's dimensions.

Formula

The formula object uses mathematical formulae to deform other objects. Drag the handles to control the size of the deformer. All surfaces including those outside the cyan box are affected. The default formula creates circular waves.



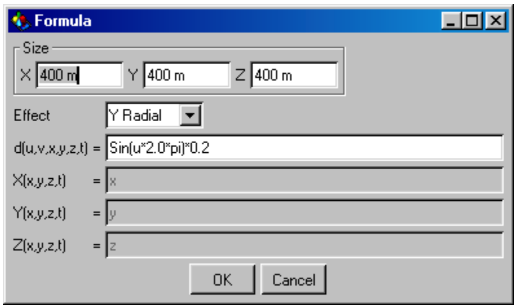
Plane with 40x40 segments

Another formula example

cos(4*sqrt(x*x+z*z)-2*t)/sqrt(1+4*sqrt(x*x+z*z))

This formula creates damped circular waves. The time parameter (t) has been introduced so that the waves are animated automatically over time.

To open the dialog for the deformer, double-click on its icon in the Object Manager. The dialog contains the following settings:



Size

You can use the X, Y and Z values to change the deformer's dimensions.

Effect

This value defines how the formula deformation should be applied.

- Manual. You can enter separate formulae for X, Y and Z. This enables you to combine several formulae.
- Spherical. The effect radiates from the deformer's origin outwards.
- Cylindrical. The effect starts from the deformer's Y axis and travels along its X and Z axes.
- X Radial. The effect starts from the deformer's origin and travels along its X axis only.
- Y Radial. The effect starts from the deformer's origin and travels along its Y axis only.
- Z Radial. The effect starts from the deformer's origin and travels along its Z axis only.

d(u,v,x,y,z,t)

This line is used for all effects apart from Manual.

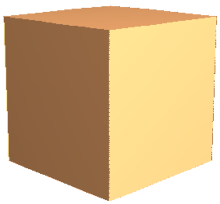
X(x,y,z,t), Y(x,y,z,t), Z(x,y,z,t)

These three lines apply to Manual only.

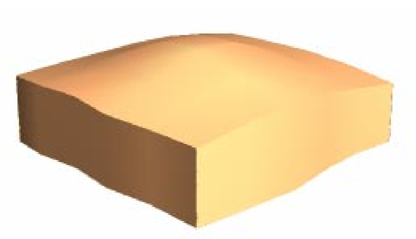
Melt

The melt deformer has no cyan box. The recipient object melts radially from the deformer's origin. Drag the orange handle to control the state of the melt deformation interactively in the editor. To animate the melt deformation, use a parameter track in the Time Line (see page 574). For a complete melt deformation, set **Strength** for the first key to 0% and **Strength** for the second key to 100%. You can reverse the melt deformation by swapping the keys around.

The recipient object will melt onto the Y plane of the deformer's origin. Consequently, the melt deformer is usually placed at the bottom of the recipient object.

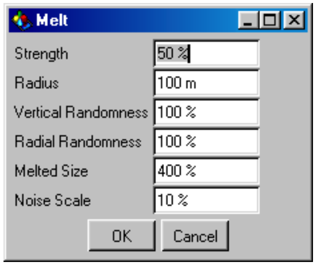


Cube with 5x5x5 segments



The same cube with a melt deformation

To open the dialog for the melt deformer, double-click on its icon in the Object Manager. The dialog contains the following settings:



Strength

This value defines the state of the melt deformation. If it is set to 0%, there is no melting. If it is set to 100%, the object is fully molten. To change this value interactively, drag the orange handle in the editor.

Radius

Surfaces within the **Radius** setting will melt more slowly than the other surfaces.

Vertical Randomness

This value defines the variation in downwards motion.

Radial Randomness

This value defines the variation in outwards motion.

Melted Size

This value defines the final width of the recipient object relative to its original width. The default value is 400%. Imagine a melting ice cube - the width of the puddle left behind is much larger that the original width of the ice cube.

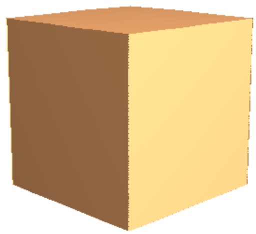
Noise Scale

The higher you set this value, the more irregular the surface becomes during the melt deformation.

Shatter

The shatter deformer has no cyan box. The recipient object shatters into individual polygons which then fall to the ground. Drag the orange handle to control the state of the shatter deformation interactively in the editor. To animate the shatter deformation, use a parameter track in the Time Line (see page 574). For a complete shatter animation, set **Strength** for the first key to 0% and **Strength** for the second key to 100%. You can reverse the shattering by swapping the keys around.

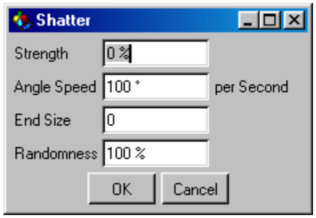
The shattered polygons will fall onto the Y plane of the deformer's origin. Consequently, the shatter deformer is usually placed at the bottom of the recipient object.



Cube with 5x5x5 segments

The same cube with a shatter deformation

To open the dialog for the shatter deformer, double-click on its icon in the Object Manager. The dialog contains the following settings:



Strength

This value defines the state of the shatter deformation. 0% is the start of the shatter effect (no shattering), 100% is the end (pieces shattered and lying on the ground). To change this value interactively, drag the orange handle in the editor.

Angle Speed

This value defines the angle through which each polygon rotates during the entire shatter deformation.

End Size

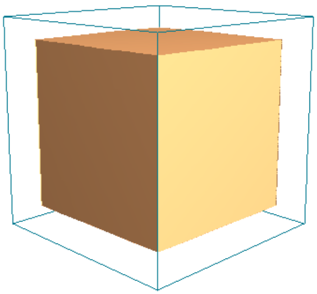
This value defines the relative size of each polygon at the end of the shatter deformation (when **Strength** is 100%). If the value is set to 1, the polygons will remain the same size throughout the deformation. If the value is set to 0, the polygons will disappear by the end of the shatter effect. If the value is 2, the polygons will double in size.

Randomness

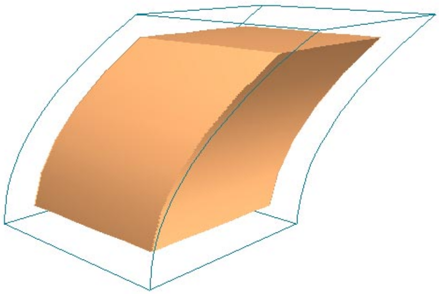
This value defines the percentage by which the speed and angle speed may vary.

Shear

This deformer shears an object. The deformer has an orange handle on its top surface. Drag the handle to control the shear deformation interactively in the editor.

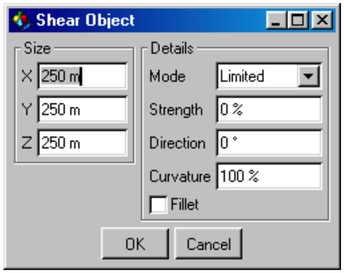


Cube with 5x5x5 segments



The same cube with a shear deformation

To open the dialog for the shear deformer, double-click on its icon in the Object Manager. The dialog contains the following settings:



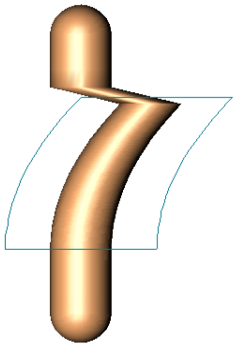
Size

You can use the X, Y and Z values to change the deformer's dimensions.

Mode

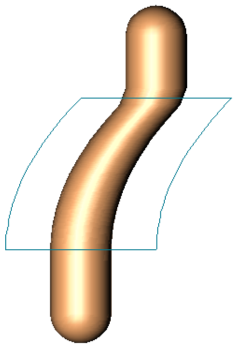
There are three modes for shear deformation.

Within Box



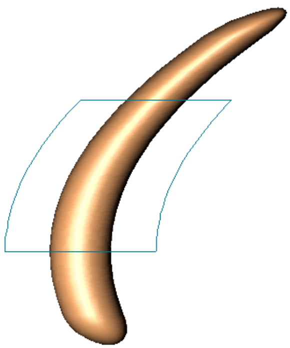
Surfaces within the cyan box are sheared. Surfaces outside the box remain exactly where they are (they are unaffected).

Limited



The entire object is affected. Surfaces within the cyan box are sheared and the other surfaces move and rotate if necessary to accommodate the shear.

Unlimited



The entire object is sheared.

Strength

This is the strength of the shear. To change this value interactively, drag the orange handle in the editor.

Direction

This value defines the direction of the shear. 0° corresponds to the deformer's local X axis.

Curvature

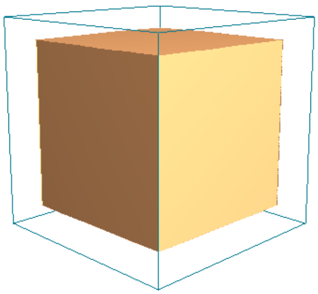
This value affects the curvature of the shear. The higher its value, the more curvy the shear.

Fillet

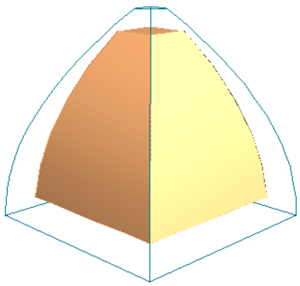
If you select this option, the deformation is softened near the top and bottom.

Taper

This deformer narrows or widens objects towards one end. The deformer has an orange handle on its top surface. Drag the handle to control the taper deformation interactively in the editor.

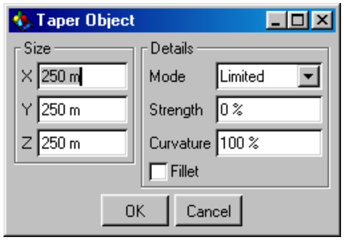


Cube with 5x5x5 segments



The same cube with a taper deformation

To open the dialog for the taper deformer, double-click on its icon in the Object Manager. The dialog contains the following settings:



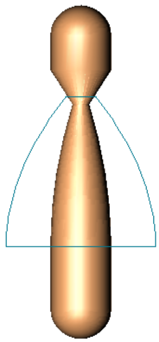
Size

You can use the X, Y and Z values to change the deformer's dimensions.

Mode

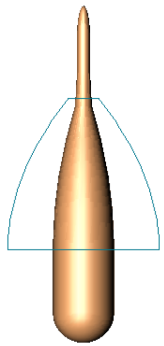
There are three modes for taper deformation.

Within Box



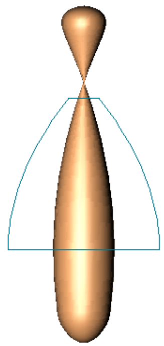
Surfaces within the cyan box are tapered. Surfaces outside the box remain exactly where they are (they are unaffected).

Limited



The entire object is affected. Surfaces within the cyan box are tapered and the other surfaces move and rotate if necessary to accommodate the taper.

Unlimited



The entire object is tapered.

Strength

This is the strength of the taper. To change this value interactively, drag the orange handle in the editor.

Curvature

This value affects the curvature of the taper. The higher its value, the more curvy the taper.

Fillet

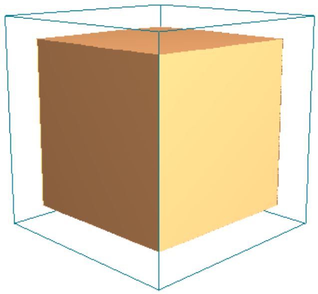
If you select this option, the deformation is softened near the top and bottom.

Twist

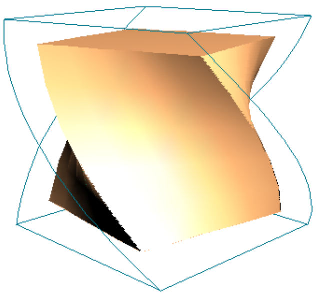
This deformer twists objects about its Y axis. The deformer has an orange handle on its top surface. Drag the handle to control the twist deformation interactively in the editor.

Note

A deformer can only work with 'what you give it'. If you wish to twist the recipient smoothly, ensure that it has a sufficiently high number of segments/subdivisions along the twist axis.

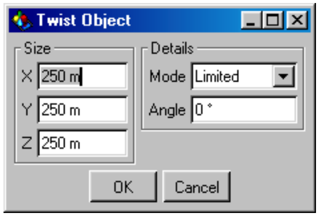


Cube with 5x5x5 segments



The same cube with a twist deformation

To open the dialog for the twist deformer, double-click on its icon in the Object Manager. The dialog contains the following settings:



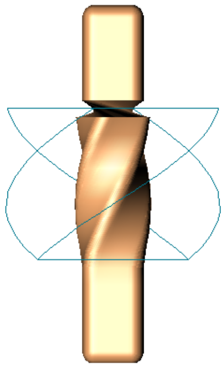
Size

You can use the X, Y and Z values to change the deformer's dimensions.

Mode

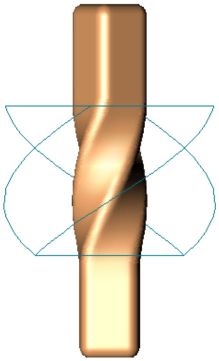
There are three modes for twist deformation.

Within Box



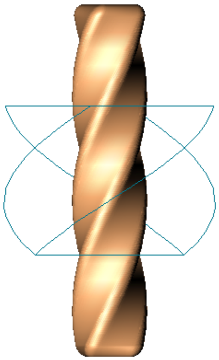
Surfaces within the cyan box are twisted. Surfaces outside the box remain exactly where they are (they are unaffected).

Limited



The entire object is affected. Surfaces within the cyan box are twisted and the other surfaces move and rotate if necessary to accommodate the twist.

Unlimited



The entire object is twisted.

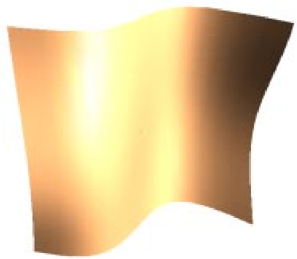
Angle

This value is the angle through which the recipient object is twisted. To change this value interactively, drag the orange handle in the editor.

Wind

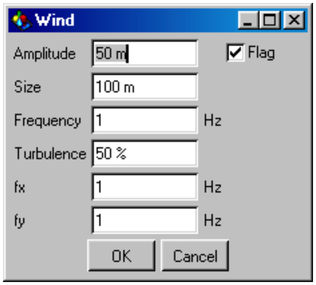
This deformer generates waves on an object. The wind *blows* in the deformer's positive X direction and is animated automatically (click on the play button).

Drag the orange handle on the Z axis to change the amplitude of the waves interactively in the editor. Drag the orange handle on the X axis to change the size of the waves in the X and Y directions.



Flag with wind deformation

To open the dialog for the wind deformer, double-click on its icon in the Object Manager. The dialog contains the following settings:

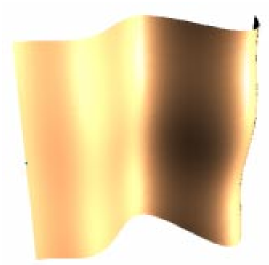


Amplitude

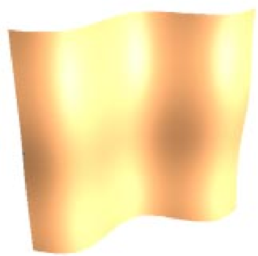
This value defines the size of the waves in the Z direction. To change this value interactively, drag the orange handle on the Z axis.

Flag

If you activate this option, all points along the deformer's Y axis remain still (fixed). For example, you can use this to simulate a flag on a pole - one end of the flag flaps freely in the wind, while the other end is fixed to the pole and does not move (place the deformer's Y axis along this end of the flag).



Flag activated - the wind deformer's Y axis is located at the left end of the flag. The left end of the flag is fixed



Flag deactivated - the entire flag flaps freely in the wind. The left end is no longer fixed

Note

If you have attached a flag to a rope (see picture below), place the wind deformer in an object group with the rope and flag. Then, both the rope and flag will move in the wind.

Size

This value determines the size of the waves in the X and Y directions.

Frequency

The frequency determines the speed of the waves.

Turbulence

This setting creates secondary waves which run in the direction of the deformer's Y axis. The percentage defines the size of these secondary waves relative to the main waves.

fx

This value determines the number of waves in the X direction.

fy

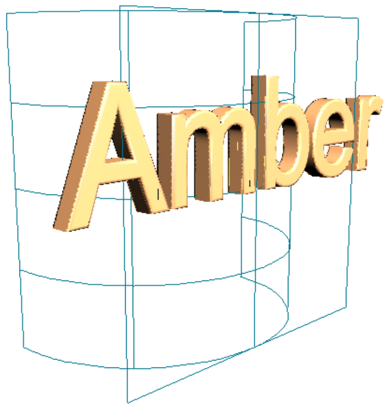
This value determines the number of turbulence waves in the Y direction.

Wrap

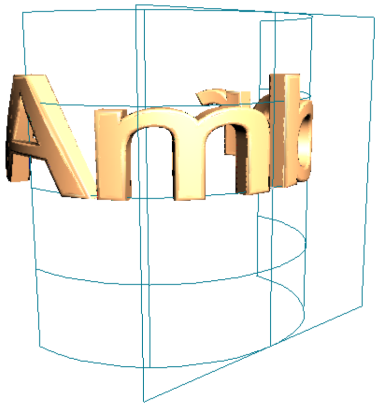
This deformer wraps objects into a cylindrical or spherical shape. The wrap deformer and the recipient should be placed as shown in the picture below. This is because the recipient is wrapped around the deformer's axes.

The wrap deformer has a flat surface and a curved surface. The curved surface represents part of the sphere or cylinder around which the recipient will be wrapped. The straight surface represents the area which will be wrapped around the curved surface exactly. If the recipient is larger than the flat surface, it will wrap onto and beyond the cyan curved surface. If the recipient is smaller than the flat surface, it will wrap onto and within the curved surface (it will not cover the entire curved surface).

Drag the orange handles on the X and Y axes to change the dimensions of the flat surface interactively in the editor. Drag the handle on the Z axis to change the radius of the sphere or cylinder.

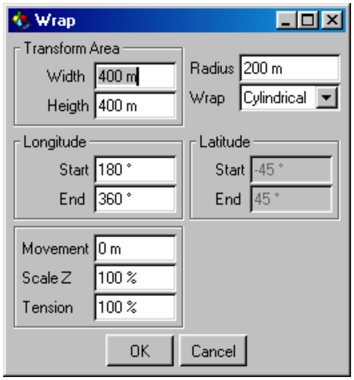


Text in an Extrude NURBS



The same text with a wrap deformation

To open the dialog for the wrap deformer, double-click on its icon in the Object Manager. The dialog contains the following settings:



Transform Area

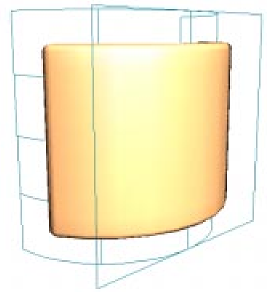
These settings define the width and height of the flat surface. If the recipient is larger than the flat surface, it will wrap onto and beyond the cyan curved surface. If the recipient is smaller than the flat surface, it will wrap on to and within the curved surface (it will not cover the entire curved surface). To change the transform area interactively, drag the orange handles on the X and Y axes.

Radius

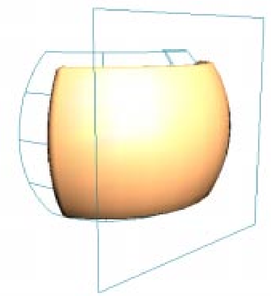
This value defines the radius of the cylinder or sphere (see below) around which the recipient is wrapped.

Wrap

You can use this value to determine whether the recipient is wrapped around a sphere or a cylinder.



Cylindrical wrap



Spherical wrap

Longitude

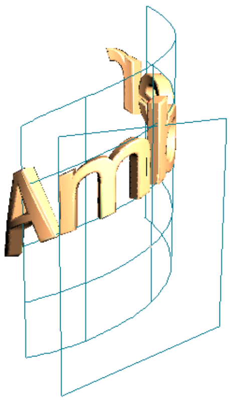
These angles define the horizontal span of the curved surface about which the recipient is wrapped. If **Start** is set to 180° and **End** to 360°, the curved surface forms half of the cylinder or sphere in the horizontal direction.

Latitude

These angles define the vertical span of the curved surface about which the recipient is wrapped. If **Start** is set to -45° and **End** to 45°, the curved surface forms the middle half of the cylinder or sphere in the vertical direction.

Movement

You can use this value to specify a movement in the Y direction. This causes the object to wrap in a spiral fashion. You can use a positive value to spiral up or a negative value to spiral down.



Scale Z

You can use this value to simulate the flattening effect that often occurs when a real-life flexible object is stretched. If you enter 50% instead of 100%, the object will be flattened by 50% in the Z direction. You can enter values greater than 100% if you would like the object to expand on wrapping.

Tension

This value represents the amount of tension applied to the recipient. If you reduce the value from 100%, the wrapping effect is weakened. With 0%, there will be no wrapping at all. To animate a wrap deformation, use a parameter track in the Time Line (see page 574).

For a complete wrap animation, set **Tension** for the first key to 0% and **Tension** for the second key to 100%. You can reverse the wrapping by swapping the keys around.

Sound

No, you have not mis-read and you are not in the wrong manual; CINEMA 4D offers you sound within your scenes. Two different options are available: *2D Sound Rendering* and *3D Sound Rendering*.

With 2D sound rendering you use the Time Line of CINEMA 4D like a multi-track audio mixer (as in many video editing programs). You can create any number of sound tracks, assign WAV files to them and adjust the timing, the volume and the balance, depending upon your requirements. This procedure is suitable for the classical tasks of synchronisation (e.g. lip-synch, footsteps, a slamming door, an explosion etc.).

3D sound rendering takes a quite different approach. With this you work with virtual acoustic sources (loudspeakers) and pickups (microphones) as objects. These virtual objects can be positioned freely within the 3D space and also can be animated. CINEMA 4D calculates the appropriate sound data then later, on the basis of the spatial position of these objects, the speed and the preset sound parameters. You can merge this data afterwards with surround sound data in an external program.

The 3D sound rendering is a most versatile method of sound production and offers many, almost infinite, applications. From a car driving from left to right up to an enormous spaceship battle with laser beams and explosions in Dolby surround sound; everything is feasible.

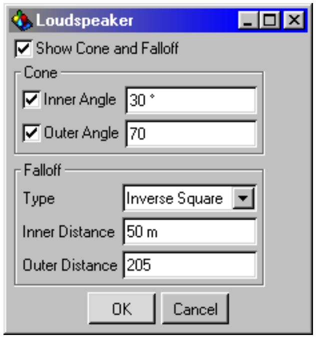
Loudspeaker

This function creates a loudspeaker object, which is needed for the calculation of 3D sound rendering (see page 576-578). You can assign a WAV sound file to a loudspeaker object in the Time Line and later record the sound information emitted by the loudspeaker with one or more microphones.

Loudspeaker objects are displayed in CINEMA 4D as genuine 3D objects (a simplified loudspeaker shape), but they are not visible when rendered.

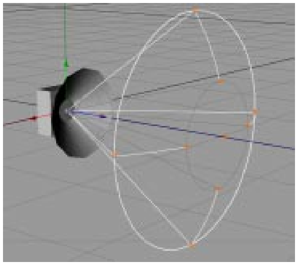
Like light sources, there are several handles on the loudspeaker object with which you can interactively change the playback characteristics of the acoustic source (adjustment, range, etc.).

More extensive and exact attributes of the playback characteristics of the loudspeaker are available in the Loudspeaker dialog; to see this, double-click on the loudspeaker symbol in the Object Manager or on the object itself.



Show Cone and Falloff

With this option you can decide whether, in the editor, the effective range (cone and falloff range) of the loudspeaker as well as the associated handles are displayed. This option is on by default. Switch the option off to avoid cluttering up complex scenes.



Cone

The cone defines the falloff range of the loudspeaker and can be compared with the cone of a spotlight source.

Inner Angle

With this value you can define an inner falloff angle. Within a cone which has this angle as its vertex, the emitted sound has maximum volume; it then gently quietens, until it reaches the surface of the cone defined by the outer angle, where the volume is zero. The permissible values for the inner angle lie between 0° and 180°, but cannot exceed the value for the outer angle (see below).

Tip

In order to define an inner angle, you must have already set the Outer Angle option

Outer Angle

Check this value to limit the falloff of the loudspeaker within a cone defined by this angle. The permissible values for this angle lie between 0° and 180°, but cannot fall below the value of the inner angle.

Falloff

The optional falloff values for the loudspeaker define the linear range of the emitted sound. Additionally a type of falloff can be selected.

Type

This changes how the sound is to decrease over the falloff distance.

None

The volume of the loudspeaker does not decrease with distance. This behavior is not particularly realistic and is only included for the sake of the completeness. This option is unsuitable for inclusion in surround sound information, since no spatial data can be calculated from it.

Linear

Generates a even, linear reduction of the volume over distance. The falloff begins at the **Inner Distance** value and decreases constantly, until it reaches 0 at **Outer Distance**.

Inverse

Creates a quick falloff to 0%. This leads to a gentler pickup characteristic, if a microphone is placed within the falloff range of the loudspeaker.

Inverse Square

(Preset value)

This is the most natural kind of falloff, which best reflects reality. It is even softer than **Inverse**.

Inverse Cubic

Creates an extremely gentle falloff, which reaches maximum volume only briefly after **Inner Distance**.

Inner Distance

This value defines the position at which falloff begins. Within this radius the emitted sound has maximum volume. The inner distance is zero by default, so that the falloff begins at the loudspeaker.

Outer Distance

This value defines the outer radius of the falloff. At this distance the volume of the loudspeaker is zero and silence prevails.

Tip

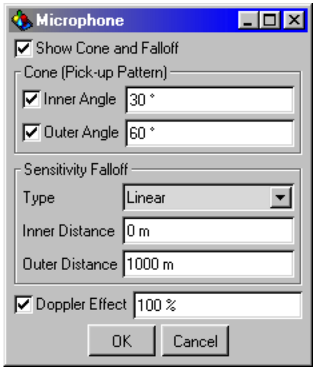
The type of falloff is only effective over the range between **Inner Distance** and **Outer Distance**

Mono

This function creates a mono microphone object. Microphones are used for the recording of emitted sound information. In order to create 3D sound data, at least one microphone object must be in your scene. The parameters of the microphone object resemble those of the loudspeaker object. So you can define a conical effective range and regulate the falloff (and the sensitivity).

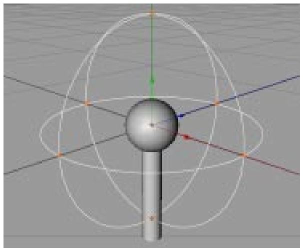
Microphones are displayed in CINEMA 4D as genuine 3D objects (a simplified microphone shape), but are not visible when rendered. As is the case for lights and loudspeakers, there are several handles with which you can interactively change the pickup characteristics of the microphone.

More extensive and exact changes to the pickup characteristics of the microphone can be made in the appropriate dialog; double-click on the object property symbol of the microphone in the Object Manager or on the microphone itself.



Show Cone and Falloff

With this option you can define whether, in the editor, the effective range (cone and falloff range) of the microphone, as well as its handles, are displayed. This option is on by default. Switch off the option to avoid clutter in complex scenes.



Cone (Pickup Pattern)

The cone defines the pickup area of the microphone and can be compared with the cone of a spotlight.

Inner Angle

With this value you can define, optionally, the inner pickup angle. Within the cone defined by this angle the recorded sound has maximum volume, thereafter it recedes gently until it reaches the edge of the cone defined by the outer angle. The permissible values for this angle lie between 0° and 180°, but cannot exceed the value for the outer angle (see below).

Tip

In order to define an inner angle, you must first activate Outer Angle

Outer Angle

Activate this value to limit the pickup area of the microphone within a cone. The permissible values for this angle lie between 0° and 180°, but cannot fall below the value for the inner angle.

Sensitivity Falloff

The optional falloff values of the microphone define the range of the pickup area. Additionally a type of falloff can be selected.

Type

This value sets in which way the sensitivity of the pickup is to decrease over distance.

Tip

The type of falloff is only effective between Inner Distance and Outer Distance.

None

Means that the pickup sensitivity of the microphone does not change with distance. This option is the default value for microphones.

Tip

If you choose Falloff > None for both loudspeakers and for microphones, it is not possible to calculate 3D sound data. You should therefore choose this option only if your loudspeakers already have a falloff behavior assigned.

Linear

Generates an even, linear falloff of the pickup sensitivity. The falloff begins at **Inner Distance** and decreases constantly until it reaches zero at **Outer Distance**.

Inverse

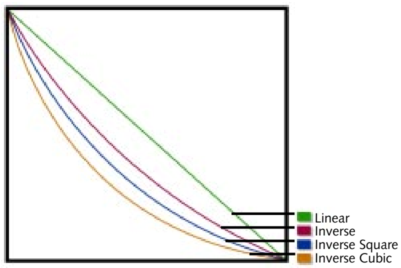
Creates a quick falloff sinking to 0%. Thus leads to a gentler pickup characteristic, if the microphone enters the falloff range of a loudspeaker.

Inverse Square

This is the most natural kind of falloff, which best reflects reality. It is even softer than **Inverse**.

Inverse Cubic

Creates an extremely gentle falloff, which reaches maximum pickup sensitivity only briefly before **Inner Distance**.



The different falloff characteristics

Inner Distance

This value defines the radius of the inner falloff range. Within this radius the recorded sound has maximum volume. The inner distance is, by default, zero so that the falloff begins directly at the microphone.

Outer Distance

This value defines the outer radius of the falloff. At this value the pickup sensitivity of the microphone is zero and silence prevails again.

Doppler Effect

This option activates the calculation of a Doppler effect (see page 576-578). Change the percentage value to adjust the strength of the Doppler effect.

Tip

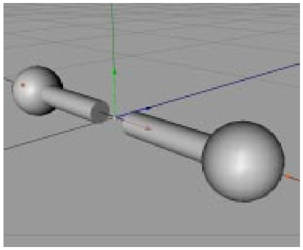
As this effect depends on the speed of travel of the loudspeakers (and the microphones), it may be necessary to use values over 100% to reveal the Doppler effect more clearly.

Stereo Microphone

Use this to create a stereo microphone, with which sound information for the left and right sound channel can be rendered automatically.

The stereo microphone object exists primarily to create stereo sound data quickly and easily and differs therefore from the mono microphone described above and also from the pre-defined groups of microphones described below. The distance between the two sound channels (stereo) can only be defined for this special microphone object. This generates a single stereo file as its output.

Naturally you can also use the Stereo group (see below) with two mono microphones. However you then get two separate mono files (one each for the left and right channel), which you have to mix with an external sound program to get a stereo sound.



Stereo Basis

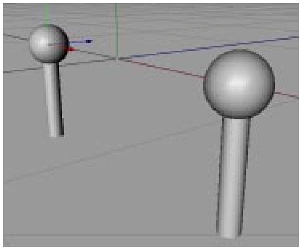
Double-clicking on the Headphone object brings up a simple, Stereo Basis, dialog. This defines the distance between the two, virtual microphones; 200 is the default. You can also change the stereo basis with the appropriate handles, interactively, in the editor.

Stereo

This function creates a group of objects, which contains two conventional, spatially shifted mono microphones.

- Microphone_L (for the left stereo channel)
- Microphone_R (for the right stereo channel)

You can make individual adjustments to the characteristics of both microphones (see Mono, page 286).



A stereo microphone comprises two mono micrphones, spatially shifted

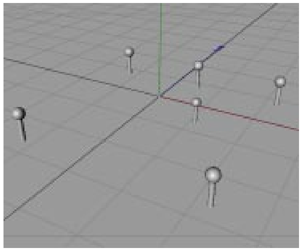
Tip

The Stereo microphone, as well as the following surround sound microphones, are not objects in the conventional sense, but pre-defined groups of objects with several mono microphone objects contained within them. In principle you could create these objects manually, by grouping many mono microphones by hand.

DTS 5.1

The DTS 5.1 (Digital Theatre System) function creates automatically a group of objects which contains six conventional, spatially-shifted mono microphones.

- Microphone_L (for the left front loudspeaker)
- Microphone_C (for the central loudspeaker)
- Microphone_R (for the right front loudspeaker)
- Microphone_SUB (for the bass channel, subwoofer)
- Microphone_LS (for the left, rear surround loudspeaker)
- Microphone_RS (for the right, rear surround loudspeaker)



The WAV files created with subsequent 3D sound rendering can be mixed later in an external sound program for the generation of surround sound data in the DTS 5.1 format. You can define individual values for the pickup characteristic etc. of all microphones (see Mono above).

Tip

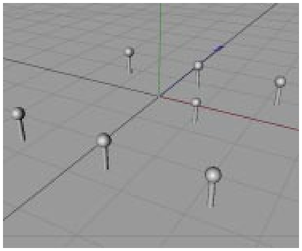
DTS 5.1 is a standard recording format for many cinema productions. The first number refers to the five sound channels. The front three (left, center, right) use the frequency range from 20Hz to 20kHz and the two surround channels the range from 80Hz to 20kHz. The rear channel is the subwoofer, which uses only low frequencies in the range between 20Hz and 80Hz.

DDS EX 6.1

The DDS EX 6.1 (Dolby Digital Surround) function creates, automatically, a group of objects, which contains seven conventional, spatially-shifted mono microphones.

- Microphone_L (for the left front loudspeaker)
- Microphone_C (for the central loudspeaker)
- Microphone_R (for the right front loudspeaker)

- Microphone_SUB (for the bass channel, subwoofer)
- Microphone_LS (for the left, rear surround loudspeaker)
- Microphone_S (for the middle, rear surround loudspeaker)
- Microphone_RS (for the right, rear surround loudspeaker)



The WAV files created with subsequent 3D sound rendering can be mixed later in an external sound program for the generation of surround sound data in the DDS EX 6.1 format. You can define individual values for the pickup characteristic etc. of all microphones (see Mono, page 286).

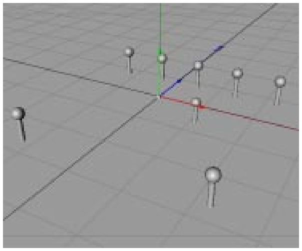
Tip

DDS EX 6.1 is a new method from Lucasfilm TXH and Dolby Laboratories Inc. It uses an additional middle surround channel to offer the listener a particularly good localization of auditory perspectives. Otherwise it is compatible with Dolby digital 5.1. The first number refers to six available channels. The front three (left, center, right) use the frequency range from 20Hz to 20kHz and the three surround channels the range from 80Hz to 20kHz. The rear channel is the subwoofer, which uses only low frequencies in the range between 20Hz and 120Hz.

SDDS 7.1

The SDDS 7.1 (Sony Dynamic Digitally Sound System) function creates, automatically, a group of objects which contains eight conventional, spatially-shifted mono microphones.

- Microphone_L (for the left front loudspeaker)
- Microphone_L (for the left center loudspeaker)
- Microphone_C (for the middle center loudspeaker)
- Microphone_R (for the right center loudspeaker)
- Microphone_R (for the right front loudspeaker)
- Microphone_SUB (for the bass channel, subwoofer)
- Microphone_LS (for the left, rear surround loudspeaker)
- Microphone_RS (for the right, rear surround loudspeaker)



The WAV files created with subsequent 3D sound rendering can be mixed later in an external sound program for the generation of surround sound data in the SDDS 7.1 format. You can define individual values for the pickup characteristic etc. of all microphones (see Mono, page 286).

Tip

SDDS 7.1 works, in principle, like Dolby digital 5.1. Additionally, however, the number of center channels is increased from 1 to 3. This makes a better sound distribution possible with the large and broad projection screens in cinemas. Otherwise it is compatible with Dolby digital and DTS. The first number refers to the seven available channels. The front five (left, left center, center, right center, right) use the frequency range from 20Hz to 20kHz and the two surround channels the range from 80Hz to 20kHz. The rear channel is the subwoofer, which uses only low frequencies in the range between 20Hz and 120Hz.

CINEMA 4D

MODELING • ANIMATION • RENDERING

8. Tools Menu

8 Tools Menu

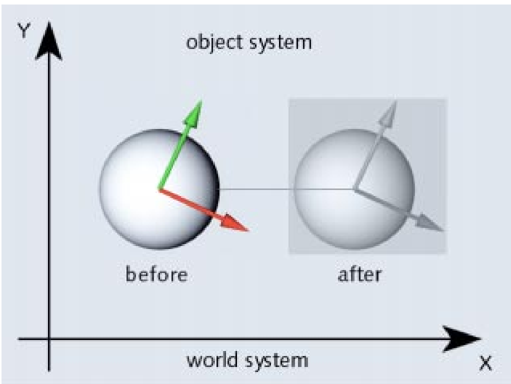
Move

This command will let you place the active object or element anywhere in the work area, subject to other options like snap, the mouse grid, whether certain axes are locked etc.

When moving objects, CINEMA 4D distinguishes between the world coordinate system and the local object coordinate system.

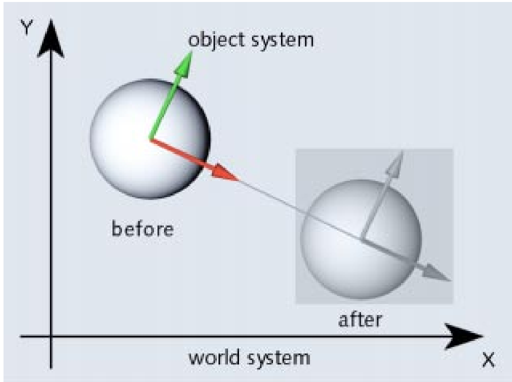
This distinction is particularly noticeable when movement takes place in different axial systems and only the X axis is activated, say.

Let's assume you are moving a cuboid which is positioned somewhat askew relative to the world coordinate system and you have locked the Y and Z axes for movement (see below). If you move within the world coordinate system the cuboid moves parallel to the X axis of the world system.



If, on the other hand, you select the object coordinate system, the cuboid moves along its own (the object's) X axis, which results in a quite different behavior as you can see.

Both can be useful but you should always be aware which you are currently using (check on the Tools menu).



The X, Y and Z symbols allow you to lock certain axes. This can be useful, for example, when you have constructed an object that is at floor level. If you now move it in one of the perspective views, it automatically changes its Y value and could, in the worst case, end up below the floor.

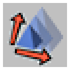
By taking the precaution of locking the Y symbol the object remains on the floor and moves only in the other directions.

A left/right movement of the mouse while holding down the mouse button moves the object horizontally on the screen.

An up/down movement moves it vertically. Keeping the right mouse button depressed (Macintosh users Commnand-click) while right/ left moving the mouse moves the object *into* the screen and *out of it*.

When editing textures, mouse movements have a somewhat different effect. A left/right movement of the mouse moves the texture along its X axis, an up/down movement moves the texture along its Y axis.

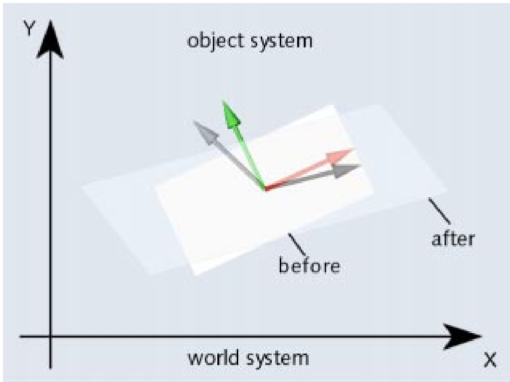
Scale



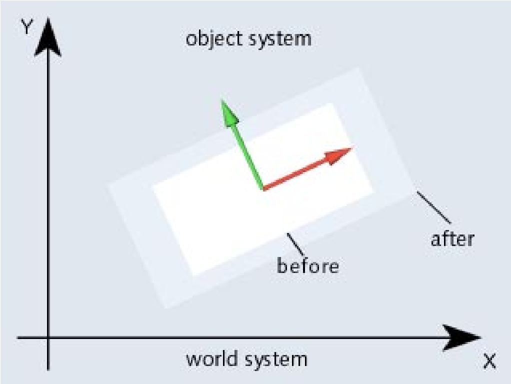
With this function you can resize the active object or element.

When in Scaling mode, CINEMA 4D distinguishes between the world coordinate system and the local object coordinate system.

The difference between the systems becomes particularly clear if you activate only the X axis. Imagine you scale a cuboid, which lies inclined in the world coordinate system. If you choose the world coordinate system for scaling, the cuboid becomes larger/smaller parallel to the X axis of the world coordinate system and is therefore distorted.



If, on the other hand, you select the object coordinate system of the cuboid when scaling, the cuboid becomes larger/smaller along its own X axis and does not distort.



Scaling is performed by left/right movement of the mouse. You can hold down either mouse button.

When editing textures, mouse movements have a somewhat different effect. A left/right movement of the mouse resizes the texture along its X axis, an up/down movement rescales it along its Y axis.

Tip

There are various ways of rescaling objects, by rescaling an object, a model or the object axes. The first of these should be used with animation only.

The default size of any axis in the object system is 1.0. If for example you resize the X axis from 1.0 to 2.0, the object doubles its size along the X axis. This results in a distortion of the object system, making precise construction more difficult since all local positions are now also distorted and no longer correspond to the length units of the world system. We recommend therefore that you do not use scaling in combination with objects until the construction phase is completed.

Rotation

This command will rotate the active object or element.

When rotating objects, CINEMA 4D distinguishes between the world coordinate system and the local object coordinate system and you can choose to rotate in either system. As long as the object lies parallel to the axes of the world coordinate system you will not notice a difference when you rotate in either system. But when the object is askew, there can be large differences between rotating in the world or object systems - see above for more details and consider carefully what you need.

A left/right movement of the mouse while holding down the left mouse button will rotate the object around its Y axis. An up/down movement rotates it around its X axis, while holding down the right mouse button causes rotation around the object's Z axis (Macintosh users use the mouse button with the Command key pressed to simulate a right mouse button).

The behavior of the rotation is totally different if, in General Settings, you have switched on the HPB system (see General Settings, page 42). A left/right movement will now change the heading, an up/down movement changes the pitch and holding down the right mouse button while moving left or right will change the bank (Mac users, remember the Command key). The HPB angles here refer to the object's parent system i.e. if the object which is to be rotated lies within a hierarchy, the parent object functions as the *world coordinate*.

An Example:

You want to rotate a cube, already tilted in space, 360° around its Y axis.

- Create a cube, with default values, then enter, in the Coordinates Manager under **Rotation** at **B** (Bank), an angle of 30° and click on the Apply button.
- In the Time Line, deactivate the **Position** and the **Scale** symbols so that only **Rotation** is active and then click once on the Record button. A new rotation sequence with a key is created.
- Move the position marker to frame 50 and click the Record button again. A new key is added to the rotation sequence.
- Double-click on this new key. In the edit field that opens enter, under Value at H, an angle of 360°, then close the dialog with OK.
- Start the animation by clicking on the Play button.

The object turns but not, as you probably thought it might, around its Y axis (the heading). Why is that? As described above, the HPB system looks to the object's parent for reference. In this case the parent is the world coordinate system and its axis does not lie, like that of the cube, *banked* at 30°.

So, how you can turn the tilted cube around its own Y axis?

- First of all, open the input windows of the two rotation keys in the Time Line and change the B value from 30° to 0°.
- Create a null object and move the cube, using drag-and-drop, into the null object. Now the null object is the cube's parent.
- Select the null object and enter, in the Coordinates Manager under **Rotation** at **B**, an angle of 30°; then click on the **Apply** button. Play the animation again.

The cube turns now around its Y axis since the null object replaces the world system as the cube's parent.

Even if you rotate in absolute world coordinates, the actual rotation takes place around the parent object or axis origin, respectively.

Use the rotation grid (see Quantize Tab, page 387-388) for greater precision. This will allow you to rotate the object in steps of, say, 10°.

Navigation with the Mouse and Keyboard

Moving, Scaling and Rotating with the Mouse

You can use the mouse for moving, scaling and rotating. A left/right movement manipulates the X axis while a back-and-forth movement controls the Y axis. For the Z axis you have to use the right mouse button.

Macintosh users; as usual, use the Command key to simulate the right mouse button.

You can toggle instantly between the left and right mouse buttons. If you are currently pressing the left button, press the right one before releasing the left and vice versa.

Moving, Scaling and Rotating with the cursor Keys

On the keyboard, use the directional (cursor) keys for moving, scaling and rotating:

Cursor right	+ X axis
Cursor left	- X axis
Cursor up	+ Y axis
Cursor down	- Y axis
Shift + cursor right or cursor up	+ Z axis
Shift + cursor left or cursor down	- Z axis

If you are working with the Edit Camera tool selected (see page 15), it is the camera that is affected. In all other cases the object currently selected is moved, scaled or rotated.

Moving, Scaling and Rotating with Quick Navigation

Using *Quick* navigation you can edit objects, the editor or the active object camera independently of the chosen tools. Use the following keys:

Key 1	- Move the view/camera
Key 2	- Scale (zoom) the view/camera
Key 3	- Rotate the view/camera (only in the central perspective view)
Key 4	- Move the active object
Key 5	- Scale the active object
Key 6	- Rotate the active object

Tip

If you want to zoom, in the central perspective view, onto an object, you can use the move tool instead of the scale tool. That has the advantage that you can zoom without perspective distortions.

Magnify

Use the Magnify command to zoom in on a particular region of the work area. To define that area, drag a rectangle around it.

Alternatively, click once using the left mouse button. This will magnify the work area by 25%. If you wish to reduce it, hold down the Ctrl key while clicking.

Using the Keyboard

These are the keyboard short-cuts for the Zoom function:

+	Zoom In (magnify)
-	Zoom Out (reduce)

Camera

When you select this command you can edit the camera in the active Editor window. All subsequent actions affect this view. In two-dimensional views (XY, ZY, XZ) you can move and magnify the displayed area; in three-dimensional views you can change the Editor camera or the Object camera.

Using the mouse, you can move in the following ways.

Move

The camera always moves in the opposite direction to the mouse. For example, when you move to the left, this will shift the camera to the right, thus causing the objects to move left. This is the most intuitive method and easy to learn. Since mouse movement is restricted to two dimensions, CINEMA 4D needs to make use of the right mouse button. This *modifier* allows you to control not only left/right and up/down movements, but also *depth* movements (backwards and forwards). If you hold down the right mouse button while moving left or right, this will be interpreted as going back and forth. It is possible to alternate between the left and right mouse buttons at any time.

Macintosh users; use the Command key to simulate the right mouse button.

Movements, scaling and rotation processes may be cancelled at any time by pressing the ESC key.

When moving objects you can choose which axis system you wish to use. Normally, this will have no effect, since the X, Y and Z symbols are all selected. However, if you switch certain axes on or off, you will observe that certain actions will show different results. If for example you have activated the X symbol only and you are working with the world coordinate system, the camera will move parallel to the X axis of the world system. If on the other hand the object system is selected, the camera will move left and right within its own camera coordinate system.

No grid is applied for the camera or the visible section of the document so that you can reach any position, even if a motion grid is active.

Scale

Using scale the visible section of the scene can be resized. You do this by moving the mouse left/right while holding the left or the right mouse button down (in this case it does not matter which).

In the two-dimensional views the zoom factor, (which initially is set to 1.0) is changed. In the perspective views it is the camera's focal length that changes. Its default value is 50mm. The shorter the focal length, the greater the distortion.

If you wish to avoid distorting your scene, do not change the focal length, instead move the camera further away from the scene. Do this by selecting Move and then right-dragging the mouse to the left. (Try it out to see the difference.)

Rotation

Rotation only makes sense if you are working with a perspective view. Two-dimensional views cannot be rotated.

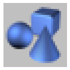
When rotating the perspective view, certain mouse movements affect particular rotational axes. For example, if you hold down the left mouse button and move left or right, this results in a rotation around the Y axis of the camera's coordinate system. An up/down movement with the left mouse button held down rotates the camera around the X axis of the camera's coordinate system.

If on the other hand you hold down the right mouse button, the camera will rotate around its Z axis. What is special about this function is that the selected coordinate system (world or object) has a somewhat different meaning from that which you might expect: the rotation is always around the camera's axis and not around the world's axis.

Macintosh users: use the Command key to simulate the right mouse button.

If an object is active, the camera also changes its position while it rotates. This occurs in such a way that the centre of the active object remains in the same position on the screen. This feature is extremely useful when you wish to move around an object. If no active object exists, the rotation is around the world origin.

Object



Selecting this allows you to edit an object as a whole. You can move a house, rotate a spline or align a light source.

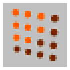
The current position of the active object in space is shown in the Coordinates Manager. That is where you can change any of the values individually.

Changing objects is performed by manipulating their coordinate axes. Scaling, for example, does not scale the number of points of an object, it is the object axes that are scaled. If you want to know what this means or why this is the case, read the section at the end of the Model tool, below.

Tip

Use the Object tool for animations.

Points



By selecting this tool you can edit the points of an object. All subsequent actions will affect the points. In addition, the Delete function in the Edit menu now refers to the points of the object rather than to the object itself.

As soon as the tool is selected, all points of the object are represented by small squares. Selected points are highlighted in color.

It is possible to select individual points by clicking on them. If several points are visually on top of each other, only the topmost is selected. The selection may be extended by Shift-clicking. If you want to select several points use one of the four selection options (see page 321-322). To deselect points, select them again by Shift-clicking.

All points can be selected with the menu option **Edit > Select All**. With **Edit > Deselect All** the complete selection can be deselected again.

To set new points, use Ctrl-click or use the Add Points tool (see page 326).

If the object you are editing is not a 2D/3D object but a spline, the following rules apply:

- Ctrl-click to add a point to the end of the spline.
- Shift-Ctrl-click to add a point to the start of the spline.
- Ctrl-click on the connection line between two existing control points to add a new point between them.

To move a point, grab it with the mouse and drag it to the new position.

To delete the active point, use the Delete command from the Edit menu or use either the Del key or the Backspace key.

If you are editing a Hermite spline and you activate a point, the associated tangent will be displayed. You can edit the tangent's ends by dragging them with the mouse. Holding down the Shift key allows you to edit them independently of each other.

You can also edit a point by double-clicking on it. An window opens in which you can change the position of the point. If you are working on a Hermite spline, you can also edit the tangent values here.

Alternatively you can edit the points with the Structure Manager (see Mode menu, page 609).

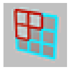
To summarize:

- Points can be placed dynamically.
- Holding down Shift lets you extend the selection or reduce it.
- The Selection tools allow you to select in various, intuitive ways.
- Ctrl-click (or Ctrl-Shift-click) creates new points.
- The Delete command, the Del key or the Backspace key may be used to delete existing points.
- Hermite tangents appear when you click on a point.
- Hermite tangents can be edited dynamically.
- The two ends of a Hermite tangent can be edited independently by holding down the Shift key.

Tip

Tools which are useful for editing points, e.g. one of the many selection options, can also be called through a context menu. Simply right-click on a point. Macintosh users should keep the Command key pressed while clicking with the mouse to pop up a context menu.

Polygons



There are polygons with three vertices (triangle polygons) and polygons with four vertices (rectangle polygons). Most objects CINEMA 4D creates consist of rectangle polygons.

Editing polygons hardly differs from editing points. As soon as you activate the polygon tool, the polygons of the chosen object are displayed. Select a polygon by clicking on it with the mouse; selected polygons are shown in a brighter color.

You can select several polygons at once by holding down the Shift key while selecting a polygon. If you Shift-click on a polygon a second time, it is deselected. All other (active) polygons remain unchanged. Another way of selecting several polygons at once is to use one of the four selection options (see page 321-322).

To create new polygons, selects **Objects > Polygon Object**. Now add points to this polygon with **Structure > Add Points** or import them into the Structure Manager with **File > Import ASCII Data**.

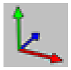
You can read more about creating polygons tool on page 98.

To delete active polygons, use either the Delete command from the Edit menu, or the Del key or the Backspace key.

Tip

Tools which are useful for editing polygons, e.g. one of the many selection options, can also be called with a context menu. Simply right-click on a polygon. Macintosh users should keep the Command key pressed while clicking with the mouse to call up a context menu.

Object Axis



Object axes play an important role in certain program features such as splines or hierarchical animations. In these cases, it is necessary for object axes to be able to be placed freely within the object, without affecting the points of the object. So the Object axis tool only modifies the axes of the active object.

The current position of the axes of the active object is shown in the Coordinates Manager, where you can change all values individually.

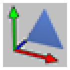
When rotating or moving the axes of a hierarchical object, all axes of the sub-objects will be changed. If these sub-objects have animation tracks, errors will occur in the animation, since the axes of the parent system will have changed. This is why, before creating the animation, it is so important to first define the axes.

Scaling object axes is a rather special case. Here, it is not only the axes that are resized, but also the points and the textures of the active object. This is the only method for producing a size animation. In contrast, Model scaling changes points and textures, but does not resize the axes.

Note

Use the Object axis tool if you want to set move and rotation points for Inverse Kinematics or to align objects created with Duplicate or to create a Lathe NURBS object with a spline contour.

Model



Selecting this allows you to edit an object as a whole. You can move a house, rotate a spline or align a light source.

The current position of the active object in space is shown in the Coordinates Manager. That is where you can change any of the values dynamically.

While the Model tool is selected, changing objects is achieved by changing the number of object points. Scaling is not a matter of scaling the object axes, but of scaling the number of points. If you want to know what this means or why it has to be this way, read on.

Tip

Note that if you scale an object to zero in any direction by using the Model tool, this operation cannot be undone.

If the active object contains sub-objects, these are also changed. If you wish to restrict the change to the active object, modify the action by holding down the Ctrl key.

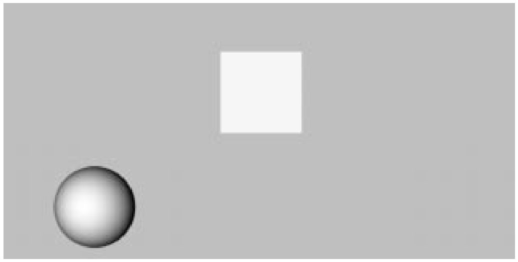
Use the Model tool during the modeling process.

The Difference between the Object and the Model Tool

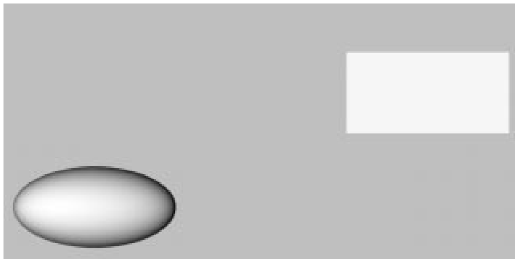
We strongly recommend that you read this section, otherwise you may be in for some unpleasant surprises when you create animations.

Let's start by clarifying the problem with the help of an example, then we'll tell how you avoid the problem altogether and how you can correct it if it does crop up.

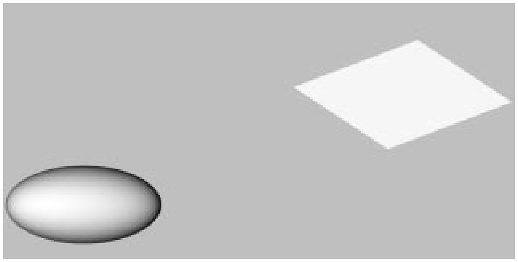
Consider a scene with two objects, a (polygon) sphere and a cube. The cube is a child (sub-object) of the sphere. The axial length of both objects is 1/1/1.



Now we choose the Object tool (**Tools > Object**) and scale the sphere with the Coordinates Manager only in X direction to, say, 2/1/1 (ensure that **Size**, rather than **Scale**, is selected in the popup at the bottom of the Coordinates Manager). As to be expected, sphere and cube are distorted.



Now rotate the cube around its Z axis (lock the X and Y axes and rotate the cube). During the rotation you will see an up and down pump-like distortion.



The points of the cube no longer obey a circular trajectory while they are rotated in the XY plane. Instead, the distorted parent system causes this movement to be elliptical.

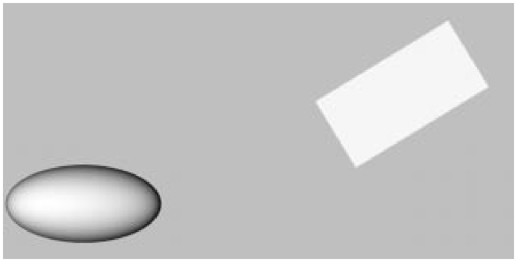
And that is where the problem lies. It invariably occurs when objects exist in a distorted parent system.

Effects of this type are encountered by each and every 3D application, since it is a fundamental problem. Many resolve it by implementing separate editors for modeling and animation. In this way, you do not see the problem but, instead, you have to keep changing editors.

So how can we prevent the problem? There are two possible solutions:

1. Use the Model tool for scaling the sphere.
2. If the damage is already done, choose **Functions > Reset System** and select the two options, **Normalize Axes** and **Offsets**.

In each case you will then get the required result when rotating the cube:



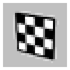
Tip

If all this is a bit much to grasp, simply remember these rules:

Use the Model tool when constructing objects (modeling).

Use the Object tool when animating.

Texture



This allows you to edit the active texture. As soon as you choose this tool the texture of the object is represented by blue grid lines.

Or, if you have activated *Real Time Texture Mapping*, or RTTM, (**Display > Textures** on the editor Window menu), you will see the texture displayed on the object. The chosen projection type is taken into account (see Mapping Types, page 528).

If the texture is displayed with grid lines, their axes are labelled in color (X and Y). Since the texture is in two dimensions only (the image has no depth information), there is no Z axis.

The grid lines are drawn according to the kind of chosen projection, e.g. spherical mapping is shown with a spherical blue grid.

An exception is UVW mapping. Here the blue grid is displayed over the entire editor window. The axes are not shown in RTTM mode.

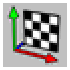
The texture axes of the object are shown with an envelope on whose surface the texture can be moved by using the familiar Move and Scale functions. The texture itself cannot be rotated (but see Texture Axis below).

A left/right movement of the mouse will move the texture along its X axis, an up/down movement will move it along its Y axis.

The Scale function uses the same principle, only here the texture does not get moved but resized.

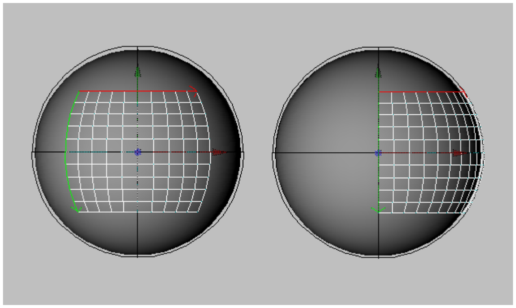
The data for X and Y referring to positioning and dimensions of the texture in the Coordinates Manager are always given as percentages, since the actual size is not relevant. A size of 100% for both coordinates means that the texture covers the cylinder, the sphere or the area completely.

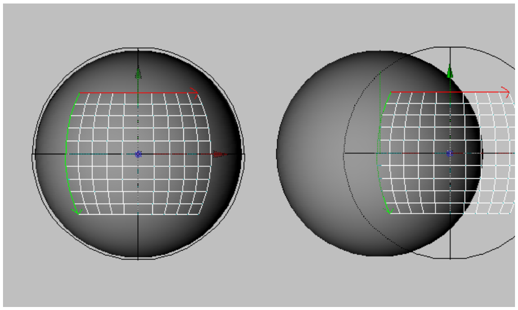
Texture Axis



This tool allows you to edit the texture axes of the active texture. As soon as you select this tool, the texture with its envelope is displayed. In RTTM mode you will see the texture itself. You can move, scale and rotate the envelope in the usual fashion.

The difference between Edit Texture and Edit Texture Axes is illustrated by the following two pictures. In both cases, the movement is along the X axis; in the upper picture using the Edit Texture tool (the texture is moved on its envelope) while in the lower picture by using Edit Texture Axes (the envelope itself is moved).



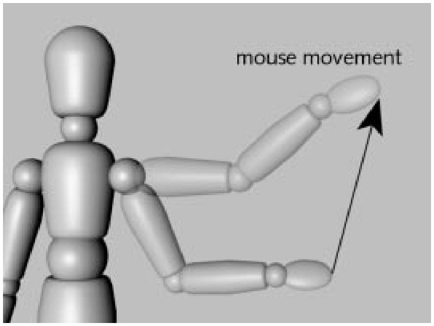


Inverse Kinematics

This tool enables you to place hierarchical objects interactively using inverse kinematics (IK). For example, you can grab the hand of an arm and move it to the required position. The arm will follow automatically, obeying any rotation restrictions you have applied to the joints.

This tool is not exclusively for animation. In fact, it can be very useful for normal object construction as well, although you will need to arrange the objects hierarchically and equip them with Inverse Kinematics tags (see IK Tag, page 460).

If you select an object at the end of a hierarchy and move the mouse, CINEMA 4D calculates the distance between the joints automatically and keeps it constant.



This prevents the chain (e.g. an arm with several joints) from falling apart.

CINEMA 4D's Figure object is perfect for experimenting with the Inverse Kinematics tool. To create the figure object, choose **Objects > Primitive > Figure**. Next, select **Structure > Make Editable** - this converts the figure into polygons with separate limbs, an existing hierarchy and all the tags you need to get started.

When setting up an IK chain, you can specify angle constraints to prevent limbs moving beyond certain angles (see Restriction Tag, page 457).

You can also define objects to be anchors. These objects cannot be moved using the Inverse Kinematics tool (see Anchor Tag, page 460).

The IK always refers to the active object. The IK chain is pulled from the object's origin or, if the object has child objects, from the origin of the first child.

Animation with IK

Several steps are involved in using the Inverse Kinematics tool to animate an object group or a hierarchically-arranged bone skeleton.

Note that the IK refers solely to the manner is which hierarchies are handled - this type of animation works in a completely different way to the Inverse Kinematics track in the Time Line (see Inverse Kinematics, page 564).

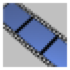
Proceed as follows:

- Activate the following tools in the Time Manager icon palette: **Position**, **Rotation** and **Hierarchy**. Ensure that the time slider is set to the start of the document. Select the entire figure in the Object Manager, then click on the Record icon.

This defines a starting position that you can return to at any time.

- Move the time slider to a different time point.
- In the Object Manager, select the last link of an IK chain (e.g. 'Left Hand', 'Right Foot').
- Activate the Inverse Kinematics tool and move the hand. The entire IK chain moves as a result.
- Activate the top object in the IK chain - this is the object with the anchor icon (e.g. 'Upper Body').
- Record the position and rotation for the hierarchy once more.
- Repeat steps 2 to 6 until you reach the end of the document.
- Drag the time slider back to the start of the document, select a new IK chain (e.g. 'Right Hand') and start again from step 2.

Animation



Selecting this tool lets you edit the animation path of the active object and the tangents of the position keys. Click on a key to display its tangents, which you can then edit. If you wish to edit both ends separately, hold down the Shift key.

You can also edit a key by double-clicking on the key itself. This opens a window in which you can change the position and the tangent values of the key.

Alternatively you can edit a key directly in the Time Line.

If no keys are activated you can move, rotate and/or scale the animation path as a whole.

The Axes

 X Axis / Heading

 Y Axis / Pitch

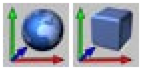
 Z Axis / Bank

These three tools allow you to lock movement, scaling or rotation along certain axes.

With a rotation you have the option of locking each axis separately. If, in General Settings (see page 42), you have selected **Use HPB System**, the HPB designators apply. (The letters HPB stand for *Heading*, *Pitch* and *Bank*.)

For each type of operation, CINEMA 4D remembers the state of the axes (locked or unlocked). If for example you have made a movement along the Y axis while X and Z were locked, and subsequently change to Rotate, all axes are unlocked again. When you change back to Move, the program remembers that only the Y axis was unlocked.

World System



Here you decide in which coordinate system an operation will take place.

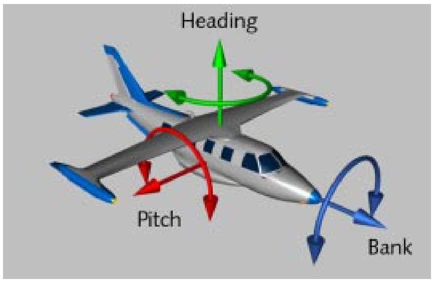
Not all options work with both systems. Scaling of object axes for example can occur only within the object coordinate system.

The object coordinate system is the local system of an object, shown in the editor by the coloured axes; X (red), Y (green) and Z (blue). Every CINEMA 4D object has its own object coordinate system.

If you chose the HPB system in the settings (see page 42), HPB angles will be used for the rotation - independently of the chosen axis system.

Internally CINEMA 4D works exclusively in the HPB system. HPB is an abbreviation for *Heading*, *Pitch* and *Bank*.

You may have come across the terms heading, pitch and bank in connection with flight simulators. An aeroplane turning left or right changes its heading; when it tilts upwards or downwards it changes pitch; when rolling it changes its bank.



So when you are changing angles you may find it helpful to think of a plane.

You might ask why we cannot just take the rotation angles around the three object axes X, Y and Z. The answer has to do with mathematics. Seen mathematically, the rotations around the object axes are a non-commutative group, in other words there is a difference whether you first rotate around X and then Y, or vice-versa. Using the same rotation angles will get you different results. This makes this method unsuitable for animations.

On the other hand, in the HPB system the angles are disassociated. You can first change the heading and then the pitch, or the other way round. Moreover, the HPB angles create naturally interpolated movements which are particularly useful for aeroplanes, cars or cameras.

When you rotate around a particular axis in the XYZ system this may cause all three HPB components to change. The result is a tumbling animation. With the HPB system this cannot happen.

Nice as the HPB system is for animation, it is useless when it comes to constructing objects. HPB angles are specified relative to the parent system, which demands a high level of abstraction.

So CINEMA 4D offers you the choice. For rotations in the Editor you have the HPB system and the (local or global) XYZ system. You will find this option in **Edit > General Settings > General**.

Note, however, that even if HPB is deactivated, all numeric input in dialog boxes and in the Coordinates Manager is in HPB.

And finally

If this part of the chapter seemed complicated to you, then you are quite right. The angle systems are not easy to understand. But CINEMA 4D is one of the very few programs to fully integrate both object hierarchies and local coordinates. Other programs tend to compromise on functionality; either they do not have real object hierarchies, or they have a completely separate modeler and animator (which interact only in a rather clumsy fashion), or they suffer from problems when creating complex hierarchical animations.

Our approach takes its cue from state-of-the-art products running on SGI hardware and benefits from our long experience with modelers and rendering products. We feel that we have managed to create a completely integrated product, thus providing you with a multitude of fascinating possibilities and features which leave other programs well behind.

But we leave it up to you to experiment and try them all out!

Why use Euler angles (HPB) at all?

We want to explain here the necessity for the HPB system using a plausible example. You may want to skip this section if you are not mathematically minded or simply don't want to hurt your brain!

Many users have the problem that rotations around the Z axis (the Bank angle) are performed in the object system whereas rotations around Y and X axes (Heading and Pitch) are always made in the world system. With animation, even switching to XYZ rotations doesn't help anymore, since CINEMA 4D is using the HPB system internally.

The HPB system is a so-called Euler system where the HPB angles do not refer in principle to the axes of the object itself.

Consider this example:

Take an object whose angle system is initially 0/0/0.

First make a rotation of 30° around Heading, so that the X and Z axes of the object system are now rotated compared to the X and Z axes of the world system. Call these new axes X′ and Z′ (Y′ is identical to Y).

A Pitch of 20° now causes the object system to be rotated upward around the world system's X′ axis. Z′ becomes Z″ and Y′ becomes Y″ (now X′ and X″ are identical).

Finally, we rotate around a Bank angle of -45°. This rotation causes the rotated object system to be tilted around the Z″ axis. X″ becomes X‴ and Y″ becomes Y‴ (this time Z″ and Z‴ are identical).

The object has now achieved an angle system of 30/20/-45 by consecutive rotations around H, P and B on a system in each case already rotated. HPB rotates thus neither around object nor around world axes. That Bank is identical to a rotation around an object axis is purely coincidental. There are several different Euler systems, each one with a particular rotation order.

Perhaps you find this all rather unpractical, and we agree that it feels like we're being boring to beat on about it. But we must stress that the Euler system has a major advantage; rotations of objects are decoupled from each other as much as possible, which is not the case with rotations around object axes. Heading does not affect Bank, Bank does not affect Pitch. Imagine that the X position of an object would always affect the Y and Z position ... now that would be really boring!

A further example clarifies the decoupling problem:

Let's assume that CINEMA 4D did not use Euler angles. Imagine a point on the X axis in position 100/0/0.

1. Now rotate the point 90° around the Y axis. It then lies exactly on the Z axis at 0/0/100. Now keep rotating, this time for 30° around the X axis. The point now lies in the ZY plane at 0/87/50.

So far, so good! Now however you reverse the rotation order:

2. The point at 100/0/0 is still at the position 100/0/0 after a rotation of 30° around the X axis. Subsequently, you rotate again around the Y axis for 90°. The point is now at 0/0/100, therefore in a complete different position.

So, due to the mathematical properties of rotations, the sequence of rotations around the object axes is not commutative (i.e. rotation a plus rotation b does not equal rotation b plus rotation a). This leads to an unpleasant and unpredictable behavior within animations.

Hopefully, this simple example should have made clear why CINEMA 4D cannot do without the Euler system. We are sure, however, that you will be able to use this system, after getting used to it, just as reliably and easily as any other system.

CINEMA 4D

MODELING • ANIMATION • RENDERING

9. Selection Menu

9 Selection Menu

With the tools from this menu you can select and deselect points and polygons in many different ways; in addition you can hide or reveal selected points/polygons.

These selection tools can be applied to splines and surface objects and partly also to the handle points of deformation objects.

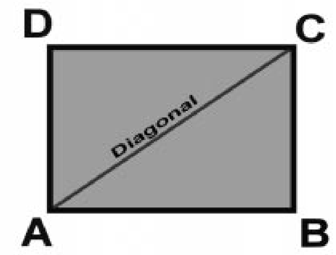
Fundamentals

CINEMA 4D works with polygons (surfaces) and points. There are two types of polygons in CINEMA 4D; triangles and quadrangles.

Polygons

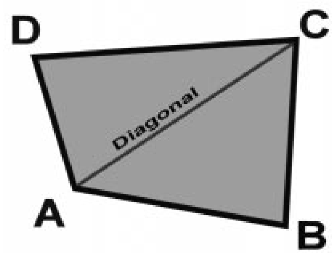
A polygon is a triangle or a quadrangle. A triangle has the points A, B and C; a quadrangle has the points A, B, C and D.

So-called *perfect* polygons, like the one shown below, are not that common, since the points may lie anywhere in 3D space...



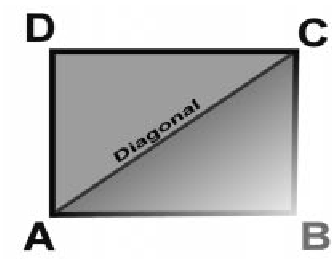
A 'perfect' polygon

This is not a problem if the points are *planar* - i.e. if they all lie on the same plane...



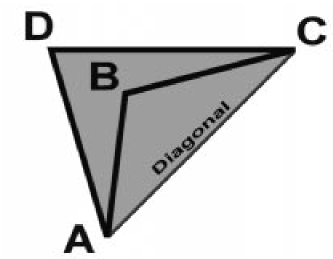
The quadrangle is no longer a rectangle. However, all the points are on the same plane - the quadrangle is still planar.

If the quadrangle's points are not on the same plane, the quadrangle is said to be *non-planar*. In the diagram below, point B has been moved into the depth plane. Now, CINEMA 4D must render this polygon as two triangles. This is dealt with internally without any negative effects.



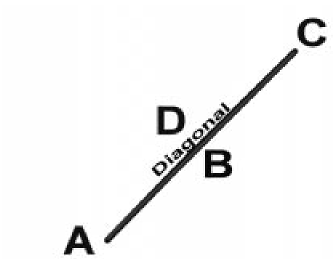
Point B has been moved into the depth plane. Now, the polygon is non-planar.

If the angle at points B or D is greater than 180°, problems can occur when rendering - this is because the polygon overlaps itself...



The angle at point B is greater than 180° - the polygon overlaps itself.

Another problem arises if all of the polygon's points are on the same line. In this case, a surface normal cannot exist and the polygon is called a *degenerated polygon*...



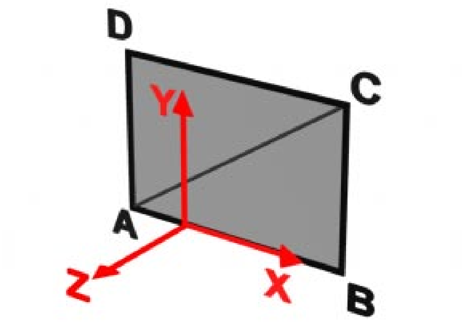
All the points for this polygon are on a line.

Polygon Coordinate System

There are a few other things you should know about polygons. For example, polygons in CINEMA 4D have their own coordinate system.

You cannot see this system in the editor, but it is important to be aware of it when using modeling tools such as **Matrix Extrude** - more about this later on.

The origin of the polygon coordinate system is located at the centre of the polygons. The X axis is along the line between A and B. The Z axis is the normal. The Y axis is perpendicular to the XZ plane.



Making Parametric Objects Editable

CINEMA 4D works almost exclusively with parametric objects (objects that can be defined mathematically) - such objects include the primitives, spline primitives and NURBS objects.

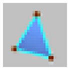
These objects have neither polygons nor points. Instead, the surface is defined mathematically and is only converted to polygons when rendered.

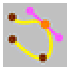
Note

Splines do, of course, have points, but you can only access these once you have made the spline editable.

In order to make parametric objects editable, i.e. to convert them into polygons or points, choose **Structure > Make Editable**. Alternatively, click on the corresponding icon.

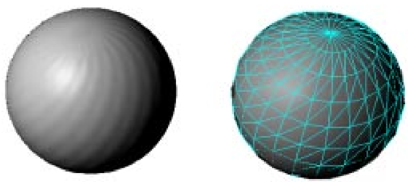

Click this icon to make an object editable.


If you see an icon like this in the Object Manager, it means the object is a polygon object.


If you see an icon like this in the Object Manager, it means the object is a spline.

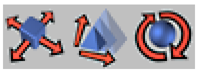
Quadrangles for Modeling

In general, quadrangles are best for modeling and triangles are best for animation. You are free to use triangles, but be particularly careful when using them with Hyper NURBS - triangles can cause irregularities. Only quadrangles generate a totally clean Hyper NURBS.



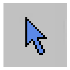
Here, triangles are responsible for the poor quality of the mesh.

To select individual points/polygons when in the move, scale or rotation mode



- To select an element click the (left) mouse button.
- To remove an item from your selection, hold the Shift key down while left-clicking on the already selected item.
- To add to your selection, hold the Shift key down while left-clicking on a new, unselected item.

To select points/polygons with the rectangle, freehand, polygon and live selection tool

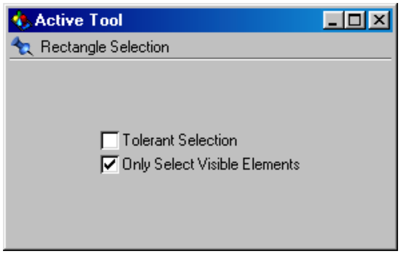


- Select with the (left) mouse button down and dragging.
- To add to your selection, hold the Shift key down while applying the relevant tool to your new, unselected items.
- To reduce the items in your selection, hold down the Ctrl key while applying the relevant tool to the already selected items.

The editor display

- In the polygon mode selected surfaces are framed in red and shown more brightly than unselected surfaces.
- In the point mode selected points are shown in light red while unselected ones are colored dark red.

Active Tool Window



The various selection modes use settings which are shown in the Active Tool window (choose **Window > Active Tool Manager** to see these settings). The settings available depend on the tool you are using.

Tolerant Selection

This option makes sense only in polygon mode. Enabling this option means that polygons are selected as soon as a corner point of the polygon is within the selection marquee. If this option is not active, a polygon is included only if all corner points of the polygon are within the marquee.

Only Select Visible Elements

If this option is active only items which are not hidden by other items are selected. For example, with a surface sphere you could select only points or polygons at the front of the sphere.

It does not matter whether the back of the sphere is visible in the screen mode or not. As soon as a polygon and/or point lies over another, the latter element is invisible as far as the selection tool is concerned.

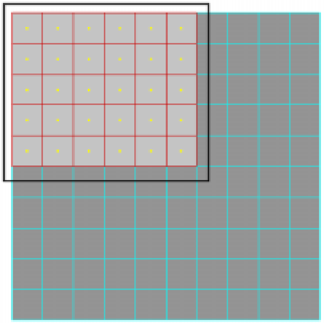
With backface culling on (see page 21) the backs of objects are always invisible and cannot be selected even if you turn off the **Only Select Visible Elements** option.

Of course, elements are also invisible if they have been made invisible with **Selection > Hide Selected** or **Selection > Hide Unselected** commands. Then again they cannot be selected even if you turn off the **Only Select Visible Elements** option.

The same applies to objects which have a red visibility switch (see page 465). Naturally, the polygons and points of such objects cannot be selected.

Rectangle Selection

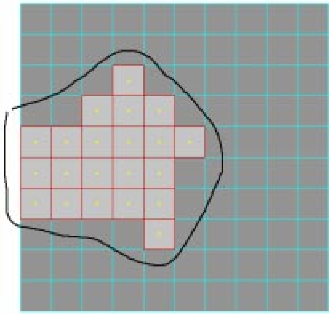
If you choose this selection tool you can frame polygons and points with a rectangle-shaped marquee. Hold the left mouse button down and drag; all items that are fully enclosed within the resulting rectangle will be included in your selection.



Both **Tolerant Selection** and **Only Select Visible Elements** options are available from the Active Tool Manager.

Freehand Selection

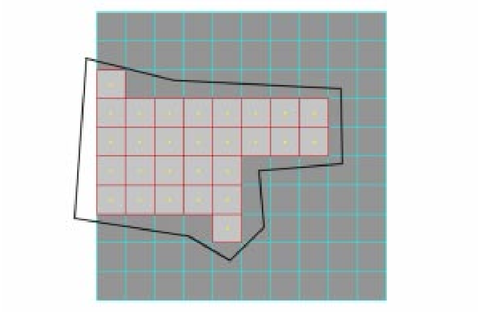
Freehand selection behaves like a lasso. Using the mouse with the left button pressed you pull a loop around all the elements that you want to select. The loop does not have to be closed.



Both **Tolerant Selection** and **Only Select Visible Elements** options are available from the Active Tool Manager.

Polygon Selection

With this selection tool you set the corner points for an n-Side that frames the elements which are to be included. The first mouse-click defines the starting point of the n-Side. All further mouse clicks define further corner points.

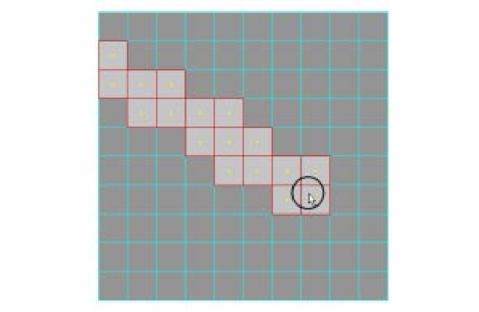


The selection ends either with a right-click of the mouse (Macintosh: Command-click) or by clicking again on the starting point of the n-Side.

Both **Tolerant Selection** and **Only Select Visible Elements** options are available from the Active Tool Manager.

Live Selection

This selection tool behaves somewhat differently from the others. Live selection functions like a paint brush with which you can paint over your objects. The painted elements are included in the selection set.



You can choose a radius for this tool from the Active Tool Manager. During the live selection you can increase this radius with the '+' key and make it smaller with the '-' key. With a trackball the radius can be changed with the wheel.

The **Only Select Visible Elements** option is available from the Active Tool Manager.

Note

By its very nature the live selection tool has a high memory requirement when you turn off Only Select Visible Elements. Therefore you should switch off this option only if it is absolutely necessary.

Select All

With this command you can select all points or all polygons of an object. If you are in polygon mode only the polygons are selected; in point mode only the points are selected. Hidden elements are not selected.

Deselect All

With this command you can deselect all points or all polygons of an object. If you are in polygon mode, only the polygons are deselected; in point mode only the points are deselected.

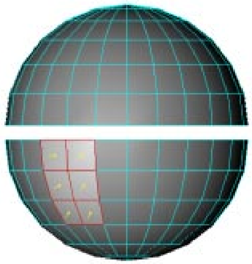
Invert

This command inverts a selection. All selected elements are deselected and all deselected elements are selected. If you are in polygon mode, only the polygon selection is inverted; in point mode only the point selection is inverted. Hidden elements are not inverted.

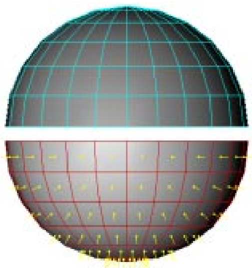
Select Connected

Polygon objects and splines often consist of several segments which are not connected by polygons or spline curves. If you wanted to select one of these individual segments completely you might encounter problems if this segment overlapped with other segments; it can be difficult to see which elements belong to this segment.

So CINEMA 4D comes to the rescue; select just one point or polygon of the required segment and then choose the **Select Connected** command. All points or polygons which are connected to the selected element are then also selected. If you are in polygon mode, only connected polygons are selected; in point mode only connected points are selected.



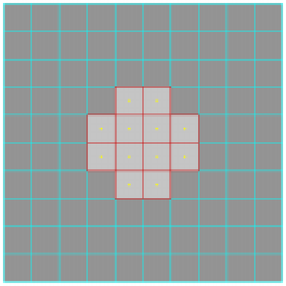
First select one polygon, then Select Connected...



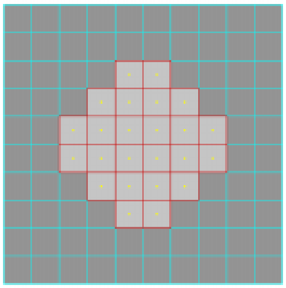
All connected polygons are now also selected

Grow Selection

With this command you can add to a selection. All adjacent points or polygons (depending on which mode you are in) are added to the current selection.



The initial selection

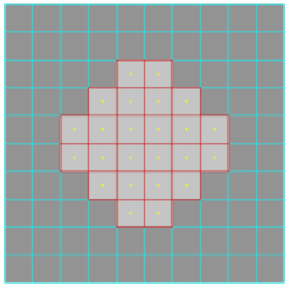


Adjacent polygons are now also selected

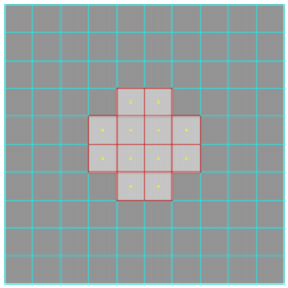
Shrink Selection

This command reduces the selection. All polygons or points (depending on which mode you are in) on the outside of the current selection are deselected.

If the polygon is closed (such as a sphere is) and you select all polygons, the selection cannot be made smaller because there is nowhere to start (there are no elements that can be considered to be on the outside).



The initial selection



The outside polygons deselected

Polygon Selection From Points

This selects the polygons which border on the points that are already selected. Polygon mode will then be entered automatically. Only polygons that have all their corner points selected are included.

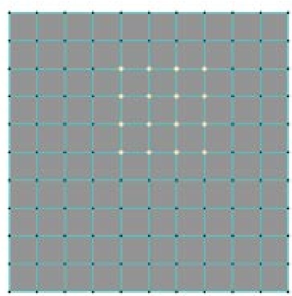
Point Selection From Polygons

This selects the points which belong to the polygons that are already selected. Point mode will then be entered automatically.

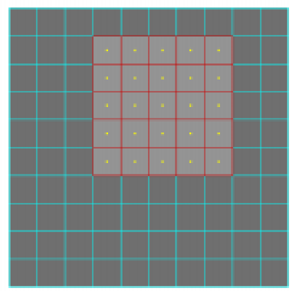
Select Adjacent Polygons

This command affects only polygons and only makes sense when you are in point mode. It selects polygons which directly border the existing chosen set of points.

You will be switched to polygon mode when you use this command.



The initial selection



The polygons bordering on the selected points are selected

Hide Selected

This makes all selected points or polygons invisible. If you hide selected polygons, the associated points are also hidden. However, in point mode, only the selected points are hidden, not the polygons attached to them.

Hiding of elements is useful if you want to concentrate on a particular area of an object during modeling; hide the bit which you are not interested.

Hide Deselected

This command hides all elements which are not selected. If you hide deselected polygons, the associated points are also hidden. However, in point mode, only the deselected points are hidden, not the polygons attached to them.

Unhide All

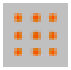
This command makes all hidden elements visible again. In polygon mode only hidden polygons are made visible, in point mode only the hidden points.

Invert Visibility

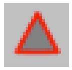
The visibility of all elements is inverted. Visible elements are hidden and hidden elements are made visible. In polygon mode only the visibility of all polygons is inverted whereas in point mode only the visibility of all points is changed.

Set Selection

Here you can freeze selections for the long term. You can freeze either polygon or point selections. You can then manipulate frozen selections at any time using these icons in the Object Manager:



Frozen point selection



Frozen polygon selection

More information can be found below under Frozen Selections in the Object Manager.

Warning

If a Polygon Selection tag is active in the Object Manager (shown by a red frame) when you call this command, the tag is replaced with the new selection. If you do not want to lose your old selection tag in this way, make sure it is not active!

Information on how to apply separate material properties to these frozen selections is in Restrict To Selection, page 542.

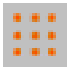
Frozen selections are important for deformation objects as well. See Restricting Bones Using Polygon Selections Or Vertex Maps, page 263.

Note

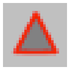
Although it is possible to freeze more than 10 selections for an object, many tools will operate on the first 10 only. For example, if you subdivide the object, only the surfaces in the first 10 selections are subdivided.

Frozen Selections in the Object Manager

If you froze one or more selections (see the preceding section), some useful functions are now available to you in the Object Manager. These are hidden behind particular small icons which are associated with the active object:



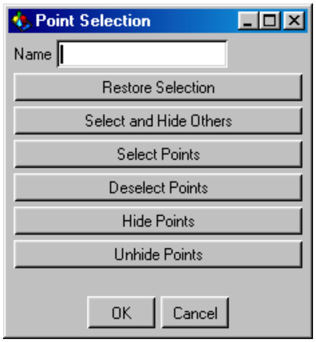
Frozen point selection



Frozen polygon selection

Frozen Point Selection

A double-click on this icon opens a dialog which contains the following choices:



All actions are performed as soon as you click on the relevant button.

Name

Use this text box to enter a name for the selection; press OK to confirm or Cancel to lose the name change.

Restore Selection

This restores the frozen selection. All other elements of the object are deselected.

Select and Hide Others

Restores the frozen selection and makes all other points of the object invisible.

Select Points

The points of the frozen selection are added to the existing selection.

Deselect Points

All points of this frozen selection are deselected.

Hide Points

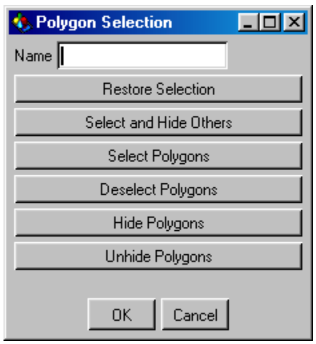
All points of this frozen selection become invisible.

Unhide Points

All hidden points of this frozen selection become visible.

Frozen Polygon Selection

Double-click on this icon to open a dialog which contains the following choices:



All actions are performed as soon as you click on the relevant button.

Name

Use this text box to enter a name for the selection; press **OK** to confirm or **Cancel** to lose the name change.

Restore Selection

This restores the frozen selection. All other elements of the object are deselected.

Select and Hide Others

Restores the frozen selection and makes all other polygons of the object invisible.

Select Polygons

The polygons of the frozen selection are added to the existing selection.

Deselect Polygons

All polygons of this frozen selection are deselected.

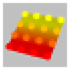
Hide Polygons

All polygons of this frozen selection become invisible.

Unhide Polygons

All hidden polygons of this frozen selection become visible.

Set Vertex Weight



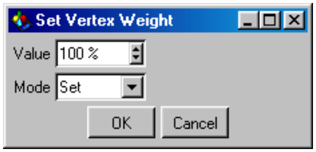
This tool is almost indispensable for working with deformation objects. You can use it to restrict a deformation object's influence with absolute precision. For example, you can use it so that a twist deformer twists the head of a figure only, not the entire body.

The most powerful application for this tool is to create *vertex maps* or *weight maps* for bones. Therefore, the steps involved in using vertex maps is described in the section on Bones, Restricting Bones Using Polygon Selections Or Vertex Maps, page 263.

To create a vertex map

First, activate the points or polygons mode then select the points or polygons you wish to apply a certain weight to.

Next, choose the **Set Vertex Weight** command. The Set Vertex Weight dialog opens.



There are three modes from which to choose:

Set

The weight specified in the **Value** box is applied to the points.

Brighten

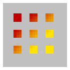
The weight specified in the **Value** box is *added* to the points.

Darken

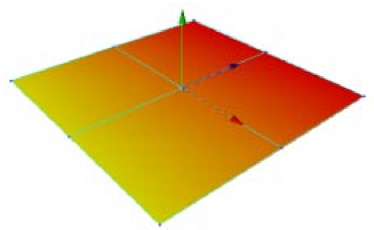
The weight specified in the **Value** box is *subtracted* from the points.

Points that have been weighted are coloured. The entire object will be coloured as well, although you will see the color only in the Quick shading and Gouraud shading display modes (see page 20). Yellow indicates 100% influence, red indicates 0% influence.

The vertex map is represented by a Vertex Map tag in the Object Manager:



To blend out a deformation object's influence smoothly, simply create a course from yellow to red. The following picture shows such a course:



The first row of points is set to 100%, the second to 50% and the third to 0%. There is a soft course from yellow to red.

CINEMA 4D

MODELING • ANIMATION • RENDERING

10. Structure Menu

10 Structure Menu

Functions selected from the Structure menu take effect on the selected object - any sub-objects remain unchanged.

With most functions the object is modified if a function can be applied to the current selection. However, some of these menu functions will not be available if you are not in Point or Polygon mode or if no elements are selected.

Hidden elements are therefore not modified (see Frozen Selections In The Object manager, page 327).

Remember to use **Structure > Make Editable** before trying to use the following tools on primitive, parametric objects.

Edit Surface

Array

Definition

An array is a list - an even arrangement of elements.

Using Array you can duplicate the selected surfaces or points of an object (in the following this selection is referred to as an *element*) and *distribute* them more or less evenly in the X, Y and Z directions. You can vary the size and rotation of the duplicated elements around their axes.

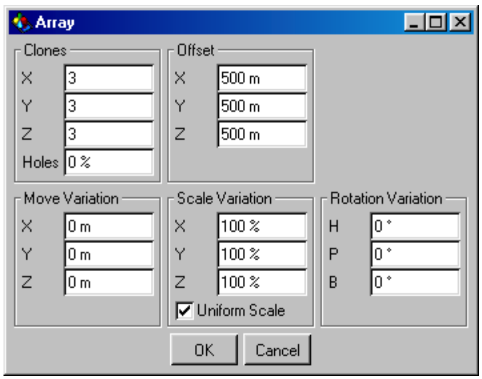
With these options you can duplicate the array of elements in a perfectly even manner or alternatively produce a more random, scattered surface or point order.

Arrays will always be duplicated along the object axes of the selected object. Connected surfaces are coherently duplicated. If no surfaces or points are selected or if you are not in the surface or point mode, all surfaces and points of the active object are duplicated.

If just points alone are selected then they will be duplicated without their adjacent surfaces. When using Array with the points of an object you will be supplied with a point matrix which you can then use to *fill* between two objects e.g. with the Bridge tool.

Imagine a blade of grass. You could easily use the Duplicate tool from the Functions menu to copy the blade of grass and then randomly distribute these copies with the Randomize function. The disadvantage of this method is the many individual objects that result from it. With the Array tool you duplicate just the surfaces (or points), and not the complete object. Thus you can produce a complete meadow from a single blade of grass.

Array Dialog



Clones

Defines the number of clones along the respective object axis.

This value also includes the original element. So if you enter the value of 2 for all three axes, it results in a total number of 2x2x2=8. In effect, however, only 7 actual *clones* are produced.

Note

If copies are only to be created in the XZ plane and not in the height plane then you need to set the value for Y to 1. This would be the correct approach for the above blades of grass example (since these normally grow on the ground and do not float around in the air!).

Holes

This value adds a random factor to the number of elements to be created. You may enter values between 0% and 100%.

0% means the complete number of elements that has been input is created. With 50% only half of the elements are created - which elements are omitted is selected randomly.

With 100% no new elements will be created.

Offset

Defines the size of the array. You can enter different values for each of the X, Y and Z directions. These values are absolute - they refer to the entire size of the array (including the start element).

Move Variation

These input fields define how the positions of the duplicated elements vary. This arrangement lets you assign either accurate or uneven positioning.

If the values for all axes are set to 0 then an accurate position is assigned to each duplicated element. If you set the X value to 100, however, the individual elements can deviate from -100 to +100 units from their position in the X direction.

Scale Variation

Defines the variation of the element size. The values are shown as a percentage.

100% means that the size is not affected. Entering, for example, 50% for the X value results in the X size of the individual elements varying between 50% and 100%. With 0% the size varies between 0% and 100%. Should you enter 200% then the variation will be between 100% and 200%.

Uniform Scale

If this option is selected then the chosen percentage values for X, Y and Z will also be used for relative scaling.

An example

X = 200%, Y = 100%, Z = 50%

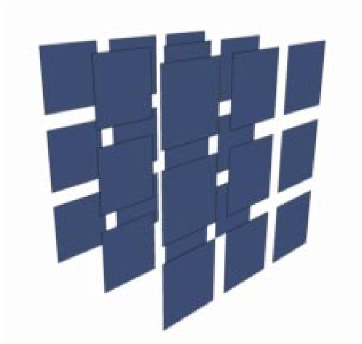
results in a relation of 2:1:0.5. The individual elements can then only be scaled according to this relational scaling. If this option is deactivated, the axes of the individual elements can be scaled independently.

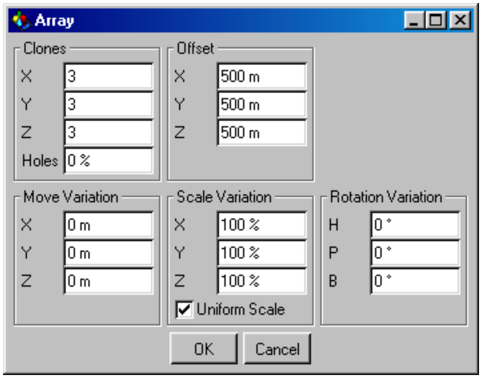
Rotation Variation

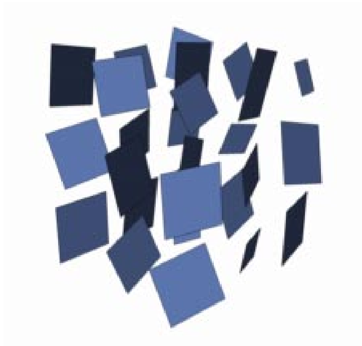
Each element is assigned its own virtual axis. The elements may then be rotated randomly. The values, in degrees, which you enter for each rotation axis define the maximum positive and negative rotation around the appropriate axis.

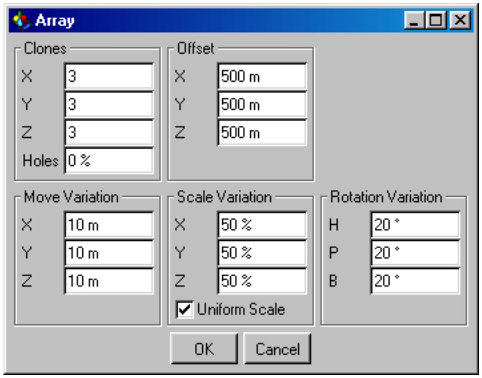
45° would mean that the element can rotate in a radial zone from -45° to 45° in each case.

Below are two array examples - you can see the values from the dialog boxes illustrated below each example.



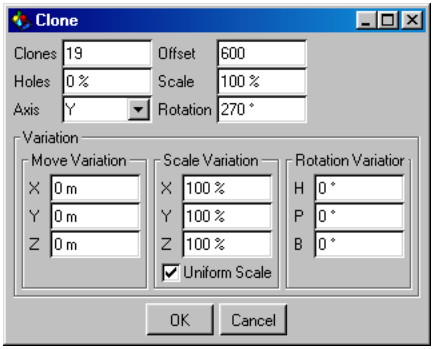


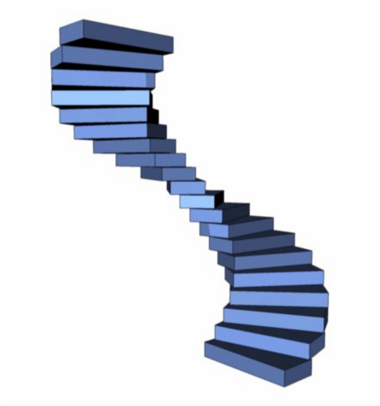




Clone

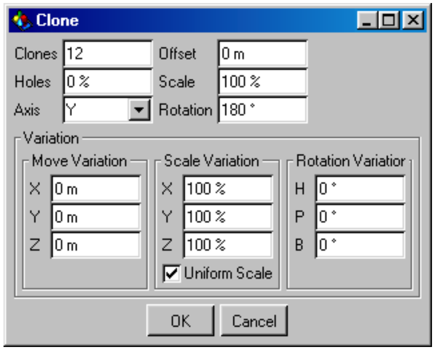
This tool gives you the possibility of duplicating the surfaces or points of an object and of optionally rotating around the object axis. Additionally you may also choose an offset that is used to move the duplicated elements along the object axis. With this method you could, for example, create a spiral staircase simply by creating a cube, converting this to a polygon object (see Make Editable, page 356), scaling it (e.g. to X = 200, Y = 30, Z = 80, see page 296), moving its object axis in the X direction and then using **Clone** with these values:





Only selected elements (surfaces or points) are cloned. In point mode the selected points are cloned individually without their adjacent surfaces. If no elements are selected or if you are not in point or polygon mode, the complete object geometry is cloned.

Clone Dialog



Clones

Defines the number of clones.

This value does not include the start element.

Holes

With this percentage value you can define the number of cloned elements that you want to be omitted from the total. With 0% the full number of clones is created. With 50% only half will be created. The omitted elements are randomly selected. With 100% no new elements at all would be created.

Axis

Defines the object axis around which the clones are to be rotated. For a spiral staircase this would be the Y-axis of the cube. And for a realistic spiral staircase the object axis should be positioned a little way outside the cube.

Offset

The offset value gives the distance from the start element to the last clone along the selected object axis. All intermediate clones are distributed evenly over this distance.

Scale

Use this value to determine the size of the last clone. If you choose 200%, the last clone is twice as large as the first element. With 50% it would be half the size. With 100% the size is not changed at all.

Rotation

Defines the total angle that the clone should be rotated around the object axis. With 180° the object would rotate half a revolution from start to finish, with 360° a full rotation is made.

Move Variation

By default, all clones are assigned a fixed position that depends on the above settings. You may vary these positions using Move Variation. If you choose, for example, a value of 10 for the Y move variation of the individual clones, this says that the clones can deviate between -10 and 10 units in their Y position.

Scale Variation

Defines the variation in the clone's size. The values are shown as a percentage.

At 100% the size is not varied. Entering 50% for the X value means that the X size of the individual elements can vary between 50% and 100%. With 0% the size varies between 0% and 100%. If you enter 200% then the value will vary between 100% and 200%.

Uniform Scale

If this option is selected, the entered percentages for X, Y and Z are used for relative scaling.

Here's an example.

With **Uniform Scale** checked, X = 200%, Y = 100%, Z = 50% results in a ratio of 2:1:0.5; the individual elements can then only be scaled according to this ratio. If this option is deactivated, the axes of the individual elements can be varied in scale independently.

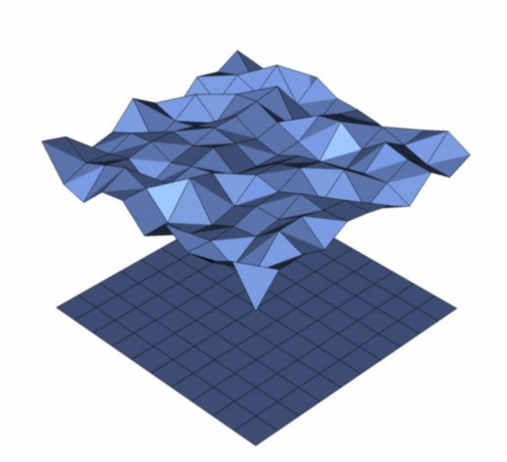
Rotation Variation

Each element is assigned its own virtual axis. The elements may then be rotated randomly around its axis with values entered here. The value, in degrees, which you enter for each rotation axis defines the maximum positive and negative rotation around the appropriate axis.

45° would indicate that the clones can vary in their radial rotation from -45° to 45° at each clone.

Crumple

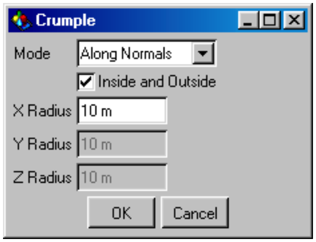
Very often you will find the need for a certain roughness and irregularity in your objects as opposed to the smooth, too-perfect appearance that can be generated with standard objects.



Using the Crumple function, selected points of the object are moved randomly so that the surface is crumpled. If no points are selected or point mode is not activated, then all points are crumpled.

Crumple can also be applied to splines and FFD objects; in this case, however, the **Along Normals** mode (see below) is not available. Since splines and FFD objects do not have surfaces, this mode is not relevant.

Crumple Dialog



Mode

Adjusts the type of movement.

Along Normals

The points are only moved in the direction of their normals (therefore you can only enter one value for the movement, that being the **X Radius**).

Note

Since object normals are contained within the surfaces of an object rather than at the individual points, these must be interpolated when moving. If only two points are selected, for example, then CINEMA 4D must create an average value from the directions of the normals of the adjacent surfaces when moving.

Axial

The points are moved along the object axes of the object.

Radial

Moves the points radially, from the origin of the object.

Inside and Outside

By switching off this option you can tell the Crumple function to move only in a positive direction outwards, up to the maximum value. With this you can ensure, for example, that a ball is only crumpled in an outwards direction, and not inwards. Not so good for craters, though.

Note

This option cannot be used in the axial mode.

X Radius

Defines the value for the axial movement along the X-axis. In the modes **Along Normals** or **Radial** the **X Radius** is the only one used.

Y Radius

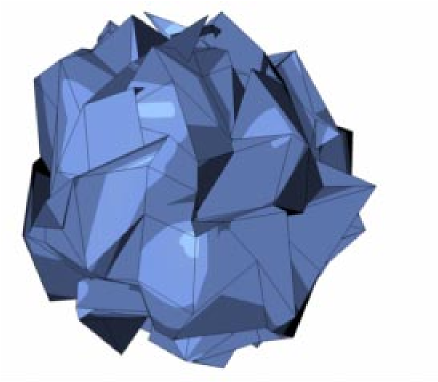
Gives the value for the axial movement along the Y-axis.

Z Radius

The value for the axial movement along the Z-axis.

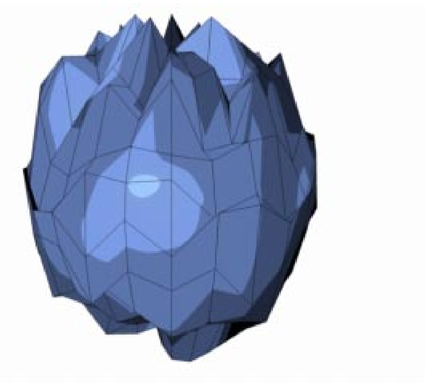
Example:

In the following illustration the points of the sphere were moved by 50 units in the axial mode:



X-Radius = 50, Y-Radius = 50, Z-Radius = 50

If you enter a value of 0 for both **X Radius** and **Z Radius**, then the points are moved only in the Y direction:



X-Radius = 0, Y-Radius = 50, Z-Radius = 0

Disconnect

Surfaces, either individual or connected surfaces, can be split from an object. Select some surfaces of an object and choose disconnect to see the results. The separated surfaces will still be at the same position, but physically they are no longer connected to the object. The original object still contains the points of these separated surfaces, so the geometry is not destroyed.

This tool normally needs a selection of polygons and polygon mode.

A good example of using Disconnect would be to cut a hole into an object and keep the disconnected surface to use as a cap.

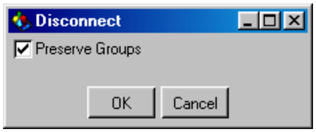
Note

At the seams of the disconnected surfaces, the Phong shading disappears and a ridge appears, since now there are two edges.(See also Smoothing Tag, page 455.)

This tool can also be applied to splines. In contrast to the Break Segment tool, the start and end points of the disconnected segment are duplicated (as is the case with polygon objects) and are not deleted from the original spline. Thus the order of the spline remains intact both before and after disconnection.

When using Disconnect on splines, a selection of points and point mode are needed.

Disconnect Dialog



Preserve Groups

This option is selected by default. With this option the surfaces are disconnected *in one piece* from the object (as long as they were connected to begin with). If this option is switched off then each active surface is separated individually and independently from all other active surfaces.

Explode Segments

Using this tool enables you to split the individual segments of a spline into separate objects. An individual spline object is created from each segment of the original. Only the first segment of the original spline remains. You do not need to have a selection and you do not need to be in point mode. The new spline objects become sub-objects of the original spline and are assigned the names '<object name>.<number>'.

So for example, a text spline object can easily be split into individual letters (bear in mind, though, that certain letters, such as 'e', may be exploded into two or more segments because of *holes* in their structure. You may want to group these segments to re-create the entire letter).

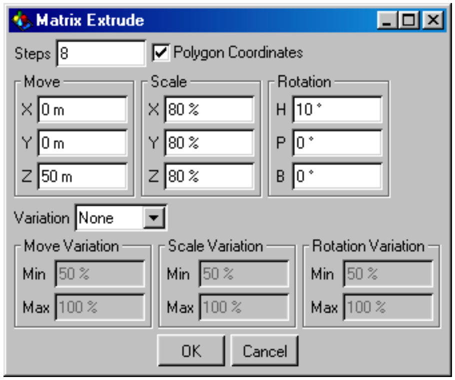
Matrix Extrude

The Matrix Extrude tool is similar to Extrude, but with one difference; as many extrusion steps as you want can be made at one time - this is achieved by defining a relative value for move, rotation and size which is then applied at each step.

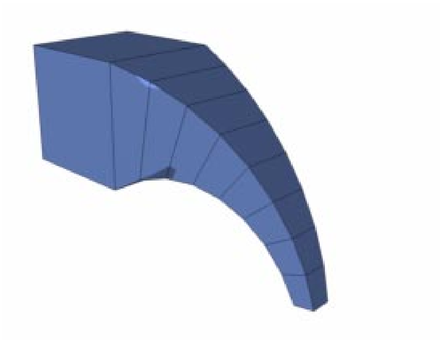
Matrix Extrude can be applied to surfaces of an object. If you have not selected any surfaces or if you are not in polygon mode, then all surfaces of the active object are automatically used.

Surfaces are always extruded individually - connected groups of surfaces are *broken apart*.

Here's an example; you have selected a side of a cube and then apply the Matrix Extrude function with the following values ...



... the result looks like this:

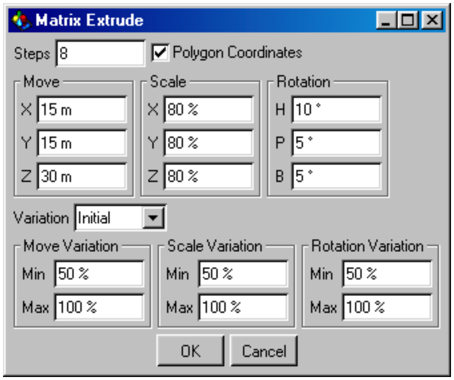


The side was extruded a total of eight times. With each extrusion step the surface was moved 50m in the Z direction. Furthermore it was also scaled by a factor of 0.8 on each axis with each step. Additionally, at each step it was rotated by 10° around the H axis (Heading).

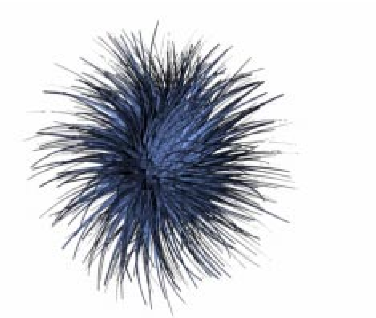
Not too impressed yet? Then read on...

Create a standard sphere with 36 segments. Change this into a surface sphere with **Structure > Make Editable**; Matrix Extrude will then be applied to all 36 surfaces, so there is no need to change into polygon mode.

Select **Matrix Extrude** from the menu - you will now see a dialog with numerous settings. No need to panic, in the next section these values are fully explained in detail. For now simply enter the following values:

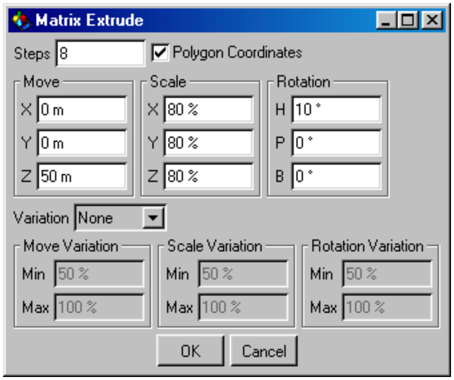


After clicking on the OK button the sphere should look like this:



As you can see, it is this easy to create a complex hairy sphere.

Matrix Extrude Dialog



Steps

Defines the number of steps of the extrusion.

Note

In the hairy sphere example it is important to note that, with just six steps, the initial 36 surfaces of the sphere become 15,768 surfaces - in other words, the number of polygons, and the memory requirements to handle them, can rise substantially. Therefore always be careful and consider the effects of increasing this value, alternatively treat your computer to another few MB of memory.

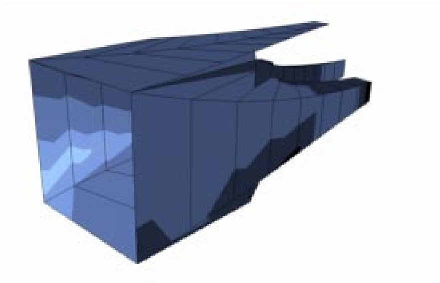
Polygon coordinates

Earlier we saw how Matrix Extrude depends on the polygon coordinates system if this option is activated.

The values X, Y and Z and H, P and B refer to the coordinate system of each individual polygon. This is defined by the order of the corner points in each polygon. If you wish to change this order, select the tool **Move Down Sequence** or **Move Up Sequence** from the **Structure > Edit Spline** menu (see page 349).

These tools were originally intended for splines, but can also be applied to polygons, helping you to control the direction of the Matrix Extrudes for one or more polygons.

If the option **Polygon coordinates** is not checked, the world coordinates are used for each extruded surface.



Polygon coordinates inactive

Move

Defines the movement of the surface for each extrusion step. The Z-axis is the direction of the normal.

Scale

Sets the scale factor for the extruded surface for each step. 100% indicates that the size on this axis is not changed. Values smaller than 100% result in smaller scaling and values larger than 100% increase the surface size along the appropriate axis.

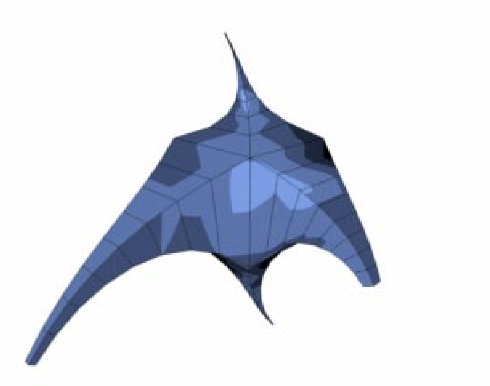
Rotation

Use these input fields to control the rotation of the extruded surface around the individual axes. The B axis (bank) is the normal. If you enter the value of 10° for B for example, the surface is rotated around its normal by 10° for each extrusion step.

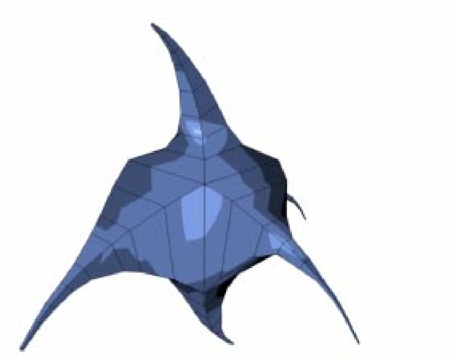
Variation

This popup menu allows you to vary the values of move, scale and rotation.

None	no variation is added.
Initial	the variation for each extrude step is defined once for each surface at the start of the extrusion. This random value then applies to each step.



Per Step	new random values are defined for the surface at each step of the extrusion.



Move Variation

using the Min and Max values you can choose the minimum and maximum deviation from the move values selected above.

Example: enter the value 50 for the movement on the Z-axis. If you activate variation with Min at 50% and with Max at 100%, the surface can be moved randomly between 25 and 50 units on the Z-axis.

With Min at 50% and Max at 160% the surface can be moved between 25 and 80 units.

Scale Variation

gives the minimum and maximum deviation of the scaling factors selected above.

Example: for scaling on the Y-axis enter the value 50%. For Min enter 50% and for Max 160%. The resulting extrusion can now vary between 25% and 80%.

Rotation Variation

defines the deviation from the rotation angles selected above using the Min and Max values. Example: for the H axis enter 10°. For Rotation Variation choose 50% for Min and 160% for Max. Now the angle will vary between 5° and 16°.

Quantize

If, during the building of an object or a spline, the points have not been aligned to a grid (see Snap Settings, page 383), the Quantize tool can achieve this afterwards. All selected points (or the points of selected surfaces) are snapped onto grid points. If no elements are selected and you are not in point or polygon mode, then all points of the object are used.

Important note

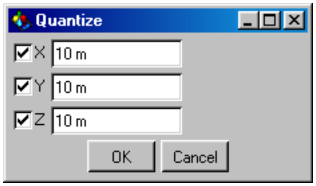
Points will be quantized within the local coordinate system of the object.

Tip

Quantize can be also applied to the points of FFD objects.

The grid width for the X, Y and Z direction can be specified in the dialog.

Quantize Dialog



Check boxes for X, Y, Z

Chooses the directions that are to be used for Quantize.

If, for example, the points are to be quantized in only the X and Z direction, but not in Y direction (height), ensure that Y is disabled.

Input fields

Enter the width of the quantize grids for each direction into these fields.

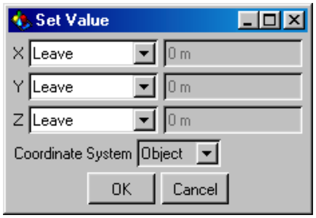
Set Value

Use this tool to set surface and point positions to a common value.

Set Value can be applied to polygon objects, splines and FFD objects.

All selected surfaces and/or points are considered. If no elements are selected or if you are not in polygon or point mode, the complete object geometry is considered.

Set Value Dialog



X, Y and Z define the axes which are to be considered.

In the popup menu

Leave — the values of the selected elements are not changed along this axis.

Set — all selected elements are set to the input value, relative to the chosen coordinate system (see Coordinate System below).

Center — all selected elements are centered to a common value, which is determined from the point weighting of all elements.

Coordinate System

Object — the set value refers to the object axis system.

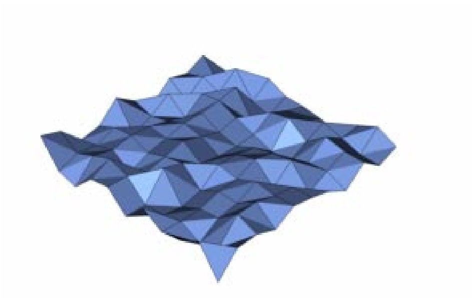
World — the set value refers to the world axis system.

Screen — the set value refers to the virtual axis system of the current view.

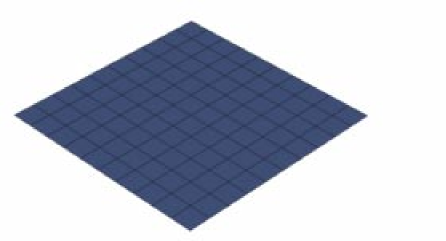
The screen axis system is no different from the (virtual) axis system of the camera, which is shifted to the place of the object axis. The XY plane is parallel to the projection plane. The Z-axis is perpendicular to this.

A working example:

If you have a flat XZ plane which has points that are not all precisely on one level, this can be resolved quite easily in, at least, two ways. Firstly you could select just the points that are out of level and use **Set Value** to set their Y values to the Y value of the rest of the plane. Or, more simply, you could select all of the plane's points and, using **Set Value**, set Y to **Center**. In either case choose **Object** or **World** for the coordinate system.



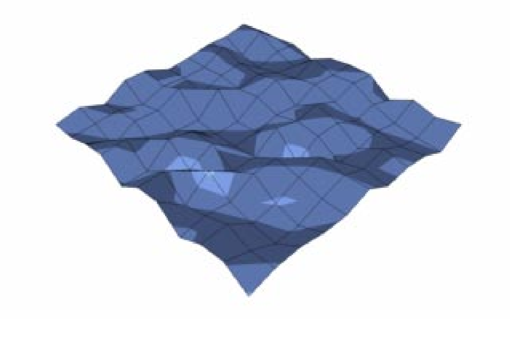
Before using Set Value - the points of this plane are not at the same height

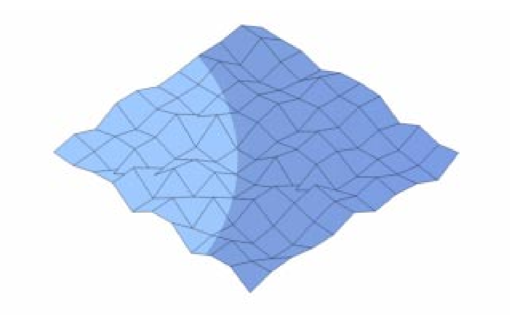


After Set Value - all points are positioned on the Y axis, set to a common value, and are now at the same height

A further example:

Sometimes it can be more meaningful to align surfaces or points parallel to the current camera perspective. In this case select Set or Center for Z and Screen for the coordinate system. If you select Set you can enter a value for Z. This value will be the distance from the camera to the origin of the object axis.





Split

The Split function differs very slightly from the Disconnect function; the difference is that, when using Split, the disconnected surfaces leave a separate object behind. The original object is not changed.

This tool generally needs a polygon selection and polygon mode.

Note

If you wish to delete the separated part from the original object, you can choose Delete directly after the split as the selection is still active (this works only if you are in polygon mode).

This tool can also be applied to splines. A separate spline is created from the separated segment (as with polygon objects) and placed in the Object Manager directly below the active object.

When splitting splines a point selection and point mode are required.

Weld

Using this tool enables you to weld several points of an object or a spline into one point. You must be in point mode and more than one point must be selected. The coordinates of the first point are taken as the base of the operation. Any polygons that become redundant are deleted automatically.

When editing spline objects only points within a particular segment can be welded. Naturally, however, you may have several selections on several segments, all of which can be individually welded.

Edit Spline

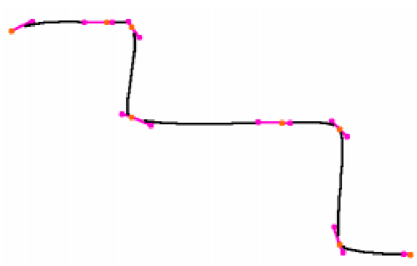
Note

If you are working with spline primitives, do not forget to convert these into editable splines before working on them (see Make Editable, page 356).

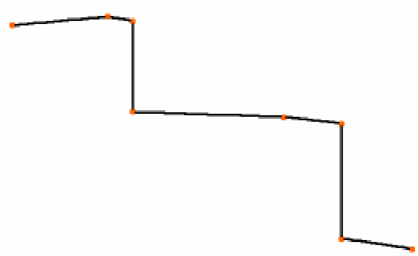
Hard Interpolation

This function switches all selected points to hard interpolation. If no points are selected, all points of the spline are automatically changed over to hard interpolation.

Hard interpolation means that the tangents of the appropriate points are set to a length of zero.



before



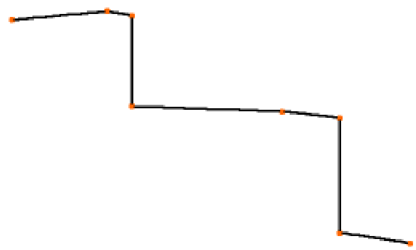
afterwards

Note

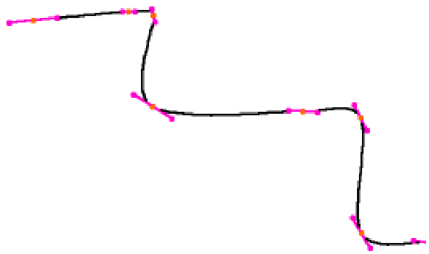
This function can only be applied to Bézier Splines. All other spline types have preset interpolation characteristics, which cannot be changed.

Soft Interpolation

This function switches all selected points to soft interpolation. If no points are selected, all points of the splines are changed automatically to soft interpolation. Soft interpolation means that the tangents of the appropriate points are set to a standard length and direction.



before



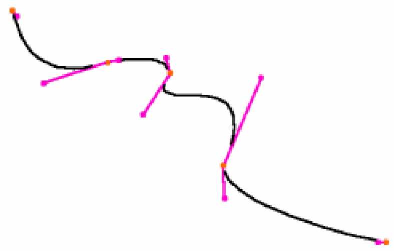
afterwards

Note

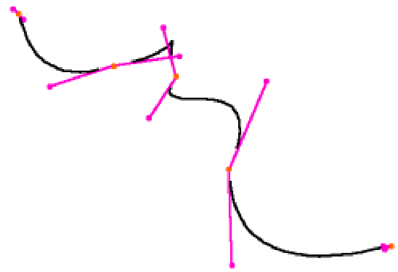
The function can be applied only to Bézier Splines. All other spline types have preset interpolation characteristics, which cannot be changed.

Equal Tangent Length

This option adjusts the individual lengths of the tangent handles of the active point to make them the same length. The right-sided tangent handle is always adapted to the tangent handle on the left. If no points are selected, all points are automatically included in the action.



before



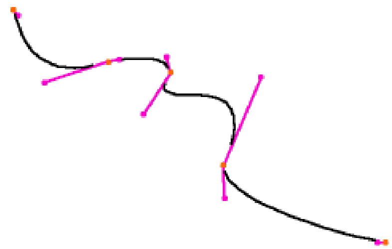
afterwards

Note

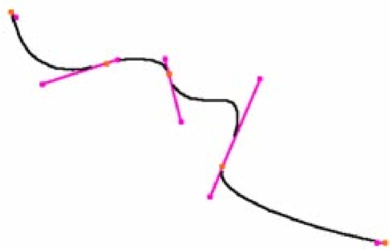
The function can only be applied to Bézier Splines. All other spline types have preset interpolation characteristics, which cannot be changed.

Equal Tangent Direction

Normally the tangent handles of a point lie on a straight line. If you decide, however, to *bend* one of the tangents (by holding the Shift key down when interactively editing the tangent) to produce a hard break in the spline, you may repair that change using this option. The tangents of the selected points are aligned to each other with this adjustment, so that they lie in a straight line once again. If no points are selected, all points are included automatically.



before



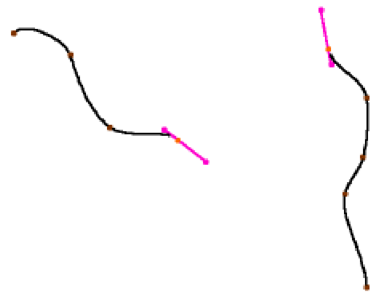
afterwards

Note

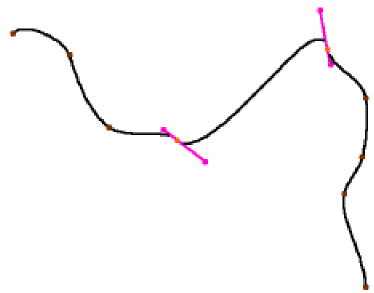
This function can only be applied to Bézier Splines. All other spline types have preset interpolation characteristics, which cannot be changed.

Join Segment

A spline can consist of several unconnected segments (take a look at a text spline for example). If you want to connect two segments, select a point, or several points, of each of these segments and use the Join Segment tool. The start points of each spline are joined to the end points of the other spline. If you directly select the end points of the two segments, however, these are also joined. If these end points have the same position, one of them will be deleted when joining.



before



afterwards

You can only join either two or all segments at the same time. If more than two segments are selected then only the first two are joined. If no points are selected, all segments of a spline are joined.

Break Segment

With this function you can create a new spline segment. Select one or more points which you wish to separate. After using Break Segment you will have a new segment and all points on either side of the separated segment will become a new segment. If the selected points are not consecutive, a number of spline segments will be created, one for each of any consecutive points and one from the remaining points.

To add a new segment to an existing spline requires you first to produce the first point of the new segment. Before the break it is still connected to the old segment. If you now use Break Segment then the new segment will start here; you can now add new points using the Add Points command described below.

Note

This function needs a point selection and functions only in point mode.

Reorder First Point

When you choose this function the selected point of a spline is defined as the new start point of the spline, around which all points of the spline are re-sorted accordingly. If there are several segments within the spline you can select a point or points within each segment; then each segment will be re-ordered according to the chosen point(s) within it.

If more than one point per segment is selected, the first point within the spline order is defined as the start point.

Remember that the start of a spline is colored yellow while the end is reddish in color.

Note

This function needs a point selection and works only in point mode.

Reverse Sequence

To reverse the point order of a segment (i.e. make the first point the last point, the last point the first point and re-order all intervening points), select one point or several points of this segment and select **Reverse Sequence**. You can also apply this option simultaneously to several segments by shift-selecting the points of these segments.

If no points are selected, the sequence of the complete spline (and all segments) is reversed.

Move Down Sequence

This moves the selected point towards the end of the segment and re-orders all other points accordingly; so the first point becomes the second point, the second moves to third place etc. The last point will become the first point. It really doesn't matter which point you select, of course.

You may also apply this option simultaneously to several segments by shift-selecting points of these segments. If no points are selected, all points of the spline (and all segments) are down-shifted.

Note

Although included as a bonus feature, this is nonetheless useful. Indeed, this tool can also be applied to the polygons of a polygon object; as explained in the Polygon coordinate System section, the Matrix Extrude tool uses this coordinate system for alignment and this depends on the order of the points (A, B, C and D) of a polygon. You can change this order with Move Down Sequence (and also Move Up Sequence). More details on this can be found in the section about the Matrix Extrude tool, page 340.

Move Up Sequence

This moves the selected point towards the start of the segment and re-orders all other points accordingly; so the first point becomes the last point, the second moves to first place etc. It really doesn't matter which point you select, of course.

You may also apply this option simultaneously to several segments by shift-selecting points of these segments. If no points are selected, all points of the spline (and all segments) are up-shifted.

Note

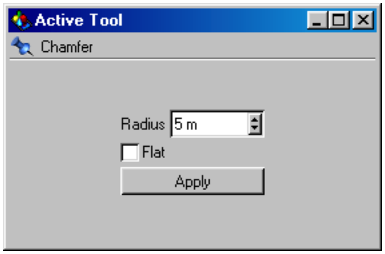
This function is also useful for polygon objects (see Move Down Sequence).

Chamfer

Chamfer is an interactive tool. This means you control the tool directly with the mouse; first select the tool then drag the mouse to the left/right while holding down the left mouse button.

Chamfer converts each selected point into two points with a soft interpolation between them. Using this you can, for example, round the corners of a square by chamfering the points once or even several times.

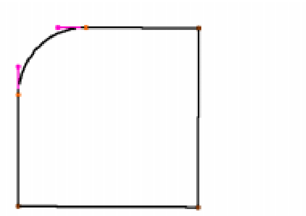
Options



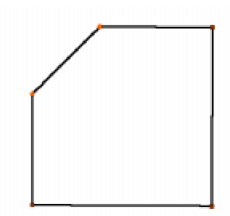
Radius
defines the radius of the chamfer.

Flat
if activated, the chamfering is not done radially, but linearly.

Here's an example:



Flat switched off - each new point has a tangent created to round the chamfer



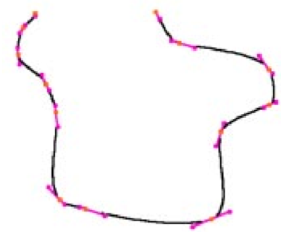
Flat switched on - no tangents are created and the spline runs linearly between the two new point

Only the selected points are chamfered. If no points are selected, all connected points of a spline are chamfered. For a non-closed spline the start and end points will not be included in the chamfer.

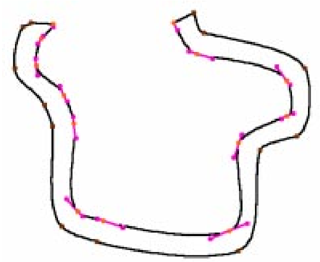
If a point possesses tangents then these will be set to zero before chamfering.

Create Outline

This tool also works interactively; first select the tool then drag the mouse to the left/right while holding down the left mouse button. This creates an outline around the original spline, like a copy of it.



before



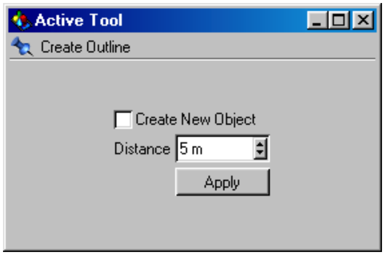
after

This function works on the entire spline.

All points of the spline should, if possible, be on one plane.

If the original spline is closed then the outline is created as a new segment with a reversed point order compared to the original. If the spline is not closed the new spline will be, by default, connected to it, thus creating a closed spline.

Options



Create New Object

If this option is active, the original spline is not changed. The outline is created as a new spline object. The original spline will remain active.

Distance

Defines the distance of the outline from the original spline.

Since only the vertices are duplicated, the outline cannot always be kept accurately parallel - particularly in the case of 3D splines, which may contain points that are not on the same plane.

Note

Linear and Bézier splines are the best choice for this function.

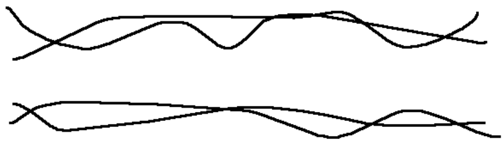
Cross Section

With this interactive tool you can create cross sections from a group of splines.

Important

The splines must be grouped in the Object Manager (see Group Objects, page 466) and the group of objects must be selected.

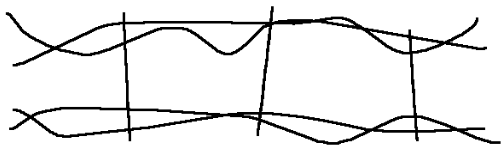
Look at the following illustration:



These four splines (called 'Rail Splines' in the following example) were grouped together in an object group

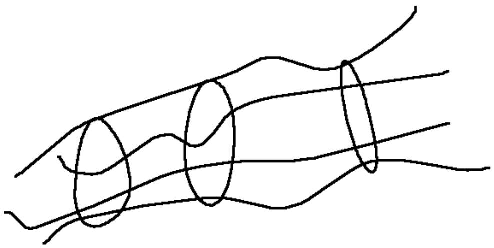
The cross sections are always created at a right angle to the current view. You should therefore select a view in which you can see the rail splines directly from the side.

If you activate the Cross Section tool you can draw a line with the mouse at the point where a cross section is to be created; to do this click with the mouse at the position where you require a cross section to be created then, holding the mouse button down, draw a cross section line over the rail splines and release the mouse button. In the following illustration three cross-sections were created:



The cross sections are seen as lines

If you now change to the perspective view, you will see that this has created circles (more or less) which are *wrapped* around the four rail splines:

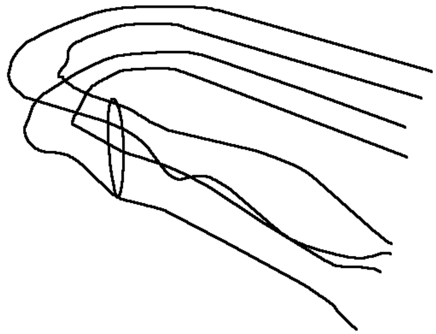


These cross sections are new splines with Bézier type interpolation, so that editing the spline shapes at a later stage is easy.

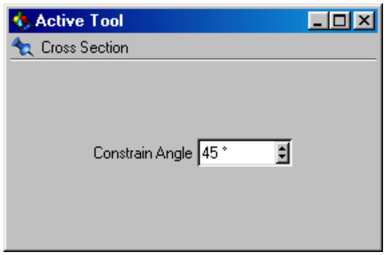
These cross sections are particularly useful for Loft NURBS objects. Simply create the first rail spline and then put the cross sections into a Loft NURBS object (see page 170).

The sequence of these rail splines within the group is important. If you work with more than two rail splines, make sure that these are placed in the right order within themselves in the Object Manager, because CINEMA 4D uses this object order when creating the cross sections. So the start point of the cross section spline is located on the first rail spline and the end point on the last.

If the rail splines wind around themselves (see example picture below), giving a cross section spline that overlaps with the rail splines, then CINEMA 4D selects the first intersection in the direction of travel of the spline.



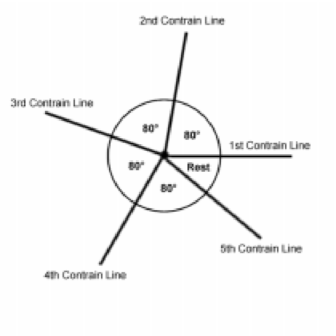
Options



Constrain Angle

Defines a relative value for the angle within which the cross section line is to engage. If you enter 45°, for example, a cross section can only be produced at 45°. To be able to use this option you must keep the Shift key pressed when drawing the cross section line. Otherwise this angle is not considered.

The angle is always increased from the east (east refers to the current view). In the following illustration a value of 80° was selected:



This allows you to work very precisely with the cross section tool.

Line Up

Sequentially selected points are aligned to a straight line using this function. The points are aligned between the two outer points of the selection (on the basis of the spline point order). If no points are selected, the entire spline is aligned.

before

after

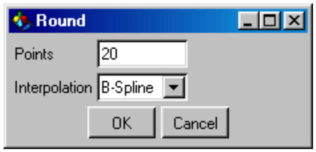
Note

Best results are produced with linear and Bézier splines.

Round

Sequentially selected points of a spline can be rounded and subdivided with this function. If no points are selected then all points of the spline are rounded.

Round Dialog



Points

The number of points that are to be created for each connected group of points of a spline.

Interpolation

The type of interpolation (see page 134).

Project

This function makes it possible to project splines onto object surfaces.

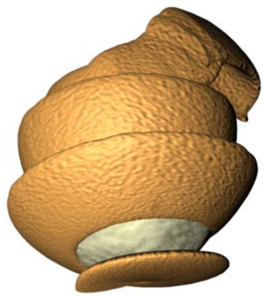
This makes it easy to move objects along a complex surface. Say you wanted to move an object through a chasm for instance. In the past a lot of thought and planning would be needed to fly your star cruiser through this winding gorge. Now, with the Project function, you can save yourself these headaches.

Simply produce the spline path in the plan view (see Spline Objects, page 127) and Project it from above onto the required area. This produces a path that is adapted exactly to that area. Your object can now move along this spline path (see Align To Spline, page 564).

A further use is in the preparation of splines for NURBS objects. For example you can create several circular cross-sections on an object surface and then use these cross sections to create a Loft NURBS object. The Project tool is outstandingly useful when you need to *wrap* splines over many objects.

Another example.

Consider a simple helix and a sphere. You can project the helix onto the sphere's surface then, with a Sweep NURBS object, create a half-peeled orange skin.



As you see, there are numerous applications for the projection of splines.

After you select the Project function, a dialog appears in which you select the type of projection. CINEMA 4D projects the Spline onto the surface of all visible scene objects, although you can exclude certain objects by making them invisible (see page 465).

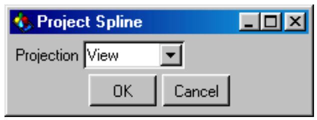
Project automatically converts procedural splines to editable splines. Please note that this step is not reversible (although you can of course use the Undo function).

Each point of a spline is individually projected. If a point cannot be projected (e.g. because no surface is available for it), then it will remain at its original position. With Bézier splines the tangents are adapted as well as possible.

Important

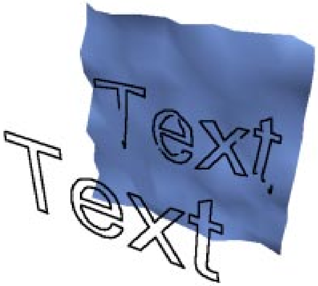
The quality of the projected spline will depend on two factors: how finely the spline is subdivided (the Project function does not add new points) and the alignment of the splines to the surface. Bézier splines can usually be projected better than other spline types.

Project Dialog



Type of Projection

View — projects the points according to the current view in the editor window. If several projection possibilities exist for one point with this projection, the surface that lies the furthest away in front of the camera is selected.



Projection of spline text on to a plane with projection viewed from another camera

XY, ZY, XZ Plane

the spline is projected according to the selected plane (the points are moved, perpendicularly to the plane, onto the objects).

Here text is projected, perpendicularly to the XY plane, onto a cylinder

XY, ZY, XZ Radial

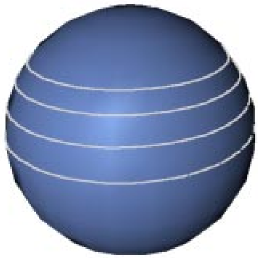
projects in a cylindrical manner. Here the projection is cylindrical, from the object coordinate origin of the spline. If several intersections are found, then the furthest one is selected.

An example: XZ Radial projects outwards from the center of the object coordinate system in the X and Z direction. The Y values of the spline points (in the object coordinate system) are not changed.

Here is a helix projected in the X and Z directions on to a cylinder

Radial

projects spherically. With Radial the spline is projected spherically, outwards from the object coordinate origin of the spline. If several intersections are found, then the furthest one is used.



A helix projected on to a sphere

Make Editable

The polygon and spline primitives of CINEMA 4D are initially created parametrically (see page 98). This means that they contain neither point nor polygon information that can be modified.

To edit the primitives at point or polygon level requires you to use the Make Editable function.

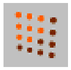
After invocation of this function, the selected parametric object is changed to either a polygon or a spline object according to its type. Now you can add new points or polygons to the object and further edit these.

Tip

You can use the Undo function to change the converted object back into a parametric one. If the Undo fails or you have saved the object, you cannot re-convert the object into its parametric form.

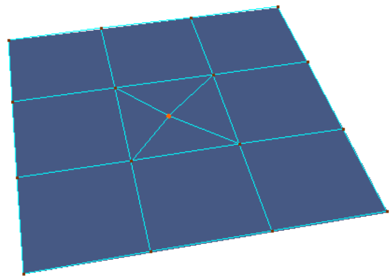
Add Points

Using this interactive tool you can add new points to objects. Point mode must be active for this to work.

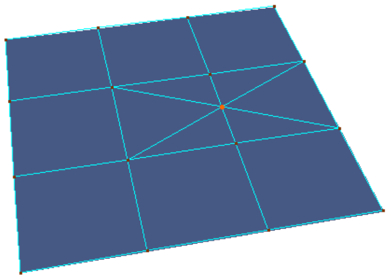


A selection is not necessary.

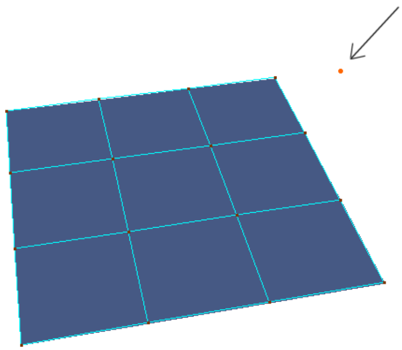
To add a point to a surface select **Add Points** and then simply click with the mouse on the surface at the position where the new point is to be created. Any *connecting lines* are drawn automatically, using the corner points of the surface to which the point is being added, together with the new point. So, adding a point to a face of a cube will result in four triangles.



To create a new, connected, point on an edge of a surface hold down the Shift key when clicking. The point is then created on the edge nearest to the mouse and the adjacent surfaces are automatically subdivided. This is a necessary step since, otherwise, pentagons would be formed and CINEMA 4D does not allow these.



If you want to create a point in *empty space*, keep the Ctrl key pressed when clicking. A solitary point, not connected to any actual object, is then added to your scene.



This tool also works with splines.

This is how to proceed with an empty spline object…

Select **Objects > Spline Object**. This creates an empty spline object with a preset Bézier type of interpolation.

More information about the different types of interpolation and their characteristics can be found on page 134.

With point mode activated, hold down the Ctrl key and click where the points of the spline are to be set. If you move the mouse while holding down the mouse button (and that Ctrl key) then a soft interpolation tangent is created for the current point. The new points are always created at the end of the spline.

To create a point on an already existing curve, select the **Add Points** function and click directly with the mouse on the curve. You can now keep the mouse button pressed to drag the point around, before letting it *drop* by releasing the mouse button in its final position. The shape of the curve does not change, since the tangents are adapted automatically (although when using the Cubic, Akima and B-Spline types of interpolation, by their very nature, the shape of the curve unfortunately cannot be precisely maintained).

If you wish to insert a new point into a curve and simultaneously affect the shape of the curve (with Bézier you can affect only the tangents and with the other types of interpolation you can only affect the position of the point itself), hold the Ctrl key down while clicking directly on the spline. Moving the mouse with the mouse button pressed will now change the curve.

Note

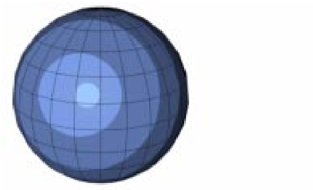
In principle you can also set points while pressing the Ctrl key in the move, scale or rotation mode.

Bevel

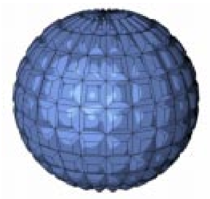
The Bevel tool is a mixture between *extruding* and *inner extruding*. This tool only functions in polygon mode. It extrudes the selected surfaces and adds edges to them. If no surfaces are selected then all polygons of an object are used. You can define the strength of the beveling interactively with the mouse by dragging the mouse left or right while holding the button down.

Example of use:

Here's how to create a faceted sphere: create a sphere, make it editable, switch to polygon mode with no polygons selected, select **Structure > Bevel**, disable **Preserve Groups** (in the Active Tool window) and then Apply ...

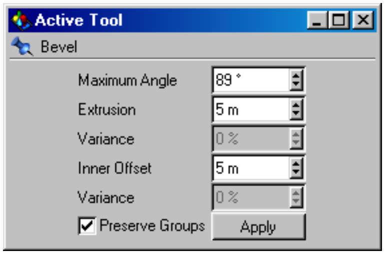


Before the beveling



After the beveling

Options



Maximum Angle

If **Preserve Groups** (see below) is selected, all polygons not exceeding this angle relative to each other will hold together. If the polygons should exceed this angle to each other then they are *broken apart* when beveled.

Extrusion

Defines the height of the bevel (the distance of the beveled surfaces from the surface of the original object).

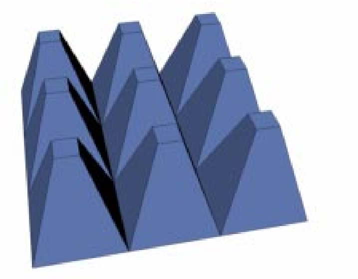
Variance

Defines a percentage value for the variation of the extrusion height of the bevel operation. This option is only available if **Preserve Groups** is inactive.

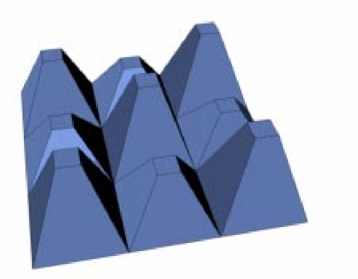
0%	No deviation from the selected extrusion value.
60%	All active surfaces are beveled between 40% and 100% of the extrusion value.
100%	All active surfaces are beveled between 0% and 100% of the extrusion value.

180%	All active surfaces are beveled between -80% and 100% of the extrusion value.

So you can see that the value you enter is subtracted from 100% to give the variation range.



Variance 0%



Variance 60%

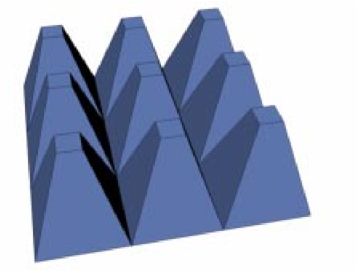
Inner Offset

Defines the internal extrusion (the length that the edges of the surfaces are to be inwardly shifted).

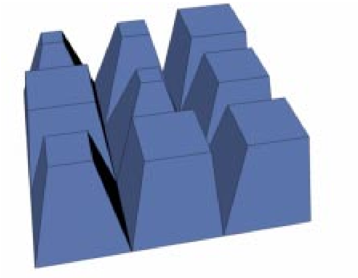
Variance

Indicates the percentage value for the variation of the inner offset. This option is only available if **Preserve Groups** is inactive.

0%	No deviation from the selected inner offset value.
60%	The edges of the active surfaces are inwardly beveled between 40% and 100% of the inner offset value.
100%	The edges of the active surfaces are inwardly beveled between 0% and 100% of the inner offset value.
180%	The edges of the active surfaces are beveled between -80% (outward) and 100% (inward) of the inner offset value.



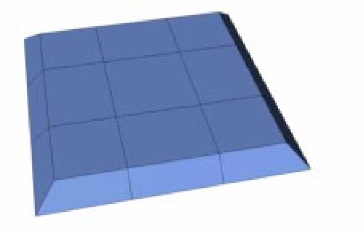
Variance 0%



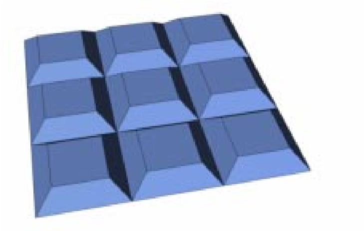
Variance 60%

Preserve Groups

With this option active, connected surfaces are not *broken apart* with the beveling, providing they do not exceed the angle set under **Maximum Angle**, relative to each other.



Preserve Groups active



Preserve Groups inactive

Apply

Use this button to execute the bevel function. Alternatively you can use the mouse to bevel interactively; just hold the mouse button down and drag.

Note

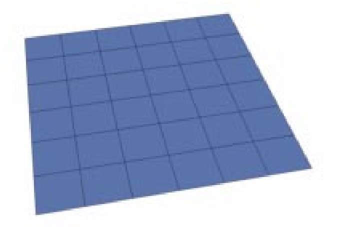
The values entered in Extrusion and Inner Offset also play an important role when interactively beveling with the mouse. In this case there are no absolute values, so they then indicate values relative to each other.

If, for example, you give the value 1 to **Extrusion** and the value 5 to **Inner Offset**, each element is moved exactly five units inward for each unit outward movement, and vice versa.

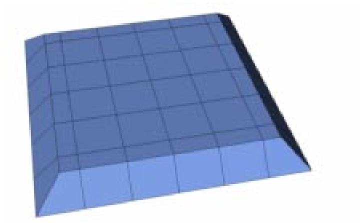
Negative values can also be used to bevel *inward*.

Another tip

You must be careful if you want to bevel several connected polygons and want to keep them as a group. In the following example only the outer edges of the selection are inwardly shifted. The edges of the inner surfaces of the selection are not affected.

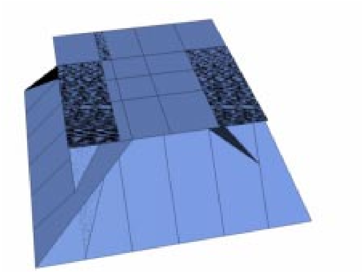


Before the beveling



After the beveling - only the outer edges shifted

You should therefore be aware that this can lead to problems when starting from a certain inner offset value, since the outer edges can possibly overlap with the internal ones.

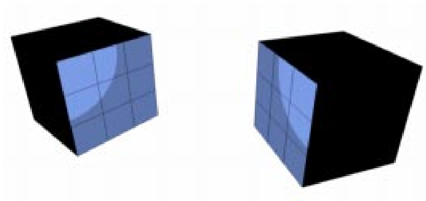


Here we see the problem that arises from starting with an inner offset value that is set too high.

Select a smaller inner offset to remedy this.

Bridge

The Bridge interactive tool behaves in point mode in a similar way to the Create Polygon tool. In polygon mode however it behaves somewhat differently. The main use for Bridge is to create connections between unconnected parts of objects. Have a look at the following illustration:

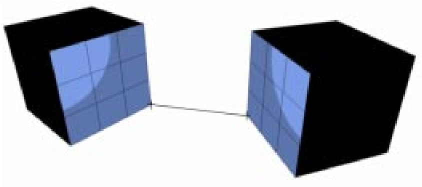


Both of these cubes were grouped and connected with Functions > Connect to form one object. They are however not physically connected

You now want to interconnect the two active groups of surfaces. To achieve this you select the **Bridge** tool and click (in polygon mode) on any corner point of the active surfaces of the right cube. You can then draw the auxiliary line by clicking on the appropriate corner point of the active surfaces on the left cube. Remember that the surfaces to be connected must be active before you start. You can also switch to the camera, change your view and then come back to connecting the cube; the surfaces you selected will still be in the same state.

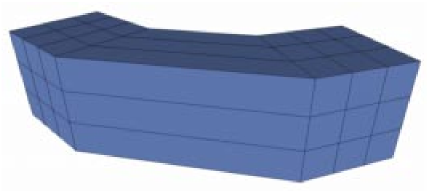
Note

To see the reverse side of the cubes you should switch the display mode, say to Wireframe mode.



Here is the auxiliary connection line

And here's the result:

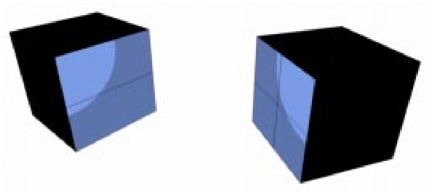


The original surfaces are connected to each other by four new surfaces

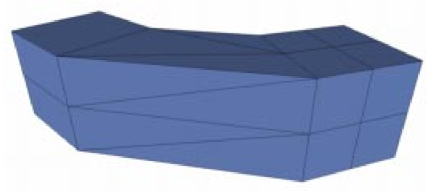
The original surfaces are deleted automatically, as necessary.

So what would happen if a differing number of surfaces were selected?

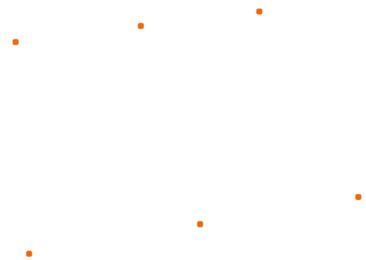
In the following illustration four surfaces are selected on the right cube and two surfaces on the left cube. These two selections are now to be interconnected.



Draw a line from one of the upper points of the right cube to the appropriate point on the left cube. CINEMA 4D must now connect the two points of the right cube with the one point of the left cube. Therefore the new surfaces must be triangulated.



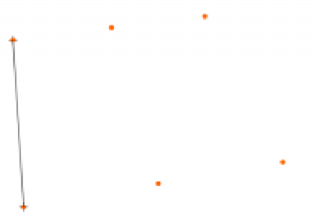
Let us now see how it works in point mode:



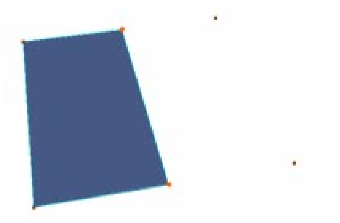
This is an empty object which contains just six individual points and is our example object

To interconnect all these points you could use the Create Polygon tool, but as you will see the Bridge tool is an ideal alternative to this.

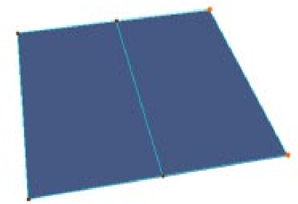
Firstly, click on the left point. Then draw the auxiliary line by clicking on the point above it; it should locate automatically on the point.



After releasing the mouse button the two points are colored red. Now repeat the whole routine again on the two points alongside. Click again on the lower point and draw the auxiliary line to the upper point and release the mouse button. You have now produced the first surface.

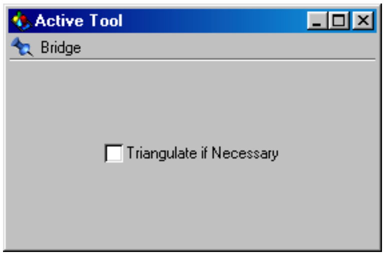


To create the second surface from the middle and right points does not require you to select the middle points again. Simply click once again on the lower point and draw the auxiliary line on to the upper one. After releasing the mouse button you will have created the second surface.



If you click in the wrong place, you can quickly reset the Bridge tool by pressing the ESC key.

Options



Triangulate If Necessary

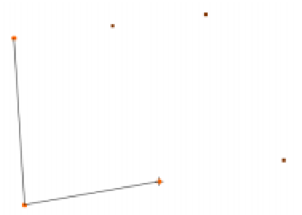
If this option is active, non-planar squares are triangulated during creation.

Create Polygon

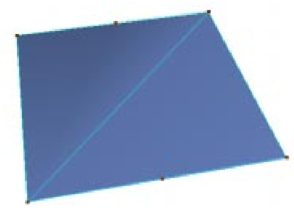
With this interactive function you can create whole new surfaces. You do not need a selection; you need only to be in point mode. In addition you need points, which are to serve as corner points for the new polygons.

In the following illustration is an object which contains six individual points. These will act as corner points for the new polygons.

To create a closed surface automatically from these six points requires that you click the points sequentially. If you begin with the upper left point, follow this by clicking on the point right beside it etc. If you look closely you will see a thin black line, ending in a cross. This acts as the auxiliary line and indicates which points have already been selected. Additionally these points are also colored red upon releasing the mouse button.

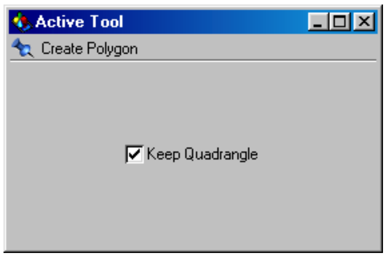


If all points have been selected, click once more on the start point and the surface is automatically closed. You can also double-click on the last point to close the surface.



In this example only squares were produced, since the points were regularly arranged. You can of course also close irregularly arranged points to a surface. In this case however you may find that triangles are created. CINEMA 4D permits squares only if the surface is even. With the more irregular type of partitioning you cannot directly influence whether squares or triangles are used. If you really need to control exactly when a square and when a triangle is to be created, and where the connecting lines lie, then you should create each polygon individually. Even better, use the Bridge tool instead (see above), which is more suitable in such a case.

Options



Keep Quadrangle

If this option is active, squares are still produced even if a polygon is not co-planar. If this option is not checked then two triangles will be created instead.

Note

If the points are selected in an anti-clockwise direction, the normals (for an explanation of this term see the Glossary) of the created surfaces point away from you and you see the surfaces from the reverse side. Then, with backface culling activated (see page 21), the surfaces cannot be displayed. In this case deactivate backface culling, or reverse the normals (see the Align Normals and Reverse Normals sections on pages 378 and 379).

If you select the points in a clockwise direction, the normals point towards you and you view the surfaces from their front.

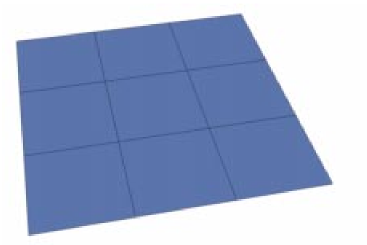
Extrude

This interactive tool functions only in polygon mode and extrudes the selected surfaces.

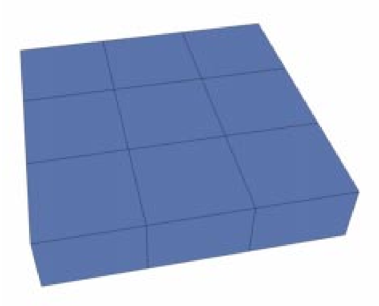
If no surfaces are selected, all polygons of an object are extruded.

You can define the offset (see below) of the extrusion interactively with the mouse by dragging left or right with the mouse button held down.

The extrusion will take place along the normals of the selected surfaces; the average value is evaluated from all normals to be extruded.

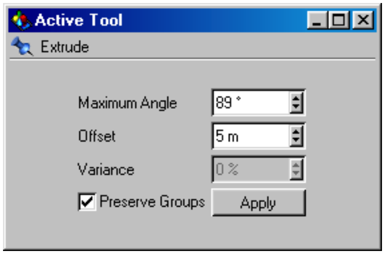


Before extrusion



After extrusion

Options



Maximum Angle

If **Preserve Groups** (see below) is selected, polygons not exceeding this angle to each other are kept together. Polygons exceeding this angle are *broken apart* during extrusion.

Offset

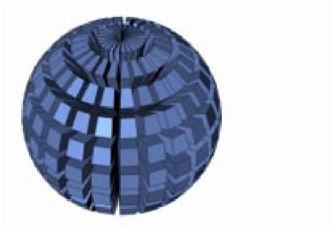
Determines the height of the extrusion (the distance of the extruded surfaces from the original object surface). This affects the extrusion when you press the Apply button. When using the mouse interactively (see above) this value is irrelevant.

Variance

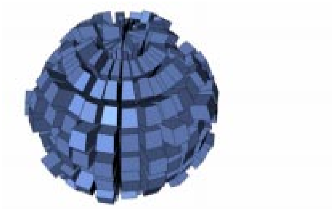
Defines a percentage value for the variation of the height of the extrusion. This option is only available if **Preserve Groups** is inactive.

0%	No deviation from the selected offset value.
60%	All active surfaces are extruded between 40% and 100% of the offset value.
100%	All active surfaces are extruded between 0% and 100% of the offset value.
180%	All active surfaces are extruded between -80% and 100% of the offset value.

So you can see that the value you enter is subtracted from 100% to give the variation range.



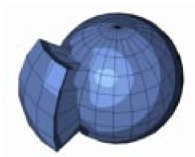
Variance 0%



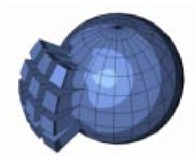
Variance 60%

Preserve Groups

If this option is active then the connected surfaces will not be *broken apart* during extrusion, assuming they do not exceed the **Maximum Angle** you chose above, relative to each other.



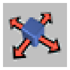
Preserve Groups active



Preserve Groups inactive

Tip

If you want to extrude along an axis using the object or world coordinates system, and not along the normals, perform a numeric extrusion (i.e. using the Active Tool window to input values, not using the mouse) with an offset (height) value of 0; then move the new surfaces with the move tool.

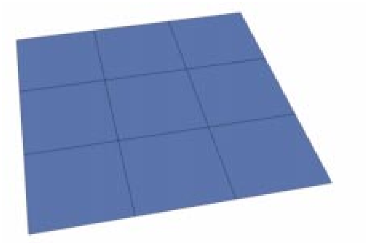


To extrude in the Z direction, simply lock the X and Y axes.

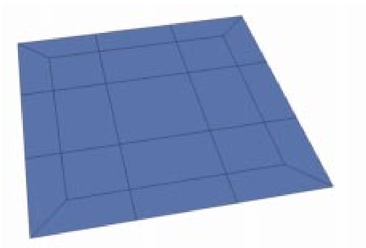
Extrude Inner

This interactive tool behaves in a similar way to the Extrude tool. Like Extrude, it functions only in polygon mode. However, in contrast to the extrude tool, the selected surfaces are extruded inwards (or optionally outwards!). If no surfaces are selected then all surfaces of the object are included in the extrusion.

You can define the offset (see below) of the inward extrusion interactively with the mouse by dragging to the right while holding the button down (if the mouse is moved to the left, the extrusion will be outwards).

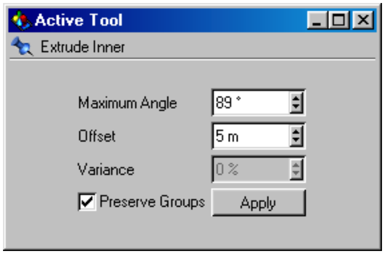


Before extruding inwards



After extruding inwards

Options



Maximum Angle

If **Preserve Groups** (see below) is selected, polygons not exceeding this angle to each other are held together. If the polygons exceed this angle they are *broken apart* with Extrude Inner.

Offset

Defines the width of the internal extrusion (the distance of the edges of the extruded surfaces from the edges of the original surfaces). This affects the extrusion when you press the Apply button. When using the mouse interactively (see above) this value is irrelevant.

Variance

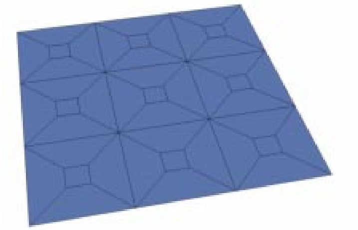
Indicates a percentage value for the variation of the width of Extrude Inner. This option is only available if **Preserve Groups** is inactive.

0% No deviation from the selected offset value.

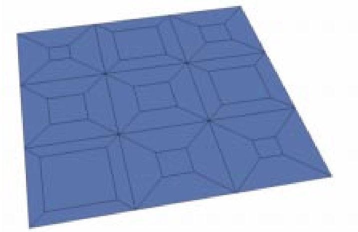
60% All active surfaces are inward extruded between 40% and 100% of the offset value.

100% All active surfaces are inward extruded between 0% and 100% of the offset value.

180% All active surfaces are extruded between -80% (outward) and 100% (inward) of the offset value.



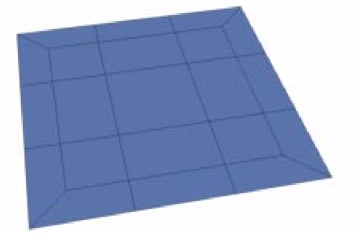
Variance 0%



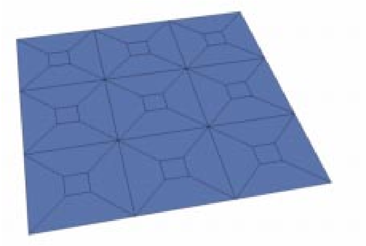
Variance 60%

Preserve Groups

If this option is active then the connected surfaces will not be *broken apart* during extrusion, assuming they do not exceed the **Maximum Angle** you chose above, relative to each other.



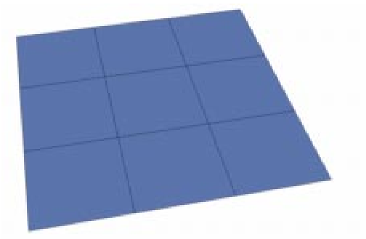
Preserve Groups active



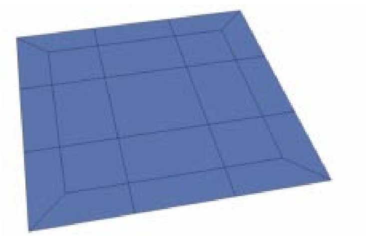
Preserve Groups inactive

Note

You must be careful if you wish to use Extrude Inner on several connected polygons and also keep them as group. In this case only the outer edges of the selection are moved inward. The edges of the inner surfaces of the selection are not affected.

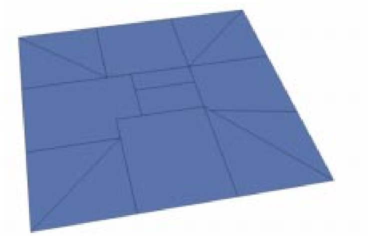


Before extruding inwards



After extruding inwards - only the outer edges are moved

You should therefore be aware that this could lead to problems when starting from a certain offset value, since the outer edges may overlap with the inner.



Here you can see the problem that arises when starting from too high an offset

Select a smaller offset to remedy this.

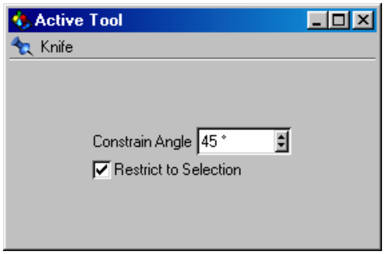
Knife

As the name suggests, you can use this tool to literally cut through surface objects and splines. The object will be subdivided at the cut so this is not quite like cutting a loaf of bread with a bread knife but it does define a cut line so that you can tear off the slice of bread later with the Disconnect tool.

Note

You must be in point or polygon mode to use the Knife tool.

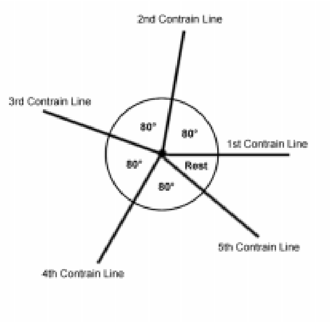
Options



Constrain Angle

Enter a relative angle in this field that will affect the Knife line's calculation. Entering 45°, for example, ensures that all cutting can only be made at 45°. To use this option you need to keep the Shift key pressed when drawing the cutting line, otherwise this angle is not considered.

The angle is always increased from the East (East refers to the current view). In the following illustration a value of 80° was selected:

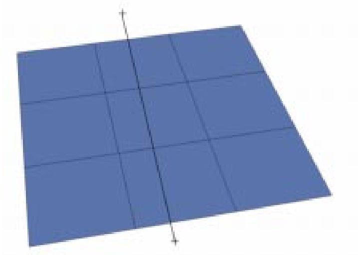


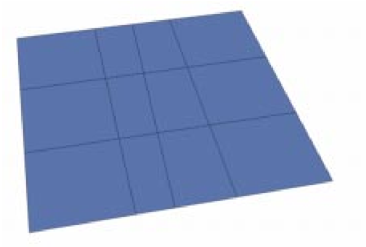
This gives you the ability to work very precisely with the Knife tool.

Restrict To Selection

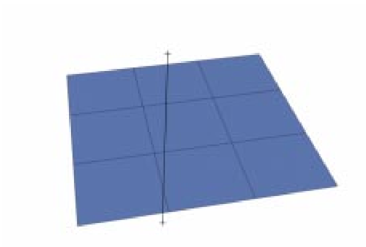
This option is switched off by default. So the cut line, by default, pays no attention to any selected surfaces (or with splines, to any connected point selections). If this option is active, only areas of any selected elements are cut.

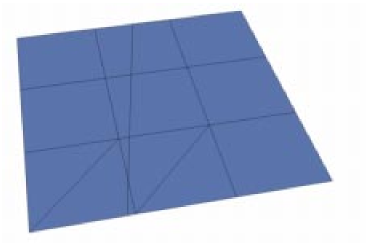
If you cut through polygon objects along a constant polygon row you will get an exact cut:





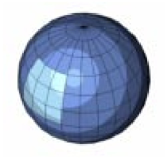
If, however, you do not cut along such a constant polygon row, CINEMA 4D must distribute adjacent surfaces as necessary and, since only triangles and rectangles may result from the cut (no pentagons or other such n-sides are allowed), this will result in a far less precise cut:



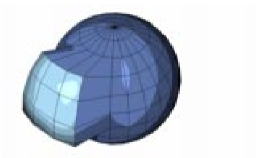


Normal Move

Selected surfaces are moved along their normals with this interactive tool. You must be in polygon mode to use this function. You may use this tool interactively with the mouse by moving left or right while pressing the mouse button. You can also use this tool with numeric input (see below). If no surfaces are selected, all surfaces are moved. If the surfaces selected for movement contain divided points, CINEMA 4D will calculate how these elements are changed.

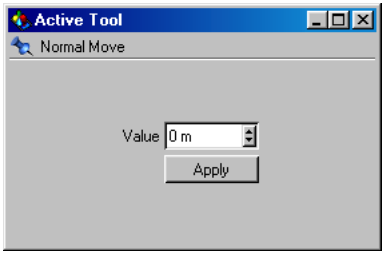


Before



After

Options

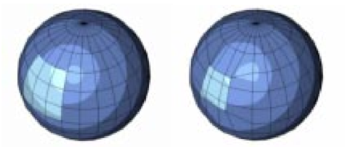


Value
  gives the value for the move.

Apply
  confirms the numeric input.

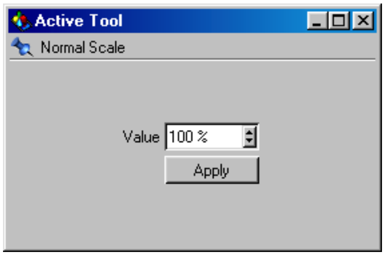
Normal Scale

Use this interactive tool to scale selected polygons along their normals. You must be in polygon mode to use this function. You can use this tool interactively by moving the mouse left or right while pressing the mouse button. You can also use the tool with numeric input (see below). If no surfaces are selected, all surfaces are scaled. If the surfaces selected for movement contain divided points, CINEMA 4D will calculate how these elements are changed.



Before *After*

Options



Value

The value for the scale. 100% means the surfaces are doubled in size.

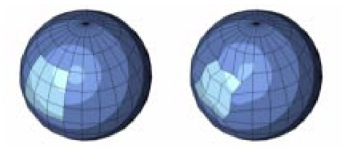
Apply

Confirms the numeric input.

Normal Rotate

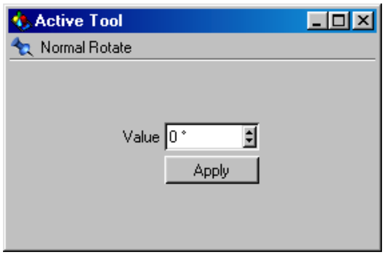
The selected polygons are rotated around their normals. The normals of each individual surface are used as the rotation axes. You must be in polygon mode to use this function.

You can use this tool interactively by moving the mouse right or left while pressing the mouse button. You can also use the tool with numeric input (see below). If no surfaces are selected, all surfaces are rotated. This tool is mostly suitable for individual polygons. If the surfaces selected for movement contain divided points, CINEMA 4D will calculate how these elements are changed.



Before *After*

Options



Value

Gives the value for the rotation.

Apply

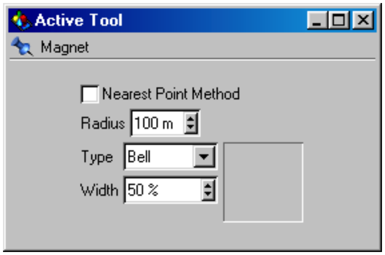
Confirms the numeric input.

Magnet

With the interactive magnet tool you can *pull* sections out of polygon objects (and also splines). You must be in polygon or point mode to use this function. If you have a selection active, only those points or polygons are modified. If no selection is active, all points or polygons of the object are included.

Click anywhere on the object and drag the mouse. The surrounding points follow the mouse pointer to a certain distance - the further they are from the mouse pointer, the weaker the influence of the magnet on them.

Options



Nearest Point Method

If this option is inactive (default), an object is deformed only if you click within the radius of influence - see below (this also applies to polygon mode). This becomes the starting point. If you click *beside* it (i.e. outside the radius of influence), nothing is deformed. If this option is active, however, deformation of the object will occur, starting from the point nearest to the mouse pointer.

The first method is far more precise. You will also benefit from the fact that points on the opposite side of the object will not be modified accidentally with this first method. Only those points, which are not covered, by other points and surfaces can be selected. However, if the Nearest Point Method is enabled, points which are also located on the back of the object can be selected (unless these have been set to invisible by Backface Culling or a red visibilty switch in the Object Manager). This makes it possible to work from the inside of objects with the magnet.

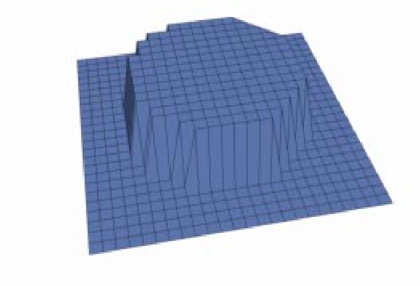
Radius

Gives the radius of the range of influence of the magnet.

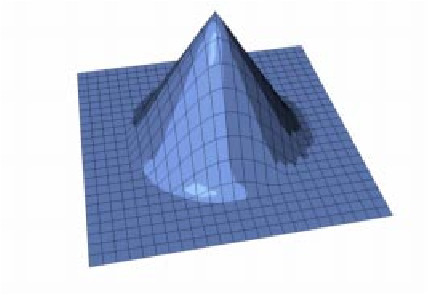
This radius can be increased or decreased interactively by pressing the '+' or '-' key while holding the mouse button down and dragging. Users of a wheel mouse can change the radius interactively with the wheel.

Type

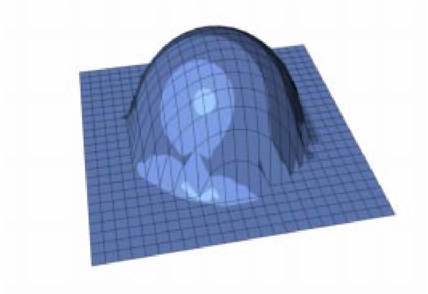
Select between several types of function curves for the magnet:



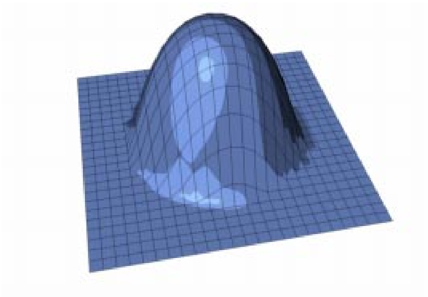
Constant



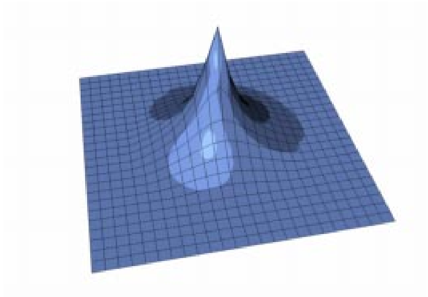
Linear



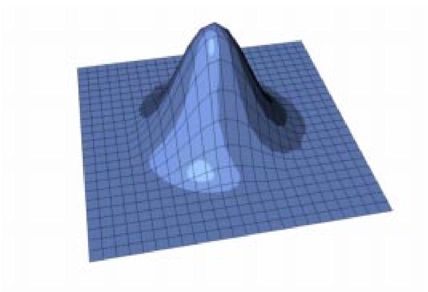
Circle



Dome



Needle



Bell

Width

This parameter determines how soft or hard the influence of the magnet is to be.

Mirror

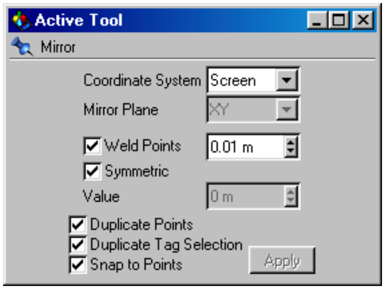
Using the Mirror tool, points and surfaces of an object can be mirrored.

This tool functions in point or polygon mode. In point mode only the selected points are mirrored (without their surfaces). If no points are selected, all points are mirrored. In polygon mode the selected surfaces are mirrored. If no surfaces are selected, all surfaces are mirrored.

Mirror can also be applied to splines. The selected points are mirrored as a new segment.

Mirror functions interactively. This means you can control the mirroring directly with the mouse; to select the axis for mirroring, simply click and drag until you see the axis you want, then let go of the mouse button.

Options



Coordinate System

Selects the coordinate system for the mirror function.

- Object

  In this mode the object is mirrored over the object axes. You can set the mirror axis using the mouse by clicking directly on a point of the object. The mirror axis automatically locates itself on the nearest point. The object is then mirrored exactly over this point.

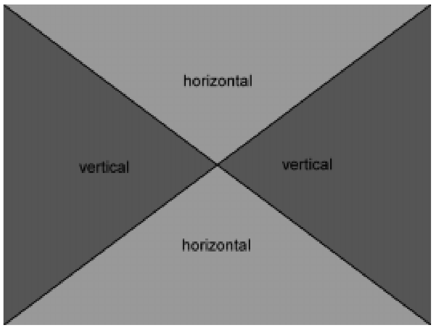
  You do not necessarily have to be in point mode; the points are also located in this way in polygon mode.

  The object mode also allows the input of numeric values (see Value below).

- World
  this mode behaves exactly like the object mode, except that the element is mirrored over the selected world axis.

  Like the object system, the world mode also allows the input of numeric values (see Value below).

- Screen
  in this mode the object is mirrored in the current projection plane. If you first click in the area of the upper or lower window border, you get a horizontal mirror axis. If you first click in the area of the right or left window border, you get a vertical mirror axis.



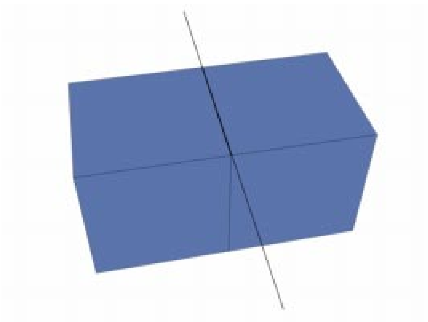
In all the above modes remember to keep the mouse button pressed! You can now choose the mirror axis by dragging it with the mouse to where you want the mirroring to occur. When you release the mouse button, the mirroring takes place.

Mirror Plane

This mode is only available for the world and the object coordinate system. You can select the XY, ZY or XZ plane. Depending upon the selected coordinate system (see above) the mirror plane refers either to the world or to the object axis.

Weld Points

This option is quite important if you mirror, for example, a cube over one of its edges and **Duplicate Points** is active. After mirroring there may be some points which occupy the same 3D space, and lie on top of each other:



If **Weld Points** is active, these duplicate points are welded after mirroring.

In the adjacent input field you can enter a distance; any point that has a duplicate point within this distance will be welded into one single point.

Value

Use this to position the mirror axis numerically. This works only with the object and world coordinate systems and allows you to freely define the distance of the mirror axis from the axis origin.

Duplicate Points

If this option is inactive, the selected elements are simply mirrored. If this option is active, the selected elements are first duplicated and then mirrored. So you obtain a mirrored copy of all the selected elements.

Snap To Points

When using interactive mirroring in the editor, this defines whether the mirror axis is to snap to the points of the object (in screen mode) or not. If this is active the mirror axis is then positioned automatically to the point nearest the mouse pointer. With this function you can, for example, mirror a cube precisely over one of its edges.

When using the object or world coordinate systems Snap to Points is turned on automatically. The mirror axis must be placed at a point of the object. That is, you cannot freely determine the mirror axis interactively when in the object or world coordinate system. You can get around this though - see Value above.

Apply

Use this button to confirm your numeric input.

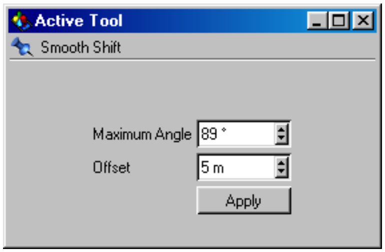
Smooth Shift

Smooth Shift is comparable to the Extrude tool. With Smooth Shift, however, the connected surfaces can only be extruded coherently. The direction in which the surfaces are extruded with Smooth Shift is determined not only from the normals of the active surfaces, but also from the normals of the adjacent (inactive) surfaces. This makes it easy and quick to extrude lumps out of surfaces accurately.

This interactive tool can only be applied to surfaces. If no surfaces are selected, or you are not in polygon mode, then all surfaces are considered.

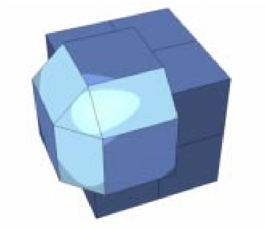
Smooth Shift is an interactive tool. This means that you are able to determine the offset of the extruded surfaces directly with the mouse (hold down the mouse button, drag left or the right, then release the mouse button).

Options



Maximum Angle

This is the maximum angle that surfaces may lie to each other to ensure that no additional surfaces are created with Smooth Shift. Rectangles (and in some cases also triangles) are inserted in these critical places where the angle is exceeded, ensuring that the surfaces are not torn apart.



The marked surfaces are those which had to be additionally built and inserted, because the Maximum Angle was exceeded.

Note

These triangles should be avoided if you want to use an object for Hyper NURBS, otherwise the Hyper NURBS surface may display uneven shading properties.

Offset

This input field is only relevant if you do not choose the offset interactively with the mouse. Using this value you may determine the offset of the extruded surfaces numerically. Use the Apply button to confirm the input and accomplish the Smooth Shift.

Align Normals

When creating surfaces (see above) you may sometimes inadvertently create surfaces with normals pointing in the wrong direction or opposite directions. Such a problem is easily fixed with this function. When you use Align Normals CINEMA 4D will adjust and re-align the incorrect surface normals to the correct direction.

CINEMA 4D adjusts the orientation of the normals according to the normal direction of the first surface of the currently selected group of surfaces.

If no surfaces are selected then all normals are aligned.

Note

CINEMA 4D does not recognize an object's inner and outer surface. A basic sphere has an inner and an outer side, but only one surface level, which can be confusing. We need a better definition.

Let us define this single surface level to have an *Inner* and an *Outer* property. Outer designates, in principle, the direction in which the surface normals point and Inner is therefore the opposite direction. This plays a role with texture projection, where you have the possibility to project textures from only the front or the back (see Texture Mapping, page 525).

So, if there is an equal number of normals pointing one way as point the other way how do we decide which is the Outer surface? We could either choose randomly or, perhaps, look at the first polygon in the sequence and use its normal as the basis of our calculation - CINEMA 4D does the latter.

Why exactly are these normals needed?

As described above, the direction of the normals defines the interior and the exterior of an object. This is important, among other things, for displaying an object in the editor.

Occasionally, when building certain objects, a situation can arise in which some polygons seem invisible. This can happen if Backface Culling is on and the reason is as follows.

To save on processor performance you may have, sensibly, enabled Backface Culling (see page 21) for your scene; this is where only the polygons visible from the front of an object are displayed in the editor. The polygons positioned directly at the back of an object are not drawn.

When displaying a sphere and other volume objects in the Gouraud shading mode you may notice no difference, simply because you do not see the back of the sphere anyway. But should you select all the polygons of this sphere and reverse the normals (see next section), you will now see only the back of the sphere; the front is now transparent since you now have *inverted* the sphere. The inside is now the outside - and this becomes invisible because of the Backface Culling.

Should you find yourself inadvertently in a situation like this you should switch off Backface Culling and reverse the normals of these polygons.

The adjustment of these normals also plays an important role with tools such as Smooth Shift, Extrude etc. These model tools always move in the direction of the normals by default. If you should need to move several surfaces with different normal alignments using Smooth Shift you will obtain useless results, since the surfaces are moved in their own respective, and opposite, directions.

Another important factor is smoothing with angle limit active (see Smoothing, page 455). CINEMA 4D calculates whether edges are to be rounded or not by considering the angle of the surfaces to each other. If two surfaces with differently aligned normals lie next to each other, CINEMA 4D calculates the wrong angle information - thus causing unwanted, often ugly, results when smoothing.

Additionally, when using Displacement Mapping (see page 508), the angle of the normals plays an important role.

Reverse Normals

This function is similar to Align Normals. Here, however, the normals are reversed. If no surfaces are selected, all the normals of a selected object are reversed. With an active selection only the normals of the selected surfaces are considered.

Note

Reversing the normals is achieved by changing the point sequence in a polygon (see also Structure Manager, page 605).

Optimize

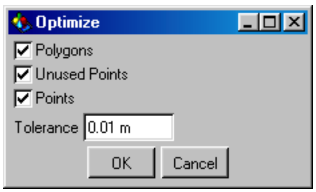
If you were to build an object from many individual triangles and rectangles, for example by using the Connect function (see page 393), very often some points and surfaces will be duplicated. For example, the parametric primitives can contain some duplicate points after being converted into polygon objects. You can eliminate these double elements with the Optimize function. The appearance of the object will not change, or only slightly change, when using this function.

Caution is required with objects that intentionally contain these double points in certain places. Such points can be intended, for example, to produce hard edges despite an active smoothing tag (see page 455) or in connection with a Hyper NURBS object (see page 165).

The selected elements to be optimized can be points or polygons. If you select polygons, then the associated points are also considered. If you select points only, then just the points are considered.

This tool can be applied also to splines. In this case, however, only the points can be optimized, since a spline does not possess surfaces.

Optimize Dialog



Polygons

When selected this will eliminate one- or two-point surfaces.

Unused Points

Check this to delete isolated points, which are un-connected with any object geometry.

Points

Specifies whether duplicated points are to be eliminated.

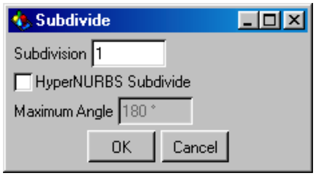
Tolerance

When eliminating points you may enter a tolerance value. This defines the maximum distance that must lie between the two coinciding points for them to be deleted when optimizing. If points are closer to each other than this value, then they are merged into one point. If polygons should become redundant (e.g. if all three corner points of the polygon occupy the same point), then CINEMA 4D will automatically delete these.

Subdivide

With this option you can partition polygon objects or splines. If there are no polygons selected when subdividing a particular polygon object, then all polygons are partitioned.

Subdivide Dialog



Subdivision

The number of subdivision steps to be applied. Caution - do not make this value too large. The number of surfaces (or the number of points), and therefore the storage requirement, for any object rises dramatically with each increase in this value. With each extra subdivision step a surface is divided into four surfaces.

So, if your object initially has three surfaces, a single subdivision results in twelve surfaces, a second subdivision results in 48, a third in 192 etc.

Hyper NURBS Subdivide

With this option active the object is subdivided using the Hyper NURBS formula (see page 165). Point positions that already exist are modified to round the structure of the surface. If this option is not active, existing point positions are maintained and the surface is not smoothed when subdividing.

Note

With Hyper NURBS Subdivide on triangles are divided into three rectangles - with normal subdividing you would get four triangles.

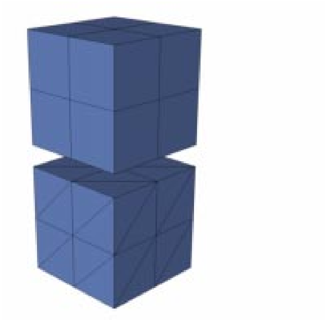
Maximum Angle

Defines the maximum angle that the surfaces may be at to each other in order to be smoothed. If the angle is larger than this value, a hard edge remains.

The Hyper NURBS Subdivide is a common method of modeling on a polygon basis - you start with a low detail screen model which you can quickly and easily modify. You then subdivide, modify it again, subdivide again etc.

Triangulate

Triangulate converts all the rectangles of an object into triangles.



When editing polygon objects you should try to work with rectangles whenever possible. Rectangles are computed more quickly than triangles, use less memory and give better results with Phong shading (see Glossary) and with Hyper NURBS.

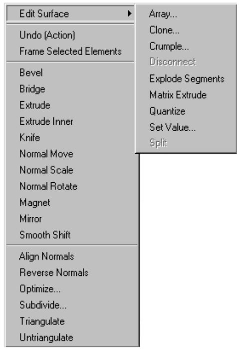
Untriangulate

If you have an object built only of triangles (e.g. exported from another program), CINEMA 4D can try to convert the triangles into rectangles. This only works as long as the triangles that you want to convert will result in a planar rectangle. Triangles that cannot be converted are left in their original state.

Structure Context Menu

There is no need to move your mouse all the way up to the **Structure** menu. Instead, click the right mouse button (Macintosh: Command-click) and a context menu will open containing all the modeling functions.

In Point Mode



In Polygon Mode

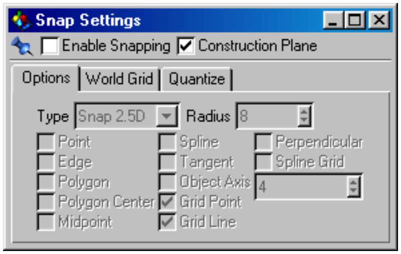
You can choose **Frame Selected Elements** from the context menu. This will zoom and centre the active view in relation to the selected elements. This can improve your workflow, since it removes the need to use the standard navigation tools.

You can also choose **Undo** from this menu.

Snap Settings

It is often useful to be able to force a construction item to a particular place in your 3D modeling space. Of course, we have the Coordinates Manger that allows precise positioning but sometimes what we need is to be able to constrain the movement of an item to a grid or, indeed, to another item - this is called *snapping*.

With snapping turned on you can snap elements to other elements automatically, e.g. one point can snap to another point. Or a spline point can snap to the axis origin of another object.



The snap will happen whenever the point (let's called it the *source* from now on) lies at a certain distance from the *target*; you have control over this *radius of attraction*.

For example, you can make the lowest point of a sphere snap to the center of the highest surface of a nearby cube - so two objects can be positioned in relation to each other precisely, easily and quickly. There's no doubt that architects need this feature but every modeler will find a use for snapping.

Snapping in the different modes

Snapping works in the following modes; object, model, texture axis, point, polygon, animation (for keys).

Say you have selected several points (or polygons) and want to move them with snapping activated, when does the snap happen? In other words which point/polygon out of all those selected is taken to be the source item, the one that when it gets within the range of the target will snap to it?

It works like this - the item that is closest to the mouse pointer when you start to move the selection is taken to be the source item; when that gets within range of the target it is snapped to it and all other selected points/polygons move accordingly.

This turns out to be a natural way of doing things so that, if you want the edge of a selection to snap, simply place the mouse pointer outside the selection before moving. It's best to try this out to see how it works. We'll give an example below.

Notes

Snapping overrides any set mouse grid (see below under Quantize). Snapping works when moving elements, not when scaling or rotating them.

Enable Snapping

Check this to turn snapping on; all the snap settings now become active. Uncheck this box to turn snapping off. The **Construction Plane** and **World Grid** tabs are independent of snapping and can be changed whether or not snapping is on.

Construction Plane

This option allows you to enable/disable the use of a construction plane.

What's the idea of a construction plane?

It's a modeling aid that allows you to constrain the creation of points and splines to a particular construction plane of your choosing.

In the **Objects > Modeling** submenu you will find the **Construction Plane** object (see page 187). You can have many of these in your scene, if you wish. If no construction plane is present, the world grid (if active) is considered to be a construction plane. If several construction planes exist in a scene, the first visible one (i.e. with its traffic light not at stop) in the Object Manager is used (see Object Display, page 465).

The construction plane is relevant only in the 3D, parallel and isometric views (thus all non-2D views). When the **Construction Plane** option is active, newly set points or newly drawn splines (including their tangents) are created within the construction plane (not above or below it, no matter where you click). The points can then be moved only on the construction plane. This applies until the points are moved from the working plane by another tool or by deactivating the **Construction Plane** option.

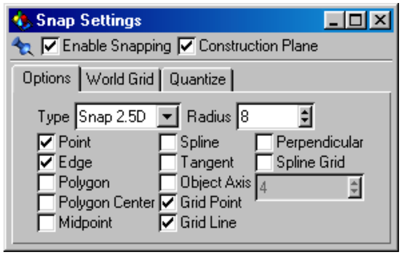
The **Construction Plane** option is active by default and thus allows you to draw splines comfortably in the 3D view. (With this option turned off splines will be drawn freely in space.)

There is always an exception, of course. If the horizon is visible in the 3D view (see Projection on page 16 for a discussion of the different views) then as long as you move a point beneath the horizon, it remains on the construction plane. However, if you move the point above the horizon, it will no longer be fixed on the working plane and is free to move in height (this is a limitation forced on us by the technical aspect of projection).

This option is not linked to the **Enable Snapping** setting.

Options Tab

There are three **Type** settings which give a great deal of control over the snapping process.



Snap 2D

In this mode the source point is snapped only if it is at same height as the target point, as well as being within range of the target. In this case height is dependent on your selected view as follows.

In the frontal view the Z values of the elements must agree, in the side view the X values must agree and in the plan view the Y values must agree. In the case of use of a construction plane the local Y values in this object system must agree. Also in all non-planar views the Y values (related to the virtual projection plane) must agree.

Snap 2.5D

The snapping takes place *visually* in the current view. Snapping will happen if the source lies visually in the current view within the snap radius of the target. In contrast to the 2D snapping the points do not have to have the same X, Y or Z values.

If you make a 2.5D snapping in the 3D view and then switch to another view you will see that, after the snapping, the points do not necessarily agree with their snap targets in the new view. The point has been snapped only parallel to the view, not moved in depth.

Snap 3D

The source is snapped directly to the target. 3D snapping works like 2.5D snapping - with the difference that the point is actually moved to the target, giving accurate, natural positioning.

Here's an example to show the difference between these snapping modes:

Suppose you have activated a **World Grid** with a grid spacing of 100 units and you have a selected point at (53/62/91) that you wish to snap to and you are working in the frontal (XY) view. Also, only the **Grid Point** snapping option (see below) is active and the snap **Radius** is 30.

2D If you move the point, it is never snapped to the nearest grid point since the neighboring grid points lie at (x/y/0) and (x/y/100) and therefore have different Z coordinates from our source point. Since the Z component never agrees, it will never be snapped. This would be different if the source point had a Z coordinate of 100, for example.

2.5D If you move the point, it is snapped to the neighboring grid points when they come within range. However, since it is moved, in this mode, only perpendicularly to the camera, it keeps its Z component. The snapped point is moved, for example, to the coordinates (0/0/91), (100/0/91), (100/100/91) or (0/100/91).

3D In this mode the source point snaps within the complete 3D space. The point can therefore be moved to the coordinates (0/0/100), (100/0/100), (100/100/100) or (0/100/100), for example.

Radius

This is the radius of attraction for the particular target you have selected. The larger this radius, the more quickly the source will be snapped to the target as the source is moved towards the target. You could say that targets with a high radius are more attractive!

Point

If this option is active, the source is snapped to the points of the active or other objects. All visible, polygonal objects and splines in the scene are considered. As primitives (see page 98) have no points, they cannot be considered as snap targets for this option.

Edge

With this option on the source is snapped to polygon edges. All visible, polygonal objects in the scene are considered.

Note

Points have a higher snapping priority than edges.

Polygon

Enable this option and the source is snapped to the surface of the target polygon. All visible, polygonal objects in the scene are considered.

This is particularly well suited to drawing splines on to polygon objects, for example. To do this you should deactivate all other options and use

Snap 3D. If you now create (or move) the points of the splines, they are snapped automatically to the polygons lying behind the spline.

Polygon Center

With this option enabled the source will be snapped not to the surface of the polygon but to the centre of the target polygon.

Midpoint

Use this option together with other options to, for example, snap to the midpoint of a polygon edge or to the centre of the spline distance between two points.

Spline

With this option on the source will snap to any part of a visible spline curve.

Tangent

This option makes sense only if you want to let a source spline curve at a point just edited snap tangentially on to another, target, spline.

This option can be very time-consuming.

Perpendicular

Here the source is not snapped if the source and target spline curves are tangential to each other, but only if the curves are perpendicular to each other.

This option can be very time-consuming.

Spline Grid

If you enable this option you can effectively use an existing spline as a snap grid and snap to the nth part of the spline; here *nth part* means the *total length of the spline divided equally into n elements*. You choose this value in the box below the option.

For example, if the spline is 200 units long and you have entered a Spline Grid of 5, the snapping will be to the nearest 40 unit segment (independent of the actual spline points).

Note

Be careful not to have too many snapping options active at the same time. For example, if you want to draw a spline on the surface of an object (see above) and both Polygon and Point are active, the new points may often disappear behind the surface since snapping is considering all points - including those on the back of the target object.

Object Axis

Enable this to snap to the object axis origin of any visible object.

Grid Point

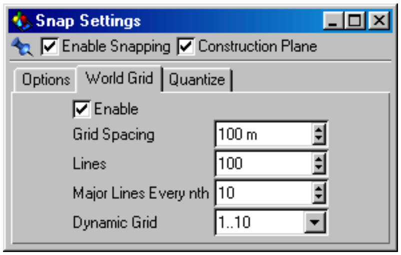
With this option on the source is snapped to the grid points of the construction plane.

Grid Line

Turn this on to snap the source to the grid lines of the construction plane.

World Grid Tab

This is where you choose the properties of the world grid which is also the default construction plane (see below) and is shown in all views.



When enabled, this gives you a working grid within the various 2D and 3D views which can be an excellent tool for precise modeling. It also shows the world axes (which the construction plane object does not).

Enable

Check this to turn the world grid on, uncheck it to turn the grid off. Remember that you may have one or more construction plane objects in your scene as well, in which case you will still see a grid on your display even if the world grid is turned off.

Grid Spacing

This is the distance of the grid lines from each other.

Lines

This allows you to choose the total number of grid lines (stretching over the X and Z axes); the default is 100. When you choose a higher value, the grid nears the horizon. This setting is only relevant in the non-planar views.

Major Lines Every nth

The grid contains major interval lines, which stand out from the others by their darker color. With this option you can choose when these interval lines should occur; after every 5, 10, 100 lines, for example.

Dynamic Grid

With this option you get always an optimal grid width on the screen - independently of the chosen grid spacing. This only applies to the 2D views. Using the popup menu you choose, with which factors the dynamic grid is to work.

If you select **None** the grid is not dynamic and the grid spacing (with its default value of 100) remains constant, no matter how much you zoom in or out.

But if you select, say, **1...10** the grid is adjusted in steps of 10 as you zoom in or out. If you zoom in and the spacing becomes to wide for the view, CINEMA 4D first switches automatically to a grid spacing of 10. If you zoom in still nearer, it is changed to 1. If you zoom out from the default grid and the grid width of 100 becomes too dense for clarity, it is first switched to a grid spacing of 1000 and then up as necessary. There are no restrictions up or down.

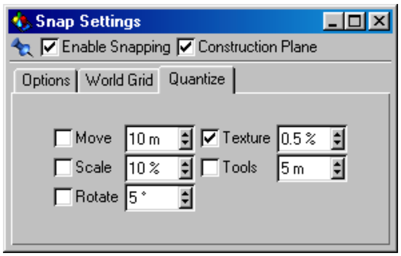
1..5..10 means that grid widths of 100*5^10*n and 100*10^10*n can be achieved.

1..2..5..10 means that is switched in steps by 2, 5 and 10. The grid can then among other things have the values 0.1; 0.2; 0.5; 1; 2; 5; 10; 20; 50 etc.

You can also choose **1..2.5..5..10,** the meaning of which is left as an exercise.

Quantize Tab

The settings on this tab affect the mouse sensitivity when modeling and editing objects, points, surfaces etc.



Move

When positioning objects, points, surfaces and other elements a small mouse movement can often result in a change larger than the one you wanted; so, for example, the element which is to be moved by a couple of units jumps from position 10,374 to position 10,694.

To prevent this, use the **Move** grid. It is not shown as lines in the view but has the effect that you can only move an object to positions which are a multiple of the chosen value. A free or unintentional movement of objects is then no longer possible.

It is a local grid - it is always relative to the current position.

If you entered, for instance, the value 10, an object will always move in units of 10 (by 0, 10, 20 units etc.). An object with the position (5,6,90) moved along the X axis would then move to (15,6,90), (25,6,90), (35,6,90) etc.

Scale

If this option is active, the relative scaling factor changes only by the value entered here when scaling objects, point quantities, surfaces etc.

Rotate

When this option is active the chosen element can be rotated only in steps, as set here. Thus a value of 10° allows a rotation of the element in steps of 10°, 20°, 30° etc.

Texture

This is a percentage which, when active, gives the increment by which you can move and scale textures.

Tools

This setting is relevant to all the interactive tools on the Structure menu. If you turn this option on, change the value to 10 and then extrude a surface, the extrusion will take place in steps of 10. Together with the various modeling tools this allows for extremely accurate control over the modeling process.

CINEMA 4D

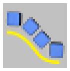
MODELING • ANIMATION • RENDERING

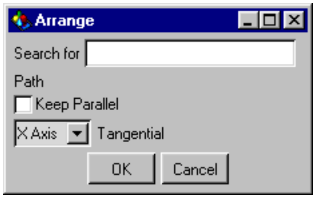
11. Functions Menu

11 Functions Menu

The Functions menu contains tools that change the position, scale and/or direction of objects (e.g. **Randomize**). The one exception is the **Connect** command, which converts an object group into a single object.

Arrange





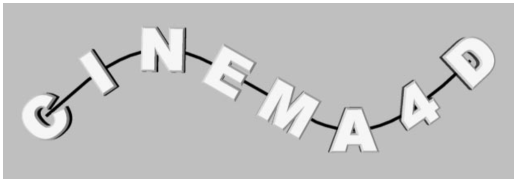
This command lets you arrange an object group along a spline. Only the first level of child objects are arranged along the spline - all other children remain with their parent.

The order of the objects along the spline is determined by their order in the Object Manager - the topmost object in the Object Manager is placed at the start of the spline and the bottom-most object is placed at the end of the spline.

Let's take a concrete example. Imagine that you have created a group of three-dimensional letters, 'CINEMA 4D', using the **Text** command from the **Objects > Spline Primitive** menu. The topmost letter in the Object Manager is the 'C', the bottom-most is the 'D'.

You have also created an s-shaped spline that will function as the path - this is the spline along which the text will be arranged.

If you use the **Arrange** command, the first letter 'C' is placed at the start of the spline and the last letter 'D' is placed at the end. The other letters are placed between, as indicated in the diagram below.

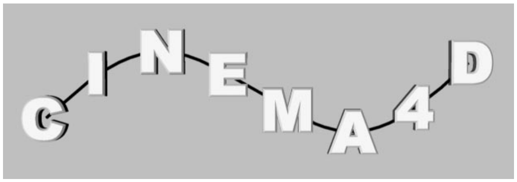


Path

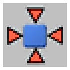
Use **Path** to specify the spline along which the objects should be arranged. You may also choose which object axis (Y, Y or Z) should be tangential to the path.

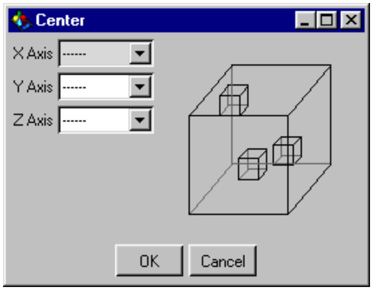
Keep Parallel

If the **Keep Parallel** option is selected, the objects will not be rotated (see diagram below); otherwise, each object will be rotated so that it is tangential to the spline.



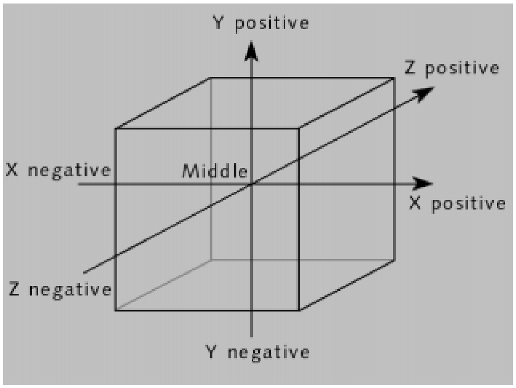
Center





This function centres objects in 3D space. It requires an object group to be selected in the Object Manager. All child objects are affected.

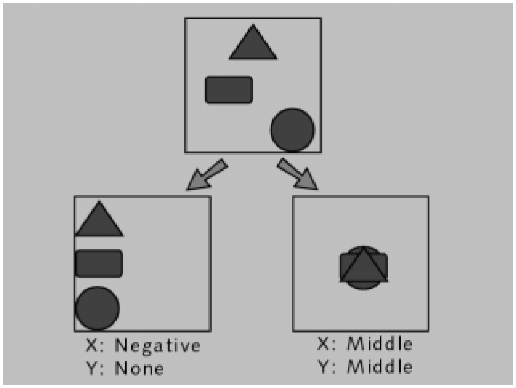
As a first step, CINEMA 4D calculates the size of the object group. Think of this as a three-dimensional cuboid which encloses all the objects.



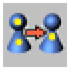
The Center command lets you specify where the objects should be placed in terms of each axis of the cuboid. You can affect how this command works using the various popups in the dialog.

Positive, Middle, Negative

Negative and Positive represent the two ends of the corresponding cuboid axis, Middle represents the centre of that axis, while choosing the dashes deactivates centralization for the particular axis.



Connect



CINEMA 4D's **Group Objects** command (see page 466) enables you to place objects into a group. The **Connect** command converts an object group into a single object. For example, a fence consisting of hundreds of individual planks can be connected to form just a single fence object.

Connect requires an object group to be selected in the Object Manager. All child object parameters, such as animation sequences, are lost. Only use the command if you are certain that the object will not require separation later on; although you can split the object into its original parts manually, it is a time-consuming process.

Note

Only polygons or splines can be connected. Other objects such as light sources will be ignored and are not included in the new object. You cannot connect spline objects and polygon objects.

Tip

You can speed up render time by connecting any groups that contain lots of objects. The reason for this is that a single object can be rendered more quickly than a few hundred objects that contain exactly the same polygons.

Current State To Object

This function creates a polygon copy of an object's current shape. For example, if you are using several deformers on an object, you can copy the resultant shape into a normal polygon object (the deformers will not be required for the copy). Or perhaps you have defined an animation (e.g. using PLA, see page 568) and you wish to create a polygon copy of the shape at a particular timeframe - simply move the time slider to the required frame and choose this option.

The copy takes the name of the original object and appends it with the current animation time. For example, the polygon copy for 'ball' is named 'ball 14 F', 'Ball 1.033 S' or 'ball 00:01:01' depending on which animation units you have specified in the general settings (see Animation Units, page 45).

This function is particularly useful for fine-tuning morph animation manually.

An example

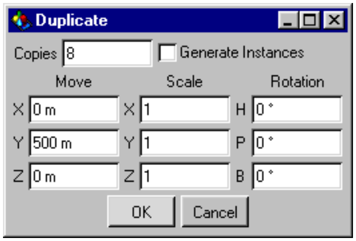
1. Create and animate an object, e.g. with PLA.
2. Move the time slider (Time Line) until the object is in the state that you wish to copy.
3. Choose **Functions > Current State To Object**.

Note

Child objects are ignored - the function must be called separately for each child object that you require.

The animation data is not copied to the new object. The original object (including its animation data) is preserved.

Duplicate



This command enables you to create as many duplicates of an object or object group as you like. It also lets you specify movement, scale and rotation values for the duplicates.

Copies

Copies specifies the number of duplicates.

Generate Instances

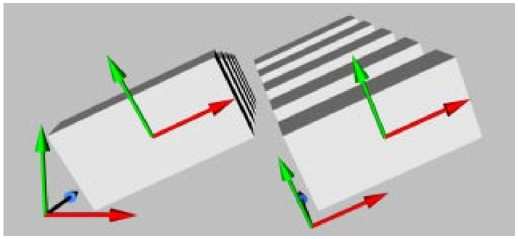
If Generate Instances is activated, CINEMA 4D will create instances (see page 184) rather than actual copies.

Move

The Move settings let you place the duplicates a regular distance apart. The values you enter here refer to the total length (the distance between the first and last copy), not the distance between consecutive copies. The X,Y and Z directions refer to the world coordinate system.

Tip

To move the duplicates along the object axes rather than along the world axes, first create a null object (see page 97). Next, use Functions > Transfer so that the null object adopts the position and rotation values of the object to be duplicated. Make the object a child of the null object (drag-and-drop in the Object Manager) and choose the Duplicate function (the object must be selected, not the group). The duplicates will be moved along the object axes.

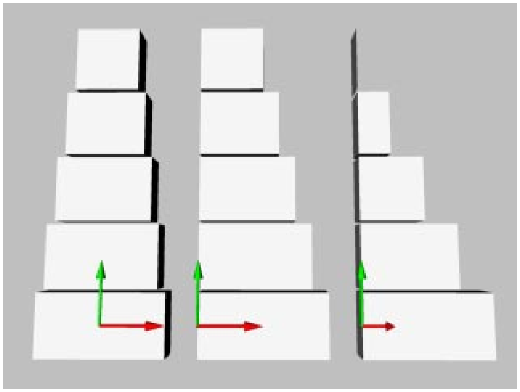


Scale

You can use the Scale values to change the scale of the duplicates. The object axes are used for the scaling. For example, if you set the X scale value to 0.5, the final copy will be half the size of the original object in the X direction. The scale is interpolated for objects between. So four copies with an X scale value of 0.5 will mean that each consecutive copy is reduced by 0.5 / 4 = 0.125 in the X direction.

Note

The object is scaled from its origin; therefore the position of the origin is important. The scaling can also be affected if any of the axes have been scaled independently of the object (Object Axis *tool, see page 304). The following picture shows three cubes of size X 200, Y 100 and Z 50. The first cube is unchanged in that its origin is still in the centre; the second cube had its origin moved to the left using the Object Axis tool while the third cube had its object axes scaled to 0.5 - again using the Object Axis tool. We wish to create four copies, each with a scaling of 0.5 and a movement of 420 units along the Y axis.*



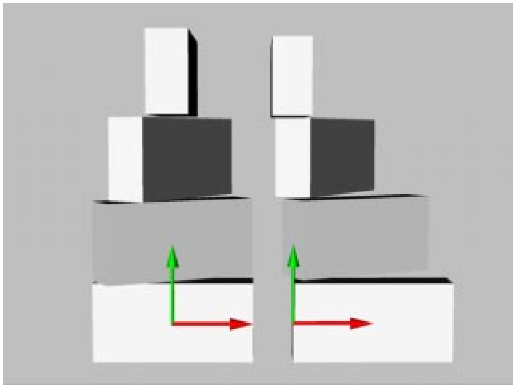
The first cube is scaled towards its centre, since that is the location of its origin. The second cube's origin is on the left, so it is scaled towards the left. The third cube has been scaled twice as much as the other cubes, due to the previous manipulation of its object axes. These three examples demonstrate why it is important to place the origin correctly and know the size of the object axes. To be safe, use the Model tool rather than the Object tool (see page 305).

Rotation

You can use the **Rotation** values to rotate the duplicates about their axes.

Note

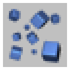
The objects are rotated about their origin, therefore the position of the origin is important. In the following picture, the first two cubes from the previous example were used (origin central and origin to the left respectively). The Heading value was set to 90° for both cubes. See page 311 for more details on the HPB system.

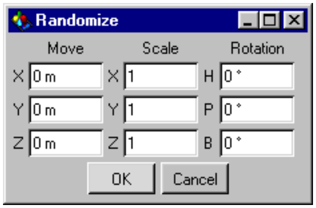


The first cube is rotated about its centre, since that is the location of its origin. The second cube's origin is on the left, so it is rotated about a point to the left. As with scaling, it is important to position the origin correctly.

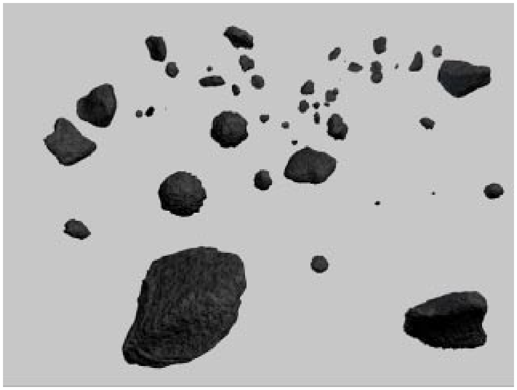
You should now feel confident about using Duplicate to create, for example, a staircase.

Randomize





You can use this command to place a number of objects in a random fashion. For example, you can use it to create an asteroid field by letting CINEMA 4D place the asteroids in random positions. You can also randomize scale and rotation. Randomize is especially useful for large numbers of objects, saving you the time it would take to position them manually.



Randomize requires an object group to be selected in the Object Manager. Only the first level of child objects are randomized - all other children remain with their parent.

Move

Move specifies the maximum values by which the objects may be moved. For example, values of (100,0,0) allow the objects to move by up to 100 units from their original position in the X direction, but there will be no movement in the Y and Z directions.

Scale

Scale specifies the maximum values by which the objects may be scaled. For example, values of (3,1,1) allow the objects to be scaled by up to three times their original size along the X axis, but there will be no scaling in the Y and Z directions.

Note

The objects are scaled from their origin, therefore the position of the origin is important. The scaling can also be affected if any of the axes have been scaled independently of the object using the Object Axis tool. To be safe, use the Model tool rather than the Object tool (see page 305).

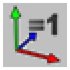
Rotation

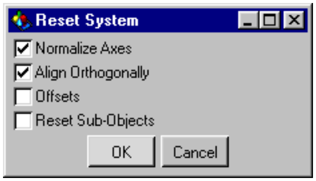
Rotation specifies the maximum values by which the objects may be rotated. For example, values of (0°,85°,0°) allow the objects to be rotated by up to 85° about the pitch axis, but there will be no rotation about the heading and bank axes.

Note

Check that none of the objects overlap each other after being randomized. You may need to move or rotate such objects manually. This tends to occur when the original objects were close together before the command was called.

Reset System





This command lets you restore the object coordinate system. Please check that you understand the differences between the Object and Model tools (see page 305) before continuing this section.

Normalize Axes

Normalize Axes resets the lengths of the object axes to 1/1/1.

Align Orthogonally

Align Orthogonally resets a distorted system to conventional perpendicular axes.

Offsets

If the Offsets option is activated, only the axes are restored, not the points - the points remain in their distorted state.

Note

Primitives, light sources and all other non-polygonal objects can only be partially reset with the Offsets option or possibly not reset at all.

Reset Sub-Objects

Reset Sub-Objects resets the axes for all child objects as well for the parent. This function can be difficult to understand until you see it in action:

An example

Create a cube and a sphere.

Make the cube a child of the sphere (drag-and-drop in the Object Manager).

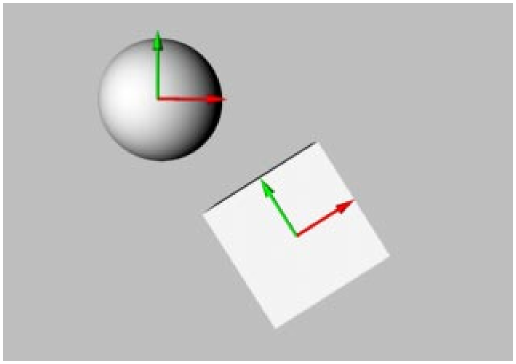
In the coordinate manager, ensure that Scale is selected (middle popup menu).

Select the Object tool and scale the sphere by 2 units in the X direction.

Select the cube and rotate it about its Z axis. Note how the cube distorts.

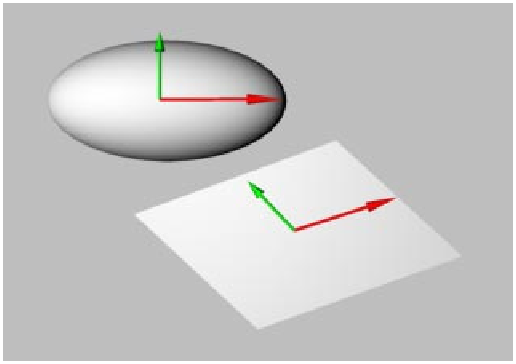
Now we are ready to see the Reset function in action.

Begin by selecting only the Normalize Axes option. The sphere and the cube are no longer distorted.

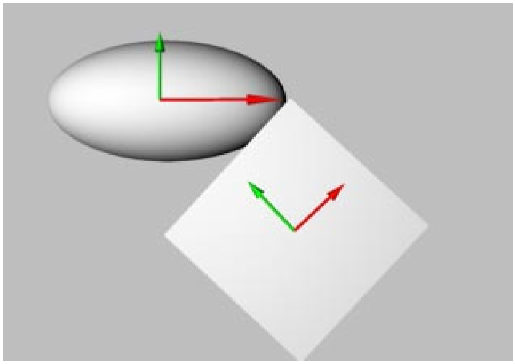


Undo the last step.

Take the cube out of the sphere hierarchy so that it is no longer a child (drag-and-drop in the Object Manager). The X and the Y axes no longer form a right angle.

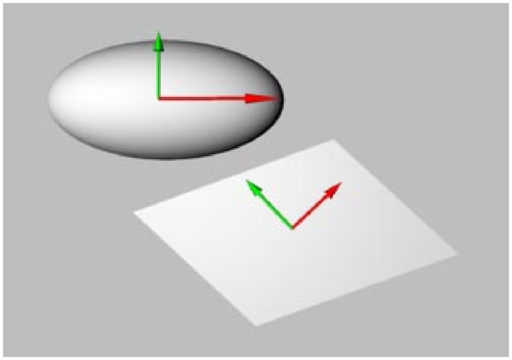


Now, select only the **Align Orthogonally** command. The cube is straightened out. However, it has not been restored to its normal size, since the **Normalize Axes** option was not selected.

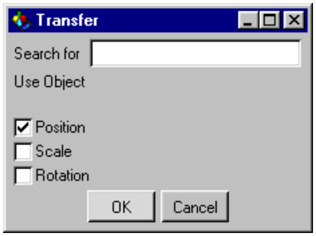


Undo the last step.

Select the cube once more and activate the options **Align Orthogonally** and **Offsets**. This time, only the axes are corrected. The object's points remain exactly where they were.



Transfer



Sometimes it is useful for an object to adopt the position, scale and/or rotation of another object. After selecting this command, select which of these properties you wish to copy to the object.

Note

The axes of the object that is being copied are used as a reference for the scale. Unlike, say, the Duplicate command, the axes must be larger or smaller to bring about a change in scale.

12. Plug-ins

12 Plug-ins

In general terms, plug-ins are auxiliary modules which extend the function range of a program. Within CINEMA 4D, plug-ins are able, for example, to automate particular functions, to make new tools available (perhaps for modeling and/or animation), to extend import and export filters or to add new shaders (so mathematical textures are possible - see Material Manager, page 475.

For this purpose CINEMA 4D includes an efficient programming language, C.O.F.F.E.E., available to both developers and end-users.

This is a completely object-oriented programming language whose syntax is closely related to C++ or Java. Further information on the development of plug-ins can be found in the C.O.F.F.E.E. SDK (Software Development Kit) on our website (www.maxon.net); there you will also find links to different plug-in vendors.

Note

Plug-ins can be developed freely by anyone and offered for sale. However, MAXON Computer, as the manufacturer of CINEMA 4D, has no influence on the quality of these plug-ins and you should assure yourself as to the value-for-money and usefulness of a plug-in before purchase. Of course, we give as much support as possible to all vendors and developers of plug-ins - however, if a problem should arise with one of these products, please contact the manufacturer of the plugin directly. Please understand that MAXON Computer can give no information on, or provide technical support for, products of other manufacturers.

As already mentioned, plug-ins can solve many diverse tasks and therefore after installation your new plug-in may appear in different places within the CINEMA 4D menu structure. Please always consult the vendor's plug-in documentation that was supplied with your new purchase. If there is no special information to be found in the documentation, a plug-in will probably be found within the Plug-ins menu, under the name of the plug-in.

Reload Plugins

In CINEMA 4D it is possible to install new or remove unwanted plug-ins at runtime. Simply copy the plug-ins, in accordance with the vendor's instructions, into the Plug-in folder within the CINEMA 4D folder. Then choose **Plug-ins > Reload Plug-ins** and the contents of this folder is scanned and all the new or deleted plug-ins are updated within the menu structure of CINEMA 4D.

Execute Last Plug-in

Use this menu option to gain quick access to the plug-in you used last.

Sub-folders

If you have many plug-ins within the Plug-in menu, things may become rather confusing. So we allow the creation of sub-folders within the Plug-in menu structure. To do this, simply create (within the Macintosh Finder or Windows Explorer) a sub-folder of any name within the Plug-in folder and copy the desired plug-ins into this folder (please take into account the particular naming conventions of your operating system). After restarting CINEMA 4D or using the **Plug-ins > Reload Plug-in** menu command, you will see the new structure within the Plug-in menu.

CINEMA 4D

MODELING • ANIMATION • RENDERING

13. Render Menu

13 Render Menu

Render View

This function renders the scene in the active editor window. To define the render mode and further render options, use the render settings (see below).

You may cancel rendering at any time by pressing the ESC key or by clicking the mouse. Once rendering commences, a render progress bar appears at the lower left of the editor window.

Some features are not supported for rendering in the editor. For example, you cannot render movies or post-processing effects such as motion blur. To obtain these features, you must render in the Picture Viewer (see Render to Picture Viewer).

Missing textures

If CINEMA 4D is unable to find the textures for any of the materials used in a scene, an alert will appear. If you choose to continue rendering, the materials will be used without the missing texture maps. CINEMA 4D searches for textures and animation files in the following locations: in the scene folder, in the scene's 'Tex' folder, in the 'Tex' folder of the CINEMA 4D folder, in the Texture Paths specified in the General Settings (including their sub-folders).

Render Active Object

This function renders the active object and its child objects in the active editor window. The other objects are ignored and will not appear in reflections or transparencies. To define the render mode and further render options, use the render settings (see below).

You may cancel rendering at any time by pressing the ESC key or by clicking the mouse.

Once rendering commences, a render progress bar appears at the lower left of the editor window.

Some features are not supported for rendering in the editor. For example, you cannot render movies or post-processing effects such as motion blur. To obtain these features, you must render in the Picture Viewer (see Render to Picture Viewer).

Missing textures

If CINEMA 4D is unable to find the textures for any of the materials used in a scene, an alert will appear. If you choose to continue rendering, the materials will be used without the missing texture maps. CINEMA 4D searches for textures and animation files in the following locations: in the scene folder, in the scene's 'Tex' folder, in the 'Tex' folder of the CINEMA 4D folder, in the Texture Paths specified in the General Settings (including their sub-folders).

Render Region

This function renders a region in the editor window. Once you have chosen the function, drag a box to define the region. To define the render mode and further render options, use the render settings (see below).

You may cancel rendering at any time by pressing the ESC key or by clicking the mouse. Once rendering commences, a render progress bar appears at the lower left of the editor window.

Some features are not supported for rendering in the editor. For example, you cannot render movies or post-processing effects such as motion blur. To obtain these features, you must render in the Picture Viewer (see Render to Picture Viewer).

Missing textures

If CINEMA 4D is unable to find the textures for any of the materials used in a scene, an alert will appear. If you choose to continue rendering, the materials will be used without the missing texture maps. CINEMA 4D searches for textures and animation files in the following locations: in the scene folder, in the scene's 'Tex' folder, in the 'Tex' folder of the CINEMA 4D folder, in the Texture Paths specified in the General Settings (including their sub-folders).

Render to Picture Viewer

This function renders the scene in the Picture Viewer. Once rendering commences, a render progress bar appears at the lower left of the editor window. The bar shows you the time that has elapsed since the render started. If you are rendering an animation, the bar also shows you the current frame number and the total number of frames.

The Picture Viewer includes some display options. For example, you can turn off color channels and change the viewing size. (See page 437)

To define the render mode and further render options, use the render settings. You may cancel rendering at any time by pressing the ESC key or by clicking the mouse.

All post-processing effects (e.g. motion blur) are available in the Picture Viewer.

You *must* use the Picture Viewer as opposed to the editor if you wish to save the picture/animation. Enter a filename in the render settings before you render. See page 418.

Missing textures

If CINEMA 4D is unable to find the textures for any of the materials used in a scene, an alert will appear. If you choose to continue rendering, the materials will be used without the missing texture maps. CINEMA 4D searches for textures and animation files in the following locations: in the scene folder, in the scene's 'Tex' folder, in the ‘Tex’ folder of the CINEMA 4D folder, in the Texture Paths specified in the General Settings (including their sub-folders).

Batch Rendering

You can use batch rendering to tell CINEMA 4D to render up to 10 scenes one after the other without your further intervention. This enables you to leave the computer and do something else such as sleep or go on holiday!

Batch rendering is easy to set up. First, you must tell CINEMA 4D which scenes are to be rendered. You can either type the paths into the text boxes or you can click on the job buttons one at a time to select the folder and file.

Be sure to double-check the render settings for each scene (e.g. save path, resolution, etc.). The render settings are described in detail on page 408.

Warning!

Ensure that you have entered the save path in the render settings for each scene.

Missing textures

CINEMA 4D will also need to locate the textures for each scene. If any textures are missing, the scene they belong to will be aborted and rendering will pass on to the next scene. We recommend that you test-render each scene before initiating the batch render - you can abort each test as soon as the picture starts to appear.

Animation frames

If you are test-rendering an animation, check that the correct number of frames appears at the lower left of the Picture Viewer. Also double-check that you are using the optimum animation codec.

Render Settings

A project can have several render settings. This function opens the active settings (indicated by a tick on the Render menu).

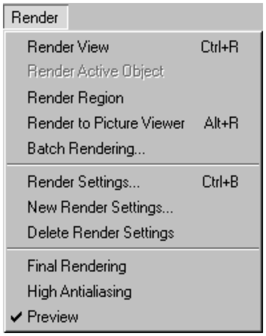
The default render settings are called ‘New’. If you wish to add further default settings, create the settings and then save the otherwise empty scene in CINEMA 4D’s root folder under the name ‘template.c4d’ (see Initialisation File, page 66). For a description of the render settings, see page 408.

New Render Settings

You can use this function to create new render settings. The render settings dialog opens.

Enter a name for the new settings under **Name** on the General page - choose a meaningful name (e.g. ‘modelling’) so that the new settings will be easy to distinguish from any other settings.

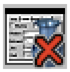
Once you have finished creating the settings, the new name will appear in the lower section of the Render menu.



You can create settings for a variety of purposes. Perhaps you will create settings with low antialiasing, no reflections and no shadows for preview rendering called ‘Preview’. You may also create settings with high antialiasing, reflections and shadows called ‘Final Rendering’. You can create as many settings as you like.

To choose which settings are active, click on the corresponding name in the Render menu. The active tick will then appear in front of that name.

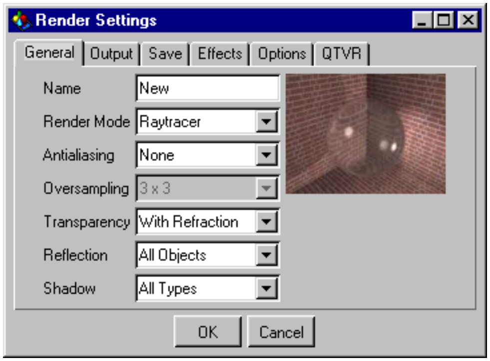
Delete Render Settings



This function deletes the active render settings (indicated by a tick on the Render menu). The name of the settings will be removed from the Render menu.

Render Settings

General Tab



Name

This enables you to change the name of the settings (the default name is ‘New’). Choose a meaningful name (e.g. ‘modelling’) so that the new settings will be easy to distinguish from any other settings.

Render Mode

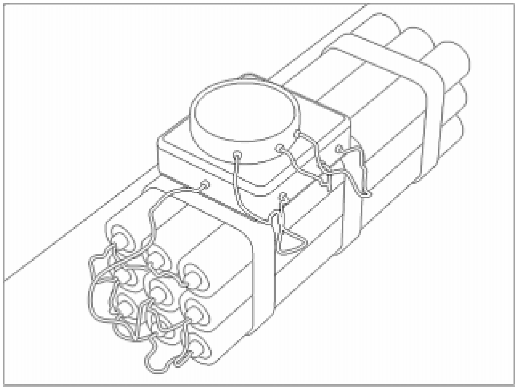
This setting defines the mode used to render the picture or animation.

As Editor

If you select this mode, the renderer will use the editor window's active shading mode, e.g. wireframe, Gouraud shading.

Cel-Render B/W

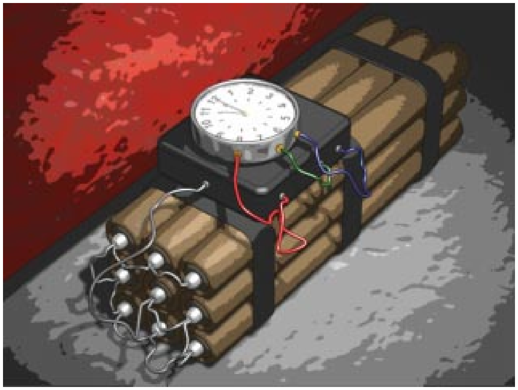
Cel-Render B/W renders all objects as black outlines on a white background. You can refine this mode using the Cel-Renderer options on the Options tab - see page 427.



The render time for the Cel-Render B/W mode increases linearly with the number of polygons, even though the mode is heavily optimized.

Cel-Render Color

Cel-Render Color renders all objects using a reduced color palette and black outlines on a black background. This gives the rendered subjects a cartoon-like feel. You can refine this mode using the Cel-Renderer options on the Options tab - see page 427.



The render time for the Cel-Render Color mode increases linearly with the number of polygons, even though the mode is heavily optimized.

Raytracer

This is a combination of two modes - scanline mode and raytracing mode. Raytracing mode is used only for those parts of the picture that cannot use scanline mode (e.g. transparent surfaces, hard shadows). Otherwise, scanline mode is used since it is faster. This automatic switching between modes (termed *adaptive raytracing*) accelerates rendering with zero loss in picture quality.

If you use the following settings, the scanline mode will be used for the entire picture/ animation:

Transparency	No Refraction
Reflection	Floor & Sky Only
Shadow	Soft Only

If you choose the following settings, scanline mode will be used as much as possible but raytracing mode will be used where required (e.g. transparent surfaces, hard shadows):

Transparency	With Refraction
Reflection	All Objects
Shadow	All Types

The two sample pictures below show the same scene.

The left-hand picture was rendered using the scanline mode only - there are no shadows, only the sky is reflected and, although the bottle and glass are transparent, there is no refraction. Raytracing mode was chosen for the right-hand picture. Now hard shadows are visible, the bottle is reflected in the mirror and the bottle and glass both refract light. Even so, all parts of the right-hand picture that do not use these effects used the faster scanline mode.

As you can see from the pictures, the effects offered by raytracing can make all the difference in rendering a realistic picture.

Note

You can speed up rendering by using a multi-processor system. CINEMA 4D detects the extra processors automatically and distributes the render task accordingly. For example, if you are using four processors, the render speed can increase by up to a factor of 3.6.

Antialiasing

Images consist of pixels and are prone to staircase effects. This phenomenon is called *aliasing*. CINEMA 4D equips you with powerful *antialiasing* modes to defeat these ugly pixels.

You can set the strength of your chosen antialiasing mode using the **Oversampling** setting - see page 411.

Antialiasing > None

If you select None, antialiasing is switched off. Expect a grainy image...

Antialiasing > Edge

If you select Edge, object edges will be antialiased. Shadows and textures will not be antialiased, though...

Antialiasing > Edge And Color

If you select Edge And Color, shadows and textures as well as object edges will be antialiased...

Antialiasing > Always

If the Always option is selected, each pixel in the image will be antialiased - even those pixels that do not require antialiasing...

The Always option should be considered an extreme measure - it causes a large increase in render time yet the image improvements are often negligible. Edge And Color with a high oversampling value gives broadcast-quality rendering and is usually the better choice.

Oversampling

This value refers to the maximum number of additional rays that are calculated for a pixel requiring antialiasing.

The higher you set this value, the more accurate the antialiasing will be. However, increasing the oversampling value will increase the render time as well.

The render time is influenced greatly by the antialiasing and oversampling values. For example, Always antialiasing with 3 x 3 oversampling takes about four times longer to render than Edge And Color with the same oversampling, yet the difference in image quality is usually minor.

You should reserve Always for the very highest image quality (usually for stills rather than animation).

Edge And Color provides almost identical results to Always and is rendered in a fraction of the time. It is often more effective to choose a higher oversampling value for Edge And Color rather than move up to Always. A good time vs. quality compromise for quality images, and especially when animating, is Edge And Color with 4 x 4 or 6 x 6 oversampling.

For still images, perhaps you will increase the oversampling to 8 x 8 or even 16 x 16 for stunning quality.

Transparency

Transparency > None

If you activate this option, transparency and alpha channels will not be rendered...

Transparency > No Refraction

No Refraction means that all transparent materials will be rendered but without refraction. If you are working with alpha channels, make sure you use No Refraction, otherwise the surfaces will be rendered opaque...

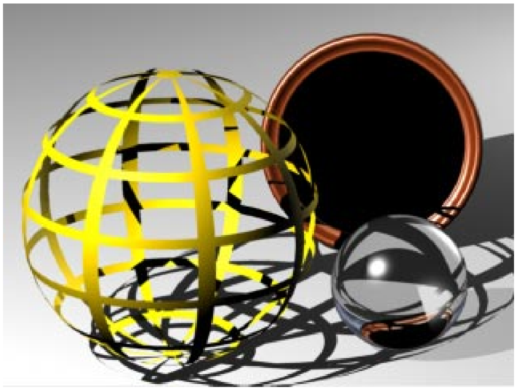
Transparency > With Refraction

Select this option if you wish transparent materials to refract as well. Refraction is often essential for realistic glass and water. Any refraction in the render will increase the render time. If there is no refraction in the render, the render time will not increase, even though this option is selected...

Reflection

Reflection > None

If None is selected, reflections will not be rendered.



Reflection > Floor & Sky Only

If Floor & Sky Only is selected, only the floor and sky objects in the scene will be reflected. This option is rendered very quickly and is a good compromise for time-critical projects...

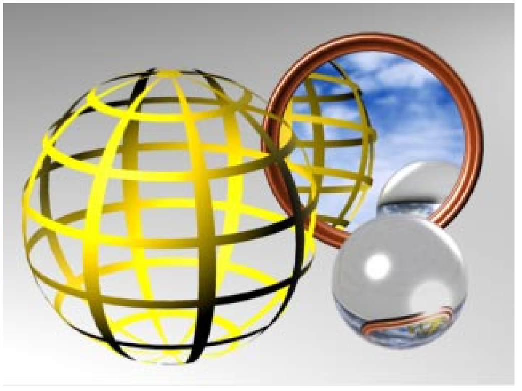
Reflection > All Objects

If you select All Objects, all the objects in the scene can be reflected. If there are no reflective objects in the scene, the render time will not increase, even though this option is selected...

Shadow

Shadow > None

If None is selected, shadows will not be rendered. The scene may lack contrast and appear flat as a result...



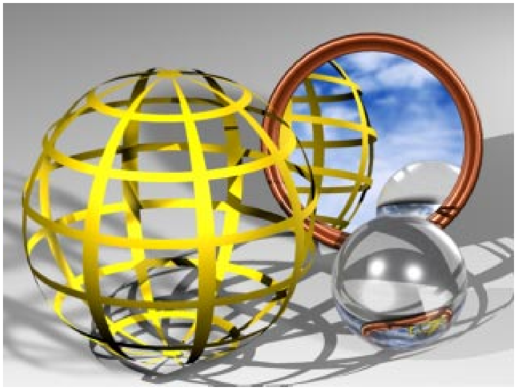
Shadow > Soft Only

If you have selected Soft Only, soft shadows will be rendered. Soft shadows render extremely quickly and look natural (often more natural than hard shadows, which take longer to render)...

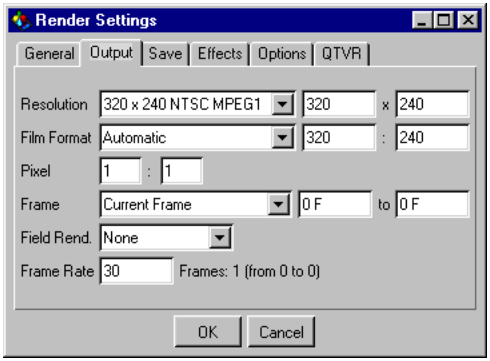
Note that CINEMA 4D is one of the few programs that enable you to cast soft shadows from omni lights. See Omni, page 196.

Shadow > All Types

If All Types is activated, soft shadows, hard shadows and area shadows will be rendered. Additional rays must be calculated for hard shadows and area shadows...



Output Tab



The settings on the Output tab refer to rendering in the Picture Viewer only. These settings have no effect on rendering in the editor window. As a result, you must render to the Picture Viewer if you wish to save the rendered still or animation.

Resolution

You can use this setting to define the size of the image. You choose the resolution from the popup menu or enter your own values in the two text boxes to the right.

If you do the latter, the resolution popup menu setting will change to Manual automatically. (You do not have to select Manual yourself.) The popup menu lists common video formats.

Film Format

The film format corresponds to an image's X:Y ratio. Photographic studios, the movie industry and the TV industry often use ratios that differ from that of a computer screen.

You can choose the film format from the popup menu or enter your own values in the two text boxes to the right.

If you do the latter, the resolution popup menu setting will change to Manual automatically. (You do not have to select Manual yourself.) The popup menu lists common film formats.

The resolution and the film format are linked. If you change the film format, the resolution will be adjusted automatically in the Y direction. Try the following example for clarification.

> Select a resolution of 320 x 240. This is the same as a computer's 4:3 ratio. Change the film format to 70 mm (cine format) - the resolution changes to 320 x 145 automatically (it is scaled in the Y direction to match the format).

The default setting for the film format is Automatic. This means that images will be rendered in the specified resolution independent of any particular ratio.

Two lines will appear in the 3D view to frame the area that will be rendered.

See page 432 for a list of common film formats.

Pixel

The two values specified here define the ratio of a pixel's on-screen width (left box) to its on-screen height (right box). The pixel ratio for most monitors is 1:1, so usually you do not need to change this setting.

However, some display media use a pixel ratio other than 1:1 and the setting must be adjusted to avoid distortion such as circles appearing as ellipses.

If you need to calculate the pixel ratio manually, expand the editor window so that it fills the entire screen. Select the side view and create a cube. Measure the cube's width and height with a ruler and enter values in the corresponding pixel boxes.

Frame

Manual

If you wish to render a frame sequence, but not the entire animation, enter the first frame for the sequence in the left text box and the last frame in the right box.

The frame popup menu will change to Manual automatically. (You do not have to select Manual yourself.) If you wish to save the animation, you must enter a save path on the Save page.

Warning!

You cannot interrupt the rendering of an AVI or QuickTime movie and pick up where you left off next time. All the frames will be lost and you must start the rendering from the beginning. Alternatively, render short sequences and assemble the clips in a suitable video editor.

Current Frame

If you select this option, only the current frame will be rendered.

If you wish for the frame to be saved automatically after it has been rendered, enter the save path on the Save page.

All Frames

All the frames will be rendered, either as a picture sequence or as a movie (AVI, QuickTime).

If you wish for the animation to be saved, you must enter a save path on the Save page.

Warning!

You cannot interrupt the rendering of an AVI or QuickTime movie and pick up where you left off next time. All the frames will be lost and you *must start the rendering from the beginning. Alternatively, render short sequences and assemble the clips in a suitable video editor.*

Preview Range

Only the preview range (see page 552) will be rendered. The frames are rendered either as a picture sequence or as a movie (AVI, QuickTime).

If you wish for the animation to be saved, you must enter a save path on the Save page.

Warning!

You cannot interrupt the rendering of an AVI or QuickTime movie and pick up where you left off next time. All the frames will be lost and you must start the rendering from the beginning. Alternatively, render short sequences and assemble the clips in a suitable video editor.

Field Rendering

You can obtain smoother animation when working with video technology by using field rendering.

With field rendering, each frame is split up into two *fields*. The two fields are interlaced, with one field containing the odd lines (the odd field) and the next field containing the even lines (the even field).

PAL video (used in e.g. Europe) runs at 25 frames per second, which equals 50 fields per second. NTSC video (used in e.g. USA) runs at 30 frames per second, which equals 60 fields per second.

Do not use field rendering for stills - it is intended for video output only.

Warning!

There is no point using field rendering unless you use a non-lossy compressor or no compression at all. Lossy compressors (e.g. JPEG, M-JPEG) blur the fields and the result is far from satisfactory.

None

Only complete frames are rendered. This option should be activated without question if you are rendering stills or movies which will not be viewed on a video system.

Even Field First

The even field will be rendered before the odd field. Check which setting your video system requires.

Odd Field First

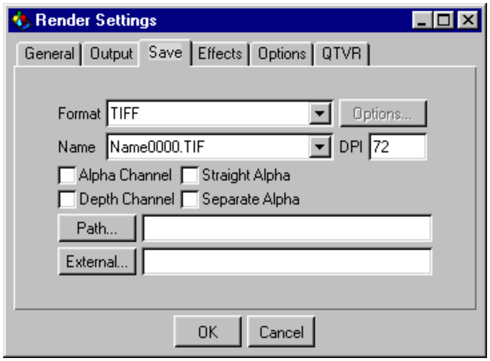
The odd field will be rendered before the even field. Check which setting your video system requires.

Frame Rate

This is where you set the frame rate for the render. This setting is independent of the frame rate defined in the project settings.

The number of frames that will be rendered is shown to the right of the text box.

Save Tab



Format

CINEMA 4D supports a large number of common picture formats. The still formats supported are TIFF, TARGA, BMP, PICT, IFF, JPEG and Photoshop PSD.

The animation formats on offer depend on your operating system:

Windows:

- AVI Movie Small: the Intel INDEO codec is used.
- AVI Movie Big: the Cinepak codec is used.
- AVI Movie: after selecting this format, click on Options to open a dialog. Choose your codec from the dialog.

Windows and Macintosh:

- QuickTime Movie Small: a special variant of the Cinepak codec is used. This produces compact movies of reasonable quality. However, you cannot play the movie backwards, nor can you convert the movie into individual pictures (the movie is time-compressed).
- QuickTime Movie Big: a special variant of a non-lossy codec is used. This produces high-quality QuickTime movies, although they are comparatively large in filesize and require a fast hard drive for playback.
- QuickTime Movie: after selecting this format, click on Options to open a dialog. Choose your codec from the dialog. If the dialog doesn't open when you click the Options button it probably means you have an old version of QuickTime installed. Please check you have the latest version installed (www.quicktime.com) before seeking further assistance.

QuickTime 4 upwards supports the following single picture formats: BMP, Photoshop PSD, SGI, JPEG, PICT, PNG, TIFF and QuickTime Image. It also supports any new codecs you have added to it.

(For information on codecs, try the Codec Central pages on the www.terran.com website.)

You can create QuickTime VR panorama and object movies under both Windows and Macintosh.

Note

If you are using Windows, you must install QuickTime to take advantage of these features.

Options

You can select this option if you have set Format to AVI Movie (Windows) or QuickTime Movie (Windows & Macintosh). A dialog will open so that you can choose your codec and adjust its default settings.

If the dialog doesn't open when you click the Options button it probably means you have an old version of QuickTime installed. Please check you have the latest version installed (www.quicktime.com) before seeking further assistance.

Name

Many editing programs accept picture sequences. The bad news is that many of these programs use different naming conventions.

Some programs expect the filename to end with a number, others an extension. Some programs can cope only with three-digit numbers. CINEMA 4D removes this headache by providing a menu from which you can choose the sequential numbering and/or lettering style required by your editor.

0000 represents a sequential number, TIF represents a three-letter extension.

Name0000.TIF produces e.g. 'Test1234.JPG'
Name0000 produces e.g. 'Test1234'
Name.0000 produces e.g. 'Test.1234'
Name000.TIF produces e.g. 'Test123.TGA'
Name000 produces e.g. 'Test123'
Name.000 produces e.g. 'Test.123'

DPI

You can use this setting to choose the DPI for the following picture formats: BMP, TIF, PICT. The DPI affects a picture's print size.

An example

You render a picture that is 700x1000 pixels. If you save the picture with 72 DPI, the print size will be 24.7cm x 35.3cm. If you save the picture with 300 DPI, the print size will be 5.9cm x 8.5cm - assuming that the print program supports the DPI setting.

Alpha Channel

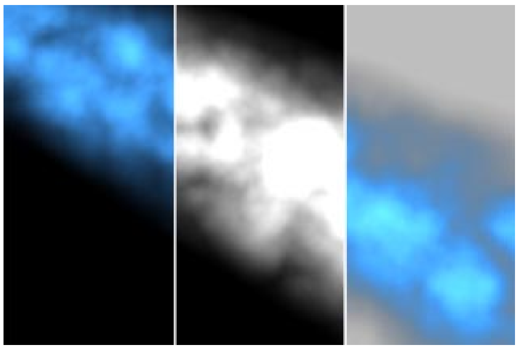
If you activate this option, a *pre-multiplied* alpha channel will be calculated during rendering.

The alpha channel uses the same resolution as the color picture. Pixels in the alpha channel are either white or black. A white pixel in the alpha channel indicates the presence of an object in the corresponding pixel of the color image. A black pixel in the alpha channel indicates no object in the corresponding pixel of the color image.

You can use the alpha channel for compositing in video programs.

Imagine that you have a real-life video sequence of an airfield and you wish to render an aircraft in CINEMA 4D and place it on the runway. You can render the aircraft with an alpha channel in CINEMA 4D. Next, use the alpha channel in the video program to cut out the non-aircraft parts of your render so that the airfield shows though in those parts. The edges of the alpha channel picture are antialiased in grayscale so that there is a soft transition in the composited picture.

Pre-multiplied alphas have one particular shortcoming - please study the image below.



On the left the rendered image, in the middle the alpha channel and on the right the result

Do you see the dark seam caused by the alpha channel? This arises because both the picture and the alpha channel were rendered with antialiasing. By definition, the color picture and the alpha channel must be multiplied and so the black is calculated twice.

You can avoid this dark seam by using the Straight Alpha option. Note that straight alphas are only suitable for compositing programs - they are unusable as conventional pictures.

Warning!

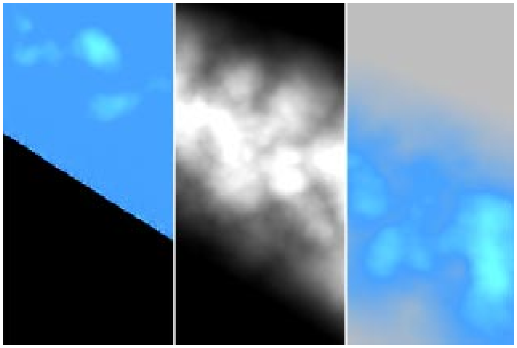
The entire alpha channel will be masked if you use a sky, floor, foreground or background object in your scene! Do not use any of these objects if you need the alpha channel.

Alpha channels are integrated automatically for TARGA, TIFF, PICT, PSD and QuickTime Movie. If you have activated Separate Alpha or if you have chosen a different picture format, the alpha channel is saved separately to the color picture. These files are indicated by an 'A_' before the filename, e.g. 'A_room.tif'. Separate alphas are saved in the TIF format.

The alpha channel can be integrated into a movie only if it is supported by the chosen codec.

Straight Alpha

You can use this option if straight alphas are supported by your compositing program. This avoids the dark seam associated with pre-multiplied alphas. Note that straight alphas are only suitable for compositing programs - they cannot be used as conventional pictures.



On the left the rendered image, in the middle the alpha channel and on the right the result

Activate the straight alpha only when you wish to post-edit the result. The picture is useless as direct output.

Warning!

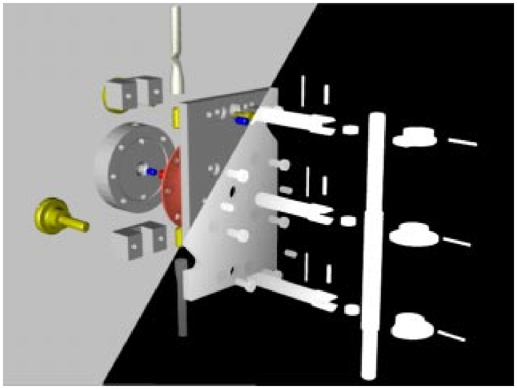
The entire alpha channel will be masked if you use a sky, floor, foreground or background object in your scene! Do not use any of these objects if you need the alpha channel.

Alpha channels are integrated automatically for TARGA, TIFF, PICT, PSD and QuickTime Movie. If you have activated Separate Alpha or if you have chosen a different picture format, the alpha channel is saved separately to the color picture. These files are indicated by an 'A_' before the filename, e.g. 'A_room.tif'. Separate alphas are saved in the TIF format.

The alpha channel can be integrated into a movie only if it is supported by the chosen codec.

Depth Channel

The depth channel contains grayscale pixels that indicate how distant objects are from the camera. The darker a pixel, the more distant that part of the object is.



On the left the rendered image and on the right the depth channel

Depth channels are often used in post-production to add effects such as depth of field and fog. The depth channel can also be used to insert objects within the picture.

Depth channels are integrated automatically for TARGA, TIFF, PICT, PSD and QuickTime Movie.

If you have activated Separate Alpha or if you have chosen a different picture format, the depth channel is saved separately to the color picture. These files are indicated by a 'D_' before the filename, e.g. 'D_room.tif'. Depth channels are saved in the TIF format.

The depth channel can be integrated into a movie only if the alpha channel is supported by the chosen codec.

Separate Alpha

Alpha channels or depth channels are usually integrated automatically for TARGA, TIFF or PICT pictures. If you wish to save the alpha/ depth channel as a separate file, activate this option. In addition to your color picture (e.g. 'room.tif'), you will also have a file containing the alpha channel (e.g. 'A_room.tif') or depth channel (e.g. 'D_room.tif').

Note

If you have activated both Alpha Channel and Depth Channel, only the alpha channel will be integrated into the picture. The depth channel will be saved as a separate file.

Path

Choose the folder and filename so that the picture/animation can be saved automatically after rendering.

You can type in the entire path yourself if you are feeling energetic! Alternatively, click on **Path** to open a system dialog so that you select the folder.

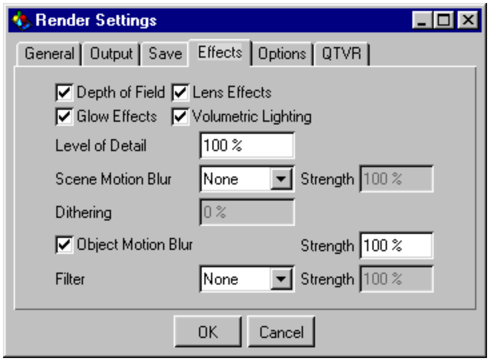
If you enter a name without a path, the picture/ animation will be saved in the active scene's folder.

External

You can use External to specify an application for the rendered picture/animation to be passed on to. For example, you can redirect animation frames to a graphics editing program for further processing. If you are using Windows, you can use a batch file with command parameters. If you use a Macintosh, you may use AppleScript.

Click on **External** to open a system dialog so that you can select the program.

Effects Tab



Depth of Field

If this option is activated, depth of field will be rendered if it is used by any of the cameras. You may wish to switch off depth of field for preview rendering.

Please note that this is a post-processing effect - it will not be visible until after the normal image has been rendered.

Lens Effects

If this option is activated, lens effects will be rendered if they are used in your scene. You may wish to switch off lens effects for preview rendering.

Please note that this is a post-processing effect - it will not be visible until after the normal image has been rendered.

Glow Effects

If this option is activated, glow effects will be rendered if they are used in your scene. You may wish to switch off glow effects for preview rendering.

Please note that this is a post-processing effect - it will not be visible until after the normal image has been rendered.

Note

Glow effects are like the lens effects. They are post processed effects (they are only taken into consideration after the actual picture is rendered), so you cannot see them in reflections and you cannot see them through transparent objects.

Volumetric Lighting

Volumetric lighting permits shadows in visible light. This can produce stunning effects, but it also increases render time significantly. Deselect this option if you want to turn off volumetric lighting.

Level of Detail

This value influences all objects in the active scene that support a reduction in detail, such as metaballs, primitives and NURBS. However, any objects that have their own Level of Detail setting (see Display Tag, page 455) will continue to use their setting.

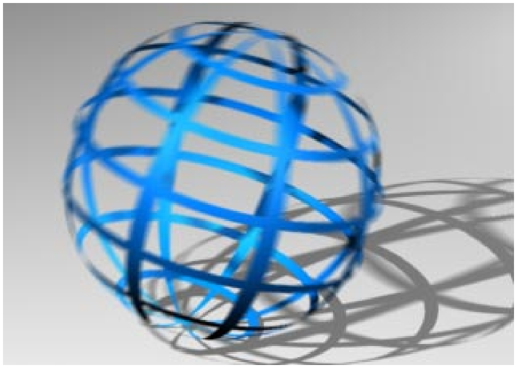
If the value is set to 100%, the objects will be rendered with full detail. If the value is set to 50%, the objects will be rendered with only half their usual detail.

Note

If you render to the editor window, the editor's level of detail value (Display menu) will be used in preference. It is only when you render to the Picture Viewer that the value in the render settings is used.

Scene Motion Blur

With a real-life camera, motion blur arises when an object flies past the camera at great speed (*object* motion blur) or when the camera pans rapidly (*scene* motion blur). This motion blur helps to create the illusion of real motion rather than a sequence of still pictures and so it is of great use to animation software. Animation software does not use real shutters and real film, so the motion blur must be faked.



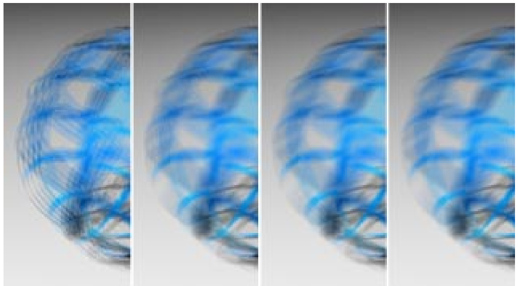
You can activate **Scene Motion Blur** (SMB) to simulate a camera panning swiftly. With SMB, intermediate images are calculated and overlapped in the corresponding frame with varying brightness.

Choose the number of intermediate images for each frame using the popup menu. The higher you set this value, the longer it takes to render.

Note

Scene motion blur will also blur shadows, reflections and so on. Object motion blur, on the other hand, does not blur these things.

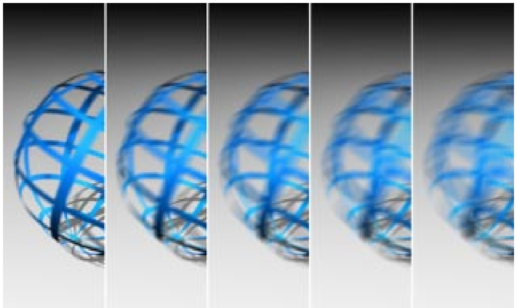
If the motion is very rapid, you may need to use a high setting to avoid a stroboscope effect (see illustration below).



Scene motion blur is coupled with oversampling. For example, 5-times SMB corresponds to at least 2x2 Always antialiasing. In the same way, 9-times SMB corresponds to 3x3 Always antialiasing and 16-times SMB to 4x4 Always antialiasing.

Stationary elements in the frame are antialiased perfectly, whereas moving elements are not antialiased. Usually, objects in motion do not require antialiasing - consider a 16-times motion blur where there are 16 intermediate frames; in this case, the missing antialiasing makes no visible difference. You can, of course, add antialiasing, although with a motion blur of 9-times or higher it is not necessary and does little but increase the rendering time.

You can enter the strength of the motion blue in the Strength box. The following pictures were rendered with 25-times SMB with Strength set to (from left to right) 20%, 40%, 60%, 80% and 100%.



Warning!

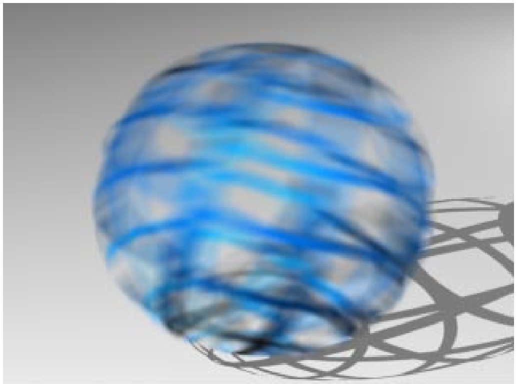
Think carefully before using field rendering and scene motion blur together, since the field effect is often nullified. Not only that, but the quality of the automatic SMB antialiasing is better without fields, and you will save render time to boot!

Dithering

You can use this option to dither the scene motion blur. This helps you to avoid stroboscope effects and you can often use a lower SMB setting as well. The dithering may create a slight noise, though. You can reduce the memory requirements for rendering by deselecting dithering (set the value to 0%).

Object Motion Blur

The advantages of object motion blur (OMB) are that the effect is rendered quickly and there are no stroboscope effects. For an object to have motion blur in the render, this setting must be activated and the object in question must have a motion blur tag (see page 461).



Please note that this is a post-processing effect - it will not be visible until after the normal image has been rendered.

Note

Use scene motion blur if you wish to blur shadows, reflections and so on. Object motion blur does not blur these features.

Use Strength to define the intensity of the blur for all objects. The value can range from 0% to 200%.

There a few limitations associated with object motion blur. For example, only position, scale and rotation animation can be blurred (so a beating wing animated using bones cannot have motion blur applied to it). Also, anomalies may appear at the frame's border and the animation may flicker.

Object motion blur is limited to a maximum frame size of 2000 x 2000 pixels and is automatically disabled at resolutions higher than this.

Also note that particles (see Particle System, page 244) cannot be blurred. Furthermore, avoid using OMB with post-processing effects (e.g. lens flares), since this may lead to unexpected results.

These limitations notwithstanding, motion blur can create a very natural effect with its analytical blurring. Object motion blur can create superb results with stills and well as with animation.

Filter

You can apply built-in post-processing filters to the rendered picture.

None

No filter is applied.

Soft

Each pixel is balanced with its neighbour to yield a softer transition. Use **Strength** to increase or decrease the effect.

Edges

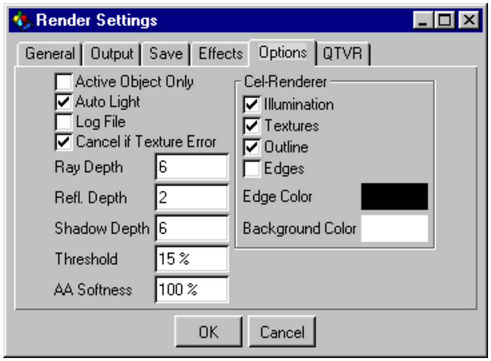
The Edges filter emphasizes transitions in the picture. This reinforces the edges. Use **Strength** to increase or decrease the effect.

You can use Edges to sharpen your pictures - for example, try using the filter with 30% strength for a still.

Medium

Medium filters out unattractive peaks in pixel color values. Use **Strength** to increase or decrease the effect.

Options Tab



Active Object Only

If this option is active, only the active object is rendered in the Picture Viewer. You can use this option to test an object's movement, for example.

Auto Light

If there are no lights in your scene, CINEMA 4D will use the auto light (a standard light source) when rendering so that you can see the objects. This is especially useful during the modeling stage as it avoids the need for you to create and position your own lights.

If you switch off the light sources during an animation, the auto light will activate itself. If you need the scene to remain dark, deactivate this option!

Log File

If this option is enabled, the render log will be recorded in 'Renderlog.txt' in the CINEMA 4D folder.

The render log contains a complete history of the render process including system resource information. In particular, you can check the log if you need to identify problems that occurred during rendering.

The information in the log file is not overwritten by subsequent renders. Rather, new log information is appended. As a result, this file can grow to a fair size over time. You may wish to delete the file manually from time to time - a new file will be created the next time the log is recorded. (You will not confuse CINEMA 4D by deleting the file).

Here is an example log file (without rendering errors).

```
*** CINEMA 4D LOG FILE ***
Renderjob started on 01/27/2000 at 23:06:49
File: Testrender
Creator: Joern Gollob, MAXON Computer GmbH
C4D Version: V6 XL 6.00
Serial number:
Frames: 1
CPUs: 1
Rendermode: Raytracing
Resolution: 384x288
Antialiasing: 3x3 Edge+Color
Field rendering: Off
Motion Blur: Off
Reflections: On
Transparency: On
Shadows: On
Volume effects: On
Alpha channel: On
Depth channel: Off
Output format: Single frames
Rendertime: 00:00:22
Renderjob finished on 01/27/2000 at 23:07:11
```

Cancel if Texture Error

If CINEMA 4D cannot find a texture when rendering the scene, an alert dialog will appear. If this option is not selected and you confirm the alert, the rendering continues without the missing texture.

If you activate this option, the rendering will be cancelled after the alert. If you are rendering several scenes (batch rendering), the next render task is started immediately.

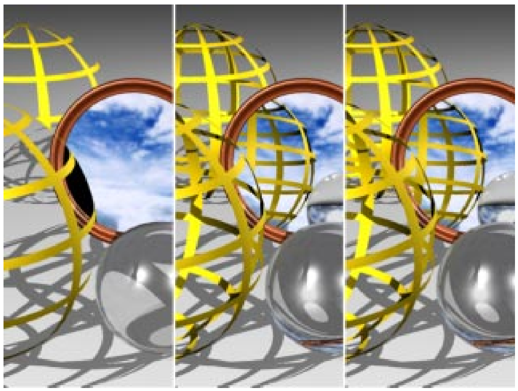
Ray Depth

The **Ray Depth** value determines how many transparent objects (or areas made invisible using the alpha channel) can be *penetrated* by the renderer. The lower you set the ray depth, the fewer the number of objects that can be seen through. Those areas that cannot be penetrated are rendered black.

A processing depth of 1 means that calculations are finished for that pixel once a ray hits something in the scene. Transparencies and alphas are therefore not visible.

A value of 2 means that, after a ray has hit a surface, a second ray is calculated for the transparency. The greater the processing depth, the further rays are followed into the scene and the results rendered.

The following scenes with transparencies and alphas were rendered with a ray depth of 2, 4 and 8.



Refl. Depth

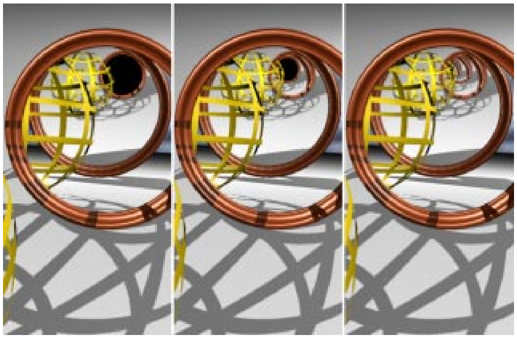
This is the reflection depth. When a ray is sent into the scene, it can be reflected by reflective surfaces. With certain arrangements, e.g. two mirrors opposite each other, it is possible that a ray will be reflected endlessly - it is trapped between the mirrors and the raytracer would never finish rendering the picture. In order to prevent this, you can set the maximum number of reflected rays in **Refl. Depth**.

You can also use **Refl. Depth** to limit the render time for the picture. Often, only the first generation of reflection is important. Further rays tend to add very little to the image quality but increase the render time considerably.

A processing depth of 1 means that calculations for a pixel are finished once a ray hits something in the scene. Reflections are therefore not visible.

A value of 2 means that, after a ray has hit a surface, a second ray is calculated for the reflection. The greater the processing depth, the further rays are followed into the scene and the results rendered.

The following scenes with reflective objects were rendered with **Refl. Depth** set to 2, 4 and 8.



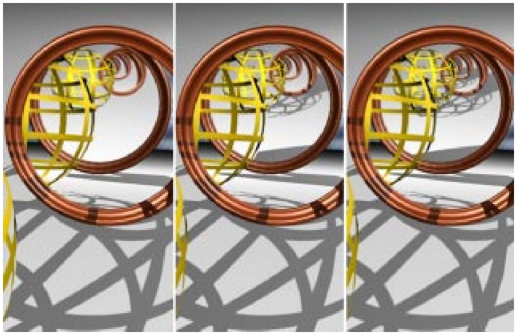
Shadow Depth

The shadow depth is analogous to the reflection depth. In this case, tests are carried out to see if a surface point lies in the shadow of another object.

This is tested for using additional shadow rays, which are sent from the surface in the direction of the light source.

The value you enter for this setting determines for which generation of camera rays shadows are calculated. For example, if you reduce the value to 2, shadows will not be rendered for reflected, transparent or refracted rays.

The following scenes with reflective and transparent objects were rendered with **Shadow Depth** set to 2, 4 and 8



Threshold

This value helps to optimize the render time. With complex scenes, particularly those containing many reflective and transparent surfaces, 90% of the processed rays contribute less than 10% to the general picture brightness and color. With a threshold value of, for instance, 15%, the rays stop their movement from the camera into the scene as soon as their brightness falls below this critical value.

What exactly does that mean?

When a ray hits a surface, the values for transparency and reflection are calculated. If, for example, the threshold is set to 15% and the surface has a material with 10% reflection (Brightness slider), the material will not reflect.

In order to render the reflection in this case, the threshold must be reduced to 9% or less (or the reflection of the material must be increased to 16%).

Sometimes it is useful to increase the threshold to prevent minor details being reflected. Although minor details are calculated correctly, too much detail in reflections can distract the viewer. However, if you wish to calculate all rays, set the threshold to 0%.

AA Softness

This stands for antialiasing softness and the option enables you to control how hard or soft the antialiasing is. You can use this to fine-tune the antialiasing to suit your picture/animation.

For crisp pictures, set the value between 0 and 50%.

If your pictures should retain a soft look, use a value between 50 and 100%.

Note

As a rough guideline, use a value between 20-60% for stills and a value between 50 and 100% for animation. This is only a rough guideline that depends on the subject matter - do not worry if your preferred setting differs.

Cel-Renderer

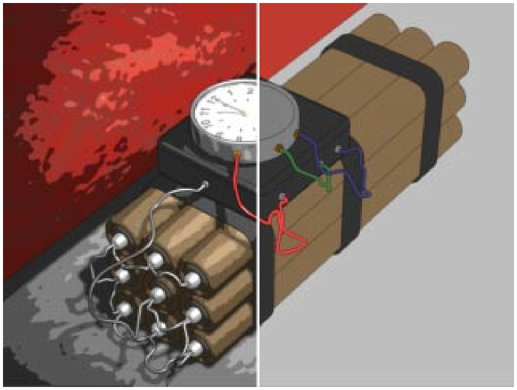
These options apply to the render modes Cel-Render B/W and Cel-Render Color.

Cel-Render B/W renders all objects as black outlines only on a white background. Cel-Render Color renders all objects with a reduced color palette and black outlines on a black background. This results in a classic cartoon style.

Illumination

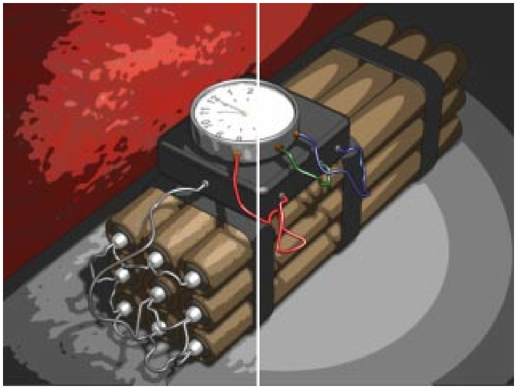
If this option is activated, the shading of objects is affected by the illumination. Shadows will also be rendered. Note that this option only has an effect with Cel-Render Color.

If **Illumination** is deactivated, the average color value of the top texture layer (the right-most texture in the Object Manager) will be used to render the objects. As a result, each object has a monotone color. Also, shadows will not be rendered with the option deselected.



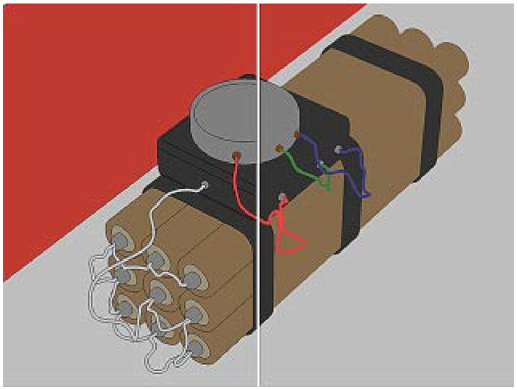
Textures

If this option is activated, textures will be rendered. If **Textures** is deactivated, the average color value of the top texture layer (the right-most texture in the Object Manager) will be rendered. Note that this option only has an effect with Cel-Render Color.



Outline

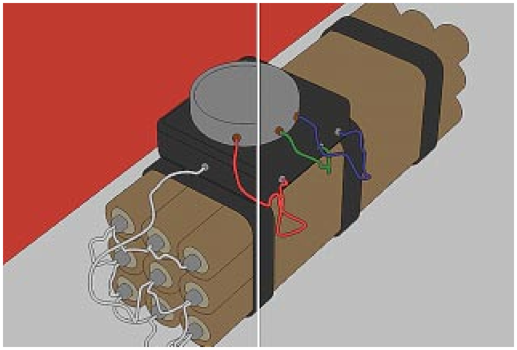
This option draws an outline around the silhouette of objects. This is critical with the Cel-Render B/W mode since if you deselect the option all you will see is the background color! With Cel-Render Color, the outline helps to bring out the individual objects and give them a cartoon feel.



Note

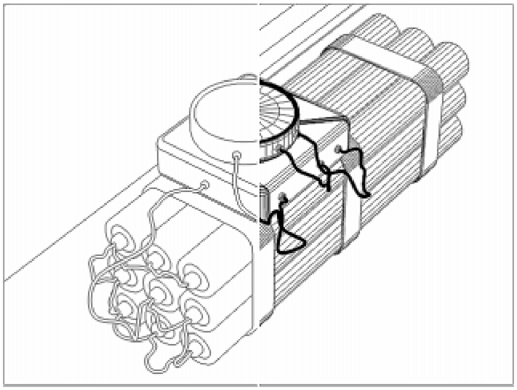
The outline is drawn around the silhouette of individual objects only. For example, if you have connected an object group to form an individual object, only the overall silhouette will be outlined, not the individual silhouettes.

You can change the color of the outline using Edge Color.



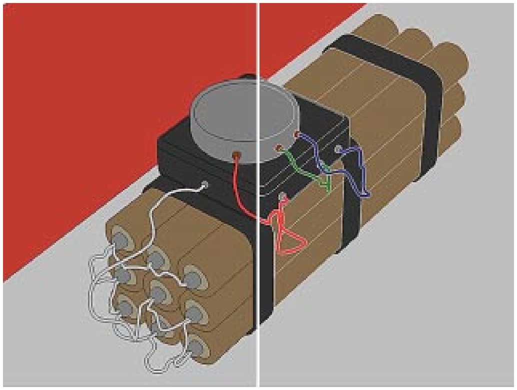
Edges

If this option is activated, all polygon edges are outlined in black. This creates a shaded wireframe feel. You can change the color of the edges using Edge Color.



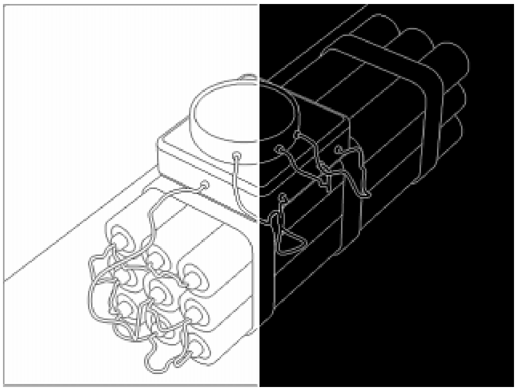
Edge Color

This option enables you to change the color used by the options Outline and Edges. This option affects both cel rendering modes (Cel-Render B/W and Cel-Render Color).

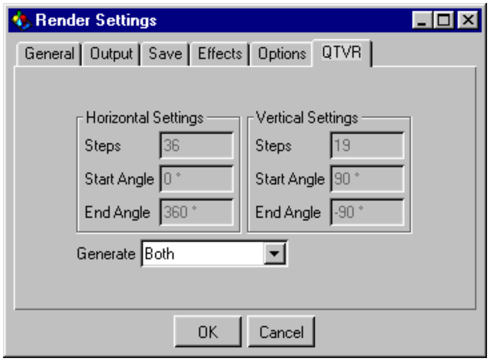


Background Color

This option allows you to change the background color for the Cel-Render B/W mode. The option has no effect on the Cel-Render Color mode.



QTVR Tab



You can use the options on this page to create your own QuickTime VR panoramas and QuickTime VR object movies. Perhaps you have already seen this technology in use (e.g. the ‘Star Trek Technical Guide’).

QuickTimeVR technology combines the frames of a 360° horizontal pan in such a seamless fashion that you can freely move around in the virtual scene that is created. You can even zoom in and out.

It is possible to create these images using real photos. However, the images must be of the highest quality and positioned exactly, otherwise the result is distorted.

This is painstaking work and it requires an expensive, high-precision camera for good results.

Unless, of course, you create the scene in CINEMA 4D and let the program do the hard work of creating the QuickTimeVR film for you.

Isn’t technology a wonderful thing!

Some terminology

A *panorama* is a 360° all-round view of the environment as seen from the camera. The QuickTimeVR movie lets the viewer spin around his or her own axis, looking around the panorama freely. The camera can even tilt up and down.

The *rings* in the panorama are usually between 10° (36 steps) and 30° (12 steps) apart. The more steps there are, the smoother the transition will be. If you wish for the viewer to be able to tilt the view, several *rings* must be rendered. So you need seven rings for full tilting at 30° intervals (one at 90°, 60°, 30°, 0°, -30°, -60° and -90°).

A QuickTime VR *object movie* enables you to rotate an object interactively using the mouse. For a smooth object movie, try 36 horizontal steps from 0° to 360° and 19 vertical steps from 90° to -90°. This gives you good coverage of the object and allows free rotation.

Note

Lens effects cannot be used with QuickTimeVR movies.

Horizontal Settings

Here you can use **Steps** to specify the number of frames for a single ring. You can also set the range of the camera pan or rotation using **Start Angle** and **End Angle**. The normal settings are 36 steps, a start angle of 0° and an end angle of 360°.

Vertical Settings

Here, **Steps** specifies the number of rings. A value of 1 is sufficient for a simple panorama or simple object rotation. However, if the viewer should be able to tilt the view, use more rings. Usually, an odd value is best, since it generates as many rings above the horizon ring as below it.

To specify the tilting range, enter values in the **Start Angle** and **End Angle** boxes. The maximum range is -90° to +90°.

Note

There are two built-in resolutions for QuickTime VR on the Resolution popup menu (Output page): 1248 x 384 QTVR and 2048 x 768 QTVR. Choose Automatic for the film format. You can type in your own resolution using the text boxes to the right of the Resolution popup menu. Ensure that the values you enter are divisible by 4.

Generate

VR Movie

CINEMA 4D creates a ready-to-view QuickTime VR panorama or object movie which you can view in QuickTime as soon as it has been rendered.

Intermediate Files

CINEMA 4D creates a panoramic picture or individual object film pictures which you can, say, edit further using Apple's QuickTime VR tools.

Both

CINEMA 4D creates a ready-to-view QuickTime VR film as well as a panoramic picture or individual object film pictures which you can process further using Apple's QuickTime VR tools.

Apple recommends:

These are Apple's recommended settings (from 'The QuickTime FAQ'):

- Use focal lengths of 15 mm, 28 mm or 35 mm.
- Do not use fish-eye lenses.
- For interior shots, use a 15 mm lens. This gives you a vertical visibility range of 97°.
- Use a 15 mm lens. This lets you reduce the number of shots in one pan to 12.
- If you are using 35 mm lenses, create additional rings for the view upward and downward.
- For determining the number of frames in a horizontal ring, two adjacent frames should overlap by 30% to 50%.

Movie Formats

Common movie formats are listed below.

Computer playback:

Resolution	Description	Film Format	Pixel (X to 1)	Frame Rate	Fields
160x120	draft				
320x240	NTSC MPEG1	4:3	1	(29.97)	(even lower)
348x288	PAL MPEG1	4:3	1	(25)	(odd upper)

TV playback (video):

Resolution	Description	Film Format	Pixel (X to 1)	Frame Rate	Fields
640x480	NTSC	4:3	1	29.97	even
720x486	D1 NTSC	4:3	0.9	29.97	odd
768x576	PAL	4:3	1	25	odd
720x576	D1 PAL	4:3	1.067	25	odd
1920x1080	HDVS 1080I	16:9	1	24, 25, 30	none, odd, even

Film playback:

Resolution	Description	Film Format	Pixel (X to 1)	Frame Rate	Fields
1920x1080	HDVS 24P	16:9	1	24	none
1800x972	WIDESCREEN	1:1.85	1	24	none
2048x872	SCOPE	2.35:1	1	24	none
2048x1536	SCOPE ANAMORPH	8:3	2	24	none

Sources: Filmwerk, ARD – Technical Guidelines, Sony HDVS, Kodak Cinesite and Gürtler - Film Transfer Department.

CINEMA 4D

MODELING • ANIMATION • RENDERING

14. Window Menu

14 Window Menu

General

Most of the following menu entries activate a window or a manager. If the particular window or manager is already present in the layout, but not in the foreground, the call will cause it to come to the front. If the selected item is not in the layout or if an additional view panel, icon palette or status bar is opened, this appears first in a new window. With the *drawing pin* (see page 61) this window can then be placed elsewhere within the layout.

Layout

Under this sub-menu entry are some functions that allow you to modify your work environment to suit your own preference. More information on this can be found in Chapter 4, Workflow, page 55.

New Icon Palette

This opens a new, empty icon palette in its own window. You can then populate this palette with icons from the Command Manager (see page 38).

Edit Palettes

If you choose this command, the **Edit Palettes** mode is activated and the Command Manager opens. The icons are surrounded by blue frames, indicating that you may edit them - e.g. you can drag icons from the Command Manager and drop them onto any of the palettes.

There are two ways to exit the **Edit Palettes** mode - either close the Command Manager or deselect the check box.

GlobalStatus Bar

This function opens the global status bar which gives information on such things as render time, help text etc.

Load Layout

If you have setup your working environment to your satisfaction and saved it (as a '.l4d' file), you can reload that configuration with this command.

Save Default Layout

Use this to save the visible working environment as the default layout ('layout.l4d'). When you next start CINEMA 4D this is the layout that will be used (remember that this only saves your CINEMA 4D setup - you must clear up your desk yourself!).

Note

In the General Settings you can choose to save the layout automatically when quitting the program.

However, if you have slaved for hours creating the perfect working environment and want to be sure that the layout is saved immediately, you should use Save Default Layout. After all, power cuts have an uncanny knack of happening when you have not saved your work!

Save Layout as

This command lets you save your layout under its own name so that you can create as many named setups as you need; e.g. one layout for modeling and one for the animation.

Layout files should have the extension '.l4d'.

Reset Layout

This instruction resets your CINEMA 4D layout to the original, preset layout. This is particularly useful if you need to call our support team since you and they then have a common interface to work from. Your own customized layouts can increase your workflow enormously but when searching for an elusive problem a common, standardized layout is essential.

Default Layouts

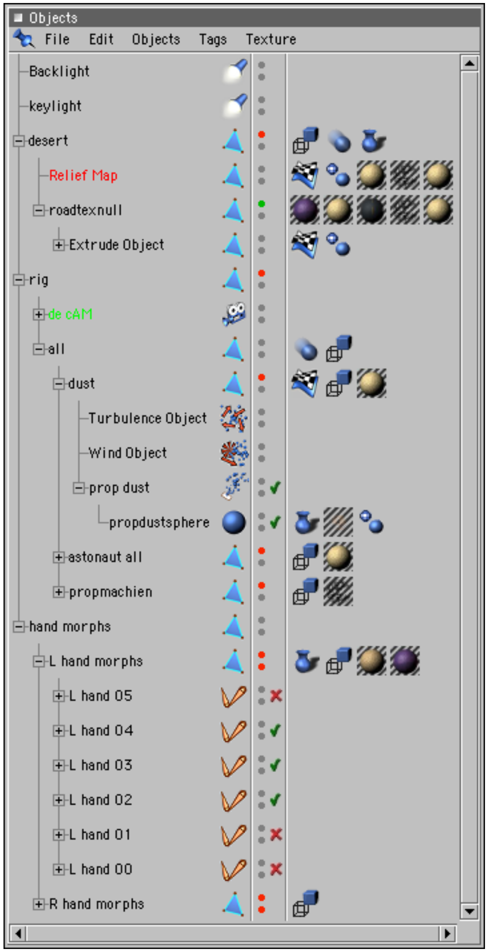
So that you can access different layouts quickly this command shows all the '.l4d' layout names that are present in the 'Prefs' folder within the 'CINEMA 4D' directory.

New View Panel

CINEMA 4D allows you to open as many views on a scene as you want and the perspective is always freely adjustable within each view (see View Menu, page 13).

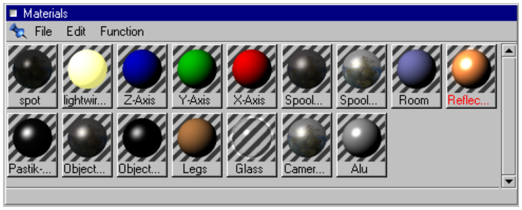
This is where you create a new view panel; when it first appears it uses the standard 3D perspective.

Object Manager



Opens the Object Manager. The Object Manager is the heart of CINEMA 4D modeling. Within it you can activate an object (even if it is not visible in the editor), change the object hierarchy and manipulate the various properties of the objects. The Object Manager is described in detail in Chapter 17, page 453.

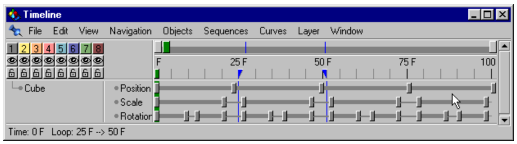
Material Manager



This opens the Material Manager which holds all the materials and textures occurring in a scene and also shows material previews. You can assign a material to an object using drag-and-drop; simply grasp the material and move it over the appropriate object in the Object Manager.

The Material Manager is described in detail in Chapter 18, page 475 while the different texture projections are discussed on page 525.

Time Line



Here you open the Time Line. This is the heart of CINEMA 4D animation. It is in the Time Line that all animation parameters are administered and controled.

The Time Line is described in detail in Chapter 19, page 547.

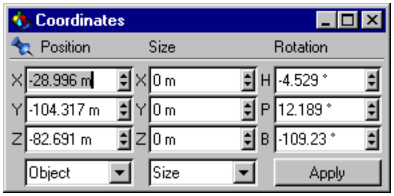
Important note for existing CINEMA 4D users

The new Time Line combines several managers that existed separately in earlier versions of CINEMA 4D. The Time Manager, Time Line, Time Control and Space Control Managers, which were separate previously, are now integrated into the Time Line.

Picture Viewer

This opens the Picture Viewer window. When you perform a final render, the picture appears in this output window (instead of in the editor). Also, you can view image files (e.g. textures) directly in this window and you are even able to convert them to other formats.

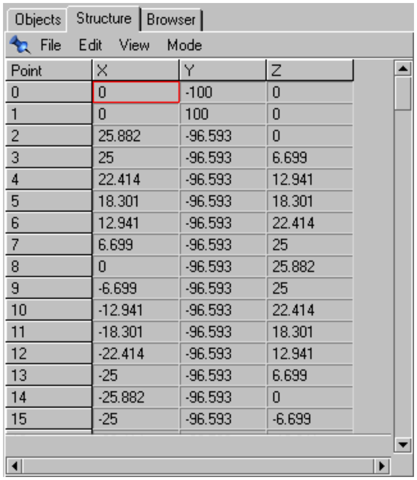
Coordinates Manager



Use this to open the Coordinates Manager. This is a universal tool for the numeric manipulation of elements within your scene.

The Coordinates Manager is described in detail in Chapter 16, page 449.

Structure Manager



Opens the Structure Manager. The Structure Manager shows how an object is constructed (of points and polygons) and allows you to edit this. You can work numerically on all individual points and surfaces of an object, even on its UVW coordinates.

The Structure Manager is described in detail in Chapter 10, page 333.

Browser

Here you open the Browser. The Browser is an enormously powerful tool for the administration of your project data and libraries. Whole directories can be scanned to create a catalog and can be saved with a preview as well as with further information. Instead of searching long and hard in the murky depths of your hard disk directories use the Browser to get your chosen textures, objects or scenes with just a few mouse clicks.

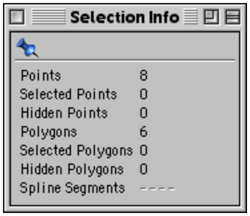
The Browser is described in detail on page 58.

Active Tool Manager

The more complex tools (for example, the selection tool) within CINEMA 4D have various parameters (such as the radius of selection) which are shown in the Active Tool window; here you can also adjust them as necessary.

The adjustable parameters are described within the appropriate chapters for the individual tools.

Selection Info

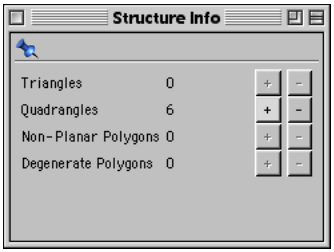


This function opens an information window which gives immediate information about the selected object. Here the number of points (general, selected, hidden), polygons (general, selected, hidden) and spline segments are shown.

Note

Only selected polygonal objects, splines or Bézier NURBS will have information shown in this window. The Selection Info window remains empty for an active parametric object, a modifier or other such objects; these usually have their own parameter boxes.

Structure Info

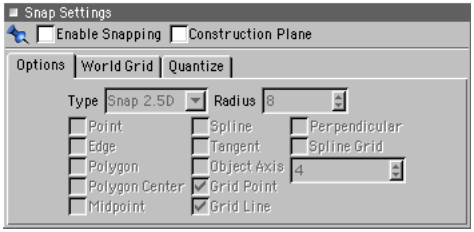


This opens a window that gives you information about the structure of the selected object (e.g. the number of triangles, quadrangles etc.). In addition, you can use the '+' and '-' buttons to select or deselect the different parts of the structure e.g. all the quadrangles.

Note

Only polygonal objects or splines can have their structure shown in this window. If you have selected a parametric object, a modifier or other such object, the Structure Info window remains empty.

Snap Settings



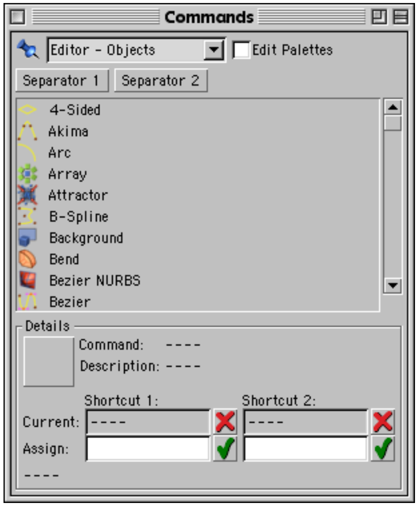
This opens the dialog for changing the snap tools. This is where you choose whether objects move freely or *snap* to various points, surfaces etc. while modeling. Snap is a very powerful construction tool.

You will find more information on using the snap settings on page 383.

Console

The Console window is used for the output and control of C.O.F.F.E.E. programs. C.O.F.F.E.E. print commands are displayed here, as are any errors. In the case of errors, the number and program position are shown.

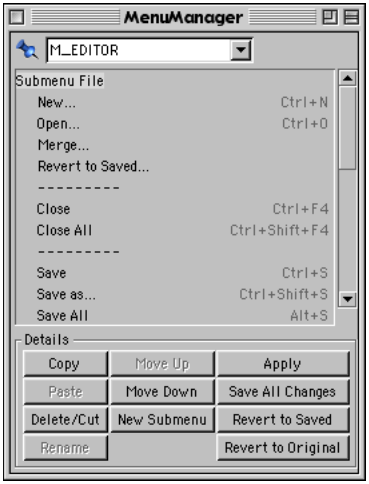
Command Manager



This function opens the Command Manager which contains a list of all the functions and commands that exist in CINEMA 4D, including the various icons and keyboard short-cuts. Here you can arrange your own icon palettes or change the shortcuts to suit your own needs.

There is a more detailed description of the Command Manager on page 38.

Menu Manager



You can use this manager to rearrange CINEMA 4D's menu structure. The use of the manager is self-explanatory. If you get in a tangle, you can restore the structure with **Revert to Original**.

Other Entries

CINEMA 4D is able to hold several scenes in memory at the same time.

At the bottom of the **Window** menu you will find a list of all the currently open scenes, under their filename. Thus you can switch quickly between individual scenes. The sequence in the menu corresponds to the order in which the scenes were opened.

CINEMA 4D

MODELING • ANIMATION • RENDERING

15. Info Menu

15 Info Menu

Help

This opens the online manual that was copied to your hard drive during the standard installation process.

MAXON Online

This menu item will open the MAXON homepage provided that you have an Internet browser installed. This is the place for the latest CINEMA 4D information as well as service updates.

Personalize

This opens the Registration dialog so that you can enter your final serial number. You will receive your final serial number once you have returned your registration form to us or to your local Maxon contact.

Warning

The serial number that is included with the program will expire after six months of use, after which you will no longer be able to use the program. Please send in your registration form as soon as possible.

Info

This opens the same info screen that appears momentarily when the program loads. You can use this screen to check the version number of CINEMA 4D - be sure to quote this number when contacting technical support. You can close the window by clicking on it.

CINEMA 4D

MODELING • ANIMATION • RENDERING

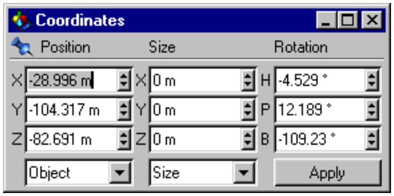
16. Coordinates Manager

16 Coordinates Manager

The Coordinates Manager allows you to manipulate objects numerically. It displays information relating to the tool you are using.

For example, if you are using the move tool, the position, size and rotation values of the active element are shown.

Once you have made changes to the values you can update the element by clicking on Apply.



You can use the popup menu at the bottom left to determine how the values are interpreted. If the menu is set to Object, all the values relate to the object's (immediate) parent system. If the menu is set to World, the position and rotation values are converted into world coordinates.

The rotation values always use the HPB System (see page 311).

The popup menu below the middle coordinates (Coordinates > Size) column specifies which object size is shown.

Size shows the size of the object (not including sub-objects).

Size +, on the other hand, shows the size of the active object including all sub-objects.

Scale shows the axis length for each axis of the object coordinate system - the default values are 1/1/1.

The size or scale is also specified in world coordinates, although along the local axes. For example, if a cube with a side length of 100 lies askew in 3D space, it still has a size of 100 units in world coordinates.

You can also enter relative values. CINEMA 4D has a parser which enables you to include mathematical operators. For example, you can append +100 to an existing position value. The active element will then move 100 units relative to its initial position. CINEMA 4D supports many other functions - see the Appendices for a complete list of valid operators, functions and constants.

As previously mentioned, the type of information displayed in the Coordinates Manager depends on the active tool. For example, if the camera tool is active, you can enter the focal length for the lens instead of its size.

Some values must be entered as relative ones, e.g. for the rotation of points. This is because points do not have their own coordinate system, so the program cannot keep track of previous rotations.

Note that you may be changing the axes of sub-objects unintentionally when you change the axes of the parent.

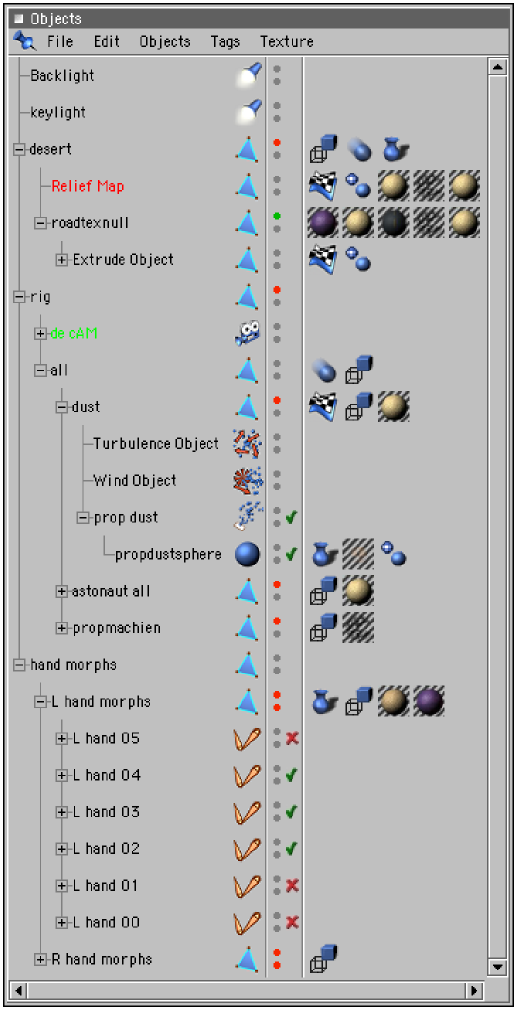
Try to avoid using world coordinates for animated rotation. CINEMA 4D converts all world coordinates into local coordinates, which can lead to unexpected behavior if you do not use local coordinates in the first place.

CINEMA 4D

MODELING • ANIMATION • RENDERING

17. Object Manager

17 Object Manager



The Object Manager is the centre of object administration in CINEMA 4D. You can use it to activate objects, change object hierarchies or manipulate tags.

On the left side of the manager is a list of all the objects in the scene. Hierarchies are shown as a tree structure. You can collapse and open hierarchies, just as you can on your computer desktop. You can use drag-and-drop to re-group or copy objects. You can identify an object's type (e.g. Hyper NURBS) by its icon. Object types are discussed in Chapter 7, Objects Menu.

The narrow column running down the centre of the Object Manager contains up to three *switches* for each object. The switches are described in detail later in this chapter.

To the right of the switches are the object tags (e.g. texture tag, smoothing tag). You can use drag-and-drop to move or copy these tags to other objects. The tags are described in detail later in this chapter.

You can use context menus in the Object Manager. To do this, click the right mouse button within the manager (Macintosh - hold down the Command key and click the mouse button to simulate the right mouse button).

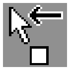
When you select a command in the Object Manager, it is applied to the active object.

Drag-and-drop in the Object Manager

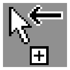
Drag-and-drop is the technique of clicking on an object, holding down the mouse button and dragging the object to another position; when the target location is reached, you release the mouse button and this will drop the object there. Depending on the target location, this may have different results.

To re-arrange objects in the Object Manager

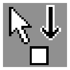
There are many ways that you re-arrange objects in the Object Manager and these are described below. The icon on the left shows what the mouse pointer will look like while you are doing the action described on the right.



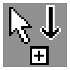
Drag an object between two others or to the end of the list.



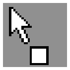
If you wish to move a duplicate, rather than the original, use Ctrl-drag.



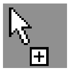
To change the object hierarchy, drag the object on top of an existing one in the list. This makes the dragged object a child of the other.



If you wish to create a duplicate and make it a child of another object, use Ctrl-drag and move the mouse pointer over an object.



You can also drag-and-drop *tags*. To transfer a tag from one object to another, drag the tag icon on to the line of the other object.



If you wish to create a duplicate, use Ctrl-drag.

If an operation is not available, this icon appears.

Each object in CINEMA 4D has a *type*, e.g. polygon object, particle emitter.

To open an object's dialog, double-click on its type icon. These dialogs are described in Chapter 7.

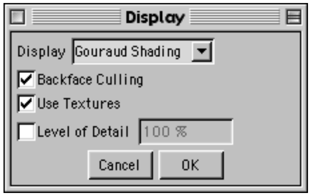
You can apply *tags* to objects (e.g. texture tag, smoothing tag). Double-click on a tag icon to open its dialog.

File Menu

New Tag

You can use this menu to select a tag. The tag will be added to the active object.

Display Tag



Display, Backface Culling, Use Textures

These settings have the same effect as their counterparts in the View menu (see Chapter 2), although the effect of a tag is limited to an object and any children it may have.

The display tags enable you to mix display modes within the editor. For example, some objects may use Gouraud shading, the others Wireframe. The main purpose of this is to reduce the strain on the processor so that the redraw rate remains fast.

If your scene is becoming sluggish in the editor, try a simpler display mode for objects of lesser importance.

Note that **Display > Use Display Property** must be activated in a view window for the display tags to have an effect there (the option is activated by default).

Level of Detail

This has the same effect as the command of the same name in the project settings (see page 52). You can use it to control the level of detail for generators and deformers.

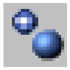
The tag's value is used in preference to the value in the project settings. For example, you can set the **Level of Detail** in the project settings to 50% and allocate a display tag with **Level of Detail** set to 100% to the object that you are currently working on.

If the tag's **Level of Detail** option is activated, it is always used in a view window, even if **Use Display Property** is not selected there.

Protection Tag

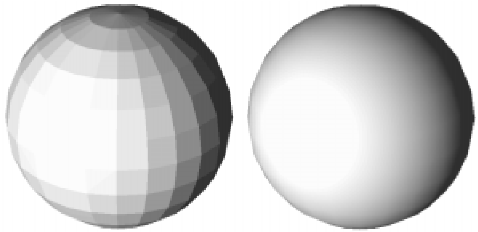
This tag does not have a dialog. An object with a protection tag cannot be moved, rotated or scaled. If you wish to make changes to a protected object, you must first remove its protection tag.

Smoothing Tag



Smoothing is an extremely important tag. It gives object surfaces a rounded appearance.

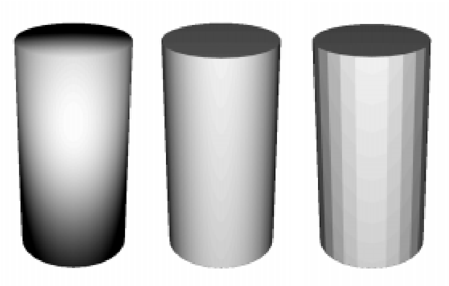
The picture below left shows a sphere before a smoothing tag is applied; on the right a smoothing tag has been applied.



If you look closely, you will see straight lines around the right sphere's silhouette. Smoothing does not increase the number of polygons. You can think of it as an illusion that loses its effect around the silhouette. If you wish to smooth the silhouette region, you must use more subdivisions.

You can use the dialog to specify the maximum smoothing angle. To do this, activate the **Angle Limit** option and type the required angle into the text box.

The following pictures demonstrate the effect of the smoothing angle. The cylinder on the left has smoothing with no angle limit specified (i.e. all angles are smoothed), the middle cylinder has an angle limit of 89.5° and the cylinder to the right has no smoothing at all.



When CINEMA 4D calculates the smoothing, it assumes that the surface normals are aligned. If this is not the case, shading anomalies may appear. All primitive objects are aligned by default.

Smoothing is a good way to reduce render time and save on memory. Without the smoothing tag, an object would require a far greater number of polygons in order to appear smooth. Note that smoothing can only take place across connected surfaces (surfaces that share points).

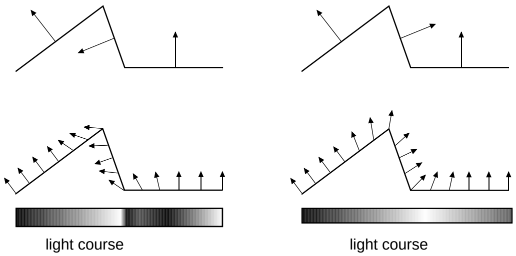
How smoothing works

During rendering, the program creates a normal for each surface. Each normal is perpendicular to its surface. The color and brightness of a point is determined by the angles which the normal forms with the rays of the camera and the light sources.

Without smoothing, two connected surfaces will have a hard transition, since each surface has its own normal. This will cause brightness bands.

If a smoothing tag is activated, the normals will be interpolated. There will be a soft transition between one normal and the next (provided that the surfaces are connected).

If a smoothing tag is not applied, there will be no interpolation.



The top-left picture shows three connected surfaces. The middle surface is not aligned to the other surfaces (you can tell by the normals). The bottom-left picture illustrates how the normals are interpolated for smoothing. The light bar shows the hard transition caused by the non-alignment.

The top-right picture shows the same three surfaces, but this time they are aligned. Notice how the interpolation (bottom-right picture) is much smoother this time. The light bar is smoother as a result.

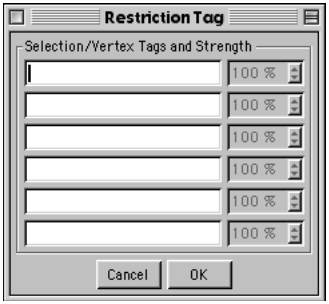
These pictures illustrate why it is important for surfaces to be aligned. The convention for the alignment direction is that the normals should point outwards from the object. For example, if you have an apple, the normals should point outwards into the world, not inwards towards the core. This convention does not matter for smoothing in CINEMA 4D - the important point is that they must be aligned, i.e. point in a consistent direction. However, it is best to follow convention. For example, the normal direction plays an important part in decal mapping (see page 534). All primitive objects are created with aligned normals (you do not need to edit their normals - they will be correct).

Note

To see the normals, select their polygons. For example, create a sphere, then choose Structure > Make Editable in the main window (this will convert the sphere into polygons). Next, activate the polygon tool and select some polygons using one of the selection tools (or choose Edit > Select All in the Selection menu).

To align normals, choose **Structure > Align Normals** in the main window.

Restriction Tag



You can use this tag to restrict a deformation object's effect to a selection of points. For more details see Deformation on page 256 and Frozen Selections on page 327. You can enter up to six selections for the tag and you can define the strength of the deformation in each case.

Render Tag

This tag has several options that affect rendering.

Cast Shadows

Sometimes it is useful to prevent objects from casting shadows - especially for technical illustrations. To turn off shadow-casting, deactivate this option.

Receive Shadows

Sometimes it is useful to prevent shadows appearing on an object - especially for technical illustrations. To turn off shadow-reception, deactivate this option.

Seen by Camera, Seen by Rays

You can use these options to create vampires in your scene (according to legend, a vampire has no reflection in a mirror).

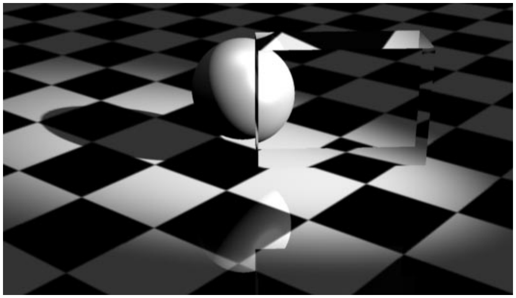
Joking apart, there are instances where it can be useful to make a visible object have no reflection. It can also be useful to make an object invisible yet have it cast a shadow.

If **Seen by Camera** is activated, the object will be visible in the render. If the option is deactivated, the object will be invisible.

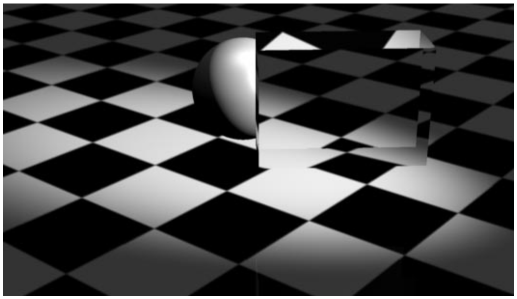
If **Seen by Rays** is activated, the reflection and refraction of the object will be visible in the render. If the option is deactivated, the reflection and refraction will be invisible.

You can combine these two options.

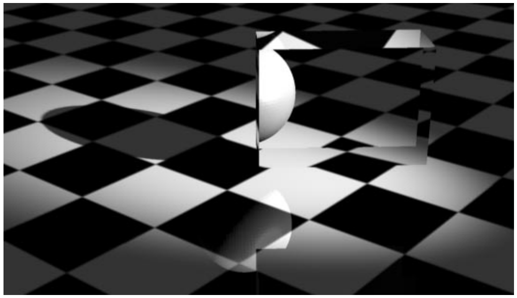
For example, you can create a visible object which casts no shadow, receives no shadows, has no reflection and cannot be seen behind glass; or perhaps an invisible object which casts a shadow, can be reflected and can be seen behind glass.



Normal object



Visible object



Invisible object

Compositing Background

This option will cause the object to be self-illuminated yet still receive shadows.

An example

You are creating a cartoon character for your website. Your website uses a white background and you need to render the character so that it appears to cast a shadow on to the webpage.

You create a floor with a white material (with the RGB values matching the white color of the web page), but when you render the picture, the floor is not of the correct brightness.

To solve the problem, create a render tag for the floor and activate **Background Compositing**. The floor will now illuminate itself evenly and with full brightness yet it will still receive the character's shadow.

Note

The object in question (in our example, the floor) must have its own material.

Texture Tag

This command creates a new texture geometry. Initially, no material is assigned. To assign a material, type its name into the **Search for** text box. This dialog is described in detail on page 256.

Note

If you allocate a material to an object, a texture tag will be created automatically. As a result, you rarely need to use this menu item.

You can assign as many texture tags as you like to an object. This allows you to apply several *texture layers* to the same object. The texture priority increases to the right in the Object Manager. This means that the right-most texture will be the top layer and the left-most texture will be the bottom layer. The top layer will cover the object completely unless it is limited in size or has an alpha channel activated.

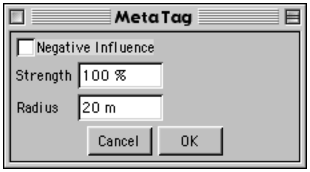
Note

If a child object has no texture tags applied to it, it will use the texture tag(s) of its parent.

Warning!

The note above does not apply to light sources i.e. if a light object has no texture tag and is a child of another object it will not inherit its parent's texture tags. This is to prevent child lights receiving gels automatically.

Metaball Tag



This tag tells an object that it is inside a metaball object. For details on metaballs, please see page 185.

Negative Influence

The object will repel the hull rather than attract it.

Strength

This defines the size of the meta-hull. A strength of 100% means that the meta-hull is as large as the original object; 50% means that the meta-hull is half the size of the original object; 200% means that the meta-hull is double the size of the original object.

Radius

Metaballs are not restricted to spheres only - you can use polygon objects and splines too. A meta-sphere will be created for each object point. For example, if you use a cube with eight points, eight meta-spheres will be created, one for each corner of the cube. **Radius** defines the radius for these spheres.

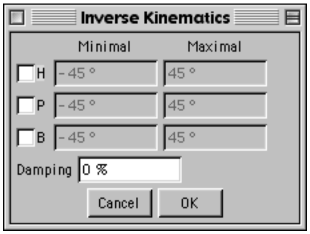
Anchor Tag

This command does not have a dialog.

When you use inverse kinematics (IK), you may not want all the objects in the hierarchy to be affected. The anchor tag will prevent an object from being moved under IK. The objects above it in the hierarchy will remain stationary (anchored) as well.

CINEMA 4D's built-in figure (**Objects > Primitive > Figure**) has an anchor tag applied to the upper body (make the figure editable, otherwise you will not see the separate body parts and tags). If you move one of the hands under IK, the upper body itself remains stationary.

IK Tag



You can use this tag to specify angle restraints for the object when using inverse kinematics (IK). For example, a real knee can only bend through about 160°. Though it would be a great party trick, an animated figure that can rotate its knee through 360° is not particularly convincing. Angle restrictions can also prevent objects from intersecting each other.

You can specify the restraint by entering a **Minimal** and **Maximal** value for the heading **H**, pitch **P** and bank **B**. You can also specify a damping factor. The higher you set **Damping**, the stiffer the joint becomes. Parts of the IK chain with a lower damping factor will move more readily.

An example

Change into View 2 (XZ plane) and create a bone object (**Objects > Deformation > Bone**). Move the view so that the bone object is near the bottom of the view.

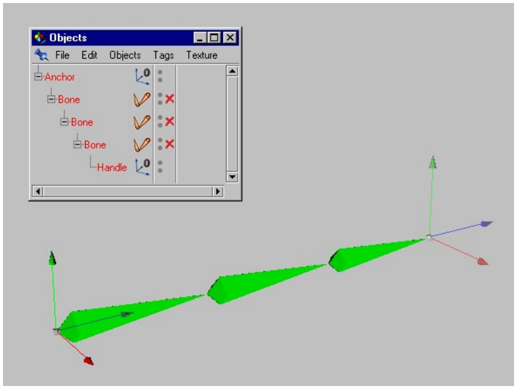
Click on the X axis icon to lock the X axis. Use Ctrl-drag to drag a new bone out of the orange point until it is about the same size as the original bone.

Next, Ctrl-drag a new bone out of the second bone until it is the same size as the others. The advantage of dragging out bones in this way is that the hierarchy is created automatically in the Object Manager.

Create two nulls (**Objects > Null Object**). Move one of the nulls along the Z axis to the end of the bones chain and rename it 'end effector'. Make 'end effector' a child of the last bone in the Object Manager.

Rename the other null 'anchor', then make the entire bones chain a child of 'anchor'.

Your chain should look like the picture below.



Click on the X axis icon to unlock the X axis. Choose **Tools > Inverse Kinematics** to activate IK mode. Select 'end effector' in the Object Manager, then move it around in the view window. The IK mode ensures that all objects maintain the same distance from each other. However, the movement is unrestricted - it is quite possible to make the bones intersect each other.

Create an IK tag for the first bone. Activate **H**, **P** and **B** and leave the values as they are. Use Ctrl-drag to copy the IK tag to the other bones in the Object Manager. Select 'end effector' and move it around in the view. Try changing into View 1 as well.

The bones are now restricted. For example, they cannot intersect each other any more. However, the bones can still move in all three directions.

Delete two of the IK tags in the Object Manager. Double-click on the remaining IK tag and enter 0 for the minimal and maximal **P** and **B** values. Use Ctrl-drag to copy the IK tag to the other bones in the Object Manager. Select the 'end effector' object and move it around in the view.

Try changing into View 1 as well. This time the movement is restricted to one plane.

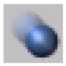
Finally, try entering different damping values for the tags. Start with 80% for the first bone, 60% for the second bone and 40% for the third bone. You will notice that the third bone moves the most readily, while the first bone is the most stubborn. Recall that increasing the damping will increase the stiffness.

You can use the figure object for further experimentation (**Objects > Primitive > Figure**). Choose **Structure > Make Editable** so that you can access the body parts and tags.

Note

The HPB angles refer back to the object's parent system, i.e. if the object is in a hierarchy, the parent system takes the place of the world system. One easy way to set the values is to activate the object and read its coordinates in the Coordinates Manager. You can then add and subtract to calculate the minimal and maximal values for the IK tag.

Motion Blur Tag



You can use this function to apply motion blur to an object. Ensure that **Object Motion Blur** is activated in the render settings (it is activated by default), otherwise the effect will not appear in the renderer.

Strength is the degree of blurring. A value of 100% will blur the object for the entire time between one frame and the next. You can enter negative values for the strength. In this case, the blur will be in the reverse direction of the motion. You can enter a strength value greater than 100% for extra blurring.

URL Tag

You can assign a URL to an object. This is useful if you are creating VRML files for the Internet. These VRML files (.wrl) contain complete 3D scenes and can be viewed in web browsers (e.g. Netscape Communicator or Internet Explorer) provided that you have a corresponding VRML plug-in.

The viewer can click on a 3D object that has a URL tag in order to link to an Internet address.

URL contains the link address. Take care to enter the complete address (do not forget http://, ftp://, https://). You can use **Info** to define the text that will appear when the mouse pointer moves over the object in the web browser.

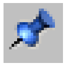
New Expression

Expressions are dependencies between objects. For example, you can move an object and have another object track it automatically. Expressions are particularly useful for automating behaviour.

There are two types of expressions in CINEMA 4D; the built-in expressions and C.O.F.F.E.E. expressions. The latter are more complex to use, but they are also very flexible and powerful.

Expressions are evaluated in the editor in realtime.

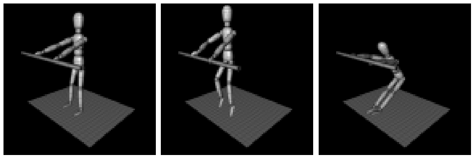
Fixing expression



This expression fixes an object's position to the specified coordinates. You can rotate and scale a fixed object, but you cannot change its position.

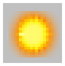
IK expression

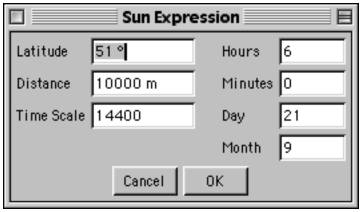
You can use this expression to set an IK target. The IK chain will try to reach the target. For the following example, we created four nulls (one for each hand and each foot). We placed the foot nulls on the floor and the hand nulls on the bar.



Then we typed in the name of the IK target for each expression. Now, if the figure's body moves, the hands and feet remain in position. If a null is moved, the corresponding hand or foot moves.

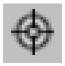
Sun expression





You can use this expression to simulate the position of the Sun. The expression is applied automatically when you create a Sun Light object (**Objects > Scene > Sun Light**). See page 237.

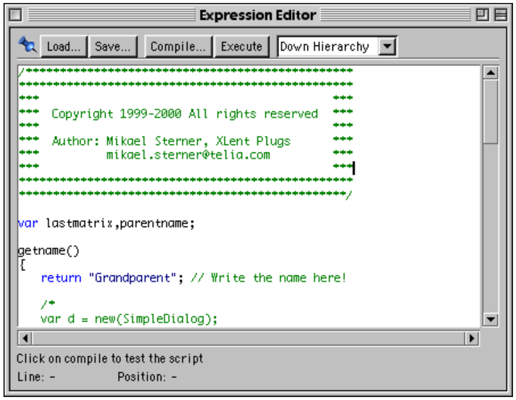
Target expression



If you apply this expression to an object, the object will point at another object automatically. For example, you can make a figure's eyes follow a target; you can have a spotlight follow a clown. Do not confuse this expression with the IK expression. If you need to set an IK target, use an IK expression. If you merely want the object to rotate in order to point at another object, use the Target expression.

Target Camera and Target Light (**Objects > Scene**) use target expressions.

C.O.F.F.E.E. expression



This is the most powerful and flexible expression tool in CINEMA 4D because you can use it to create your very own complex expressions. For example, you can use control objects to close a character's eye or open its hand. You can even create *secondary animation*. For example, you can have biceps bulge (using a bulge object) when you bend an arm that has bones.

C.O.F.F.E.E. expressions can create any type of dependency. For example, you can have an object's texture change according to the brightness of a light source. You will need to learn C.O.F.F.E.E. before you can create your own expressions.

Load Object

You can use this command to load a file containing object information (e.g. DXF, CINEMA 4D, Illustrator path, etc.). The objects in the file will be loaded into the scene along with any material and animation data.

Save Object As...

This function saves the active object. The standard system dialog for saving files will open.

Display Tags

You can use this option to switch on or off tag display in the Object Manager.

Close

This function closes the Object Manager.

Edit Menu

Undo

This function reverses the last change (action) that you made, restoring the scene to its previous state. You can select **Undo** repeatedly to continue reversing the actions.

Redo

Redo restores the last action that was undone. You can select **Redo** repeatedly to continue restoring the actions.

Cut

This function deletes the active object and copies it (including its materials and animation data) to the clipboard. The object can be copied back from the clipboard with the **Paste** function (see below).

Copy

The **Copy** function copies the active object (including its materials and animation data) to the clipboard. The object can be copied from the clipboard to the active scene with the **Paste** function (see below). You can paste repeatedly to create additional copies.

Paste

This function inserts an object from the clipboard into the scene.

Delete

This function deletes the active object or the active tag without copying it to the clipboard.

Object Menu

Object Display

The items on this menu control the editor and renderer visibility for the selected object. Alternatively, you can change the visibility using the *switches* in the middle column of the Object Manager:

The two switches (we could call them traffic lights) are coloured grey by default. Each can have one of three states: grey, green and red. These switches control the object's visibility.

The top switch controls editor visibility, the lower switch controls render visibility.

Editor Unchanged / top switch grey

The object adopts the editor visibility of its immediate parent. If the object is on the top hierarchy level (i.e. has no parent), it will be displayed as normal. Editor Unchanged is the default setting for new objects.

Editor On / top switch green

The object will be visible in the editor, even if the hierarchy parent is invisible (red).

Editor Off / top switch red

The object is not displayed in the editor, even if the hierarchy parent is visible (green).

Note

An object that is invisible in the editor will nonetheless be visible in the renderer.

Renderer Unchanged / bottom switch grey

The object adopts the renderer visibility its immediate parent. If the object is on the top hierarchy level (i.e. has no parent), it will be rendered as normal. This is the default setting for a new object.

Renderer On / bottom switch green

The object will be visible in the renderer, even if the hierarchy parent is invisible (red).

Renderer Off / bottom switch red

The object is not displayed in the renderer, even if the hierarchy parent is visible (green).

Note

To apply a status to all child objects, Ctrl-click on the switch for the parent object. The status will be transferred to all child objects.

Object Activation

Generators and deformers are two of the most important object types in CINEMA 4D. Generators use other objects or data to create a new body.

Generators include most NURBS types and the particle system. Deformers modify an existing object.

Deformers include not only those listed in the **Objects > Deformation** menu, but also Hyper NURBS, metaballs and the symmetry object.

All generators and deformers have the two standard visibility switches (see Object Display above) in the Object Manager.

In addition, they have a third switch for Object Activation.

The activation switch is represented as either a tick (activated) or a cross (deactivated).

You can use this switch to turn on or off the effect of the generator/deformer.

An example

You have placed several splines into a Loft NURBS. If you wish to edit the splines extensively, you can see them more clearly if you turn off the skin of the Loft NURBS (just turn off the activation switch for the Loft NURBS). Note that the NURBS object is not invisible; rather, it is not having an effect.

Another example

Create a cube and make it a child of a hyper NURBS object. The cube will be deformed into a sphere. If you deselect object activation, only the cube (the original object) will be shown.

Note

If you have an object in the scene that uses deformers, you can increase the redraw rate by deselecting object activation for each deformer.

Edit Object

You can use this function to edit the object type. A dialog will appear. For a detailed description of the type dialogs, see Chapter 7, Objects Menu. You can also call this function by double-clicking on the object's type icon.

If an object type cannot be edited (e.g. a polygon object), the Rename Object dialog will appear instead.

Rename Object

You can use this function to change an object's name. You can also call this function by double-clicking on the object's name.

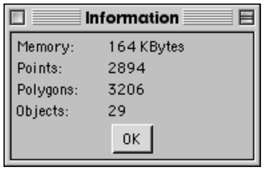
Group Objects

You can use this function to group several objects in the Object Manager. When you select this function, the mouse pointer changes into crosshairs. Use the crosshairs to drag a bounding box over the objects that you wish to group together. Child objects will also be incorporated into the group - existing hierarchies will be preserved within the new group.

Expand Object Group

This function is the reverse of Group Objects. It removes all objects from the group and places them on the same hierarchy level as the group parent. Existing hierarchies within the group will be preserved.

Information (Object)

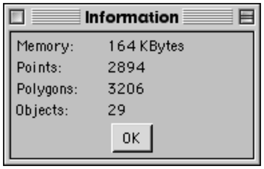


This function displays the following information about the active object (including its children): size in kilobytes, number of points, number of polygons and number of objects.

Note

Polygons that are created by generators will not be included in the number of polygons.

Information (Scene)



This function displays the following information about the scene: size in kilobytes, number of points, number of polygons and number of objects.

You are not required to select an object before calling this function.

Note

Polygons that are created by generators will not be included in the number of polygons.

Search Active Object

You can activate an object by clicking on it in the editor window. You may then wish to find the object in the Object Manager. However, it may not be visible immediately. You may need to unfold a very long IK chain, for example, or perhaps there are thousands of objects in your scene. Searching for objects manually can be time-consuming.

If you call this function, the active object will be shown in the Object Manager. The manager will scroll and the hierarchy tree will be opened if necessary.

Fold All

This command collapses all hierarchies in the Object Manager. In this state, the objects take up the least amount of space in the Object Manager.

Unfold All

This command is the reverse of **Fold All** (see above) - it expands all hierarchies. In this state, the objects take up the most space in the Object Manager. The advantage is that all objects will be visible (although you may need to use the scroll bar).

Warning!

Unfold with caution if your scene is very large. In this case, it may be wiser to unfold the hierarchies by hand. Large projects often have more than 1000 objects. The display speed will be just as slow as if 1000 files were to be displayed hierarchically in your operating system's window. You can query the number of objects in your scene by selecting the Objects > Information (Scene) command.

Fix Bones

Once you have finished positioning bones, you must *fix* them before you use them. This tells CINEMA 4D the fixing (starting) position of the bones. To fix the bones, simply call this function.

The Object Activation switch (see above) will be turned on automatically for the bone and all its child bones.

Reset Bones

This function resets the bones to their fixing (start) position. The object will return to its state at the time of the fixing.

The Object Activation switch (see above) will be turned off automatically for the bone and all its child bones.

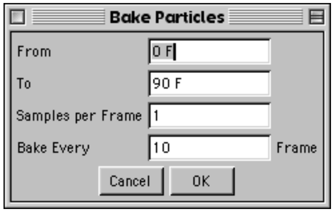
Bake Particles

This function has nothing to do with baking particles until they are a light, golden-brown color. Rather, baking particles refers to freezing the particle stream, including all its modifiers. This can be useful for several reasons:

- In extreme cases, very fast particles may behave unexpectedly due to processor inaccuracies (they may pass through deflectors). Baked particle streams avoid this problem since they are calculated much more accurately.
- You may wish to mix several particle streams but prevent modifiers affecting particles in the other streams. To do this, create one particle stream and its modifiers and bake the stream. Delete the modifiers before you start the next stream and continue in the same manner.
- If you are using CINEMA 4D NET to render across a network, jumps may occur in particle streams due to differences between the CPUs. You can remove this problem in CINEMA 4D NET version 6 and higher by baking the particles.

An example

Please ensure that you are familiar with the material in Particle System (starting on page 244) before proceeding with this example, otherwise you may find it difficult to follow.



Start a new scene and create an emitter and a few modifiers. Ensure that the emitter is selected in the Object Manager, then choose the **Bake Particles** command. The dialog shown above opens. Use the **From** and **To** values to mark the period over which the particles will be baked (the default values cover the entire document length). Click on **OK** once you are ready to bake the particles - a Baked Particles icon will appear in the Object Manager to the right of the emitter.

Important note

You cannot edit the settings that were used to bake the particles. If you need to re-bake the particles (e.g. because you have increased the document length), first delete the Baked Particles icon in the Object Manager, then bake the particles afresh (after all, we want light, golden-brown particles, not burnt offerings!).

Tags Menu

Edit Tag

You can use this function to edit the active tag. The tag's dialog will open. You can also access this dialog by double-clicking on the tag.

Copy Tag to Children

If you select this function, the active tag will be copied to all child objects of the active object.

If a child object already has a tag of the same type, its tag will be overwritten with that of the parent. There is one exception, the texture tag. This tag is still copied, but the child will keep its own tag as well (an object can have more than one texture tag).

Proceed with caution when using this function with complex scenes.

Delete Tag from Children

This function does the reverse of **Copy Tag to Children** (see above). **Delete Tag from Children** will delete the active tag from the active object and its children.

Proceed with caution when using this function with complex scenes.

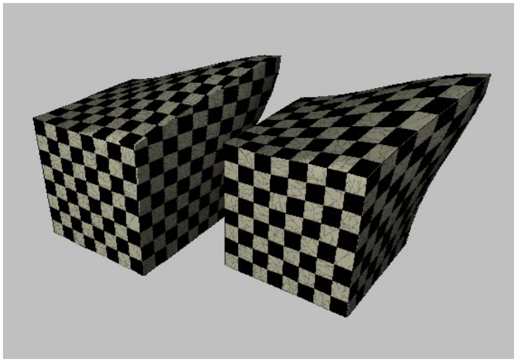
Texture Menu

Generate UVW coordinates

You can use this function to generate UVW coordinates. This is particularly useful for imported objects that do not have UVW coordinates. UVW coordinates prevent a texture from slipping when you deform the object.

Proceed as follows:

- Create a texture and allocate it to the object.
- Set the required projection type (e.g. spherical, cylindrical, etc.).
- Generate UVW coordinates.
- Deform the object.



The effect of UVW coordinates is shown in the picture above. The object to the left uses cubic mapping. The texture slips when the object is deformed. The texture for the object to the right does not slip since its original cubic mapping has been fixed with UVW coordinates.

You may use more than one UVW geometry to texture an object. To do this, give the object a new texture tag and set the required projection type, e.g. flat mapping for a label. Next, choose Generate UVW coordinates. A new UVW geometry will be created and the active texture tag will switch over to UVW mapping so that the texture is fixed to the object surface.

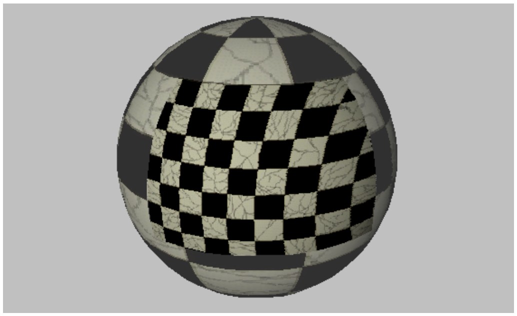
For more details on UVW mapping, see page 531.

Assign UVW coordinates

This function enables you to texture an object with several different projection types using a single UVW geometry and a single texture tag.

Proceed as follows:

- Create a sphere and convert it into a polygon object with Make Editable.
- Create a new material with a texture, e.g. the Checkerboard shader, and allocate it to the sphere.
- Change the projection type from UVW Mapping to e.g. Flat.
- Activate the polygon tool and select several polygons.
- Select Texture > Assign UVW Coordinates in the Object Manager.



If you are in RTTM mode, you can see immediately that the selected polygons use flat projection while the unselected polygons continue to use the normal UVW mapping. If you deform the object, the texture remains fixed in the selected region as well.

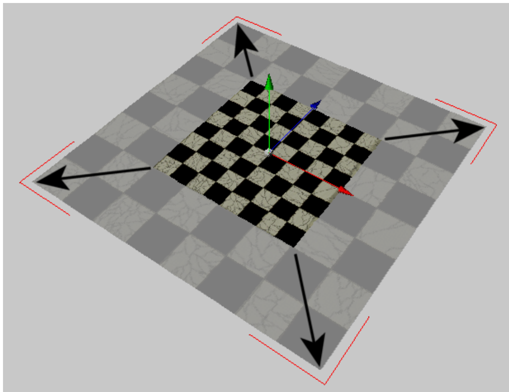
Note

Selective UVW mapping is intended for you to optimise projection for a single texture. If you wish to use more than one texture, use Restrict To Selection - see page 542.

If the object has no UVW coordinates (i.e. no UVW tag), new coordinates are created automatically.

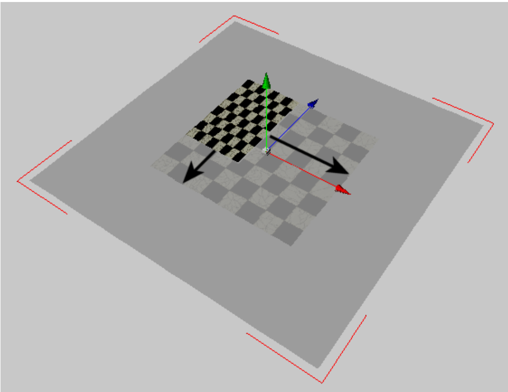
Fit to Object

If you select this function, the texture will be made to cover the object completely - the texture will have a length of 100% in both the X and Y directions.



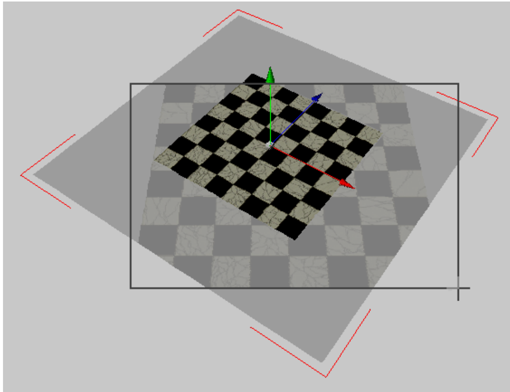
Fit to Image

You must apply your texture with flat projection if you wish to use this function. Type the name of an image into the dialog. CINEMA 4D calculates the image's X and Y resolution and scales the texture image accordingly. You can use this function to ensure that your texture uses the correct proportions, thereby avoiding distortion.



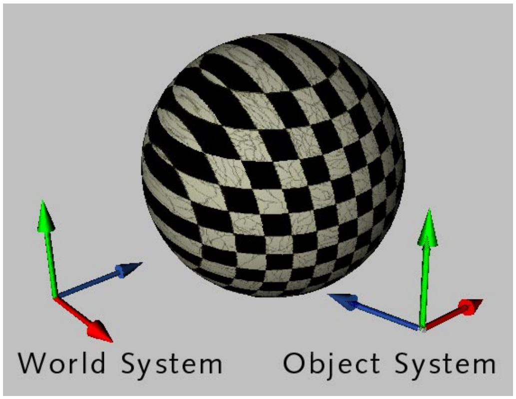
Fit to Region

You must apply your texture with flat projection if you wish to use this function. Use the mouse to drag a bounding box. CINEMA 4D will set the projection so that the size of the texture matches the specified region exactly.



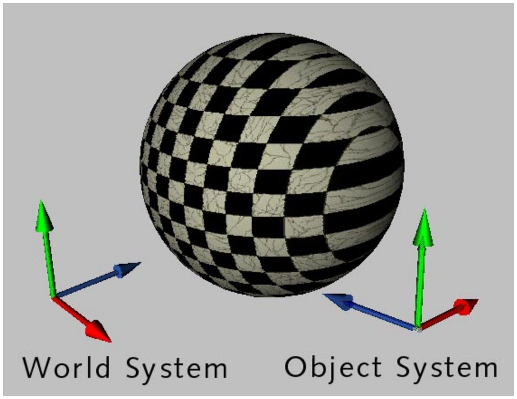
Adapt to Object Axis

This function rotates the texture axes in such a way that they are parallel to the object axes.



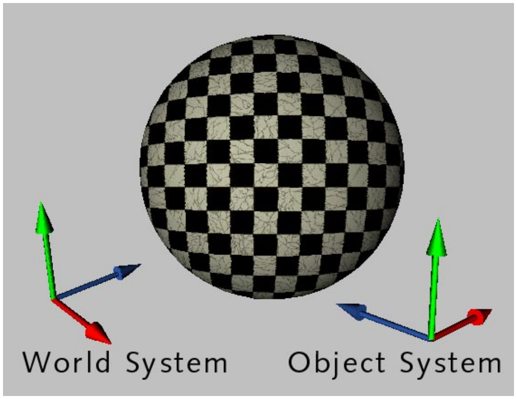
Adapt to World Axes

This function rotates the texture axes in such a way that they are parallel to the world axes.



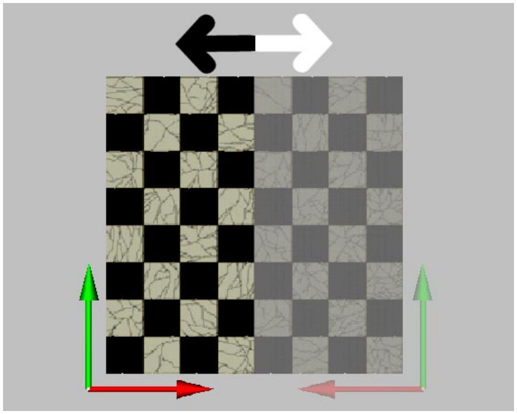
Adapt to View

This command rotates the texture axes in such a way that the texture is perpendicular to the viewing perspective. For a 3D view this is the camera plane; for all other views it is the work surface.



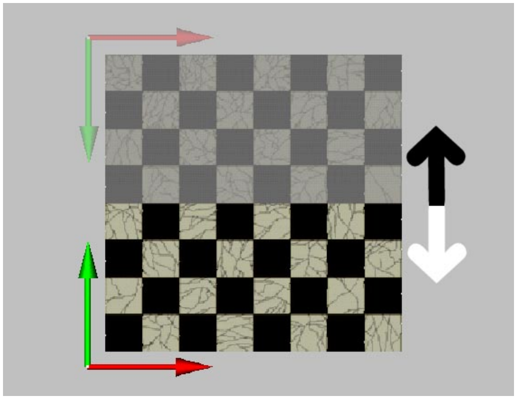
Mirror Horizontally

This command flips the texture horizontally. This effect is the same as if you were to view the texture's reflection in a real mirror.



Mirror Vertically

This command flips the texture vertically. This effectively turns the texture upside-down.

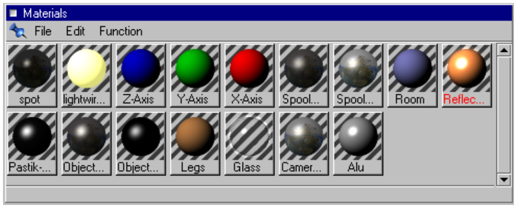


CINEMA 4D

MODELING • ANIMATION • RENDERING

18. Material Manager

18 Material Manager



General

You use the Material Manager to create materials for the objects in your scene. Good materials and lighting are essential for photo-realistic images.

The Material Manager contains all the materials and 3D shaders that belong to the active scene. A preview picture and a name is shown for each material. Names that are too long for the display space are shortened with a full-stop.

The material preview shows how the texture looks when placed on a sphere, in front of a striped background. This helps you determine how the material will look when applied to an object. You can choose between three different preview sizes.

When an object is active, all the materials it uses are shown depressed. (i.e. lower than the surrounding surface - they are certainly not unhappy!) This makes it easy for you to tell which materials are used by an object.

If an individual texture tag (rather than the object itself) is active in the Object Manager, only that corresponding material is shown depressed.

From now on, if we say that a material is *active*, we mean that its icon is shown in a depressed, or sunken, state in the Material Manager.

You can apply a material to an object using drag-and-drop from the Material Manager. You can drop the material on to the object in the Object Manager, or you can even drop it directly on to the object in the View window (see Applying a Texture, page 525).

If you drop a material on to a *texture geometry tag* in the Object Manager, this material will replace the previous one and the existing texture geometry will be used.

If instead you drop a material on to an object name, a new texture geometry is created. Any existing texture geometry tags remain intact so that you can layer textures. You can read more about layering, material administration and texture geometry in Texture Mapping, page 525.

In addition to any materials that are active, you can also select a material. Only one material can be selected at any time. The selected material has its name highlighted with red text. All menu functions in the Material Manager operate on the selected material.

You can select a material using the mouse (click once on the preview). You can also use the cursor keys to change which material is selected.

To edit a material, double-click on its preview. This opens the Material Editor window, which has its own preview picture so that you can see easily see the effects of your changes. You can read more on the Material Editor on page 480.

You can access many of the menu commands via the context menu. Please note that the context menu is accessible only if you have at least one material in the scene. If you are using a Windows operating system, you access the context menu by clicking the right mouse button in the Material Manager. If you are using a Macintosh, hold down the Command key and click in the Material Manager. The context menu contains the following commands: **Edit**, **Apply**, **Rename**, **New Material**, **Render Active Material**, **Render All Materials**, **Sort Materials**, **Remove Unused Materials** and **Remove Duplicate Materials**.

File Menu

New Material

This function creates a new material with the default material values (white with 80% brightness and a specular width and height of 20%). The new material will be placed at the start of the material list.

You can also access this function via the context menu.

New 3D Shader

New 3D Shader opens a popup menu showing all the 3D shaders installed on your system. Select the name of a shader to add it to the material list.

Shaders, also known as procedural textures, are more sophisticated than conventional textures. Shaders are computed using mathematical formulae whereas conventional textures are pixel-based. One advantage of shaders is that they do not become pixelated when viewed close-up.

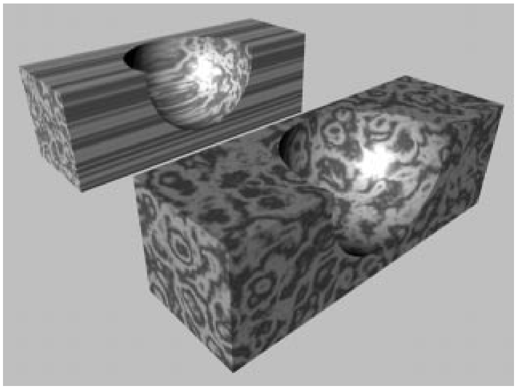
CINEMA 4D recognizes two-dimensional and three-dimensional shaders.

2D shaders can be loaded in the Material Editor in the same way you would load a conventional texture.

3D shaders cannot be loaded from the Material Editor. This is because 3D shaders take an object's volume into account, whereas 2D shaders and standard textures are simply applied to the object's surface. 3D shaders are independent of the object's geometry and the texture projection type (an exception is that UVW projection can be applied to volume shaders).

The difference between conventional textures and 3D shaders is particularly apparent when applying them to an object with a section cut out. With conventional textures, you can see the edges of the cut very clearly. With 3D shaders, the cut is taken into account.

The following picture compares a 2D texture with a 3D shader. Note how the 3D shader seems to flow from the sides and into the hollow.



A 2D shader (top) in comparison with a 3D shader

3D shaders can do even more. For example, the Fog shader fills a volume with animated fog clouds. Shaders are often used with simple objects (such as a cuboid) to create computer-generated landscapes.

Please note that you cannot load 3D shaders *into* a material; they are materials in their own right.

Note

CINEMA 4D computes 3D shaders using SAT Mapping (see page 485).

For a detailed description of the 2D and 3D shaders supplied with CINEMA 4D, please see page 508, The Shaders.

Load Materials

This function loads materials, adding them to any materials already in the scene. You can also import materials from another scene by loading the scene file.

A word of caution regarding textures; when CINEMA 4D renders the scene, it must locate all the textures. CINEMA 4D will look for the textures in the same folder as the scene, as well as in a sub-folder called 'Tex'. In addition, you can specify up to 10 alternative search paths (see Texture Paths, page 51). When the scene is to be used on another computer (perhaps by a colleague) we strongly advise that you save the scene using **Save Project** (see page 73). This will ensure that all of the textures are saved in a 'Tex' sub-folder along with the scene.

Save Material As

This function saves the active material. The standard system dialog for saving files will open. Once you have saved the material, you can reload it using **Load Materials**.

Save All Materials As

This saves all the materials in the active scene. You can use this function to create your own material libraries. Use **Load Materials** to import the materials.

Close

This function quits the Material Manager and closes its window.

Edit Menu

Undo

Undo will undo the last change that you made to a material. Keep calling this function to continue undoing (multiple undo).

You can set the maximum number of undos using **Undo Depth** in the General Settings (see page 44).

Note

The functions Remove Duplicate Materials and Remove Unused Materials cannot be undone. If you delete a material, any objects which used that material will use the default material instead. Although it is possible to undo the deleted material, it will not be reapplied to the objects; you must do this manually.

Redo

Redo undoes an undo. You can set the maximum number of undos using **Undo Depth** in the General Settings (see page 44).

Cut

Cut removes the active material from the Material Manager and copies it to the clipboard. You can use the Paste function to retrieve the material from the clipboard, even if you have changed the active scene (i.e. you can paste between scenes).

Copy

This copies the active material to the clipboard. Use the Paste function to retrieve the material from the clipboard. Note that you can paste more than one copy; each new copy is added to the start of the material list.

Note

You can quick-copy materials by using drag-and-drop with the Ctrl key held down. Drop the copy at the required position in the material list. The first copy will be called 'name.1', the second copy will be called 'name.2' and so on.

Paste

The Paste function inserts the last material that you copied (or cut) to the clipboard. The copy will be placed at start of the material list. The first copy will be called 'name.1', the second copy will be called 'name.2' and so on.

Delete

This function deletes the active material. Alternatively, use the Delete or Backspace key.

Small, Medium, Large Icons

Select one of these three settings to determine the size of the material previews (the default is small). Small icons are 45x45 pixels, medium icons 60x60 pixels, large icons 90x90 pixels. The preview pictures may be slightly pixelated with some graphics cards. Do not be concerned, there are good technical reasons for this.

Function Menu

Render Material

This function redraws the preview picture of the active material.

When you create a new material, it is rendered automatically. Why, then, would you need to use this function?

Because when you save a scene, the preview pictures are compressed to reduce the file size. As a result, when you load a saved scene, you may notice artifacts with some materials.

Also, preview pictures are not rendered automatically when importing foreign formats such as DXF or 3D Studio R4.

If only the base color is shown after rendering the material, it means CINEMA 4D could not find the texture(s).

When saving scenes for use on another computer, you can ensure that all textures are included by using Save Project (see page 73).

If you cannot find a texture, select an alternative texture or delete the name on the appropriate page of the Material Editor.

You can also access this function via the context menu.

Render All Materials

This function redraws the preview pictures of all the materials.

When you create a new material, it is rendered automatically. Why, then, would you need to use this function?

Because when you save a scene, the preview pictures are compressed to reduce the file size. As a result, when you load a saved scene, you may notice artifacts with some materials.

Also, preview pictures are not rendered automatically when importing foreign formats such as DXF or 3D Studio R4.

You can cancel the render process with the Esc key. If you are using a Macintosh, you can also cancel with the standard Command-dot keypress.

If only the base color is shown after rendering the material, it means CINEMA 4D could not find the texture(s).

When saving scenes for use on another computer, you can ensure that all textures are included by using **Save Project** (see page 73).

If you cannot find a texture, select an alternative texture or delete the name on the appropriate page of the Material Editor.

You can also access this function via the context menu.

Sort Materials

This will arrange the material list in alphabetical order.

You can also sort materials manually using drag-and-drop. This lets you position the materials in any order you like. Drop the material in the position of your choice. The insertion is right-justified, which means it will appear to the right of the material that you drop it on.

If the target position of the material is outside the visible range of the Material Manager, you can scroll by moving the mouse to the upper or lower edge of the window.

You can also access this function via the context menu.

Edit

This function opens the Material Editor if it is not already open, and the Material Editor will become the active window. You can use the Material Editor to change the properties of the active material.

You can also open up the Material Editor by double-clicking on a material's preview picture. For more details on the Material Editor see below.

You can also access this function via the context menu.

Apply

Apply creates a texture geometry for the active object. The active material is applied to the texture geometry.

You can alternatively apply the material with drag-and-drop. If you drop the material on to an existing texture geometry tag...

...the previous material in the tag is replaced by the new one. If, however, you drop the material on to the object name, a new texture geometry is created for the material.

Texture geometry is described in detail on page 525 under Texture Mapping.

Note

Hold down the Shift key if you do not want the texture geometry dialog to open.

You can also access this function via the context menu.

Rename

Use this function to change the name of the active material.

It's also possible to rename a material by double-clicking on its name, which is just below its preview picture.

You can also access this function via the context menu.

Remove Unused Materials

This deletes all materials which have not been applied to objects in your scene. Materials which are used in a texture track are not deleted (see page 572).

This function is particularly helpful when using material libraries as it will remove the (possibly many) unused materials.

You can also access this function via the context menu.

Note

The Remove Unused Materials function cannot be undone.

Remove Duplicate Materials

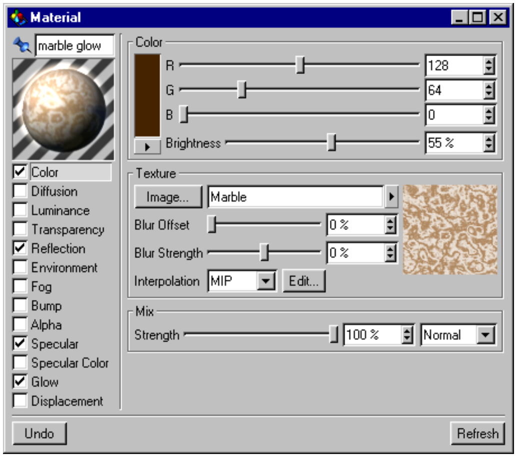
This deletes all materials of the same name which have identical parameters.

You can also access this function via the context menu.

Note

The Remove Duplicate Materials function cannot be undone.

The Material Editor



You use the Material Editor to change a material's properties.

Open the Material Editor by double-clicking on a preview in the Material Manager. The Material Editor is a non-modal window, which means that it does not have to be closed before you can edit another material. Simply click once on another material in the Material Manager and it will appear in the Material Editor. This helps speed up your workflow.

You do not have to close the window in order for the parameter changes to be remembered.

If you do not like the changes that you have made and wish to revert the material to its previous state, click on the **Undo** button. This function is for the active material only. You can restore other materials by using the **Undo** menu function.

Click on the **Refresh** button to reshade the objects in the editor window (an automatic refresh would take up too much CPU time).

The Material Editor window is divided into up to five panes. The material display is at the top-left.

There are also 13 parameter pages. The settings on the parameter pages combine to form an overall material property. The entire settings for a parameter page can be activated or deactivated using the corresponding checkmark below the material preview. Do not be daunted by the sheer number of settings! Each parameter page operates in a similar way and the control elements are located in the same place. To access a parameter page, click on the parameter name that you require, e.g. **Diffusion**.

Property	What it controls
Color	Surface color
Diffusion	Irregularities in surface color (works by lightening and darkening the color channel)
Luminance	Luminescent color (light-independent color)
Transparency	Transparency (including refraction index)
Reflection	Ability to reflect other objects
Environment	Environment reflection (simulates reflection)
Fog	Fog effect
Bump	Virtual bumps on a surface
Alpha	Localized texture invisibility
Specular	Highlight
Specular Color	Highlight color
Glow	Halo around an object
Displacement	Authentic bumps on a surface

The Color pane

Most parameter pages have a color that you can adjust. Depending on your General Settings (see Color System, page 45), you will adjust the color using either a color table or sliders. The meaning of each slider also depends on the General Settings. You can use either the HSV color system or the RGB color system and you can choose whether the units should run from 0-100%, 0-255 bits, or 0-65535 bits.

Use the **Brightness** slider, which is below the three color sliders (**R** red, **G** green, **B** blue or **H** hue, **S** saturation, **V** value), to adjust the overall brightness of the color. Note that if you are using the HSV system, the **Brightness** slider has the same effect as the **V** slider (i.e. you do not have to use the **Brightness** slider; you can leave it at 100%).

The resultant color is shown just to the left of the sliders. Click on this color field if you want to open the color dialog for your system.

Earlier we said you can change the color system by using the General Settings. You can also change the color system by clicking on the small, right-facing triangle just below the color field. A popup menu will open for you to select your color system. The Material Editor will use the new system (or color table) for as long as it is open. The moment you close the Material Editor, it will revert to the color system that is selected in the General Settings.

The Texture pane

Use the texture pane to select a two-dimensional picture, a 2D shader or a movie (QuickTime, AVI or a frame sequence). Your selection will be used as a texture. CINEMA 4D recognizes these formats: JPEG, IFF (ILBM), TIFF, TGA, BMP, PICT, Photoshop PSD, MOV and AVI. All formats supported by QuickTime are also recognized, provided that QuickTime is installed on your system.

Note

Avoid using numbers in picture filenames such as 'leaf01', 'leaf02'. This is because CINEMA 4D tries to interpret files numbered in this way as a frame sequence. Unless you really are working with a frame sequence, use more descriptive names rather than numbers (e.g. 'leaf_maple', 'leaf_oak').

Once you have selected a texture, its preview will appear to the right with three numbers immediately below. These numbers tell you the width, height and color depth of the texture. You can copy a color from the preview to the color pane by clicking within the texture preview; this acts like a color picker.

Image

Use the **Image** button to load a texture into the texture pane. Use the system dialog to load an image file from either your scene's folder, your scene's 'Tex' sub-folder, or a texture path that you have specified in the General Settings (see page 51). A dialog will warn you if the image file is not in a search path and you will be asked if you wish to copy the image to the document's folder or, if your scene does not have its own folder yet, to the CINEMA 4D root folder.

Once you have loaded a texture, its path name appears in the input line. To the right you can see the texture's preview picture.

Note

CINEMA 4D searches for textures in the 'CINEMA 4D/Tex' folder, the scene's folder, the scene's 'Tex' sub-folder, the texture paths specified in the General Settings (including sub-folders).

If CINEMA 4D cannot find a texture when rendering, a message will appear to tell you which textures are missing and which materials use these textures. You can still render the scene (just click on OK); the materials concerned will still be used without the missing textures.

You can load a 2D shader into the texture pane by clicking on the small, right-facing triangle to the right of the image button. Select your shader from the popup menu.

You can also use the small, right-facing triangle to reload the image. This is useful if you have changed the texture in an imaging program and the preview is now out of date. Reload the image by selecting the top entry, **Reload Image**.

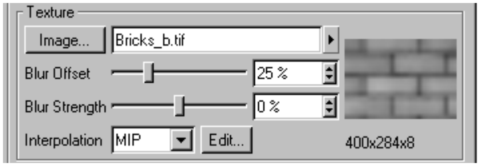
Note

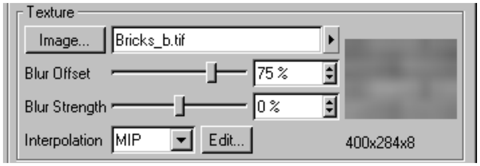
You cannot reload a texture while it is in use (e.g. during rendering).

Blur Offset / Blur Strength

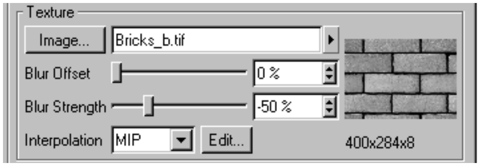
MIP and SAT mapping only approximate the optimum computation, since a precise computation would increase the render time greatly. SAT mapping is more accurate than MIP mapping. But sometimes these approximations can make a texture too blurred or too sharp. Hence the usefulness of these options.

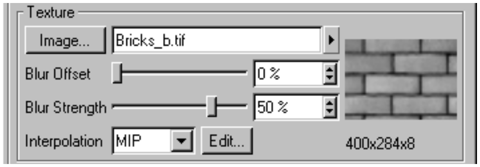
Blur Offset softens a texture. The illustration below shows how you can use this setting to blur a texture.





Use **Blur Strength** to fine-tune the strength of the MIP/SAT mapping. A positive value increases the blur; a negative value weakens it. A strong value blurs detail but helps prevent flickering with animation. A weaker blur strength brings out more detail but the animation is more likely to flicker.





Note

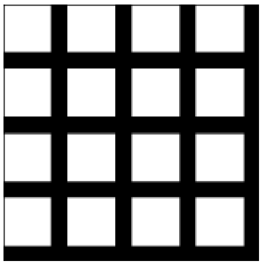
With floors, try a positive blur strength of about +20%. Floors tend to suffer most from perspective distortion, so they require special treatment.

Interpolation

Use **Interpolation** to change the method by which a texture's pixels are interpolated.

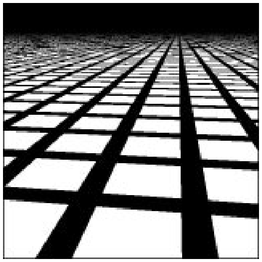
There are many ways to guess, and so there are several interpolation types. Each type is explained below using an example picture. In particular, we pay special attention to MIP and SAT mapping.

The texture we used was a mere 16x16 pixels in size and was placed on to a floor object.



None

When the interpolation type is set to **None**, the original texture values are used without any interpolation. This method is very fast but often gives poor results. Textures tend to become pixelated.

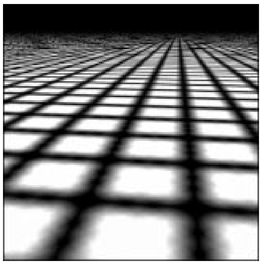


You can try to compensate for the pixelation by using a high antialiasing setting, but then the texture may flicker wildly the moment you animate.

Generally, avoid using this interpolation type unless you are sure of what you are doing.

Circle

Circle interpolation uses a circle of texture pixels (those that surround the intermediate value). Textures that are enlarged at render time tend to look more natural than with the **None** interpolation type. However, as the picture below demonstrates, straight lines are a problem.

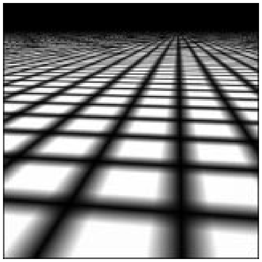


The lines seem to be frayed at the edges. The texture also appears very jagged near the horizon, which would cause flickering when animated.

Circle interpolation is, however, well suited to very small textures (e.g. 3x3 pixels), since it helps the pixels to blend softly.

Square

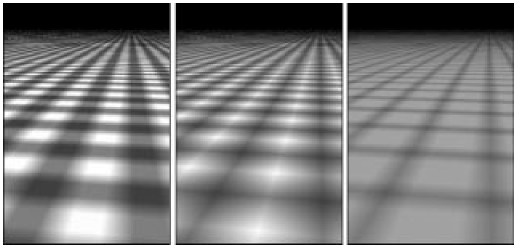
Square interpolation uses a square of texture pixels (those that surround the intermediate value). This leads to a softer transition between texture pixels than with the **None** interpolation type.



The picture quality is good, although textures may be flicker-prone when you animate (especially floor textures).

Alias 1, Alias 2, Alias 3

Alias 1, **Alias 2** and **Alias 3** interpolation blend the texture more strongly than with **Circle** and **Square** interpolation. **Alias 3** blends the most, **Alias 1** the least.

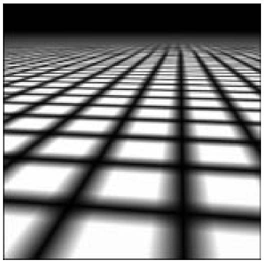


In the picture above, the texture is difficult to recognize with **Alias 3** because it is so small (16x16). **Alias 3** can give smoother results than **Alias 1**, but it also takes longer to calculate.

Even **Alias 3** cannot prevent flickering near the horizon.

MIP

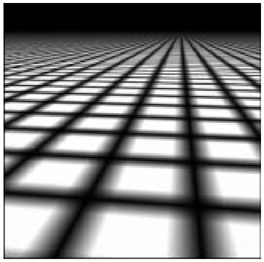
MIP stands for *multum in parvo*, which is Latin for many things in a small place. When many texture pixels effectively lie within a single screen pixel, an approximation is made based on the (known) texture pixel values.



This results in very smooth blending and flicker-free animation. **MIP** is the default mapping type.

SAT

SAT stands for *summed area tables* and it does an even better approximation than MIP mapping. As with MIP mapping, the approximation is based on the texture pixels that lie within a single screen pixel.



SAT is the highest-quality interpolation type and it almost guarantees flicker-free animation, even near the horizon.

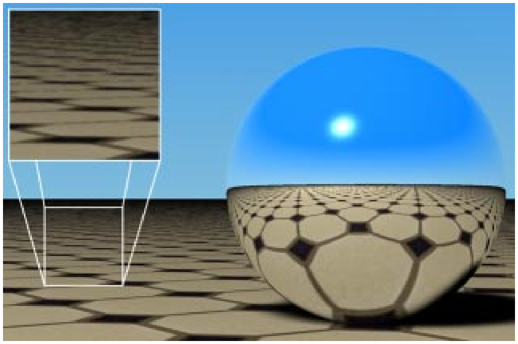
Note

SAT mapping works with textures up to 4000x4000 pixels. CINEMA 4D will use MIP mapping automatically if you try to use SAT mapping with larger textures.

MIP/SAT mapping

MIP and SAT mapping are very important for top-quality animation. MIP mapping is the default interpolation type.

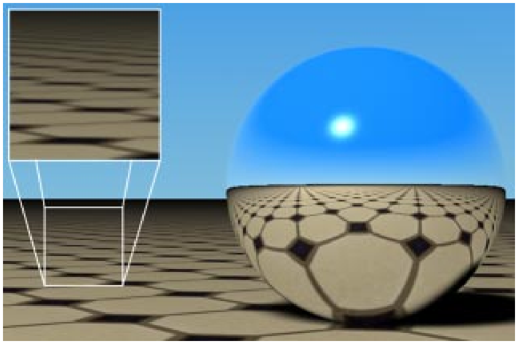
The next two pictures demonstrate MIP/SAT mapping. The top picture was rendered with the antialiasing set to **Always** and oversampling set to **2 x 2**. The tiled texture used **Circle** interpolation. Although the quality is relatively good, you can see how it falls apart near the horizon. This would cause intense flickering when animated.



The texture seems to flicker near the horizon.

This effect is caused by perspective distortion. Each screen pixel representing the floor near the horizon contains perhaps hundreds or even thousands of texture pixels. MIP and SAT mapping approximate a value using these pixels. Only an approximation is made, since calculating the exact value would increase render time greatly.

The lower picture shows **Edge** antialiasing with **2 x 2** oversampling. The material used SAT interpolation. Now even the reflection in the sphere looks great.



No more flickering horizons!

SAT and MIP mapping give you superb render quality. As with most things wonderful, there is a price to pay; MIP and SAT mapping *love* memory.

MIP mapping needs an extra byte of memory per texture pixel. SAT mapping is even greedier, consuming an extra 12 bytes per texture pixel.

So, although SAT mapping gives you higher render quality than MIP mapping, MIP mapping needs far less additional memory. Because of this, MIP mapping is CINEMA 4D's default interpolation type.

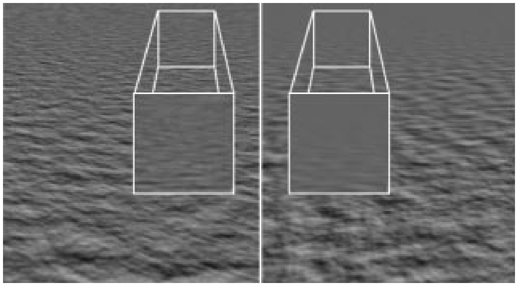
As a rule of thumb, use MIP mapping initially, then switch over to SAT mapping if required.

Interestingly, CINEMA 4D's shaders use SAT mapping automatically without consuming additional memory.

MIP and SAT mapping will affect your render time. On the one hand, MIP and SAT mapping take longer to render. On the other hand, you may be able to reduce the antialiasing setting. Sometimes you can even work with just **Edge** antialiasing. In any case, the superior render quality more than makes up for a slight increase in render time.

MIP Falloff (Bump page)

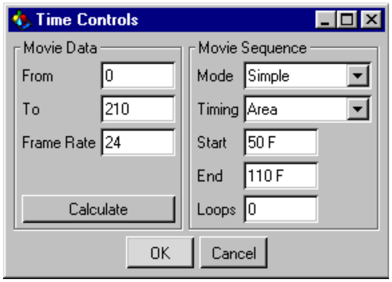
Use MIP Falloff to help enhance the MIP/SAT mapping effect for bump maps. This will reduce the strength of the bump map with increasing distance from the camera.



Edit

If you have loaded a 2D shader into the texture pane, you can access its parameters by clicking on the Edit button.

If instead you have a movie in the texture pane (QuickTime, AVI or a frame sequence), click on the Edit button to access the time control for the movie.



Movie Data

Use this pane to choose which frames you want to use from the original movie. You also need to set the frame rate of the original movie.

If you click on Calculate, CINEMA 4D sets the From and To values for you (from the start of the movie to the end of the movie). However, the Frame Rate will be set to 30 frames per second (FPS) by default. Change the frame rate if your movie does not run at 30 FPS (perhaps the movie is 25 FPS for PAL).

An example

Let's say your movie (QuickTime, AVI or frame sequence) has 600 frames (from 0 to 599) and a frame rate of 15 FPS. To use frames 70 to 119, enter these numbers as the From and To values respectively. To play the movie backwards, set From to 119 and To to 70.

Movie Sequence

You use this pane to tell CINEMA 4D how to play back the animated texture.

Mode sets the general playback mode: Simple will play the movie once from start to finish; Cyclic will play the movie from start to finish repeatedly; Ping-Pong will play the movie from start to finish to start repeatedly. With Cyclic, the texture remains on the last frame of the movie once it has finished playing.

You use Timing to set the timing of the movie. Exact Frame will use one frame of the movie per frame of your animation. No frames will be dropped. If the movie and your animation use a different FPS setting, the movie will play back either more slowly or more quickly than the original. Exact Second matches each second of the movie against each second of your animation, which ensures that the movie will be played back at the same speed as the original. If you select Area, CINEMA 4D will play the movie once over a specified frame range (From and To) of your animation. Use this option if you do not want the texture to start playing immediately.

You can use Loops to repeat the movie from Start to End a finite number of times. If you set Loops to 1, the movie will be repeated once.

Example 1

You want to play a movie (QuickTime, AVI or frame sequence).

1. Select the movie in the Texture pane of the Material Editor.
2. Click on the Edit button to open the Time Controls.
3. Click on Calculate.
4. Close the Time Controls window.

Result: the movie is played back once and is second-synchronized.

Example 2

You want to play a movie from frame 25 to frame 350 of your animation, forwards and backwards (ping-pong) twice.

1. Select the movie in the Texture pane of the Material Editor.
2. Click on the Edit button to open the Time Controls.
3. Click on Calculate.
4. Set Mode to Ping-Pong.
5. Set Timing to Area.
6. Set Start to 25 and End to 350.
7. Set Loops to 1 (with one loop, the movie will be played twice).
8. Close the Time Controls window.

Result: the movie is played forwards and backwards, then backwards and forwards using frame 25 to frame 350 of your animation.

Mix

You use the Mix pane to mix the color and texture panes using one of four mixing modes. The default mixing mode is Normal, apart from the Environment page which uses Multiply as the preset.

Not all pages have a mixing pane.

If you load a texture or a 2D shader, it is placed on a *layer* above the color (i.e. the texture is placed on top of the color) and you can use the Strength slider to set the mixing proportion between the texture and color panes.

The Mixing Modes

Normal

In normal mode, Strength sets the opacity of the texture. If Strength is set to 100%, then you see the texture only (remember, the texture is the top layer, so if it is opaque, you will not see the color underneath). If Strength is set to 70%, the result is 70% of the texture and 30% of the color.

Let's take an example: if a texture pixel of RGB 255/0/0 (red) is used with a color value of RGB 255/255/0 (yellow) with Strength set to 50%, the resultant color is 255/128/0 (orange).

Add

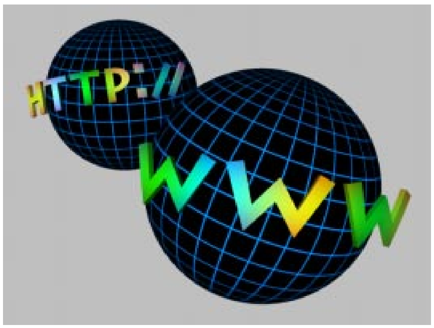
The texture's RGB value is added to the colour's RGB value. Color channel values cannot exceed the maximum of RGB 255. So if a texture pixel of RGB 0/255/255 (cyan) is added to a color value of 255/255/0 (yellow), the result is 255/255/255 (white).

Subtract

The colour's RGB value is subtracted from the texture's RGB value. Thus if a texture pixel is RGB 255/255/255 (white) and the color value is 255/0/0 (red), subtracting with 100% strength gives the result 0/255/255 (cyan).

Multiply

The RGB value of the texture is multiplied by the RGB value of the color. **Multiply** takes as its result the lowest R value, the lowest G value and the lowest B value of the texture and color. For example RGB 255/128/0 (orange) multiplied by RGB 0/255/0 (green) results in RGB 0/128/0 (dark green).

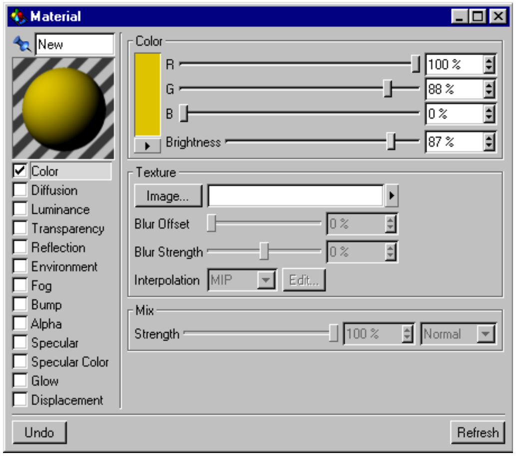


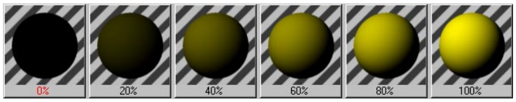
By layering textures over colors you can create some spectacular materials

The Material Editor Pages

Color

You use the Color page to set the basic color of the material, e.g. RGB 255/0/0 (red).





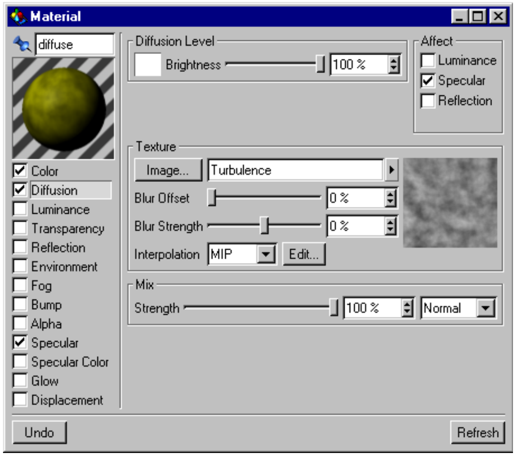
If you want to create a more complicated material (such as a chequered pattern using several colors), use the Texture pane. The texture is layered above the color. If you want to see the color only and not the texture, set the **Strength** slider in the Mix pane to 0%.

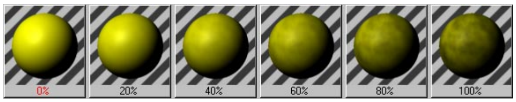
Note

If you set the Strength slider to 0%, the texture is not loaded into memory since no calculation is required.

Diffusion

The Diffusion page lets you darken and lighten the material in specific areas using a *diffusion map*. One reason why you might want to use a diffusion map is to add dust or dirt to the material, helping you achieve a more natural look. The diffusion property is a must for photorealistic results.



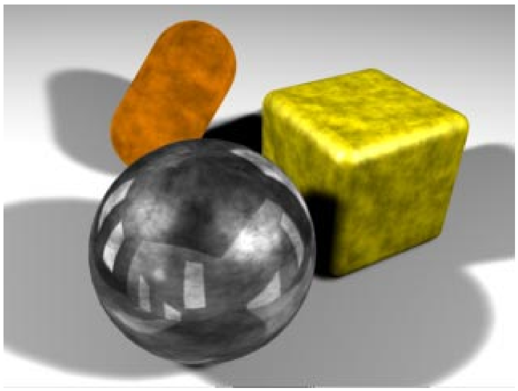


You use either a conventional texture or a 2D shader as the diffusion map. (If the texture is colored, it will still be treated as a greyscale map.) The darker a pixel in the diffusion map, the darker the corresponding region of the material.

You select the **Luminance** option if you want to use a diffusion map with the luminance property. The darker a pixel in the diffusion map, the darker the corresponding region of the luminance. This helps you add irregularities to the luminance to achieve a more natural look.

The **Specular** option applies the diffusion map to the specular property as well. This will reduce the material's specular values where the diffusion map is dark. This option is selected by default, since it enhances the realism considerably.

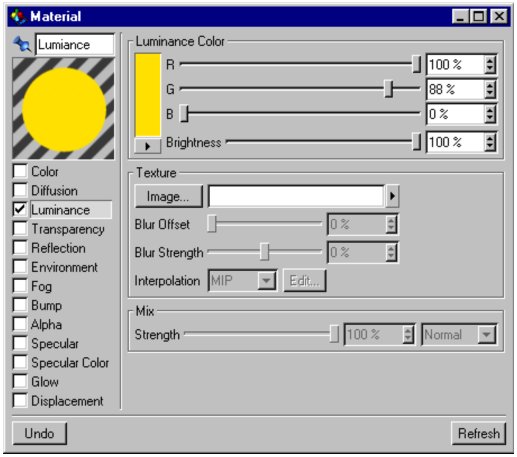
Select **Reflection** if you want to apply the diffusion map to the reflection and environment properties for an even more natural look. The darker a pixel in the diffusion map, the darker the corresponding region of the reflection.

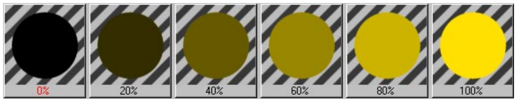


Luminance

A luminescent object can be seen even when there are no lights in the scene. It is self-illuminated.

You can use the **Image** button to load an image that is to act as a *luminance map*. The brighter a pixel in the luminance map, the more luminescent the corresponding region of the material.





If you have chosen a Luminance Color and loaded a texture (luminance map) as well, the color will be added at 100% strength to the texture. If you want to see the result without the chosen color you can set the **Mix** slider to 0%.

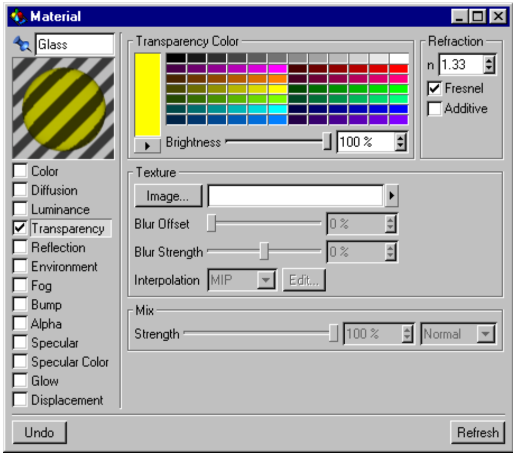
Luminescent materials are used to help simulate objects that seem to be self-illuminated in the real world, e.g. the windows of an office block late at night, or neon writing.

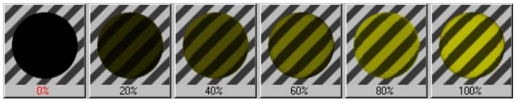
Note

The Luminance property does not emit light, i.e. an object with a luminescent material will not cast light on to other objects. If you want to simulate the light cast by luminescent objects, use light sources.

Transparency

You use this page to make a material transparent or semi-transparent.





If your material also has a color, the color is automatically reduced with increasing transparency.

The equation is: *color percentage + transparency percentage = 100%*.

So a white material with 0% transparency is white (100%). A white material with 50% transparency is 50% white (grey). A white material with 100% transparency has no color.

If you select the **Additive** option, the color strength is not reduced automatically and unless you take care the material will look unnatural.

Transparency is similar to a light filter; black lets no light through, white lets all light pass.

You can use a texture as a *transparency map*. The brighter a pixel in the transparency map, the more transparent the corresponding region of the material.

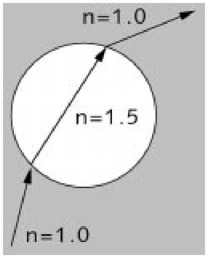
To control the transparency via the Transparency Color only, set the **Strength** slider in the **Mix** pane to 0%.

A transparency texture is similar to a photographic slide. Red parts of the slide allow only red light to pass through; white parts allow all the light through. With black, no light can pass through the slide.

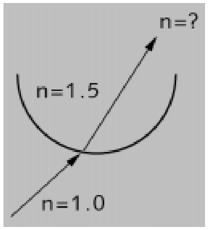
You can use a transparent material with a light source to create a *light map*. If a transparent texture is assigned to a light source, the light will be filtered according to the texture's coloration, just like a real slide. You can use this effect to simulate disco lights, light cast from a monitor and so on.

You can also simulate the refractive index of a material by setting the **n** value on the Refraction pane. There is, of course, no point setting the refractive index unless the material is transparent or semi-transparent.

Objects that are not closed (such as a hemisphere without a cap) can give unexpected results with refraction:

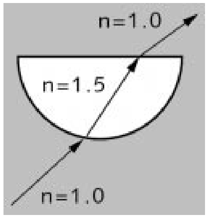


When a ray hits a surface with transparency and refraction, the ray is bent to simulate refraction. The bent ray is considered to be inside the object. When the ray reaches another surface of the object (the exit side), it is bent back as in real life. If, however, you are using an open object, the ray may not hit a second surface of the object.



The raytracer will think that the ray is still inside the object (e.g. the open hemisphere), because it never meets an exit surface (which would bend the ray back as in real life).

Avoid using open surfaces with refraction, otherwise you may get unexpected refraction results. In the example, you could effectively close the open hemisphere with a second wall or a cap; the important thing is to make sure there is an exit surface, otherwise the poor ray still thinks it is inside the object.



If you activate the **Fresnel** option, the viewing angle (i.e. the angle between the camera and the surface) will affect the transparency and reflection values. If in real life you look at a pane of glass with your eyes parallel to the pane (i.e. with a 90 degree viewing angle), you will notice that the pane barely reflects; almost all light passes through. However, look at the pane from a narrow viewing angle and you should see that it reflects much more of its surroundings. The transparency and reflection values are dependent on the viewing angle. The **Fresnel** option simulates this phenomenon for you.

For example, if you have transparency with RGB values 80%, 80%, 80%, the material is 80% transparent and 0% reflective with a viewing angle of 90 degrees. With a very low viewing angle, the material is approximately 0% transparent and 80% reflective.

If you have entered a reflection value in addition to transparency, the reflection value is added to the angle-dependent reflection.

If **Fresnel** is not selected, the transparency and reflection values are used as they are, irrespective of the viewing angle.

Note

If there are a large number of overlapping transparent objects in your scene, you may notice that some of the overlapping areas are black when rendered instead of transparent. In this case you need to increase the Ray Depth value on the Options tab of the Render Settings (see page 426).

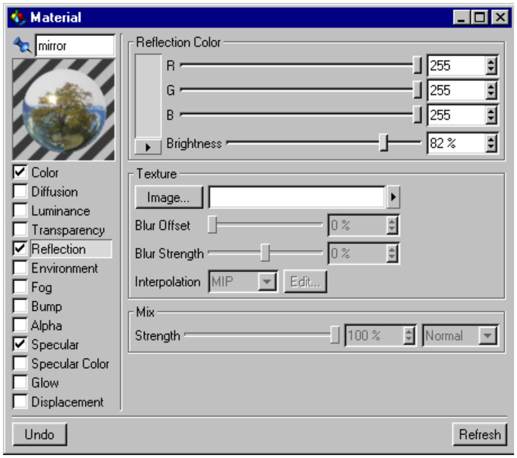
You may also encounter problems with the **Threshold** default value of 15% (see page 426). Try lowering the **Threshold** value to 0%.

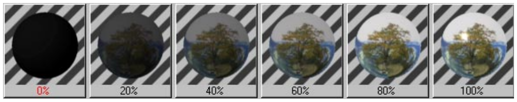
Some useful refraction values

Material	Refractive Index
Vacuum	1.000
Air	1.000
Ice (H_2O)	1.310
Water	1.333
Glass	1.440 – 1.900
Obsidian	1.480 – 1.510
Onyx	1.486 – 1.658
Acrylic glass	1.491
Benzene	1.501
Crown glass	1.510
Jasper	1.540
Agate	1.544 – 1.553
Amethyst	1.544 – 1.553
Common salt	1.544
Amber	1.550
Quartz	1.550
Sugar	1.560
Emerald	1.576 – 1.582
Flint glass	1.613
Topaz	1.620 – 1.627
Jade	1.660 – 1.680
Sapphire	1.760
Ruby	1.760 – 1.770
Diamond	2.417 – 2.419

Reflection

You use the Reflection page to set a material's ability to reflect. The color that you set determines the color of the reflection.





You can use a greyscale texture as a reflectivity map. The brighter a pixel in the reflectivity map, the more reflective the corresponding area of the material.

You can also use a coloured texture in the texture pane. The color of a pixel will affect the color that is reflected from the corresponding area of the material.

To control the transparency via the Reflection Color only, set the **Strength** slider in the **Mix** pane to 0%.

The picture above shows some reflectivity effects including a reflectivity map. The flask has a simple reflective material. Note how the reflection of the rod is distorted as you would expect in real life.

Look closely and you will see that the flask itself is reflected on the tiles.

Look even more closely and you should see that the flask is reflected on the tiles but not on the joints, even though the tiles and joints are part of the same tiled material.

This effect was created by using a greyscale reflectivity map. The reflectivity map was based on the original tile and joint texture. In the areas covered by a tile the reflectivity map is white. In the joint areas the reflectivity map is black. The resultant map means that only the tiled areas, not the joints, are reflective.

This is just one example of how you can combine several properties to create more realistic materials.

Note

If there are lots of reflective objects in your scene, you may notice that with some of them shadows do not appear in the reflections. To make the shadows appear, increase the Shadow Depth value on the Options tab of the Render Settings (see page 426).

Similarly, you may notice that subtle reflections are missing. In this case set the **Threshold** value in the Render Settings to 0 (see page 426).

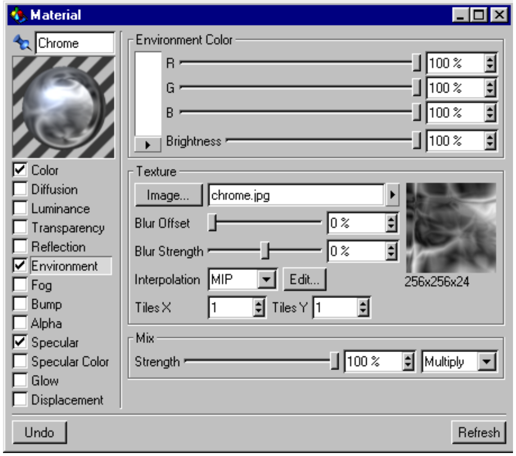
Environment

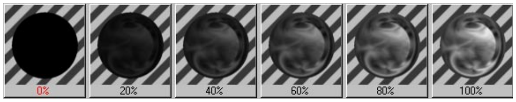
The Environment page uses a texture to simulate reflection. Here, in contrast to the other pages, the Color and Texture are *multiplied* in the Mix pane (i.e. not added).

Why would you want to use the environment property instead of reflection? One reason is that your scene may not have enough objects in it to produce good results with reflection. Another reason is that the environment property renders more quickly than the relatively sluggish reflection property.

However, the reflection property has a very important advantage: it can simulate the object reflecting itself. Just how important self-reflection is depends on the object.

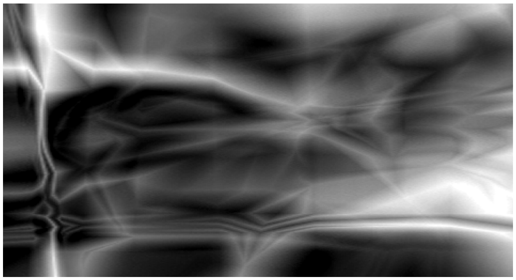
Imagine the handle of a brass carriage clock. The clock looks odd if the handle is not reflected on the top lid. With a metal ball-bearing, on the other hand, there is no self-reflection in real-life, so environmental reflections are fine.





In practice, sometimes you will use an environment map and reflection in the same material to get the best of both worlds (self-reflection and good reflection despite a lack of other objects to reflect).

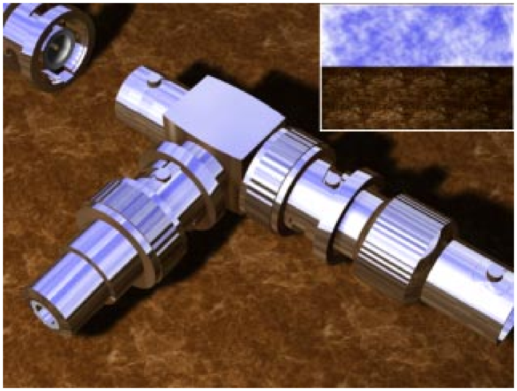
Environment reflections are very useful for simulating metal surfaces, which typically have soft transitions from black to white.



The environment property is independent of the projection type of the material. The environment is always placed spherically around the object, parallel to the world axis. Use **Tiles** to set the number of tiles in the X and Y directions. Note that these tile settings are used instead of the tile options in the texture geometry (see page 526). The latter settings are ignored for the Environment property.

Note

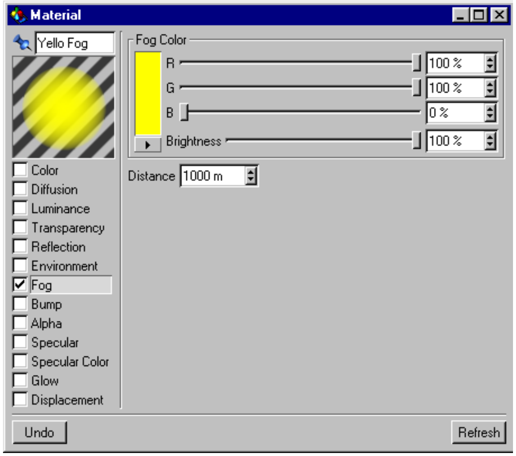
Environment reflections are rendered very quickly, since the raytracing mode is not required.

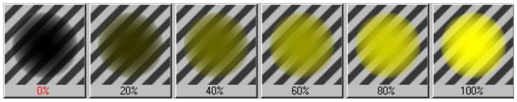


The reflections on the BNC connectors were simulated using the environment property only

Fog

With these parameters you can simulate fog or gas clouds. Objects with such materials are translucent but weaken the light that shines through them, depending upon their density.





If a light ray penetrates into the fog, it is weakened. You can control this weakening with **Distance**. The larger this value, the thinner the fog. **Distance** indicates at which distance a light ray is completely weakened.

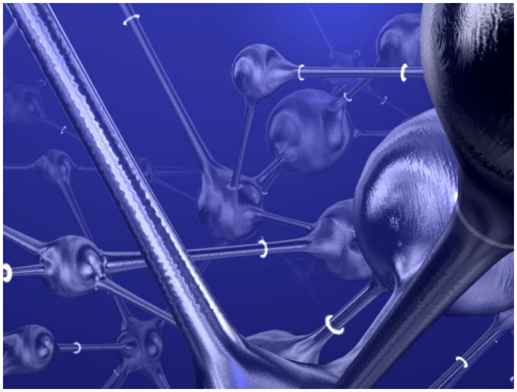
You can also color the fog and this also affects its visibility. The further you look into the fog, the less the objects are visible and the more the fog color becomes visible.

The fog color therefore also depends on the distance value. If you choose, say, a **Distance** of 500 units, a light ray of originally 100% intensity has an intensity of 50% after a distance of 250 units while after a further 250 units it is extinguished completely.

The shorter the distance, the thicker appears the fog. In addition to this effect, after 250 units half the fog color is added to the light and after 500 units the full fog color is added.

You can use fog objects for the simulation of smoke and vapor in mountain valleys or for clouds, among many other things.

Fog objects should be always closed volume objects. Non-closed objects can lead to physically incorrect results since a light ray, having once entered the object never again emerges from the object. The raytracer then assumes that the light ray is still lost in the fog.



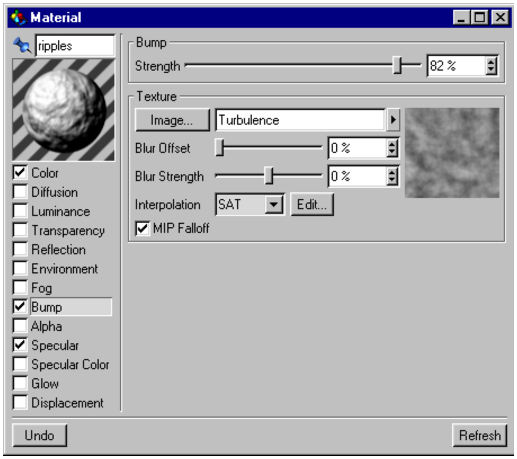
In the illustration above the scene was placed into a square filled with fog. Because of this it is still possible to see any existing background picture. If you use the Environment Object instead, you will not see the background picture.

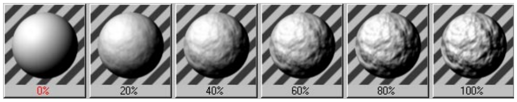
Note

Fog uses the refractive index defined in Transparency and deactivates the transparency. Fog and transparency are thus never rendered together, you can render either fog or transparency.

Bump

Activate this option to produce a bump map, or relief map, for your material.





When you select Bump you must always choose a texture since it is only from the greyscales in such an image that a bump map (a height or relief map) can be calculated.

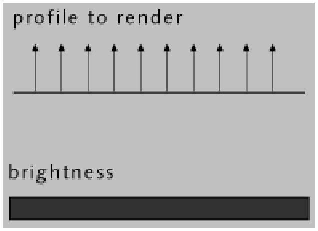
You can change the strength of the bump map with the **Strength** slider. This value controls how far the normal vectors of the object to which the material is applied change when the bump is calculated at render time. The higher the value, the rougher the surface.

However, apply large values carefully since a material can look pretty unrealistic with high bump values due to the large jumps in lighting. If you move the slider to the left, you can choose negative values. If the strength is negative, the bump effect is reversed; bright pixels within the map cause the material surface to indent and darken while darker pixels elevate the height of the normals.

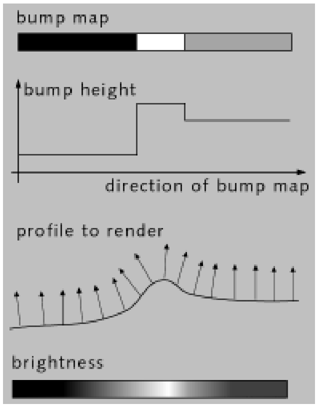
Note

You can type in values over 100% (up to 500%). This can be meaningful and useful if you are using MIP or SAT mapping since, in those cases, the bump map is rendered somewhat flatter than usual.

Here is an even surface, viewed from the side.



Since during the lighting of such an even surface the same normal vector is used, the surface shows a uniform brightness. But if you use a bump texture, CINEMA 4D interprets the brightness values of the picture as height values for the surface, as you can see in the following picture.



These height values are converted into a profile, whose height affects the inclination of the normal vectors. Although the surface is actually smooth, through the change in the normal vectors an apparently three-dimensional surface with a bump-like structure is created at render time; this is shown in the picture below.

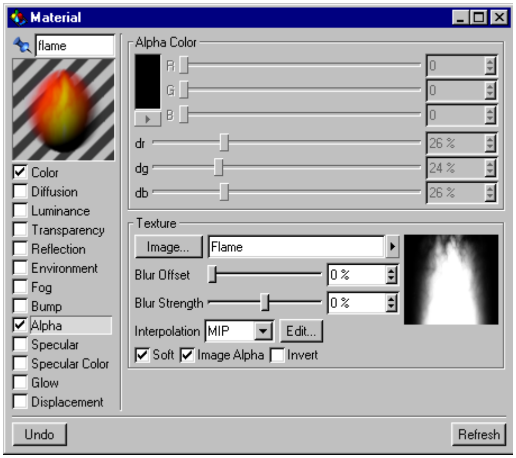
You can strengthen the MIP/SAT mapping effect when using bump mapping by selecting **MIP Falloff**. The bump mapping effect is then reduced more strongly with increasing distance from the camera.

Left without, right with MIP Falloff

Alpha

With the parameters of this page you can punch out particular parts of a texture by selecting an image to apply to the material. There are two ways to do this:

1. Use hard genlocking (so-called *clip mapping*) to punch out particular areas with a color value.
2. Use Alpha channels to punch out areas softly and more accurately.



The idea is to define areas of your material that effectively become non-existent so that any underlying materials show through. The difference between the two modes is that with clip mapping color seams can be visible around the punched out texture. Using alphas this can be avoided. Further, using alphas you can fade textures and materials softly from one to another, which gives you even more ways of creating realistic-looking objects.

If you switch off **Soft**, you can choose the color (using the RGB sliders) that is to be punched out of the material.

Alternatively you can click on the texture preview picture and pick any particular color that exists in the material's color.

By setting values for **dr** (delta red), **dg** (delta green) and **db** (delta blue) you can define extra color deviations; in this way the color seam around the punched out color can be adjusted.

Similarly, alpha/genlocking is often attempted with texture images that are antialiased; this produces a bright border around an object (caused by the antialiasing of colours between the main texture and the alpha color); by adjusting these deviation sliders you can remove this border.

With **Soft** enabled (the default setting) the color and delta sliders lose their meaning. The texture map is now used to decide which ranges should be faded. A white texture pixel within the image means that here the material is to be 100% opaque. If the texture pixel is black the underlying material shines through 100%.

With **Image Alpha** checked you can use any existing alpha channel of the loaded image. The alpha channels of the image formats TIF, TGA, PICT, Photoshop PSD and QuickTime MOV are supported (as well as all QuickTime supported formats). If no alpha channel is present, the option **Image Alpha** will be ignored.

Use the **Invert** function to invert the result of your genlock operation, without having to rework the texture in your image processor (e.g. Photoshop, PaintShop Pro).

Note

Many of the built-in shaders have built-in alpha channels (see Shaders below).

The simple clip mapping does not work with MIP and SAT mapping - only if you work with alpha channels can you use MIP and SAT mapping.

If many alpha materials are present on an object, it can happen that some underlying materials are not calculated at render time or are rendered partly with black areas. If this is the case, increase the **Ray Depth** option in the Render Settings (see page 425).

Likewise, the preset **Threshold** value of 15% (see page 426) can lead to unexpected jumps in the rendering of animations. If that is the case, you can avoid it by reducing the threshold value to 0%.

If clip mapping or alpha mapping affects a part of the surface, then the underlying material becomes visible. If the object does not have an underlying material, the object will be non-existent at this point.

An example

If you want to place, say, a scanned picture of a tree into a scene, you will create a material, activate the **Color** option, choose a picture of a tree as the color texture/image and then assign this material to, perhaps, a rectangle polygon primitive (see page 145).

If you render this scene now, you should see the tree on the rectangle polygon. However the area around the tree is probably not transparent but may well be blue (if the scanned picture has a blue sky background).

The background can still be seen

So now edit your tree material, check the **Alpha** option, switch to the Alpha page and load the tree texture there as well. Now simply use the mouse to choose the color which you want to punch out - in our case the blue sky around the tree.

CINEMA 4D immediately sets the color sliders to this color and punches out according to the picture. You should now see only the tree without surrounding background (yes, in the editor, assuming you have **Gouraud Shading** or **Quick Shading** on). You can now select a slightly different color on the Alpha page, click **Refresh** and see the effect immediately.

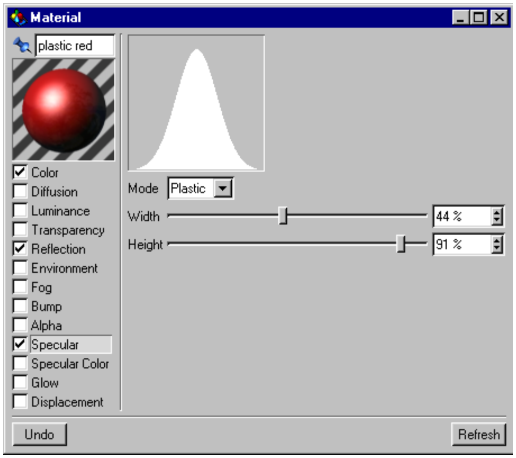
However it may happen that there is still some background left around the leaves, branches and the trunk. So the result is not quite right yet. To obtain a more accurate result, create an alpha channel in your favorite image processor (e.g. Photoshop, PaintShop Pro) and integrate this into your tree image - for details on how to do this consult you image processor manual. Then load that picture into the Alpha page and check **Soft** and **Image Alpha**. Now the texture is punched out cleanly.

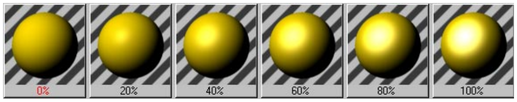
In the illustration below two materials have been used, a reflecting gold and a matt wood. To make the wood visible, one of the two colours was cut out (i.e. genlocked) from a scanned black-and-white graphic.

The section on texture mapping describes the handling of several materials in detail, starting on page 525.

Specular

Here you can adjust the width and height of the specular, or highlight.

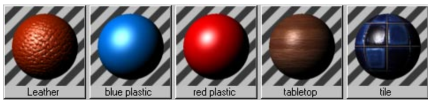




If you want a matt surface you should select broad and low specular values; for polished and shiny surfaces, however, narrower and higher values are appropriate.

You can also choose between two lighting models for the surface:

With **Plastic** the color of the specular is independent of the color of the material i.e. it will normally appear white. This mode is particularly useful for materials such as plastics, glass or wood.



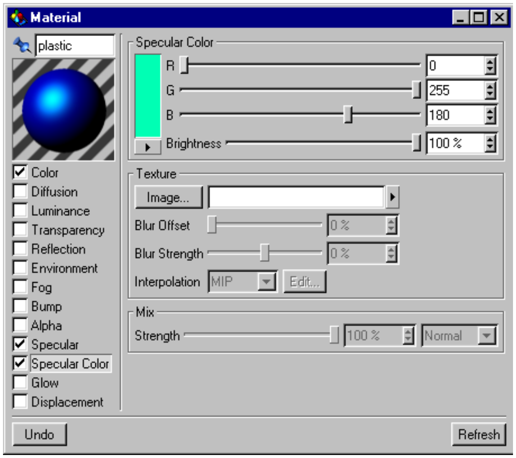
With **Metal** the color of the specular is calculated from the material color. This lighting model is well suited to matt (i.e. not highly reflective) metal surfaces such as silver, brass and gold.

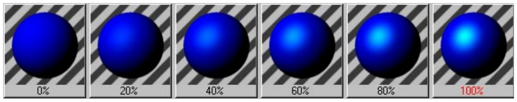
Note

You can enter values over 100% (up to 1000%) for the height of the specular to achieve almost any result you want. To do this you must enter the values, numerically, into the box and not use the slider. High values can be very effective if you are using the Metal mode.

Specular Color

Here you can select the color of the specular. The strengths of the Color page and the Specular Color page are added together.





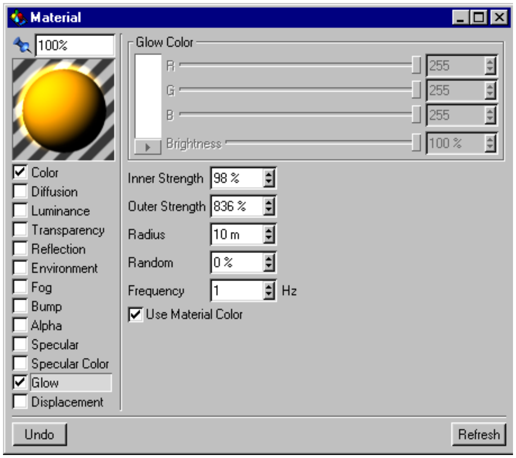
The total color here is multiplied with the normal color of the highlight. If, for example, you have a white plastic highlight, you can define its color here directly.

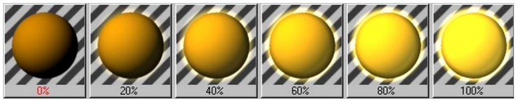
The intensity of the specular is affected by any chosen texture image (color or greyscale). The brighter a pixel in the image, the more evident the highlight is at that point.

We have found that, with metallic effects in particular, any highlight color other than white adds to the realistic appearance of the material. The example above of a spaceship surface shows that quite clearly.

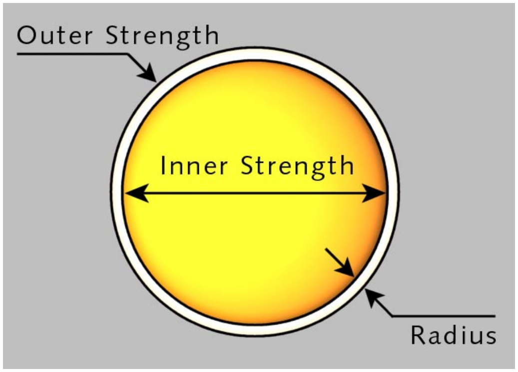
Glow

This property enables you to create a glow, a kind of halo that emanates from the object and surrounds it.





Inner Strength specifies the intensity of the glow above the material surface; Outer Strength is the intensity of the glow on the outside (at the edges).



The Radius determines how far the glow is to extend from the object. This value is rendered relative to the distance of the object from the camera. The further the object is, the smaller the glow and vice versa.

If a random percentage is defined, the intensity of the glow in each animation frame is increased and decreased in a random pattern, as follows:

0%	No change
100%	Maximum change

Frequency specifies how often you wish the glow to change. The amplitude of the change is given by the Random value.

1Hz the glow reaches a new random value after 1 second

25Hz the glow has a new value for each frame (for 30 fps), which causes a flicker

Selecting Use Material Color causes the glow to be calculated on the basis of the material color, rather than from the color specified here.

If this option is turned off, the object color and the glow color will be mixed; green objects, for example, will appear yellowish under a red glow.

Above are two examples of using glow. For the neon advertisement only an outer glow was used. For the charcoal the glowing areas were created with **Use Material Color**.

Notes

The glow you specify here does not act as a light. In other words, other parts of the scene will not be lit by the glow, nor will any shadows be cast.

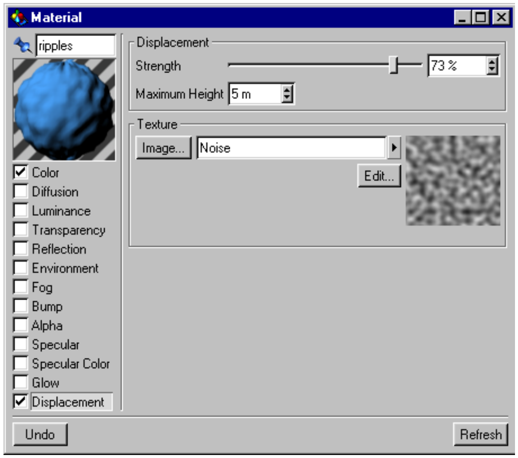
Glows cannot be seen through transparent objects, nor in reflections.

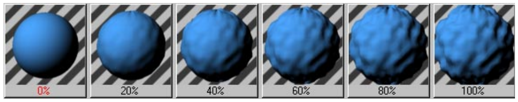
Glows are restricted to a maximum image resolution of 4,000 x 4,000 pixels.

When object motion blur is in use, applying glows to lights may result in an unwanted overlapping of colours.

Displacement

Displacement is similar to Bump, the difference being that here the object is actually (not just apparently) deformed.

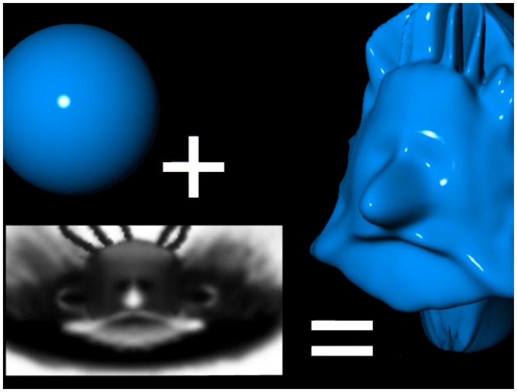




This difference is best seen at the edges of objects. Look carefully at the illustration below.

A bump texture has been applied to the left half of the sphere, a displacement texture to the right. The bump region is characterized by a smooth edge, the displacement region has distinct deformities; as a consequence of the actual deformation, the shadows on the inside of the sphere's surface have changed slightly.

You can adjust the strength of the displacement with the **Strength** slider. Under **Maximum Height** you specify a distance from the object surface, which may not be exceeded whatever the strength setting.



The illustration above illustrates that fairly complex models can be created using relatively simple means.

Experiment with objects that have different subdivisions, although keep in mind that it is easy to go over the top and create an unnecessarily large scene.

Note

It is in the nature of the displacement effect that objects must be finely subdivided for this effect to work (see page 381).

Since the displacement mapping moves the points of an object this material property does not have any effect on parametric objects. Displacement works only with objects that possess points.

The Shaders

Shaders are mathematically computed textures which can be two dimensional or three dimensional. The advantage of shaders is that they are always only as large (detailed) as necessary since they are computed on the fly. That means that you are able to zoom infinitely close to a shader without ever seeing a pixel.

You will find shaders in different places in CINEMA 4D. There are native CINEMA 4D shaders which are built into the program, and there are external shaders that are found within the CINEMA 4D folder in the subfolder 'Extensions/Shader'.

External shaders can be in CINEMA 4D's C.O.F.F.E.E. format (extension '.cof' ASCII or '.cob' binary) or programmed natively in C for a particular platform (extension '.cdl').

All shaders are loaded when you start CINEMA 4D and can be invoked directly from the Material Manager using **File > New 3D Shader** from the menu or from within the Material Editor, directly from the Texture input field. Shaders cannot be invoked by directly typing their name.

2D Channel Shaders

2D shaders are also known as *channel shaders* because they are only ever used for a single material channel in CINEMA 4D lingo, i.e. for a particular material property such as Color or Transparency. These shaders are always flat and are applied to an object using a particular type of projection (see page 528).

2D shaders are loaded in the Material Editor in place of bitmap textures or bitmap movies. To open a 2D shader click on the right-facing triangle, which is to the right of the texture input field in the texture pane. This opens a popup menu from which you can select the appropriate 2D shader.

To edit a 2D shader, click the **Edit** button in the Material Editor. If it is an animated shader it's effect is shown in the preview.

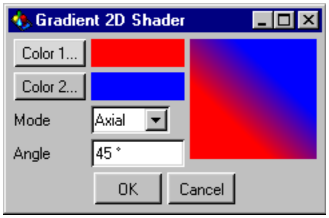
Note

There are three ways of changing the detail (i.e. the frequency) of the shading; adjust the length of the texture axes, change the actual frequency values in the shader dialog, or modify the tiling or texture lengths.

Therew follows a description of each built-in 2D shader, complete with a description of its parameters (accessible through the **Edit** button) and the effects of changing those parameters.

Gradient

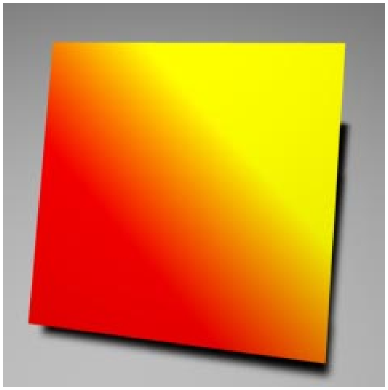
This shader creates a smooth gradient between two colours.



Color 1 and Color 2 specify the start and the end colours for the transition.

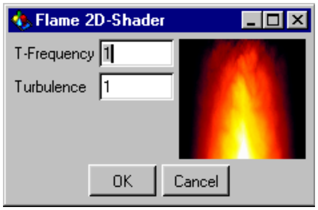
Mode gives the type of the gradient. Axial is color gradient along a line, the orientation of which is defined by Angle (see below). Radial is a radially expanding gradient starting from the center of the texture.

Angle gives the direction of the (axial) color gradient. 0° is the X axis, 90° is the Y axis, etc.



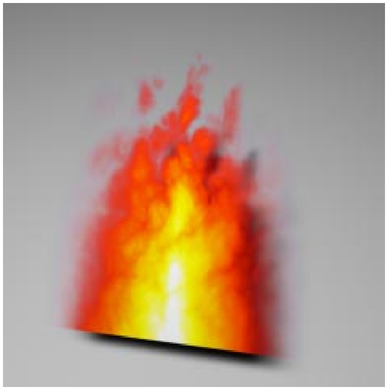
Flame

This shader simulates a single flickering animated flame, such as a candle. The Flame shader has an alpha channel which you can use within the Material Editor on the Alpha page.



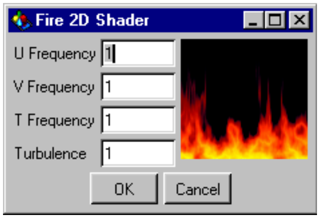
T-Frequency is a scaling factor that affects the speed of flicker, how quickly the flame changes.

Turbulence determines how violently the flame moves around, or breaks up, in a notional wind. A setting of 2 doubles the speed of movement (i.e. the wind); a setting of 0 suppresses all wind.



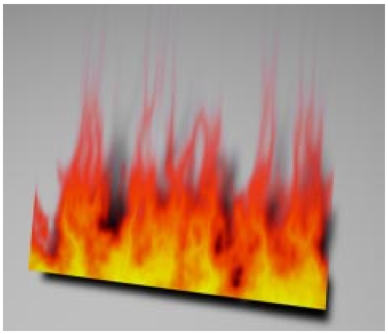
Fire

This shader simulates an animated wall of flame blown by wind. The Fire shader has an alpha channel which you can use in the Material Editor on the Alpha page.



U-Frequency and V-Frequency determine the fineness of the structure. Thus 1/1 results in regular flames, 1/0.25 rather elongated flames. T-Frequency affects the speed of the flicker, how quickly the flames change - the higher the value, the higher the frequency of the flicker.

Turbulence determines how violently the flames move around, or break up, in a notional wind. A setting of 2 doubles the speed of movement (i.e. the wind); a setting of 0 suppresses all wind.

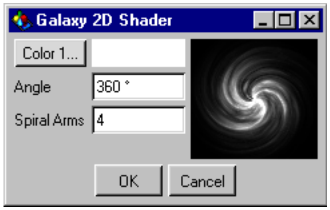


Note

The wall of flames stretches infinitely in the U direction. Good flame materials can be created by using this shader both in the Alpha channel and the Transparency channel (in the Alpha channel, dr/dg/db should be set relatively high, to approx. 30%).

Galaxy

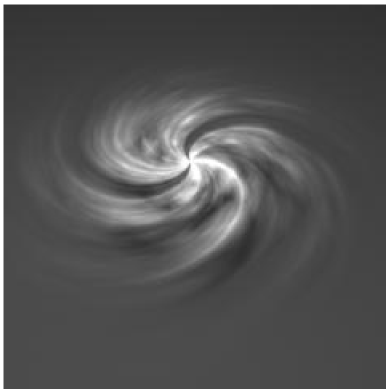
This shader simulates a galaxy with spiral arms. The Galaxy shader has an alpha channel which you can use within the Material Editor on the Alpha page.



Color 1 is the color of the star clouds.

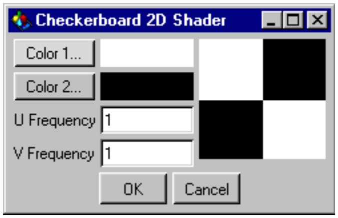
Angle is the degree of rotation of the spiral arms.

Spiral Arms is the approximate number of spiral arms.



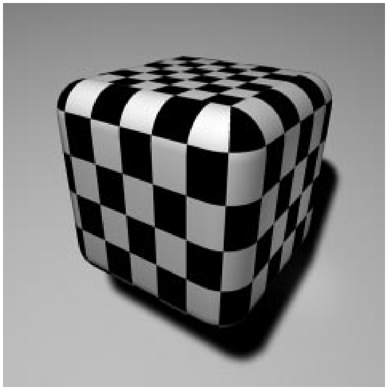
Checkerboard

This shader creates checkerboard patterns.



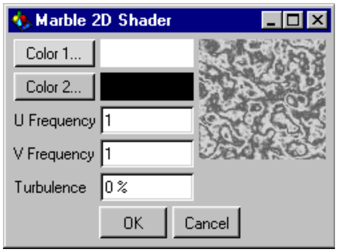
Color 1 and Color 2 determine the colours of the two tiles.

U-Frequency and V-Frequency determine the size of tiling, the fineness of the structure, in two independent directions. Higher values result in a smaller tiles and vice versa. If you use unequal values such as 1/2, instead of square tiles you'll get rectangular ones.



Marble

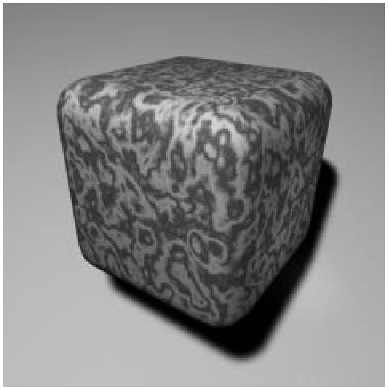
This shader creates marble structures.



Color 1 and Color 2 determine the marble coloring.

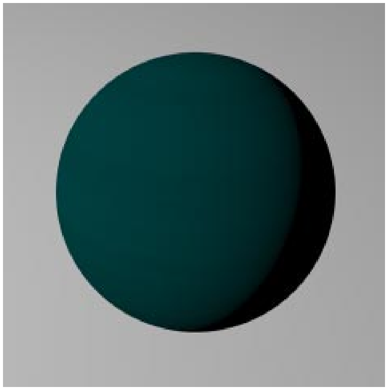
U-Frequency and V-Frequency determine the fineness and shape of the structure. Thus, for example, 1/1 results in a radial-like pattern, 1/0.25 rather elongated shapes. The higher the value, the higher the frequency, or detail, of the pattern.

Turbulence gives a static (this shader is not animated) factor that adds a certain amount of noise to the detail. 0% = no turbulence.



Neptune

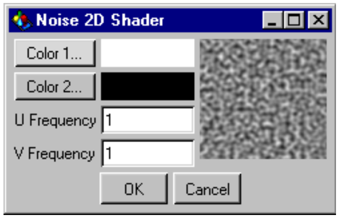
This shader has no dialog. It simulates the planet Neptune with its typical colouring and cloud structure.



Noise

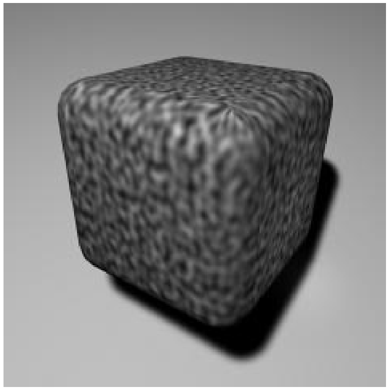
This shader creates a random pattern that can be used, for example, for sun surfaces and stone reliefs.

By overlapping several Noise shaders with different amplitudes and frequencies, you can create masses of interesting patterns (this is like signal synthesis).



Color 1 and **Color 2** determine the start and end colours of the transition.

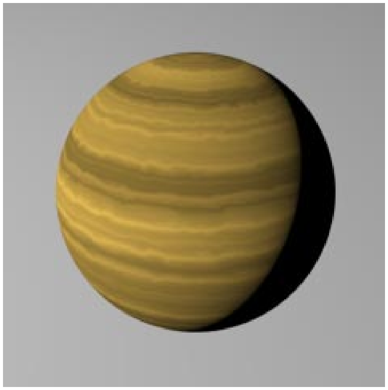
U-Frequency and **V-Frequency** determine the fineness of the structure. Thus, for example, 1/1 results in a radial-like pattern, 1/0.25 rather elongated shapes. The higher the value, the higher the level of detail in that direction.



Saturn

This shader has no dialog. It simulates the planet Saturn with its typical coloring and cloud structure.

The texture is cyclic in the U direction.



Note

Because of its fast rotation speed (a mere 10 hours) Saturn has an elliptical shape. If you want an astronomically accurate representation of the planet, you will need to flatten any sphere to which this shader is applied — in other words its Y axis should be scaled by about 0.85.

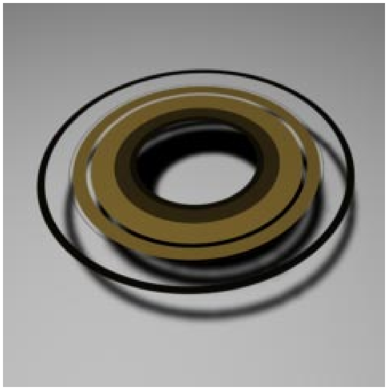
Tip

If you mix the Saturn shader with, say, a brown color (50% shader/50% brown color) you can simulate many rock formations which you can then project on to a Landscape object.

Saturnring

This shader has no dialog. It creates, for use with the Saturn shader, an astronomically correct simulation of the rings around Saturn — the D, C, B, A, F and G rings, with the Cassini and Encke gap.

The Saturnring shader has an alpha channel which you can use within the Material Editor on the Alpha page.



Notes

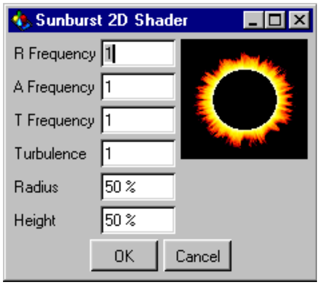
Saturn is approximately one third as wide as the width of the ring structure.

So that stars shine through between the rings, you should activate the alpha channel of any material to which this is applied.

You may want to make the rings quite transparent since in reality these rings are millions and millions of tiny rock and ice particles which allow the light from beyond to shine through.

Sunburst

This shader generates animated sun flares and eruptions. The Sunburst shader has an alpha channel which you can use within the Material Editor on the Alpha page.



R Frequency determines the radial frequency; a value of 0 yields a lovely aurora.

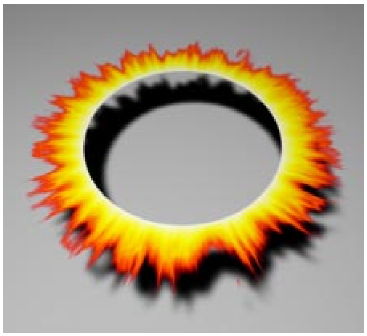
A Frequency gives the angular disturbance; 0 gives individual layers.

T Frequency defines the speed of the sunburst; 2 doubles it, 0 suppresses all movement.

Turbulence changes the appearance of the eruption; the higher the value, the more fragmented this region appears.

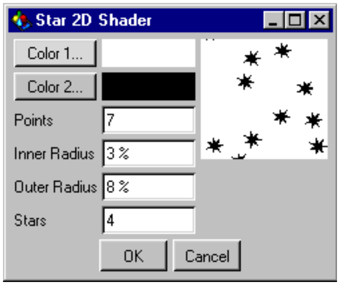
Radius defines where the eruption begins, as a percentage of the overall size.

Height defines the width of the eruption region relative to the radius.



Stars

This shader creates a star-filled wallpaper.



Color 1 is the color of the wallpaper.

Color 2 is the color of the stars.

Points is the number of star tips or points.

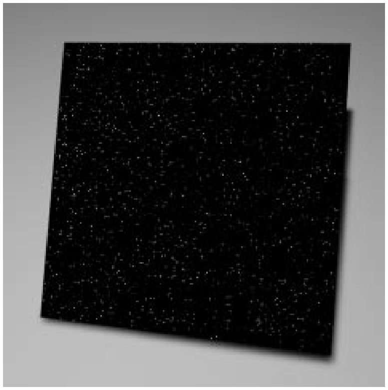
Inner Radius and Outer Radius determine the dimension of each star, given as a percentage of a U/V unit.

Stars is the average number of stars per UV unit.

Although we use the term *U/V unit* above accurately, you may want to think of the preview as an element that is one U/V unit in each direction - this will help you visualize the changes you make.

Starfield

This shader has no dialog and simulates a starry night. The number of stars can be controlled by tiling the texture.



Note

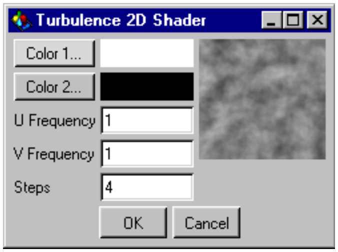
The stars are always computed with a continually varying size. In addition, the brightness of the stars varies. Thus you should have the impression that some stars are closer than others.

Tip

If you project the Starfield shader with spherical projection on to the sky object, you will obtain an accumulation of stars at the North and South Pole of the sky, since the shader is compressed here. You can avoid this if you use cubic projection instead.

Turbulence

This shader creates non-animated, colored, fractal turbulence.

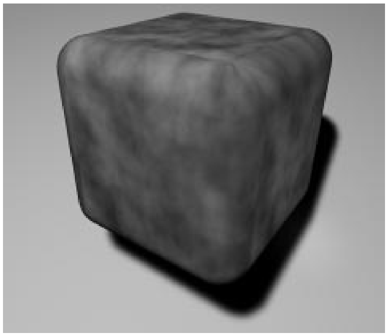


Color 1 and **Color 2** specify the ends of the color transition.

U Frequency and **V Frequency** determine the fineness of the structure. 1/1 creates a radial-like pattern, 1/0.25 elongated shapes. The higher these values, the greater the detail (or frequency) in the relevant direction.

Steps is the number of iteration steps for generating this fractal turbulence.

The more steps you have the more added detail you obtain. With a setting of 1 the Turbulence shader is almost identical to the Noise shader; there is no point in setting this value too high since only a certain amount of detail can be added.

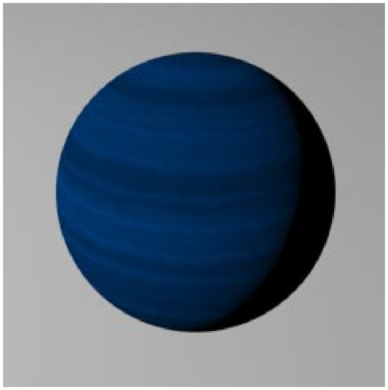


An example of using the Turbulence shader on a cube

Uranus

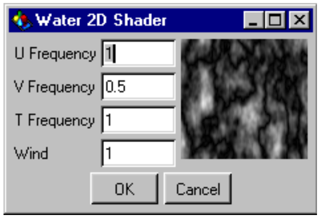
This shader has no dialog.

It simulates the planet Uranus with its typical colouring and cloud structure.



Water

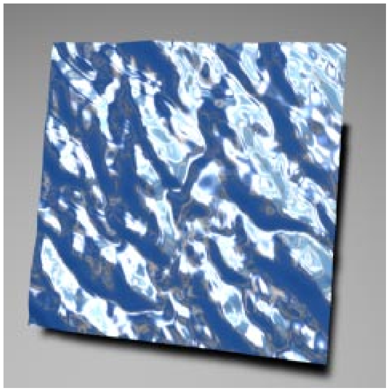
This shader generates animated water surfaces and is ideal for use in a material's Bump channel for simulating water surfaces perturbed by wind. It can simulate slight turbulences (ripples) and more significant ones (waves).



U Frequency and **V Frequency** determine the fineness of the structure. 1/1 creates radial-like wave patterns, 1/0.25 rather elongated wave fronts. The higher the values, the higher the effective wave detail in that direction.

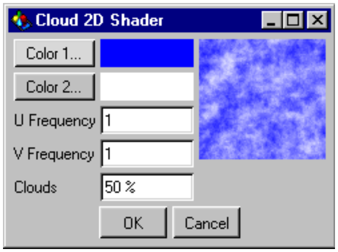
T Frequency is the speed at which the water moves in the U direction (0 means no movement, 2 doubles the speed of movement).

Wind specifies the amplitude of a notional wind that breaks up the water — the higher this value the more the wind disturbs the water surface.



Cloud

This shader simulates simple cloud structures. The Cloud shader has an alpha channel which you can use within the Material Editor on the Alpha page.

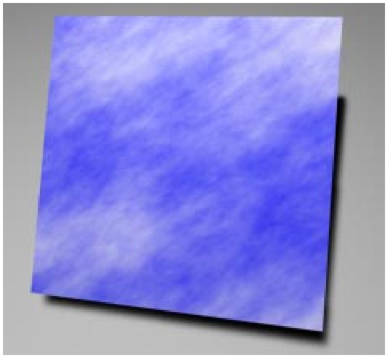


Color 1 determines the color of the sky.

Color 2 determines the color of the clouds.

U Frequency and V Frequency determine the fineness and shape of the structure. Thus 1/1 results in rather regular cloud structures, 1/0.25 rather oblong clouds and the higher the value, the finer (less wispy) the clouds.

Clouds affects the number of clouds in the sky.

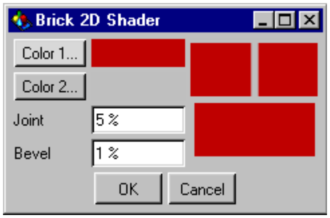


Note

Effective Cirrus-like clouds can be created with asymmetrical UV parameters (e.g. 0.25/1).

Brick

This shader generates complex brick patterns. The Brick shader has an alpha channel which you can use within the Material Editor on the Alpha page.

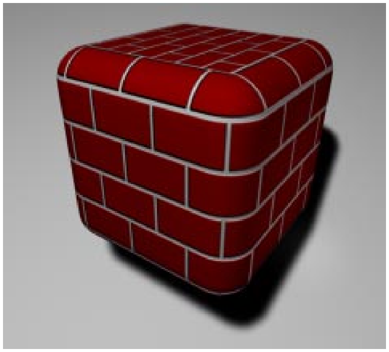


Color 1 determines the color of the brick.

Color 2 determines the color of the joints.

Joint is the width of the joint relative to the size of the brick.

Bevel defines the width of the sloping edge between joint and brick, as a percentage of the brick width; this gives a fuzzy edge to the brick.

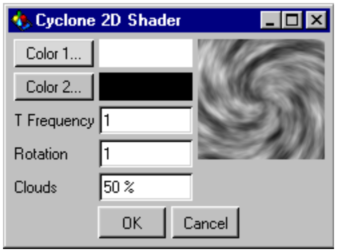


Note

You change the number of bricks using the texture tiling.

Cyclone

This shader simulates an animated cyclone. The Cyclone shader has an alpha channel which you can use within the Material Editor on the Alpha page.

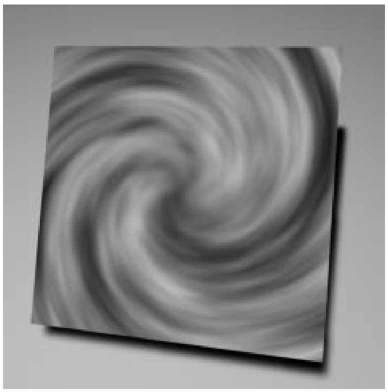


Color 1 and **Color 2** define the start and end colours for the color transition.

T Frequency defines the timing of the cyclone rotation, the strength of the storm.

Rotation determines the effective density of the cyclone, the higher the value the more spirals in the storm.

Clouds affects the number of clouds (**Color 1** areas) in the cyclone.



3D Volume Shaders

3D shaders are also known as *volume shaders* because they penetrate the volume of the object and emerge on its surface. This means that they cannot be used as textures within the Material Editor; instead, a 3D shader directly defines a material - or, in other words, a 3D shader *is* the material.

3D shaders are loaded in the Material Manager in place of materials. To load such a shader go to the menu **File > New 3D Shader** and select a shader from the submenu.

3D shaders are edited, like all materials, by double clicking in the Material Manager on their preview picture.

All volume shaders can be applied to a 3D object very precisely either by changing the values in the relevant Shader dialog or, often more simply, by adjusting the texture axes values (double-click on the texture attribute icon in the Object Manager). By changing the length of the texture axes (in addition to modifying the shader settings) a change of the effect of the shader is possible.

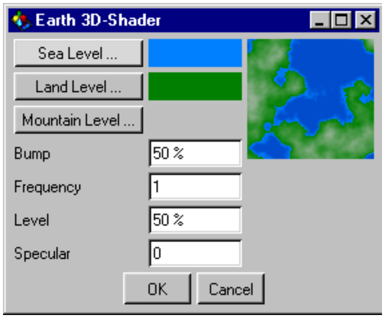
A 3D shader will always adapt to the size of (or *grow* on) the 3D object to which it has been applied. There will be no edges or seams. Since they exist throughout an object's volume, 3D shaders can give much more realistic results when applied to objects that have areas cut out.

Note

3D shaders cannot be combined, unlike normal textures.

Earth

This simulates an Earth-like planet with mountains.



Sea Level determines the color for areas which have a height of less than zero.

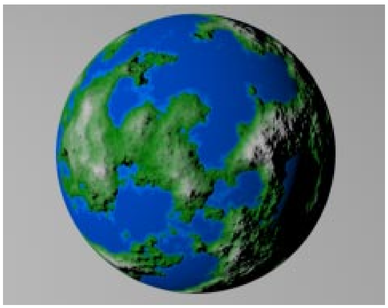
Land Level is the color for middle height terrain.

Mountain Level is the color for high terrain.

Bump gives the degree of bump mapping — 0% means a smooth surface with only patches of color. Note that water is always smooth; only land areas should be covered with a relief.

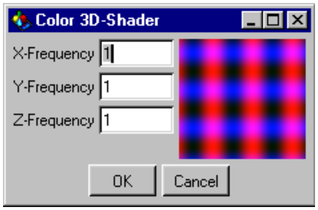
Frequency adjusts the level of land detail. 0% is practically all water; 50% is equal parts of land and water; 100% is practically all land.

Specular is the specular factor, which appears only on water surfaces. 0 is none; 1 is large; 50 is small; 150 is very small

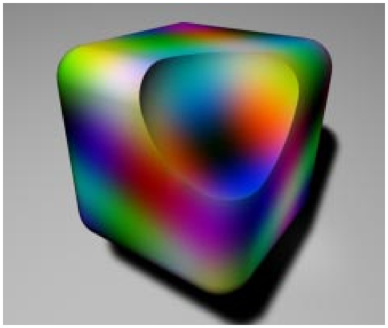


Color

This colourful shader uses sine functions to cycle through the RGB color range.

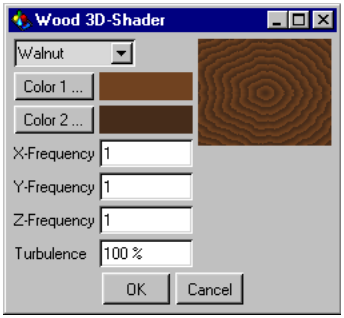


X-Frequency, **Y-Frequency** and **Z-Frequency** specify the behaviour of the colours: e.g. high values mean more detail in that direction, different values for X, Y and Z give asymmetrical behavior.



Wood

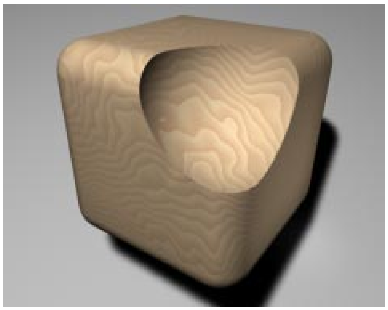
This shader simulates wood patterns. The popup menu at the top allows you to choose some pre-defined wood types (which you can then change) or go for a user-defined wood from the beginning.



Color 1 and **Color 2** change to color of the wood and its grain.

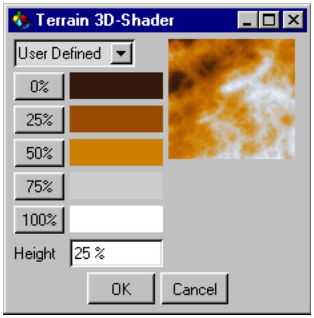
X-Frequency, **Y-Frequency** and **Z-Frequency** affect the look of the wood. X and Y change the frequency of the rings in those directions (high values lead to fine detail) while Z affects the grain — for example, values of X=0.5, Y=1 and Z=1 will produce elliptical rings.

Turbulence determines the degree of growth irregularity (0% = even concentric annual rings, 100% = a more natural, uneven ring appearance).



Terrain

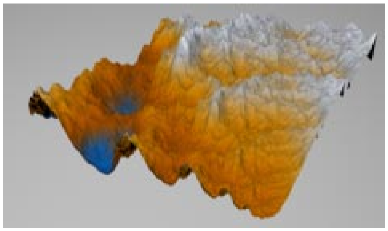
This shader generates virtual, fractal landscapes featuring mountains and valleys. The popup menu at the top allows you to select from a list of predefined types of terrain or to start from scratch with user-defined.



Using the buttons below the popup menu you can assign colors to different heights of terrain. The values are percentages of the fractal height.

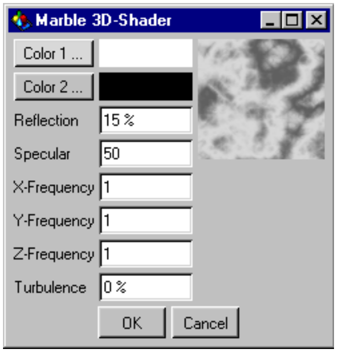
Height defines the vertical dimension of the fractal within a 3D object. With a value of 50 the fractal covers half the object (assuming the texture is adapted by size to the object).

The Terrain shader is not infinitely large. Its maximum size is determined by the size of the texture geometry. If this is smaller than the object on which the shader is used, the shader does not fill the object. If necessary adapt the size of texture geometry to the object.



Marble

This shader generates 3D marble structures.



Color 1 and Color 2 specify the marble coloring.

Reflection is the degree to which the environment is reflected in the marble. To see a weak reflection you will need to activate Reflections in the Render Settings and possibly reduce the Threshold from its default 15%.

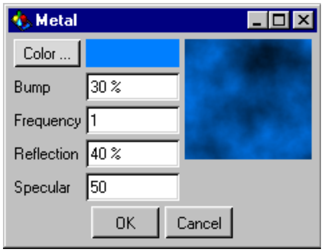
Specular determines the factor for the specularity. 0 is none; 1 is large; 50 is small; 150 is very small, etc.

X-Frequency, Y-Frequency and Z-Frequency determine the detail of the marble in those directions (e.g. double values mean twice as much detail). Use different values for X, Y and Z for asymmetry.

Turbulence changes the overall complexity of the marble.

Metal

This shader simulates metallic surfaces.



Color specifies the color of the metal.

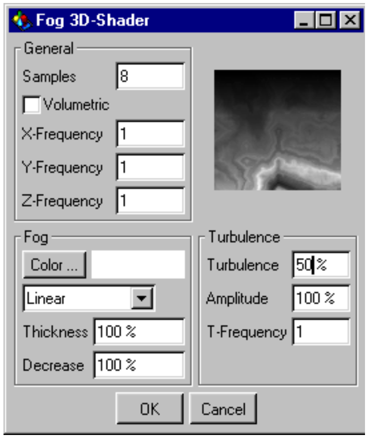
Bump and Frequency define the roughness of the surface. The surface is reflective and optionally takes a metallic specular.

The strength of the reflection is determined by the Reflection setting.

Specular is the strength of the specularity.

Fog

This shader simulates a volumetric, animated fog.



General pane

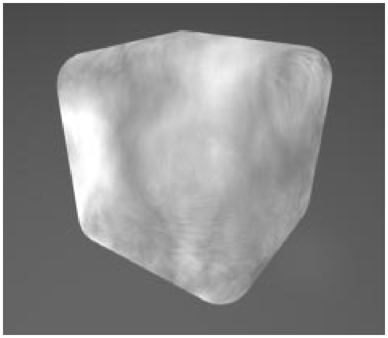
Samples defines the average number of samples that need to be computed per raytracing ray. The higher this number, the greater the quality of the fog but the longer the calculation time.

Tip

Start with low numbers, say 6 or 8. Increase this value only if you get disturbing artifacts or if the detail is not good enough (e.g. in relation to visible shadows in fog). Note that after a certain point (depending on what's in the scene) higher sample values will not produce better images.

Volumetric is the ultimate performance killer. If the option is switched off, the basic color of the fog is all pervading. Light sources have no effect. This is normally sufficient to simulate fog in a fractal valley.

With **Volumetric** switched on, all light sources (including the type of the light source) will be taken into account. If the light sources cast soft shadows and there are objects in the beam, these will cast shadows even in fog.



Caution!

The Volumetric option costs a tremendous amount of computing time.

X-Frequency, **Y-Frequency** and **Z-Frequency** determine the appearance of the fog: double the values to get twice as much detail, use different values for X, Y and Z for asymmetry.

Fog pane

Color is the color of the fog.

The popup allows you to control the fog intensity over distance. Linear decreases the fog intensity along the Y axis of the texture axes. Exponential decreases the fog intensity along the Y axis of the texture axes. None means constant fog density.

Thickness: the lower this value, the thinner the fog.

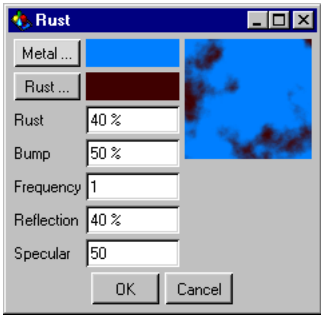
Decrease: the lower this value, the lower the volume (or depth) of fog that is generated.

Turbulence pane

In addition to the above parameters you can also create turbulent fog patches. **Turbulence** specifies the degree of whirl within the fog (0 = no turbulence). **Amplitude** specifies the average size of the rotating turbulence cells (rolling fog). **T-Frequency** controls the speed of the swirling fog (0 = no movement).

Rust

This shader simulates rust on metal surfaces.



You choose the colours for the metal and the rust using the color fields, **Metal...** and **Rust...**.

Rust specifies the percentage of rust on the metal surface.

The rust is initially flat. It can be raised by optionally using the **Bump** (relief) setting.

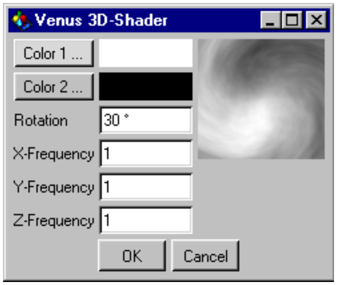
Frequency determines the degree of jaggedness of the rusty areas.

You define the degree of reflection of the clean part of the surface with the **Reflection** setting.

The rust-free areas are reflective and may be enhanced by an optional metallic specular. **Specular** defines the size of this specular.

Venus

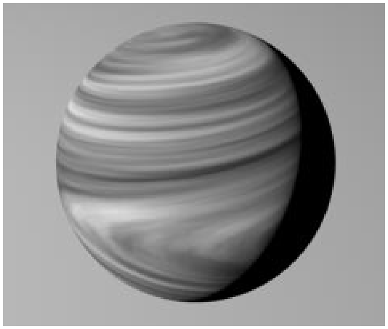
This shader simulates a gaseous planet with cloud structures whirled around by the Coriolis stream.



Color 1 and **Color 2** define the colours of the clouds and the background sky.

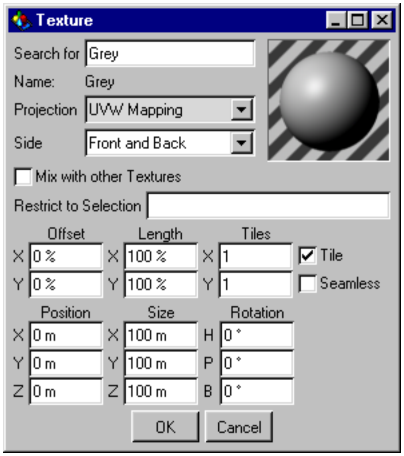
Rotation determines the degree of whirl or turbulence caused by the Coriolis stream.

X-Frequency, **Y-Frequency** and **Z-Frequency** determine the fineness of detail in those directions.



Texture Mapping

Texture geometry



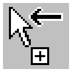
The Texture geometry dialog opens when you allocate a material to an object. The settings in this dialog tell CINEMA 4D how to apply the material. For example, you may want the texture to be tiled (i.e. repeated), or you may want to place the texture in a specific region of the object. You can also have the texture mapped on one side only (decal mapping). In this chapter we will explain all the options in the Texture geometry dialog.

Applying a texture

You can apply a texture to an object in the following way:

- First, make sure that you can see the object in the Object Manager. Then, hold down the left mouse button while you drag the material from the Material Manager and drop it on to the name of the object in the Object Manager. The Texture geometry dialog will open for you to enter details of how to apply the texture. This dialog can be skipped if you hold down the Shift key while dragging the material on to the object.

The mouse pointer will change during this process to indicate the *add* state.



- You do not have to use drag-and-drop, you can also use the following method: first, activate the object in the Object Manager, then activate the material in the Material Manager. Now select **Function > Apply** in the Material Manager. The Texture geometry dialog will open for you to enter details of how to apply the texture. This dialog can be skipped if you hold down the Shift key while dragging the material on to the object. Once this dialog is OK'd (or if the Shift key was held down), the active material will be allocated to the active object.
- You can drop a new material on to an existing texture geometry. The new material will replace the old one but will inherit the existing geometry settings.

If the material does not use texture maps (pure glass, for example) or if it a 3D shader, you will not need to change any settings in the Texture dialog; you can click on **OK** to close the dialog immediately. Such materials do not use the texture geometry settings.

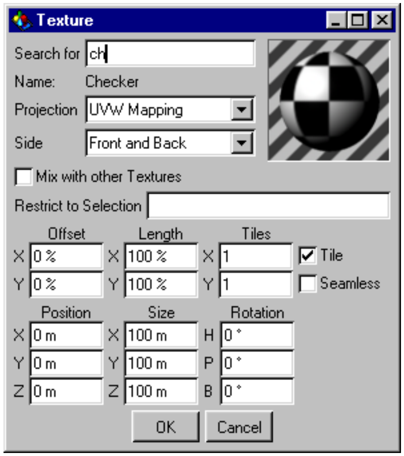
Note

Remember, to prevent the Texture geometry dialog opening hold down the Shift key when you apply the texture. This is particularly useful for 3D shaders or materials that do not use textures, since they do not use the texture geometry settings.

If, on the other hand, your material does use texture maps, you will need to set the Texture geometry dialog to specify the projection type, the position of the texture and so on.

Search For

The first text box contains the name of the material that is being applied. If you type in the name of a different material, CINEMA 4D will use the new material instead of the previous one for this texture geometry. Also, note that you usually need type only the first few letters of the name, since CINEMA 4D will complete the rest of the name for you in the area to the right of **Name**.



Comment

Perhaps you are wondering why you must type in the material name rather than select it from a list. Imagine that you have started a new project and you have loaded your standard material library, which contains 100 woods, 50 marbles, 20 relief textures, 30 backgrounds and so on. You want to add one of the mahogany textures to an object. Up pops the selection window. Okay, it's down here. Down a bit more. Oops, missed it. Back a bit ... Once you have become accustomed to typing in material names (and giving your materials sensible names!), you should find this a much more efficient way to work.

Offset, Length, Tiles

These settings are to be found towards the middle of the dialog. **Offset** and **Length** set the position and size of the texture respectively on the texture geometry. You can also change these values interactively in the editor with the Texture tool active (see page 307).

Offset defines the position of the texture on the *texture envelope* (the texture geometry). You can use **Length** to increase or decrease the size of the texture on the texture envelope. The **Offset X** and **Offset Y** values are given as percentages, since the actual size is irrelevant. 100% for both means that the texture covers the envelope completely.

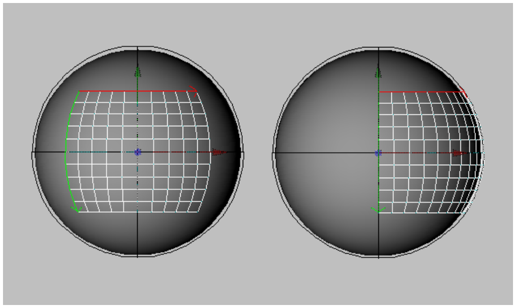
The **Tiles X** and **Tiles Y** values define how many times the texture fits on to the texture envelope in the X and Y directions. Hold on a moment, isn't that the same as changing the length? Yes, exactly. You can change the length either in terms of tiles (**Tiles**) or as a percentage of the texture envelope (**Length**). Either way, changing one will cause the other to change too.

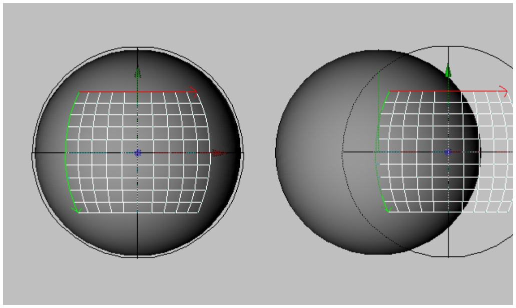
Using the **Tiles X** and **Tiles Y** settings does not mean that the texture will be repeated (tiled) automatically. This only happens if you activate the **Tile** option (which we will return to later).

Position, Size, Rotation

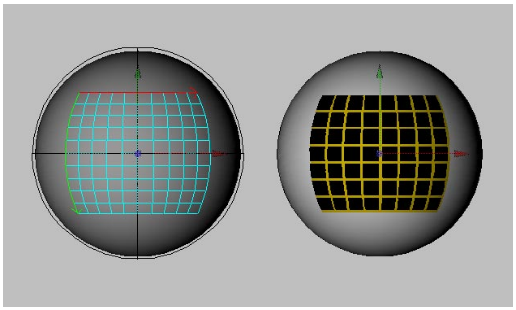
These settings appear near the bottom of the dialog window. You can also change these values interactively in the editor with the Texture Axis tool selected (see page 308).

The following pictures show you the difference between the Texture tool and the Texture Axis tool. Both pictures demonstrate a movement in the X direction. In the first picture, the texture is moved about the texture envelope (Texture tool, **Offset**). In the second picture, the texture geometry itself is moved (Texture Axis tool, **Position**).





The texture geometry can be shown either as a texture grid or as a realtime texture. You can set this option globally (enable **Display > Textures** in the viewport), or you can give the object its own (local) display tag with this option on or off (see page 465).



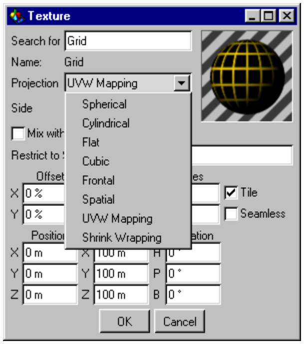
Mapping types (projection)

The **Projection** setting determines how the texture is projected on to a surface. The projection surface is independent of the real surface of the object, although often it has the same basic shape (e.g. flat, spherical, cubic, etc.).

UVW mapping (which is explained in more detail later) fixes the projection on to the surface points of an object so that, when the object surface is deformed (like a flag would be in the wind), the texture deforms with it.

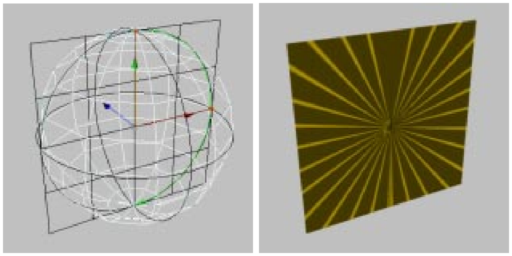
The best mapping type to use depends on the shape of the object to which you apply it. First let's take a look at some examples for the first three mapping types (spherical, cylindrical and flat) and then we'll describe the others with fewer examples.

You can change the mapping type using the **Projection** popup menu in the Texture geometry dialog.

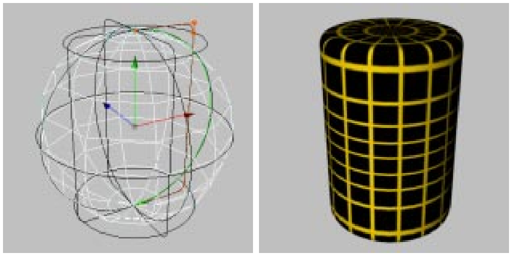


Spherical mapping

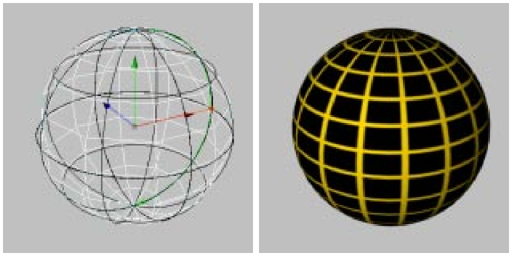
Spherical mapping projects the texture on to the object in a spherical form.



Spherical mapping applied to a plane



Spherical mapping applied to a cylinder

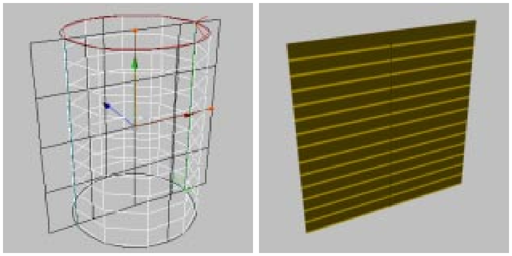


Spherical mapping applied to a sphere

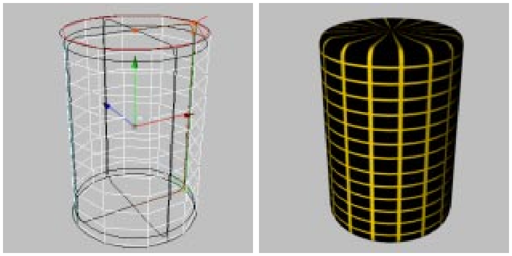
Spherical projection is rarely suitable for flat objects. There is distortion with cylindrical objects too.

Cylindrical mapping

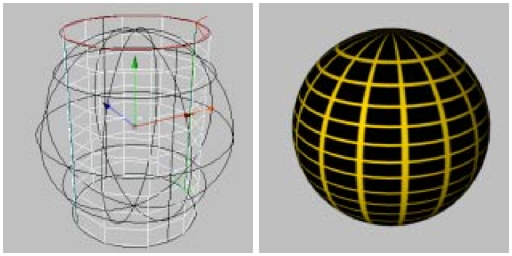
This mapping type projects the texture on to the object in a cylindrical shape.



Cylindrical mapping applied to a plane



Cylindrical mapping applied to a cylinder

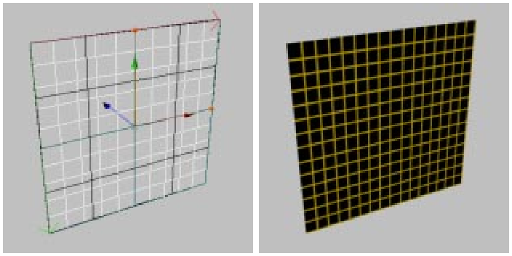


Cylindrical mapping applied to a sphere

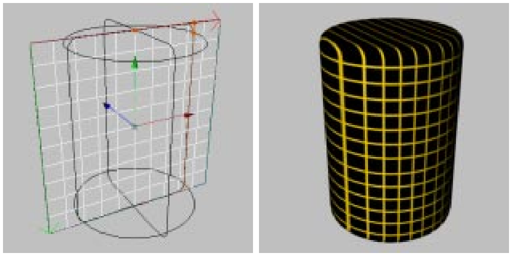
Cylindrical projection is rarely suitable for flat objects. It also leads to distortion when used with spherical objects. Notice how the pixels near the top and bottom of the texture map are pulled inwards on the caps. You should apply separate textures to the caps.

Flat mapping

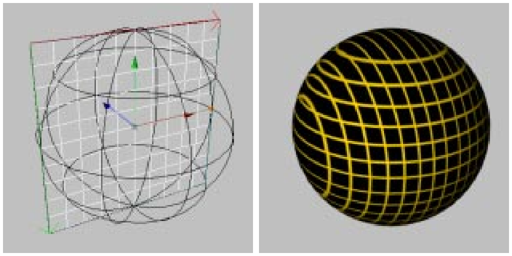
Flat mapping projects the texture on to the object in a planar direction.



Flat mapping applied to a plane



Flat mapping applied to a cylinder

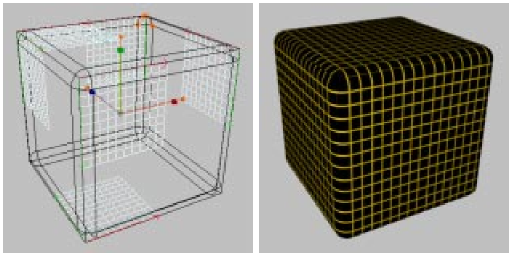


Flat mapping applied to a sphere

Flat projection tends to be used with flat objects only. The texture is soon distorted when applied to a sphere or cylinder, as the examples demonstrate.

Cubic mapping

Cubic mapping projects the texture on to all six sides of a texture cube.

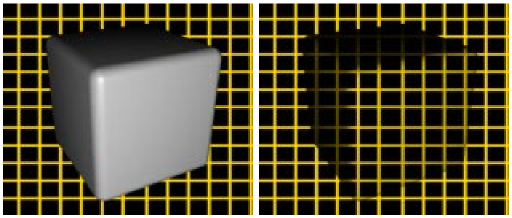


Cubic mapping applied to a cuboid

We have halved the size of the texture above left so that you can see the mapping more clearly. In the rendered picture the texture length has been restored to 100%.

Frontal mapping

The texture is projected from the camera position on to the object. This ensures that, it you project the texture on to a polygon object and on to a background object, the two textures match exactly (assuming the texture geometry for both objects use the same offset and length values).



Frontal mapping applied to a cuboid

Frontal mapping can create spectacular effects. You can even perform compositing directly in CINEMA 4D (more later). The picture above shows how the cube blends into the background using frontal mapping - only the cube's shadows are visible. You have probably seen science fiction films where characters or spaceships gradually disappear into the background or are only partially visible. It's easy when you know how!

For another interesting effect, try removing the background object, then move the cube around.

Camera mapping

Camera mapping? Huh? That's not in the texture dialog...

Quite right. You cannot select camera mapping from the **Projection** popup menu. You create this effect using frontal mapping.

So what is camera mapping?

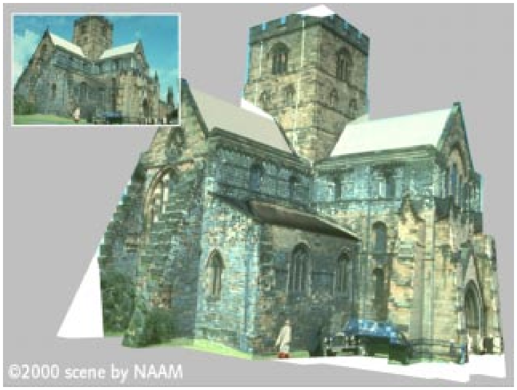
Imagine that you want to use a photo and have it interact with your models, e.g. perhaps you want a 3D figure to walk between some of the objects in the photo. You can create such an effect with camera mapping.

First you must create a background object. Then, load the photo into the luminance channel of a new material. Next, apply the material to the background object with frontal mapping.

Now you reconstruct (model) any objects in the real picture which are required for the interaction. For example, if you want a 3D figure to walk behind a crate that is in the photo, you build the crate in 3D (it can be very simple - it is just a screen for the crate texture). Next, project the background texture on to the reconstructed objects (e.g. the crate) using frontal mapping. Now, your figure can walk behind the crate.

You will usually want to move the camera around the scene a little. To this end, you should first fix the textures to the objects. Click once on the texture geometry in the Object Manager.

This causes the icon to be framed in red. Next, select **Generate UVW Coordinates** from the Object Manager's Texture menu. The texture will be fixed to the object geometry. You can then move the camera.

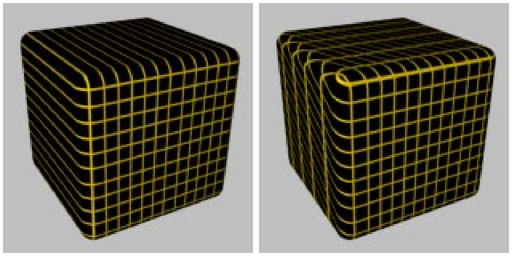


Note

Please do not expect miracles from camera mapping. You cannot, for example, expect to rotate a full 360° around a building. The photo is usually already distorted by perspective so, at certain angles, you will get a distortion of a distortion (not always a pretty sight).

Spatial mapping

Spatial mapping is similar to flat projection. However, with spatial mapping, the texture is pulled up and to the right as it *passes through* the object.



The difference between flat and spatial mapping

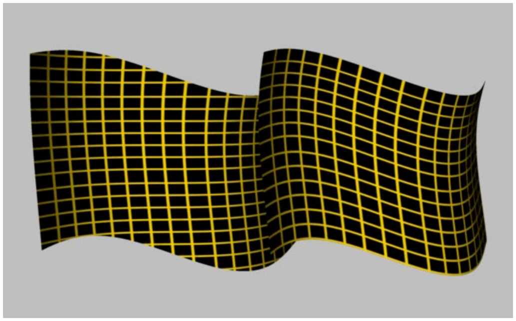
On the left, notice how flat projection can lead to unattractive stripes. The picture on the right shows how spatial mapping solves this problem.

Spatial mapping does, however, cause some distortion and as such it is not suitable for photographic images. Spatial mapping is more suitable for structure textures (e.g. marble, plaster, ...).

UVW mapping

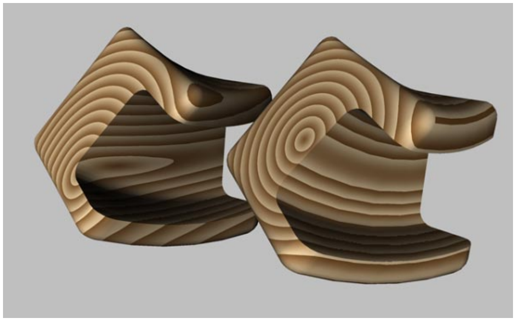
If an object has UVW coordinates you can select them as the projection type. In this case the texture geometry is fixed to the object surface and is subject to all subsequent movement and deformation applied to the object.

A classic example of UVW mapping is the page of a book as it is being turned. First you must *fix* the texture (e.g. ornate text and a pretty picture) to the page using UVW mapping. Next, you animate the turn of the page with a deformation. The texture bends with the page.



All of CINEMA 4D's primitive objects and NURBS objects have UVW coordinates. If you apply a new texture to these objects, the projection type in the texture geometry will default to UVW mapping.

All polygon objects with UVW coordinates display a UVW coordinates icon in the Object Manager.



In the illustration above, flat projection was used for the object on the left, UVW mapping for the one on the right. Notice how the UVW texture has been deformed along with the object.

Primitive objects and NURBS objects have internal UVW coordinates and do not display a UVW icon in the Object Manager. You can still use UVW mapping with these objects. If you convert a primitive object or a NURBS object into a polygon object, a UVW coordinates icon will appear in the Object Manager.

You may be wondering why there are three coordinates (UVW). What is the third coordinate for?

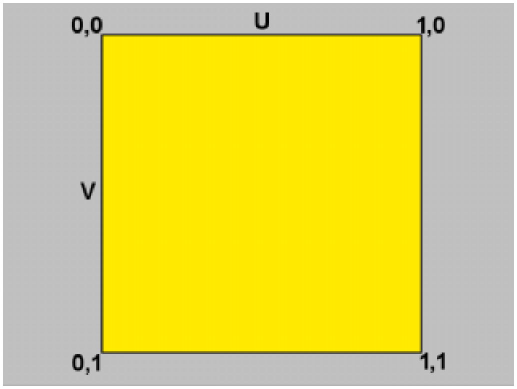
The third texture coordinate (W)

Conventional textures have two coordinates, one for the horizontal position X, and one for the vertical position Y. In order to make it clear that the coordinates refer to a texture, X is renamed U, and Y is renamed V. Two coordinates (U and V) would be sufficient were it not for 3D shaders. These are three dimensional textures (see The Shaders, page 508), and as such they require a third coordinate (W) in order to be fixed to the object.

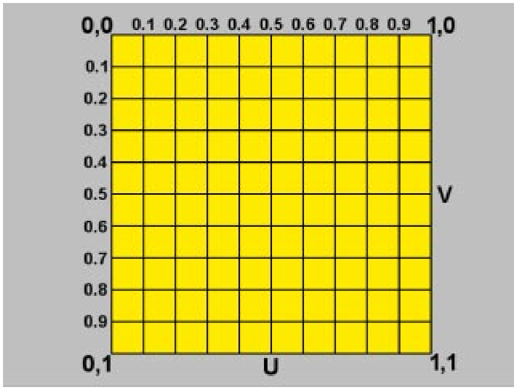
You can apply more than one UVW texture geometry to an object. Create a new texture geometry for the object, then set the projection you require, e.g. flat mapping for a label texture. Next, create new UVW coordinates for the active texture by selecting **Generate UVW Coordinates** in the Object Manager. The active texture geometry will be set to UVW mapping and will deform together with the object. Your object will now be able to cope with the worst enemies of texture mapping (morphing, magnet, bones...).

The UVW coordinate system

What is the structure of UVW coordinates? Imagine a grid divided into a U direction and a V direction.



The UV range starts at 0,0 and ends at 1,1. For an upright polygon 0,0 describes the top left; 0,1 the bottom left; 1,0 the top right and 1,1 the bottom right. A texture is stretched out between these four coordinates.



But where is the W coordinate in this system? Recall that conventional textures are two-dimensional - the W coordinate is created only when it is needed. Once created, the W coordinate behaves in the same way as the UV coordinates.

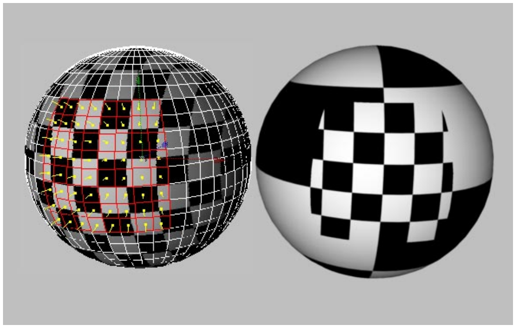
Selective UVW mapping

CINEMA 4D has two ways of allocating texture projections to polygon selections (rather than to the whole object as described above). The first method is described below. The second method, **Restrict To Selection**, is described on page 542.

Selective UVW mapping allows you to apply a different projection type to several regions of the object using the same texture geometry.

Proceed as follows

- Create a sphere and convert it into a polygon object using **Make Editable**.
- Create a new material with a texture, e.g. the checkerboard shader.
- Change the projection from UVW mapping to Flat.
- Activate the Polygon tool and select several polygons in various locations.
- Select **Generate UVW Coordinates** from the Texture menu (in the Object Manager).



If you are in RTTM mode you can see immediately that the selected polygons use flat projection while the unselected polygons continue to use the normal UVW mapping. If you deform the object, the texture remains fixed in the selected region.

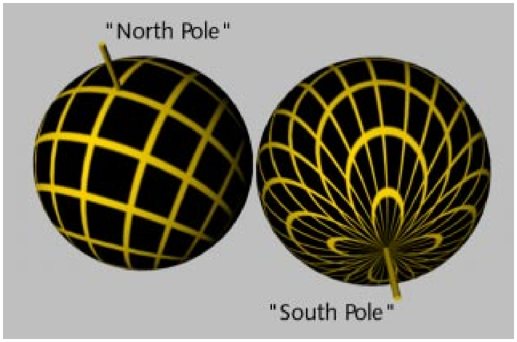
Note

Selective UVW mapping is designed to allow you to allocate an optimum projection type to specific areas. If you want to use different materials in these areas you should use Restrict To Selection - see page 542.

Shrink-wrapping

With this projection type the centre of the texture is fixed to the north pole of a sphere and the rest of the texture is stretched over it. The advantage of this mapping type is that the texture meets itself at the south pole only. This avoids a seam running between the poles.

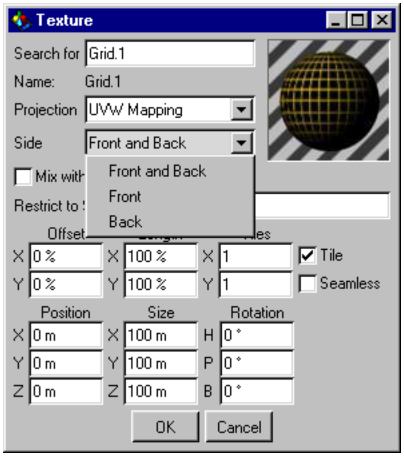
Only a circular section of the texture is used, with the centre of the circle corresponding to the centre of the picture. The remainder of the picture is discarded.



In the illustration above, notice how the texture meets itself at the south pole.

Decal mapping

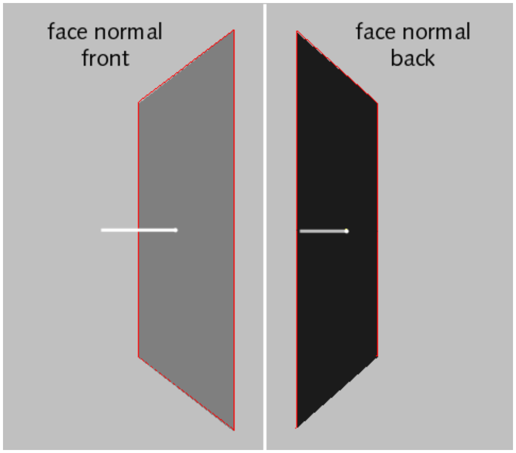
Unfortunately, the term *decal* means different things in different programs. Therefore we need to be clear on CINEMA 4D's definition.



Imagine that you project a texture on to a rectangle with flat mapping. If you move the camera around the rectangle to look at the other side of the surface, you will still see the texture, but it will be the wrong way round. You can solve the problem by using a *decal* - a material that is projected on one side of a polygon only.

It is very important for you to understand how decal mapping works, since guessing is not always enough. (You may find that, whatever you guess, you still cannot get the decal you require. You have been warned!)

The direction of the surface normals for each polygon (see page 378) plays a pivotal role in deciding to which side of the polygon the texture is mapped. **Front** is in the direction of the surface normals and **Back** means in the opposite direction to the surface normals.



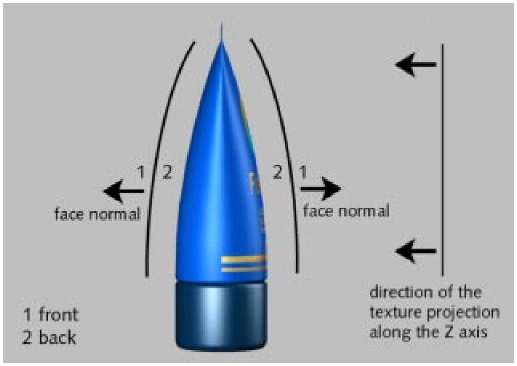
Example

You wish to place a label on a tube. With flat projection this ought to be simple enough. You have adjusted the settings (see Labels, page 539) and you render the tube. Hold on a moment, that's not right... the texture also appears on the reverse side of the tube:

What has happened? With flat projection a texture is projected from the front through to the back of an object. As a result, the texture is also visible where it is not wanted. Decal mapping comes to the rescue - change **Front and Back** in the texture geometry to **Front**. Now render the tube again. This time the label is visible on the front side only:

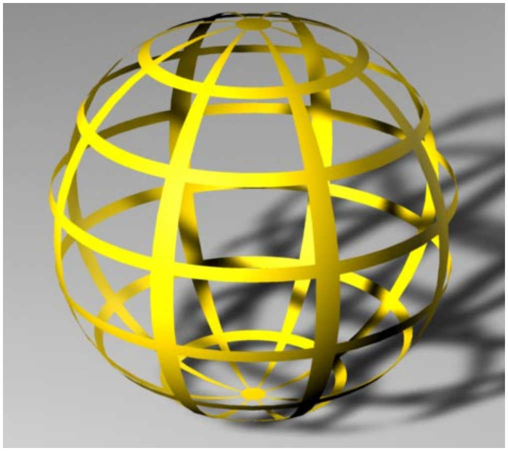
The explanation is simple. If the viewing angle (i.e. the camera angle) and the surface normal form an angle of less than 90° to each other, the polygon is a *front polygon*; otherwise it is a *back polygon*.

The only exceptions are for flat and spatial mapping. Here there is an additional criterion: the direction of the texture projection's Z axis. If the texture's Z axis points in the opposite direction to the surface normal, and if the viewing angle and surface normal form an angle of less than 90° to each other, the polygon is a front polygon; otherwise it is a back polygon.



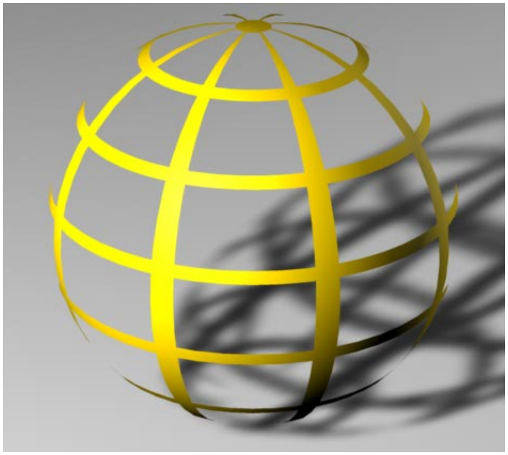
Front and Back

If you choose **Front and Back** the texture is projected in the direction of the surface normals and also in the opposite direction.



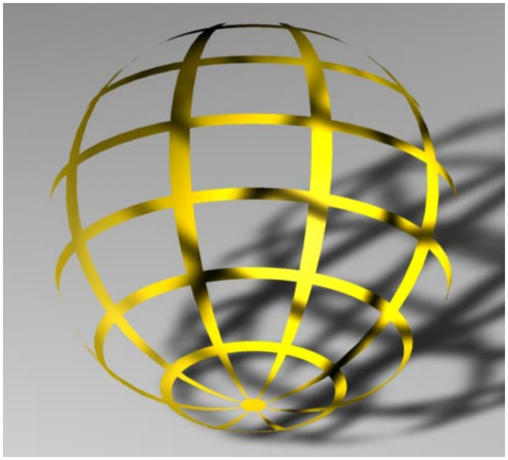
Front

If you have selected **Front** you see the texture where the surface normals point towards the camera, otherwise the material is invisible.



Back

If you project the texture from the back you will see the texture only where the surface normals point in the opposite direction to the camera. The material is otherwise invisible.

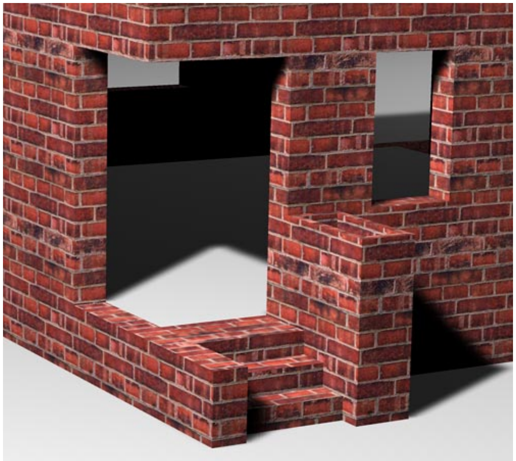


A practical example of decal mapping

Tiled Textures

Sometimes we need to do more than merely project the texture on to an object. Imagine you are texturing a brick wall. Do you really want to create a texture for an entire facade and four walls? There is a much easier way.

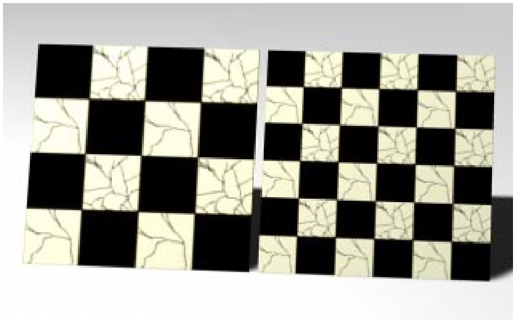
All you need is a seamless texture, which you project, perhaps with cubic mapping and a suitable number of tiles.



Tiles

You can use the **Tile X** and **Tile Y** settings to define how many times the texture picture is repeated, i.e. you use these settings to specify the number of tiles. CINEMA 4D calculates the size of an individual tile from the current texture size. For example, if you have scaled the texture so that it has a length of 25% in the X direction and 50% in the Y direction, the texture fits four times in the X direction (1.0/0.25) and twice in the Y direction (1.0/0.5) on the surface.

If you change the **Tile X** or **Tile Y** settings, the **Length** settings change automatically. For example, if you change the number to 3, the texture shrinks from 50% to 33.33%. You can see this immediately if you leave the window by clicking on **OK**.



Tile

If you activate this option the texture picture will be repeated endlessly on the surface.

The effect becomes visible when you scale down the texture (see page 296), or when the texture geometry has not yet been fitted to the object (see Fit To Object, page 470). Otherwise, the texture map fills the entire texture geometry once.

If this option is not active, the texture map will not be repeated on the surface.

Any materials that are underneath (see Texture Layers, page 539) will show through in the parts not covered by the texture tile.

Note

If you select the Tile option for a 2D or 3D shader it is not, strictly speaking, tiled, but instead fills the entire object seamlessly. There may or may not be a repeating pattern depending on the programming of the shader.

Seamless

If the **Seamless** option is activated, tiles are mirrored to prevent visible seams. This is particularly useful for objects that are not seamless, although typically it generates a *butterfly* pattern.

Note

Seamless is generally of little use for photo textures (although you can generate some interesting patterns). This option is better suited to pictures with a pattern, such as wood, stone or marble.

Labels

By now you know how to apply textures, how to tile (or not tile) them, and how to prevent seams. How, though, can you put a label on a bottle?

This is what you need to do:

- Open the Texture geometry dialog.
- Deselect the **Tile** option.
- Check that only one tile is created in the X and Y directions.

Done. OK, the texture probably covers the entire object (that's one big label) but now you can scale it down.

Usually, the quickest way to scale (and for that matter position) your textures is to work in RTTM mode. Select the Scale tool, then select the Texture Axis tool. You can use the mouse to reduce the scale of the texture. Next, select the Move tool and place the texture wherever you like on the object surface.

The texture is often slightly out of proportion after scaling. However, we have a little trick for you. Open the texture geometry dialog and adjust the size of your texture in the length fields. Since the length cannot exceed 100%, you may need to divide both values.

For example, if your texture is 800 x 600 pixels, you might set the lengths as follow:

X	Y	Conversion Factor	
80	60	/ 10	
8	6	/ 100	
32	24	/ 100 x 4	etc.

Texture Layers

CINEMA 4D lets you use as many materials and texture geometry tags on an object as you like. Think of a suitcase with travel stickers - there is a base material (e.g. the leather of the suitcase) and many materials on top (e.g. the stickers).

You cannot see the original suitcase material (leather) in those places where there are stickers. Also, when there are many stickers on the suitcase, they overlap each other. The stickers on top cover those underneath. Where several stickers share the same space, only the top sticker is visible. If you want to see one of the old stickers, you must either remove one of the newer ones or make a hole in it.

This analogy can be related closely to CINEMA 4D's behaviour. Your object has a base material. You have additional materials on top of the base material. In order to see the base material, the overlying materials must be scaled down and not tiled. You can do this by scaling down the texture geometry and at the same time turning off the **Tile** option (see Labels above). If two materials overlap and you want to see the bottom one, you must make a hole in the top one. You can do this using alpha mapping or clip mapping (see page 500).

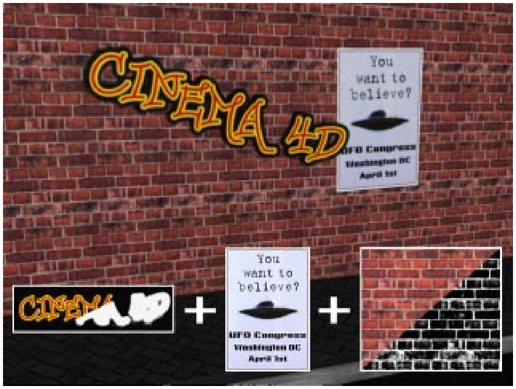
Only one question remains unanswered: how does CINEMA 4D know which layer a material is on?

The answer is quite simple. When you apply several materials, each new material is placed on top of the previous one. The order of the texture tags in the Object Manager (see pages 454 and 459) defines the layer - the right-most material is the top layer, the left-most is the bottom layer.

You can change the layering order simply by swapping the positions of the texture icons using drag-and-drop.

Note

The Transparency material property does not allow the next layer to show through. Instead, use alpha or clip materials.



In the example above T1 is a wall material, T2 is a plastic material (scaled down, no tiling) and T3 is graffiti (with alpha mapping to remove the non-graffiti parts of the texture).

The order of the materials in the Object Manager (from left to right) is: T1-T2-T3.

The graffiti (T3) is the top material layer. However, it uses the alpha channel to remove the non-graffiti parts, thereby exposing the next layer down (the plastic material (T2). Even though the plastic material (T2) is on a layer above the bricks (T1), the bricks can still be seen because the plastic was scaled down and is not tiled (i.e. the plastic does not cover the entire surface).

Exercise

Load the Graffiti scene from the Examples folder on the CINEMA 4D XL CD and place the remaining posters on the billboard.

Additive textures

In the previous example a wall material was created using a color channel and a bump channel. The bump channel creates the illusion that the wall has joints. Now we want to add a second bump map to the wall without changing the texture itself. How can this be done?

The powerful function that makes this possible is called **Mix With Other Textures** and, no prizes for guessing, you can use it to mix textures together. The material properties are added together, hence the term *additive textures*.

For example, the sum of the colours 100/0/0 (red) and 0/100/0 (green) is 100/100/0 (yellow). If the green color has a brightness of 50%, then only 50% of the color is added. The result in this case would be 100/50/0 (orange).

However, the result cannot exceed the maximum color values. Adding 100/0/0 to 100/100/0 does not produce 200/100/0, but 100/100/0.

Some channels cannot be added meaningfully, e.g. two materials with a refractive index of 1 would result in a material with a refractive index of 2, which is probably not what you intended. So in such cases the value of the additive material is used (provided that the channel is active).

Notes

You can add together as many textures as you wish.

Only the following properties are additive: Color, Transparency, Reflection, Relief, Displacement and Luminance.

Only active properties are evaluated.

The alpha channel marks the parts of the additive material that should not be added.

3D shaders cannot be added.

An additive texture (option ticked) must be to the right of the texture to which it should be added in the Object Manager.

All textures to the right of the first additive texture, up to but not including the next non-additive texture, are added.

The Transparency property does not expose the next material layer. Use alpha mapping instead.

It's time we returned to our example:

Now you can see the second bump map (T2) on the wall in addition to the original bump (T1).

Mixed textures

By now you should know how to use several material layers and how to add materials together.

Let's combine these two techniques to place several materials on the same object and add some of them together.

Our example graffiti wall uses five materials. Their order in the Object Manager (from left to right) is: T1-T2-T3-T4-T5. T1 (wall), T2 (poster) and T4 (graffiti) are normal materials. T3 (50% bump of T1) and T5 (100% bump of T1) are additive. T4 (graffiti) uses alpha mapping to remove the non-graffiti parts of the texture.

T3 is added to T2, giving it an additional bump texture. Since T2 is not tiled, T1 is visible. T5 is added to T4, giving it an additional bump map. T4 uses an alpha channel to expose the lower layers, hence you can see T1 and T2.

Restrict To Selection

The function enables you to use different materials on different parts of the same object. This is a convenient way to add, for example, labels to objects. First of all you need a selection tag.

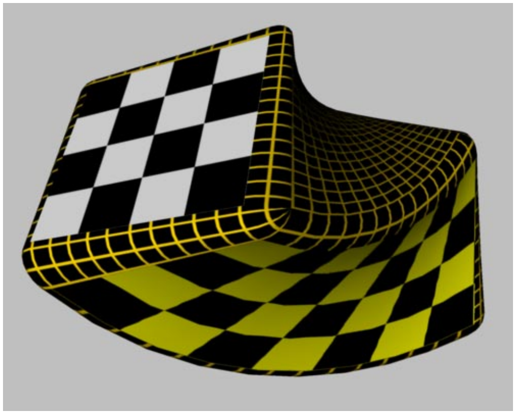
Proceed as follows

- Activate the object and select the Polygon tool.
- Select several polygons using the selection tool (if you selected a primitive object, you must convert it to polygons first, use **Structure > Make Editable**).
- Choose **Set Selection** from the selection menu.

A polygon selection tag appears in the Object Manager to represent the selection.

See Chapter 9, Selection Menu, page 317 for more details on selections.

- Double-click on the polygon selection tag. Enter a name for the selection in the dialog that appears, then click on **OK** to close the dialog.



- If your object does not have a texture yet, apply a new texture (drag the material from the Material Manager and drop it on to the name of the object in the Object Manager). The Texture geometry dialog opens. Enter your settings (e.g. the projection type, tiles, etc.), then enter the name of the selection in the **Restrict To Selection** field. Close the Texture geometry dialog by clicking on **OK**.

Tip

When you are positioning a texture on a selection you may find it helpful to hide the unselected surfaces. You can hide them using Selection > Hide Unselected.

Different materials for the hull, caps and rounding

You can apply different materials to the hull, the caps and the rounding of an object. You can either convert the object into polygons with **Structure > Make Editable**, or you can use the so-called invisible selections. For example, you can use **Extrude NURBS** to create marble letters with a golden, rounded or bevelled edge.

Note

You can use existing invisible selections for the caps and rounding of a NURBS object. For example, you can apply a material to the start cap by using the Restrict To Selection function (see page 542). You should type in ‘C1’ to apply the material to the start cap (please use a capital C). The options are:

C1 = Start Cap (Cap 1)
C2 = End Cap (Cap 2)
R1 = Start Rounding (Rounding 1)
R2 = End Rounding (Rounding 2)

CINEMA 4D

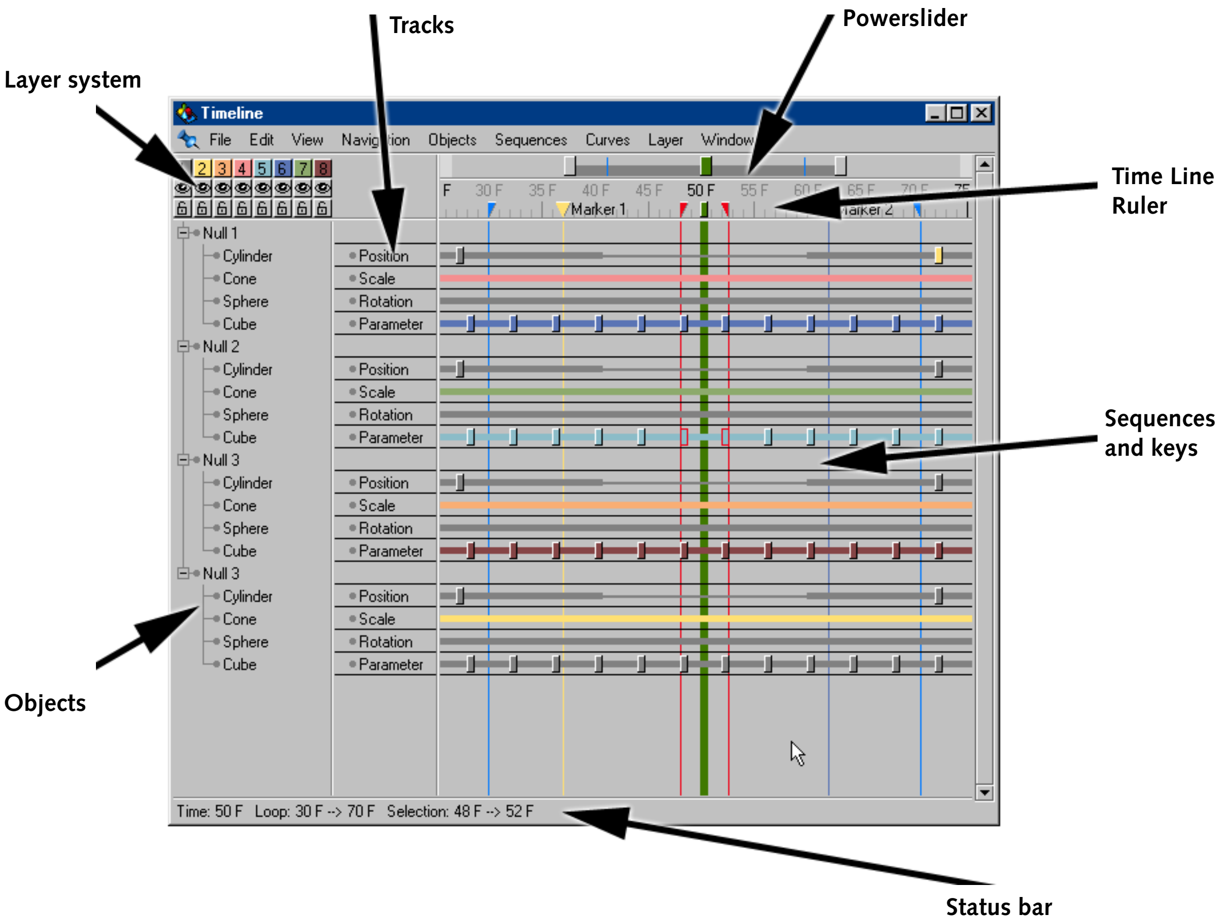
MODELING • ANIMATION • RENDERING

19. Time Line

19 Time Line

With the Time Line, you have at your disposal a very powerful tool for controlling and playing back animations created within CINEMA 4D.

In the Time Line, just like on a sheet of music, the timing of all the animated elements of your scene is represented horizontally. However, to define the type of each element of your composition, instead of different notes, *keys* are used instead. If you have ever worked with a computer music program you might have used a sequencer, which is quite similar in use to CINEMA 4D's Time Line.



Each horizontal line on the Time Line is called a *track*. These tracks control particular aspects of how an object is to be animated. This can range from a simple change of position or rotation up to complex special effects such as a pulsating, morphing etc.

A track can contain one or more sequences. These dictate over what time (how many frames) the animation is to take place for that track. So you can, for example, limit certain animation effects to a certain time.

A sequence is then filled with keys at positions of your choosing. These define the detail of how an Time Line change or effect is developing over time, e.g. a change of position from the first key to the second key. Some effects need only one key (e.g. Pulsate) while others require two or more (e.g. a change of position).

Each object may have as many tracks, sequences and keys as desired. As in the Object Manager for any particular object, the vertical position of a track decides the priority of the animation. So if a spline animation for a dog's tail is placed before a position animation, the tail is animated along the splines first.

Starting with version 6 of CINEMA 4D XL you now also have the capability to define your own *effective ranges*. So you may now deliberately create *dead* or undefined sequence ranges for a track, and CINEMA 4D will try to automatically evaluate the parameters of the next track and sequence (see below, influence range of sequences).

Note

Users of previous CINEMA 4D versions will notice that, in the Window menu of the editor, both the time control and the space control are missing. These two animation managers are now integrated seamlessly into the Time Line, giving you a more efficient system of editing animations while also freeing up extra monitor space. As an additional bonus it is now possible to view and work with several curves using both the time control and space control. Both the time control and the space control are now fully integrated with each other, enabling you to edit, for example, with real tangents in both modes.

The former time manager now exists as a freely configurable tool palette. Before we continue with the actual operation of the Time Line, we shall describe this 'little brother' of the Time Line.

Time Manager Tool Palette

Users of older versions of CINEMA 4D will probably remember the Time Manager. This was a small, solitary window that contained some important navigation and recording tools for the control of animations.

In the course of the evolution of CINEMA 4D, and through the modern, fully configurable interface, the Time Manager has become a simple tool palette into which the most frequently needed navigation and recording tools of the Time Line are integrated. Among many other things, one advantage is that you can dock the time manager palette completely, or in parts in the Time Line, or in any other part of the CINEMA 4D interface.

The Time Manager tool palette is, by default, in the lower region of the main CINEMA 4D window and contains just the conventional tool icons and a slider for adjusting the current time value.

Tip

The slider in the Time Manager tool palette is particularly suitable for the quick playback of your animation since, technically, it has a speed advantage over the time slider of the Time Line.

Symbols in the Time Manager Tool Palette

Playing

Goto Start

Previous Frame

Backwards

Stop

Forwards

Next Frame

Goto End

Recording

Record

Autokeying

Position Keys

Scale Keys

Rotation Keys

Parameter Keys

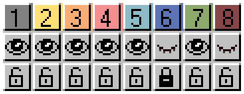
Hierarchy

PLA

Working in the Time Line

As we said before, the Time Line is a powerful tool for the creation and editing of animations.

Layer System



In the upper left area of the Time Line window are the controls for the *layer system* of the Time Line, in three rows of icons. Using this system arbitrary elements of the scene can be combined in layers, with the ability to be hidden or to be locked.

Positioned on the top row are eight colored buttons, which represent the individual layers.

The second row contains another eight buttons that give you the option to switch the layer from visible to hidden and back. If a layer is hidden then all elements belonging to this layer are invisible in the main Time Line window.

On the third row you see the buttons for locking and unlocking layers; the icon used is a small padlock. If the padlock of a layer is closed then all objects of this layer are locked and cannot be selected or edited in the Time Line.

A single-click on one of the colored layer buttons on the first row causes a simultaneous toggling of the visibility and locking attributes of this layer.

You may assign each element of your scene (keys, sequences, tracks and objects) to a particular layer.

To assign one or more elements to a layer, simply select the appropriate elements in the Time Line and choose one of the layer color entries from the Time Line menu **Layer > Color Selection**.

Alternatively you may assign a layer to selected elements by clicking on the appropriate layer color button while holding down the Ctrl key.

Note

Please note that layers (and also their selection) work hierarchically within an object. If for instance a yellow sequence has a blue key and you switch the yellow layer to invisible, the blue key also disappears, since it is hierarchically under the yellow sequence.

A further useful function is the automatic selection of layers. Select one of the layers from the Time Line menu **Layer > Select Layer**. CINEMA 4D now automatically selects all elements in the Time Line belonging to this layer. Alternatively, to select all the elements of a layer, you can click on the appropriate color button while pressing the Shift key.

The use of layers offers many advantages and often saves much clicking and searching in the Time Line. Try to become accustomed to this layer system, especially when working with complex animations.

As an example; you could place all objects that have complex inverse kinematics assigned to them to a specific layer and switch the remaining parts of the animation to hidden to arrange the work in a clearer fashion.

The colored layering of keys and sequences alone offers a great advantage, as the layers are of substantial visual assistance (perhaps different layers for different morph stages within character animations, for example).

By default all new elements are placed within the first layer (layer 1) and are visible and unlocked.

Note

You may choose the eight layer colors in the General Settings of CINEMA 4D. These colors are also used for the markers.

Note

Throughout the following sections we will often refer to the 'current time' or to a 'time value'. We use the word time as a convenience to readability to mean the position within the animation; this may be expressed in seconds, frames or SMPTE units. This depends on the setting you have chosen for Animation Units in the General Settings (see page 45).

Powerslider

At the top of the Time Line window, to the right of the layer controls, is the Powerslider. With the help of this horizontal, two-tone grey bar and its colored slider controls (we'll call them *tags* from now on) the visible range of the Time Line can be moved and scaled quickly and easily. The powerslider is above the Time Line Ruler which is described below.

- By manipulating the darker bar (you may see only this dark bar to start with) and its tags (the slider controls) you can adjust the powerslider itself and, hence, the display in the Time Line window.
- By moving the rectangular grey tags at the beginning and end of the bar you can scale the powerslider and thus scale the view in the Time Line. The left tag moves the origin of the Time Line window while keeping the finish point constant while the right tag does the converse of this.
- If you hold down the Shift key during scaling, both tags move and the display is moved around the center of the bar (centered scaling).
- If you double-click on the brighter range of the powerslider, the actual time is set to the respective position.
- If you double-click on the darker range of the powerslider, the powerslider is maximized or set again to the last condition before maximizing. Thus, the lighter grey bar disappears.
- If you double-click on the tag at the left of the darker range of the powerslider, the powerslider is only maximized on the left or set again to the last condition before maximizing. This also applies, in a similar manner, to the tag at the right side of the bar.

The two perpendicular blue lines in the darker area of the powerslider mark the adjustable *preview range* (see below).

Time Line Ruler

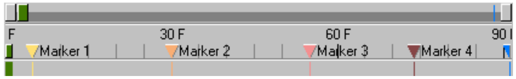
Below the powerslider you can see a ruler with animation units laid out horizontally (depending on what you chose for **Animation Units** in the General Settings this can be frames, seconds or in the SMPTE format; see page 45). As with a physical ruler, the dividing lines are at regular intervals to mark the appropriate units.

The green tag marks the current position in the animation and as such is used for actual navigation. You can move the tag with the mouse or alternatively you can double-click the green tag on the Time Line ruler or the green tag on the powerslider to enter a position value numerically.

Preview Range

The range between the triangular blue pointers on the Time Line ruler defines the *preview range*. You can adjust this preview range by dragging the blue pointers with the mouse or by manually entering an exact value after double-clicking on the one of pointers.

Markers



CINEMA 4D also has the ability to set arbitrary markers on the Time Line ruler. These are handy for, among other things, simplified navigation within the Time Line. You can use as many markers as you wish and assign an individual name to each marker. Note that these markers are not only used for visual guidance, they also work in a magnetic way for positioning and alignment. Keys or sequences can therefore be positioned very accurately at these magnetic marker lines.

Note

The colors of the markers are identical to those of the layer system in the Time Line (which is determined in the General Settings under Window > Color) and can be switched to hidden or locked just like all other layered elements of the Time Line.

Setting Markers

To set a marker by hand requires that you simply click, with the Ctrl key pressed, at the position within the Time Line ruler where you wish to create a new marker. By default, CINEMA 4D assigns the second layer color to all new markers and numbers these automatically and consecutively throughout. Alternatively you may also select **File > New Marker** from the Time Line menu and manually enter the position, your choice of name and your preferred color.

Deleting Markers

To delete a marker you simply click on the appropriate triangle symbol of the marker and drag it upward or downward until the pointer of the mouse is outside the Time Line ruler. As soon as the mouse pointer takes the shape of a simplified trashcan you can release the mouse button to delete the marker. This system of deletion resembles the tab control used in most word processors.

You can also delete all markers of your project at once by selecting **Edit > Delete All Markers** from the Time Line menu.

Edit Markers

Existing markers can be freely positioned on the Time Line ruler by moving them with the mouse. To adjust the position of an existing marker numerically, or to change its name or color, simply double-click on the appropriate marker. A small dialog appears allowing you to change the appropriate values and select a color for the marker.

Time

This value determines the position of the marker on the Time Line ruler.

Name

In this field you can enter any name for the marker. This makes navigation much easier, especially for those projects with many markers.

Color

In this popup menu you may select one of eight pre-defined colors which is to be assigned to the marker.

Magnetic Markers

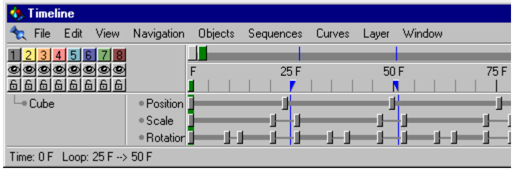
As already mentioned previously, a further helpful use of markers is that they can *magnetically* affect the mobile elements of the Time Line. If you move a sequence or a key in the Time Line and it approaches a marker, the appropriate element will be snapped accurately to the position of this marker. This can be very useful, for example, if you want to position many different keys to a certain timeframe.

Navigation with Markers

In the menus of the Time Line are various functions that enable you to navigate the Time Line with the help of existing markers. This can ease your workflow dramatically, especially with complex animations.

So you could, for example, center the view of the Time Line on a certain marker simply by selecting the function **View > Frame Marker** from the Time Line menu (see below for details on how to do this). A similarly useful function is **Navigation > Goto Marker**, which sets the current Time Line position to the exact position of a chosen marker.

Creating Tracks, Sequences and Keys



In CINEMA 4D there are several possible ways of creating animation tracks and animation sequences for a certain object. The simplest method is the keyframing technology, in which keyframes are created for you when you choose to *record* them.

Keyframing with the Help of the Record Function

When using keyframe recording, CINEMA 4D creates tracks, sequences and keys within the Time Line, according to some settings of your choosing. For the object currently selected in the Object Manager, you can record its position, rotation and size together with other parameters plus the structure of a group of points (point level animation). In addition you can also define whether the entire hierarchy of the selected object is to be included in the keyframing or not.

You can define which of these characteristics are to be keyframed by activating the appropriate icons in the Time Manager Tool Palette or by selecting the entries from the Time Line menu **Navigation > Record**. As usual, if an option is activated you will see a small check symbol against its menu entry. The activated option is also shown in the time manager tool palette with its icon depressed (pushed-in).

To start a keyframe recording from within the Time Line you can click either on the appropriate record icon in the navigation palette or select the menu function **Navigation > Record**. In both cases the appropriate tracks, sequences and key are created at the currently selected timeframe (as indicated by the green pointer in the Time Line ruler) for the object currently selected in the Object Manager.

Autokeying (Automatic Record)

As an alternative to this manual recording of keyframes you can activate the option **Navigation > Autokeying** in the Time Line menu. This function tells CINEMA 4D to record keyframes automatically, as soon as any animatable change in the scene is made. CINEMA 4D creates these keys in an intelligent manner and creates keyframes only for those objects for which a change took place. This saves you a large amount of work, especially when keyframing objects within a complex hierarchy.

But be warned; if you should forget to switch off this option, you will very quickly create not only an enormous amount of new keys, but the animation you so laboriously created can easily be ruined. Therefore you should use this function only with extreme care and consideration.

Despite the appeal of automatic keyframing, the possibilities can be quite restricted within keyframe recording and it is often necessary to create the appropriate elements using the good old fashioned manual technique.

How to Create Animation Elements Manually

To assign a new track manually to an object, ensure that the chosen object is selected in the Time Line (on the left-hand side of the Time Line) and then select a track type from the Time Line menu **File > New Track**. Now a new entry with the name of the track (e.g. Position) appears alongside the object name. CINEMA 4D automatically creates a new sequence to the length of the animation range preset for the current project (see Minimum, Maximum on page 52).

You may assign as many tracks as you wish to an object. A track can also contain as many sequences as you like which can contain (you guessed it) as many keys as you like.

When using several sequences in a track you need to consider that certain restrictions may come into force when using automatic repetition (looping). A sequence can be only be looped so many times until it collides with the next sequence of the track. Therefore it is advisable to create animations which are intended to be uniformly looped on separate tracks.

To set a key within a sequence hold down the Ctrl key and click the mouse at the position where you wish the new key to be created. Alternatively you may use the function **File > New Key** from the Time Line menu. In both cases, after the creation of the key, a dialog appears which allows you to adjust values that will depend on the track type (with a position track, for example, this would be the coordinates and tangents).

Selecting Elements

The Time Line offers a host of selection options. The simplest of these is the selection of an individual element. For this you simply click on an object, a track, a sequence or a key. The appropriate element (including all child tracks, sequences or keys, as relevant) is then colored or bordered in red.

You can also select several elements by clicking them in succession, with the Shift key held down. To deselect one of severally selected elements, click on it once again with the Shift key held down.

Region Select

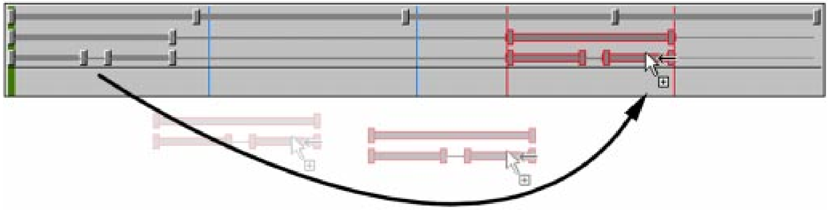
An even simpler method for multiple selection of keys and sequences within the Time Line is to use rectangle selection. To achieve this simply click with the mouse on an empty place within the track/sequence section of the Time Line and drag a rectangle around the elements that you wish to select (remember to hold the mouse button down when dragging - sorry, computer experts). If you hold the Shift key down while doing this you can extend any existing selection. If you hold down both the Shift key and the Ctrl key during the rectangle selection, the new selection is removed from the existing one. Further types of selections, like freehand and polygon selection, are described below.

Note

The Time Line selection tools Rectangle, Freehand and Polygon work with sequences and keys. A multiple selection of objects and tracks is therefore only possible if these are selected while holding down the Shift key.

Moving and Copying with drag-and-drop

CINEMA 4D gives you the moving or copying of elements within the Time Line quickly and easily using drag-and-drop. As a basic guideline, to change from the standard move mode into copying mode during all drag-and-drop operations in the Time Line, keep the Ctrl key held down.



Always pay attention to the form of the mouse pointer when using drag-and-drop. For example; a mouse pointer that includes a small '+' sign signals that copying mode is active.

If you try to move an element of the Time Line into a forbidden area, the mouse pointer changes into a small no-entry sign. If you finish the drag-and-drop operation here, CINEMA 4D will ignore the entire action.

You can of course, as an alternative to drag-and-drop, use the Cut, Copy and Paste functions from the Edit menu of the Time Line for moving and copying elements. However these do have certain restrictions (see page 579).

Moving Animations Hierarchically

To transfer all existing tracks, sequences and keys of an object to another object, simply select the appropriate object in the Time Line and then drag-and-drop on to the desired target object. All animation characteristics of possible sub-objects are also moved i.e. you can transfer even complex, hierarchical animations with this single action from one object to another. Remember this is a move operation; the selected characteristics of the original object are removed.

If the object hierarchy of the target object deviates from that of the original object, CINEMA 4D will try to achieve the optimum assignment.

For example: if you transfer the run movements of a spider with eight legs to a fly with six legs, CINEMA 4D ignores the tracks and sequences for the missing legs of the fly when copying. If you reverse the example and transfer the movements of the fly to the spider, the two additional legs will remain untouched.

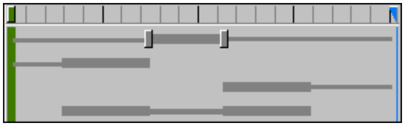
Moving Tracks, Sequences and Keys

Tracks, sequences and keys are the actual mobile elements of the Time Line. So you can transfer, for example, one or more selected tracks, including associated sequences and keys, with drag-and-drop from one object to another. In principle, this also applies, within certain limits, to all sequences and keys. So the sequences and keys of a position track, for example, can be transferred to other position tracks. Of course it is not possible to move sequences or keys of different track types (e.g. the sequence or key of a position track to a rotation track).

Note

When simultaneously copying or moving several elements in the Time Line with drag-and-drop (e.g. sequences or keys) it is the sequence representation within the Time Line, and not the hierarchical layout of the objects, which is decisive in the distribution of the individual elements.

Sphere of Influence of Sequences



From version 6 of CINEMA 4D there are two new options in the sequence dialog (double-click on a sequence to see this dialog); **Right Influence** and **Left Influence**. To better explain the use of these new options it will be useful to look back at the sequence procedure of earlier versions of CINEMA 4D.

Since a sequence may be as long or as short as you like, the question arises; what should happen within the undefined ranges of the track, where no sequence exists?

A small example; say you create a rotation track for an object and define a sequence range from frame 30 to frame 60. Within this range a rotation of the object from 0° to 180° is defined. But the entire span of your animation covers the range from 0 to 90 frames. This means that undefined ranges result both at the beginning and at the end of the animation. What angle value (rotation) should the object possess at the first frame? Or at the 89th frame?

Up to now this problem has always been solved thus; CINEMA 4D simply extended the sequences internally until they reached the beginning or end of the animation or hit another sequence on the same track. This sequence extension is called *the extended sphere of influence*.

When applied to our above example these spheres of influence would have defined the angle value for frame 0 to 29 as 0° and for frame 61 to 90 as 180°. This method is still available and is active by default.

But, starting from version 6 of CINEMA 4D, you can now also apply these spheres of influence visually. They are indicated by a thin dark grey line, leading outwards from the sequences to the left or to the right.

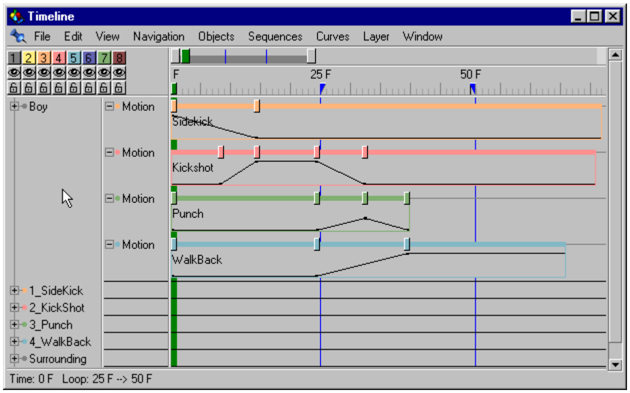
There are certain times, however, when it can be more helpful to switch off the spheres of influence. Back to our previous example...

So what would actually happen if you were to now assign an additional align track to the object with the rotation track mentioned above? Say this align track produces identical rotation parameters to that of our rotation track, except with a different beginning and end. The object rotates. Which of the two tracks is CINEMA 4D to give priority to? Up to version 6 the rule was *only one track at a time* i.e. only the values of the first track (in this case the rotation track) were evaluated. So, even within the undefined ranges of the rotation track, the extended sphere of influence ensured that the sequences of the align track were not considered.

You can change this now, by switching off the left and/or right sphere of influence in the sequence dialog window. Now real, undefined ranges are possible so that CINEMA 4D can also evaluate the secondary tracks and sequences. For our example that would mean that, within frames 0 to 29 and 61 to 90 the sequences of the align track can be evaluated (if there are any such sequences, of course).

Motion Sequencing Motion Synthesizing

CINEMA 4D offers you a completely new and easy-to-use way of grouping and combining complex animations. We call this *motion grouping*, where all existing position, rotation and scale animations of an object (including sub-objects) are combined into just one track. This new combined motion track can again contain its own sequences, in which you may later define the strength and weighting of the respective animation.



Note

Since only the position, rotation and scale tracks are considered in motion grouping, you will need to ensure that those movements created with the aid of other animation tracks (e.g. inverse kinematics) are converted accordingly. In most cases the Bake Object function from the Objects menu of the Time Line will help you. This function converts your animation tracks (as far as possible) to real position, rotation and scale tracks, which you can then combine afterwards to a motion group with no problems.

Combining Animations to a Motion Group

Imagine you have several hierarchically-developed objects with multiple animation tracks, sequences and keys. How should you best deal with this animation?

In such a situation it is very easy to lose the overview in the Time Line. To prevent this you can *fold* the animations by selecting the appropriate object in the Time Line and then calling the command **Sequences > Group Motion** from the Time Line menu. CINEMA 4D now combines all animation parameters of the object to just one motion track. The sequence on this track now contains all animation parameters and can be edited. So it is possible to shift the entire animation and begin it at a later time, for example, by simply moving the sequence.

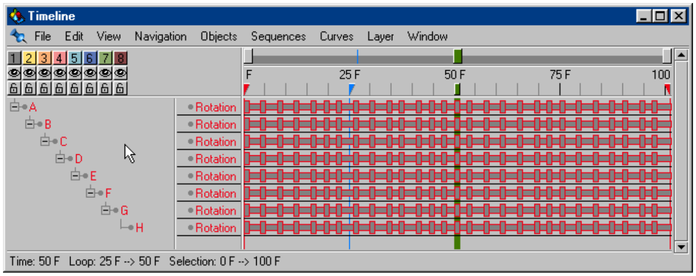
Using the function **Sequences > Ungroup Motion** allows you to unfold grouped animations at any time, enabling you to further edit the data, for example.

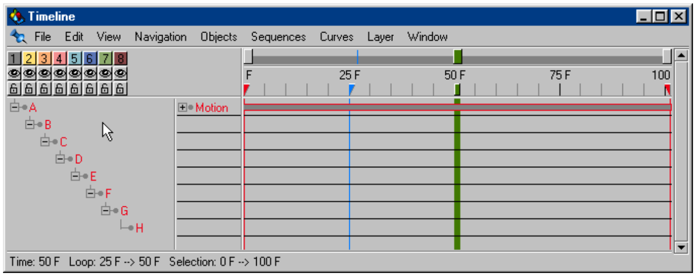
Note

After using the Ungroup Motion function all keyframes set on the motion track will be lost.

Mixing Several Motion Groups

To create realistic and convincing animations it is often necessary to combine several movements with each other or to fade smoothly from one movement into another. Especially in the area of character animation, which is undoubtedly the most impressive of all animated computer graphics, it is a fact that countless 3D graphic artists encounter such problems.





Here's a simple example; a human figure is required to be running, then perform a forward roll and then return to the previous running motion. For an experienced animator a simple run movement or a forward roll is no big problem. However the transitional phase between the two movements can cause real difficulties and, under normal conditions, the animator would be forced to study these in-between motions before laboriously transferring them manually to the character animation.

With CINEMA 4D many of these problems are gone. For example you can now easily fade arbitrary animations smoothly from one to another (motion sequencing) or, by overlaying different animations, you can create completely new movements (motion synthesizing). These cross fades are controlled by simple keyframes which you define on the appropriate motion sequences.

Application Types for Character Animation

The major use of motion sequencing and motion synthesizing is the possibility of smoothly merging as many further adjustable hierarchical animations as you like, one with another.

The principle use and meaning of *motion sequencing* and *motion synthesizing* can be roughly divided into the following procedures.

The first, in a similar way to that used in video editing, involves the arrangement of two animation sequences using overlaps and the fading in of transient areas of one motion track while the other track is being faded out at the same time. This method is generally called motion sequencing.

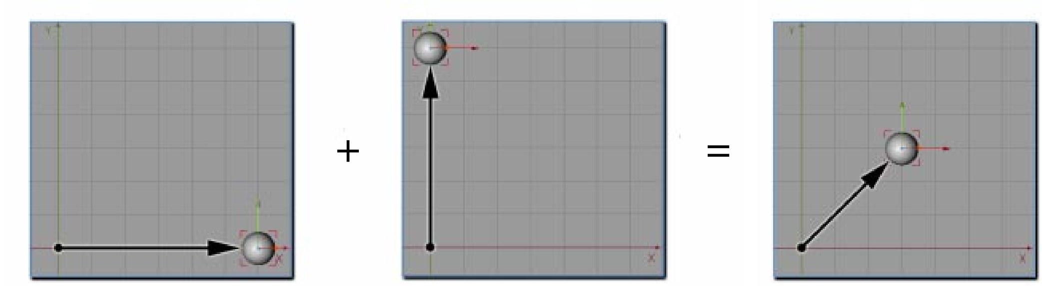
The second, and substantially more complex procedure, is motion synthesizing. Here, for example, several animation tracks with arbitrary weightings are fully overlaid, so that a completely new movement develops or is *synthesized*. The handling of these two methods is identical in CINEMA 4D, since they both take the same approach.

Mini Tutorial - Motion Synthesizing

So how now does the whole process work in practice?

Let us look first of all at a very simple task. Two sphere objects will be created and animated using different movements. Initially, the first object moves upwards, the second moves from left to right. With the help of motion sequencing technology we can now overlay the two movements in such a way that we end up with a diagonal movement from the lower left to the upper right.

- First, create a sphere by selecting **Objects > Primitives > Sphere** in the Editor menu.
- In the Object Manager, double-click on the object properties of the sphere and, in the parameter dialog, change the radius of the sphere to 50 units. Close the dialog window by clicking on the OK button.
- Duplicate the first sphere (perhaps with **Edit > Copy**, **Edit > Paste** in the Object Manager) and rename the two objects A and B (double-click on their names in the Object Manager).
- Now go to the Time Line and select sphere A. Create a new position track for this sphere by selecting the command **File > New Track > Geometry > Position** from the Time Line menu.
- With the Ctrl key pressed, click with the mouse on the beginning of this position sequence (position 0) to create a new key. Leave the values for X, Y and Z at 0 and close the position key dialog by clicking the OK button.
- Create, on the same sequence, a further key at time frame 90 with position values of X=0, Y=500 and Z=0 (you can type in 90 against the **T** value in the dialog to ensure a time frame of 90).
- Now drag the position track in the Time Line, while holding down the Ctrl key, to drag-and-drop this track from object A to object B. This copies the position track of object A to object B.
- Double-click on the second key (at time frame 90) of the position sequence for object B and change the position values to X=500, Y=0 and Z=0.



- Now click on the play icon in the Time Line. The two spheres should move in different directions.
- Select the two objects A and B in the Time Line by successively clicking on their names with the Shift key pressed.
- From the Sequences menu of the Time Line select the entry **Group Motion**. The two position tracks are now combined into two *motion* tracks.
- Choose **Edit > Deselect All** and then drag the complete *motion* track of object B on to object A, so that both of the tracks are assigned to object A.
- Create keyframes for the two motion sequences at time frame positions of 0 and 90 and adjust the value to 100% for all four keys.

If you now play your animation, sphere A should move as planned diagonally from lower left to upper right. This movement happens because both animations are synthesized with one another to the same proportions. If, instead of 100%, you enter another equal value to all the keys you will obtain the same result. Interesting effects result if you use unequal values.

Experiment a little, e.g. with two *ramps* moving in opposite directions (in this case, the weighting of the animation of object A decreases constantly, while the weighting of object B increases).

Tips and Tricks when Handling Motion Tracks

The successful use of *motion sequencing* or *motion synthesizing*, especially in areas like character animation, relies on your ensuring that the appropriate hierarchies and arrangements of the objects to be animated are as identical as possible.

The reason for this is easily explained. Assume you have two animated human figures, with fundamentally different hierarchical structures, that you are combining in their animation. CINEMA 4D tries to interpolate the entire animation structure from the first to the second object. Now, assume the arms and legs were exchanged in their hierarchical arrangement; the arms would try a run movement, while the legs stroll comfortably at the hip. The resulting animation would probably resemble a character from Monty Python's 'Ministry of Silly Walks'.

Missing parts of the hierarchy are usually less dramatic. If, for example, you try to transfer the animation of a hand with five fingers to a hand with only four fingers, the animation of the *remaining* finger will be ignored by CINEMA 4D. If you reverse this example, the last finger assigned in the hierarchy will contain no animation data.

When considering this overlay of hierarchical animations it is important to note that even the non-moving parts of an object are included in the synthesizing procedure, if they have their own animation tracks. Again using the above example of the two animated human figures; human A possesses a run movement, of which only the legs move. The arms hang down motionless beside the body but do contain the required hierarchical keyframing animation tracks.

Human B likewise has legs provided with blank animation tracks, but lifts the arms up (a rotation of 180°). If you now completely overlay the animations of human A and human B using motion synthesizing, you obtain the following result; the figure makes only half the number of steps as before but also lifts the arms to only the height of the shoulders (90° rotation).

The reasons behind this are the semi-redundant animation tracks of the objects that we mentioned before. In motion synthesizing, which uses an even overlay, these tracks *drag* their appropriate animated counterparts, for example, by 50% into their own movement. This results in the halving of the animation values seen above. This effect can strengthen further as each new animation object is included in the computation.

Put simply; if you have two figures, one with arms that keep still, while the other one has arms that rotate upward by 180° the result would be only a 60° rotation - a third of the original value.

You can avoid this problem in many cases by simply deleting the redundant animation tracks of the non-moving parts of your object from the hierarchy before creating the *motion groups*. As soon as these animation tracks are gone, then these parts of the object can no longer have any influence on any further combined animations. For more on this take a look at the appropriate *motion synthesizing* sample scenes on the CINEMA 4D CD.

File

New Track

Geometry

Position

Using this track type you can animate the position of an object in 3D space. After you invoke this command CINEMA 4D creates a new position track and a related sequence. In the dialog of the position key you define the appropriate X, Y and Z values for the spatial position of the object. Additionally you can define tangents that affect the movement of the animation in a similar way as for splines (see Spline Objects, page 135).

Scale

Using this track type enables you to animate the size of an object. CINEMA 4D creates a new scale track as well as a related sequence. In the dialog of a scale key you may define the appropriate X, Y and Z values for the spatial dimensions of the object. Additionally you can define tangents that affect movement of the animation.

Rotation

Use this track type to animate the rotation of an object. After you choose this command CINEMA 4D creates a new rotation track and a related sequence. In the dialog of the rotation key you can define the appropriate H, P and B values for the rotation of the object. Additionally you can define tangents that affect the movement of the animation.

Motion

This function creates an empty motion track *without* any related sequence. Motion tracks are used for animation sequences developed via *motion grouping* (see page 558, Combining Animations in a Motion Group).

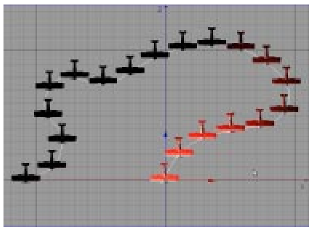
The function is present only for the sake of completeness since, under normal conditions, corresponding motion tracks are created automatically when combining animations into motion groups.

However, it can be useful should you need to assign motion sequences of other previously created objects to a new object with an empty motion track.

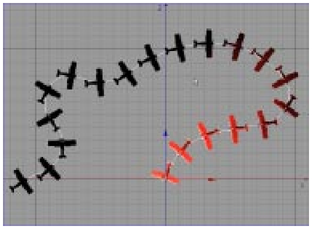
Align To Path

When you have created an animation path for an object (say, an aeroplane) — a position track, in other words — it is rather tedious to have to set the position of the object so that it is always tangential to the defined path by using a direction track.

The Align to Path track has the effect that the object will always follow the animation path you have created, either via the position track or via keyframes, with its Z axis parallel to the tangent of the path.



Without an Align to Path track



With an Align to Path track

Of course, this assumes that you do not already have a rotation track for the object; if you do, the rotation track data will override the Align to Path track.

The object's X axis always stays parallel to the XZ world coordinates. Thus, the camera follows the natural motion path.

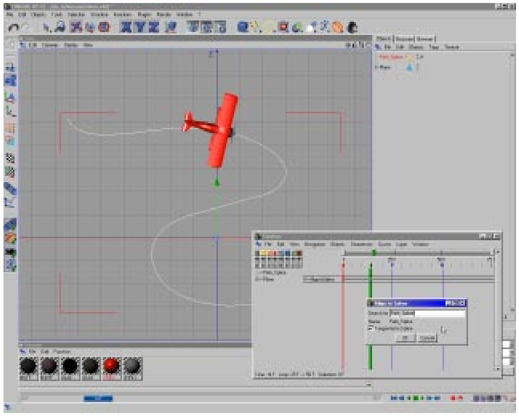
In addition, you can specify a bank angle which will allow the object to rotated around its Z axis by this value throughout the animation.

With the **Look Ahead** value you can choose how many frames should be considered when working out the orientation of the object.

Align To Spline

If you wish to define an animation path for an object, we recommend that first of all you create the path as a spline object. This has an advantage over the keyframe method in that you can create B-spline paths and use tools such as the magnet. You can also use completely closed splines for creating a cyclic motion. This would be difficult to do with the keyframe method.

In the spline key window simply enter the name of the required spline object. Your object now follows the path of the spline for the duration of the sequence.



In the spline key window you can optionally check **Tangential to Spline**. The effect of this function is similar to that of the Align-to-Path track i.e. the appropriate object's Z axis is kept parallel to the spline's tangent at all times (assuming your object does not already have a rotation track, which will override this effect).

This effect needs only a single key. However, you may use as many keys as you like with different spline parameters within a sequence. CINEMA 4D interpolates the movement as necessary.

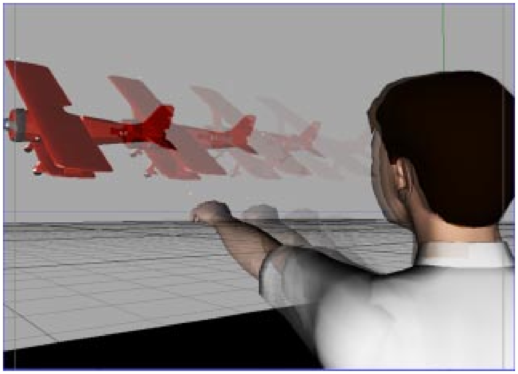
Note

If a spline has its intermediate points set to be Uniform, this is also taken into account for the spline animation. It will have the effect that the object follows the spline at a constant speed.

Inverse Kinematics

With an Inverse Kinematics (IK) track, all objects, starting from an anchor, follow a particular target object that you specify. To do this, you enter the name of the object to be followed in a key. CINEMA 4D then tries to have the object and all its hierarchically linked parent objects *pursue* this object, while obeying the laws of IK and the specified angle limits.

You could, for example, define an inverse kinematics track for the hand of a figure, specifying an aeroplane as the target object. The hand will then automatically keep pointing at the aeroplane.



Depending on the object hierarchy, it could happen that the object with the inverse kinematics track reaches the target only approximately or not at all. An arm, for example, can be moved only within the range defined by its joints. Even this range of movements may not be fully available, since IK always attempts to generate soft movements.

Before defining an inverse kinematics animation for an object, make sure you record the position and direction of all IK objects at or before the first keyframe. This is the only way to ensure that the object has a precisely defined position at a particular time and that the animation is reversible.

This effect needs only a single key. However, you can use as many keys as you like within a sequence, perhaps with different target objects. CINEMA 4D interpolates these movements accordingly.

Note

You can also calculate IK animations with the help of IK Expressions. For this you must assign an inverse kinematics tag to the appropriate objects in the Object Manager (see IK Tag, page 460) and then animate the target objects which are controlled by the tags.

Target

An example of when you might use target is when you have a camera that you want to follow the movement of an object so that the targeted object always remains in the center of the picture. For this, create a Target track; you only need to set one key, entering the name of the object which is to be followed. The Z-axis of the selected object then follows the other object automatically.

Objects can also be aligned mutually to each other. So for example the camera can be aligned to an object and the object to the camera.

Something that is not possible is the mutual alignment of hierarchically connected objects (e.g. an object to its sub-object).

This effect needs only a single key. However, you can use as many keys as you like within a sequence, perhaps choosing different objects to which the current object is to be aligned. CINEMA 4D interpolates these movements accordingly.

Special Effects

Morph

This special effect changes (*morphs*) an object into another object. You can use Morphing with polygon objects and spline objects; you cannot, however, morph primitives or spline primitives.

You can only morph between objects that have the same number of points. For example, you cannot morph a sphere into a cube when the sphere has many more points.

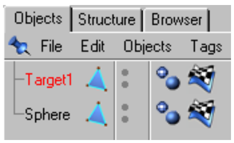
Rather, you should morph between modified duplicates of an object. For example, if you use the magnet or another modeling tool to fashion a copy of a sphere into a cube, it is possible to morph between a sphere and a cube.

Before you can morph an object you need to create target objects (duplicates of the original object).

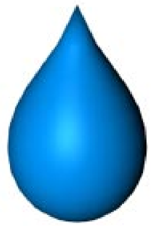
Perhaps morphing is best explained with an example:

Create a sphere and convert it into a polygon object by making it editable (see Make Editable, page 356).

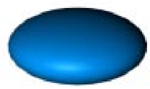
Next, create the first copy (**Edit > Copy**, **Edit > Paste** or Ctrl-drag within the Object Manager). This is the first target object. Rename it 'Target1'.



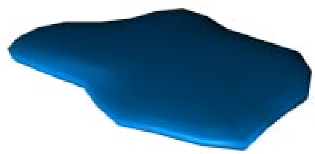
Activate the magnet and set the type to **Needle** (use the Active Tool tab for this). Working in either the point or polygon mode, deform the object to create a droplet shape.



Make another copy of the original sphere and name this copy 'Target2'. (You can hide 'Target1' to give yourself a better view in the editor - see Object Display, page 465). Scale the sphere along the Y-axis as shown in the following picture:

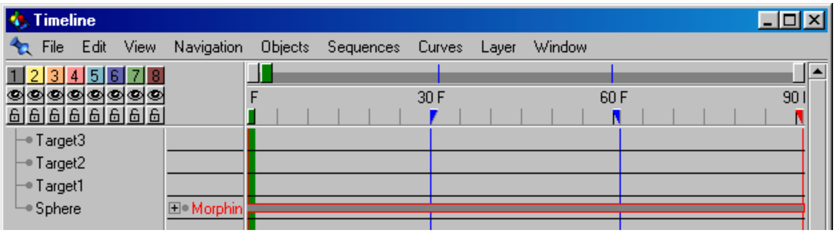


Next we need a puddle! To this end create a third target object by copying the original. Name this new object 'Target3'. This time, scale the target to flatten and widen it into a puddle shape. By all means create a few irregularities by tugging at the edges of the puddle with the magnet.

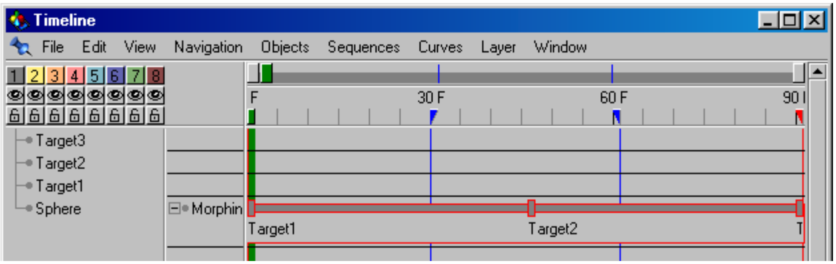


The target objects are now ready to be used. Hide the targets in the Object Manager (see Object Display, page 465). Keep the original sphere visible.

Now, only the original sphere is visible. Open the Time Line and assign a Morph track to the sphere.

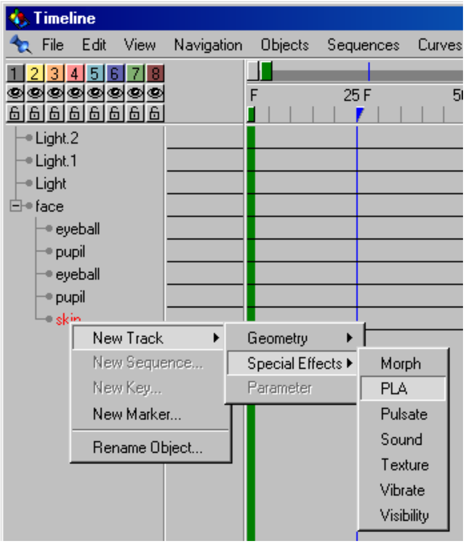


Create the first key at the start of the sequence and enter ‘Target1’ in the text field. Create the second key in the middle of the sequence and enter ‘Target2’ in the text field. Add a third key at the end of the sequence and enter ‘Target3’.



Now play the animation. You can, of course, fine-tune the morph. You are free to remodel the target objects.

Point-Level Animation (PLA)

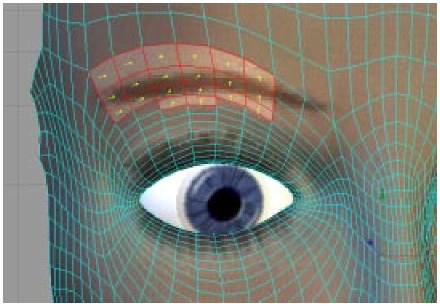


This special effects track lets you animate polygon objects and splines at the point-level. Primitives and spline primitives must be made editable before you can use them with point level animation (see Make Editable, page 356).

Use a key to record the positions of all points belonging to the active object. This method of recording points is considerably more flexible than the morphing method, since PLA does not require target objects.

Load the example file 'pla.c4d' from the CINEMA 4D CD Examples folder. The example shows a textured face. The texture was *nailed* to the face using UVW mapping so that it moves with facial animation (see UVW Mapping, page 531).

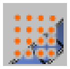
Change into polygon mode, then select the surfaces of the eyebrow.



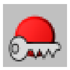
You do not have to be in point mode in order to use PLA. After all, polygon mode allows you to effectively move points (those points that belong to the selected polygons).

First we need a starting key to record the current position of the eyebrow's surfaces. Select a PLA track (**File > New Track > Special Effects > PLA**). If you create a key with the Ctrl key held down, the current position of the eyebrow at this frame will be recorded.

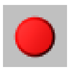
The process is even easier if you activate the PLA icon:



Now you can either record keys automatically (*autokeying*) for the active object...



....or set the keys manually using the Record button.

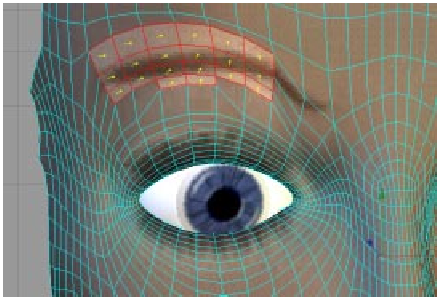


In both cases, a PLA track will be created the moment you record a key.

Let's create the first key. The eyebrow is in its starting position.

Before you set the next position and record, you need to move the blue time slider to the required frame, e.g. frame 30.

Once you have moved the time slider, move the eyebrow surfaces up a little (i.e. raise an eyebrow), then record a new key.

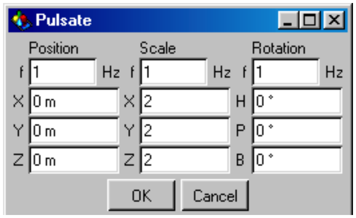


You can play back the animation in the editor thanks to the realtime texture preview (see Textures, page 22).

You could also use PLA to open and close the mouth, turn up the nose and so on. PLA opens up countless animation opportunities.

Before we leave PLA, bear in mind that you can animate spline points as well.

Pulsate



You can use this effect to change an object's size, position and orientation cyclically. You can use Pulsate with all object types - from primitive objects to deformation objects and so on. This track requires one key only.

Here's a very quick example to demonstrate pulsate; create a sphere, allocate a pulsate track to it and create a key. Use the key's default values, then play back the animation in the editor.

Note

This effect works with absolute position. So that you can still move the object freely, make it a child of a null object and move the null.

- Position

Use Position to enter the maximum positive and negative position values for the object along its X, Y and Z axes.

- Scale

Scale defines the maximum scale of the object along each axis using factors. A factor of two means that the object will pulsate between double and half the size of the original object.

- Rotation

You can also animate the object's orientation. Set the maximum angle of rotation for each axis.

- f in Hz

The frequency f defines the frequency of the position, scale and rotation settings.

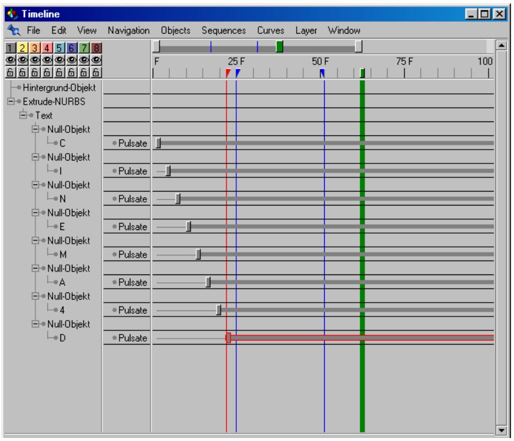
- Example

Pulsating individual objects is child's play. However, things start to get interesting with text!

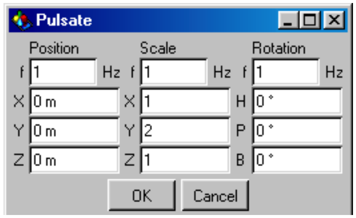
If each letter is a separate object, you can allocate a pulsate track to each letter.

You can prevent the letters from wobbling in synchronisation by setting the keys at different frames. You can do this quickly by dragging and dropping the first sequence including its key onto all the other letters one by one, dropping the sequence some distance to the right in each case.

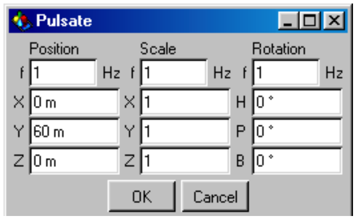
Here is the Time Line for the text object pictured below.



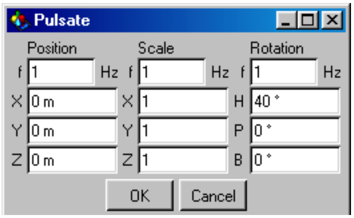
These are the settings used to make the text wobble - the scale along the Y axis changes cyclically:



Here is another example of wobbly text - the Y positions of the letters are animated cyclically:



To round off, here is a final example of wobbly text:



Sound

This function creates a new sound track, as well as an appropriate sequence, for the object selected in the Time Line. Using sound sequences you can apply WAV sound files to any objects. You will need to do this to use the 2D and 3D sound rendering abilities of CINEMA 4D (see pages 576 and 579).

—Applying a Sound File

To apply a sound file to a sound sequence, first unfold the appropriate sequence by clicking on the + symbol to the left of the word **Sound**. Now double-click in the empty field that appears beneath the sequence or select the function **Edit Data** from the Sequence menu.

Tip

Alternatively you can insert a sound file directly into a sound sequence using drag-and-drop from the Browser (see page 58).

In the dialog that appears select a sound file by clicking on **Load Sound**. You can then play the file by clicking on **Play**. Additionally, the following information is shown for the loaded sound file:

- Size
- Frequency
- Length
- Channel
- Bits

Tip

For playing sound files, CINEMA 4D uses the default playback program of the operating system (e.g. Media Player under Windows or QuickTime on the Macintosh.)

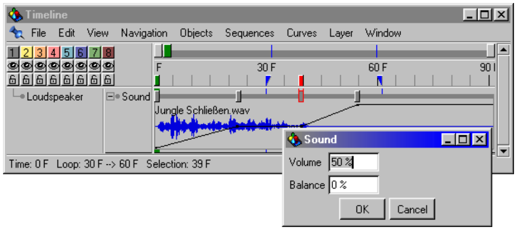
CINEMA 4D supports uncompressed WAV files at 11, 22 and 44 kHz as well as 8-bit, 16-bit, mono and stereo sound formats. Labels in the files are accepted.

Unfortunately many sound programs on the market (shareware editors, QuickTime etc.) do not always conform to the WAV file format guidelines when writing files. So if a file cannot be loaded by CINEMA 4D or loads incorrectly, please try to convert the sound file with a different sound editor.

Other programs often load incorrectly-written data quite happily, since they have very little or no control mechanisms to check the format. CINEMA 4D, on the other hand, interprets the sound data, efficiently and correctly. This is important, since otherwise CINEMA 4D's Browser could crash, or at least behave very strangely, with such incorrectly-written files.

—Changing the Volume and Stereo Balance

If you intend to use 2D sound rendering you can adjust the volume and balance of any sound sequence by adding keys to the sound sequence (in a similar way to video editing programs). When you add a key (Ctrl-click on the sequence as usual) a dialog will appear in which you can change the volume and balance values (see below). Once you have added a key, a black curve will appear below the sequence (when it is unfolded) to show the changing levels.



Volume

This is the volume of the appropriate sound file. Values between 0% (minimum volume, silence) and 100% (maximum volume) are permissible. By default, the volume is set to 100%.

Balance

This value gives the stereo balance of the appropriate sound file. Values between -100% and 100% are permissible. Negative values cause a shift of volume to the left channel, positive values to the right channel. By default, the balance is set to 0% (equal balance between left and right channels).

Tip

With 3D sound rendering the balance is ignored since volume and balance information comes from the 3D sound parameters, distances and movements. You can, however, still change the volume level.

Texture

You can use this special effects track to animate as many of the materials used by an object as you like (*material morphing*). The order of the texture tracks in the Time Line must correspond to the sequence of the texture geometry tags in the Object Manager; the topmost track in the Time Line must refer to the right-most texture geometry in the Object Manager, the next track down in the Time Line must refer to the next texture geometry to the left and so on.

For example, if you want to animate the third-from-top material of an object, you must create three texture tracks and animate the third track only. Since you do not want to animate the top two layers, you should leave the first two texture tracks empty.

All of the texture's parameters can be animated. You can, for example, make a texture *grow* by animating its scale; perhaps you will animate the texture by rotating it.

You can also morph between materials. Specify different materials in two texture keys and CINEMA 4D will automatically morph between the materials. You can get blood from a stone if you like!

Try this example:

- Create any primitive you like, e.g. a sphere.
- Create two new materials in the Material Manager. In the first material, load the Checkerboard shader on the Color page (click on the little triangle to the right of Image and select the shader). Rename the material ‘checks’. For the second material, load the Marble shader on the Color page and rename the material ‘marble’.
- Drag-and-drop ‘checks’ on to the primitive in the Object Manager, holding down Shift

during the process (this prevents the texture dialog from opening).

- Bring up the Time Line. The object should be selected already (its name should be highlighted with red text). If the object is not selected, click once on its name. The object's name will turn red. Create a texture track using **File > New Track > Special Effects > Texture**. A Texture track and sequence will appear.
- Hold down the Ctrl key and click near the start of the sequence. The Texture dialog opens. It already contains the 'checks' material. These settings are fine, so click on OK to close the dialog. Now create a key at the end of the sequence. This time, change the texture from 'checks' to 'marble' (type 'marble' in place of 'checks'). Before you close the dialog, enter an X offset of 100%. Then, click on OK to close the dialog.
- Hold down the Ctrl key and press the 'B' key. This handy shortcut opens the Render Settings (see page 408). On the **Output** tab, set **Frame** to **All Frames**. On the **Save** page, set **Format** to either **AVI Movie Small** or **QuickTime Movie Small**.

If you now start rendering in the Picture Viewer (**Render in Picture Viewer**) you will see how the 'checks' material morphs into the 'marble' material. Note also that the texture rotates. The rotation effect is made possible by using the offset value with UVW mapping (see UVW Mapping, page 531).

—Animated Textures

There are many reasons why you may wish to animate a texture. Perhaps you want to play a video on a TV screen.

If you want to use a picture sequence as an animated texture, you need to incorporate the logical number into the filenames, e.g. 'Picture0001', 'Picture0002' and so on.

You need to create two materials. Set the color texture of the first material to the name of the first picture in the sequence (e.g. 'Picture0001'). Set the color texture of the second material to the name of the last picture in the sequence (e.g. 'Picture0127'). Next, create a texture track and morph from the first material to the second one. CINEMA 4D will calculate the intermediate pictures.

You can also animate a picture sequence using a single material. In this case load the first picture ('Picture001') into the color page of the material and click on the **Edit** button to bring up the Time Controls dialog (see page 487). You can use the Time Controls dialog to control the playback.

You do not have to use picture sequences for animated textures; you can use AVI or QuickTime films too. Load the film into the material's color page and adjust the settings in the Time Controls dialog (see page 487).

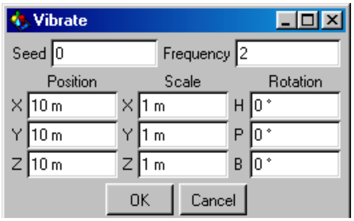
Note

CINEMA 4D searches for textures in:

- *the CINEMA 4D/Tex folder*
- *the scene's folder*
- *the scene's Tex sub-folder*
- *the alternative paths specified in the General Settings (including sub-folders)*

If CINEMA 4D cannot find a texture when rendering, a message will appear to tell you which textures are missing and which materials use these textures. You can still render the scene (just click on OK) - the materials that are affected will be used without the missing textures.

Vibrate



Computer animations are often too static and predictable. The Vibrate effect can help you add a random vibrating effect to your animation. If, for example, you are simulating a car chase, try vibrating the camera for a far more realistic effect. Ask your viewers to sit down first before they watch the animation, though.

This effect can be used with all object types including primitives and deformation objects. Only one key is required.

<u>Note</u>

This effect works with absolute position. So that you can still move the object freely, make it a child of a null object and move the null.

—Seed

Enter a start-value (seed). This helps the random number algorithm, since computers cannot generate truly random numbers. The same seed will generate the same vibrational behaviour. Change the seed value for a different vibrational pattern.

—f in Hz

f is the frequency value. It determines the speed of vibration.

—Position

You can set maximum and minimum values for the object's position along its X, Y and Z axes.

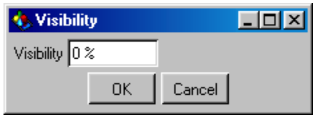
—Scale

Scale defines the maximum scale for the object along the individual axes.

—Rotation

You can also vary the object's orientation. Enter the maximum rotational angle for each axis.

Visibility



This effect can blend objects into and out of the scene. The strength of the visibility is defined as a percentage.

This effect is not visible directly in the editor; you must render to see the effect.

Parameter

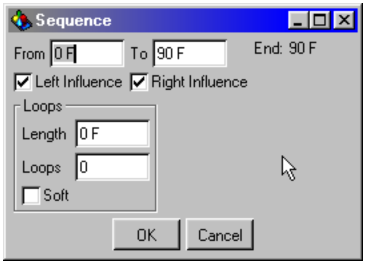
Using this track type enables you to animate the characteristics of most types of parametric objects (e.g. cameras, light sources, parametric primitives and deformation objects). Depending on the type of object, the appropriate object parameters may be entered into the key dialog for the respective object type, thus achieving an animated effect. So you can create a parameter track for a camera object then change the settings of the camera at each keyframe, as desired. CINEMA 4D then interpolates - if it makes sense to do so - between these different keys.

Areas of parameter tracks that are animatable would be, for example, animated depth of field effects, falloff angles of spot lights or deformations.

Note

Not all object types support parameter animations. In such a case the menu entry of the parameter track cannot be selected and no track will be created when recording.

New Sequence



Use this function to create a new sequence on the active track. It opens a dialog, allowing you to enter the start and end time of the sequence. To the right of these values the overall length of the sequence is shown.

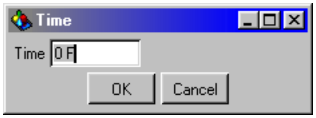
Additionally you can make this sequence loop a number of times. You can determine the overall length of the loop period or alternatively the number of loops. These two values are linked to one another and will change according to each other's value. Looped sequences are recognizable in the Time Line by the fact that the end part of the sequence is displayed in a darker grey. This range is the automatically generated loop and cannot have further keys added to it.

By checking the **Soft** option you can additionally define whether CINEMA 4D should softly interpolate between the individual loop sections. When checking the **Soft** option always bear in mind that the last key should not be directly at the end of the sequence, otherwise CINEMA 4D will not have sufficient time for the interpolation. Therefore, to avoid sudden jumps, always leave some space at the end of the original sequence.

Note

New sequences can also be created directly in the Time Line. For this simply hold down the Ctrl key and click with the mouse within the track. Keep the mouse button pressed and drag the pointer to the right or left to define the sequence.

New Key

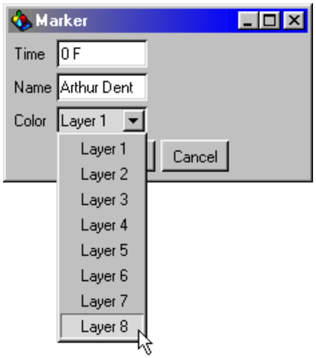


Use this function to create a new key on the active sequence. It opens a dialog, allowing you to enter the time position of the key.

You can edit the key data afterwards, either by double-clicking on the key or by calling the function **Sequences > Edit Data** from the Time Line menu (see below).

You can also directly create new keys in the Time Line. To do this simply hold down the Ctrl key and click with the mouse in the sequence at the position that you want to add the key. The new key is created at this timeframe position and its data dialog window opens immediately.

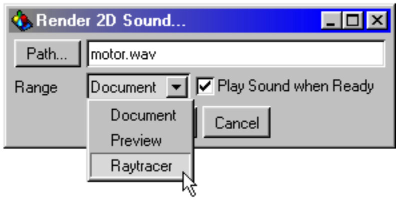
New Marker



This function creates a new marker (a downward-facing colored triangle) on the Time Line ruler. Markers are ideal for simplifying the look and navigation of the Time Line (see above). After calling this function a data dialog window appears allowing you to define the timeframe position and the name and color of the marker.

You can also create new markers directly on the Time Line ruler. To do this hold down the Ctrl key and click with the mouse on the Time Line ruler. The new marker is created at this time position. Markers which are created by such a mouse-click have no name assigned by default and will be given the color of the second layer. To change a marker's attributes, simply double-click on the marker to open its data dialog.

2D Sound Rendering



With this function you can render 2D sound data. CINEMA 4D creates a single, coherent WAV sound file, based on the sound sequences in the Time Line. Any volume and balance information in the appropriate keys is also included in the file.

With this feature you are, in effect, in front of a multi-track recording machine, with which you can cut together and mix many sound files individually and non-linearly.

Tip

When working with 2D sound rendering, CINEMA 4D creates uncompressed stereo WAV files in 16 bits (44.1 kHz).

Path

Enter the desired file path and name for the WAV sound file you want to create. The files are automatically given the extension '.WAV'.

Range

Use this to choose over how many frames 2D sound rendering is to be performed.

Document

Performs 2D sound rendering for the entire length of the scene.

Preview

Performs 2D sound rendering for the part of the document marked as a preview range (see page 522).

Raytracer

Performs 2D sound rendering for the number of frames defined in the render settings of the document (see page 414).

Play Sound when Ready

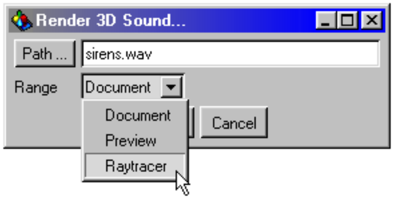
Check this option for the result of the 2D sound rendering to play automatically after the completion of rendering.

Tip

CINEMA 4D uses the default playback program of the operating system (e.g. Media Player under Windows or QuickTime on the Macintosh) for playing sound files.

You can, by the way, interrupt the calculation of the sound data at any time by pressing the ESC key or the Command key + '.' (Macintosh only).

3D Sound Rendering



With this function you can render 3D sound data. For that CINEMA 4D creates, for each microphone object in the scene, an appropriate WAV sound file. CINEMA 4D calculates the volume and pitch of each sound file according to the position and speed of all cameras and microphones in the scene.

If, for example, you have a loudspeaker emitting the thruster noise of a spaceship passing the camera and you also position two microphones on the right and on the left of the camera, you will generate sound files in which the sound (as in reality) moves from left to the right. If the spaceship/loudspeaker moves away from the camera, the sound will become quieter. If it moves closer to the camera, the sound becomes accordingly louder.

If, in addition, you turn on Doppler effect, the pitch of the spaceship will change according to whether it flies towards or away from the camera.

Naturally you can also adjust all of this by hand in a sound program. However, as soon as you change something in the way the objects in the scene animate, you have the problem of having to update all the sound data accordingly. The 3D sound rendering of CINEMA 4D is thus far more flexible than using conventional methods.

Tip

When working with 3D sound rendering, CINEMA 4D creates uncompressed mono WAV files in 16 bits (44.1 kHz).

Path

Enter the desired file path and name for the WAV sound file you want to create. The actual names of the files are built up as follows:

'File name from dialog' + '_' + 'object name' + '.WAV'

Example:

If you enter 'C:\temp\test' as the file path and there are two microphones with the names 'MicroA' and 'MicroB' in the scene, CINEMA 4D creates in the folder 'C:\temp' two new files with the names 'test_MicroA.WAV' and 'test_MicroB.WAV'.

Range

Use this to choose over how many frames 3D sound rendering is to be performed.

Document

Performs 3D sound rendering over the entire length of the scene.

Preview

Performs 3D sound rendering over the part of the document marked as a preview range (see page 522).

Raytracer

Performs 3D sound rendering over the number of frames defined in the render settings of the document (see page 414).

You can interrupt the calculation of the sound data at any time by pressing the ESC key or the Command key + '.' (Macintosh only).

Close

This function closes the Time Line. The animations created in the Time Line will remain.

Edit

Undo

This function is used to undo the last change made to the animation.

If you use this function several times, one after the other, first the last change you made will be undone, then the editing prior to that change is undone and so on. By default, CINEMA 4D saves the last ten edit steps internally and all of these steps may be undone.

You may change the number of undo steps in the General Settings (see Undo Depth, page 44).

Redo

If you should use the Undo function a little too vigorously and undo too far back then you can quickly reverse the undone steps with the Redo function.

Basically, with Undo you go backwards through the edit history of your scene, with Redo you go forwards.

The number of these restorable steps corresponds to the number of Undos (see above) and therefore cannot be separately changed.

Cut

This function copies the keys and the sequence data that are currently selected in the Time Line into the clipboard and deletes it from the Time Line. Elements stored in the clipboard may be inserted into the Time Line again with the Paste function (see below).

Note

When several sequences and keys are selected in the Time Line, CINEMA 4D always cuts the elements of the first selected line, top to bottom.

Copy

This function copies the keys and the sequence data that are currently selected in the Time Line into the clipboard. Elements in the clipboard can then be inserted again into the Time Line with the Paste function (see below).

Note

When several sequences and keys are selected in the Time Line, CINEMA 4D always copies the elements of the first selected line, top to bottom.

Paste

Inserts the stored elements from the clipboard into the active document. In the case of the Time Line the pasted elements *stick* to the mouse pointer and must be given a position in the Time Line. Do this by moving the mouse arrow to the position where you wish to paste the elements and click to paste them.

Delete

Deletes the animation elements selected in the Time Line. To delete all animation parameters of a certain object select the appropriate entry on the left. Objects themselves cannot be deleted with this command.

Delete All Markers

Use this function to delete all existing markers from the Time Line, in one step.

Select All

This function activates or selects all visible and invisible elements of the Time Line (objects, tracks, sequences, keys).

Deselect All

This function will deactivate or deselect all elements of the Time Line (objects, tracks, sequences, keys).

Invert All

Inverts the entire selection in the Time Line. So all selected objects will become deselected and all deselected objects selected.

Region Select

The selection tools described below work only in connection with sequences and keys. By using the Shift key and the mouse you can extend existing selections. Use Shift and Ctrl during the selection process to subtract the appropriate elements from an existing selection.

Rectangle

With this selection tool you select elements of the Time Line by holding down the mouse button and drawing a rectangular frame with the mouse.

Freehand

Use this selection tool to select elements of the Time Line by holding down the mouse button and drawing a free hand selection with the mouse.

Polygon

With this selection tool you select elements of the Time Line by holding down the mouse button and clicking with the mouse on consecutive points of the Time Line, thus drawing a selection polygon. To finish the process simply click in the proximity of the starting point. Alternatively you can close the polygon by pressing the right mouse button or, on the Macintosh, press the Command key while clicking with the mouse.

Snap to Frame

This function helps you to position keys and sequences accurately to frames when moving them with the mouse. If this option is deactivated all keys and sequences can be positioned freely between frames, without the use of time steps.

Project Settings

This function opens the dialog window for the Project Settings (see page 52).

View

Frame All

Using this function enables you to frame (or view) the entire animation within the visible work area of the Time Line. If necessary the view will be scaled horizontally.

Frame Selection

Use this function to frame the selected elements (sequences and keys) within the visible work area in the Time Line. If necessary the view will be scaled horizontally.

Frame Start

This function frames the visible work area in the Time Line from the beginning of the document. The view is not scaled.

Frame End

Frames the visible work area in the Time Line to the end of the document. The view is not scaled.

Frame Active Time

This frames the visible work area in the Time Line starting at the current position of the green time pointer. The view is not scaled.

Frame Time

This function frames the visible work area in the Time Line starting at a numerically entered time value. The view is not scaled.

Frame Marker

This function frames the work area in the Time Line starting at a selected marker. The view is not scaled.

Frame Right Marker

Frames the work area in the Time Line starting at the nearest right hand marker (the selection of the marker is based on the current view in the Time Line). The view is not scaled.

Frame Left Marker

Frames the work area in the Time Line starting at the nearest left-hand marker (the selection of the marker is based on the current view in the Time Line). The view is not scaled.

Zoom in

Increases the scale of the view in the Time Line by a factor of 2.

Zoom out

Decreases the scale of the view in the Time Line by a factor of 2.

Curves

Tangents

This command activates or deactivates the display of all curve tangents in the time control and space control modes.

Crosshairs

This activates or deactivates the display of the crosshair pointer in the time control and space control modes.

Activates or deactivates the display of the background grid in the time control and space control modes.

Range

This function activates or deactivates the display of the effective range in the time control and space control modes. The effective range is indicated by two dark red vertical lines.

Space Curves

X Curve, Y Curve, Z Curve

These commands activate or deactivate the display of the X, Y and Z curves in the space control mode.

Time Curves

Path, Velocity, Acceleration

These activate or deactivate the display of the path, velocity and acceleration curves in the time control mode.

Navigation

Record

All the functions in the Record submenu may be switched on or off. For each active track type option CINEMA 4D will attempt to create, for the object that active in the Object Manager, the appropriate tracks (including sequences and keys, if these do not already exist), when the Record function is next used.

If an object does not support one of the selected track types then no appropriate tracks for this object are created when keyframe recording.

Position, Scale, Rotation

Activate these options to create position, scale and rotation keys when keyframe recording.

The dialog windows of the position, scale and rotation keys are very similar. In the upper range of the window you change the appropriate X, Y, Z or H, P, B values.

In the tangent fields you can also change the shape of the animation curve (see Spline Curves on page 135 for a general discussion of these curves).

Point Level Animation (PLA)

When using the Point Level Animation track, CINEMA 4D saves all information for the points or the polygons of an object into single keys. This method, among other things, produces a very efficient and easy way of creating animated deformations. So you can edit, for example, a face with the magnet tool and record the intermediate stages with PLA keyframing. When you play the animation your object will be animated using these intermediate transformations and can change from a happy, smiling individual to a grouch.

At first glance this technology has strong similarities to that of the morph track, which also allows an object to transform through several stages. However ...

Note

When using PLA animation you should note that the complete geometry data of the animated object is needed for each key; therefore you should use this method only with smaller objects. Imagine animating a huge, 20 megabyte dinosaur with PLA. With only ten keys created for the beast you would already have a scene needing approximately 200 megabytes, even if the dinosaur just blinked! In cases like this you should use other animation techniques such as bones or morph tracks instead.

Parameter

Activate this option to create parameter keys when keyframe recording. CINEMA 4D creates, if possible, the appropriate tracks and keys with the current parameters of the selected objects.

Hierarchy

This option defines whether the sub-objects of the selected objects will also receive keys when keyframe recording. This can make sense, for example, when animating a character. You simply adjust your figure into your chosen pose and select the main object of the hierarchy. If you now start keyframe recording CINEMA 4D will create tracks, sequences and keys for the main character and all child objects.

Record (Function)

This command adds a keyframe recording at the current time. When keyframe recording CINEMA 4D automatically creates tracks, sequences and keys for the selected object in the Object Manager. Exactly which track types are to be created can be changed in the Record menu of the Time Line.

Autokeying

With the Autokeying command you can switch to fully automatic keyframe recording. CINEMA 4D will then add a new keyframe recording after each noticeable change in the scene.

This can result in an efficient recording system with swift results, especially with less complex animations. You simply change, for example, the time, move your object and CINEMA 4D notes the new position and records it with the appropriate keys. You then repeat this process until you are happy with the animation. There is no simpler way to animate.

Note

You can move forward and backward in time quite freely when Autokeying. Note, however, that keys that already exist can easily be overwritten.

Play Mode

Preview Range

Using this function you can play the section of the animation that is currently defined as the preview range in the Time Line (see above, Preview Range). This option can be switched to one of three playback modes: Simple, Cyclic or Ping Pong.

Simple

This system of playback plays the animation from the start to the end and then stops.

Cyclic

This system of playback repeatedly plays the animation from beginning to end again and again. You can end the playback using Stop.

Ping Pong

With this type of playback the animation plays forwards and then plays in reverse. You can end the playback with Stop.

Frame Rate

This menu allows you to choose the playback speed of your animation. The values are the number of frames per second (fps).

Note

The playback speed here has nothing to do with the real frame rate of the document or the raytracer, it is used only for the playing back of animations within the editor.

All Frames

This option takes priority in the Frame Rate menu. Unlike the other values in the menu, this option does not define a certain number of frames per second, but forces the display of each and every frame during playback. This can be very helpful, especially when dealing with complex animations, as you are able to view quick movements that could otherwise not be seen due to a slow screen update.

Note

If possible always select this option when using particles, as only then will you see the animation in the editor as it will appear when raytraced. If you do not choose this option for particles, CINEMA 4D may miss the occasional frame when trying to keep to the selected frame rate. This can lead to the particles in the editor being displayed inaccurately. For the raytraced rendering, however, this function will have no effect. The raytracer always renders the particles correctly!

Project

This option changes the playback speed to the value defined in the Project Settings (see page 52).

1 to 500

Select the frame rate from a number of sensible rates, within the range of one frame to 500 frames per second.

Play forwards

Use this command to play the animation forwards in the editor.

Play backwards

Use this command to play the animation backwards in the editor.

Stop

Use this to stop the playback of the animation in the editor.

Goto Start

This command will set the current time position to the beginning of the animation.

Goto End

This will set the current time position to the end of the animation.

Goto Frame

This displays an input dialog into which you can manually enter any timeframe. After confirming the dialog the current time position is set to this timeframe.

Goto Marker

This displays an input dialog into which you may manually enter the name of an existing marker. After confirming the dialog the current time position is set to the position of this marker.

Goto Next Frame

This moves the time position forward by one frame.

Goto Prev Frame

Moves the time position backward by one frame.

Goto Next Key

Moves the current time position to the next key.

Goto Prev Key

This command moves the current time position to the previous key.

Objects

Rename Object

This allows you to rename the object currently selected in the Object Manager. It is identical to the other ways of renaming an object (such as double-clicking its name).

Search Active Object

This command allows you to search the Time Line for the object currently selected in the Object Manager. This can be helpful when an object is hidden deep within an object hierarchy. The hierarchy of this object is unfolded to the point where the selected object is visible.

Unfold All

This function unfolds all hierarchies in the Time Line. This action is also applied to invisible and locked objects.

Fold All

This folds all open hierarchies in the Time Line. The folding is also applied to invisible and locked objects.

Bake Object

This function will convert animations which were not created using position, scale or rotation tracks (but nonetheless refer to the position or size of the object) into real position, scale or rotation tracks. As an example, you could convert a movement created with a spline-based inverse kinematics track into a rotation animation with appropriate keyframes.

This is necessary, for example, when editing animations using motion sequencing (see page 558). Another application would be the export of an animation into a file format such as VRML, which does not recognize geometry effects such as *aligning to* or *inverse kinematics*.

Note

Bake Object creates keys at regular intervals, paying no attention to any necessity for the positioning of the keys; very many keys are created. Therefore you should use this function sparingly and economically. You can try to reduce the keys of the animation afterwards with the help of the Simplify Curve function (see page 601).

Also note that not all types of animation can be *baked*. You can convert into real keys, for example, only those movements that alter the position, scaling or rotation of an object.

Expressions are also exempt from conversion, since they are only evaluated when drawing the scene (see The Drawing Pipeline, page 90) and, as such, are not contained within the animation.

Position Track to Spline

This converts a keyframe based position animation into a spline animation.

First, select the object that you wish to adjust. Then call up **Position Track to Spline**. CINEMA 4D will now create a new spline that corresponds to the movement path of the object. You can edit the spline and assign this to the object again with **Spline to Position Track**.

Tip

This command can be useful, for example, when editing an animation path that was created by keyframing with tools such as the magnet.

Spline to Position Track

This converts a spline-based animation into an animation that is based on keyframes. This can be useful, for example, if you wish to adjust certain path points of the animation to be accurate time frame positions.

First, select the object you wish to change. Then call **Spline to Position Track**. In the dialog enter the name of the appropriate spline and click the OK button. CINEMA 4D now creates a new position track for the appropriate object.

Sequences

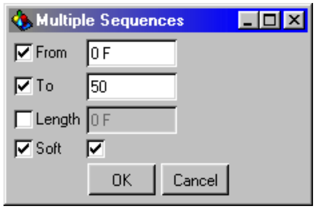
Edit Data

This has the same effect as double-clicking on the (unfolded) data area of a sequence or a key in the Time Line; it opens the appropriate dialog in which you can change the values of the selected element.

Edit Time

Enables you to edit the time values of a sequence or a key. This allows you, for example, to manually enter a timeframe at which a key is to be set.

Edit Sequences



This makes it possible for you to change the values of one or several selected sequences at the same time. So you can simultaneously move or scale several sequences, for example.

It is important to note that, within this dialog, only those values which are active (those that are checked) are applied to the selected sequences.

An example: if you want to switch the **Soft** option on or off for all selected sequences, first activate the left checkbox for the **Soft** option to tell CINEMA 4D that changes to this value are to be made. Now use the adjacent checkbox to determine whether the **Soft** option is to be on (ticked checkbox) or off (empty checkbox).

It is the same with the other values; if a value is not activated, it is also not changed. So you could quickly change, for example, the end of all selected sequences to 60F by deselecting all options except **To** and entering a value of 60 alongside the **To** box.

Note that, if the action cannot be performed (perhaps a key exists beyond the value to which you are trying to set the end of the sequence) nothing will happen.

From

This value defines the starting point (at the left) of the sequence(s).

To

This value defines the end point (at the right) of the sequence(s).

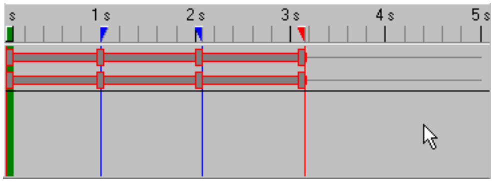
Length

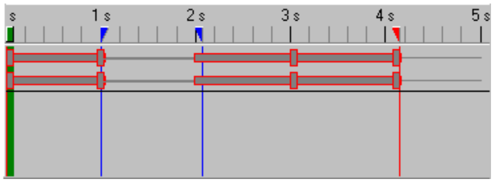
This value determines the length of the sequence(s).

Soft

This option defines whether the **Soft** option is switched on or off for the selected sequences (this is important for loop sequences).

Insert Preview Range



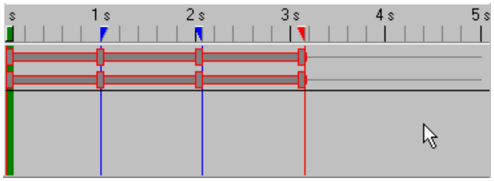


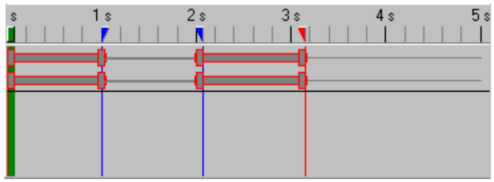
Using this command you can insert a gap that is the same size as the adjusted preview range between the selected sequences (remember, the preview range is the range between the two blue triangles on the Time Line ruler).
CINEMA 4D divides the sequences at the beginning of the preview range and moves the separated parts to the right and to the end of the preview range.

Tip

This function is very useful for creating extra space later on at a certain timeframe of a complex animation.

Delete Preview Range





This command resembles the function Insert Preview Range described above. However the appropriate range is actually deleted from the selected sequences. Keys that lie within in this range are therefore lost.

Adjust

This adapts the length of the selected sequence to the first and last keys of the sequence. Any overlapping parts of the sequence are cut off.

Tip

This can be helpful when you need to bring some order into the scene or to create further space for extra sequences.

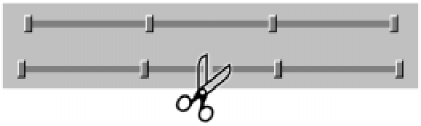
Connect

Using this you can combine several individual sequences. You can connect as many sequences of a track as you like. The sequences must be positioned next to each other, but do not have to touch (i.e. there can be a gap between the sequences but not another sequence).

Tip

This function can be useful when you require to loop a movement that is combined from several sequences.

Divide



With this function you can split one or more sequences into two halves by defining a time value. The sequence(s) will then be divided into two separate sequences positioned either side of the time value entered.

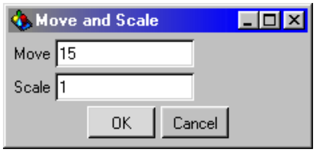
Markers from Selection

This function will create new markers based on the time values of the selected keys as well as the start and end positions of the selected sequences on the Time Line ruler.

Note

Some sound editing programs add markers to the sound file. If a sound track should contain a sound file with such markers or labels then these will be converted into real CINEMA 4D markers when using the function Markers from Selection.

Move/Scale



With this function you can simultaneously Move and/or Scale one or more selected sequences to a certain value.

Move

This value indicates how many units or frames the selected sequences are to be shifted to the right. Negative values will cause a shift to the left.

Scale

This value indicates the size factor that the sequence is to be scaled by. Example: if the value is 1, the sequence remains unchanged. With 2 it doubles the length and with 0.5 it is half as long.

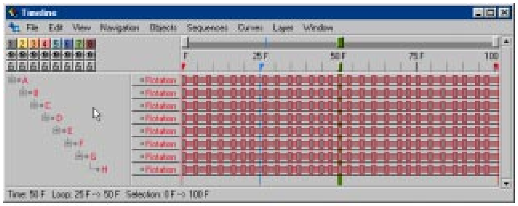
Quantize

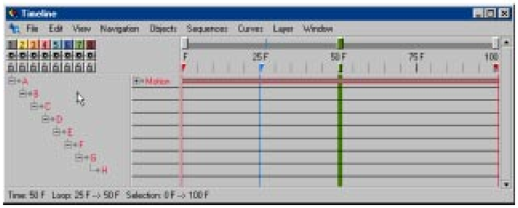
This function *rounds down* selected sequences or key positions to whole time frames. This can be helpful if, for example, the keys or sequences were moved to *odd* values by scaling procedures.

Tip

In certain cases this function can eliminate errors in courses of motion caused from scaling procedures (e.g. with motion capture data).

Group Motion





Using this function allows you to group or *fold* the complete animation of an object to only one *motion group*.

Note

The Grouping also functions hierarchically, i.e. if you group a complex figure with many animated sub-objects, then all such groupable animation tracks of these sub-objects will disappear.

For grouping, select the appropriate object and call the function **Group Motion**.

You will obtain a new motion sequence containing all animation information of the object, which can be moved or scaled quickly and easily. You can also assign several such motion groups to an object and mix together the different movements with the keys on the motion sequences (see page 558).

You can group position, scale and rotation tracks. You should therefore convert movements which were created with the help of other track types (such as Inverse Kinematics) into these types of tracks by using the **Bake Object** function.

Note

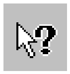
Please do not confuse motion grouping with the Unfold All and Fold All functions from the objects menu, which simply fold the view of the object hierarchy in or out.

When creating motion groups no information is lost. You can re-establish the original un-grouped layout at any time by using the **Ungroup Motion** function.

Ungroup Motion

This function ungroups any motion group back into its original form. Simply select the appropriate motion track and call the function.

Get Time Curve from



Use this function to assign an already existing time curve of another sequence to one or more selected sequences. Select one or more sequences and then call this function. A question mark will appear at the mouse arrow. Now simply click the sequence that should receive the chosen time curves.

Curves

The description of the Curves menu is handled here somewhat differently from the previous sections on the Time Line. To be more meaningful, we have split up the description into sections on Space Curves and Time Curves.

Space Curves

The Space Curves window is available from within the Time Line. Here the data of the position, rotation and scale keys of the selected sequence are displayed as space curves. Among other things this has the advantage that you can see the tangents directly and you can edit the curves interactively using the mouse.

Call up the space curves window by selecting the **Window > Space Curves** menu option from within the Time Line.

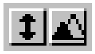
Now you may find these diagrams rather daunting initially; but perhaps you remember those space-time graphs from your physics lessons? Well the space control window is really just a space-time graph with some added processing options which, together with the Time Curves (see page 602), allow a huge degree of control over how your animation turns out.

Navigating in the Space Control

The diagram shows space-time curves for any number of active sequences.

A green vertical line indicates the current frame of the animation; you can move this to other frames by dragging the green box at the top of the line.

The various ways of framing the window using the powerslider at the top of the window and the View menu are discussed earlier in this chapter; they work identically here.



Within the Space Curves window you will see two small icons towards the top left of the window; these allow vertical control over the window. You can move the window display up or down using the icon on the left or scale it using the icon on the right; position the mouse pointer over the icon, click and drag up or down.

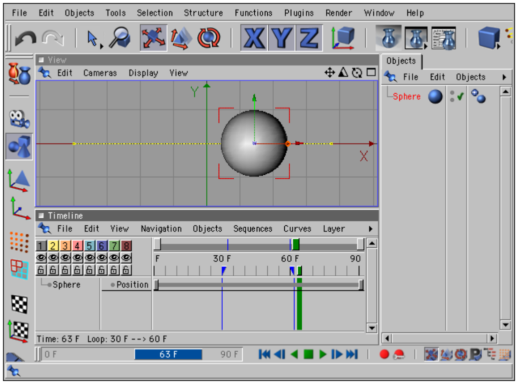
Editing in the Space Curves Window A Mini Tutorial

In order to give you a feeling of how to use the Space Curves features we'll run through a short tutorial.

First, create a short animation.

Keep it simple; perhaps a sphere moving along the X axis from the origin to (200,0,0).

To do this create a sphere, hit the Record button, move the animation slider to say 30 frames, move the sphere to (200,0,0) (use the Coordinates Manager or lock the Y and Z axes and move it interactively) and hit the Record button again. If you have difficulty creating such an animation have a read through this chapter and see the Tutorial manual.



If you save the scene now, you can use it for the following Time Curves section.

Now select the position sequence in the Time Line by clicking on the sequence. Switch into space curve window (**Window > Space Curves**) and look at the diagram. A reddish-brown line (representing the X axis) shows how the position of our object has changed over time along the X axis. The green and blue lines (for the Y and the Z axis) are both constant on the zero line.

Now move the time slider to the middle of your animation (about frame 15 in the above example), go back to the editor window and move the sphere up along the Y axis (again, either use the Coordinates Manager or lock off the X and Z axes, activate the Y axis and interactively move the sphere). Record this new position, so creating a new keyframe.

As you will have noticed, assuming all windows are visible, the green curve within the Space Curve window (movement in the Y direction) changed immediately - it became a small hill! In addition all three lines have an additional key now (the small point in the center).

Click on one of these keys with the mouse - immediately the tangent of this point becomes visible. You can now move the point and edit the tangents with the mouse. The tangents behave exactly the same as the tangents of Bézier splines and you can read more about those in Spline Curves, page 135.

Now move the points and tangents a little and you will very quickly have a feeling for what you can do with these diagrams.

Note

The individual keys can be moved vertically completely independently. However in the horizontal direction (along the time axis), all points are moved together; the three values for X, Y and Z are kept in one key.

Moving keys vertically is how you specify the position, direction or size of an object at a particular point in time and separately for each of the three curves.

Moving keys horizontally is how you specify when an object will be at a particular position, in a particular direction or have a particular size.

In many cases you will see only a particular section of the animation or of the sequence. It is of course possible to fit the animation into the window using the power slider and other methods, described elsewhere. However, this can sometimes make the display small and difficult to work with.

So CINEMA 4D has a convenient way of scrolling the display. Click in the free region of the inner graph window. Hold the mouse button down and drag, left and right or up and down. This will move the window contents in real time.

You can also add new keys within the Space Curves window. Hold down the Ctrl key while clicking in the inner graphics area. This will add a new key automatically.

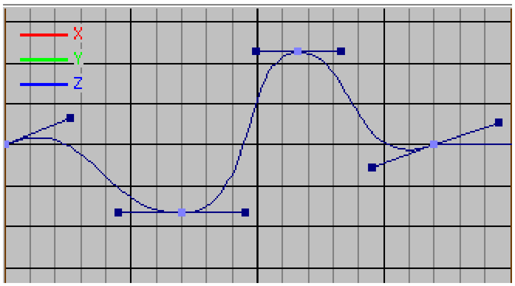
Curves Menu

Tangents

—Soft / Hard Interpolation

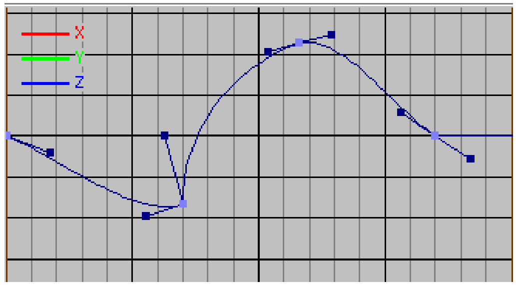
As already mentioned the curves here behave, as far as possible, just like the Bézier splines of the Objects menu (more exactly they are Bézier Splines - but not used for object construction).

With this menu option (**Curves > Tangents**) you can select between hard or soft interpolation for the tangents. Hard Interpolation sets the tangent length to zero (giving a hard transition at this key) while Soft Interpolation produces tangents of equal length and of such a length as to produce as soft as possible a course for the curve.



—Unify

For any of the space curve keys you can change each tangent arm independently of the other by holding down the Shift key while dragging the tangent around; just like you can for any Bézier spline.



The Unify command evens things out again; it makes both tangents of the selected keys the same length and aligns them in a straight line, in opposite directions. The right tangent is the one that is modified to adapt to the values of the left tangent.

—Flat

Use this to align all tangents of the selected keys horizontally (the length of the tangents will not be affected).

Edit Data

Selecting this option allows you to edit the position and tangents of a point numerically. You can achieve the same thing by double-clicking on a point.

Move

If you want to move one or more points by a particular value, you can use this command to enter the (X,Y) values directly. Of course you can also move the points by hand (or, more accurately, mouse).

Scale

This function ensures for the fact that both the position of a point quantity and their tangent lengths and distances to each other can be scaled a freely selectable factor in X and Y direction. Origin of the scaling is always the first key from the left.

X Axis/Y Axis

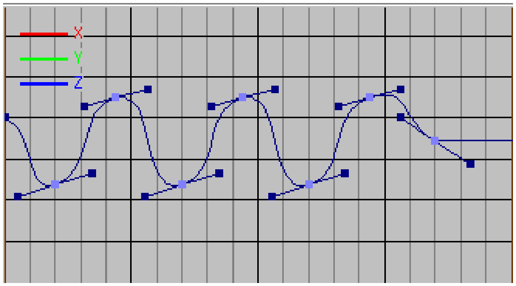
By checking/unchecking these options, you can limit the movement of keys and their tangents so that they can be moved with the mouse only horizontally or only vertically or both or not at all. This only affects movement using the mouse; the **Edit Data** command ignores these settings.

Mirror X/Mirror Y

This option mirrors the selected key values including the tangents about a horizontal (**Mirror Y**) or a vertical (**Mirror X**) axis. This option needs at least two selected points.

Cycle

With this option you can group a number of selected keys and have them repeat cyclically. Here the first key of the selection steps to the position of the second key, the second key to the third key and so on. This option needs at least two selected keys (not points on the same key).



Cycle With Offset

This command is similar to the Cycle command described above. This time, though, the first point stays where it is and is not repeated. The remaining points are repeated, and each repeat is offset. The size of the offset is determined by the vertical distance between the first and second points of the original selection. This command requires at least two points to be selected.

For example, if the starting key has a starting position of 200, then the first key of the repetition will have a position value of 400, the next one of 600 etc.

Bake Curve

Perhaps you've already given your curve the basic correct form with the help of the tangents, but you would like to fine tune it in some places, adding some detail or variation?

With Bake Curve you can provide the curve with as many extra keys as you need. For **Frequency** enter at which frames CINEMA 4D should insert new keys automatically (1 for every frame, 2 for every other frame etc.).

The form of the curve will remain unchanged but the new keys inserted will allow fine tuning to take place as desired.

Simplify Curve

This function does roughly the opposite of Bake Curve. If a curve has too many keys in places where these are not needed at all, these superfluous keys can be eliminated, with separate controls for both horizontal (frame) and vertical (position etc.) data.

This is useful when working with motion capture data. There you normally have to cope with thousands of (mostly unnecessary) keys. With Simplify Curve you can reduce this to a bearable number and thus make the motion capture data much easier to work with.

Example:

If keys are to remain every ten frames, you should enter for X a value of 10F. If keys are to remain only when a change of position is more than 50 units from the previous key or to the following key, you enter a value of 50 for Y. Naturally, you can set both values at the same time.

Note

Use this function with extreme caution. Carefully adjusted curves can be ruined easily with an indiscriminate use of Simplify Curve. So, approach your optimal curve slowly and reject over-simplified results with the Undo function.

Time Control, Time Curves

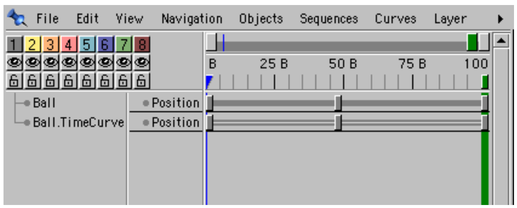
We'll begin this section with a little theory. Please make sure you read through these pages because, although the time control is easy to use, it is also exceptionally powerful. A little understanding now will help you create stunning animation later.

You should already know how to give an object motion, animate light parameters, animate camera parameters and so on. In each case, the first step is to create a track and sequence for the object. Next, you need at least one key for the sequence. A key is like a snapshot in time - it contains the values for that exact moment (frame). Sometimes, dozens of keys are used for a sequence.

Good timing is essential for top-quality animation. Not only is it difficult to create smooth animation (e.g. ease-in ease-out) using Time Line keys alone, it is not a very flexible way to work - altering one key may affect the entire sequence.

There is, however, a wonderful solution; time curves. As soon as you apply a time curve to a sequence, the time curve takes control of the timing and the comparatively clumsy frame positions of the original keys no longer matter.

You can tell if a sequence has a time curve by its appearance:



Time Curves

We will explain time curves with the help of a practical example. We shall use the sphere scene, which you may remember from the Space Curves section above (a quick reminder, a sphere moves along the X axis, from left to right. There are two keys, one at the start and the other at the end of the position sequence).

Change into the time curve view (select **Window > Time Curves**). The graph is empty to begin with.

Why is the graph empty? The answer is simple; sequences do not usually have a time curve because their Time Line keys are interpolated linearly. This is in contrast to space curves, which always show graph readings. Make things easy on yourself and, even if you do not understand why, accept that the space curves and the time curves have almost nothing to do with each other.

The most important menu for time curves is, unsurprisingly, **Curves > Time Curves**. We will explore this menu in detail. The remaining menu items have the same functionality as their counterparts in the space curves and are covered towards the end of this chapter.

Path Mode, Velocity Mode, Acceleration Mode

There are three modes for working with time curves; path mode, velocity mode and acceleration mode. You should work in the mode relating to the values you want to control. For example, if you want to control the object's acceleration, you should work in the acceleration mode.

Note

No matter which mode you are in, the curve that you edit is a master curve in the sense that if you change modes, the master curve will then be applied to that mode. For example, if you create a time curve in velocity mode, the master curve is a velocity curve. However, change into acceleration mode, and it becomes an acceleration curve. The shape of the master curve remains the same when you switch modes. You can only edit the master curve, since all three curves are interdependent. The result of the master curve can be seen by playing back the animation in realtime in the editor (you can even keep the animation playing while you edit the master curve!). Note that the curve is approximated for realtime playback - you must render in order to see the exact results.

Ramp Up

Enough of the theory...

Let's get back to our sphere scene. Select **Curves > Time Curves > Ramp Up**. Notice how a red curve appears on the graph. As the red **P** on the graph suggests, the red line represents the path. The path curve rises linearly, with a key at either end.

Note

The graph's vertical units refer to an abstract percentage (%). 0% equates to the values of the first key in the Time Line sequence. 100% equates to the values of the final key in the Time Line sequence. In other words, 0% refers to the initial state of the sequence, 100% refers to the final state of the sequence.

Play back the animation in the editor. Nothing seems to have changed, at least not visibly. OK, drag the right key on the time curve down to the 50 (%) value. If you like, you can leave the animation playing while you do this - you can edit keys in realtime! Notice how the sphere only reaches the halfway mark now. The sphere travels at half the original velocity as well, since it now covers half the distance over the same time period.

Move the right key up to 200 (%). Now the sphere travels with twice the original velocity. As a result, it has already reached its destination midway through the animation. The sphere remains stationary throughout the second half of the animation.

Hang on a moment

Something doesn't add up! How can the time curve have a value greater than 100%? No matter what the time curve suggests, only values between 0 and 100% can be evaluated. So, when the path exceeds 100%, the sphere remains stationary.

Did you notice how the green velocity curve changed? The velocity curve often runs parallel to the time axis apart from near the start and end (for ease-in ease-out behaviour). The greater the distance in units between the velocity curve and the null line, the greater the velocity.

Now, change into velocity mode, then select **Ramp Up**. This makes the velocity increase linearly. A linear increase in velocity means constant acceleration - falling objects, for example, experience constant acceleration. If you fancy a challenge later on, try creating constant acceleration without time curves - good luck!

Ramp Down

Change into path mode, then select **Curves > Time Curves > Ramp Down**. The red path curve now decreases linearly and the green velocity curve is below the null line. The sphere is travelling backwards. Now you really can turn back time!

Note

You can use this type of reverse behaviour to create eye-catching effects. For example, you can turn an explosion into an implosion or unmelt a melted object! Oh, did we forget to tell you that you can use time curves with any type of sequence?

Plateau

Select **Curves > Time Curves > Plateau**, then play back the animation. The result is not exactly spectacular. Change into velocity mode.

Now, the object accelerates at the beginning of the animation and decelerates at the end. This is *ease-in ease-out* behaviour. Look at the blue acceleration curve on the graph. Acceleration curves can be a little tricky to understand at first - it may take a while to sink in.

Finally, select **Curves > Tangents > Soft Interpolation**. The plateau becomes a smooth arch. Now is a good time to experiment. Try moving the tangents for the keys. Try working in some of the other modes, and be sure to create some new keys (Ctrl-click).

Fit Path End to 100%

Sometimes you may notice that an object is not reaching its destination at the correct time. Perhaps its velocity is too high or too low (in which case the red path will end above or below the 100% mark respectively).

If you select **Fit Path End to 100%**, CINEMA 4D will ensure that the curve reaches 100% exactly.

Note

In some instances you do not want the path to end at 100%! (e.g. when you have used Ramp Down to reverse the sequence).

Formula

Mathematicians will have a field day with the Formula function. This lets you enter a formula to generate a time curve. Even if you are hopeless at maths, don't run away - we're going to show you some very useful formulae that anyone can use.

You enter the formula in the **s(t)=** field. You can also set the number of intermediate points using the **Keys** field.

The Sine Function

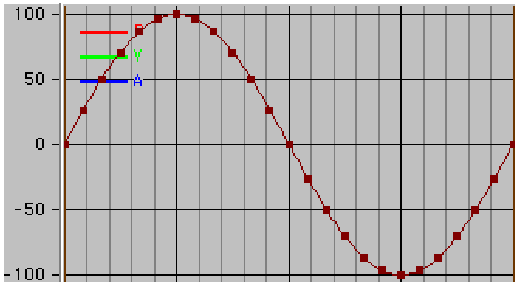
Let's return to our old friend, the sphere scene. Change into path mode, then select the **Formula** function. The **s(t)=** field contains the default formula:

sin(t*pi*2.0)*0.5 +0.5

'sin' stands for sine and describes a sine curve. The expressions in the brackets define the amplitude and frequency of the sine curve. The letter 't' stands for time. Don't worry if the formula means nothing to you.

Enter the formula 'sin(t)'. The result is rather uninspiring - a shallow curve which reaches 100 (%). We can make the curve more interesting by using a *scaling factor*. We shall use 2*pi, which to many mathematicians suggests one oscillation. Though we shall use Pi, you can use a number as a scaling factor (after all, Pi is only a number; 3.141... - we hope mathematicians are not offended by the use of the word *only*).

Anyway, let's try a scaling factor - enter the value 'sin(t*2*pi)'. Sure enough, the result is a sine wave.

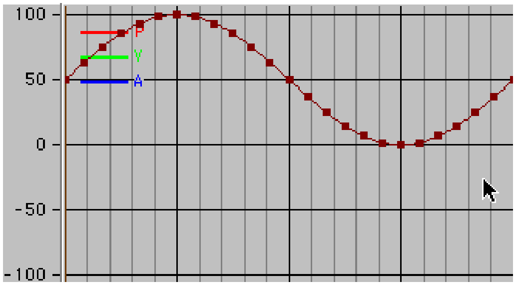


Notice how the sphere only moves during the first half of the sine curve. Recall that a path value can only be evaluated when it lies between 0 and 100%. The sine curve values range from -100% to 100%. The negative values cannot be evaluated, and so the sphere is stationary for the second half of the sine curve.

How, then, can we adjust the sine curve so that it can be evaluated in full? We can *see* what needs to be done - the curve should be shifted up and scaled to fit between 0 and 100%. The amplitude currently runs from -100 to 100%, so we need to halve it, i.e. divide it by 2. Dividing by 2 is the same as multiplying by 0.5.

Here is the final formula ...

sin(t*pi*2.0)*0.5 +0.5



Play back the animation and give yourself a well-deserved pat on the back!

The Exponential Function

Let's try the exponential function. Start by entering 'exp(t)', then select **View > Frame All** so that you can see the curve in full.

The curve begins at 100% and rises *exponentially*. Add a scaling factor by entering 'exp(t*2)', then select **View > Frame All**. The curve is much steeper now. Change the scaling factor to '*0.5' - this should give you a more shallow curve.

Let's try a negative scaling factor! Enter 'exp(t*-2)', then select **View > Frame All**. Now the curve decreases exponentially towards (but never quite reaches) the null line.

Play back the animation and notice how the sphere slows down exponentially. Very nice, but don't sit back just yet - we have something special lined up.

The Exponentially Damped Sine Curve

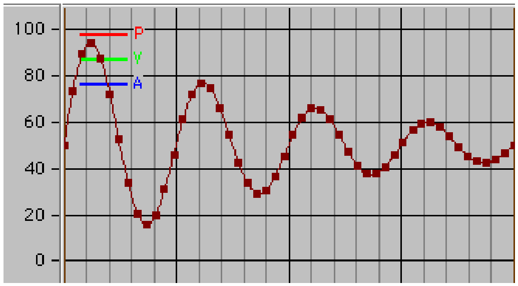
In this section we're going to use the functions we've just learnt (sin and exp) and put them together for something special; the exponentially damped sine curve.

Believe it or not, damped sine curves are very common. If you need convincing, grab your computer mouse by the tail, swing it and then keep your hand still. That's a damped sine curve. If you can't conduct our mouse experiment because you have the cordless variety, grab your monitor cable instead and, ... on second thoughts, leave your monitor exactly where it is!

We need to combine our sin and exp formulae and add a few more oscillations for good measure:

Enter

exp(t*-2)*sin(t*8*pi)*0.5+0.5



Sit back, watch the animation, and don't forget to close your mouth.

Very important note

You can use a formula with any type of animation including parameter and special effects sequences.

Offsets

This is where things get mathematical. If maths is not your cup of tea, stay for the ride anyway - we're almost done.

You can use this function to set an *integration constant*.

Before we continue, recall that the path, velocity and acceleration are interdependent. The acceleration is the differential of the velocity, which in turn is the differential of the path. Put another way, we can integrate the acceleration to arrive at the velocity, and we can integrate the velocity to give the path. Passionate mathematicians will know that every integral has an integration constant which shifts the curve up or down the graph.

If you didn't quite understand that, the main point is that you can use an offset to give an object an initial velocity or start it from anywhere you like along the path. A positive value shifts the curve up the graph. A negative value shifts the curve down the graph. If you are unable to select both entries, you are in path mode. If only **Path** is active, you are in velocity mode.

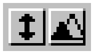
This is because, as discussed earlier, we can integrate the acceleration to calculate the velocity, which in turn can be integrated to calculate the path. The path is the end of the road, which is why you cannot use offsets in that mode (an integration constant can only be used when you integrate and the path does not integrate into anything meaningful).

The Remaining Menu Items

In this section we cover the remaining menu items. All of these items are used in the space curves too - you can skip this section if you have already read the space curves section.

Navigation

The section on navigation showed you how to use the Time Line's **View** menu. The time control's **View** menu operates in the same way.



The time control has two icons to the left of the graph. You can use these icons to move or scale the graph (click on the icon you require and then drag the mouse).

Curves Menu

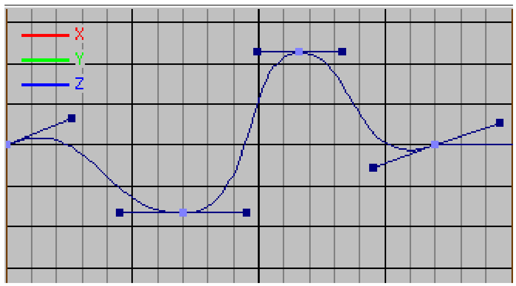
Tangents

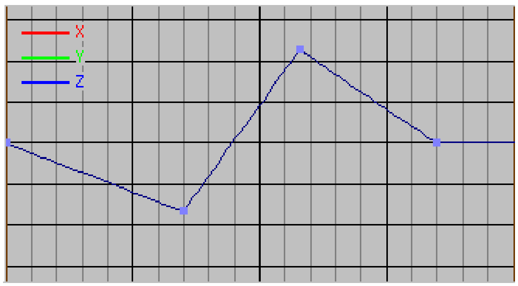
—Soft/Hard Interpolation

Time curves are Bézier splines. You should already be familiar with Bézier splines thanks to the **Objects** menu.

You can use these commands to give the time curve a hard or soft interpolation.

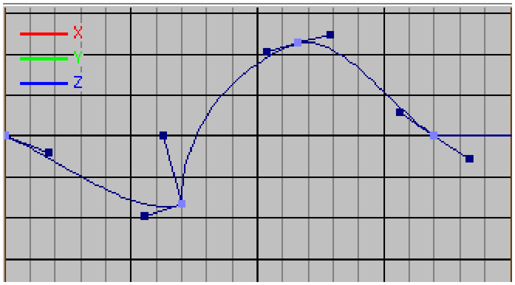
In mathematical terms, *Hard Interpolation* sets all tangents to zero; *Soft Interpolation* adjusts them to create as smooth a curve as possible.





—Unify

You can move a tangent arm independently of its twin (use the Shift key) and thus the tangents do not have to be linear with each other (on the same straight line).



The **Unify** command makes the tangent pair point line up again; it also equalises the tangent lengths. The right tangent is adapted to the direction and length of the left tangent.

—Flat

This function sets the tangents of all the selected points so that they have a horizontal (flat) direction.

Edit Data

You can use Edit Data to change a point's position and tangent values. You can access the same dialog by double-clicking on the point.

Move

This lets you move one or more points by the distance you enter. You can, of course, move the points manually.

Scale

This function lets you scale the selected points. The left-most point marks the origin of the scale operation.

X-Axis/Y-Axis

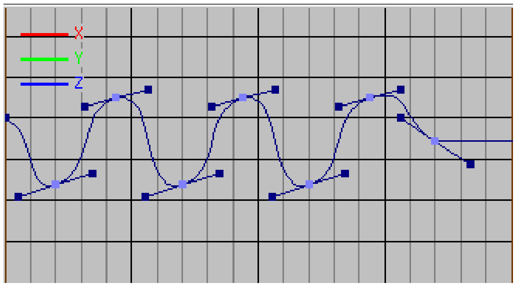
You can use these options to enable or prevent movement along the X and Y axes. For example, you can deselect **X-Axis** if you want to move a key vertically only.

Mirror X/Mirror Y

These commands mirror the selected points (including their tangents) horizontally or vertically. These commands require at least two points to be selected.

Cycle

Cycle repeats the selected points. The last point of the selection is not repeated but shifted to the end of all the cycles. This command requires at least two points to be selected.



Cycle With Offset

This command is similar to the Cycle command described above. This time, though, the first point stays where it is and is not repeated. The remaining points are repeated, and each repeat is offset. The size of the offset is determined by the vertical distance between the first and second points of the original selection. This command requires at least two points to be selected.

Bake Curve

Imagine you have used the tangents to form the general shape for your time curve, and now you want to add small details that require extra points.

You can use **Bake Curve** to add as many points as you like. **Frequency** defines the distance between each point. The new points will fit the existing curve shape.

Simplify Curve

This command has the reverse effect of the Bake Curve function in the sense that it removes points. Imagine that you have too many points, making it difficult to make smooth changes. You can remove points using the **Simplify Curve** command. You can set a horizontal and/or vertical tolerance value. Points that are closer than the tolerance value(s) are removed.

Example

If you want the keys to be at least 10 frames apart from one another, set the X value to 10. If, on the other hand, you want keys to be at least 15% apart from each other, set the Y value to 15.

Note

Use this function with caution! If your tolerance value is too large, your new curve will lose its shape.

Layer

Color Selection

With this menu you can assign one of the eight pre-defined colors to the elements (objects, tracks, sequences, and keys) selected in the Time Line.

Select Layer

Choose one of the eight layer entries from the **Select Layer** menu to select all elements related to this layer in the Time Line.

Toggle Layer

Choose one of the eight layer entries from the **Toggle Layer** menu to both lock and switch to invisible the appropriate layer. Another call to the same layer toggles the layer to visible and unlocks it.

Solo Layer

Choose one of the eight layer entries from the **Solo Layer** menu to switch all layers except for the selected one to invisible and locked.

All Layers

Using the menu functions **Visible**, **Invisible**, **Unlock** and **Lock** allows you to toggle on or off and lock / unlock all layers at once.

Window

Sequences

Changes the Time Line window into the standard mode in which you can edit the sequences and keys of your animations.

Space Curves

Changes the Time Line window into the space curve mode in which you can edit the single space curves of your animations (see page 602).

Time Curves

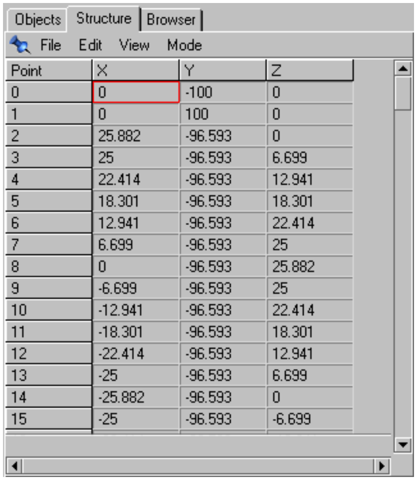
Changes the Time Line window into the time curve mode in which you can edit the single time curves of your animations (see page 602).

CINEMA 4D

MODELING • ANIMATION • RENDERING

20. Structure Manager

20 The Structure Manager



Point	X	Y	Z
0	0	-100	0
1	0	100	0
2	25.882	-96.593	0
3	25	-96.593	6.699
4	22.414	-96.593	12.941
5	18.301	-96.593	18.301
6	12.941	-96.593	22.414
7	6.699	-96.593	25
8	0	-96.593	25.882
9	-6.699	-96.593	25
10	-12.941	-96.593	22.414
11	-18.301	-96.593	18.301
12	-22.414	-96.593	12.941
13	-25	-96.593	6.699
14	-25.882	-96.593	0
15	-25	-96.593	-6.699

The Structure Manager resembles a spreadsheet; both can process data directly within cells which, in turn, are divided into lines and columns.

Within CINEMA 4D's Structure Manager, various attributes of the active object are displayed and can be edited directly in the cells. The points and polygons of an object and its UVW Coordinates can all be displayed (if relevant) by selecting from the Mode menu; by default, an object's points are displayed.

Values in the cells can be edited directly, lines can be moved by means of drag-and-drop and cut, copy, paste is supported. Larger quantities of data can be processed rapidly, even if the object has a large number of points or polygons. The selection frame (a red frame around an active box) shows you which data you are working on; navigating around the table is thus very simple.

Note

If you are working on one of the basic objects or on a Spline Primitive, you will not necessarily see anything when you choose the Structure Manager. There's no need to panic and call technical support; the solution is quick and simple. Initially, basic objects do not possess a defined point set, but that can be changed by simply converting the object into polygons or into a spline object using Tools > Make Editable - see page 356.

Navigation within the Structure Manager

Selection

Clicking on one of the line numbers to the left of the table selects this line and highlights it.

If you keep the Shift key pressed while clicking (known as Shift-clicking), several lines can be selected at the same time; Shift-clicking an already-selected line will deselect that line.

To select all the lines of a particular attribute (such as all the points) click directly in the relevant name field (e.g. Point). Shift-clicking a selected set will deselect the set.

Selection frame

When you first open the Structure Manager, the selection frame is over the cell at the top left of the display (the first column of the first line). Single-clicking on a particular cell moves the selection frame to this cell i.e. makes it active. You can also move the selection frame with the cursor keys.

Using the TAB key moves the selection frame left-to-right and top-to-bottom over the cells; Shift-TAB reverses this.

The Home key moves the selection frame to the very first cell of the table whilst the End key moves it to the last cell.

Note

The Apple USB Keyboard does not have an End key. Please use the '+' key on the numeric keypad instead.

Page Up and Page Down move the selection frame a page at a time, back and forward respectively.

Double-clicking on a cell moves the selection box there and enters edit mode, where you can modify the value of the cell. While in Edit mode you can use Tab and the cursor keys as explained above and you will remain in Edit mode.

The Return key acknowledges input and switches between editing and selection modes.

If you press the ESC key, the previous value of the cell is restored and you revert to selection mode; assuming, of course, that you have not already pressed Return!

Drag-and-drop

By means of drag-and-drop you can re-order one or more lines and thus modify, say, the point order. Click at the left of the display, over a line number, hold the mouse button down and drag; a red line appears to show where the selected row(s) will be moved. The row(s) will be inserted at the position of the red line and all rows above will be shuffled up.

Re-sorting of points is useful with a spline object that you created from another object. Here the point sequence is often not correct; by re-ordering you can recover that. Re-sorting the points of a polygon is less practical.

Additionally you can transfer the contents of an individual cell to another cell; simply click on a cell and move the mouse with the left button held down until you the pointer is over the target cell. Release the mouse button and the value of the original cell is copied here.

File Menu

New Line

A new line is inserted into the table, below the selection frame.

If you are in the point mode (default), a new point is added to the object. This is created at the world origin (X=0, Y=0, Z=0). By the input of suitable X, Y and Z coordinates, you can change the spatial position of the point. If the active object is a Bézier-type Spline, you can also enter values for the tangents.

If you are in the polygon mode, **New Line** adds a new polygon to the object. The new polygon will not be visible yet, since it has not been allocated suitable points (see Mode). You must do this point allocation by hand.

If you are in UVW mode, New line creates a new UVW coordinate. Since CINEMA 4D equips basic objects with UV or UVW coordinates automatically and UVW coordinates can also be subsequently created easily (see Generate UVW Coordinates, page 469), you may find little use for this function.

Import ASCII Sheet

CINEMA 4D is able to import point data, polygon data and UVW coordinates into the Structure Manager. The data to be imported must be present as an ASCII file and have the following format:

```
Point X Y Z
1 <Coordinate> <Coordinate> <Coordinate>
2 <Coordinate> <Coordinate> <Coordinate>
3 <Coordinate> <Coordinate> <Coordinate>
```

Here's a real Point mode example for a cube:

```
Point   X    Y    Z
0   -100   -100   -100
1   -100   100   -100
2   100   -100   -100
3   100   100   -100
4   100   -100   100
5   100   100   100
6   -100   -100   100
7   -100   100   100
```

The ASCII file must start with a header (the 'Point X Y Z' in the example above) and requires line numbering as shown. The values within each line may be separated with a TAB character, a comma, a semicolon or a combination of these. Each line must end with the ASCII LF (linefeed) character or the CR (carriage return) character, or a combination of both. Thus it does not matter whether the ASCII file was created on a Macintosh, Windows or Unix computer.

If data already exists in the Structure Manager, the imported data is inserted before the line containing the selection frame.

Note
A 'cloud' of points does not define a 3D object; you must describe the required polygons manually. To find out how to do this see Create Polygon, page 364.

Export ASCII Sheet

CINEMA 4D can export the Structure Manager data so that you can use it within, say, a text editor or some other 3D program or perhaps import it into a spreadsheet for analysis.

In Point mode, the X, Y and Z coordinate for each point is exported. If the object is a Hermite Spline, then the tangent values are also exported.

In Polygon mode, the coordinates of each three or four point polygon are exported.

In UVW mode the UVW coordinates of each polygon (defined so far) are exported.

Close

Exits the Structure Manager, closing the window.

Edit Menu

Undo

This cancels the last action that changed the object and restores the previous values to the cells. The undo level (i.e. how many actions are remembered) is set in the General Settings (Undo Depth, see page 44).

Redo

Undoes or cancels the last undo. The redo level is the same as the undo level, set in the General Settings (**Undo Depth**).

Cut

Removes the selected line(s) from the table and copies to the clipboard. Use **Paste** to insert back into the table, below the selection frame.

Copy

Copies the selected line(s) from the table into clipboard, without deletion. **Paste** will insert line(s) from the clipboard back into the table, below the selection frame.

Paste

Insert any data already copied or cut into the clipboard back into the table, below the selection frame.

Delete

Deletes the selected lines from the table.

Select All

All lines within the table are selected.

Deselect All

All selected lines of the table are deselected.

Invert All

All the not-selected lines of the table are selected and the selected lines are deselected.

Select Area

The mouse pointer changes into a crosshair and you can now draw a selection area with the mouse. All lines within the area you draw are selected. If lines that you want to select are outside the visible area, move the mouse outside the Structure Manager window in the direction that you want the window to scroll; the window will then scroll until you move the mouse back within the window.

View menu

Jump Last Selection

The selection frame moves up to the last active line.

Jump Next Selection

Move the selection frame down to the next available line.

Jump Page Up

Display the previous page of information (if it exists) in the table and move the selection frame to the first column of the first line on the page.

Jump Page Down

Display the next page of information (if it exists) in the table and move the selection frame to the first column of the last line on the page.

Jump Home

The selection frame moves to the first column of the first line in the table.

Jump End

The selection frame moves to the first column of the last line in the table.

Mode menu

Points (default)

In Point mode, the spatial coordinates of the individual points of the object are displayed in the Structure Manager. If the active object is a Hermite Spline, the tangent values are also displayed.

The display is organised as follows:

X Y Z

show the coordinates of the respective point in the world system. No unit is displayed; the unit of measurement is selected in the General Settings and is assumed here.

<-X <-Y <-Z

is the position of the end of any left tangent. No unit is displayed; the unit of measurement is selected in the General Settings and is assumed here.

X-> Y-> Z

is the position of the end of any right tangent. Here no unit is displayed. It corresponds however to the unit selected by you in the General Settings.

Polygons

If you are in Polygon mode, the number of each defining point is displayed, as follows.

A, B, C, D (which could be blank) correspond to the respective point numbers of the three (or four) corner points of the polygon.

Note

If C and D are identical, CINEMA 4D interprets the polygon as a triangle.

UVW

If you are in UVW mode, the UVW Coordinates of the polygons of the object are displayed, as follows:

U[A], U[B], U[C], U[D]

are the U coordinates of the corner points of the polygons.

V[A], V[B], V[C], V[D]

are the V coordinates of the corner points of the polygons.

W[A], W[B], W[C], W[D]

are the W coordinates of the corner points of the polygons.

Note

All modes operate independently of the tool that you are using in the main editor window. So you can process points in the Structure Manager, while working on polygons in the editor. If you want to see in the editor the items that you have selected in the Structure Manager, you must change to the appropriate tool in the editor.

Vertex Map

If you are in Vertex Map mode, the weighting values for the points are shown. The value for a point ranges from 0 to 1.

Note

All modes work independently of the tool that is currently active in the editor. If you wish to see the elements in the editor, you must activate the corresponding tool (see Chapter 8, Tools Menu, page 295).

CINEMA 4D

MODELING • ANIMATION • RENDERING

Appendices

Appendices

Appendix 1 Formulas

You can type in a formula for the Formula spline primitive and the Formula time curve. In fact, you can type in a formula wherever CINEMA 4D accepts a value, e.g. in the Coordinates Manager.

This appendix lists all the units, operators, functions and constants that you may use in your formulae.

You may enter values using any of the units listed below (examples in brackets) - regardless of the basic units defined in the general settings (CINEMA 4D will convert the units for you).

km *kilometres (23 km, 0.125km)*
m *metres (13.23 m, 1000m)*
cm *centimetres (11.5 cm, 328.275cm)*
mm *millimetres (14 mm)*
um *micrometres (678 um)*
nm *nanometres (3.867 nm)*
mi *miles (12.5 mi)*
yd *yards (17.9 yd)*
ft *feet (512 ft)*
in *inches (0.125 in)*
F *frame number (0 F)*

Note

If you change the basic units in the general settings, e.g. from metres to millimetres, only the measurement units are changed, not existing numerical values. For example, if an object has a width of 10 metres, but you then change the basic units to millimetres, the object will then have a width of 10 millimetres. If you wish to scale the objects to reflect the change in units, group all the objects and scale the group using the Coordinates Manager.

The function parser has the most important arithmetic operators built in (examples in brackets):

+ *addition (144 + 14 = 158)*
- *subtraction (144 - 14 = 130)*
***** *multiplication (144 * 2 = 288)*
/ *division (144 / 12 = 12)*
MOD *modulus (123 mod 4 = 3)*
^ *power (12 ^ 2 = 144)*
(*open bracket (3 + (4 * 2) = 11)*
) *close bracket ((3 + 4) * 2 = 14)*
ABS *absolute value (abs(-123) = 123)*
SIN *sine (sin(30) = 0.5)*
COS *cosine*
TAN *tangent*
ASIN *arc sine*
ACOS *arc cosine*
ATAN *arc tangent*
SINH *sine hyperbola*
COSH *cosine hyperbola*
TANH *tangent hyperbola*
LOG10 *logarithm to base 10 (log10(100) = 2)*
LOG *logarithm to base e (log(e) = 1)*
EXP *exponential function (exp(5) = 148.413)*
SQRT *square root (sqrt(144) = 12)*
SQR *square (sqr(12) = 144)*

Note

Function arguments must be bracketed. The number of open brackets must equal the number of close brackets. Functions may be embedded: sin(sqr(exp(pi)))

*The argument of a trigonometric function is always interpreted in degrees. sin(2*pi) does not* *mean the computation of sin 180 degrees, merely approx. sin 6.283 degrees.*

Two of the most important constants have been built in:

PI Pi (3.142)
E Euler's number (2.718)

With all the above you should be able to define even the most complex operations in a very precise way. You can combine them freely. For example:

```
2km+exp(sin(4mm*pi))/((sin(14cm))^2
     +(cos(14cm))^2)
```

Appendix 2 Programming Plugins

The C.O.F.F.E.E. Programming Language

C.O.F.F.E.E., CINEMA 4D's plugin language, is not based on macros or scripts but is a complete and powerful programming language in its own right. It closely resembles C++ and Java so that if you are already familiar with these languages you will immediately feel at home with C.O.F.F.E.E. You simply have to learn the various functions implemented by CINEMA 4D.

To start programming you will need to get hold of the SDK (Source Development Kit) directly from MAXON; this can be obtained from MAXON Computer's web page at www.maxon.net.

So what is the advantage of programming in C.O.F.F.E.E.?

Well, apart from the ease of integrating new functionality into CINEMA 4D, as you know, CINEMA 4D is a multi-platform program; at the time of writing, versions of CINEMA 4D exist for the Apple Power Macintosh (Mac OS 7 and above), for Intel PCs (Windows 9x and Windows NT) as well as for DEC Alpha, while it is planned to produce versions for Silicon Graphics, other UNIX platforms and The BeOS. Writing plugins in C.O.F.F.E.E. means that your new CINEMA 4D function will work immediately on all those platforms, with no annoying re-compilation or reprogramming.

So that CINEMA 4D can find its C.O.F.F.E.E. programs and load them automatically, they must be placed in the Plugins folder which should be in the root CINEMA 4D folder. If you check the contents of this folder, you should find some examples already there.

However, you can also store C.O.F.F.E.E. programs elsewhere on your hard disk. If you want to load such a program into CINEMA 4D just use the **File > Open** menu command - such a file cannot be automatically integrated into CINEMA 4D's menu structure.

So how do you create such a program?

Simply write your C.O.F.F.E.E. programs in any editor (perhaps that supplied with your computer) or word processor and save it as a regular ASCII text file; CINEMA 4D will happily process regular text, with no high-ASCII characters.

The API

Perhaps you do not want to use C.O.F.F.E.E. as your programming language?

As usual, CINEMA 4D allows you the flexibility to do it the way you want to; if you like, you can write your applications with any C/C++ compiler. Here you have access to the functionality of CINEMA 4D through pre-defined interfaces. These interfaces are in the form of an API (Application Programming Interface) library which is part of CINEMA 4D's SDK.

Note, however, that if you use an external compiler (as opposed to C.O.F.F.E.E.) this will be platform dependent and you will need to re-compile your program for each platform on which you want you plugin to work. You may also need to do some reprogramming.

C.O.F.F.E.E. Support

Support for CINEMA 4D developers is available exclusively on MAXON Computer's website:

www.maxon.net

There you will find, among other things, the SDK. This contains the C.O.F.F.E.E. compiler and detailed descriptions of the programming language and the interface libraries. It is, of course, possible for commercial plugin manufacturers to keep their source code secret and proprietary.

Our developer support is not static; the interfaces to CINEMA 4D and their functionality are constantly being extended. You should always, therefore, pay attention to the relevant announcements on the Internet.

Appendix 3 File Formats

While working with CINEMA 4D there will be occasions when a particular graphic format will not load or a 3D file will prove difficult to convert. There are so many formats and sub-formats for images, animations and 3D files that CINEMA 4D cannot even dream of coping with all of them.

The following sections contain summaries of all formats that CINEMA 4D supports. If you need more detailed information, you should refer to the relevant technical information for that format.

Image Formats

TIFF

Bit depths

1, 4, 8, 24, 32

Compressions

Uncompressed, RLE compressed.

Notes

Only Baseline TIFF is supported. Exotic formats such as CMYK images are not supported, nor are files that have been LZW compressed (this is due to licence rights). It is of course not possible to give an exhaustive list of non-supported formats, since such a list in a sense could never be definitive.

With QuickTime installed LZW compressed images and other variants are also imported.

IFF

Bit depths

1, 4, 8, 16, 24

Compressors

Uncompressed, RLE compressed.

Notes

IFF images are read only if they conform to the Commodore/Electronic Arts specifications.

EHB, HAM-6 and HAM-8 modes are supported.

TARGA

Bit depths

24, 32

Compressors

Uncompressed.

Note

Only TGA-1 is supported. With QuickTime installed other variants are also imported.

PICT

Bit depths

4, 8, 16, 24, 32

Compressors

Uncompressed, RLE compressed.

Note

With QuickTime installed all PICT variants are imported (as long as the QuickTime compressors are available).

BMP

Bit depths

1, 4, 8, 16, 24

Compressors

RLE-4, RLE-8.

JPEG

Bit depths

24

Note

Greyscale JPEGs cannot be loaded.

PSD

Bit depths

1, 8, 24, 48

Color Formats:

Indexed Color, RGB, not CMYK.

Notes

For writing, alpha channels are supported.

With QuickTime installed, all QuickTime formats are supported i.e PNG, SGI and QuickTime image.

Animation Formats

AVI

Compressors

All Codecs (compressors) that are installed in the operating system are supported.

Notes

This format can be read and written only under Windows 95/98/2000/NT. Using QuickTime, AVI animations can also be used on the Macintosh, depending on the codec.

When using AVI animations as textures, only the first video track is evaluated; all others (e.g. music) are ignored.

If the first video track contains data other than images these are also ignored.

QuickTime

Compressors

All Codecs (compressors) that are installed in the operating system are supported.

Notes

When using QuickTime animations as textures, only the first video track is evaluated; all others (e.g. music or QuickTime VR) are ignored.

If the first video track contains data other than images these are also ignored.

Caution

Alpha channels are integrated directly into the animation only if the compressor supports this. For the QuickTime format these are the compressions Animation and None (i.e. uncompressed).

In both cases, the number of colors must be set to Million Colors +.

3D Formats

DXF

CINEMA 4D offers complete support for DFX files written by AutoCAD (up to and including version 12) or by the export filters of other applications, provided they are 100% compatible.

LightWave

Although CINEMA 4D can convert LightWave files and scene descriptions completely (including PSD animations and bone structures), it is sometimes necessary to post-edit light source settings and texture placements.

3D Studio Import

- These files are loaded:
  3DS (regular 3DS files)
  PRJ (3DS project files)
  MLI (3DS materials libraries)
- The object hierarchy is copied 1:1, referenced objects are duplicated in CINEMA 4D.
- The following material channels are imported: environment light, specular color, specular settings (are recalculated), transparency, luminance, color texture, specular texture, transparency texture, environment texture, relief (bump) texture, luminance texture.

CAUTION!

The 3DS transparency texture is the exact opposite of the transparency mode in CINEMA 4D. In 3DS materials are more transparent the darker a texture pixel, whereas in CINEMA 4D they are more transparent the lighter the pixel.

- UV mapping is copied.
- Animation.
- Position, scaling, rotation and light sequences are adjusted to suit CINEMA 4D.
- Textures can be renamed automatically on loading.
- So-called *target objects* loaded from 3DS (from cameras and light sources) become axes (null objects) and are given the extension ‘t’, which is added to their object name.
- 3DS files are binary files and are not recognised by their extensions but by their identifier.

3D Studio Export

- All polygon objects, light sources and cameras are exported, NURBS objects are transformed into polygon objects.
- Material export:
  color, luminance, transparency, environment, specular, specular color, relief (bump), all with any defined textures. The mean value of the texture channel is exported with the shader.

Note

Regrettably, 3D Studio can cope only with filenames consisting of eight characters plus a three-letter extension. Therefore texture filenames will be truncated to conform with this restriction.

3D Studio accepts only one UV coordinate per point. Therefore texture mapping may appear different after exporting in this format.

QuickDraw3D Import

- Light source and camera information cannot be read.
- The following objects are ignored:
  Torus, TriMesh (new with QD3D v1.5); NURBS can cause problems in certain cases.

– References (both internal and external) are not read.
– UV coordinates are not read.
– Textures are not read.

QuickDraw3D Export

– Light source and camera information cannot be written.
– UV coordinate export is supported.
– Texture export is supported.
– ASCII 3DM files cannot be written, only binary.

Note

QuickDraw 3D accepts only one UV coordinate per point. Therefore texture mapping may appear different after exporting in this format.

Direct3D Export

– Typical extension *.x, ASCII Format, MESH and FRAME format.
– Zoom factor for entire scene, automatic indenting.
– Rename texture name to any extension.
– Texture information (UV coordinates and texture names)
– Texture channels:
color, luminance, specular, specular color, transparency, environment.

Note

For all scenes to display properly with a Direct3D Viewer it is necessary for all textures to have an edge length of a power of 2 (i.e. 2, 4, 8, 16, 32, 64, 128, 256, 512, 1024, …).

VRML V1.0c and 2.0 Import

– ASCII format.
– Creating all basic objects (cuboid, sphere, cone, cylinder).
– Polygon objects of any size and number of vertices (n corners are triangulated).
– Perspective cameras, light sources (direct, point, spot).
– Material tags:
ambient color, diffuse color, specular color, emissive color, shininess.
– WWW Links are created as a CINEMA 4D attribute (WWW tag).

Note

*Object names in VRML files must not contain any special characters (not even +, –, *, /). This may be the only reason that CINEMA 4D is refusing to load a file!*

VRM L 2.0 Import

– Animation import, scenes in a line (references to scenes are automatically loaded).

VRML1.0c and 2.0 Export

– ASCII format (optionally formatted).
– Hierarchical saving of all objects: NURBS are converted to polygon objects.
– Object names are converted, special characters are filtered/converted.
– Textures:
If there are any textures, the program looks for the color texture, the luminance texture and the environment texture (in that order). Color textures, even inline textures, are saved as files.

– WWW links/addresses are saved: when an object is selected in the web browser, the program branches to that link.

VRML 2.0 Export

– Additional available animation export option.

Wavefront OBJ Import

– ASCII format.

– Polygon objects are loaded.

– Objects are given a dummy material.

– UV mapping is supported.

– No object hierarchy can be created.

Wavefront OBJ Export

– ASCII format.

– Polygon objects; NURBS are converted to polygon objects, UV coordinates.

Appendix 4 Support

What can you do when you're stuck, the manual doesn't seem to have the answer and you're getting nowhere fast by experimenting? Do not fret - there is still technical support!

We would like to take this opportunity to clarify a few important points that, no matter how hard we try, always seem to lead to misunderstandings.

Firstly, you are our valued customer - MAXON Computer, and its distributors worldwide, will be happy to help you with any technical problems you encounter. So that we can help you as efficiently as possible, please try to follow the guidelines below:

Contact us (or your local distributor) in writing if possible, preferably by email.

We have telephone lines, of course, but problems with a package as complex as CINEMA 4D can take time to solve - it is not always possible to solve the problem there-and-then. With email, our technicians can ask other colleagues for assistance — even the programmers if necessary — and get back to you as soon as possible. Email is also convenient for attaching an example of the problem and, likewise, it may be helpful for us to send you a scene.

Please do not mix support enquiries with something else, such as an order.

Orders are dealt with by busy sales staff so your support question will stand little chance of making it to the support technicians if you mix it with an order.

If you send us your support question by fax, do not expect a reply within five minutes.

We operate a strict queuing system to be fair to all customers.

Please provide us with a telephone number and times when we may contact you using that number.

Occasionally we may need to contact you for further details.

Send us an example scene to demonstrate the problem, if applicable.

"When I boolean two objects I get a mess". It is difficult to solve problems with such limited detail and sometimes we really do need to see the scene. After all, we and our hard-working beta testers, have tested the functions many-a-time.

Keep any example scenes as small as possible.

For example, if only an alloy wheel is required to demonstrate the problem, please delete the rest of the car - it merely gets in the way. This saves our time and in turn we can get back to you sooner.

Please supply us with a complete description of the relevant steps leading up to the problem.

Ideally we would like a little 'recipe' that generates the problem consistently. (No five-page essays, please!)

Include rendered images if relevant.

Please tell us which settings you used.

Include details of your hardware configuration.

"I have a Macintosh/PC/SGI" really isn't enough. Also, please let us know which version (e.g. 6.00) and which edition (e.g. GO, SE, XL) of CINEMA 4D you are using. If you have Internet access, please use the support form on our website (www.maxon.de). Tell us what other programs and system extensions you are running concurrently with CINEMA 4D.

Please do not despair if the answer takes a little while.

Sometimes we need a little time to locate the problem. We may even need to grab the programmers. We want to help you and we will do our best for you.

If the program crashes, it will display an error message. Please let us know the exact message.

If you are using Windows, you'll see many other details listed.

Please ignore these extra details - they are as enlightening as the infamous Macintosh message "Application Unknown has quit unexpectedly because of error -1".

All we need is CINEMA 4D's message.

If you have Internet access, check the FAQs on our website before you contact technical support.

Often, you will find the answer there.

Our service is limited to technical support only. We cannot undertake subcontracting.

"I want to create a mouse which runs through my house. What do I need to do?"

This is NOT technical support.

There are numerous places on the Internet where users help each other with such questions that are clearly beyond the scope of our technical support. You can find links to these valuable resources on our website.

Appendix 5 Glossary

Alpha channel, Alpha buffer

Used for fades with 2D images or movies. This channel determines at which points and to what extent an underlying picture will be visible. Alpha channels are usually greyscale images; the darker a pixel the more intensely the underlying picture comes through.

Ambient

This refers to the surrounding light which causes the scene to generally appear brighter. In CINEMA 4D this property is set in the environment object.

Animator

This refers to the environment (with all its functionality) in which the objects are animated. Many programs have two distinctly separate components, an Animator and a Modeller, which forces the user to constantly change between them. This is not the case in CINEMA 4D.

Antialiasing

Method for reducing the undesirable zig-zag effect along object and colour edges. It is achieved by generating intermediate points from colours of adjoining pixels. Images that have had antialiasing applied normally appear somewhat blurred.

Backup

Security copy of data or of files.

Bevel, Beveling

Slanting or rounding of edges, to achieve smoother transitions.

Bitmap

Two-dimensional pixel graphic.

Blob

Object (usually a sphere), with a surrounding gravity field, which attracts objects or parts thereof.

Boole

B. George, English. mathematician (1815–1864), founder of logical algebra.

Boolean operation

Combining two or more elements according to Boolean algebra. In 3D programs it is the linking of two objects. This enables e.g. the forming of holes by subtraction (drilling).

Browser

Application that lets you manage and view files.

B-Spline

Beta spline. Method for achieving soft, curved spatial curves.

Bump Map

Relief texture. The surface is seemingly indented. Usually greyscale images. The darker a pixel, the more strongly the object is indented. CINEMA 4D also lets you reverse this behaviour.

CAD

Computer Aided Design.

Constraints

In CINEMA 4D this refers to restricting the angle of a joint. Useful particularly in connection with Inverse Kinematics, to prevent, for example, a rotation of the upper with the lower arm.

CPU

Central Processing Unit, the heart of the computer. Without it, nothing works.

Drag-and-drop

This is the technique of grabbing an object on screen with the mouse and keeping the mouse button depressed while moving it to another position. When the target is reached, the mouse button is released and the object 'dropped'. This may trigger other actions (like launching a program).

Extrude, Extrusion

A 3-dimensional object is generated by pulling a contour into a particular dimension, therefore creating depth. In addition, CINEMA 4D can create covers with and without bevelling or rounding.

Gouraud Shading

This shading algorithm smooths the edges of objects. Without it, objects usually look faceted, i.e. the individual surfaces are visible.

Halo

Refractive and reflective effects around a light source.

HSV

One of the colour models—Hue-Saturation-Value.

Inverse Kinematics

Using ordinary Kinematics on a hierarchically structured object you can for example move the shoulder of a puppet. The upper and lower arm and hand will automatically follow that movement. I.K. will allow you to move the hand and let the lower and upper arm go along with the movement. Without I.K. the hand would come off the model and would move independently in space.

Keyframe

Key image within an animation. The user defines certain key positions for objects at given points in time. The program automatically calculates the intermediate positions.

Label

This is usually a non-tiled texture, analogous to the labels that you find on bottles.

Lathe, Lathing

Generating a 3D body from an envelope curve.

Lens Flares

When photographing or filming light rays may fall into the lens, causing smaller or larger coloured rings on the exposed material. Such flares can be the result of air bubbles or lenses that are not completely tight. One normally tries to prevent this disturbing effect, however, in photorealistic computer graphics it is sometimes desirable to use them as a design element (this is sometimes overused).

Local Coordinates

Every object has its own origin, which is subordinate to the world coordinate system (or other objects that are higher in the hierarchy). Local coordinates are useful for determining positions of subordinate objects.

Mapping

The way in which a texture is projected onto an object. Also refers to the technique that is used, such as Bump Mapping, etc.

Mesh

Synonym for wireframe.

Model

Complex 3D structure consisting of one or many (hierarchically structured sub-) objects.

Modeler

Refers to the environment (with its complete functionality) in which objects are created and modified. In many programs Modellers and Animators are separate entities, so you have to switch between them. Not so in CINEMA 4D.

Motion Capture

Special sensors are used to record particular movements of humans and animals (such as swimming, running, dancing …). This data can then be assigned to 3D computer models.

Multi processor system

Computers working with multiple central processors. This can be used to work on several processes simultaneously or to have several processors tackling one task. Applications need to support this type of processing in order to benefit from it.

OpenGL

The standard, developed by Silicon Graphics, for exchanging 3D data between applications and graphics cards.

Phong Shading

This Shading algorithm smooths the edges of an object. Without it, objects may look faceted, i.e. each individual surface is clearly visible.

Pixel

Picture element. The size of a pixel depends on the resolution of the output device. Monitors usually have 72 pixel per inch (dpi), laser printers 600.

Plugin

Separate add-on which is integrated into the main application at launch and is then called from within it. Plugins are not normally autonomous, i.e. they do not work outside an application.

Polygon

3D models consist of (control) points and connecting lines. The area that is formed is called a polygon.

Primitive

Basic element of a (graphics) program. In 2D programs these are circle, line, …, in 3D programs sphere, surface, … CINEMA 4D has a large set of primitives.

Procedural textures

Mathematically generated textures (2D and 3D). Their advantage is that they are largely independent of the projection type.

QuickTime

Apple graphics standard. There are QuickTime movies and images as well as the VR (virtual reality) walkthroughs.

Radiosity

Special rendering method which takes into account not just the light that is radiated from light sources but also light that is reflected from other objects. This process is very CPU-intensive.

RAM

Random Access Memory: Data may be read and written to this memory in a non-sequential manner. When you switch off the computer, the contents of this type of memory are deleted.

Raytracing

Computes the course of a light beam in space. In non-scientific computer geometry it is not light rays that are being traced but visual rays, i.e. rays that emanate from the viewer's eye rather than from a light sourc).

Rendering

Refers to the computing of images. The method used (raytracing, scanline ...) is irrelevant. These days, the application of filters to 2D images (such as brightening and sharpening) is also called R.

RGB

The colour model Red/Green/Blue. Mixing varying parts of these three colours produces the intermediate colours.

Rotation

A 3-dimensional object is generated by rotating a contour around an axis. In addition, CINEMA 4D can automatically form covers with or without bevelling or rounding, as long as the rotation angle is less than 360 degrees.

Scanner

Device for reading images (from books, photos etc.) into the computer. Useful for creating realistic textures. With a 3D scanner it is even possible to capture three-dimensional objects and convert them into models.

Scene

Refers to the whole of a 3D computer model, consisting of objects, light sources, cameras, etc.

Shadow buffer

Buffer for storing information which allows objects to cast a shadow. These buffers are used particularly for generating soft shadows.

Texture

Usually a 2-dimensional image, which can be used as a label, a tile, or in its full format for defining material attributes. There are also 3-dimensional textures, which are normally generated with the help of mathematical algorithms. These are normally referred to as procedural textures (see separate entry) or shaders.

Tile textures

These are textures which can be joined seamlessly (tiling). However, when looked at from a distance, distinct repetitions can be visible in the pattern, if you cover a large area with small tiles. If you want to avoid this, use a mathematically generated 'infinite' texture.

User interface

Appearance of a program allowing interaction with the user. Includes all graphical elements, such as menus, popups, buttons, etc.

Vertex

A node. Vertices are the intersections of two lines in a wireframe model and of three edges in a surface model. In CINEMA 4D vertices are edited in Point mode.

Virtual Reality

Another fashionable term, just like 'multimedia'. No accepted definition exists, but what is generally meant is an artificial, computer-generated 3-dimensional world (which you can produce with CINEMA 4D).

Volumetric Lighting

Special lighting technique, which calculates shadows within visible light.

Voxel

Volume element. Originally, the expression was used in medicine, in analogy to pixels, when scanners were able to read in 3-dimensional objects. They were the smallest spatial unit that a medical scanner was able to resolve.

Wireframe

Most common way of representing objects in the Editor. Objects are shown as wire structures. Often, this is the only possible representation, but CINEMA 4D also supports Gouraud Shading, Flat Shading, Cuboid, Skeleton and invisible.

Z buffer

Is used for computing quick previews, that take no account of shadows or surface detail.

CINEMA 4D

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