CINEMA 4D™ XL

3D-Modelling • Raytracing • Animation

Reference Manual

CINEMA 4D™ XL

REFERENCE MANUAL

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

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

Contents

About this Manual

This Reference Manual consists of two parts. The first is a description of the menus and menu options in the CINEMA 4D Editor, the second explains about the Managers and the menus that are available in each of these.

Each function in CINEMA 4D has its own icon contained in the appropriate toolbar. If you are looking for a particular one that is not currently visible on your screen, it is either part of a toolbar that is currently hidden, or you can access it via the Palette Manager.

You will find a short description of each function, as you would expect from a Reference manual. Use this for a quick overview of what each command does. If you want to find out more about how different commands can be combined to achieve special effects, it might be worth your while working through some of the tutorials.

Because it is such a powerful program, there are endless possibilities with CINEMA 4D. It would be far beyond the scope of this manual to cover them all. Just take your time, start by playing around with some simple scenes, and then go on to be more adventurous. It takes more than a day to become a raytracing master!

I came across a very nice comparison recently on the Internet which I would like to share with all multi-platform enthusiasts—turn to the next page.

Michael Giebel, Product Manager

HALL OF HONOUR

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and all the other guys and gals at HiSOFT.

US Beta Testing

The Knights of the Render Table:
Garrett Cobarr, Peter Jay Gould, Kenn Kilgore,
Carey Klein and thorn.

If Operations Systems were Airlines

Dos Air

Passengers out onto the runway, grab hold of the plane, push it until it gets in the air, hop on, then jump off when it hits the ground. They grab the plane again, push it back into the air, hop on, jump off …

Mac Airways

The cashiers, flight attendants, and pilots all look the same, and act the same. When you ask them questions about the flight, they reply that you don't want to know, don't need to know, and would you please return to your seat and watch the movie.

Windows Airlines

The terminal is neat and clean, the attendants courteous, the pilots capable. The fleet of Lear jets the carrier operates is immense. Your jet takes off without a hitch, pushes above the clouds and, at 20,000 feet, explodes without warning.

OS/2 Skyways

The terminal is almost empty – only a few prospective passengers mill about. The announcer says that a flight has just departed although no planes appear to be on the run-way. Airline personnel apologize profusely to customers in hushed voices, pointing from time to time to the sleek, powerful jets outside.

They tell each passenger how great the flight will be on these new jets and how much safer it will be than Windows Airways, but they will have to wait a little longer for the technicians to finish the flight systems. Maybe until mid-1995. Maybe longer.

Fly Windows NT

Passengers carry their seats out onto the tarmax and place them in the outline of a plane. They sit down, flap their arms, and make jet swooshing sounds as if they are flying.

Unix Express

Passengers bring a piece of the airplane and a box of tools with them to the airport. They gather on the tarmac, arguing about what kind of plane they want to build. The passengers split into groups and build several different aircraft but give them all the same name. Only some passengers reach their destination, but all of them believe they arrived.

Author unknown
Found on the Internet

File Menu

Contents

1. The File Menu

1.0 Starting

There are several ways to start CINEMA 4D:

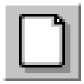
1. Double-click on the application icon.
2. Double-click on a scene file.
3. Double-click on a preferences (.prf) file.

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

The Template.c4d file

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

1.1 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 display ‘Untitled’.

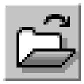
If you have several documents open you can switch quickly between them by using the Tab key.

The New.c4d file

If the CINEMA 4D startup folder contains a scene named ‘New.c4d’, this is loaded every time you create a new file.

If, for example, you want to permanently set the animation rate to 30 frames per second, create a new file, change the values under Options / Animation and possibly in Render …, then save the file as ‘New.c4d’ in the CINEMA 4D startup folder.

1.2 Open



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

CINEMA 4D can read the following formats:

- CINEMA 4D scenes (.C4D), catalogs (.CAT), preferences (.PRF)
- CINEMA 4D C.O.F.F.E.E. programs (.COF, .COB)
- DXF to AutoCAD R12
- QuickDraw 3D (binary only, no ASCII)
- VRML V1 and V2
- 3D Studio R4 (including materials, light sources, textures and animations)
- Wavefront (.OBJ)
- LightWave (.LWO, .LWS; as scene descriptions, light sources, textures and animations)
- Imagine (.IOB)
- DEM scenery files (.DEM)
- Illustrator paths as polygons (.AI, .EPS)

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

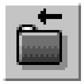
You can also use this command to view images, play animations or load other settings. If you open a QuickTime movie or an AVI animation, this will launch the internal system player.

Alternatively, you can also open new files by drag-and-dropping them into the Editor window.

1.3 Import

This command lets you add scenes, objects, materials etc. from storage to the active document.

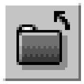
1.4 Revert to Saved



This command will load the last saved version from storage. Before this happens, a dialog appears asking for confirmation.

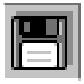
You will lose any changes that were made to the current document after it was last saved.

1.5 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.

1.6 Save



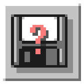
This command saves your document to a writeable disk, without first opening the File Selector dialog. The scene is saved under the name that was chosen when you selected the Save As command (i.e. the name that appears in the title bar).

If this is the first time you are saving a new document and it does not have a name yet (the title bar says 'Untitled'), then the Save command behaves just like Save As.

Tip:

CINEMA 4D Version 4 (SE) cannot read files which are saved in the XL version.

1.7 Save As



Save As always displays the File Selector dialog. The filename you enter in the text box here will be displayed in the title bar of the document window.

CINEMA 4D automatically appends the appropriate extension to the filename.

CINEMA 4D V5

This is the current CINEMA 4D XL file format.

Direct 3D

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

The standard exchange format for graphics files.

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

QuickDraw 3D

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

VRML-1

The Virtual Reality Modelling Language enables you to produce platform-independent three-dimensional representation of objects and scenes on the Internet.

VRML-2

Version 2 of the standard format for three-dimensional graphics files on the Internet enables you to display animation sequences.

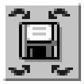
3D Studio R4

Common 3D data format in the DOS world.

Wavefront

Widely used 3D data format in the UNIX world.

1.8 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 (Preferences / Paths).

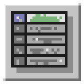
CINEMA 4D helps you build *complete* scenes.

Selecting this command opens the usual system dialog 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 subfolder, named Tex, into which it copies all frames and textures necessary for rendering the scene.

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

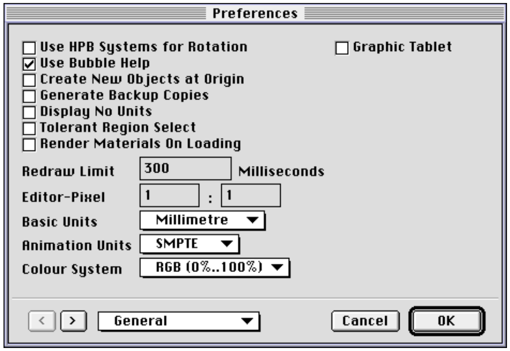
1.9 Preferences



Use the Preferences to change the appearance of the Editor and the details of how commands work.

General

General Page



Use HPB system for rotation

Enable this option if you are really into animation sequences. During interactive data entry using the mouse, CINEMA 4D rotates objects around their local axes or the world axes. These rotations may not always produce the desired results in the animation because in the HPB system (see Chapter 5: Options / Rotation) rotations work in a non-intuitive fashion.

If this option is enabled, CINEMA 4D uses the HPB system only—even at the input stage. This means that you are changing the heading, pitch and bank of an object (or of selected points, etc.) relative to its parent system. This allows you to see at once what the animation will look like. But since this type of rotation demands a high degree of abstract thought, it is definitely not for the uninitiated.

Use Bubble Help

By leaving the mouse pointer over a tool icon for a while you cause a brief help message, a so-called tooltip, to appear. This gives a quick explanation of the tool's function. You can switch this off by disabling the option.

Generate new objects at the origin

By default, all new objects are created at the origin of the global coordinate system. If your view of a scene is shifted off to the side somewhere, you may not be able to see a newly created object.

By enabling this option you ensure that new objects are centred within the current view.

Generate backup copies

Normally, when you save a file you overwrite any existing file of that name in the destination folder. However, if you enable this option CINEMA 4D renames the existing file (giving it the extension '.bak') before saving your current file.

Thus, when saving a file named 'Design.c4d', an existing file in the destination folder named 'Design.c4d' will become 'Design.bak'. (If a file named 'Design.bak' already exists in the destination folder, it will be overwritten.)

Display no units

By default, all values in dialog fields are followed by the unit they refer to (length, angles, etc.).

If you enable this option, only the values are shown.

Tolerant Region Select

Normally, edges, triangles and quadrangles are selected only if they are completely enclosed by the bounding box.

However, if you enable this option, the selection will include elements that are only partially enclosed.

Load Material Editor

CINEMA 4D always saves materials with their previews. This preview is then used when loading materials.

If you do not load a CINEMA 4D file, a flat disc in the basic colour of the material will be displayed. By enabling this option you force CINEMA 4D to automatically load all materials when loading, which is time-consuming.

Graphics tablet

If you are working with a graphics tablet and are encountering problems, make sure you enable this option.

Redraw limit

Depending on the processor, the graphics card, the colour depth and the complexity of the objects you are working with, the speed of the screen redraw may not be sufficient to give a smooth movement.

CINEMA 4D uses a sophisticated algorithm that takes all these factors into account and measure the time that it takes to redraw the screen when objects are moved. If the time limit specified here is exceeded, CINEMA 4D automatically downgrades to a faster display type. If for example you have chosen Gouraud Shading, this changes to Wireframe, and if that is not enough, CINEMA 4D goes to Cuboid. This ensures that work proceeds without interruption. You can choose the threshold level at which you want the reduction to occur. Set it according to your own needs. The default value is 300 milliseconds, which gives you a minimum of three frames per second.

If you do not want to have the display downgraded, set a higher value, for example 10,000 milliseconds.

Pixel ratio

Correct screen output was something of particular importance to the developers of CINEMA 4D. A central concept is the 'pixel ratio', which is the proportion of the visible width to the visible height of an individual pixel. This is usually 1:1.

Some monitors cannot display a 1:1 pixel ratio and if this ratio is not taken into account, circles have elliptical form on the screen. However, once you have set this value correctly, CINEMA 4D works without any distortion. To achieve this, open the Editor so that its window fills the entire screen, choose a 'side' view and create a cube. (This should appear as a square.) Now, using a ruler, measure the width and height, then enter these values into the appropriate boxes.

Basic Units

This option lets you specify the unit of measurement. This is for data input only. If you have chosen 'cm' as the basic unit, all distances and positions are indicated in centimetres.

You can still enter values in a different unit though, by simply adding the appropriate abbreviation after the value. If you enter '5 km' with 'cm' as your specified 'basic unit', your input will be converted to 500,000 (cm) by the system.

The pixel setting uses simple numerical values, without specifying a unit. It is up to you how you interpret this.

You may use the following abbreviations in input fields:

Pixel	*no units specified*
Kilometre	km
Metre	m
Centimetre	cm
Millimetre	mm
Micrometre	um
Nanometre	nm
Mile	mi
Yard	yd
Foot	ft
Inch	in

Animation Units

Here you have the option between frames, seconds or SMPTE time code.

The SMPTE time code has the format Min:Sec:Frame. '3:20:14' for example means: 3 minutes, 20 seconds, 15th frame. The last two digits are not hundredths of a second, but the number of the frame within that second (starting at 0). So if you have set the frame rate to 25, the Frame value ranges from 0 to 24.

With SMPTE notation, the minutes may be left out, for example '15:14'. The first two digits are the seconds, the second two the frame.

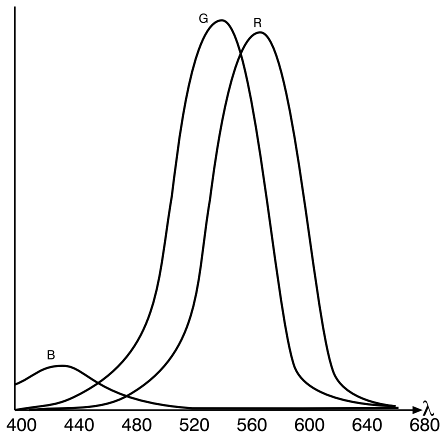
The following abbreviations are accepted in input fields:

Frames	F
Seconds	S
SMPTE	min:sec:frame

Colour System

There are two colour systems to choose from, the RGB and the HSV models. In addition, you can choose whether for numerical input you want to use steps between 0% and 100%, increments from 0 to 255, or increments from 0 to 65,535.

Colours determine the aesthetic and technical quality of an image. When used sensibly, they not only increase the information content, but also the realism of the representation of natural objects—which is a yardstick for applications 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 colour 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.

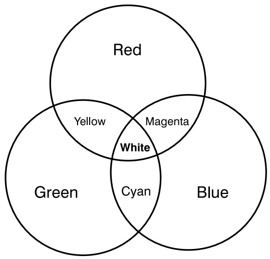
The colour which the human eye perceives as white does not contain equal parts of red, green and blue light—this would be called ‘chromatic’—but must, in accordance with the overlapping sensitivity ranges, be made up of varying proportions of these colours. Only then does the eye see white. This is what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

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

Two different colour 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 colour 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 colour dot, but for example the red and the green, the added colour value is yellow.

The colour 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.

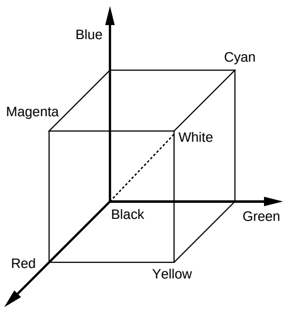
By beaming different intensities at the three dots it is possible not only to generate the eight basic colours (black, red, green, yellow, blue, magenta, cyan and white) which are the result of mixing the three primary colours, but many, many mixed colours.



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

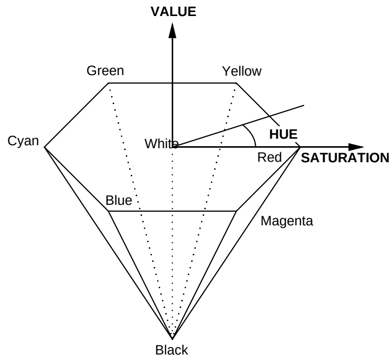
Using four gradations per primary colour results in 4 red x 4 green x 4 blue = 64 colours. The standard is 256 gradations per primary colour, which gives 256 red x 256 green x 256 blue = 16,777,216 colours.

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 colour value. The illustration below shows what these mean.



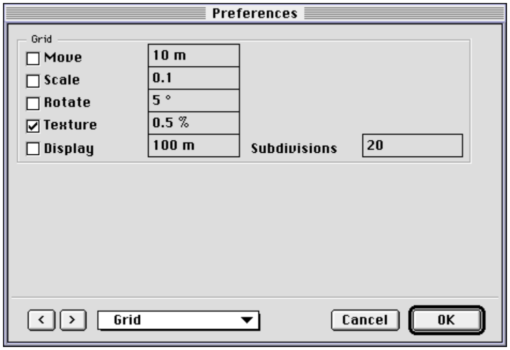
The six basic colours (red, yellow, green, cyan, blue, magenta) form a hexagon around the colour white, together with the colour black. The hue is the angle: starting with 0° for red, through 180° for cyan, to 270° for magenta. The saturation (S) is always measured radially towards the outside. On the 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. However, you cannot change the hue by simply changing the saturation.

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 colour value is used for darkening the hue.

Let's summarise this:

- Pure colour 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 colour value.

Grid page



Move

It can be difficult to position objects precisely on the points of a grid. A small mouse movement is enough to inadvertently move an object from position 10.374 to 10.694. In order to prevent this, CINEMA 4D can work with a grid. Even though you do not see any lines overlaying your work area, the grid ensures that objects can be moved only to positions that are a multiple of the specified grid value. Free positioning of objects is no longer possible.

When objects are moved, they move by the value that you specify here (while this option is enabled). If you wish to have complete freedom of movement, you must disable this option.

The grid is a local grid, which means it always works relative to the current position. If you have enabled a grid of 10 units, the object jumps by 0, 10, 20 etc. units, starting from its current position. An object that is currently in position 5.6 would jump to 15.6, 25.6, 35.6 etc.

If you prefer to work relatively freely but still need some control, choose a compromise. For example, by specifying 1 as your grid unit your coordinate values will always be integers, but you will still have considerable freedom of movement.

If you create and edit objects with regular shapes you will find the grid a great help. For example, if you are an architect you will find that drawing the ground plan of a house is easy since most of the walls will be at right angles to each other and their lengths multiples of a certain basic unit; if the walls are to be built from 30 cm bricks, a 30 cm grid should simplify your task.

The grid fulfils one other important function: it ensures that newly created objects or points always appear on grid points.

Scale

This option specifies the scaling factor. If you wish to retain complete freedom with regard to scaling, disable this option.

Rotate

This option specifies the degree of rotation. A value of 10° lets you use rotation increments of 10 degrees. You may find this useful for positioning lights and cameras.

However, if you wish to be able to rotate objects to any angle, disable this option.

Texture

This is a percentage value which defines the incremental steps when moving and scaling textures.

Display

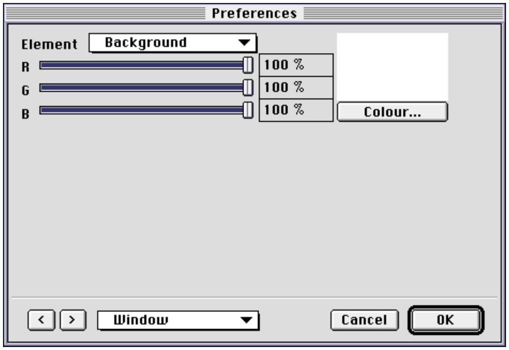
The most important grid is the line grid. It overlays the drawing in the form of several vertical and horizontal lines and is a visual help. You can specify the distance between the lines. The grid will not ne displayed if the lines get too close to each other.

Use this option to specify the grid width in the Editor.

Subdivisions

Specify a value here to give the number of segments for the line grid in a 3D view.

Window page

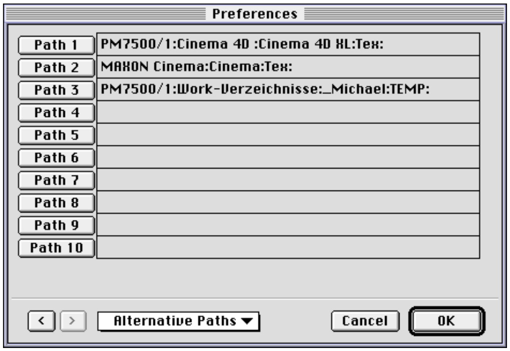


Element

This option lets you specify the colours of the Editor and the displayed elements. Choose the element and then change its colour either by using the slider or the System colour dialog (Colour ...).

All changes are immediately visible in the Editor.

Path page



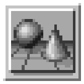
CINEMA 4D looks for textures and animated materials in specific locations and in a predefined order of priority:

1. In the same folder as the scene.
2. Inside a folder named Tex that is in the scene's folder.
3. Inside a folder named Tex that is in the CINEMA 4D startup folder.

It can happen that textures cannot be found in any of the above default folders. You can, of course, manually finc the locations of textures after launching the rendering process, but this will be a nuisance when working with a large number of textures.

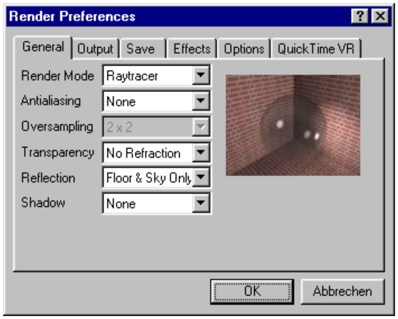
For this reason CINEMA 4D lets you define up to 10 extra texture locations. If the Editor or the Raytracer fails to find a texture in any of the default folders, it then automatically searches through the extra locations. This search is recursive, i.e. the named folder, plus all its subfolders. (Try to avoid using CD-ROM or network paths since the search process could take a long time.) If a texture cannot be located in any of the named locations an error message is generated.

Render



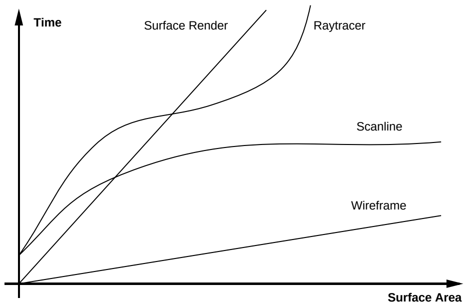
This takes you to all the options for specifying the Render quality.

General page



Render mode

This specifies the rendering quality. The modes are listed in ascending order, according to the required processing time and the image quality. The diagram below shows the relative time requirements.



'Use Editor' renders the scene just as it is displayed in the Editor window. When rendering an animation you can use this option to compute a wireframe or fast Gouraud shaded preview.

The time taken for 'Surface B/W' and 'Surface Colour' is determined mainly by the number of surfaces. Even with optimisation, the time for sorting increases linearly with the number of surfaces. This is why this mode is not particularly suitable for scenes that contain hundreds of thousands of surfaces.

A largely constant rendering time (no matter how many surfaces) can be achieved by using 'scanline' rendering. This mode is started by setting up the following conditions in the Raytracer mode:

Transparency:	max. 'without refraction'
Reflection:	max. 'Floor & Sky Only'
Shadow:	max.' Soft Only'

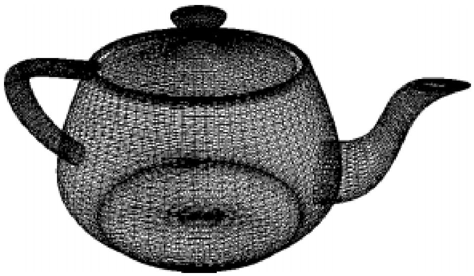
With all other settings, genuine Raytracing rendering will be started automatically if the scene requires it.

The two factors which determine the speed are screen resolution and the number of objects. Concerning resolution, the more pixels there are to render, the more calculations will be needed to light an object. With regard to objects, if you construct objects in greater detail, although the number of surfaces increases, the size of the surfaces diminishes, which means that the product of size and number of surfaces remains more or less constant, as will the rendering time. This makes the scanline algorithm ideal for rendering animations. Moreover, the image quality is still very high.

With the Raytracing algorithm things are not quite so simple. The more surfaces that need to be calculated, the more computing time is normally needed. However, in CINEMA 4D the Scanline algorithm has been integrated into the Raytracer (adaptive Raytracer) and this is used in all places where no raytracing (no transparency, no shade, …) is required. This reduces the exponential increase in computing time and accelerates rendering.

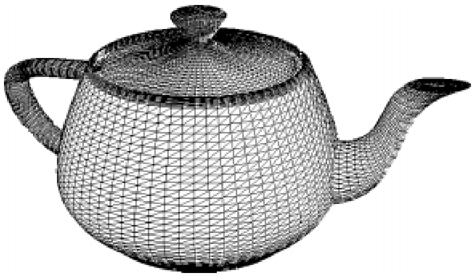
Use Editor

This options renders all objects in the same way they are displayed in the Editor window. This mode is useful for a quick overview of the scene, particularly for animations, since the calculation is extremely fast.



Surfaces B/W

The ‘Surfaces B/W’ mode displays only visible surfaces, not hidden ones.



This rendering mode corresponds to the flat shading display mode in the editor (see chapter 3 – Display Mode). It is of use mainly for technical applications.

Surfaces Colour

This mode works just like ‘Surfaces B/W’ except that colour and lighting are also calculated. Only one colour is used per surface, which produces a rather faceted image with no highlights.

This mode is most suitable for obtaining a rough overview of the arrangement of objects in a scene. It does not allow for reflections, transparencies or shadows, nor can textures be rendered.

Raytracing

This mode offers the best image quality.

All properties, such as hard shadows, transparency, light refraction, textures, relief (bumps), smoothing and fog, are computed and rendered.

The Raytracer in CINEMA 4D is an adaptive Raytracer. This means it automatically detects those places in an image where raytracing is required. Everywhere else an integrated scanline algorithm is used.

The values of the Transparency, Reflection and Shadows fields lets you control how much real raytracing will be used, and how much scanlining. You must specify

Transparency: ‘With refraction’
Reflection:‘All’ or
Shadow: ‘Sof t and Hard’

if you want the real Raytracer to be used.

Look at the two sample pictures. They show the same scene. On the left, the Scanline algorithm was used—all shadows were ignored, only the sky is reflected and transparencies were calculated without refraction. On the right you have Raytracing. Here you see hard shadows. Not only the sky, but also the bottle is visible in the mirror. Moreover, you can recognise the refraction properties that are typical for glass and water. And yet even here, in those places that do not use any of these effects (on the floor, for example), the Scanline method was used.

Tip:

The Raytracer can benefit from multiprocessing. It detects automatically if there is more than one processor in the system and then distributes rendering tasks accordingly. If you have four processors installed, CINEMA 4D can increase its speed by a factor of 3.6 to 3.8.

Antialiasing

Since an image is made up of a number of pixels, it has a grainy structure which is more pronounced in lower resolutions. You can see these grains particularly at the edges of objecvts, where you get a ‘staircase’ effect. This phenomenon is called ‘aliasing’.

CINEMA 4D gives you the option of cancelling out this unwanted effect with its Antialiasing function.

Specifying ‘None’ will prevent antialiasing from being applied. ‘Edge’ will smooth object edges and suppress colour jumps as much as possible. ‘Edge + Colour’ will apply antialiasing also to textured regions, and ‘Always’ irons out everything neatly.

CINEMA 4D gives you ‘Broadcast Antialiasing’. This guarantees that TV and cinema movies of perfect quality are produced.

Tip:

The option ‘Always’ might be better thought of as ‘Extreme’ and refer to the increase in processing time rather than a quality improvement. If in doubt, always start with a lower setting and then go up. Increase the Oversampling (see below) before selecting a higher antialiasing grade.

Oversampling

This lets you specify how many extra rays (maximum) are needed for a pixel that uses antialiasing. If you have enabled ‘Always’ for Antialiasing, ‘3 x 3’ requires nine times as long! The ‘Always’ setting should therefore only be used if you require the very highest quality.

A much better bet is ‘Edge + Colour’. This setting gives you almost the same results as ‘Always’, while needing only a fraction of the processing time.

Experience has taught us that it makes more sense to use higher oversampling rather than the ‘Always’ setting. If you wish to combine high image quality with modest rendering times, use ‘Edge’ or ‘Edge + Colour’ in combination with the oversampling factors 3x3 or 4x4—these are particularly well suited for animations.

Transparency

You can choose ‘None’ if you do not want transparencies to be processed. ‘Without Refraction’ means that all transparent materials are displayed but without their specified refraction index. ‘With Refraction’ enables the highest and most realistic setting.

For glass objects you need to enable ‘With Refraction’. This will increase the render time.

By the way, there is no processing overhead if you have enabled ‘With Refraction’ but the scene does not contain any refractive materials.

Reflection

The ‘Floor and Sky’ option causes the Raytracer to render reflections of the floor and the sky on the surfaces of reflective objects. This function requires hardly any processing time and is therefore strongly recommended for time-critical projects. It is often all that is required to render realistic scenes.

Reflections of other objects on the surfaces of objects are visible only when ‘All’ is enabled.

Like everything else in CINEMA 4D, reflections are programmed adaptively. This means that simply enabling the function will not mean longer processing times—this will happen only if you actually use reflective materials in your scene.

Shadows

This option determines whether rendering is to include shadows. Shadows lend greater depth to a scene, while shadowless scenes often appear flat.

Soft shadows are rendered quickly and look realistic—often much more so than ‘hard’ shadows.

You should use the option ‘Soft and Hard’ in combination with the Raytracer only if you need hard, realistic shadows. Since this requires extra rays for the shadow calculation, rendering may take noticeably longer.

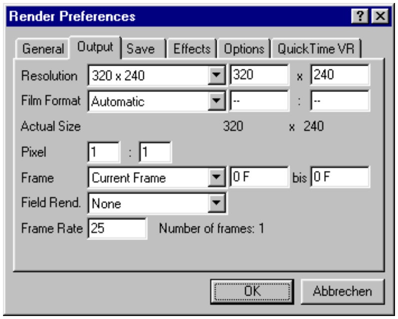
On the other hand, hard shadows do have one distinct advantage: since they are calculated with mathematical precision, they do not produce any artefacts in the image.

When calculating soft shadows, the scene is mapped to what is called a light map. For reasons of memory space this normally has a maximum size of 768 x 768 pixels and hence a limited resolution. Thus it may happen that small details in soft shadows—particularly in animations—can vary in brightness, an effect that can be avoided only by using a higher resolution light map. This is why CINEMA 4D provides four different grades of light map in the light settings dialog.

CINEMA 4D is one of the very first programs to allow soft shadows not only with spotlight sources but also with point light sources. To do this, six light maps are placed cubically around the internal light source. Small shadow anomalies may occur at the edges and corners, but this can easily be remedied by, for example, aligning the light source to the scene by its Z axis.

By definition, parallel light sources cannot produce soft shadows.

Output page



All settings on the Output page apply to the calculation in the separate image window only. Since only single frames and parts of single frames get calculated in the Editor window, these settings have no effect there.

Resolution

Specify your frame format here. The 'Manual' option lets you define a custom size instead of any of the default values contained in the list.

Film Format

The film format corresponds to the X:Y ratio of an image. Photographic studios, the movie industry and the TV industry all often work with film formats that are not the same as the ratio of a computer screen.

If you are the lucky owner of an IMAX cutter or if you plan to create a film in cinema format, choose a suitable option from the list. The 'Manual' option lets you define a custom size instead of any of the default values contained in the list.

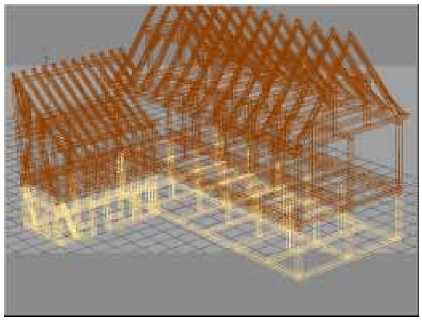
Resolution and film format are directly linked. If you change the film format, the resolution will be adjusted automatically.

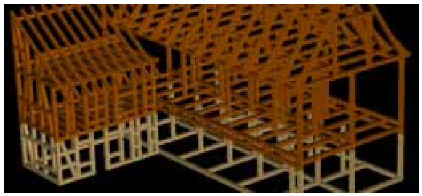
This can be illustrated with an example:

Select a resolution of 320 x 240. This is equal to a 4:3 ratio and so is matched up with the 'Computer' film format. Now change the film format to 70 mm (cine format), and the resolution automatically changes to 320 x 145.

The film format default setting is 'automatic'. This means that images are rendered in the specified resolution independent of any particular ratio.

The Editor shows this format, too. Just as with widescreen movies on your television, a horizontal band appears at the top and at the bottom of the scene. The region between the bands is the 'visible area' (the area that will be rendered), thus providing you with control over the entire scene and the region that is actually visible.





The appendix contains a list of the most commonly used film formats.

Actual Size

This line shows the calculated result on the basis of resolution and film format, i.e. the frame size which is actually being rendered.

Pixel

Correct screen output was something of particular importance to the developers of CINEMA 4D. A central concept is the ‘pixel ratio’, which is the proportion of the visible width to the visible height of an individual pixel. This is usually 1:1.

Some monitors cannot display a 1:1 pixel ratio and if this ratio is not taken into account, circles have elliptical form on the screen. However, once you have set this value correctly, CINEMA 4D works without any distortion.

Frames

If you wish to render only part of the animation, you can specify the frame numbers here. This allows you, for example, to resume a rendering process that was interrupted. The first frame of an animation is numbered 0.

If you specify a path name and an image format for saving frames, a four-digit number and an extension for the graphics format is appended to the filename, for example ‘frame0021.tif’.

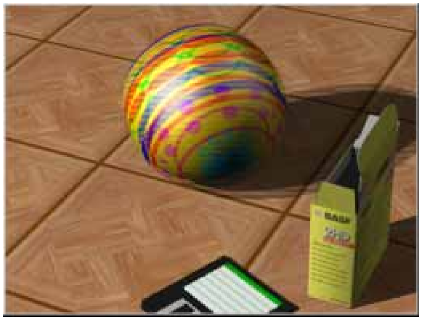
Important!

AVI or QuickTime films cannot be completed if rendering is interrupted. Instead, you must start rendering from scratch or must use a suitable video editor for assembling the film clips.

Field Rendering

When working with video technology you will probably obtain much better animations by using so-called field rendering. Here, a frame within an animation is divided into two‘fields’, one containing all the odd lines, the other all the even lines.

To create the animation, the odd lines of one frame are mixed with the even lines of the other.



Here you can specify whether mixing is to start with the field containing the odd or the even lines. The method you choose will largely depend on your video equipment. You may wish to experiment with both possibilities.

Tip:

Field Rendering is not suitable for single frames and is only meant for video output.

Important!

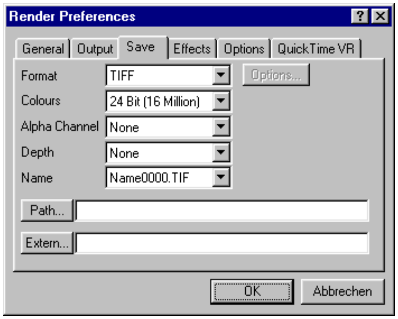
Field Rendering makes sense only if the created pictures are saved with a loss free compressor or completely uncompressed. All other compressors (e.g. JPEG, M-JPEG, etc.) smear the fields and the result will not be that satisfying.

Frame Rate

This option lets you specify a frame rate for rendering the animation, independently of the rate defined for the document. If for example you want to do a test render, you can reduce the rate from 25 frames per second to only 5 frames per second. This will calculate every 5th frame only, and thus save processing time.

To the right of the input box you can see the actual number of frames to be rendered.

Save Page



Format

CINEMA 4D supports many frame formats across platforms. On some systems, the particular system format for animations or frames is also supported (AVI / BMP on Windows and QuickTime / PICT on MacOS).

Compressed image formats take longer to save than uncompressed ones. Particularly with animations, where each second counts, this can be important. On the other hand you need to think about disk space.

Availability and functionality of automatic creation of animations varies with the operating system.

Windows 95:

AVI High Compression: Intel INDEO compression is used.

AVI Medium Compression: Cinepak compression is used.

AVI External: The system dialog box appears after you click on the Options button and lets you choose the compression method.

Macintosh:

Movie High Compression: A special variant or setting of the Cinepak-Codec compression method for good quality, very small films is used. These cannot be played backwards, however, or reconverted to individual pictures, as they are time-compressed.

Movie Low Compression: A special variant or setting of the Codec animation compression method for loss-free saving of the film is used. The result is high-quality QuickTime movies, but these become very large and require a fast hard drive.

Movie External: The system dialog box appears after you click on the Options button and lets you choose the compression method.

Options

Enable this switch when you have chosen AVI External (Windows) or Movie External (Macintosh).

This will open the system-specific dialog box for you to specify the compression setting (for example those of a particular video card), which will then be used for rendering.

Colour Depth

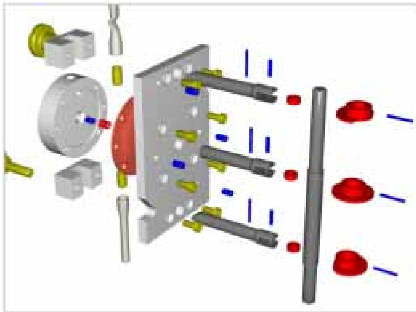
Here you select the colour depth at which the rendered picture will be saved. CINEMA 4D always works internally with a colour depth of 24 bits and then converts the picture to your desired colour depth using highly optimised algorithms.

For reductions of the colour depth to 8 bits (256 colours) you can select whether the picture is to be dithered. When dithering is enabled, a colour transition required by the reduced number of colours used is achieved through the mixing of two adjacent colours. This is not a genuine blend, however, as when two pots of paint are mixed, but can be compared rather with the method used for printing newspapers. The different grey levels in newspapers are achieved by varying numbers of small black and white dots. Dithering reduces the colour gradients but makes the picture grainier.

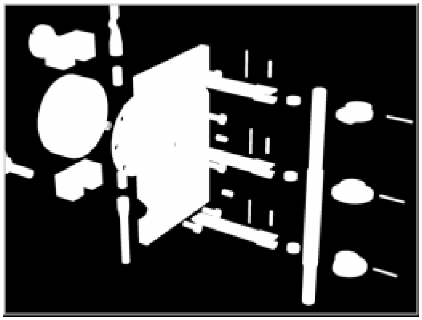
Alpha Channel

The alpha channel contains the information about each point of an image that tells it whether at that point there is an object or not.

In the alpha channel, all the parts of the colour picture which contain objects are white, while all others (the environment, the background) are black. The hard edge between the black and the white parts is smoothed with grey gradations, depending on the selected antialiasing value.



The scene.



The scene's alpha channel.

Such alpha channel pictures are used by graphics and video editing software to mix two pictures. This is done by punching out the background from the raytraced picture so that these parts show the second picture (for example a real photo or a video shot). Since the edges of the alpha channel picture have been smoothed with greyscales, even the mixed picture will have soft edges.

'None' prevents the creation of an alpha channel.

'Separate' creates a second greyscale TIFF image, with'_a' added to the name of the corresponding colour image. The extension will be '.tif'.

For example, if the colour image is called 'house.tif', then the attached alpha channel will be saved as 'house_a.tif'. For animation frames a sequenced four-digit number will also be added, e.g. house_a0123.tif'.

'Include in File' saves the alpha channel in with the colour image.

Tip:

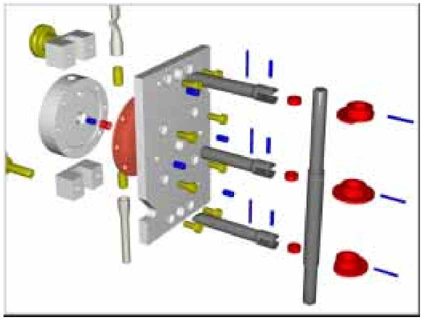
Alpha channels can be integrated into image files only of Targa, TIFF and PICT formats. Integration into AVI or QuickTime animations depends upon the compressor that is being used.

Tip:

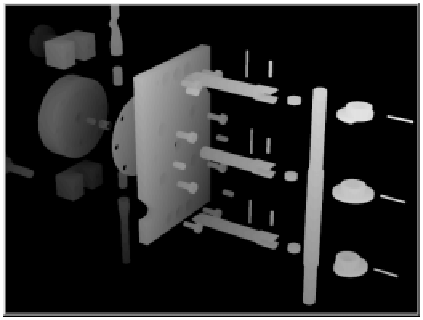
If you have selected 'Include in File' you will not be able to enable the option of the same name under 'Depth Channel' (see below).

Depth channel

A depth map contains, for each point of a rendered picture, information concerning its distance from the camera. The further away a point is from the camera, the darker it will be; the closer it is, the lighter its colour.



The scene.



The scene's depth channel.

Depth channels are often used when editing images to create various effects (such as depth of field).

'None' prevents the creation of a depth channel.

'Separate' creates a second greyscale TIFF image, with '_d' added to the name of the corresponding colour image. The extension will be'.tif'.

For example, if the colour image is called 'house.tif', then the attached depth channel will be saved as 'house_d.tif'. For animation frames a sequenced four-digit number will also be added, e.g. 'house_d0123.tif'.

'Include in File' saves the depth channel in with the colour image.

Tip:

Depth channels can be integrated into image files only of Targa, TIFF and PICT formats. Integration into AVI or QuickTime animations depends upon the compressor that is being used.

Tip:

If you have selected ‘Include in File’ for the depth channel, you will not be able to enable the option of the same name under ‘Alpha Channel’ (see above).

Name

Many video editing programs can process rendered animation frames. Unfortunately, almost all of them work with a different naming convention.

Some expect the filename to end with a number, others an extension. Some programs can cope only with three-digit numbers. CINEMA 4D deals with this nonsense by providing a menu from which you can choose the sequential numbering and/or lettering style you need.

‘0000’ means a sequential number, ‘TIF’ stands for 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

Path

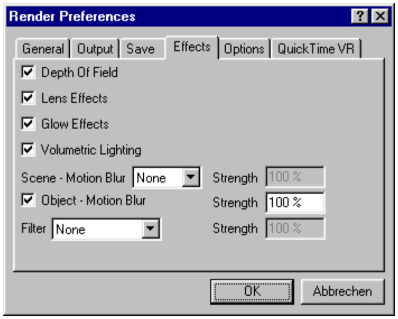
If the rendered image or a whole animation sequence is to be saved permanently, enter a valid name here, with a path.

If instead of a path you enter only a name, all rendered images or animations are saved into the same folder as the scene.

Extern

Here you can specify an application to which the rendered picture will automatically be passed. You could, for example, use this to pass the animation frames to a graphics editing program for further processing. Under Windows you can use a batch file with command parameters; on a Macintosh you may want to use AppleScript.

Effects Page



Depth of Field

If you have enabled depth of field for one or more cameras, this will be calculated if the Depth of Field option is enabled here.

Please note that this effect is generated *after* the normal image rendering and is therefore not immediately visible.

When you work in the editor at a colour depth of 8 bits (256 colours), all post-processing effects will cause a lightening of the picture. This occurs only in the editor window, however, and not in the external picture output window, because internally only 8 bits are used for the editor window. CINEMA 4D does this to economise on processing resources.

Lens effects

If you have enabled lens effects for one or more light sources, these will be calculated if the Lens Effects option is enabled.

Please note that this effect is generated *after* the normal image rendering and is therefore not immediately visible.

When you work in the editor at a colour depth of 8 bits (256 colours), all post-processing effects will cause a lightening of the picture. This only occurs in the editor window, however, and not in the external picture output window, because internally only 8 bits are used for the editor window. CINEMA 4D does this to economise on processing resources.

Glow effects

Enable this option if you want to have glow effects.

Tip:

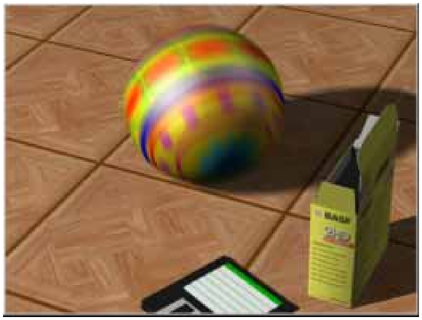
Glow effects, just like the lens effects, are so-called post-processing effects. This means they are only created after the rendering. They are therefore not reflected, nor are they visible behind transparent objects.

Volumetric Lighting

Enable this option if you want shadows to be computed in visible light.

Scene—Motion blur

When objects move in front of the eye of the viewer, or if a camera rapidly pans through a scene, the image becomes blurred, especially if this happens at great speed. This effect is not taken into account by animation software, which is why certain tricks need to be used if you want a life-like effect.



Motion blur is required when you wish to simulate the camera panning across the whole scene. Intermediate images are then calculated which will overlap each other with decreasing intensity in the final image.

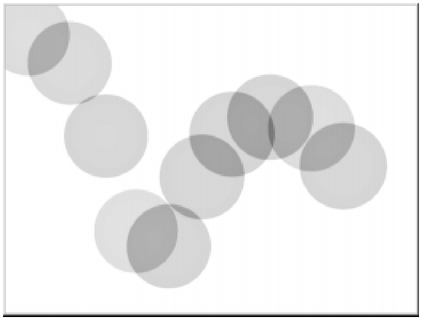
Select from the popup menu how many intermediate images you wish to have computed for the final frame of an animation. This will increase the processing time for the animation accordingly.

Tip:

If you want shadows, reflections, etc. to have motion blur, you need to use the Scene - Motion blur function.

Tip:

For very rapid movements you need to increase the number, otherwise you will get a stroboscope effect (see illustration).



Tip:

Scene - Motion blur and Oversampling (with antialiasing) are closely interconnected. For example if you choose ‘5 times’ for Motion Blur, this corresponds to antialiasing ‘2x2 Always’. In the same way, ‘9 times’ corresponds to ‘3x3 Always’ and ‘16 times’ to ‘4x4 Always’.

Elements in the frame that are not moving are antialiased perfectly, whereas moving elements will not be antialiased when Scene Motion Blur is activated. Usually, objects in motion will not require antialiasing—consider a 16-times motion blur where there are 16 intermediate frames; in this case the missing antialiasing simply is not visible. You can, of course, add antialiasing manually, although with a motion blur of 9 or higher it really is not necessary and adds substantially to the rendering time.

Object - Motion Blur

For individual objects to have motion blur, assign them this attribute in the Object Manager (see Chapter 11).

This effect is produced only after normal rendering and is hence not visible immediately. However, the benefits are clear:

- calculation is very quick
- there are no stroboscope effects

'Strength' is used to specify the degree of blur. It can take a value between 0% and 200%.

There a few limitations that come hand-in-hand with object motion blur. For example, only position, scaling and rotation animations can be blurred (so a beating wing formed using bones cannot have motion blur applied to it). Also, imperfections may appear at the edges of the frame, or some flickering may occur with animation sequences. However, tbecause movements are analytically blurred, generating a natural motion effect, object motion blur can be very effective for single frames.

Object motion blur is limited to a maximum frame.size of 2000 x 2000 pixels and is automatically disabled at resolutions higher than this.

Tip:

Should you wish to apply motion blur to shadows, reflections and the like, use scene motion blur.

Tip:

Particles (see chapter 4 - Particle system) cannot be blurred. Furthermore, you shouldn't use object motion blur together with post-processing effects (such as lens flares, etc.) as this may lead to unexpected results.

With motion blur activated you should think carefully if you need field rendering (see above). As a general rule, the field effect will be unnecessary. Furthermore, the quality of the automatic motion blur antialiasing will be a little better without field rendering. Additionally, you will save on rendering time.

Filter

You can apply the built-in post-processing filters to the rendered picture.

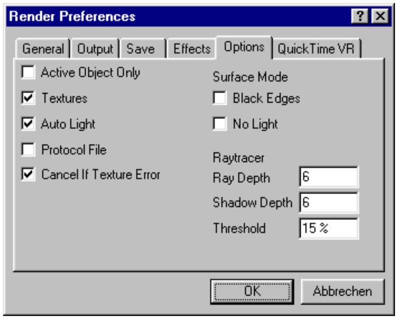
'Soft', for example, will recalculate each pixel in relation to adjacent ones, thus creating a slight reduction in sharpness. This is not so much intended for still pictures as for animations. Computer animations often show an unwanted juddering at the edges of objects. Using Soft will reduce this effect. The lack of sharpness will not be noticed in animated pictures and therefore will not be a problem.

'Edges' emphasises transitions in the picture, thus placing considerable emphasis on edges. This filter is of little practical use but is popular with artists.

When you don't want to use Soft, you can try the 'Mid' filter. This filters out unwanted extremes (e.g. isolated white pixels) and should always be enabled for final rendering.

'Strength' defines the intensity of the filter.

Options Page



Only active object

When this option is enabled, only the active object is rendered for output in the separate image window.

Textures

Decide here whether you want textures to be displayed when using Raytracing. Doing without saves processing time, and it means the textures do not need to be kept in memory, but the rendered scene may look less realistic.

Auto Light

CINEMA 4D features automatic lighting. If you have not defined a light source, the program will render the scene using a standard light source at the position of the viewer, if you enable this option. Thus you can view and judge objects under optimal lighting even in the construction phase. However, as soon as you create one or more normal light sources, the automatic lighting is disabled.

For spectacular scenes you should certainly use your own light sources which could light objects from the side and/or from behind. This gives a scene depth. The automatic light source, which is always located at the position of the viewer, will light objects only from the front. The resulting lack of shadows makes the objects appear flatter and less realistic.

Protocol File

If this option is enabled a file with the name 'Renderlog.txt' will be created after rendering in the main folder of CINEMA 4D.

This file will contain a history of the entire rendering process plus important information about the system resources used and the rendered scene. In addition, any problems that occurred during rendering are recorded in this file—useful if, for example, you are rendering several pictures overnight or over the weekend.

If a history file already exists in the CINEMA 4D folder, new results will be appended to the end of the existing file.

Tip:

Because the history file is not overwritten, it can grow gradually to a large size. Therefore you should delete this file manually from time to time.

On the following page is an example history file (without any errors).

```
**************************************************
*                                                *
*             CINEMA 4D PROTOCOL FILE            *
*                                                *
**************************************************
*                                                *
*         MASSIVE IMPACT RENDERING SYSTEM        *
*                                                *
**************************************************

Renderjob started on 10/31/1997 at 12:0:0
File            : D:\CINEMA_4D\XL-Beta\Szenen\XL-Shader\Glas.c4d
Creator         : Michael A. Giebel, MAXON Computer
C4D Version     : V5 XL 4.966
Serial number   : 16050200103
Frames          : 1
CPUs            : 1
Rendermode      : Raytracing
Resolution      : 640x480
Antialiasing    : 3x3 Edge+Colour
Field rendering : Off
Motion Blur     : Off
Reflections     : On
Transparency    : On
Shadows         : Hard
Volume effects  : On
Alpha channel   : Off
Depth channel   : Off
Output format   : Film
Renderjob finished on 10/31/1997 at 12:0:30
```

Cancel if Texture Error

CINEMA 4D puts up an alert during the rendering of a scene if one or several textures can't be found. If this option is not selected and you confirm the alert, the rendering continues and instead of the texture the defined material colour is used.

With this option enabled, the rendering will be cancelled after the alert. If you are rendering several scenes automatically, the next render will be started immediately.

Surfaces

Black Edges

If you enable this option all surfaces in surface view are surrounded by a thin black line.

No light

In surface view you can disable angle-dependent light by light sources. This results in all surfaces of an object having the same uniform colour.

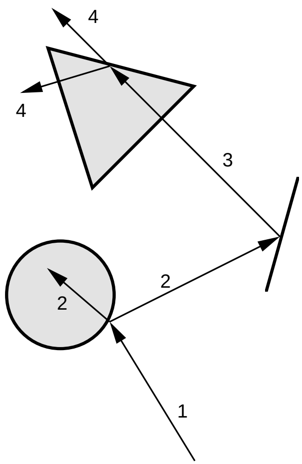
Particularly in combination with 'black edges', this option makes objects appear more uniform and more 'technical'.

Raytracer

Ray depth

When the raytracer sends a ray into the scene, it will, depending on the material it hits, be broken and reflected. With certain arrangements of surfaces, for example two mirrors opposite each other, the ray may for ever be mirrored backwards and forwards between the two mirrors. The raytracer would never finish the rendering process. To prevent this you can define the maximum number of reflected or broken rays using the Ray depth setting.

Skilful use of the ray depth can also set a limit on rendering time. It is often only the initial reflections and refractions that are of interest. Further rays affect the picture only insignificantly, but take up a disproportionate amount of processing time.



A processing depth of 1 means that calculations are finished once a ray has hit something in the scene. Reflections and transparencies are therefore not visible.

A value of 2 means that, after a ray has hit a surface, a second ray is calculated for transparency and reflection. The greater the processing depth, the further rays are followed into the scene and the results rendered (see the illustration).

Shadow depth

The same test as for Ray depth applies to whether a surface point lies in the shadow of another object. This is tested by additional shadow rays which are emitted from the surface in the direction of the light source.

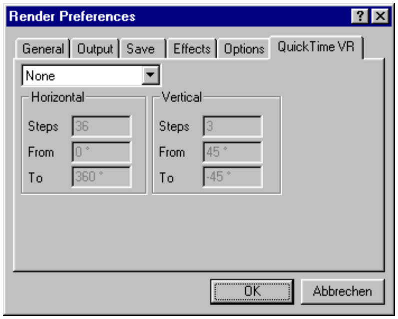
This value can be used to optimise the rendering time. With complex scenes, particularly those containing many reflective and transparent surfaces, 90% of the processed rays contribute less than 10% to the general picture brightness You can define the maximum number of reflected or broken rays using the Ray depth setting.

Threshold

This value can be used to optimise the rendering 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 colour. With a threshold value of, for instance, 15%, the rays stop their outward movement as soon as their brightness falls below this critical value.

However, if you wish to calculate all rays, enter the value 0% here.

QuickTimeVR page



The options on this page let you create complete QuickTime VR panoramas and object rotations quickly and easily.

You may have seen games (for example the 'Star Trek Technical Manual') which make use of these features.

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.

Moreover, you can integrate objects into a panorama which can be rotated and zoomed independently of the background.

For this to work, the images need to be of the highest quality, and correctly positioned, otherwise you will get distortions and 'jumps'. Normal photos rarely meet these requirements, unless they are taken with high-precision, expensive cameras.

Why not do the modelling of objects and scene with CINEMA 4D and then let the program create the QuickTimeVR film automatically for you?

Players for QuicktimeVR are available from Apple for Macintosh and Windows. You will find them on Apple's Homepage on the WWW.

Mode

The default setting is 'None'. It means that no QuickTimeVR movie is computed. This setting allows normal processing of images and animations. In all other cases, all animation functions are automatically disabled for rendering images. However, you can still specify resolution, image format, render mode etc. on any of the other pages.

'Object Movie' is a QuickTimeVR animation where the camera stands still while the viewed object

rotates depending on the settings described further below. The light on the object is constant.

‘Panoramic Movie’ is a QuickTimeVR animation where the camera rotates around its own axis depending on the settings described below.

‘Sightseeing Movie’ is a QuickTimeVR animation where the camera rotates around the global origin in accordance with the settings described below.

‘Panoramic Picture’ is similar to the Panoramic movie. Here, a foldout image of the panorama is created. It is then possible to combine several such panorama pictures by using a special application (for example Macromedia Director). You can then define hot spots that jump to yet another panorama. Combinations of panorama pictures with object movies are also possible. This is one way of creating a virtual department store. For each department you have a panorama, and within these you have object movies—the goods on display in their glass cabinets.

Horizontal

Here you can specify the number of frames for a single ‘ring’ and the range of the camera pan or rotation. Normally, the full range from 0° to 360° is used and 36 frames (= 10°).

Vertical

This is for specifying the number of rings. For a simple panorama or a simple object rotation, one ring is enough. But if you wish to have tilting (up and downward camera movements), you need several rings. It is best to have an odd number, for example three above the horizon and three below, plus the one in the middle, i.e. a total of seven rings. The extent of the panning is specified by entering values for ‘From’ and ‘To’. The maximum range here is -90° to +90°.

Tip:

QuickTimeVR panoramas have their own rendering resolution: QTVR. Use ‘Automatic’ as your film format.

If you prefer to work with your own resolutions, make sure the values for the X and Y resolutions can be divided by 4.

Tip:

It is not possible to produce lens effects when creating QuickTimeVR movies.

Summary:

A panorama is a 360° 'all-round' view of the environment, seen from the camera. The QuickTimeVR movie lets the user spin around his or her own axis, moving freely around in the panorama. The camera can even tilt up and down.

The frames for a panorama are usually created with an angle difference of 10° to 30°, i.e. by generating a ring of 36 to 12 shots. By choosing more frames (smaller steps) you obtain smoother transitions.

If you wish to include camera tilts the software needs to calculate several rings, for example each 30° upward, i.e. for 90°, 60°, 30°, 0°, –30°, –60° and –90°. This will allow you a view vertically upwards to the zenith.

Objects are interactive elements that can be viewed from all sides by using the mouse. Since the changes between individual frames can be considerable with detailed objects, it is advisable to make many shots of the objects.

Ideal figures are 19 rotations from +90° to –90° (every 10°), with each rotation consisting of 36 frames (one every 10°), thus giving a total of 19 x 36 = 648 pictures. This achieves a very good coverage of the object, which can then be rotated freely in space in the finished QuickTimeVR film.

Rendering QuickTime movies:

After you have specified all the settings, CINEMA 4D renders a QuickTime movie or a frame sequence, if that is what you have chosen as your format (in which case you will need to assemble these individual frames into a QuickTime movie).

The sequence of the frames is determined by the rings. The topmost ring is processed and saved first. So if you have three, the frames in the ring at +45° are rendered first, then the ones of the ring at 0°, and finally the frames of the ring at –45°.

This is also the sequence which the Apple QuickTimeVR tools expect for the rendered frames.

Rendering QuickTimeVR movies:

The following instructions refer to the Apple tools Make QTVR Object, Make QTVR Panorama and QTVRPlayer for the Macintosh. They can be downloaded from the Apple homepage on the Internet.

To create a QTVR movie, launch Make QTVR Object, then load the QuickTime movie that CINEMA 4D has rendered. Under Preferences, specify what you wish to create—object, scene or object in a scene—and what the movie is made of: number of rows, frames per row, viewing angle … Click to create the QuickTimeVR movie and then view it.

To create a QTVR movie from a panorama picture, you must first edit the image. Launch an image editing application and load the rendered image. Now rotate the panorama by 90° in a counter clockwise direction (floor to the right, sky to the left). Then save the image as a PICT. The rotation is needed, among other reasons, because in PICT format the horizontal dimension is restricted to 4000 pixels—panorama pictures may be wider than that.

Now start the Make QTVR Panorama program. Load the rotated PICT image. In the dialog that appears specify how to view the image (rotation angle horizontal and vertical, visible segment, …), then click on ‘Create’. This creates a QuickTimeVR movie with the extension ‘snm’. Use the QTVRPlayer to view it.

Important!

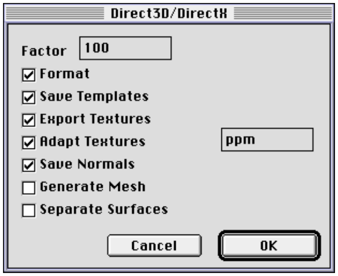
Use the same data in these programs as you used for rendering in CINEMA 4D, otherwise you will confuse the software and produce movies that are not right.

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 fisheye 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%–50%.

Direct 3D/DirectX



Factor

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

Format Text

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 'Frame.jpg' becomes 'Frame.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.

Important!

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

Note that DirectX can only process graphics measuring 2^n 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.

Separate Surfaces

When exporting to Direct3D format, the corner points for each object are saved separately. This means that for two adjacent quadrangles eight points in total (four for each quadrangle) are saved—and not just six (since two of the points are shared).

This avoid conflicts when converting cuboid-texture projection to UV mapping.

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 colour '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.

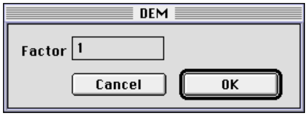
Layer

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 colour (Connect by Colour) 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.

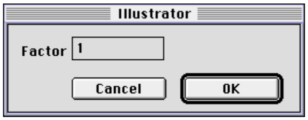
DEM



Factor

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

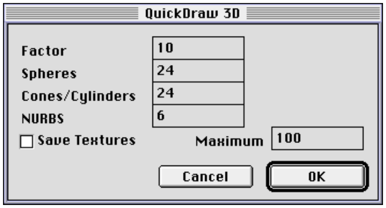
Illustrator



Factor

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

QuickDraw 3D



Factor

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

Textures are not exported, since CINEMA 4D projection types are not recognised by QuickDraw 3D.

Sphere

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

Cone/Cyl.

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 colour information only (i.e. without textures).

Maximum

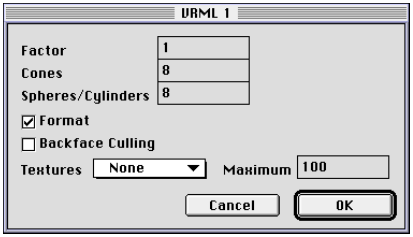
CINEMA 4D allows you to use any size of texture—provided of course you have plenty of memory. However, when viewing a scene it can be irritating to wait for textures which are very large to load.

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

Tip:

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.

Sphere

The VRML format recognises mathematical spheres. When importing them into CINEMA 4D these objects are converted to polygon objects. Specify here how finely they should be subdivided.

Cone / Cylinder

The VRML format recognises mathematical cones and cylinders. When importing them into CINEMA 4D these objects are converted to polygon objects. Specify here how finely they should be subdivided.

Format

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 colour 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

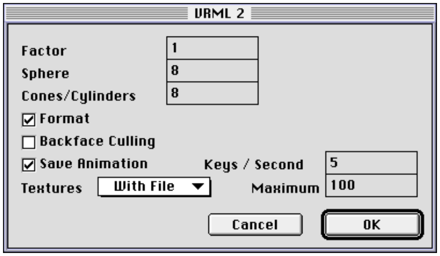
CINEMA 4D allows you to use any size of texture—provided of course you have plenty of memory. However, when viewing a scene it can be irritating to wait for textures which are very large to load.

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.

Tip:

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.

Sphere

The VRML format recognises mathematical spheres. When importing them into CINEMA 4D these objects are converted to polygon objects. Specify here how finely they should be subdivided.

Cone / Cylinder

The VRML format recognises mathematical cones and cylinders. When importing them into CINEMA 4D these objects are converted to polygon objects. Specify here how finely they should be subdivided.

Format

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 WWW 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 colour 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 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.

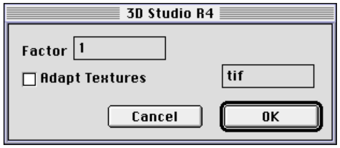
The second integrates the graphics data directly into the VRML-2 file. Since the texture is written uncompressed, in text format, a texture of 1000 x 1000 pixels quickly reaches a file size of 4MB. If you wish to avoid having such large files, you can specify a value (larger than 0), to restrict the size of textures. The materials are then scaled to that value (in pixels). The proportions remain intact.

If you have a texture of 800 x 600 pixels and you set a maximum value of 100, the texture is proportionally scaled down to a size of 100 x 75 pixels before being saved.

Tip:

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

3D Studio



Factor

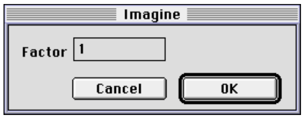
This is for specifying whether and to what degree 3D Studio files are scaled when they are loaded and saved.

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).

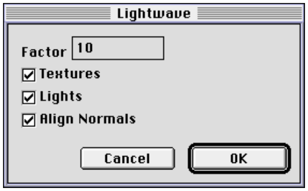
Imagine



Factor

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

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.

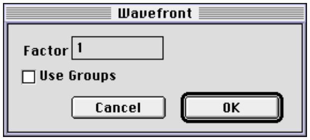
Lights

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

Align Normals

This lets you specify whether CINEMA 4D should import the surface normals of LightWave objects.

Wavefront



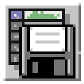
Factor

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

Use Groups

Wavefront can combine any number of surfaces into groups. If you want to load these into CINEMA 4D, you need to enable this option. Note that, depending on the Wavefront scene, you may get a very large number of objects.

1.9 Save Preferences



Saves the current layout of open windows and the preference settings into a file named ‘Cinema4DXL.prf’ in the CINEMA 4D startup folder.

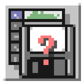
At startup, CINEMA 4D locates this file automatically in this folder (which also contains the program itself). If the program does not find this file, it uses the default settings and layout instead.

You can load customised preference files with the File / Open command.

Tip:

The view in the Editor is not saved in the preferences file, but instead with each scene. So if you wish to start with something other than the 3D view, create your own ‘Template.c4d’ or‘ New.c4d’ file (see Chapter 1.1).

1.10 Save Preferences As

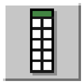


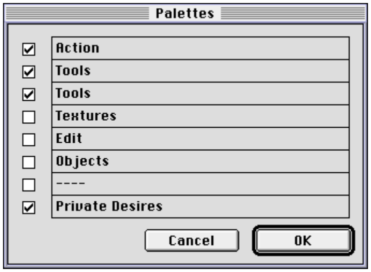
When you have modified the preferences and the program layout to suit your own taste (including some of the Manager settings), you may want to save these for later re-use.

By saving them under the filename ‘Cinema4D.prf’ in the program folder, you can ensure that CINEMA 4D loads them automatically each time it starts up.

You can use this command to save several different layouts (custom configurations) under different names. This means that in addition to your default layout you can, for example, have a special one for construction and one for animation. Each layout will then have only the required Managers open. This allows you to open any required layout in seconds using the File / Open command.

1.11 Palettes





You can have up to eight palettes open. In addition to the built-in ones there are empty ones that you can customise. Specify a name, size and position for them.

Use the Palette Manager to configure the contents of these palettes. The Palette Manager is accessible via the popup menu that appears when the mouse is on a palette and you right-click (Windows) or hold down the Command key while you click (Macintosh).

The Palette Manager displays all available symbols. From here you simply drag-and-drop the required ones into your palette.

In the Windows version the palettes are docked to the Editor window as soon as they come close, but they can be brought inside the window if you wish.

1.12 Quit

This command is used for leaving the program. If any unsaved changes are detected in any Editor window, a dialog asks you if you wish to save these before quitting.

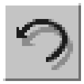
Clicking on ‘Cancel’ in this dialog returns you to the program.

Edit Menu

Contents

2. The Edit Menu

2.1 Undo

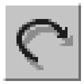


Use this command to undo the last change that you made. If you moved an object by mistake, Undo will move it back to its old position. Even if you performed a complex process, such as crumpling or deleting a large object, you can restore the object to its previous state with Undo.

Using the command repeatedly will undo one action after another. By default, CINEMA 4D remembers 10 actions, all of which can be undone.

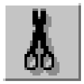
The number of Undos allowed can be changed; CINEMA 4D XL comes with a C.O.F.F.E.E. applet which allows you to set the number of steps that may be undone. For details, please refer to the section on C.O.F.F.E.E. applications in the appendix.

2.2 Redo



If you inadvertently use Undo once too often, use Redo to restore the command you have just undone. In other words: Undo steps backwards through the processes you have carried out, Redo takes you forwards.

2.3 Cut



Removes the selected object or element from the current scene and copies it, together with any associated materials, on to the clipboard. Use Paste if you wish to retrieve the object.

2.4 Copy

Copies the selected object or element on to the clipboard, together with any associated materials, leaving the original behind. You can then use the Paste command as often as you like in order to copy it into this scene or into other scenes.

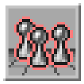
2.5 Paste

Inserts the object currently on the clipboard into the current document.

2.6 Delete

Deletes the selected object or element without placing a copy on to the clipboard.

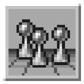
2.7 Select All



Selects (highlights) all objects within a document. If necessary, all objects are first grouped into a single object group and then selected.

If you are using the points tool when you use this command, all points of the object are selected instead.

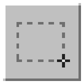
2.8 Deselect All



Deselects the highlighted object or element.

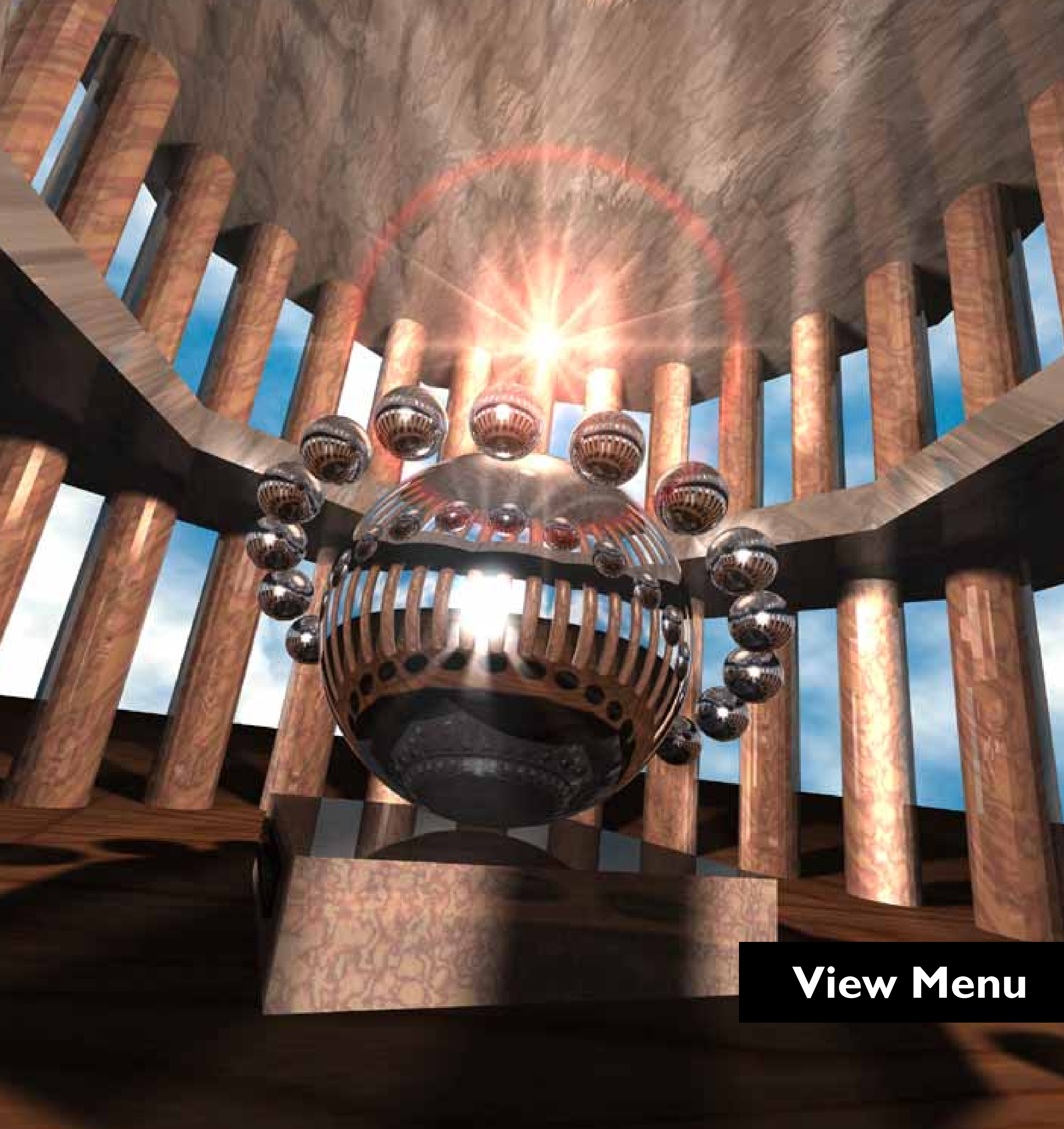
If you are using the points tool when you use this command, all points of the object are deselected instead.

2.9 Select Area



If you are using the points tool, the edges tool or one of the area tools, this command will frame a region of the selected object and highlight all elements within that section.

You can choose (in Preferences) whether or not an element needs to lie entirely within the frame for it to be selected (see Chapter 1, Preferences / General / Tolerant Region Select).

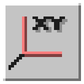


View Menu

Contents

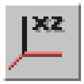
3. The View Menu

3.1 XY-Axis (Front)



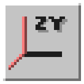
Switches to XY-Axis (Front) which gives a front elevation.

3.2 XZ-Axis (Top)



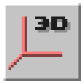
Switches to XZ-axis (Top) which provides a view from above (or ground plan).

3.3 ZY-Axis (Side)



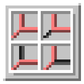
Switches to ZY-Axis (Side) which corresponds to the view from the side (or side elevation).

3.4 3D View



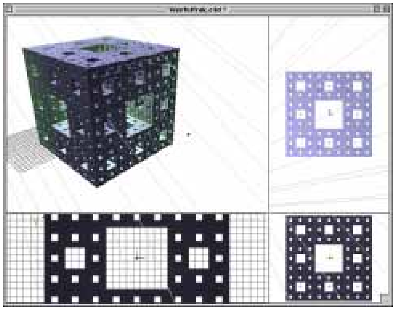
Switches to a three-dimensional view. Here, the objects are shown in perspective, as if seen through an imaginary camera. If no camera has been defined as the current 3D camera for a particular scene, the document-specific Editor camera is used (see Chapter 4: Objects / Special objects / Camera).

3.5 4T View



This is a combination of all the previous views, where the document window is divided into four panes. The top left pane shows the 3D view, the bottom left is the ZY-Axis (Side), the bottom right is the XY-Axis (Front), and the top right is the XZ-axis (Top).

You can resize these panes if you wish. Grab the intersection of the four panes and drag it to the desired position.



Tip for Windows users:

Changing the Editor window in this fashion causes the system to slow down considerably.

Why? Because changing the window forces CINEMA 4D to start a drawing task. At the same time, Windows has to start a second task, that of refreshing the content of the window. As long as both these tasks have the same priority, they can be carried out only at half speed.

Under Windows NT the priority for drawing tasks needs to be reduced drastically in order to prevent blockage of the system.

This in turn gives the other task so much weight that it practically blocks the CINEMA task for several seconds. Unfortunately, Windows NT is relatively slow with this type of changeover. To prevent tasks from 'killing' each other, each runs in its own memory block, with its own system variables. When a changeover occurs, Windows NT needs to save the entire block, with all its variables, and fetch a new one; this is time-consuming.

Windows 95 does not have this type of memory protection and can make the changeover rather more quickly.

3.6 View

Clicking this icon in the View toolbar opens a menu with the following commands.

Active Object

The visible section of the work area is set so that the current object is centred and fills the area.

In perspective view the camera is shifted in parallel, without changing the direction of the view.

Scene No Camera/Lights

If you want an overview of the entire scene, without any light sources or cameras, use this command. It sets the visible section of the work area to contain the scene without lights or cameras, to fill the area and to be centred.

In perspective view the view is shifted in parallel, without changing the direction of the view.

Scene

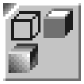
If you want an overview of the entire scene (including the light sources and the cameras) use this command. It displays the visible section of the work area with the scene centred and filling the view.

In perspective view the view is shifted in parallel, without changing the direction of the view.

Default

Restores the camera and zoom factors to their default settings (also works in the plane views).

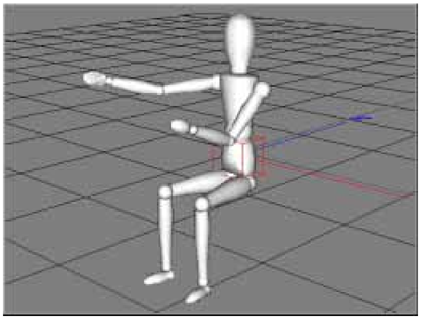
3.7 Display Mode



Clicking this icon in the View toolbar opens a menu which enables you to very quickly change the display mode for all objects.

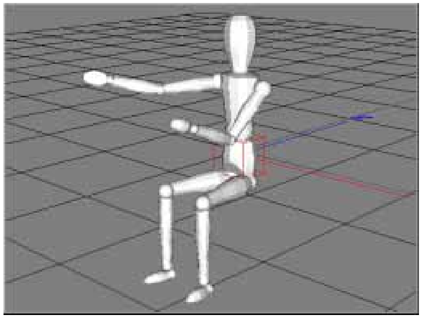
Gouraud Shading

This option displays all objects shaded and with rounded surfaces. Gouraud Shading gives the highest-quality representation in the Editor and is ideally suited for controlling the hiding of objects. With the highly optimised rendering engine that is used in CINEMA 4D you can move objects in real time, set light cones and observe their effects. The display speed depends on the processor and graphics card (if any) that is fitted. If the display is too slow you can try reducing the number of colours from TrueColor (16 million colours) to HiColor (65,535 colours) or you might want to reduce the resolution of your work area.



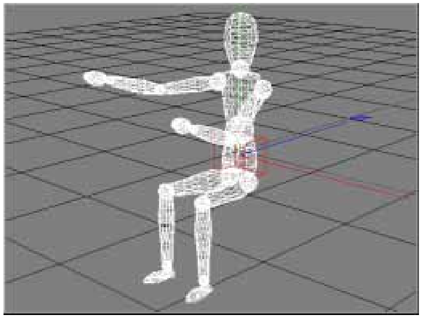
Flat Shading

Flat Shading is similar to Gouraud Shading. The only difference is that smooth transitions between areas are not calculated, so the surfaces are facetted, which increases the refresh speed by about 30%. It also gives a fairly good idea of depth and the way objects interlock.



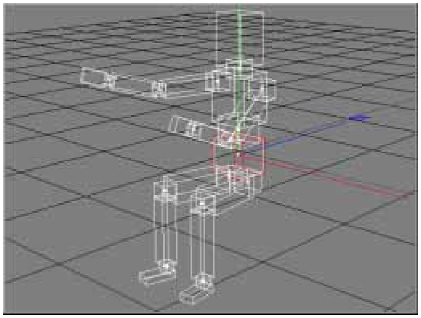
Wireframe

Wireframe represents objects with lines. In combination with Backface Culling (see below) this provides an excellent view that is well-suited for working quickly, even on complex scenes.



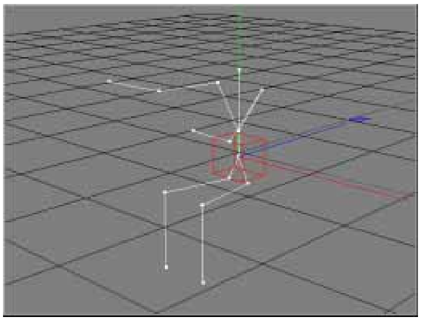
Bounding Box

Bounding Box encloses each object within a box made from 12 lines that correspond to the object's dimensions. The actual lines of the object itself are not drawn. This produces a much faster refresh rate than with wireframe. Bounding Box representation is particularly good for very complex scenes.



Skeleton

The Skeleton view shows the object hierarchy, drawing only the origins of the objects' axes and connecting them with lines. This view is particularly useful for character animations as it leaves out all distracting lines.

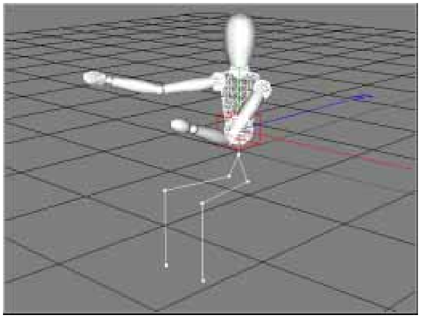


As Preset

Each object may be assigned its own individual representation (Chapter 10: Object Manager / Function / Display); it is even possible to combine several different types.

This means that, for example, you can display an aeroplane using Gouraud shading and have a large landscape behind displayed in wireframe.

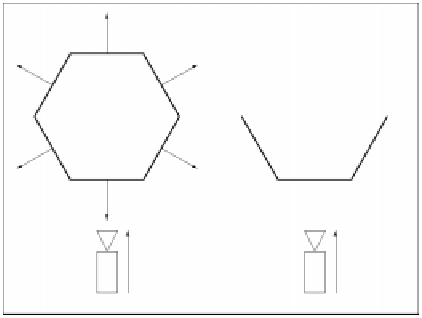
Use this option to view each object according to its preset representation.



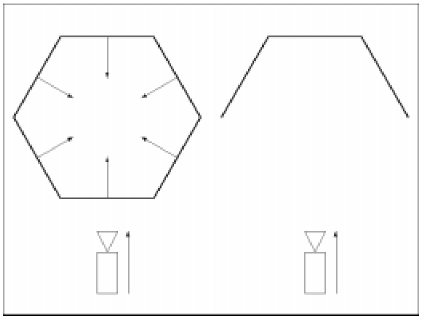
Options

Backface Culling

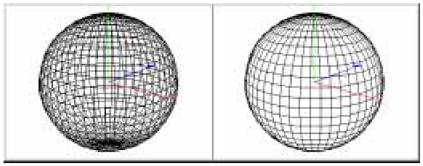
Accelerates the reproduction of scenes in the Editor when using Gouraud or Flat Shading. When selected, surfaces facing away from the camera are not drawn. Surfaces facing away include all those with normal vectors running in the same direction as the camera's Z axis. This is shown in the illustration below.



When the normal vectors show towards the object's interior, apparent mistakes in the representation can appear. The solution here is to turn around the normal vectors (see Chapter 12 – The Structure Manager).

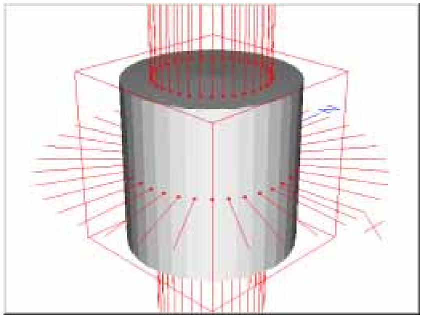


Backface Culling can be combined with wireframe. The illustration below shows a simple object without (left) and with (right) Backface Culling.



Show Normals

With this option switched on the normal vectors of all surfaces of the selected object are drawn. This allows you to verify very quickly whether Backface Culling (see above) is shown correctly, or whether the normal vectors of an imported object need to be aligned.



In a representation of area normals, the length of the lines is proportional to the size of the area. In other words, the larger the area the longer the lines.

Show All Axes

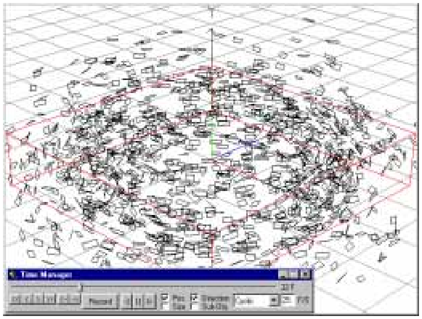
With this option switched on, the object hierarchy—starting from the selected object—will also show the local axial centres for all child objects.

Show Path

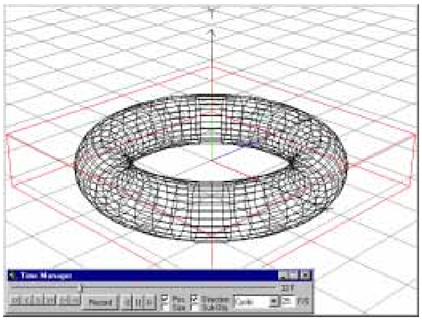
With this option switched on the Editor will display the animation path for the selected object. If an object has several animation paths, only the top one in the hierarchy is shown.

Animation Effects

With this option switched on the Editor will show any animation effects (Merge, Explode, Morph …) if the Edit Camera tool is active.



If this option is not active, or if any tool other than Edit Camera is selected, the objects in the Editor are shown in their original, unaltered state throughout the animation.



Back Picture

When this option is active the Editor will display the background image, if one exists.

For this to happen there needs to be a background object which has been assigned a material with a colour texture (image or animation).

4T-Shading

This lets you define, for each Editor view, whether the objects are to be shaded (Gouraud or Flat).

This requires the object to have been assigned that characteristic, either locally or globally, within the scene.

3.8 3D Camera

Object

CINEMA 4D lets you use several virtual cameras for generating realistic scenes.

The sole purpose of the Editor camera is to view the scene while you are constructing objects within the Editor. At any time, though, you can use any object as a camera. For instance, it can be useful to use a light source as a camera temporarily, in order to control the lighting of a scene.

After selecting this command the Object camera is associated with the currently selected object. In the Object Manager this object is drawn in blue, and in pink when it is also the active object.

For animations, and to adjust focal length, you need to use a real camera as the Object camera.

The division between Editor and Object camera was introduced to provide you with many ways of viewing a scene without interruption. In this way, when you race around a scene with your Editor camera, you are not changing the all-important camera settings.

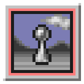
Editor

This command switches from an Object camera back to the Editor camera.

Use this function whenever you have defined one or more cameras or lights within a scene and you are simply trying to view objects from a different perspective.

3.9 Render Picture

All



Renders the scene in the Editor window. This can be selected in any view but if the 4T View is active a question mark appears after selecting this menu; at this point you need to click in the window that you want to be rendered.

You can change the rendering method and other options in the Render Settings dialog.

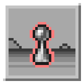
You may cancel rendering at any time by pressing the Esc key.

Rendering in the Editor does not allow all CINEMA 4D features. It cannot, for example, render QuickTime VR images or movies, nor can it calculate the number of particles.

After the rendering starts, a progress bar appears at the lower edge of the editor window. This bar shows you how far the render has progressed. You can also see how much time the render has taken and, if you render an animation, which frame of the total number of frames is actually on the screen.

If CINEMA 4D can't find the textures for any of the materials used in a scene, an alert will appear. If you choose to continue rendering, the defined material colour will be used instead of the texture (see chapter 1 - Preferences).

Active Object



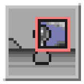
Renders the active object dynamically in the Editor window. Keep in mind that reflections and transparencies of the active object will be only partly effective because the surrounding scene is missing.

You can change the rendering method and other options in the Render Settings dialog.

Post-processing effects, such as lens flares, will not be rendered.

You can cancel the rendering process with a mouse click or by selecting any command.

Region



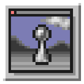
Renders a region dynamically in the Editor window. You need to first drag an area in order to define the region that is to be rendered.

You can change the rendering method and other options in the Render Settings dialog.

Post-processing effects, such as lens flares, will not be rendered.

You can cancel the rendering process with a mouse click or by selecting any command.

New Window



Renders all objects in a separate window. At the lower edge of the window a progress bar appears. This bar shows you how far the render has progressed. You can also see how much time the render has taken and, if you render an animation, which frame of the total number of frames is actually on the screen.

Once you have chosen New Window you will notice some new menu entries that allow control over such things as the choice of colour channels, different zoom factors and more.

You can change the rendering method and other options in the Render Settings dialog.

If you wish to cancel the rendering process, simply press the Esc key or choose Stop Rendering from the File menu.

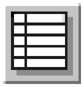
During the rendering you can continue working in the Editor, and you can even render another scene. However, the current version of the software does not support parallel rendering, i.e. multiple launches of a rendering process in the window.

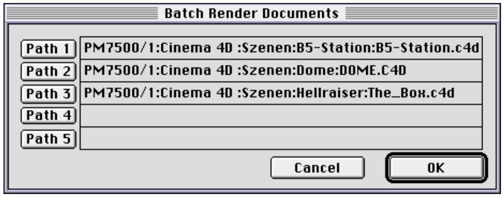
Tip:

Displaying all render effects is only possible when rendering is performed in a new window.

You *must* render in a new window, and you must have defined a filename in the Render Settings, to be able to save scenes and animations.

Batch Render





This command will process and render up to five scenes in a row—individual frames or animations—which is useful, for example, if you want to render while you are asleep the scenes that you have constructed during the day.

Enter the locations and names of the scenes into the lines of the dialog. The settings used for rendering will be those defined in the Render Settings dialog for each scene.

Tip:

Ensure that the Render Settings for each scene contains a location and filename. If it doesn‘t, the frame or animation will be rendered on-screen but will not be saved.

Tip:

Ensure that all the textures that belong to a scene can be located, otherwise the renderng of the current frame or animation will be cancelled and the next scene in the queue will start rendering. It is useful to begin by quickly rendering each scene individually. If the results are not what you expect, check the file ‘Renderlog.txt’. But don’t forget to enable the Protocol file option.

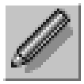
3.10 Redraw

Tip:

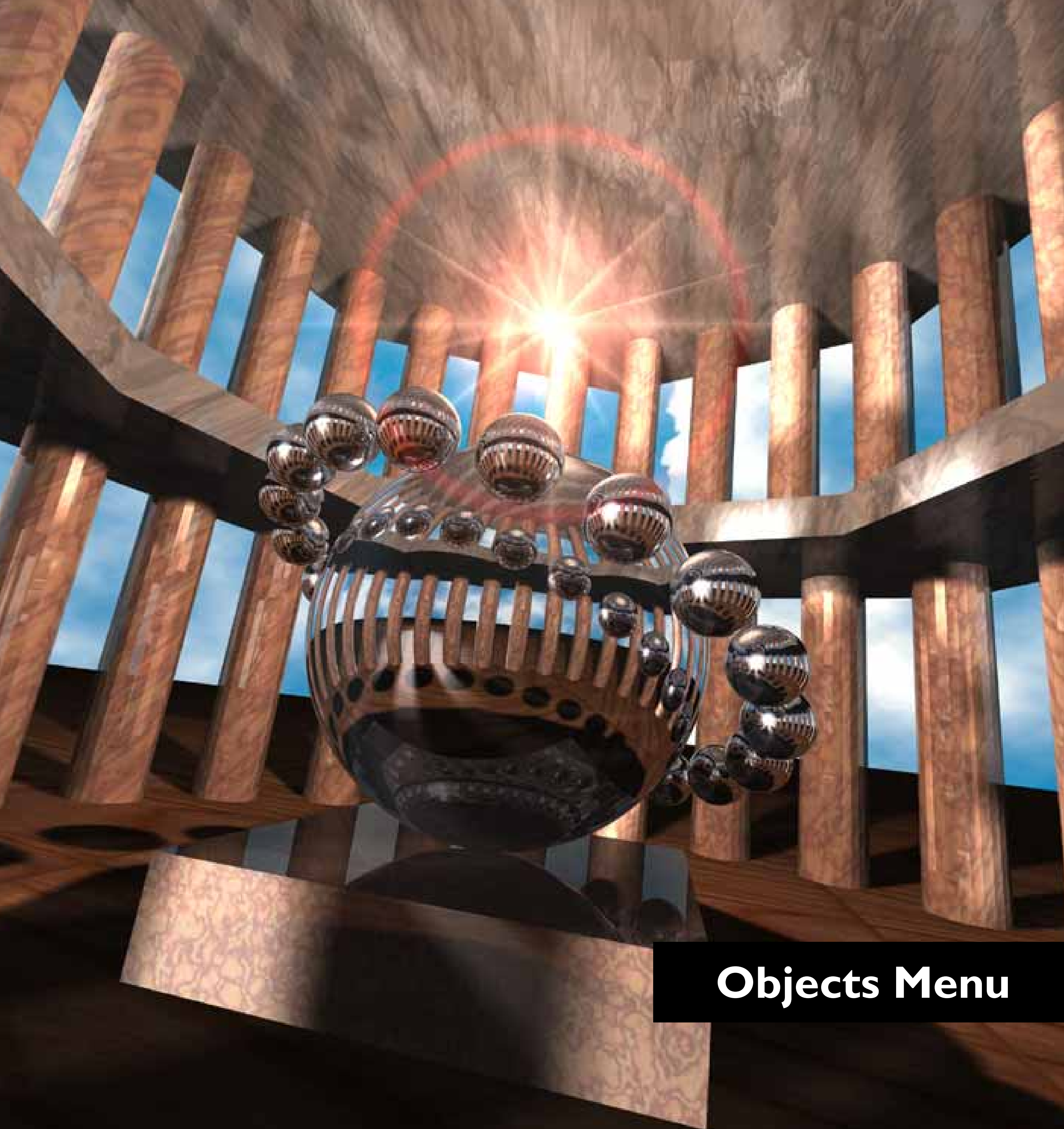
Don’t forget to select the correct settings when rendering animations with system compressors (see chapter 1 - Render Preferences).

Tip:

A dialog appears when attempting to save images over existing ones of the same name. Ensure that the target folder does not contain any images or animations that have the same filenames as those you have specified in the Batch Render dialog.



This command redraws the Editor window, which includes a recalculation of all animation effects.

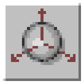


Objects Menu

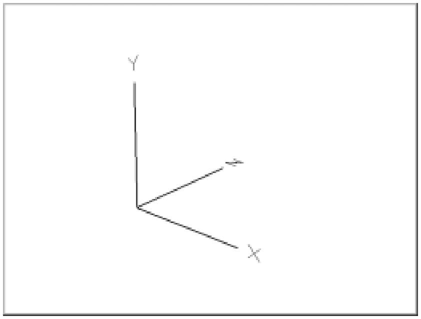
Contents

4. The Objects Menu

4.1 Empty Object

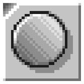


This command creates an empty object, identifiable only by its origin and the axes.



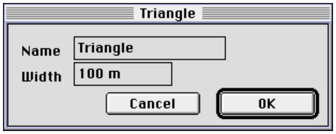
The object may then be filled with points and areas, or it may be used for grouping other objects.

4.2 2D Object

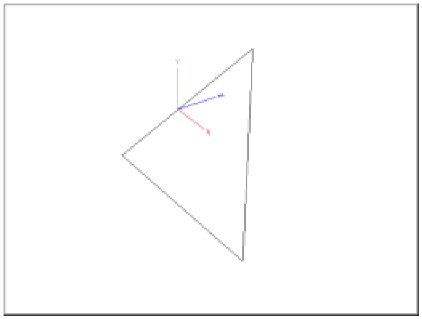


Clicking this icon in the Objects toolbar will open a menu containing the following commands.

Triangle

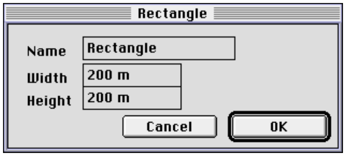


This command generates the most elementary of all objects in computer graphics, a triangle.

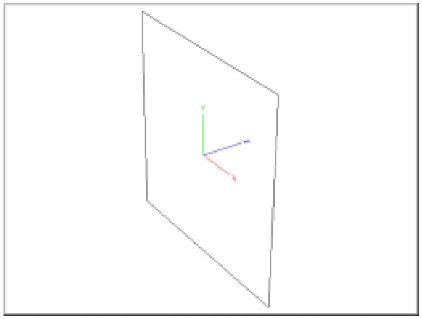


Use ‘width’ and ‘height’ to determine the size. The triangle is created parallel to the XY plane of the world coordinate system.

Rectangle

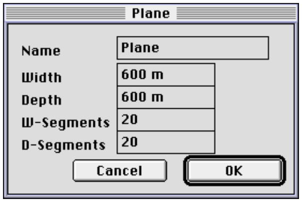


This command creates a rectangle on the XY plane.

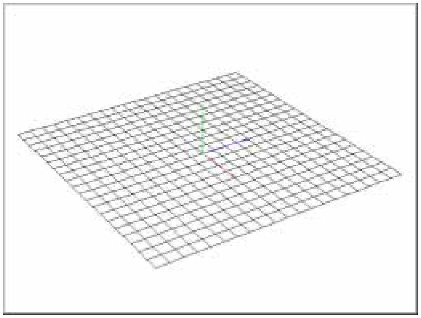


The sides of the rectangle run parallel to the X axis (width) and the Y axis (height) of the world coordinate system.

Plane



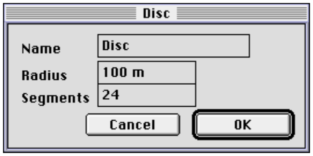
This command creates a rectangle which is subdivided into further rectangles.



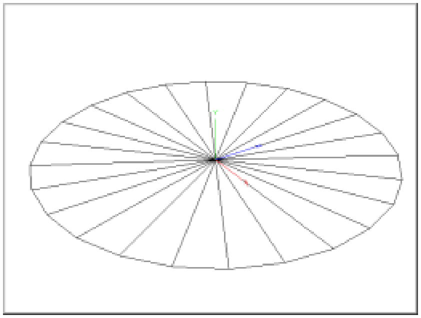
The object lies on the XZ plane of the world coordinate system. The basic‘plane’ object is ideally suited to modification by functions such as Crumple, Wrap and Deform.

Define the dimensions of the plane along the X and Z axes by using ‘width’ and ‘depth’. Specify the number of rectangles by using ‘W-Segments’ and ‘D-Segments’. For example, if you specify four width and three depth segments, the object will be made out of 3 x 4 = 12 rectangles.

Disc



This command creates a disc on the XZ plane.



‘Radius’ defines the size of the disc, ‘Segments’ its circularity.

Tip:

Subsequent subdivision of the object (see Chapter 5) will not make the disc more circular. You must use a finer segmentation when you first create the object.

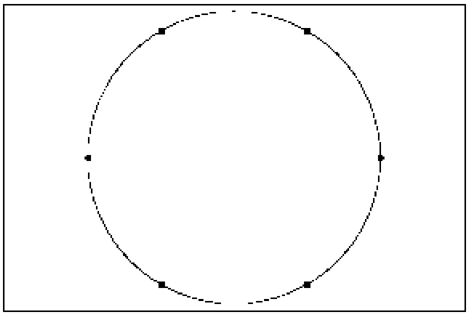
4.3 3D Object

Clicking this icon in the View toolbar will open a menu containing the following commands.

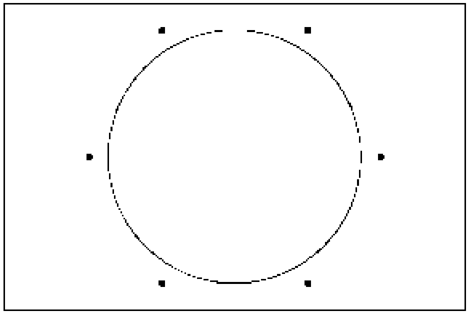
Platonic Object

With Platonic objects you can enter any of the construction values. Only the currently active value will be used for creating the object since the three parameters are interdependent—changing one of the values will immediately cause the other two to also change.

The R parameter defines the radius of the circumscribing sphere. With a circumbscribing sphere, all points of the object are on the sphere's surface.



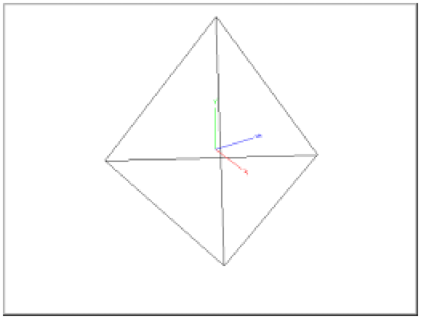
The r parameter specifies the radius of the inscribed sphere. With an inscribed sphere, the surface of the sphere touches all of the object's surfaces.



The a parameter specifies the sides of the regular polygons of the object.

Tetrahedron

This command creates a three-sided pyramid.

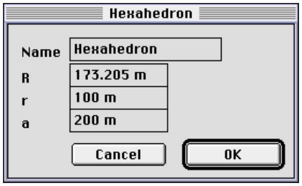


The four faces (the three sloping faces and the ‘base’) are all equilateral triangles (have sides of equal length). This object is sometimes called a regular tetrahedron.

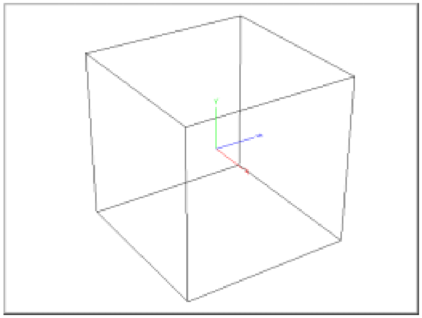
One of the side-faces (the ‘base’) lies on the XZ plane of the world coordinate system, where one of the edges is parallel to the X axis.

The R parameter specifies the radius of the circumscribing sphere. The a parameter specifies the sides of the regular polygons of the object. The r parameter specifies the radius of the inscribed sphere.

Hexahedron



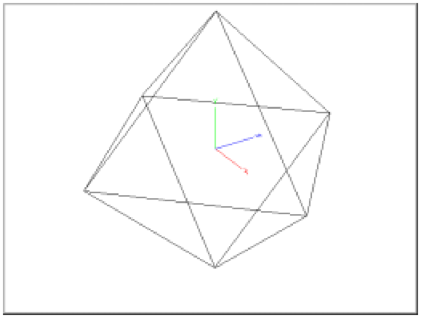
This command creates a hexahedron (cube) whose side-faces are parallel to the world coordinate system.



The R parameter specifies the radius of the circumscribing sphere. The a parameter specifies the sides of the regular polygons of the object. The r parameter specifies the radius of the inscribed sphere.

Octahedron

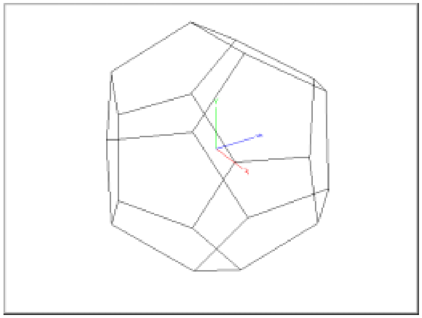
This creates an octahedron, which is basically two combined pyramids.



The R parameter specifies the radius of the circumscribing sphere. The a parameter specifies the sides of the regular polygons of the object. The r parameter specifies the radius of the inscribed sphere.

Dodecahedron

This command creates a dodecahedron. The 12 side-faces of this object are all regular pentagons.



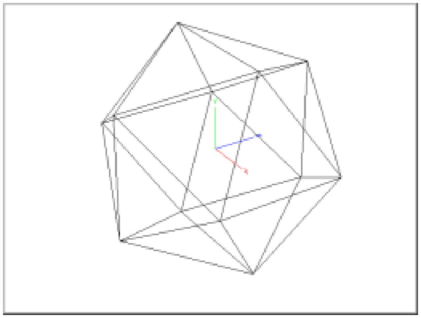
The R parameter specifies the radius of the circumscribing sphere. The a parameter specifies the sides of the regular polygons of the object. The r parameter specifies the radius of the inscribed sphere.

Tip:

The pentagons of the dodecahedron are each divided into a triangle and a rectangle. In order to improve the visualisation of the dodecahedron, the edge between the triangle and the rectangle has been omitted in the figure above.

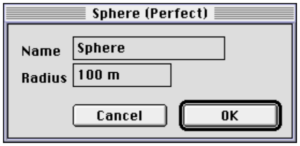
Icosahedron

This command creates an icosahedron whose 20 side-faces are all equilateral triangles.

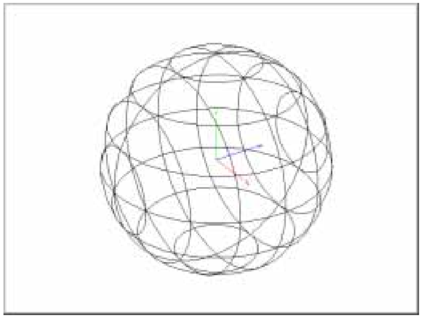


The R parameter specifies the radius of the circumscribing sphere. The a parameter specifies the sides of the regular polygons of the object. The r parameter specifies the radius of the inscribed sphere.

Perfect Sphere



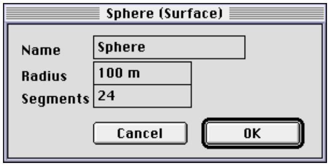
This command creates a mathematically perfect sphere.



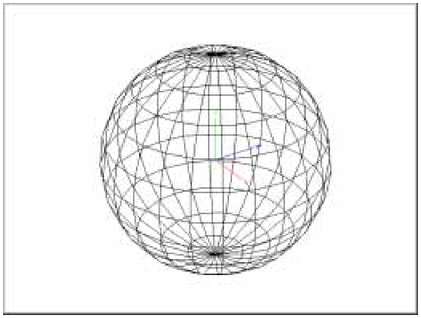
The advantage of the perfect sphere is that it looks ‘perfect’ because it is truly spherical. Moreover, its calculation is very quick, much faster than spheres that are made from surfaces. The drawback is that perfect spheres cannot be deformed.

If you need to deform a perfect sphere you must first convert it into polygons (see Chapter 5: Tools / Structure / Convert to Polygon).

Surface Sphere



This command creates a sphere made from triangles and rectangles.

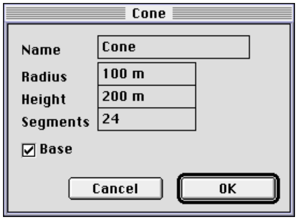


For a surfaced sphere you can specify the number of segments it should be made from.

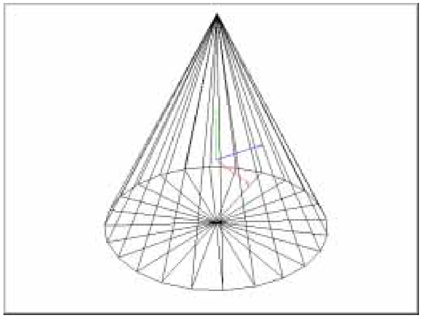
Tip:

Subsequent subdivision of the object (see Chapter 5) will not make the sphere more rounded. You must use a finer segmentation when you first create the object.

Cone



This command creates a cone whose base lies on the XZ plane.



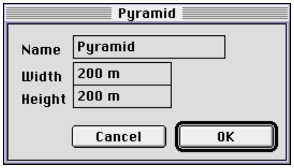
Use ‘Segments’ to vary the number of subdivisions. The outer surface of the cone and its base are made from the number of segments you specify here.

If you want the cone to be open at the bottom, deactivate ‘Base’.

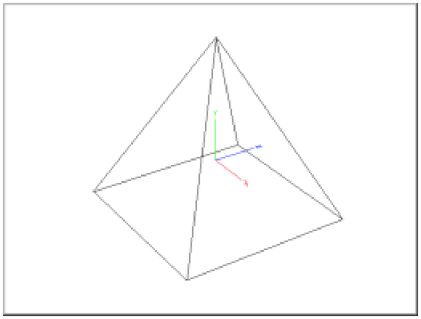
Tip:

Subsequent subdivision of the object (see Chapter 5) will not make the cone more rounded. You must use a finer segmentation when you first create the object.

Pyramid

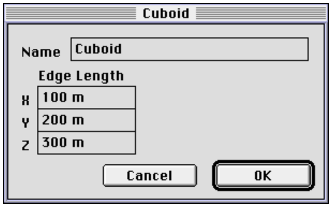


This command creates a four-sided pyramid whose square base lies on the XZ plane of the world coordinate system and is parallel to its axes.

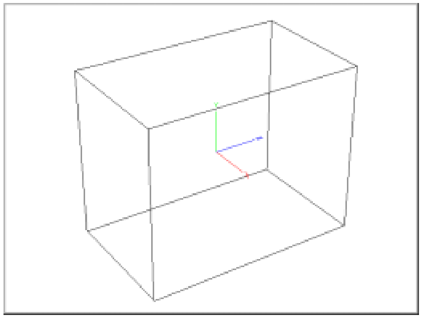


Use ‘Width’ to specify the side of the square base and ‘Height’ for the height of the pyramid.

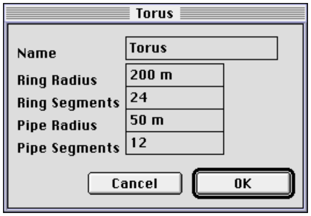
Cuboid



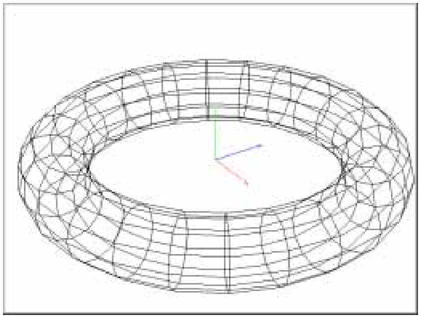
This command creates a cuboid whose three edge-lengths are specified separately.



Torus

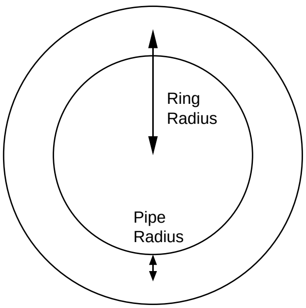


This command creates a ring (Torus) on the XZ plane.



Size and smoothness of the ring are specified using ‘Ring Radius’ and ‘Ring Segments’.

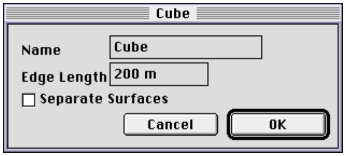
Similarly, you use ‘Pipe Radius’ and ‘Pipe Segments’ to specify the radius and the smoothness of the pipe.



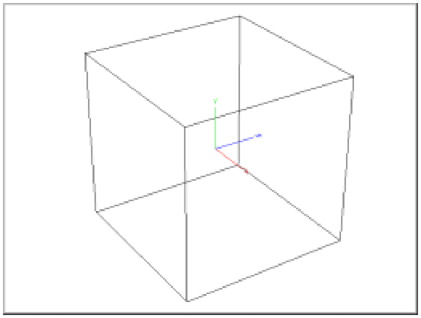
Tip:

Subsequent subdivision of the object (see Chapter 5) will not make the torus more rounded. You must use a finer segmentation when you first create the object.

Cube

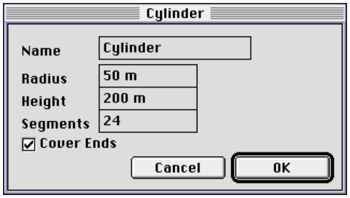


This command creates a cube whose side-faces are parallel to the coordinate planes of the world coordinate system.

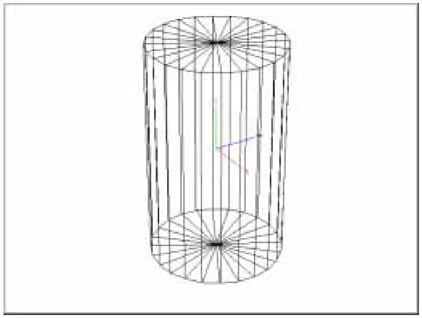


It can be useful for certain applications—for example to apply a different texture to each side—to define the side-faces of a cube as individual objects. To do this, select the Separate Surfaces option.

Cylinder



This command creates a cylinder.



The axis of the cylinder is parallel to the Y axis of the world coordinate system.

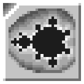
Under ‘Segments’ specify the number of parts that you wish to use to cunstruct the cylinder.

Use ‘Cover Ends’ to specify whether you wish the cylinder to be open or closed.

Tip:

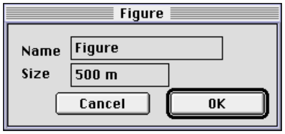
Subsequent subdivision of the object (see Chapter 5) will not make the cylinder more rounded. You must use a finer segmentation when you first create the object.

4.4 Special Object



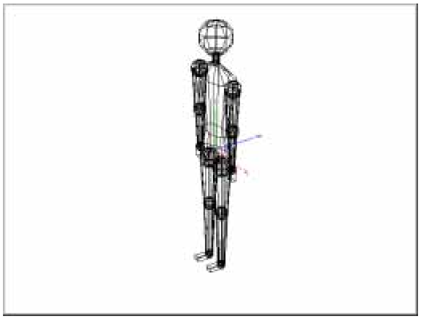
Clicking this icon in the Objects toolbar will open a menu containing the following commands.

Figure

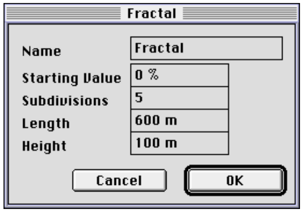


This command lets you access a figure that is ready for animating.

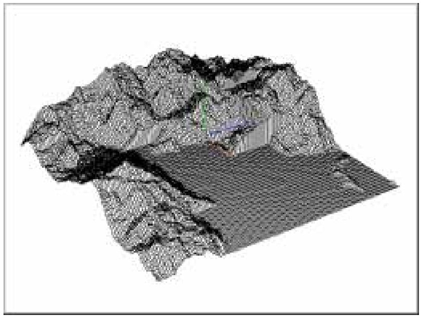
Since all hierarchies are in place you can use the Inverse Kinematics function to position the figure as you wish. Most of the joints will have angle restrictions imposed.



Fractal



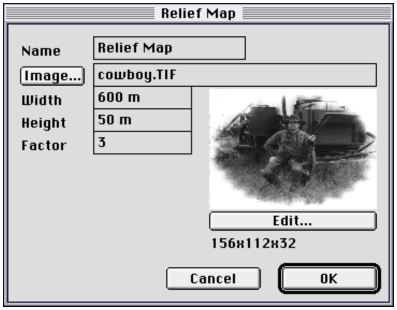
This command creates irregularly shaped objects based on fractals—wild, ragged mountains, smoothly rolling hills, all at the press of a button.



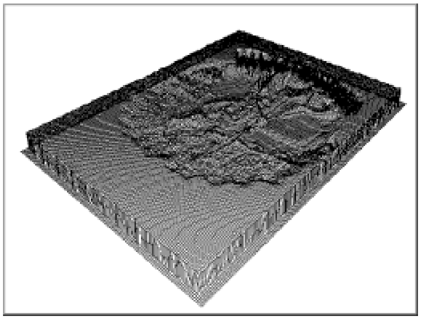
The number of subdivisions determines how often the subdivision process is executed. A single rectangle with *n* subdivisions will give $2^{(2n)}$ rectangles.

To prevent widely different fractals from occurring, a quasi-random function is used, which is launched with a Starting Value. Identical values will give you the same fractal. You can specify any starting value between 0% and 100%.

Relief Map



This command interprets the shades of a picture as height values, converting them to a 3D relief. This relief is created on the XZ plane of the world coordinate system.



The mean value of the red, green and blue values of a pixel is interpreted to be the height. Black is the minimum height, white is the maximum.

‘Width’ specifies the edge-length of the relief, which on the XZ plane has a rectangular base, while the ‘Height’ controls the elevation in the Y direction.

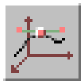
The depth of the relief is given automatically by its width and the image resolution.

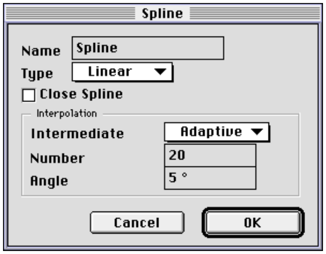
‘Factor’ indicates whether each colour pixel within an image should be converted, i.e. made into a rectangle. Even a smallish picture with merely 320 x 256 pixels will produce 81,920 rectangles.

If you change the reduction value to 3, the application will always take 3 x 3 pixels to yield a single height value. The bigger the ‘factor’ the fewer rectangles are generated. This means of course that less and less height detail is available.

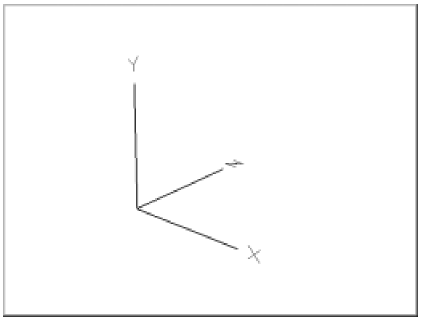
If instead of an image you have a Shader (see Chapter 9: Material Manager) you can define its characteristics by using the Edit switch. There is a description of the supplied Shader settings in the appendix.

4.5 Empty Spline





This command creates an empty spline object. It is identifiable on the screen only by its origin and its axes.



This object should be used as the basis for constructing your own splines.

Splines are extremely important tools in CINEMA 4D. Not only do they allow you to build complex objects within seconds, but they may also be used for defining movement paths for animating objects.

Splines are primarily a sequence of three-dimensional vertices which are connected by lines. Apart from forming direct links between these points—interpolation is the term sometimes used—there are other types of splines, where the interpolation is not a straight line, but a curve. This type of spline is characterised by a curve that has no corners or 'jumps'.

How it's done:

1. Create an empty spline.
2. Set your vertices.

   Do this by holding down the Ctrl key while clicking in the Editor window. The new vertices are always placed at the end of the existing spline.

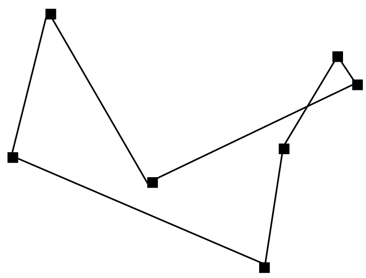
   If the mouse pointer is located between two existing points on the spline, the new point will go between the two.

   If in addition to Ctrl you also hold down the Shift key, the new points are placed before the start point of the spline, thus forming a new start point.

Type

Linear

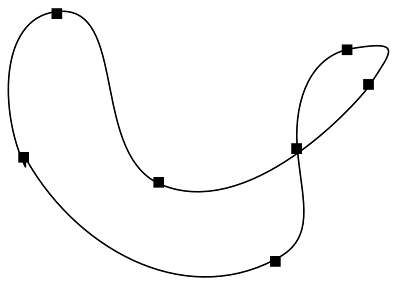
The simplest of all spline types. It connects the vertices defining the polygon by direct, straight connection lines.



This type of spline is best used to generate angular objects or to simulate 'jumpy' movements in an animation.

Cubic

This type creates a smooth curve between the vertices, where the interpolated curve runs precisely through the points.

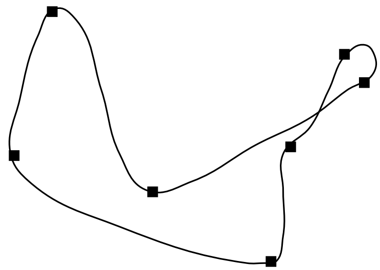


The curve stretches further up and to the right than is strictly necessary. This is particulary evident when comparing the curve segment with the same segment in the Akima interpolation.

Cubic splines tend to overswing when curvatures are tight, as you can see with the two points at the top right.

Akima

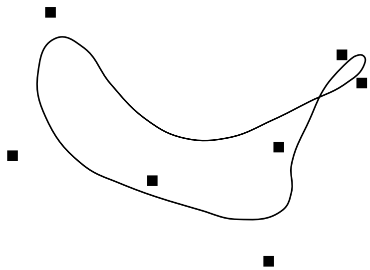
This type creates a smooth curve between the vertices, with the interpolated curve running through the vertices. No overswing occurs.



This interpolation type sticks very closely to the given curvature, which occasionally makes it somewhat harsh. If this happens you might want to use cubic interpolation instead.

B-Spline

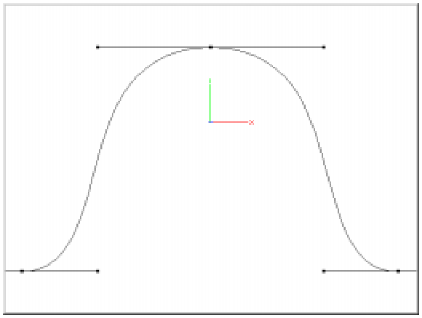
This type creates a smooth curve between the vertices, with the interpolated curve not running through the vertices.



The resulting curve is extremely smooth. The vertices define the approximative path only. More distant points have less influence on the curve than the ones in close proximity.

Hermite

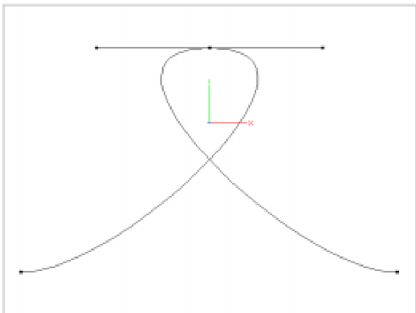
This type of spline generates a smooth curve between vertices which can be verified precisely by using the tangents.



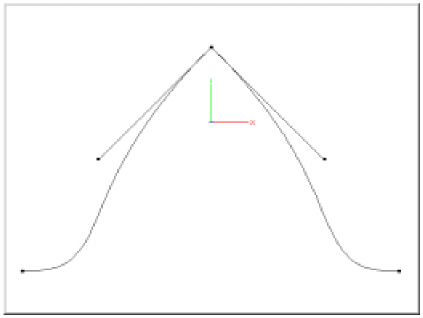
Activating a spline support point will make additional tangents visible.

Use the directional tangents to define the incline of the curve in each support point. Click on a tangent end point and move it with the mouse.

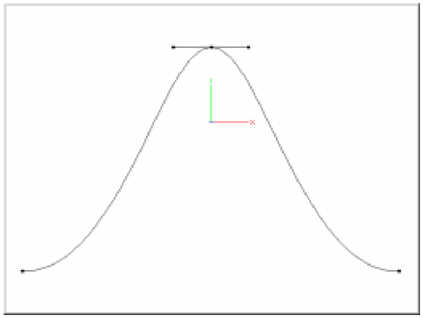
The figure above has all tangents on the horizontal. If the tangent of the upper point is rotated by 180˚ so that the end point of the left tangent is now on the right and the right on the left, we end up with the curve shown below.



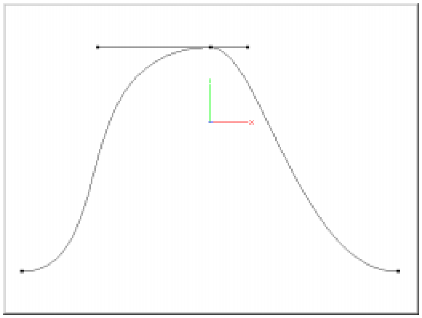
You can specify different tangent directions to the left and right of the vertices, thus causing peaks and corners in the otherwise smooth curvature. To do this, hold down the Shift key, click on a tangent end point and drag with the mouse.



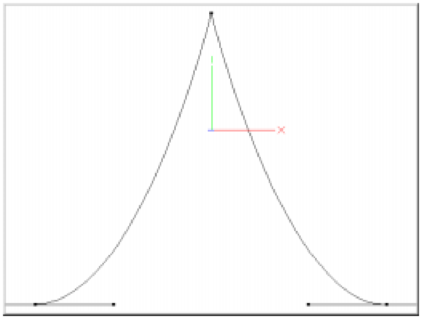
The degree of curvature can be set by the length of the tangents. Simply drag a tangent end point toward the spline vertex.



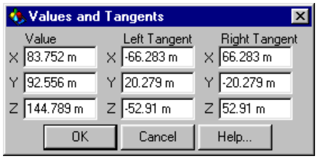
Here too you can specify the lengths of each tangent separately. Again, hold down the Shift key while clicking on an end point and dragging. For an illustration of this, see the figure below.



If the tangents of two neighbouring points have zero length, the line segment between the two is linear. This means you can mix linear segments with spline forms.



Double-clicking on a Hermite vertex will open a dialog. Here you can specify numerically the position of the vertex (in the world) as well as the tangent end points (relative to the vertex).


Values and Tangents

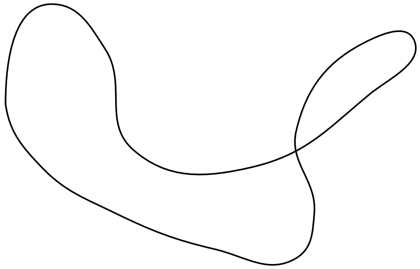
	Value		Left Tangent		Right Tangent
X	83.752 m	X	-66.283 m	X	66.283 m
Y	92.556 m	Y	20.279 m	Y	-20.279 m
Z	144.789 m	Z	-52.91 m	Z	52.91 m

OK | Cancel | Help...

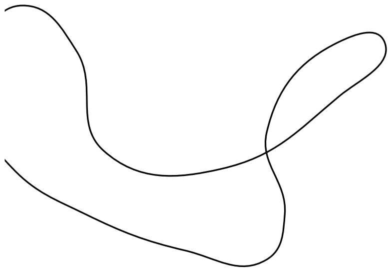
Compared with other spline types, Hermite splines offer the most control features. This is why, without exception, CINEMA 4D uses this type of spline for all animations.

Close Spline

A polygon can be either closed or open. If it is closed, the start and end points coincide.



Closed spline



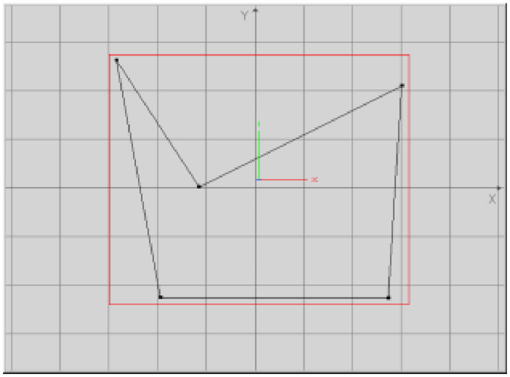
Open spline

Closing a polygon is not the same as choosing exactly the same start and end point. In the first case the transition from start to end point is smooth, in the second it is abrupt.

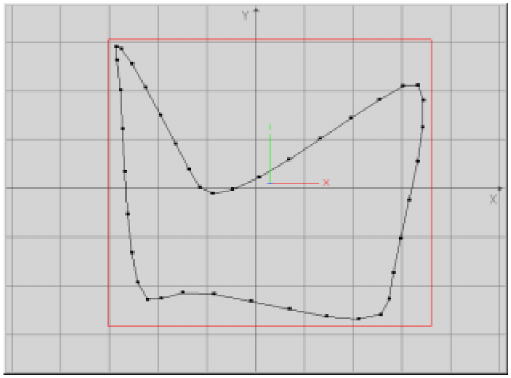
Intermediate Points

This is for specifying how to subdivide the spline when processing it.

None
Uses the vertices of the splines directly, without setting intermediate points.

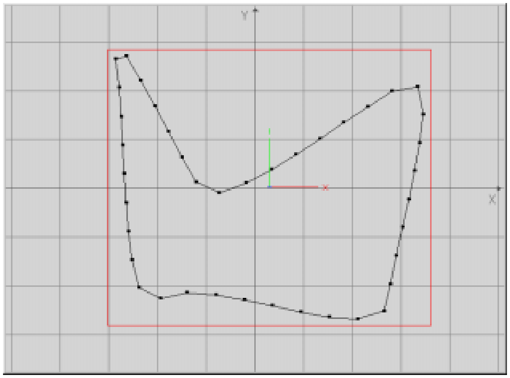


Natural
Subdivides the spline in such a way that the 'number' of points is utilised. The points follow the natural flow of the spline, i.e. they are packed more closely at the vertices and less so in between. They do not necessarily run through the vertices.



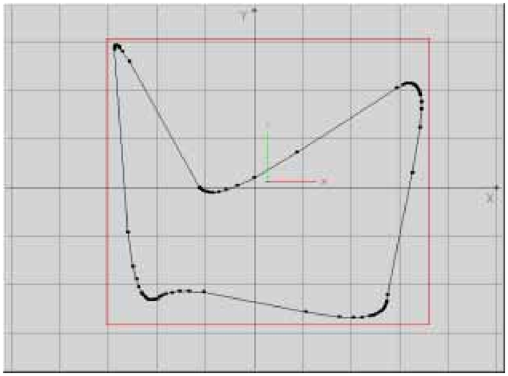
Uniform

Subdivides the spline in such a way that the 'number' of points is utilised. The intervals between the points are equal and do not necessarily run through the vertices.



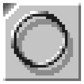
Adaptive

This is the default method. It works by setting intermediate points whenever the angle deviation is greater than the value specified for 'Angle'.



The control points require great precision. Adaptive subdivision yields the best results for rendering.

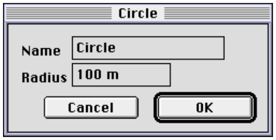
4.6 Splines



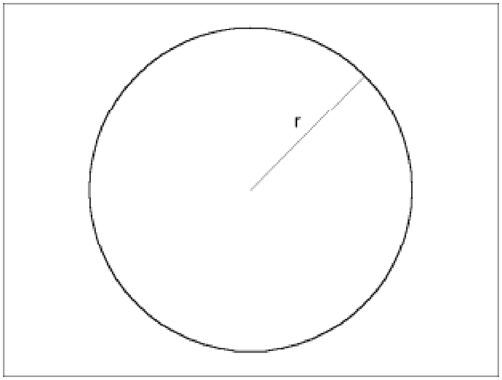
Clicking this icon in the Objects toolbar will open a menu containing the following commands.

Circle Elements

Circle

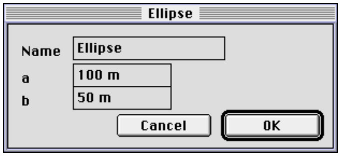


This command creates a circular spline.

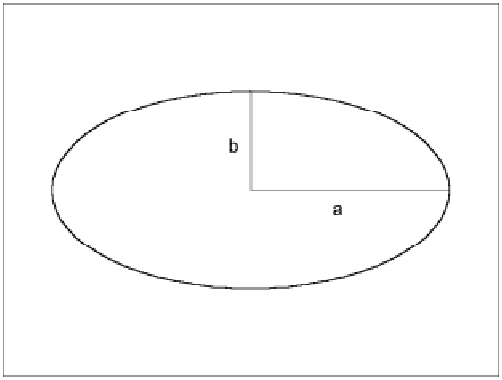


It is particularly useful for creating pipes or tubes with the help of the Path Object function.

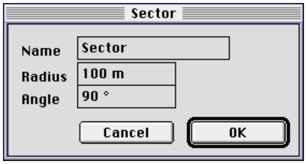
Ellipse



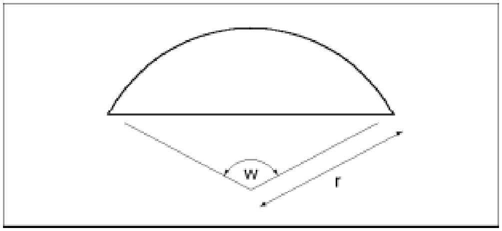
This command creates an ellipse with the half-axes a and b.



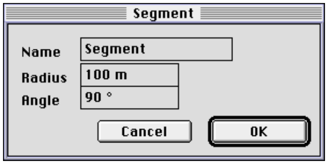
Sector



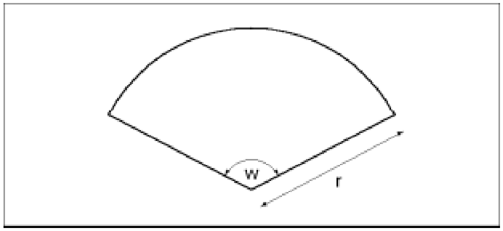
This command creates a sector on the basis of the values specified under ‘Radius’ and ‘Angle’.



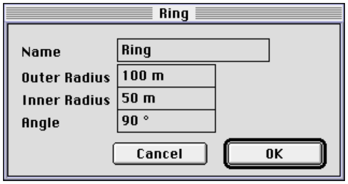
Segment



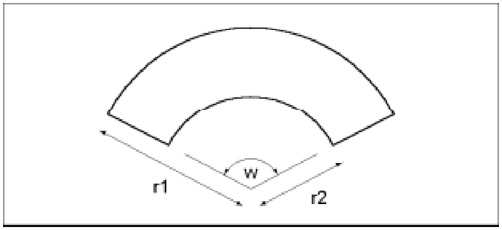
This command creates a segment on the basis of the values specified for ‘Radius’ and ‘Angle’.



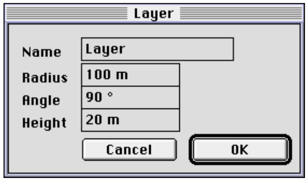
Ring



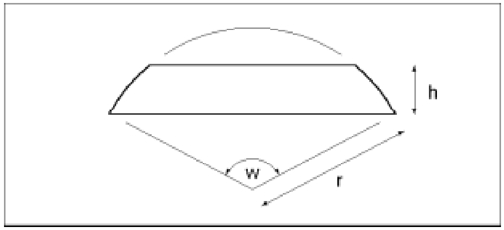
This command creates a ring on the basis of the values specified for ‘Outer Radius’ and ‘Inner Radius’ as well as ‘Angle’.



Layer



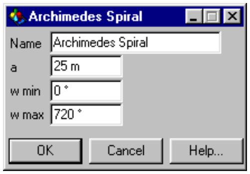
This command creates a layer on the basis of the values specified for ‘Radius’ and ‘Angle’.



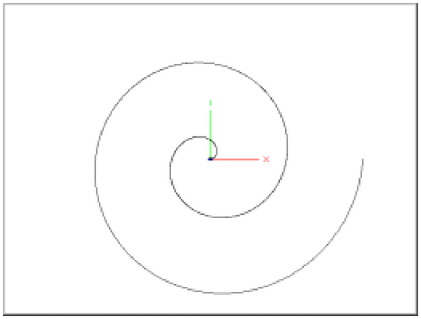
The greater the ‘Height’, the thicker the layer that is cut from the circle.

Curves

Archimedes Spiral

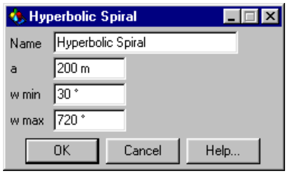


This command creates an Archimedes spiral. This is the result of a point rotating along a rod at constant speed, where the rod itself rotates with constant angle speed.

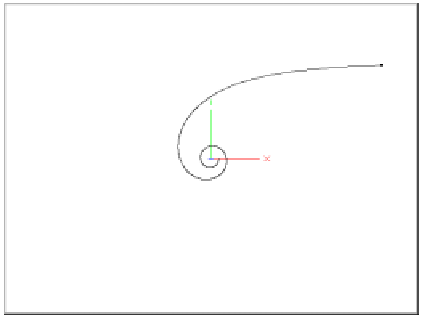


Parameter a describes the relationship between the speed of the point along the rod and the angle speed of the rod. ‘w min’ and ‘w max’ specify the start and the end angles of the rod rotation.

Hyperbolic Spiral

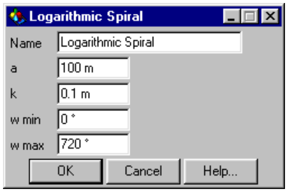


This command creates a Hyperbolic spiral.

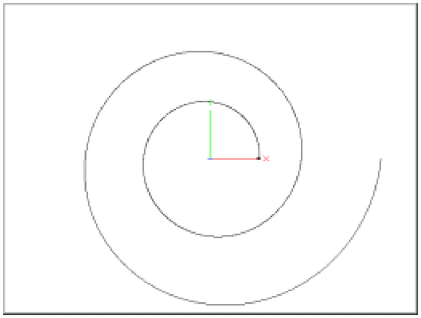


Parameter a is the horizontal asymptote of the spiral along the y axis. ‘w min’ and ‘w max’ determine the start and end angle of the rotation.

Logarithmic Spiral

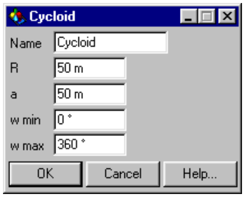


This command creates a logarithmic spiral.



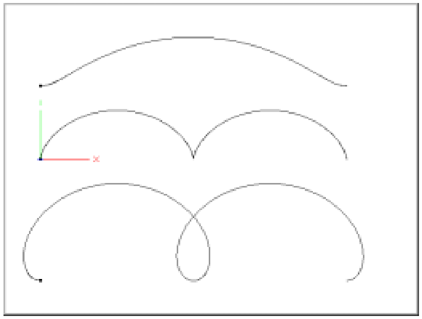
The a parameter specifies the start point of the spiral on the X axis. k is the rate of growth (if it is 0, the circle will have a radius of r=a). ‘w min’ and ‘w max’ are the start and the end angles of the rotation.

Cycloid



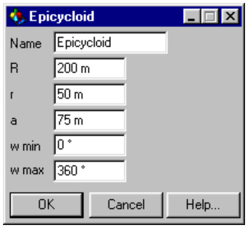
This command creates a cycloid—the curve described by a point on the circumference of a circle as the circle rolls along a straight line.

With a normal cycloid (below, centre) the observed point, which forms the curve, is on the radius of the circle. With the curtate cycloid (below, top) it is inside the circle, and with the prolate cycloid (below, bottom) it is outside.



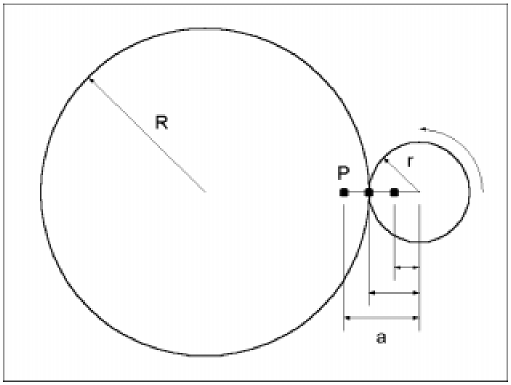
Cycloids, and also epicycloids and hypocycloids, are used for all types of ‘rolling’ movements like walking, and the movement in gear mechanisms and the movement of planets in orbit.

Epicycloid

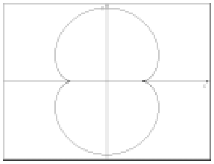


This command creates an epicycloid—the curve described by a point on the circumference of a circle (radius r) as this circle rolls around the outside of another, fixed, circle (radius R), the two circles lying in the same plane.

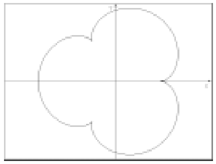
With a normal epicycloid the observed point (which forms the curve) is on the radius of the inner circle (a=r). With a curtate epicycloid it is on the inside of the inner circle (a<r), with the prolate epicycloid it is outside (a>r).



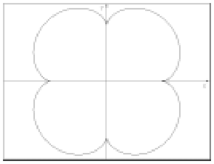
The following figures show some of the curves that are possible. Below each figure are the values used to create the curves.



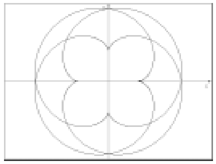
R = 4, r = 2, a = 2



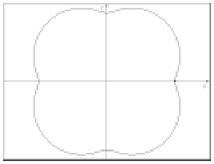
R = 3, r = 1, a = 1



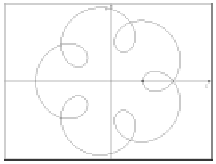
R = 4, r = 1, a = 1



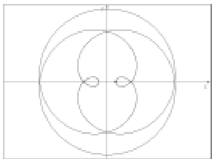
R = 4, r = 3, a = 3



R = 8, r = 2, a = 1

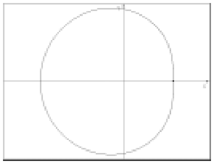


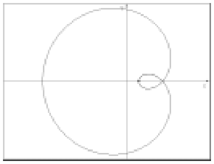
R = 10, r = 2, a = 5

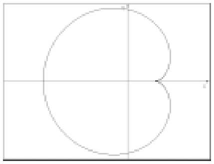


R = 2, r = 3, a = 4

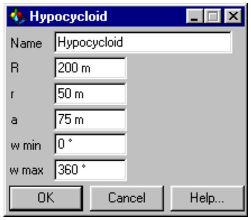
Special cases result when the radii of both circles are equal (Pascal's curve). If, in addition, point P is on the radius of the outer circle (a=r), we get what is called a Cardioid (see the illustration below).


R = 2, r = 2, a = 1


R = 2, r = 2, a = 3

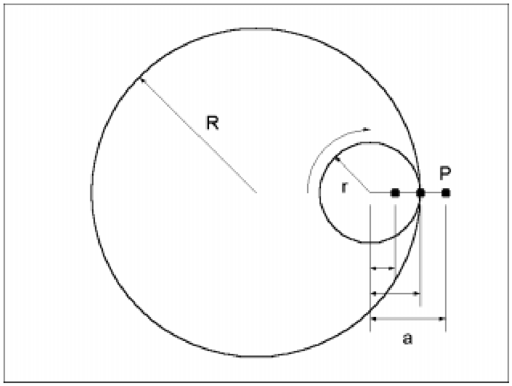

R = 2, r = 2, a = 2
Cardioid

Hypocycloid



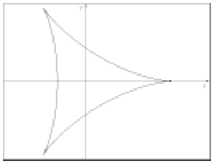
This command creates a hypocycloid—the curve described by a point on the circumference of a circle (radius r) as this circle rolls around the inside of another, fixed, circle (radius R), the two circles lying in the same plane.

With a normal hypocycloid the observed point (which forms the curve) is on the radius of the inner circle (a=r). With a curtate hypocycloid it is on the inside of the inner circle (a<r), with the prolate hypocycloid it is outside (a>r).

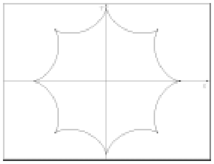


If the radius of the outer circle is exactly four times that of the inner circle, the resulting curve is called an Astroid.

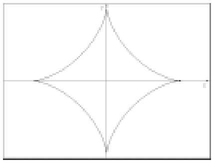
The following figures show some of the curves that are possible. Below each figure are the values used to create the curve.



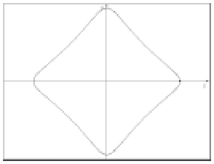
R = 6, r = 2, a = 2



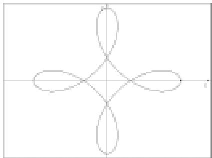
R = 8, r = 1, a = 1



R = 8, r = 2, a = 2
Astroid

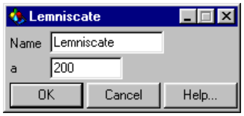


R = 8, r = 2, a = 1

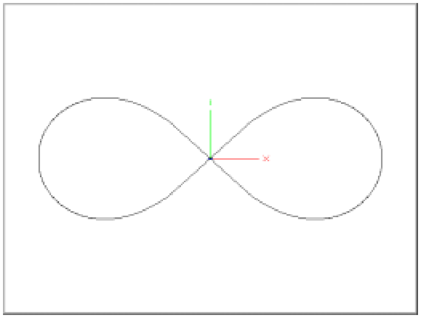


R = 12, r = 3, a = 6

Lemniscate

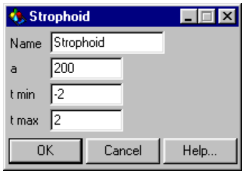


This command creates a special kind of ‘Cassini Curve’ known as a Lemniscate—a closed plane curve consisting of two symettrical loops meeting at a node. The symbol for infinity is a well-known example of a Lemniscate:

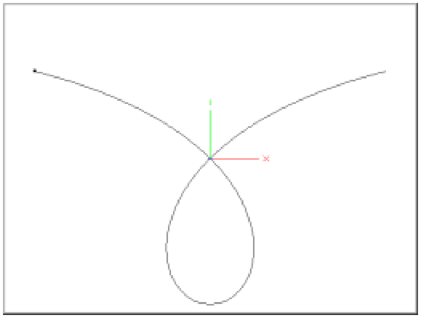


The a parameter defines the distance of the two focal points on the X axis. On a Lemniscate the product of the distances between the focal points to any point on the curve is constant.

Strophoid

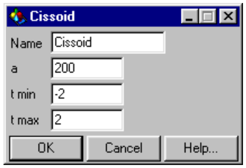


This command creates a strophoid—a curve with a twist.

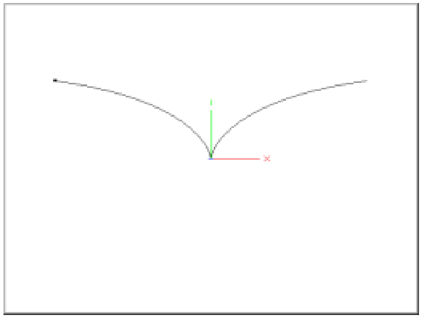


The a parameter specifies the distance of the asymptotes parallel to the X axis. The minimum of the curve is at y = –a. ‘t min’ and ‘t max’ give the definitional range of the curve.

Cissoid



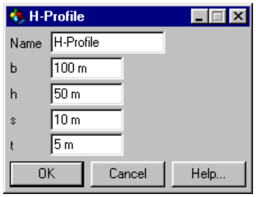
This command creates a cissoid—a geometric curve whose two branches meet in a cusp at the origin and are asymptotic to a line parallel to the Y axis.



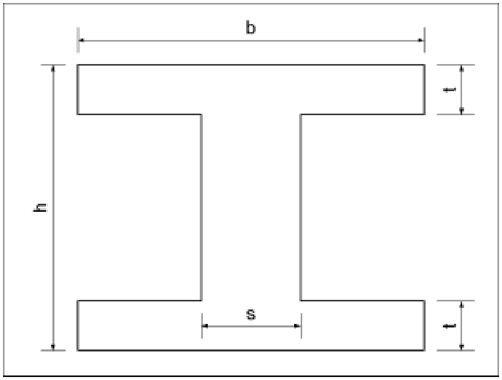
The a parameter specifies the distance of the asymptotes parallel to the X axis. The minimum of the curve is at y = –a. ‘t min’ and ‘t max’ give the definitional range of the curve.

Profile

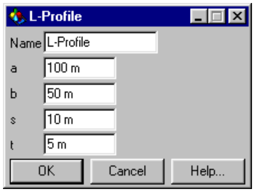
H-Profile



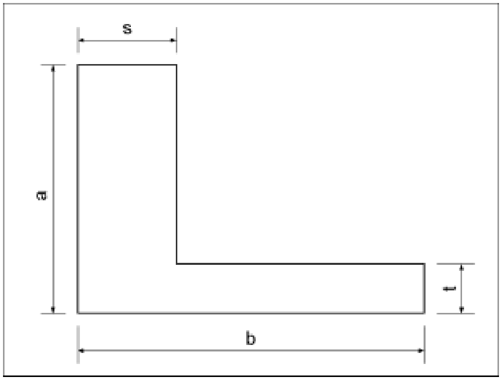
Creates an H-shaped profile. For the meaning of the parameters see the figure below.



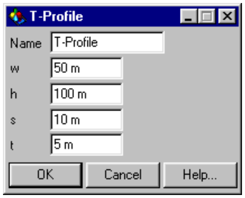
L-Profile



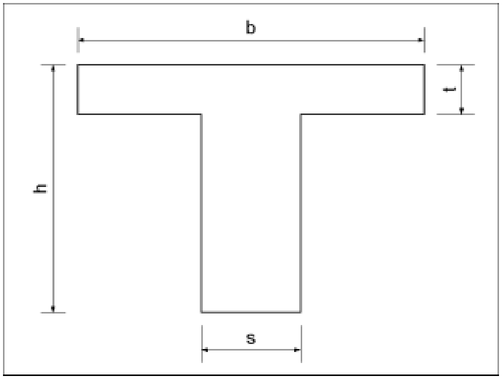
Creates an L-shaped profile. For the meaning of the parameters see the figure below.



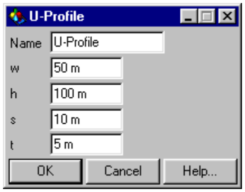
T-Profile



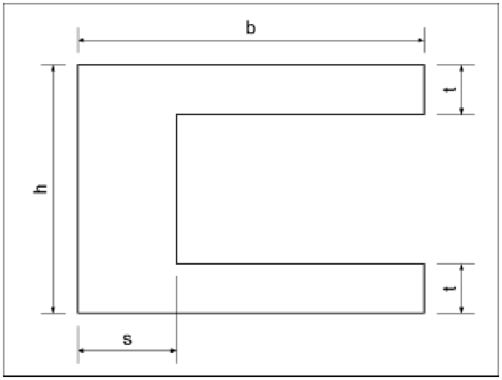
Creates a T-shaped profile. For the meaning of the parameters see the figure below.



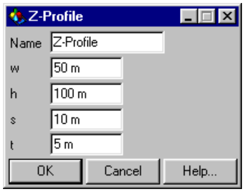
U-Profile



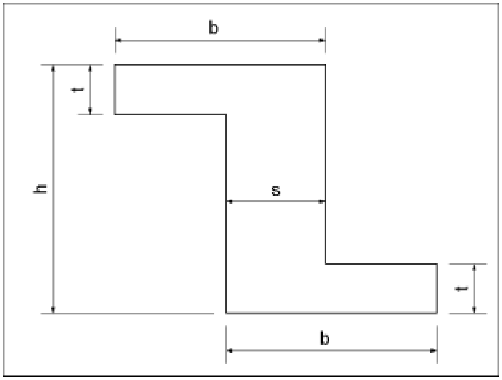
Creates a U-shaped profile. For the meaning of the parameters see the figure below.



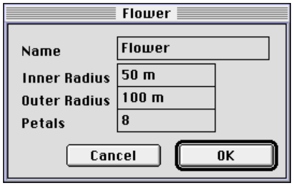
Z-Profile



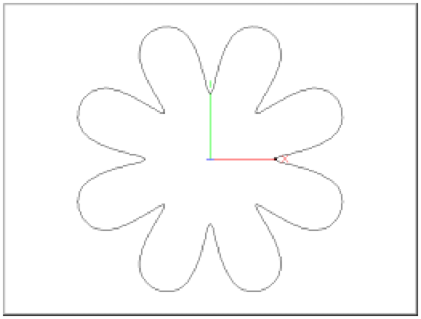
Creates a Z-shaped profile. For the meaning of the parameters see the figure below.



Flower

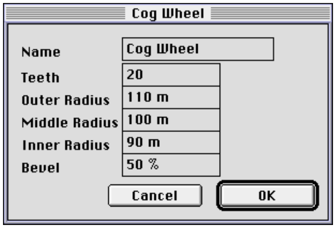


Creates a Spline flower with a customisable number of petals on the XY plane of the world coordinate system.



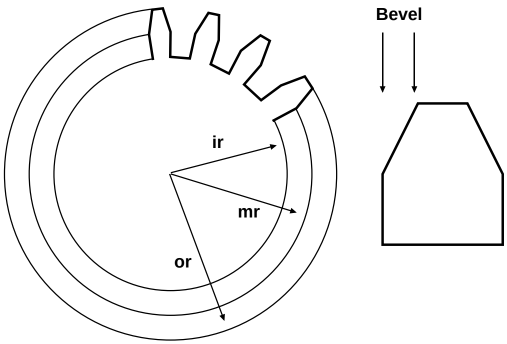
'Inner Radius' is the size of the inside area from which the petals grow. They stretch from the inner to the outer radius.

Cog Wheel



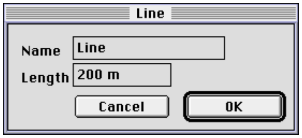
This command creates a cog wheel with a customisable number of teeth. The base radius of the cog wheel is defined by the value for ‘Middle Radius’ (d0), the height and depth of the cogs from the values for ‘Inner Radius’ (df) and ‘Outer Radius’ (dk).

In addition, the cogs can be bevelled. The bevel is expressed as a percentage and goes from 0% (no bevel) to 100% (maximum bevel).

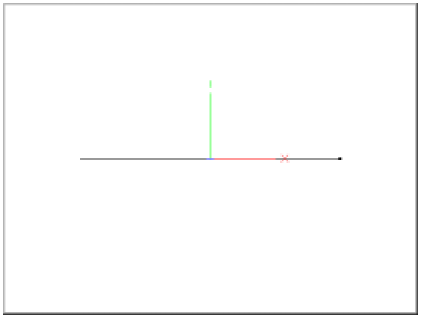


Polygons

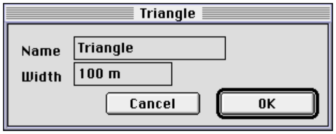
Line



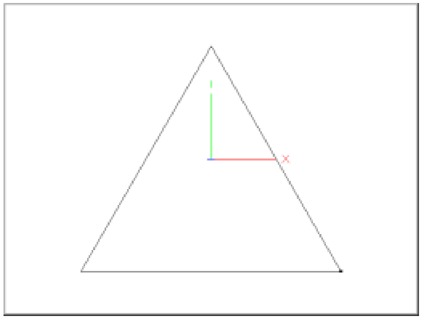
This command creates a line that runs parallel to the X axis of the world coordinate system.



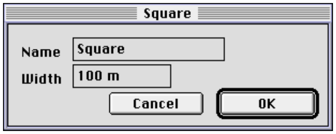
Triangle



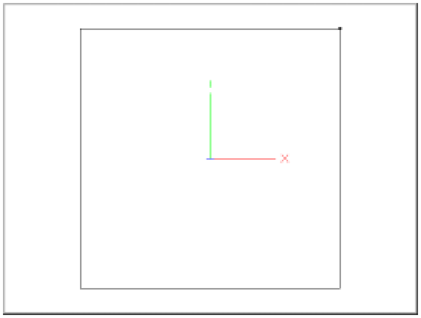
This command creates an equilateral triangle with edge-length ‘Width’.



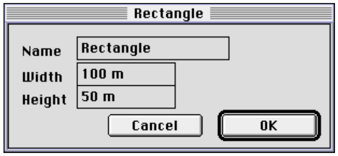
Square



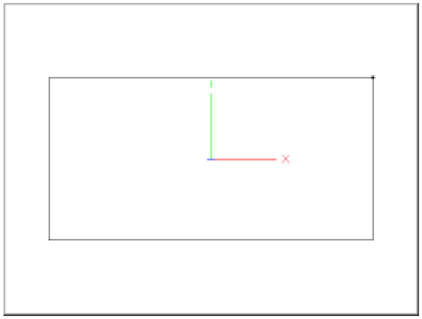
This command creates a square with the edge-length ‘Width’.



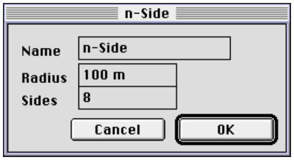
Rectangle



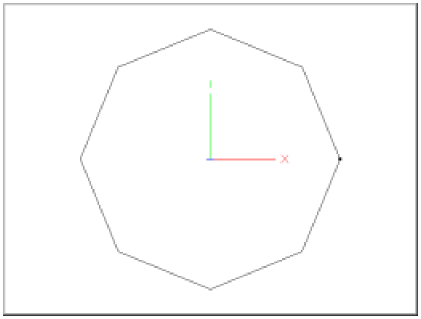
This command creates a rectangle with the side-lengths ‘Width’ and ‘Height’.



N-Side



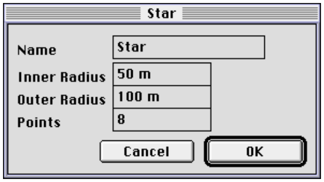
This command creates an angular, closed spline.



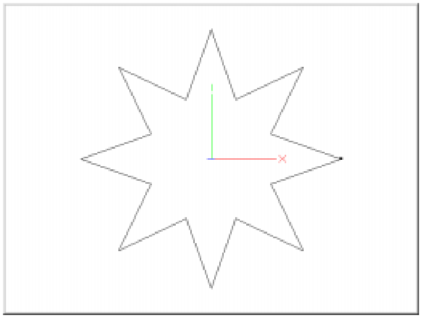
It is ideally suited for pipes or tubes created with the help of the Path Object function.

'Sides' is the number of sides.

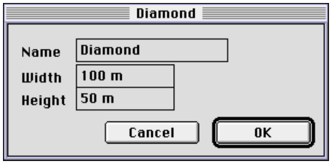
Star



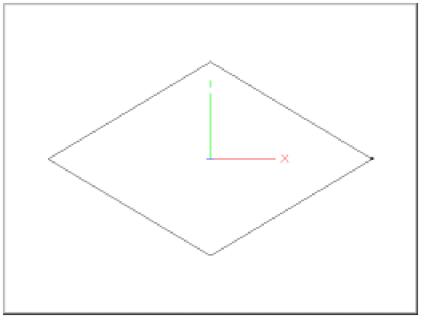
This command creates a star with any number of 'points', whose length is determined by the distance between the 'Inner Radius' and the 'Outer Radius'.



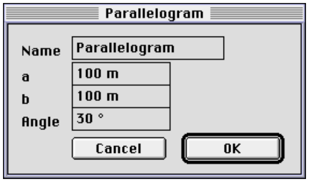
Diamond



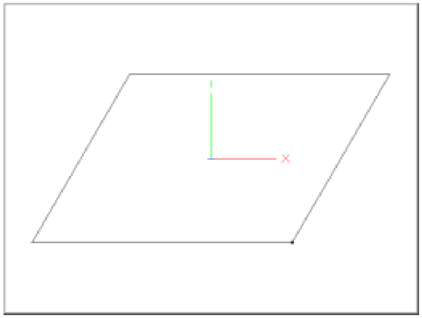
This command creates a diamond whose horizontal dimension is ‘Width’ and whose vertical dimension is ‘Height’.



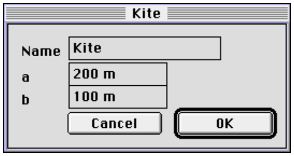
Parallelogram



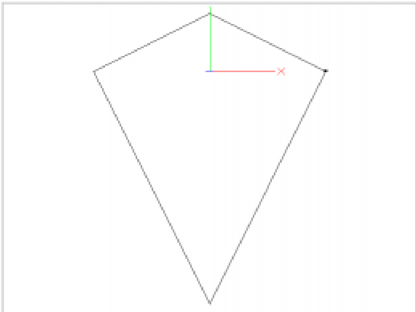
This command creates a parallelogram with the edge-lengths a and b and the Angle as specified.



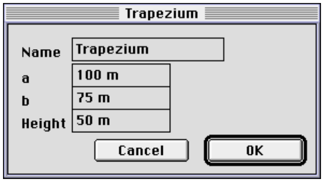
Kite



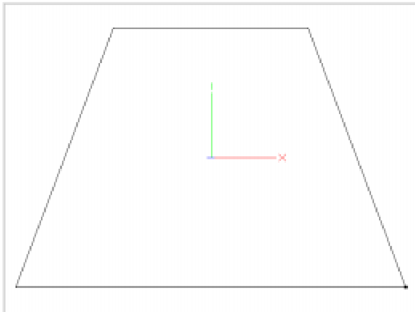
This command creates a kite with the edge-lengths a and b.



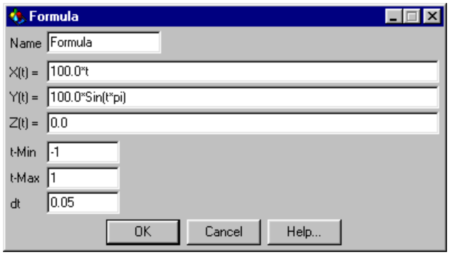
Trapezium



This command creates a diamond whose lower edge is a and whose upper edge is b. The interval between these two is the ‘Height’.



Formula



This creates a geometric curve based on mathematical formulae. There is a list of inbuilt functions, operators and constants in Appendix A2.

X(t), Y(t), Z(t)

Enter a mathematical function depending on the variable t for each of these directions.

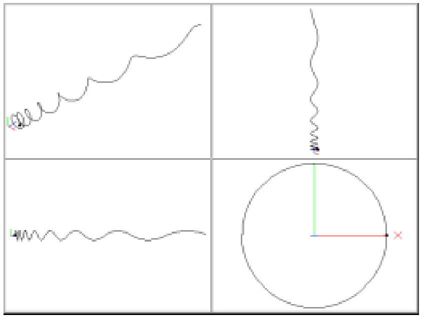
t-Min, t-Max

This is for specifying the definitional range.

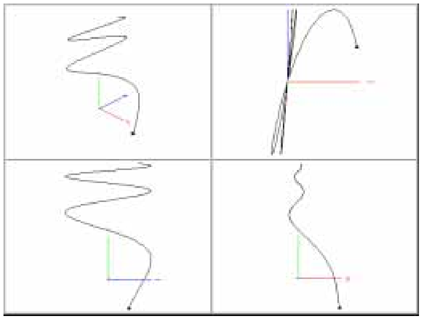
dt

This factor specifies how often a vertex for the spline needs to be created. If for example your definitional range covers -1 to 1 and if you have a step interval of 0.5, five vertices will be generated, for these values: t = –1, –0.5, 0, 0.5, 1.

Examples:

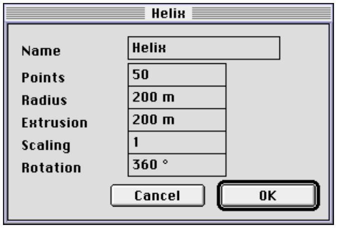


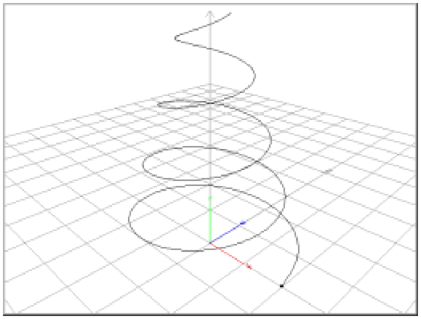
X(t) = 100 * cos(pi*t)
Y(t) = 100 * sin(pi*t)
Z(t) = 100* exp(0.25*t)
t = 0 … 15



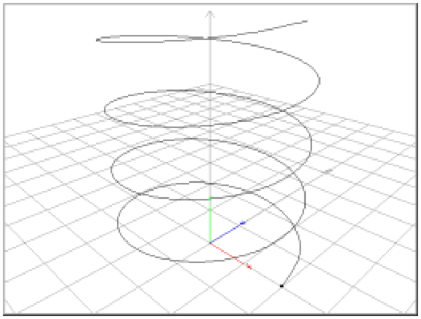
X(t) = 100 * sin(t) / t
Y(t) = 100 * log(t)
Z(t) = 100 * sin(t)
t = 0.5 … 15

Helix





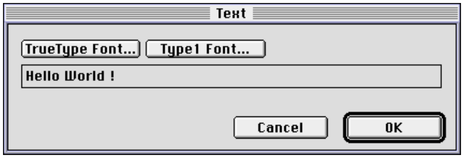
This command creates a spiral-shaped helix, where the distance from the Y axis is the one specified under ‘Radius’.



‘Steps’ defines the number of vertices from which the helix will be built. ‘Rotation’ is the number of times that the helix winds around the Y axis; ‘Movement’ is the height of the thread.

In addition, you may enter a Scaling value. This will make the thread tighter or wider as the spiral winds upwards.

Text



This command lets you create any logo or bit of text. Simply type it into the text box, click on Select Font, and then select the font you wish to use.

In CINEMA 4D you can select between TrueType or PostScript Type-1 Fonts by clicking the button TrueType or Type-1. In the first case the system dialog for selecting fonts will be appear. In the second case a system dialog will be opened, allowing you to locate the PostScript font you wish to load.

CINEMA 4D will generate several three-dimensional splines which you can modify further. You can, for example, add depth to them by using the Extruded Object command.

Some TrueType Fonts are poorly designed, with edges that overlap. CINEMA 4D cannot improve on these. Make sure you use only high-quality fonts.

You can achieve high-quality text objects by using the ‘Smoothing’ command and setting the ‘Angle Limit’ to about 20˚(see Chapter 11: Object Manager / Smoothing).

Tip:

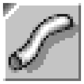
CINEMA 4D doesn’t use any kerning information.

Entering multiple Text Lines:

Under Windows this is not a problem, since multi-line entry fields are supported. Simply use the Enter key to place your insertion marker on the next line.

On a Macintosh you cannot press Enter since this will close the dialog window. Instead, launch SimpleText and enter your lines into a SimpleText document. Select the entire text and copy the block on to the clipboard. Now, in the comments field in the Browser information dialog, paste that text into the entry line.

4.7 Spline Objects

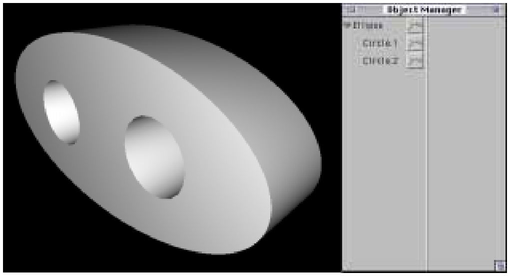


Clicking on this icon in the Objects toolbar opens a menu containing various options.

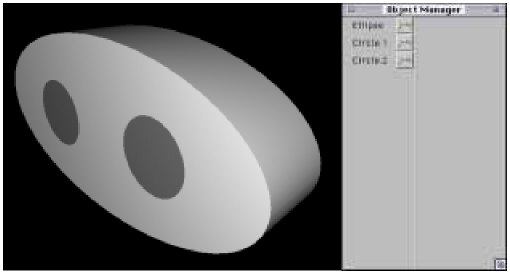
Spline objects offer the most sophisticated functions for generating objects. It is possible to wind a spline around another, or you can combine several splines into a single object group. Using the contour of a letter you can very quickly generate three-dimensional letters with rounded edges. A unique feature is the option of defining holes in the shapes.

A common characteristic of all spline objects is the convention of grouping hole and curved surface splines, or different spline layers, hierarchically.

Polygon objects that are generated from splines can have holes in them. These do not need to be calculated in a roundabout way with the help of Boolean operations. All you need to do is to arrange them in a particular fashion. The rule is: sub-splines of a spline are taken to be holes.



If this arrangement is not used (the operation in the above illustration was applied to the three splines grouped into one object) the holes are apparently ignored. In fact, they are made into full objects. In the illustration below this is shown by a different colour.



Note that holes must be completely enclosed by an ‘envelope’ curve. No overlapping between holes is allowed.

Some functions need only a single spline (for example the Extrude object). This spline can be selected immediately before the function is used.

If a function expects several splines (like Skin Object and Morph Object), all layers must be grouped into an object group within the Object Manager. The sequence indicates how the layers will be linked. You need to select the group before activating the function.

When passing over an object group to an Extrude, Lathe, Pipe or Path object, the function is applied to each spline separately.

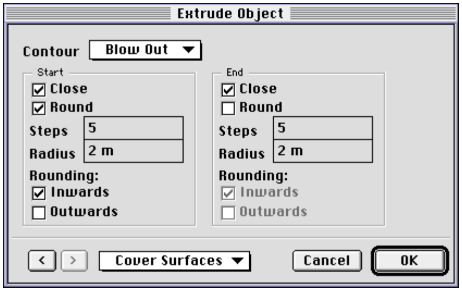
Spline layers can also include holes defined by sub-objects.

Caps

When defining a spline you have to decide whether it is going to be a closed three-dimensional object or whether you want it to be open at both ends.

In addition, it is possible to apply a bevel or curve to the seam or boundary between the curved surface and the flat caps.

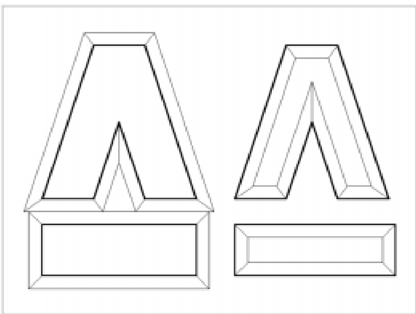
Curved surface, lid and bevel are all separate objects and can have different materials assigned to them. This allows you to create beautifully crafted letters made of marble which can be embellished by a bevelled rim made out of gold.



The value for ’Contour’ specifies whether the object is to be enlarged when a bevel is applied. This is useful when the size of the object or of the lids needs to match the original spline. However, it can cause two adjoining splines to ’merge’ at the edges.

This option is enabled only when you have selected ’Rounding’ (see below).

The following picture illustrates the two possibilities: ’Blow out’ on the left, ’Constrain’ on the right. The original contour is clearly marked with a thicker line.

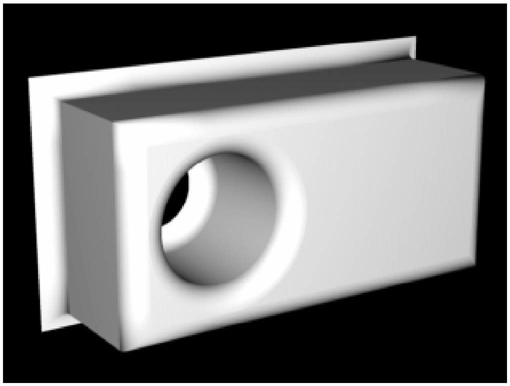


’Start’ and ’End’ can use the ’Close’ option. This indicates that the contour will be closed. CINEMA 4D automatically takes into account any existing hole polygons and combines the lids accordingly.

Another interesting feature in CINEMA 4D is that it is possible not only to put the lids ’flat’ on the object, but to generate rounded edges as well.

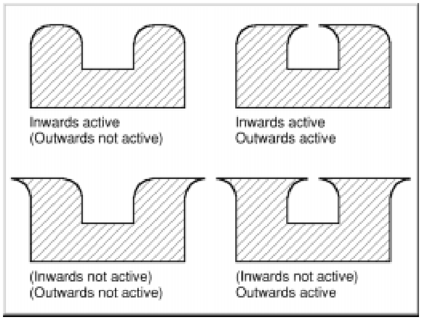
If you have enabled the ’Rounding’ option, CINEMA 4D shifts the edges of the caps by a number of specified steps so that the edges form a quarter circle (when seen as a cross-section) with a radius which can also be specified. This is called ’rounding off’. To create a bevel, reduce the number of steps to 1. This is all you need to create professional looking fonts.

Whether the bevels are formed towards the inside or the outside can be controlled by using the options ’Inwards’ and ’Outwards’.



In the above picture the front cover was closed with the ’Inwards’ option and the back one ’Outwards’.

The following illustration shows the four alternatives.



Note that there are certain constraints for choosing a radius for bevelling. If for example a contour has a diameter of 10 units, you should not use a radius larger than 5 units. Otherwise you will not be able to have closed covers.

Use the object attributes 'Round' and a 'Angle restriction' if you wish to have higher quality objects (see Chapter 11 - The Object Manager).

Tip:

Subsequent rounding or bevelling of object edges is not possible.

Tip:

You can even add caps to freely curved (not planar) splines although, in this case, the caps will be converted to triangles and you may not get the curvature you wanted. In addition, you will see shading artifacts (see comments to chapter 5 - Boolean).

Tip:

Please keep in mind that inward bevelling especially can cause problems. In Figure 1 you can see the original shape. If you bevel it with a moderate radius you will get a proper result, as shown in Figure 2. In Figure 3 you see the result of a bevel radius that has been set too high. Unfortunately CINEMA 4D cannot know whether a bevel radius makes sense or not—that's up to you.

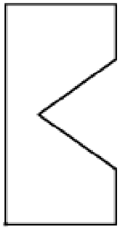


Figure 1: The original shape

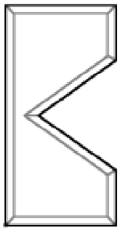


Figure 2: Moderate radius

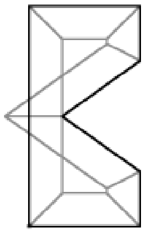
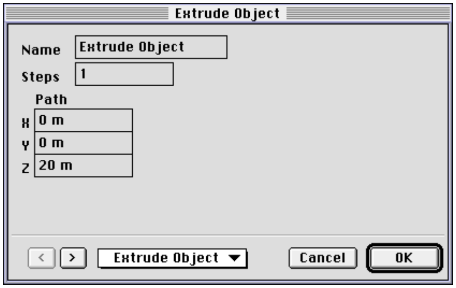
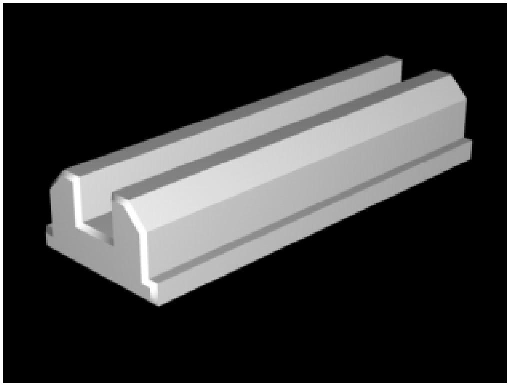


Figure 3: Radius too high

Extrude Object



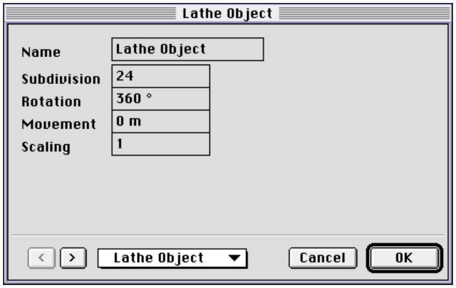
This will let you move a spline in any direction and generate a polygon object.



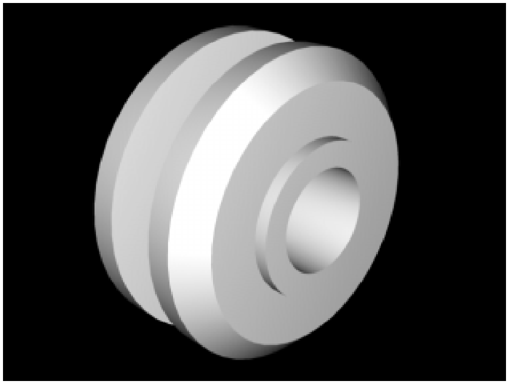
Under 'subdivisions', specify how many steps you want the movement to consist of. A value of 1 causes the start and end contours to be linked directly. If you intend to deform the object subsequently, use a higher value here. CINEMA 4D then inserts additional contours between the start and the end.

For 'movement' and 'direction', specify which contour is to be moved. The movement always occurs within the local contour system.

Lathe Object

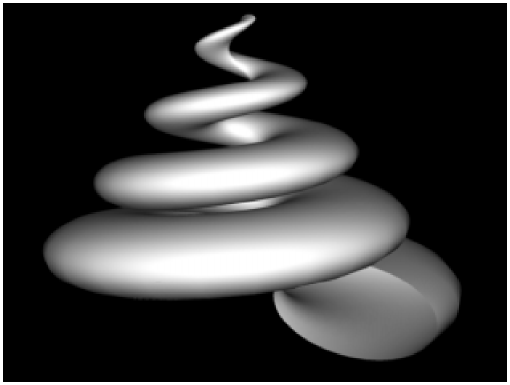


This will let you rotate a spline around its local Y axis, thus generating an object with surfaces.



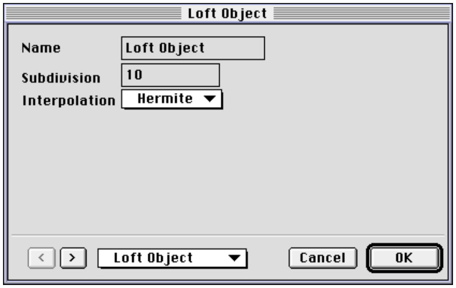
The illustrations showing the Extrude and the Lathe object were created using the same contour. With the Lathe object, the local axis system was moved and rotated.

If you specify a movement as well, the contour will turn around the rotation axis on a screw. This allows you to create threads and screws as well as vases and glasses.

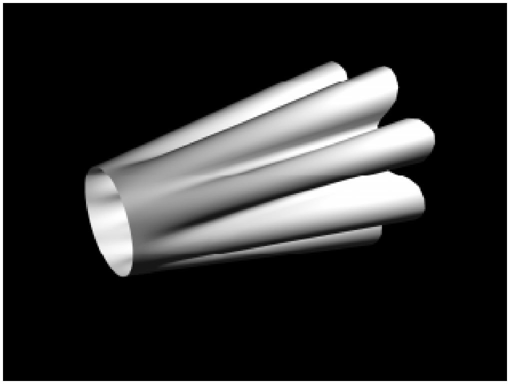


If you specify a ‘Movement’ value of 0, the contour will move only on a circle, otherwise on a screw. For ‘Rotation’ indicate at what angle you want the contour to rotate around the rotation axis. An angle of 720˚ gives two rotations. ‘Scale’ indicates whether the contour is to be resized during the movement.

Loft Object



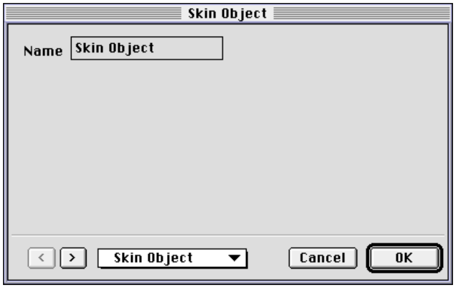
This extremely powerful function allows you to create organic forms quickly and easily.



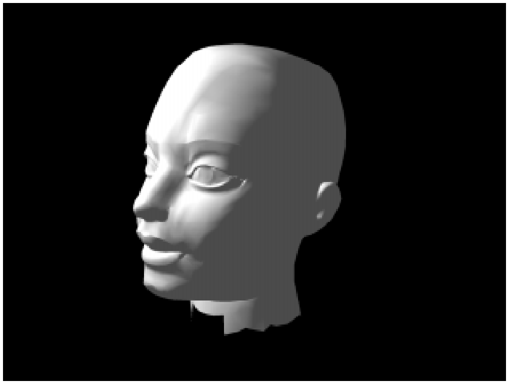
You can select several contours. CINEMA 4D links them in order of the maximum number of points which is calculated for all contours. In addition you can specify whether you want the link between two contours to be straight or a particular type of interpolation. This makes it possible to construct, for example, a bottle with a rectangular base tapering to a round neck, bent downwards.

For ‘Subdivisions’ select how many steps the transition between the first and the last contour should consist of. ‘Interpolation’ specifies which spatial curve the interpolated intermediate contours will lie on. With linear interpolation the intermediate contours move on a direct path between the specified contours; in other cases a soft interpolation occurs, depending on the subsequent contours.

Skin Object



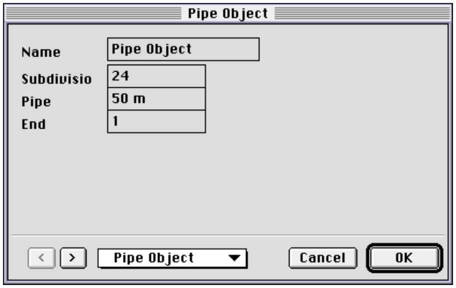
The Skin object is a special case as far as spline objects are concerned. Here, you can control the exact appearance of an object by specifying each layer in turn.



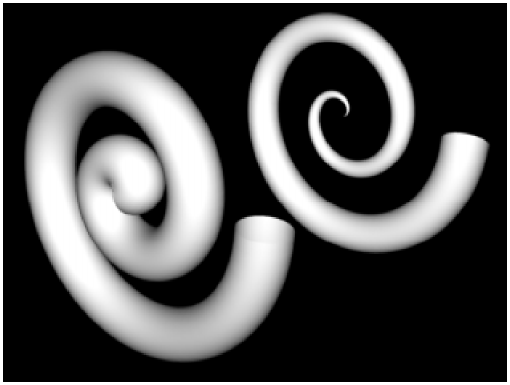
If for example you have several splines (that might come from the images of a computer tomograph) you can connect these, in order to reconstruct a three-dimensional head.

Remember: Make all the splines concerned part of one single object group and select that group before using the command.

Pipe Object

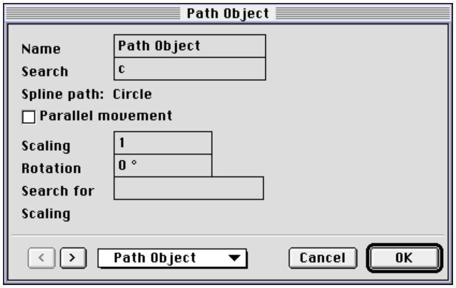


This command lets you create tubular and snake-like objects. CINEMA 4D generates a circular contour with a customisable radius and subdivisions. It then guides the contour along the spline shape of the active object, thus creating a pipe.

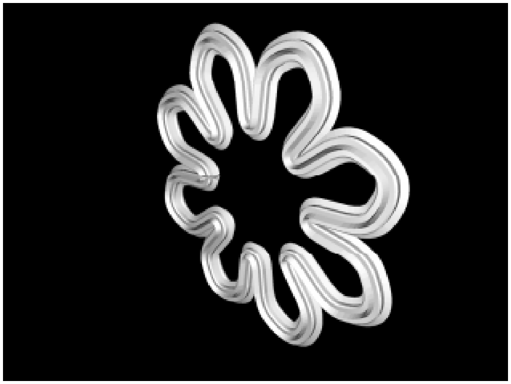


If you want the pipe to taper, specify an ‘end scale’ of less than 1.0. In the illustration above we chose the opposite method: a small start radius and a larger end value.

Path Object



With this function you can have a contour follow a path in order to create an object.



This is how you do it:

- In the Object Manager select a contour.
- Call the ‘Path Object’ function.
- In the dialog box, select the spline path which you want the contour to follow.

If you don’t want the contour to follow the curvatures of the path, but instead to remain parallel to its original position, enable the ‘Parallel Movement’ option. This means that the contour will not be aligned with the start of the path but will retain its original alignment.

Scaling

You can shrink or expand the contour while it moves along the path. With a scaling factor of 3.0 the contour becomes three times its original size, while a factor of 0.5 will halve its size.

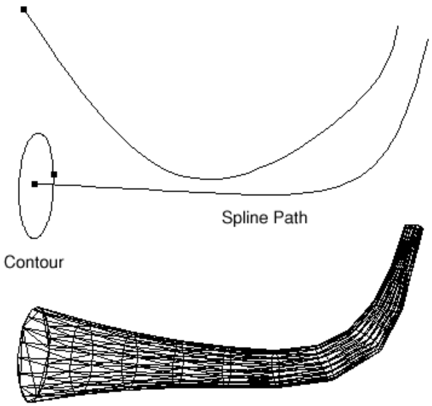
Unless you explicitly use the scaling path (see below) scaling occurs in a linear fashion.

Rotation

You can rotate the contour while it moves along the path. This rotation always occurs around its Z axis.

Scaling Path

If you want to change the size of a contour along the path in a predictable fashion, specify a scaling path.



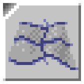
CINEMA 4D then calculates the current distance between the path polygon and the scaling polygon when creating the path object. If the distance is larger than the distance at the beginning of the two polygons, the contour gets larger, otherwise it shrinks.

In order to get to the desired result you have to understand the alignment of the two polygons. The decisive factor is the relative position of the two object axis systems to each other. This is how it works:

- CINEMA 4D first aligns the contour to the start of the path.
- It then rotates the contour in such a way that its Z axis is at a tangent to the path, while *pointing* in the direction of the path.
- Then, the contour is rotated around the Z axis until the X axis is on a parallel plane to the XY plane of the path.
- Finally, the Y axis of the contour is placed in such a way that it points in the opposite direction to the Z axis of the path.

Confused? Thinking about the contour of your left hand might help you visualise this. Your thumb is the X axis of the contour, your index finger is the Y axis, and your middle finger is the Z axis. Spread your three fingers till they form the coordinate system and then turn your hand until you get an impression of how the axes need to be positioned.

4.8 NURBS



Clicking on this icon in the Objects toolbar opens a menu containing various options.

CINEMA 4D provides lots of ways to create and modify objects. NURBS (free-form polygons) are by far the most powerful and most flexible. They are particularly suitable for creating ‘organic’ surfaces.

You start with ordinary splines—choose any of the built-in ones or create your own.

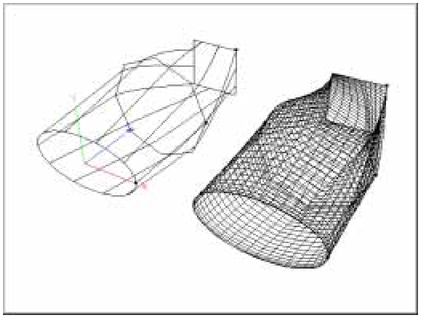
This is how it’s done:

1. Create and place the required splines.
2. Create the NURBS object.
3. In theObject Manager, drag-and-drop the splines into the NURBS object.

So far, the procedure is not that different from using ordinary spline objects. However, the special feature of NURBS is that you keep full control over the original objects; if the result is not what you expected, you do not need to start over from scratch.

Select one of the splines, switch to Edit Points mode and move the control points of the spline. This will not only change the curve, but the NURBS object will now follow the changes.

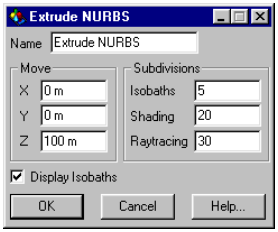
With all NURBS you can switch from wireframe to isobathic representation. You can see the difference in the illustration below. On the left is the isobathic representation and on the right the wireframe.



Tip:

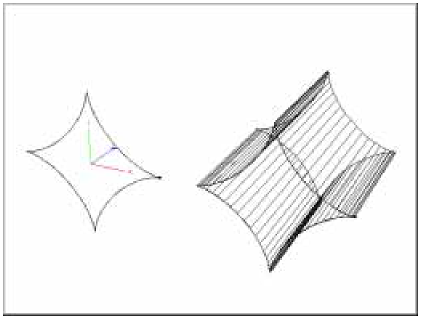
NURBS can be animated. This is achieved by morphing the splines that define the NURBS. However, this is not visible while you have isobaths enabled in the Editor.

Extrude NURBS



This will create an Extrude NURBS without caps, similar to the process used with splines. In fact it is a spline, stretched to give depth. This movement occurs in real time, as soon as you drag the spline into the Extrude Object.

It is not possible to use hole splines here.



Under ‘Movement’ in the attributes dialog, specify the extent and direction of the movement.

With ‘Subdivisions’ choose the details of the object separately for the isobathic display, the Editor display (‘Shading’) and the final render (‘Raytracer’). This is also the place to decide between isobathic and Editor display.

Tip:

This type of Extrude NURBS has no caps (flat ends). If you need to create caps, use ’Skin Object’ and place the surfaces where they belong.

Tip:

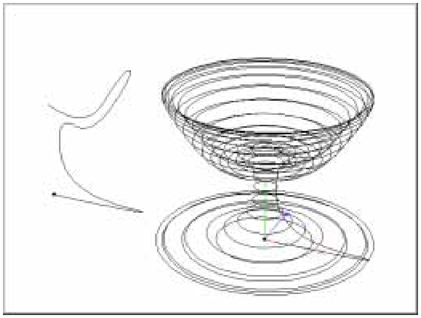
If you want to selectively change the NURBS object at various points of the grid, start by converting the NURBS to a polygon (Options / Structure / Convert to Polygon). You are then free to choose from Crumple, Deform, etc.

This conversion is irreversible, even though the starting NURBS remains intact.

Lathe NURBS

This creates a Lathe NURBS, similar to the Lathe Object (Splines). You create a spline, which is then turned around the Y axis of the Lathe NURBS. The rotation occurs in real time, as soon as you drag the spline into the Lathe Object.

Hole splines cannot be used.



Use the attributes dialog to specify the rotation angle of the spline.

Under ‘subdivisions’ specify the details of the object separately for isobathic and Editor display (‘Shading’) as well as for the final render (‘Raytracer’). Choose your preferred display type here.

Tip:

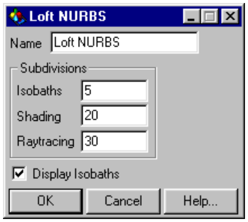
This Lathe NURBS creates no caps (end surfaces). If you want caps, use the Skin Object and place the surfaces where they belong.

Tip:

If you want to selectively change the Lathe NURBS at various points of the grid, start by converting the NURBS to a polygon (Options / Structure / Convert to Polygon). You are then free to choose from Crumple, Deform, etc.

This conversion is irreversible, even though the starting NURBS remains intact.

Loft NURBS

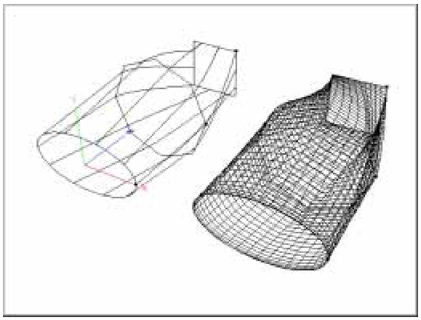


This creates a Loft NURBS. Loft NURBS are very similar to skin and loft objects. You create a number of splines which are connected by an ‘envelope’. The sequence of the splines in the Loft NURBS determines their order.

Unlike conventional spline objects, the layers are not connected in a linear fashion. Instead, the transition from NURBS to NURBS is smooth.

You can mix splines of different interpolation types, for example Akima-closed and Hermite-open.

It is not possible to use hole splines.



Under ‘subdivisions’ in the attributes dialog you specify the detail of the object separately for isobathic and Editor display (‘Shading’) as well as for the final render (‘Raytracer’). Choose your preferred display type here.

Tip:

The loft object creates no caps (end surfaces). If you want caps, use the Skin Object and place the surfaces where they belong.

Tip:

Instead of a cap you can have the edges of the object meeting at one point (‘peak’). To do this, create a new spline, which contains one single point, and place this at the start and/or finish of the spline list.

Tip:

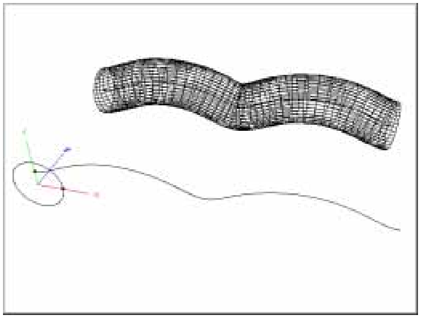
If you want to selectively change the Loft object at various points of the grid, start by converting the NURBS to a polygon (Options / Structure / Convert to Polygon). You are then free to choose from Crumple, Deform, etc.

This conversion is irreversible, even though the starting NURBS remains intact.

Sweep NURBS

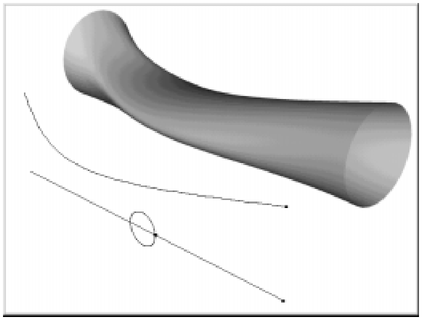
This creates a Sweep NURBS. Sweep NURBS are very similar to path objects. You create two splines, one for the envelope curve, the other for the path along which the envelope will move.

You can use splines of different types (cubic, Hermite ...). Within the Object Manager, the sequence of the splines in the sweep object indicates which spline is guided along which other spline. The first spline is the one that moves, the second is the path. As with the path object, here too the envelope curve is guided along the path with the local Z axis.



Under 'subdivisions' in the attributes dialog you specify the details of the object separately for isobathic and Editor display ('Shading') as well as for the final render ('Raytracer'). Choose your preferred display type here.

Optionally, you may indicate a third contour for a sweep object. The first (the circle in the example below) is fitted into the two that follow (the straight line and the curved line). This is known as a Rail Object.



Tip:

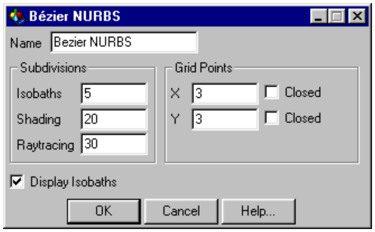
The Sweep object creates no caps (end surfaces). If you want caps, use the Skin object and place the surfaces where they belong.

Tip:

If you want to selectively change the Sweep object at various points of the grid, start by converting the NURBS to a polygon (Options / Structure / Convert to Polygon). You are then free to choose from Crumple, Deform, etc.

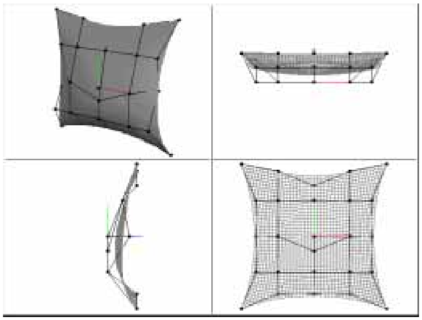
This conversion is irreversible, even though the starting NURBS remains intact.

Bézier NURBS



This creates a Bézier NURBS. This is a surface which is being pulled in the X and Y directions via Bézier curves. The control points (with the exception of the start and end points) are like small magnets which affect the surface.

Bézier NURBS are ideally suited to modelling curved surfaces (the wings of a car, nose of an aeroplane, sails...).



Under ‘subdivisions’ in the attributes dialog you specify the details of the object separately for isobathic and Editor display (‘Shading’) as well as for the final render (‘Raytracer’). Choose your preferred display type here.

‘Gridpoints’ allows you to specify the number of control points separately for the X and Y directions.

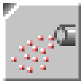
In addition, you can specify whether you want the surface to be closed in one or both directions.

Tip:

If you want to selectively change the Bézier NURBS in various points of the grid, start by converting the NURBS to a polygon (Options / Structure / Convert to Polygon). You are then free to choose from Crumple, Deform, etc.

This conversion cannot be reversed, but the starting NURBS remains intact.

4.9 Particle system



After clicking this icon in the Objects toolbar a menu opens with a number of entries for you to select from.

Have you ever wanted to create a school of fish, a fleet of space-ships, a volcano or the smoke of a cigar? This might have been difficult in the past, but CINEMA 4D makes it easy for you.

The heart of the particle system is an emitter, which ejects a stream of particles. The particles continue to move in a straight line until they come into the range of one or more modifiers which will deflect them, decelerate them or cause them to rotate. As a general rule, these modifiers work in the Z direction of their coordinate system. If this is not the case, we will point this out explicitly.

You can embed modifiers within other modifiers. For example, placing a turbulence modifier within a wind modifier can produce very realistic smoke effects.

The intensity of all modifiers can be controlled via a fade-out track (see Chapter 13 - The Time Line).

The particles of the stream appear in the Editor as line fragments, whereby the length gives an indication of the current direction and speed of the particle. The longer the line the faster the particle.

For the animation rendering you need to indicate which object is to be used as a particle (drag-and-drop in the Object Manager). If you do not specify an object, spheres covered with the default material will be used.

This is how it's done:

1. Create one or more emitters.
2. Create one or more modifiers.
3. Open the Time Manager, change to Forward, and observe the result.
4. Project one or more objects into the emitter.

Good:

Any object can be used as a particle—even an object group. Yes, you could use a *whole car* as a particle. But don't overdo it: when it comes to rendering, all objects, including their textures, must fit into your available memory.

Better:

You can project any number and type of objects into an emitter. The particle stream is then made from equal parts of randomly selected objects.

Even better:

The objects of the emitter can be animated in any way you like. This means that you can for example create an entire school of dolphins from three or four morphing dolphins.

Tip:

Visible light sources are excellent for creating fire, gas, smoke, glittering stars ... 20 to 100 lights are all you need.

Tip:

If you want to ensure you actually live to see the rendered animation, don't forget to switch off the light emission from the light sources. Calculating the lighting is one of the most intensive and time-consuming rendering tasks!

Tip:

Emitters cannot themselves be used as particles.

Tip:

The particle stream—the birth rate of the particles, that is—can also be controlled by the Fade-out track in the Time Line.

The meaning of the values is as follows:

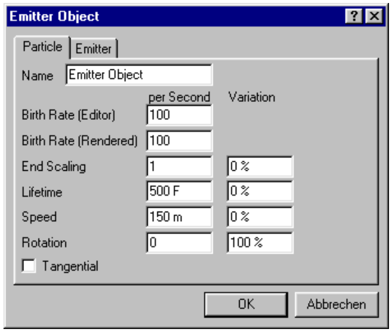
0%	no emission
x%	x% of birth rate being generated
100%	maximum emission

And by the way ...

Particles generated by CINEMA 4D cast shadows.

Emitter

Particles page



Birth Rate (Editor)

This is for specifying the number of particles that will be created per second. The particles are emitted randomly from all over the surface of the Emitter. This rate is also used when you start rendering in the 3D window of the Editor.

Birth Rate (Rendering)

This is for specifying the number of particles that will be generated per second during the actual rendering in the special window. The particles are emitted randomly from all over the surface of the emitter.

End scaling

This is for indicating the final size of the particles relative to their starting size. If you enter a value of 0.5, the particles will shrink to half their size.

'Variation' is for any deviation, for example if you want the particles to be larger or smaller at the end of the animation.

Lifetime

This is for specifying the time during which you want particles to be generated. This value also controls the length of the animation sequence in the Time Line.

'Variation' is for setting a deviation. It is possible for example to have a longer or a shorter particle life. This value also affects the animation length. If you set the value to 100%, the sequence will be twice as long.

Speed

This is for specifying the speed of movement of the individual particles. The value refers to the units (specified in the Preferences) per second.

The higher the value, the longer the particle lines in the Editor.

'Variation' is for any deviation. Particles can be faster or slower. If you enter a value of 100%, they may be twice as fast.

Tip:

It is quite possible to enter a speed of 0 so that if you move only the emitter it leaves behind a trail of particles.

Even negative values may be used. This means that the emission occurs in the negative Z direction.

Rotation

This is for specifying the angle at which the particles will rotate around a spatial axis.

'Variation' indicates a deviation. If you enter 100%, the particles will rotate twice as fast.

Tangential

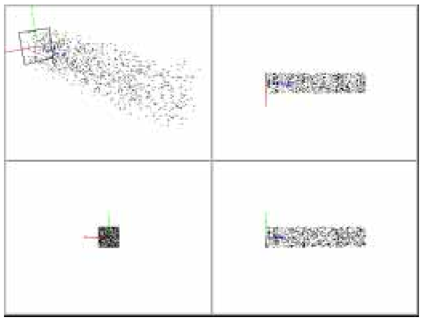
The trajectory of individual particles may be curved by the using a modifier. If this option is enabled, the Z axis is aligned along the trajectory (aeroplanes flying a curve, for example).

Tip:

This option means extra computing time and should be switched off for objects without direction, such as spheres or light sources.

Tip:

You can use only one of the two options 'Rotate' or 'Tangential'. For obvious reasons, these two are mutually exclusive.

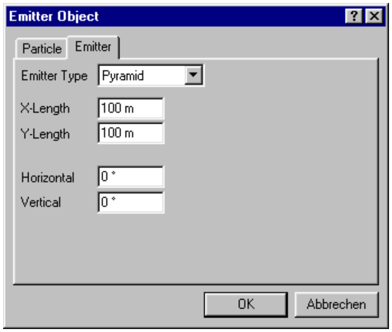


Tip for animations in the Editor:

Particle effects will only have the desired result if you play the animation at a constant rate in the Time Manager; if you go backwards in time or more than a frame forward, strange things may occur on the screen.

This is because a particle's new position is calculated from its previous position. Therefore you should reset the time slider of the Time Manager to the start every time you add new modifiers to the particle stream.

Emitter page



Radiation

This is for specifying whether you want the particles to radiate in the shape of a cone or a pyramid.

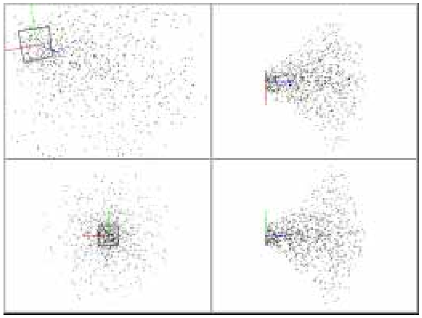
X length, Y length

This is for specifying the size of the emitter. Alternatively, you can resize it in the usual fashion by using the Scaling tool from the toolbar.

Please note that scaling a sub-object emitter (i.e. where the emitter is the child object of another object) is reversible only if scaling has been performed with the 'Edit Object' command. Scaling cannot be undone if it is carried out with the 'Edit Model' command.

Horizontal, vertical

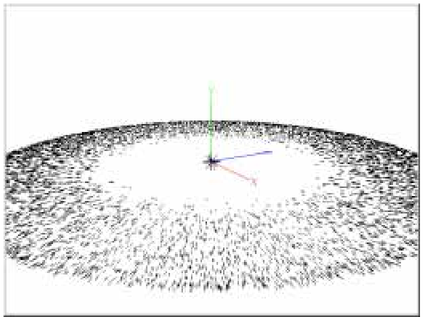
This is the emission angle of the particles. If the value is 0˚ the particles are emitted parallel to the Z axis of the emitter; if the value is 180˚, particles may exit on the XY plane of the emitter (Z=0).



Animation of Particle rate:

If you want to have pulsating emission of particles, you can control the emitter by using the Fade-out track. 0% means no emission, 100% means maximum emission.

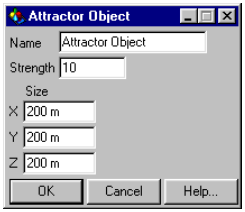
Note however that the emission of particles starts at a *visibility* of 50%. If you wish to terminate emission at an exact point in time, you need to place a 100% key directly in front of the 0% key in the fade-out track. This will cause the emitter to switch off from one frame to the next.



This radial emission was generated by using the following values:

X length = 0; Horizontal = 360º
Y length = 0; Vertical = 0º

Attractor



The attractor is a radially symmetrical gravitational force. This lets you capture particles in a similar fashion to the sun ‘capturing’ planets. You can also create water whirls with this function.

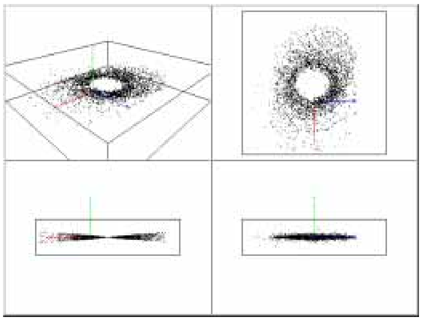
Outside the attractor, the particles will move in a linear fashion.

Strength

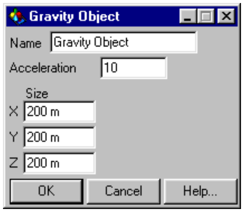
This is the strength of the gravitational force, and it lets you simulate different magnetic poles. If you wish to produce repulsion, you can use a negative value.

Size

This is for specifying the spatial dimensions of the attractors in all three directions.



Gravita



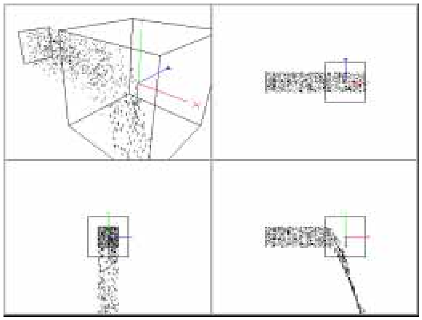
The gravitational pull of the earth is a force that you have known ever since you dropped your first slice of buttered toast on the floor. The gravitation modifier lets you simulate this effect.

Acceleration

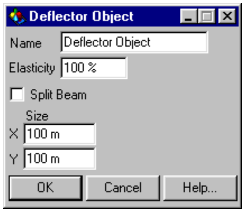
This is for specifying the degree of acceleration.

Size

This is for specifying the spatial dimension of the gravitation modifier in all three directions.



Deflector



This modifier is for deflecting particles. For example, you could use five of them to create a snooker table, the emitter generating one particle only (the ball) which never leaves the 'ground', rebounding nicely off the cushions.

Elasticity

This is for specifying the degree of elasticity of the cushions, i.e. the degree of rebound. A value of 100% means that the entry angle will be the same as the exit angle.

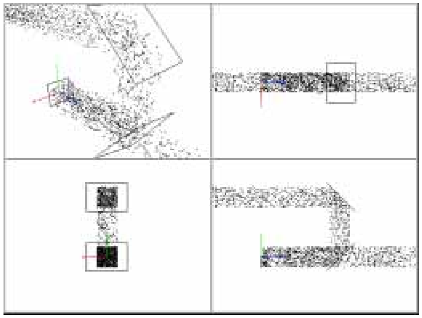
The lower the elasticity value, the more particle energy is absorbed by the deflector and the more the movement proceeds along the deflector.

Size

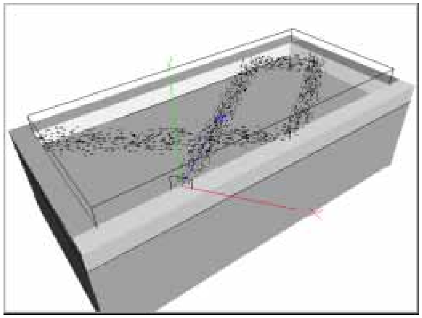
This is for specifying the spatial dimensions of the deflector in the X and Y directions.

Division

If this option is enabled, the particle stream is divided at the deflector. Half the particles are deflected, the others pass through the modifier as if it was simply not there.



Here is another snooker table:



Friction

Friction reduces the speed of the particles—it may even bring them to a complete standstill.

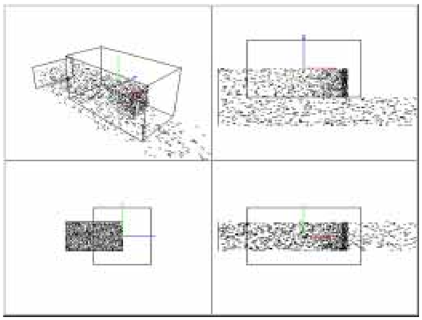
Friction coefficient

This is for specifying how strong you want the friction to be, i.e. how much it causes the particles to slow down. After leaving the modifier the particles continue moving with constant (but reduced) speed.

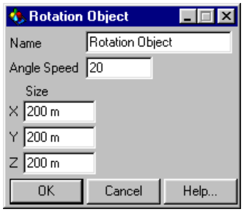
The friction coefficient can have a negative value. This will cause an acceleration of the particles.

Size

This is for specifying the spatial dimension of the friction modifier in all three dimensions.



Rotation



Rotation adds a tangential acceleration to the particle movement. The rotation occurs around the Z axis. The radius is half of the smaller dimension of the modifier in the X or Y direction.

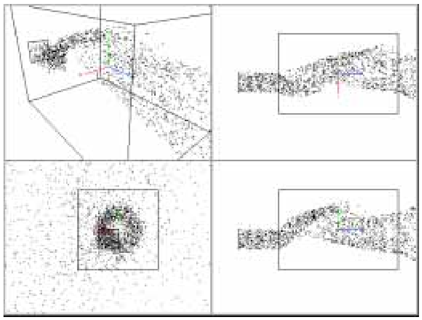
You can create fascinating effects by placing the modifier with its Z axis parallel to the diffusion direction of the particles. This will cause a helical movement.

Angle speed

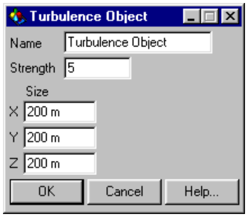
This is the speed with which the particle stream is to be rotated around its Z axis.

Size

This is for specifying the spatial dimensions of the rotation modifier in all three directions.



Turbulence



The Turbulence modifier will cause a whirl within the particle stream.

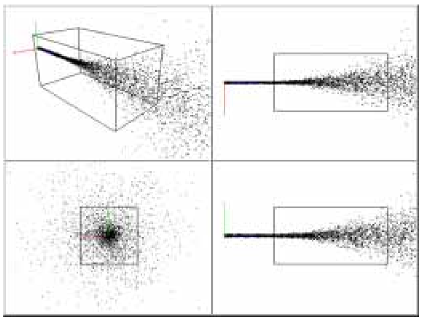
You can create interesting effects by moving the particles using an elongated modifier. This will let you create smoke curls, for example.

Strength

This is for specifying the strength of the whirl.

Size

This is for specifying the dimensions of the Turbulence modifier in all three directions.



Destructor

The Destructor will let you remove particles from the stream.

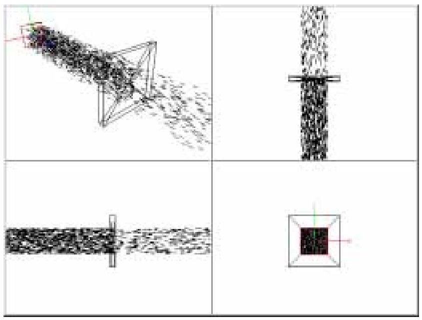
Random

This is for specifying the 'survivors':

0% – All particles to be destroyed
x% – x% of the particle stream to remain intact
100% – All particles pass through the destroyer

Size

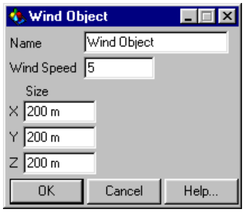
This is for specifying the dimensions of the Destroyer in all three directions.



Tip:

To be sure that the destructor has an effect, which involves catching and killing particles, it must have a minimum thickness greater than the length of run of the particles from one frame to the other. Otherwise a particle cannot be caught and so cannot be destroyed.

Wind



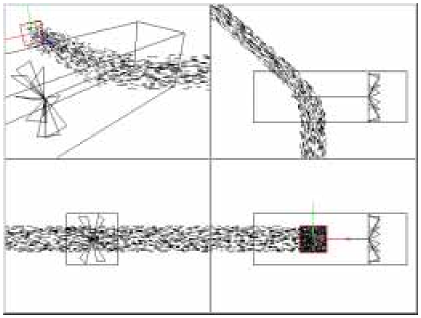
Wind deflects the particle stream towards one side. The wind direction is shown in the Editor as a small arrow in the modifier.

Wind speed

This is for specifying the degree of deflection.

Size

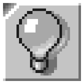
This is for specifying the dimensions of the Wind modifier in all three directions.



Tip:

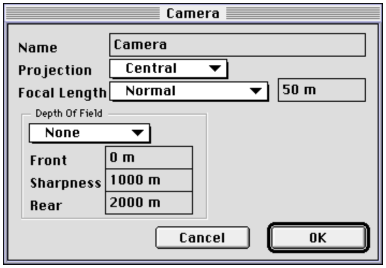
The Wind modifier shows a small windmill. The side of the cube which is next to it marks the direction from which the wind blows. The rotation speed indicates the wind force.

4.10 Scene Objects



After clicking this icon in the Objects toolbar a menu appears from which you can select the following entries:

Camera

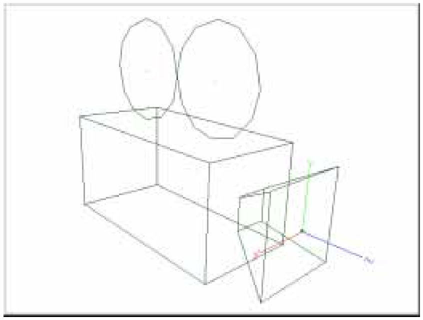


In addition to the default editor camera you can generate any number of extra cameras. Each one can view the scene from a different perspective.

When creating a new camera, position and focal length are taken from the current values of the 3D view.

In order to specify the position and alignment of the camera properly, CINEMA 4D uses the camera coordinate system. This is always arranged in such a way that the X and Y axes define the focal or film plane, while the Z axis indicates the direction into which the camera points and displays the scene in the editor. In the editor, the camera is shown as a box with two rolls of film and a lens.

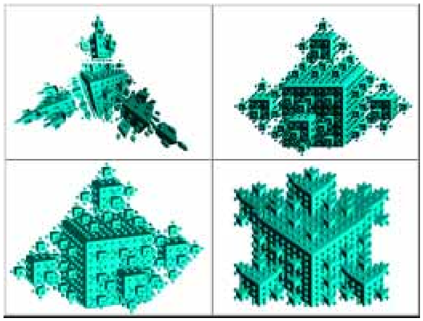
The additional lines and positions of the camera are described below.



Projection

In order to represent objects, CINEMA 4D projects them from a central perspective onto your computer screen. Objects are shown from the viewpoint of a virtual camera.

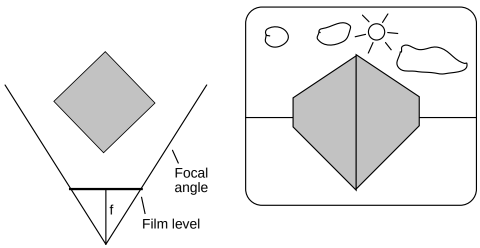
Alternatively, you can choose from a variety of other projection methods (for example dimetric or isometric methods, which are common for technical applications). The following picture shows some examples: top left: central perspective; top right: cavalier projection; bottom left: dimetric, bottom right: isometric.



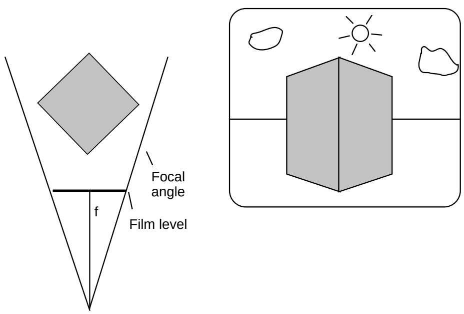
Focal length

The CINEMA 4D cameras, like the genuine article, have lens systems. You can choose from different lenses, and specify the focal length.

Short focal lengths are the equivalent of wide-angle lenses and give a good overview of a scene. However, they distort the objects, an effect that is particularly striking with the extremely short focal length of the fisheye lens.



Long focal lengths, by contrast, are the equivalent of telephoto lenses. They depict only a small section of the scene since they can capture only a small spatial angle.



This is compensated for by the fact that you have far more detail and that there is hardly any distortion. With extremely long focal lengths, the depth of the perspective is lost completely as the perspective projection is transformed into 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 lets you simulate the actual quality of capture, depending on aperture and blurring, which we summarise by what is called Depth of field.

'Depth of field' determines which part of a picture will be out of focus. You can choose between 'Front' and 'Back', depending on whether you wish the objects in the foreground or the background to be shown clearly. You can also decide to have the centre part in focus, in which case both back and front will be out of focus. Choosing 'None' will leave the camera settings unchanged, with all objects in focus.

If you have enabled 'depth of field' you can define the effect precisely by using the following boxes. (Depending on the particular setting not all are available.)

'Sharpness' specifies the distance from the camera in which the scene will be perfectly 'sharp'. Depending on the depth of field that you have chosen, sharpness will decline towards the front or the rear.

'Front focus' and 'Rear focus' determine the distance from the camera to the front and the rear where the objects will become completely out of focus.

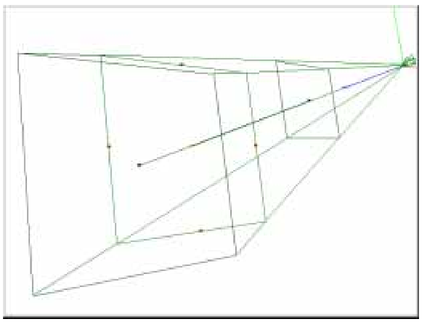
Tip:

The contrast of the grayscale depth channel is controlled by the sharpness setting of the camera. You will get optimum contrast if you have ‘Front focus’ start immediately before the first object of the scene and ‘Rear focus’ immediately after the last object. It is best to manipulate this in the Editor window by using the camera handles (see below in the section on interactive control of the camera).

Interactive control of the camera and its parameters

The camera is a frequently used tool, so we decided to make it as easy to use as possible. You can change the camera parameters in the Editor, without having to open up the attributes dialog each time. This is how you proceed:

Open a new, empty document; create a camera object and set Front and Rear focus to 500 and 2000; now look at the camera object through the editor camera. Select View / View / Scene. Zoom out even further and turn the camera object so that it becomes completely visible. The camera symbol in the editor is now relatively small. You get a picture that looks approximately like this. (You might want to switch to 4-Tile view to get a better overview.)



We will now describe this in more detail.

A green line runs from the camera’s origin, ending in an orange point. This is the target point of the camera. You can grab it with the mouse, move it, and align it to a new object, thereby rotating the camera around its origin.

At the same height as the target point there is a plane. This is the focal length plane. At the centre point of every side of the square there is a brown handle. This allows you to change the focal length interactively.

Go to 4-Tile view, activate the object camera and change the focal length. You can see the result in real time, in the 3D area.

There are two further planes which run parallel to the focal length plane, one in front, one at the back. These two planes (or one of them) are only visible if you have selected field of depth. At the centre of each plane you have more handles (green ones). Use these to shift the depth of field planes interactively along the Z axis of the camera. You can see the result dynamically in the editor.

You can change the focal range too, i.e. the area that is shown ‘sharply’. Hold down the Shift key while clicking on the handles and dragging. You will see that this time it is not the focal length that is affected but that the entire plane can be moved along the camera’s Z axis.

As you can see, handling the camera in the Editor really is quite simple.

As was mentioned before, you can create as many cameras as you like in CINEMA 4D. When it comes to rendering, it is always the active camera that is used.

Multiple cameras in one scene

1. Using the Objects / Special Objects command to create a camera. It appears at the spot where the Editor camera is.

2 Change the view (Rotate, Move, Scale) and create a second camera object.

3 Switch to the camera which you want to use (best done in the Object Manager), and activate it.

This is the camera that will now be used for rendering. If no camera is activated, the 3D window will show the Editor camera.

And here is the exception:

If you have at least one camera with a Fade track assigned, CINEMA 4D will use the camera that is highest in the object hierarchy.

Multiple cameras in an animation:

1 Create several cameras in your scene.

2 In the Time Line, assign a Fade track across the entire animation to each camera.

3 Switch on the cameras by means of Fade out keys (100%) and off (0%). Make sure you always have one camera active, while the others are disabled.

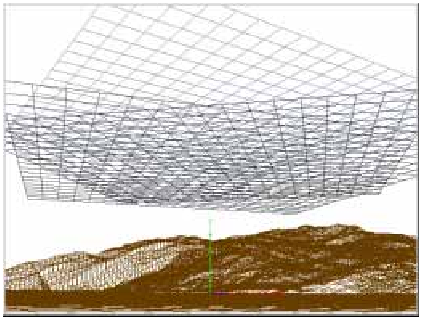
4 Now animate the various cameras at those times where they are active (for example focal length, position ...).

Floor

This command creates a floor object. The floor is always on the XZ plane of the world coordinate system, stretching into infinity in all directions, independent of its object axes.

CINEMA 4D lets you have several floors. In an animation you can then use these as you see fit by using the Fade track.

You could also, for example, use extra floors as pseudo skies on which you could place several transparent layers of clouds. In the following, simple example, four floors were used: one for the actual floor, and three for the sky, each one a little higher than the preceding one. By animating the cloud textures a very realistic effect can be achieved.



It is possible to move floors relative to each other, and to rotate them. This allows you to use identical cloud textures without the pattern looking repetitive.

Tip:

You can also use floors to simulate walls of a room that stretch to infinity. All you need then to close off the room is a rear wall.

Sky

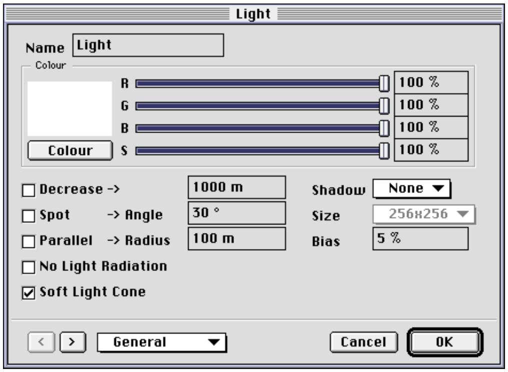
This command creates a sky object. Unlike the floor, this is a sphere extending into infinity, whose centre is in the origin of the global coordinate system. Note that rendering will take into account only one sky object. If there are several, use the Fade track in the animation to decide which one to render.

Light source

This creates a light source for illuminating your objects. You can assess the lighting of a scene by using Gouraud Shading in the editor—even dynamically, for example when shifting a light source.

When you do this, i.e. move a light source with Gouraud shading enabled, you can choose to suppress re-drawing of the entire scene. By holding down the Ctrl key while dragging you can restrict the re-drawing to the active object (the light source).

General page



Use the sliders and the text entry boxes in the top half to modify the colour of the light source.

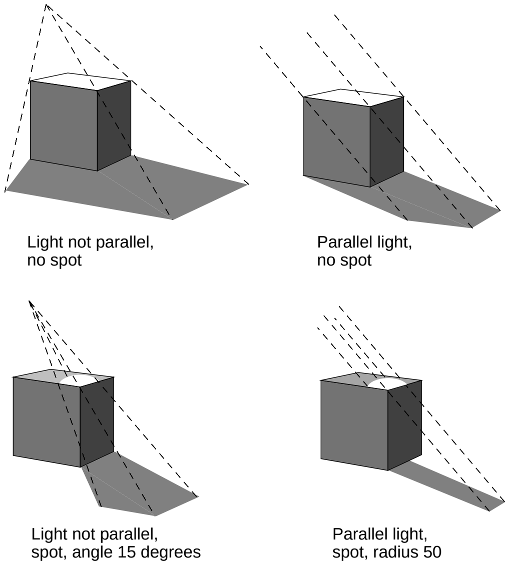
You can decide its brightness independent of the colour of the light source. The brightness value can be adjusted gradually, in the manner of a dimmer switch. This will allow you to simulate soft candle light as well as glowing, bright sunlight.

Decrease

This option allows you to specify whether you want the light intensity to decrease over distance, or to remain constant. By enabling this option, the brightness of the light beams decreases as the distance from the light source increases. Use the 'Distance' setting to specify over what distance the decrease reaches zero.

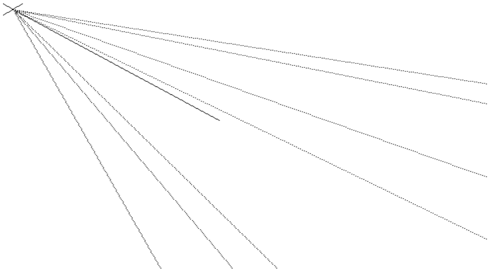
Spot

To achieve life-like scenes, you may occasionally want to use light sources that work like spotlights—only lighting a particular area.

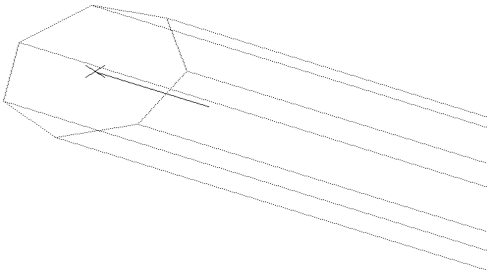


You do this by using a spot light source. If you have divergent light, specify the radiation angle, if you have parallel light, use the radiation radius.

With divergent light, the rays are all within a cone whose starting point is the position of the light source (see image).



The rotation axis of the cone runs along the Z axis of the object coordinate system of the light source. Points outside of the cone do not receive any light from the light source. With parallel light, all rays run parallel to the Z axis of the object coordinate system within a cylindrical shape.



Parallel

This allows you to specify whether the light of the active object is diffused in parallel, or from a specific point. With a parallel light source, a light front is beamed from the light source in the direction of the Z axis. Parallel light sources are useful, for example, to simulate sunlight.

Parallel light sources cannot cast soft shadows.

No light radiation

Enable this option if you wish to use the special effects of the Lens Effects page, without having the light source cast any light onto objects.

Tip:

If you use light sources for special effects you must disable light radiation.

Soft Light Cone

Enable this option if you want to ensure that a spot light source does not produce an evenly lit cone, enable this option. This will cause the intensity to decrease towards the outside, starting from 100% in the centre of the cone. At the edges of the cone intensity reaches 0%.

Shadow

This is for specifying whether the light source is to cast a shadow when rendering.

CINEMA 4D provides two types of shadow.

The ‘hard’ shadow which normally comes with Raytracers requires genuine raytracing for rendering. Since this means calculating a large number of additional rays, this method is time-consuming. Hard shadows are particularly popular for technical illustrations. In more ‘artistic’ pictures they tend to look unrealistic, since this type of shadow is not found in nature.

In real life, objects are lit by several, sometimes extended, light sources. This gives a gradual transition from light to shade. This soft edge can be simulated by CINEMA 4D by using soft shadows and shadow maps, which are images of the scene from the viewpoint of the light sources. The shadow map contains all the objects that are visible from the light source, i.e. all illuminated objects. During rendering it is then easy to check whether or not an object is located in the shadow of the light source or not.

The advantages of this method are fast processing speed and natural appearance.

Let's not gloss over the drawbacks though. A large shadow map will require extra memory so use this option sparingly. It is normally enough to have just one light source casting a shadow. You can then use two or three additional light sources simply to lighten up the scene or to provide highlights.

Soft shadows cannot show transparencies. If you want to depict a stained glass window, for example, you must use hard shadows.

Tip:

Soft shadows cannot be combined with a parallel light source, but are fine with the point variety.

Size

This is for specifying the size of the shadow map for soft shadows. The larger the size, the more precisely the rendering of the soft shadow. At the same time, it will be less extensive, so that the transition from light to shadow will occur over a narrower area.

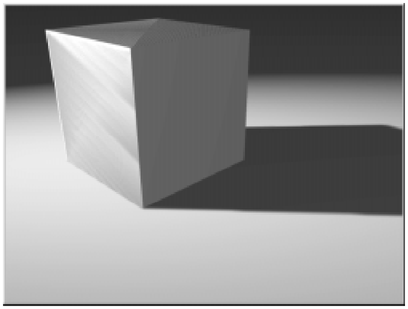
Larger sizes are recommended when very detailed shadows are needed or when the light source is far away from the scene. In this case, the objects are very small as seen by the light source, and precise shadows require a high degree of detail.

Use small sizes when precision is not important, but the shadow effect is.

Bias

The bias lets you adjust the distance from a light source to the shadow it casts. Values can range from 0% to 50%.

As a rule, the greater the distance between a light source and the object being lit, the smaller you should set the bias value. If you then find that your scene has more shadows than you require, increase the bias. If you get no shadows, then your bias is too high and you need to reduce it.

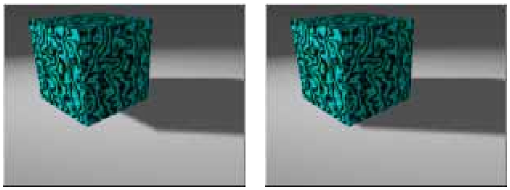


In the above picture, a very low bias was used. Note the abnormal shadow bands, particularly on the illuminated front face of the cube, and also on the top.

The following illustrations show the effects of the distance between the light source to the object, the size of the shadow map, and the bias, on a soft shadow.

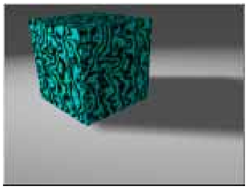
Effects of the bias

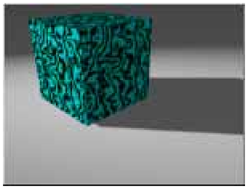
On the left: large bias; on the right: small bias.



You can see clearly how the shadow comes closer to the object; however, because of the way in which soft shadows are created, it never reaches the edge of the object.

Size of the shadow map:
On the left: smallest shadow map; on the right: largest shadow map.



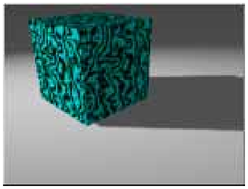


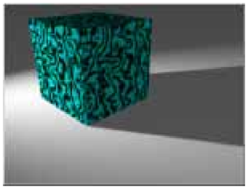
The shadow quite clearly gets ‘sharper’, the larger the shadow map. However, a small soft edge always remains.

If you make your shadow map too small and have too large a distance between the light source and the object, spheres may suddenly start casting rectangular shadows.

Always keep in mind that large shadow maps will take up a lot of your memory.

Distance between light source and object:
In the picture on the left the light source is far away from the object (approx. 3200 units); in the picture on the right it is relatively close (some 690 units).





Observe how the shadow creeps even closer to the object without changing the bias or the size of the shadow map.

It is best to always consider changing the distance of the light source as a first option.

Light map
We would like to bring one other option to your attention, which is not actually available in this dialog: Light maps.

A light map is created by assigning to the light source a material with a transparency texture.

The light colour is then filtered through this texture, just as in the slide projector the light is filtered through the slide. You can have as many light maps as you like for each light source, creating amazing effects. You can simulate, for example, the shadows of a Venetian blind, without needing any actual (processor-intensive) shadow calculations simply by assigning a light map with black and white stripes to your light source.

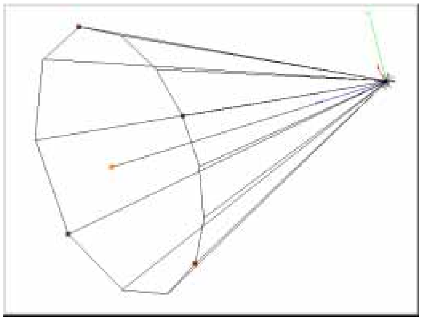
Light sources do not take on the material of a parent object.

Interactive control of light sources and their parameters:

Light sources are commonly used objects, which is why we made them easy to use. The most important parameters of a light source that is used to light a scene can be changed interactively in the Editor, without having to go into the attributes dialog every time. Details are discussed below.

1. Create a new, empty document.
2. Create a light source and enable the 'Decrease' and 'Spot' options.
3. Look at the light source in the editor window.

   You may want to switch to 4-Tile view and reduce the display, to get a better overall picture.



A line runs from the origin of the light source, ending in an orange point. This is the target point of the light source. You can grab it with the mouse, move it and direct it at a new object, thereby rotating the light source around its own origin.

Several beams are emitted from the origin of the light source, symbolising the aperture of the spot light. Within these beams you can see maroon points which, by dragging with the mouse, you can use to interactively change the aperture.

Click on one of the points. Hold down the mouse button while you move the mouse. The light cone gets larger or smaller.

Tip:

If in addition to 'Spot' you have also selected 'Parallel' you can use the same method to change the diameter of the light cylinder.

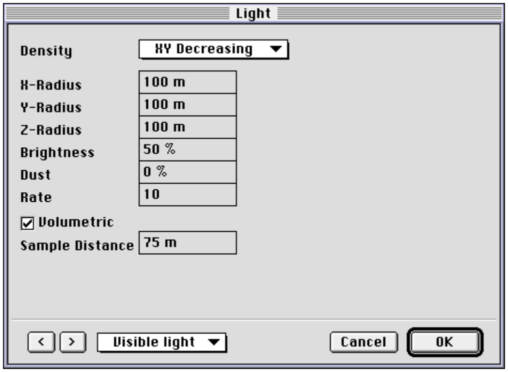
In this case the light cone ends at a certain distance. This represents the decrease distance as specified in the dialog box, and can also be changed interactively.

To do this, hold down the Shift key while clicking on a handle. By moving the mouse you can now move the light cone in the Z direction of the light source and resize it.

Possible light source combinations:

Type	Spot	Parallel	Decrease	Soft
Point-shaped light source casting light in all directions	no	no	no	no
Point-shaped light source casting light in a limited direction	yes	no	no	no
Point-shaped light source casting light in a limited direction, with intensity decreasing with distance from the Z axis of the light source	yes	no	no	yes
Point-shaped light source casting light in all directions, with intensity decreasing with distance from light source	no	no	yes	no
Point-shaped light source casting light in a limited direction, with intensity with distance from the light source	yes	no	yes	no
Point-shaped light source casting light in a limited direction, with intensity decreasing with distance from the light source and from the Z axis of the light source	yes	no	yes	yes
Parallel light source illuminating a half-space in Z direction.	no	yes	no	no
Parallel light source illuminating a half-space in the Z direction, with intensity decreasing with distance from the light source	no	yes	yes	no
Parallel light source illuminating a cylinder space in the Z direction, with intensity decreasing with distance from the light source	yes	yes	no	no
Parallel light source illuminating a cylinder space in the Z direction, with intensity decreasing with distance from the cylinder axis	yes	yes	no	yes
Parallel light source illuminating a cylinder space in the Z direction, with intensity reduced with distance from the light source and from the cylinder axis	yes	yes	yes	yes

Visible light



In CINEMA 4D you can make light sources and the light cones emanating from them visible, an effect that you see for example in smoke-filled rooms.

You might compare this to a kind of fog which does not absorb light but does add brightness.

Visible light can help create the most beautiful effects. Floodlights, illuminated displays on control panels, glowing and shimmering, laser beams, special atmospheric effects, and much more.

In its pure form, visible light penetrates objects and is not broken by walls or objects. You could, for example, place visible light in the centre of a planet in order to simulate an atmosphere around that planet. If you want to have shadows in your light cone, read the section further down.

Visible light is of special importance when used in combination with the particle system. Using visible light sources (with 'No Light radiation' enabled) you can create fog patches, clouds of smoke or soot, tails of comets, fire ... all kinds of special effects.

Density

This is where to decide what the density of the visible light is going to be, independent of the actual light source type.

None
No visible light is produced.

XYZ decreasing
The visible light decreases radially in all spatial directions and appears to have a spherical shape.

This is probably the option most used for Decay in connection with particle systems.

XY decreasing
The visible light decreases radially in the XY direction while remaining constant in the Z direction. It looks like a cylinder which decreases towards the outside.

Z decreasing
The visible light decreases in the Z direction and remains constant in the X and Y directions.

Constant
The visible light remains constant in all directions.

The form of the visible light depends on the type of light source and the density distribution. The appearance is first and foremost determined by the density but can then be modified in part by the type of light source: A spot or parallel light source limits the density function of the visible light in space. Hence, with a spot light source for example, only one light cone will be visible irrespective of the density distribution. The latter determines the speed and direction of the reduction in visible light.

Watch the alignment of the axes of the light source!

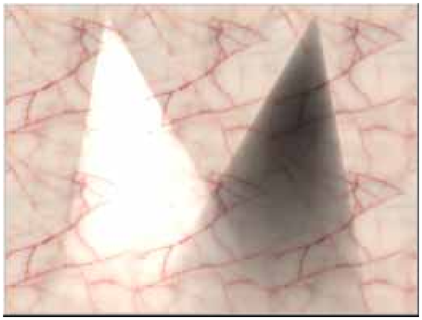
X radius, Y radius, Z radius
Specify here, for each axis, at what distance the visible light reaches zero intensity.

Brightness
This is for entering the brightness of the visible light relative to the light source. With decreasing density distribution, the brightness of the visible light decreases to the square of the distance.

Dust
This determines the black part of the visible light cone. Instead of adding light (brightness), this subtracts light.

If you are using the dust effect, ensure you decrease the brightness accordingly.

The two have distinct effects, which are illustrated in the picture below. On the left is bright visible light, on the right dusty light.



Negative light sources can be used to create some interesting effects. For example, they let you 'extract' light from particular places in a scene; this type of light source is also ideal for producing nasty black soot.

Rate
This setting determines the rate at which the visible light decays to zero intensity. The higher the setting, the faster the visible light will decay.

Volume effect
If you have experimented with visible light for a while you will have noticed that it disregards any objects that may lie in its light cone. The light beam penetrates them effortlessly and does not cast any shadows.

In order to cast shadows in visible light, Volumetric Lighting is used. For this to work, the following conditions must be fulfilled: Visible light, soft shadows, 'Volumetric' option enabled. In addition, ensure that in the Render settings (see Chapter 1) the option for rendering soft shadows is enabled.

Tip:

Calculating the 'Volumetric' effect makes demands on processing time—the higher the decay rate, the more time is taken (see below).

Sample distance
This value determines how finely the light shadow will be calculated. Lower values give a coarser (but faster) calculation, higher ones give a more precise result, but take longer.

The sample distance value is defined in world units. This value defines how fine the sampling is within a visible ball of light. Typical values range from 1/10 to 1/1000 of the radius of the light source. The higher the value, the coarser the sampling, the faster the render. But beware, beyond a certain distance sampling artefacts will appear and these will increase with the increase in sample distance.

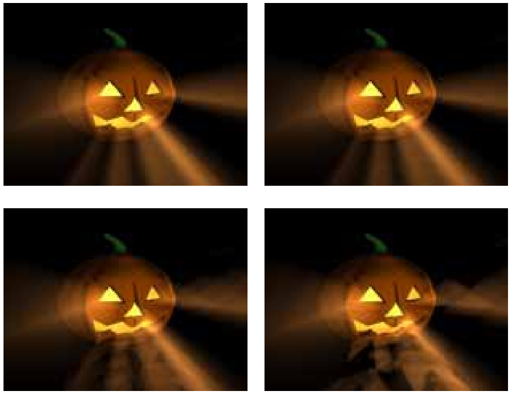
Conversely, a lower sample distance reduces the artifacts, but costs you render time.

CINEMA 4D uses integrated antiliasing at the ray level which is able to iron out the most coarse areas of your image. In general, this feature allows you to choose a higher sample distance value.

General tips:

If you find light coming through small gaps or cracks, you have to set the sample distance to a lower value. If the light source is completely covered, you can increase the value.

Here is an example which should made it clear: A pumpkin has a radius of 150 units and the visible volumetric light in the scene has a radius of 700 units.



Above to the left:
Sample distance: 10 units
Render time: 105 s
The pumpkin looks perfect.

Above to the right:
Sample distance: 20 units
Render time: 60 s
Artifacts can be seen in the rays coming from the mouth and the right eye.

Down to the left:
Sample distance: 40 units
Render time: 35 s
You can see clearly how the shadows have been moved sideways in the visible light.

Down to the right:
Sample distance: 80 units
Render time: 23 s
Forget it; the picture has been wrecked by artefacts.

Tip:

As Volumetric Lighting requires soft shadows, this effect cannot be combined with parallel light sources.

A few observations:

Our little Pentium 90 fell over while computing the above picture using a sample distance of 1.0. So why does calculating the shadows require so much processing power?

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:

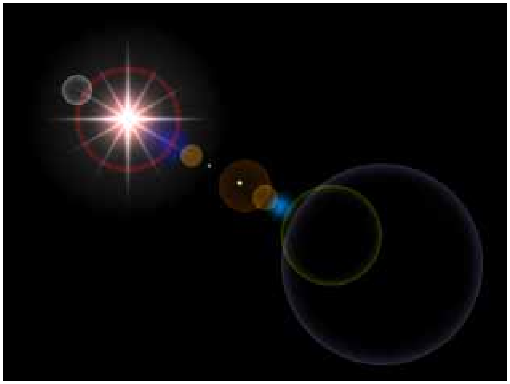
Volumetric Lighting needs a lot of calculation time, therefore render such light sources only when it is absolutely necessary. If you choose to use a Volumetric Light as a particle (perfectly possible), then perhaps you should consider buying a second computer which you can leave to render that scene over a period of days.

Take care with your decay rates. Make them no higher than is absolutely necessary to get the desired results.

Lens artefacts

CINEMA 4D provides a powerful tool for producing spectacular effects of all kinds. For simulating camera defects, for example, and especially for generating light effects.

You can make sunrays visible, for example, or create solar coronas and halos. Lens reflections can be used to simulate low-quality camera lenses. With back-lit scenes, these lenses create rainbow coloured circles which run diagonally across the image, a welcome change from the otherwise all too perfect virtual world.



Just as with properties of other objects, light effects too can be animated, right down to the smallest detail. So, for example, you could create a revolving corona while the lens flares go from red to green.

Just let your imagination run wild!

The General page of the light source contains the ‘No Light Radiation’ option. If this is enabled, the light source no longer contributes to lighting the scene but instead only provides the lens effects or the visibility (see above).

This can be an advantage if you have already created all the lighting for your scene and fear that an additional light source might change this for the worse.

The settings for these effects are extremely varied, which is why they have been spread across three ‘pages’.

To start with, all you need is the Effects page. Here you can choose glows and reflections from a number of predefined sets.

The two other pages of the dialog allow you to fine-tune the details. Each page has its own preview so that you can always see at a glance what effect your changes are having.

Tip:

Why not set up a light source library, containing your best effects? Create any number of light sources, using many different effects, save the individual objects in the Object Manager then simply load the required effects when you need them.

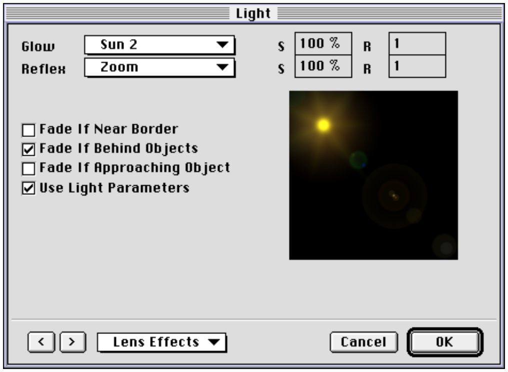
Tip:

Light effects are only visible when the associated light sources can be seen by the render camera.

And another tip:

Don’t go overboard with the light reflections as they can soon become irritating. Real camera operators try their hardest to avoid them.

Effects page



Use this page to specify glow and reflections separately by making your choice from a dropdown list.

There are also a number of options for particular lens effects that you can enable.

Glow

From the dropdown menu select a built-in set for the glow of the light source.

Reflections

From the dropdown menu select a built-in lens reflection set.

For a list of all built-in effect sets see the end of the section on light sources.

Brightness - B

Use this value to control the brightness of glows and reflections globally.

Selecting values of less than 100% will diminish the effect, values greater than 100% will increase it.

Ratio

Use this value to change the ratio for glow and reflection effects. With a value of 1, both appear as circles; lower or higher values will result in horizontal or vertical ellipses.

Fade if near border

This causes the light effects to disappear when the light source approaches the edge of the image. If it is in the centre, the lens effects have maximum intensity. This corresponds to physical reality.

Fade if behind objects

This option determines whether light sources that are behind objects produce 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 object

If a light source with lens effects disappears behind an object, the effects remain visible until the point of the light source is behind the object. The effect is switched off from one frame to the next.

If this option is enabled, the lens effects fade out slowly as the light source approaches the object.

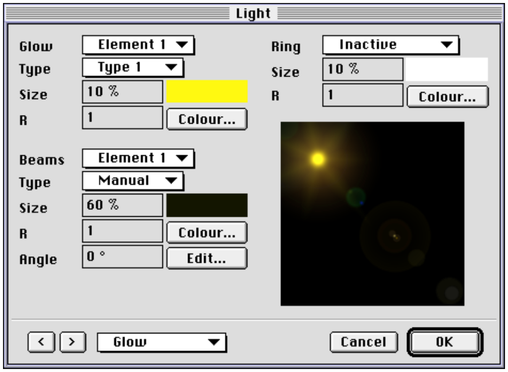
Tip:

This can be used if you want to show, for example, the gradual disappearance of the sun behind a planet with atmosphere.

Use light parameters

If this option is enabled the general settings of a light source also affect glows and reflections. If for example the colour of the light source is red, glows and reflections will also have red tints.

Glow page



This page lets you customise the glow to your precise requirements. The dialog has three parts: one for the glow (top left), one for the surrounding halo (top right), and one for coronas (bottom left).

Glow
From the dropdown menu select a built-in set for the light source glow.

Type
From the dropdown menu select a built-in set for the type of glow (distribution of brightness).

Size
Use this to specify the dimensions of the element. The radius is given as a percentage, where 100% is the distance from the centre of the screen to the edge.

Ratio
This value lets you change the ratio of the glow. A value of 1 corresponds to a circular shape; lower or higher values give horizontal or vertical ellipses.

Colour
From the dialog, choose the colour components of the element.

In the second part of the dialog you specify the halo surrounding the light source. (The halo is a faint illumination surrounding the light source.)

Halo
From the dropdown menu select a built-in set for the central glow of the light source.

Size
Use this to specify the dimensions of the element. The radius is given as a percentage, where 100% is the distance from the centre of the screen to the edge.

Ratio
This value lets you change the ratio of the halo. A value of 1 corresponds to a circular shape; lower or higher values give horizontal or vertical ellipses.

Colour
From the dialog, choose the colour components of the element.

The third part of the dialog is for defining the corona that surrounds the light source.

Beams
From the dropdown menu, select a built-in set for the corona of the light source.

Type
From the dropdown menu, choose a built-in set for the type of corona you want to use.

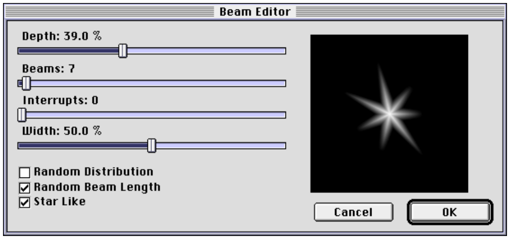
Size
Use this to specify the dimensions of the element. The radius is given as a percentage, where 100% is the distance from the centre of the screen to the edge.

Ratio
This value lets you change the ratio of the corona. A value of 1 corresponds to a circular shape; lower or higher values give horizontal or vertical ellipses.

Colour
From the dialog, choose the colour components of the element.

Angle
If you have created a corona you have the option of rotating it to any angle.

Edit
Still not satisfied? That's OK, there's more!



This dialog lets you change the type and the appearance of the corona. You have three sliders and three options with which to experiment. The preview on the right shows the effects of your changes as you make them.

Thickness
This is the width of the beam. The lower the value, the 'sharper' the beam.

Beams
This is the total number of beams. You can assign up to 200 to your light source.

Breaks
This option lets you insert breaks in your corona. These are added to the spaces which already exist between the beams.

Width
This defines the size of the break.

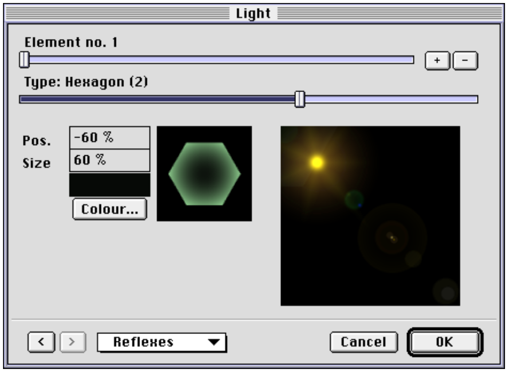
Random distribution
Enable this option if you want the beams to be arranged randomly rather than symmetrically.

Random beam length
Enable this option if you want the beams to be of varying lengths.

Star like
If you enable this option the beams are arranged in a star layout, with their ends thickening towards the centre.

This effect is particularly noticeable if you use a small number of thick beams.

Reflections page



This is the dialog for customising the familiar reflections known as lens flares.

The results of any changes that you make are immediately visible in the preview on the right.

Element number

Use the slider to choose the reflection that you wish to edit.

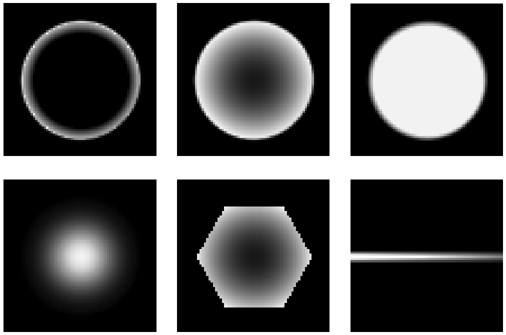
The plus and minus keys are used to add and remove reflections. The maximum available is 40—quite enough to capture even a large object with many lenses.

Type

Here you select the form. Note that different form types occur in combination only very rarely. This means that you normally have either only circular or only hexagonal types, not both.

This setting applies to all the light sources in a scene—reflections are caused by the camera lens, not by light sources.

Here are some of the available choices:



Position

This specifies the position of the element on the screen. The axis on which all reflections lie always passes through two points: the light source and the centre of the screen (which is also the centre of the lens).

The values mean:

0% = Light source
50% = Screen centre
100% = 2*distance light source-centre

Negative percentage values place the reflections behind the light source.

Size

This defines the dimensions of the element. The radius is given as a percentage. 100% is the distance from the centre of the screen to the edge.

Colour

From the dialog, choose the colour components of the element.

Effects and their physical causes:

Glow

Glows are a type of over exposure. When there is sufficient light intensity, the exposure includes film grains in the areas surrounding a bright light, even though those areas are not actually illuminated.

Halo

Halos, too, are a kind of over exposure, but with additional colour distortions caused by the diffraction of the film grains.

Reflection

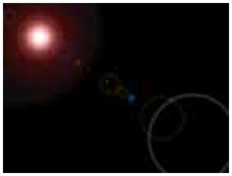
Reflections are produced from the focal image when working with poor quality lenses. The colour produced is an artefact of the lens surface, the shape is a consequence of the form. Large focal apertures cause small reflections, small apertures large ones.

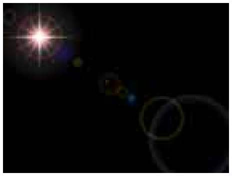
Just in case you are unsure:

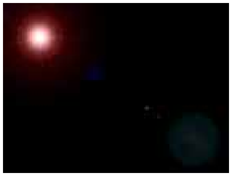
Every effect that has been described on the preceding pages can, of course, be animated!

Further examples

We will now show you pictures of all the built-in lens flares and glow effects, as well as their combinations. If some of them are not clearly visible here, load the online PDF reference where you will find all of these pictures in colour.

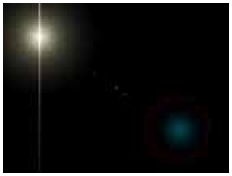

Default


CINEMA V4

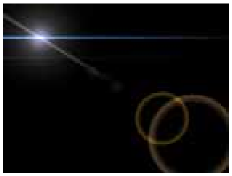

Wide angle

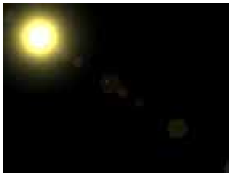

Zoom

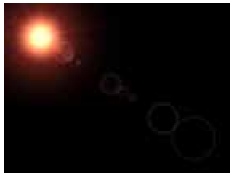

Hi-8

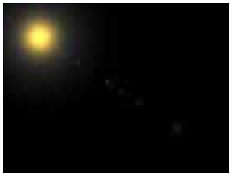

Camcorder

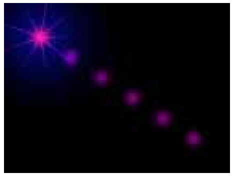

Floodlight


Artefact


Star 1


Star 2


Star 3

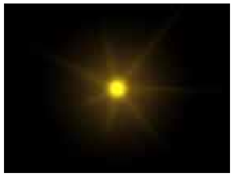

Violet

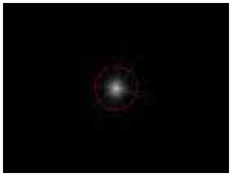

Flash 1

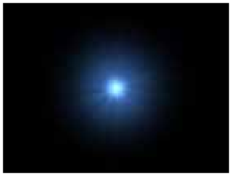

Flash 2

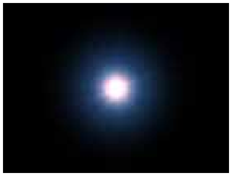

Flash 3

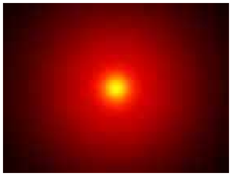

Sun 1

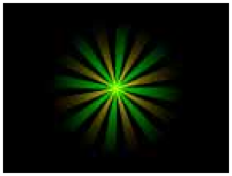

Sun 2

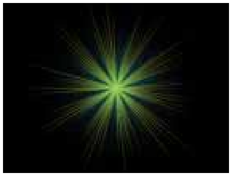

Grey

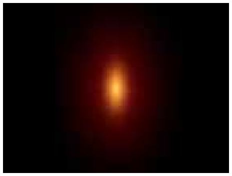

Blue 1


Blue 2


Red


Yellow-green 1


Yellow-green 2

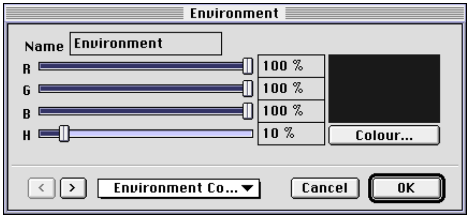

Candle

Environment

This lets you define a number of global scene parameters.

Note that rendering takes into account one single environment object only. If there are several, use the Fade track of the animation to decide which one to render (just as you would do with multiple cameras).

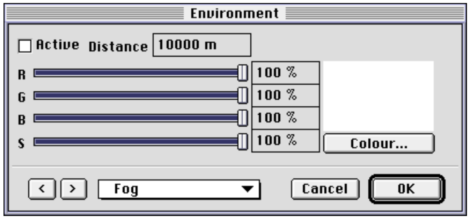
Environment colour



Environment colour is the colour 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 room light.

In general, the environment light ought to match the colour of the light source used, but there may be exceptions. For example, you might have a murky blue for a night sky, while illuminating the window of a house with a light source in warm yellow.

Fog page

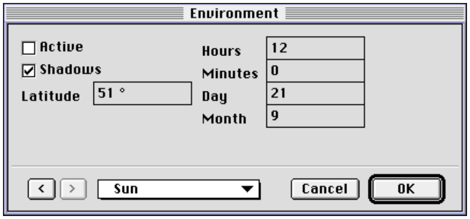


Environment fog fills the entire screen, stretching to infinity. In this dialog you can select its colour. 'Distance' refers to the density of the fog by specifying the distance over which a light beam loses its intensity completely, while fog colour is being added. If, for example, you have entered a value of 500 for 'Distance', this means that 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 be completely gone. The shorter the distance, the thicker the fog.

Beams that penetrate the fog beyond the limit set by 'Distance' are completely absorbed into the colour of the fog. This means that if you enable Environment fog you cannot see a sky or a background image.

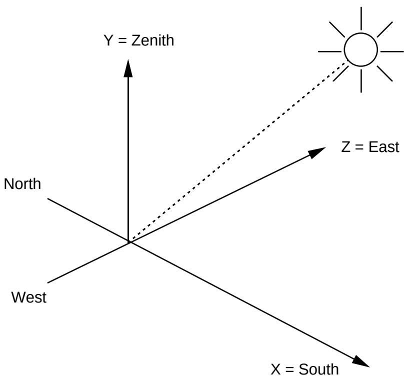
Use Environment fog for atmospheric autumn images or underwater scenes.

Sun page



This function, which produces a sun as the light source, will be of particular interest to architects. Enter some simple details and your scene will be lit by a light source that gives precisely the required seasonal effect. You need to enter the date, the time of day and the geographical location (latitude).

The X axis of the world coordinate system is taken to be south, i.e. the position of the midday sun. East (the rising sun) is therefore the Z axis and West the negative Z axis. North is the negative X axis.



This light source, which emits parallel light, is placed at a great distance from the origin of the world coordinate system.

Daylight simulation.

The sun is generated only when it is above the horizon (i.e. during daylight). If you want to animate the sun you should disable automatic lighting (Auto Light on the General page of the Render settings dialog) otherwise the scene will be continue to be illuminated after the sun has set.

The colour of the sun is a yellowish light that is affected by the absorption spectrum of the atmosphere, which moves towards the red spectral range as the sun gets closer to the horizon.

The Sun function is designed for users who want to simulate realistic colours and shadows at different times of the day and with the changing seasons—for example landscape planners, architects and garden designers.

Hours, minutes, day, month

These text boxes are for entering the time and date for which the sun position is to be calculated. Summer time is not taken into account, so you will have to subtract one hour to get the correct result during the summer months.

Latitude

This is the latitude of your geographical position on earth. For example 51.3° for London, 40.5° for New York and 35.4° for Tokyo.

Front layer / Back layer

You can place a front and/or a back layer image in front of and/or behind any frame that is rendered by the Raytracer. This might be an interior shot of a cockpit or simply a copyright or authorship notice that you want to appear in a particular place.

These images will neither be reflected by a reflective object nor lit in any way, nor will they change if you change the camera settings. The back layer image will show through transparent and refractive objects, but it will not change with altered camera settings. You might compare it to a background layer generated by the Genlock feature, on which the rendered image is then superimposed.

You can view the back layer in the Editor by using the Back picture option in the Display mode settings (see Chapter 3). The front layer image becomes visible only after rendering.

To render (or display in the Editor) a front and/or back layer image, assign a material with a colour texture to this object, as you would with any other.

For transparent areas use the Genlocking feature (see Chapter 9).

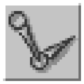
This CINEMA 4D object (bridge) fits perfectly in the foreground and the background photo. Scene: Joachim Hoff

You can use tiling for the front and/or back layer. In this case, open the Texture dialog box. The default setting for both layers is Frontal mapping (see Chapter 10).

During rendering, the front and/or back layer is scaled to the size of the film format (see Chapter 1: Render settings). Transparent areas of the back layer are ignored.

You may use an animation or a sequence of frames as the front and/or back layer. In case of the back layer the editor lets you see this, too.

4.11 Bone Object



You might be faced with the problem of having to animate a complex object. There are different ways of going about it:

1. You can cut up the object in Points mode with the help of the Structure Manager, creating individual parts, which you then animate separately, as with a robot.

   However, you need to be careful with the joints. These are the places where the model tends to ‘break up’ and reveal ‘holes’.

2. You can make duplicates of the object and distort those in Points mode, while bringing the object to life by means of a morph animation.

   This requires you to assemble 200,000 parts of a puzzle without losing your nerve. Morphing needs a great deal of patience!

Since the results in both these cases are relatively unsatisfactory (depending on the object), the common approach is to imitate Mother Nature. In other words, you give your object a skeleton made of bones and use this for your animation.

The skin—i.e. the object surface—stretches and shrinks as the bone structure moves. The Bones method is ideally suited for character animations (in combination with Inverse Kinematics), and also for constructing objects. Once a skeleton has been animated it is completely autonomous, i.e. independent of the geometry of the surrounding object. Where you had human models waltzing one minute, you may have cars dancing the next.

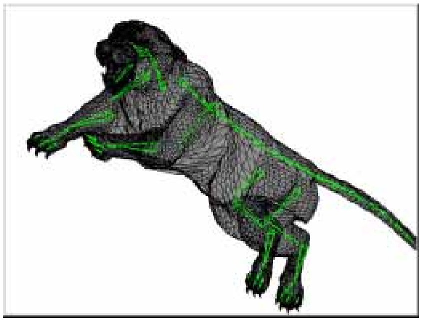
This is how it’s done:

1. Model a 3D object whose shape you wish to change.
2. Fit bones of appropriate size and effective range into all joints.
3. Order the bones hierarchically and assign them with Inverse Kinematic if required.
4. Fix the bones. This automatically activates them.

‘Fixing’ anchors the bones in their current position. If you then change the position, direction or size of a bone, all points lying within the effective range undergo a transformation.

You can now use any of the tools to change or animate the bones, for example, by using Rotate and Inverse Kinematics.

Below is an example of how such a combination of object and bones might look:



When an object is taken from the Object bones group it is undistorted. Similarly, if you disable bones, the objects appear in their original form once again. In other words: CINEMA 4D does not destroy your original objects.

Alternatively, disable the ‘Activation’ symbol in the Object Manager.

Caution:

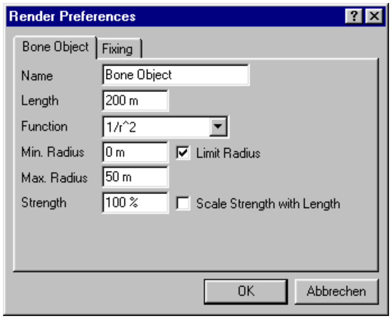
A bone also affects the group itself. If the group has points, they too are distorted. This means that you do not necessarily have to create an object group—you can also project a bone into an object or a group.

When you fix a bone, it is automatically activated.

Tip:

If you turn the bones more than 180°, it comes to a jump. The bone will be calculated then as if the turn comes from the other side.

Bone object page



Name

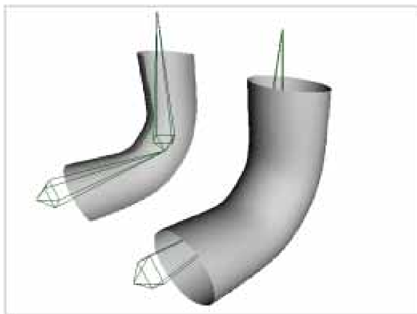
This is where you indicate the name of the Bone object.

Length

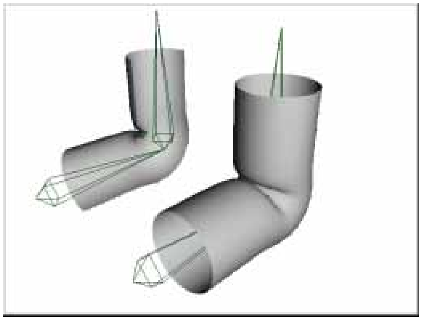
This is for specifying the length of the Bone object.

Function

‘Function’ is the influence that the bones exert on each other. The higher the power of 1/r, the greater the strength that affects the surrounding points. Consider this example:



Decrease function 1/r^2



Decrease function 1/r^10

The above illustrations show that the bend in the joint is much more pronounced if you use a higher power setting for the radius.

Lower values are more suitable for tubular objects, such as animated snakes; anatomical simulations (the knee, the elbow) require higher settings.

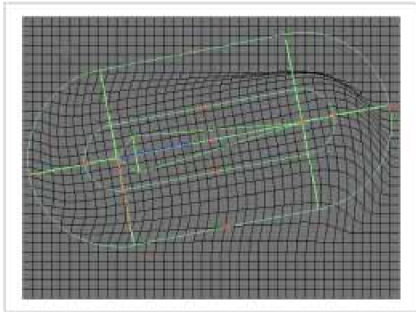
Tip:

You can specify the decrease function only for the uppermost object of a bone chain. All child objects automatically use the same function.

Min. radius, Max. radius

Unless you do something about it, a bone affects all points of an object with greater or lesser strength, depending on the distance between the bone and each point. (This is a consequence of the mathematics involved.) You may find it irritating to have the head move simply because you are moving the big toe! This is why we have built in an option to restrict the effective range of the bones. If you make use of this option, only those points that lie within the outer radius are affected. In addition, you can specify a second, inner radius, to define an area in which the points of the object are to be transformed 1:1 (rotate, move). The result is that these points react as if there was no bone defined, simply a set of points.

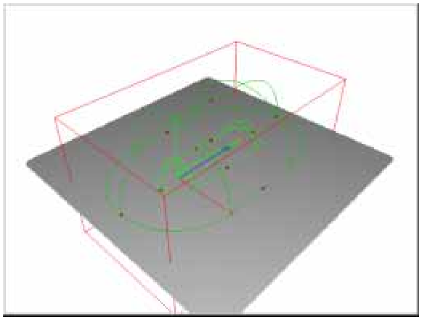
Special treatment is reserved for the intermediate area between the two radii. Here, there is a soft transition of joints. If both radii are equal, the points stop abruptly at the edge.



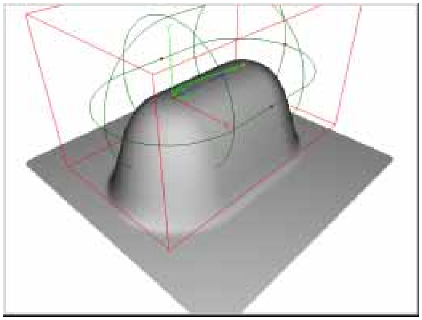
Bone with limited effective range
Min.: 35, Max.: 95

Note how in the above picture, starting with the originally horizontal position of the bones:

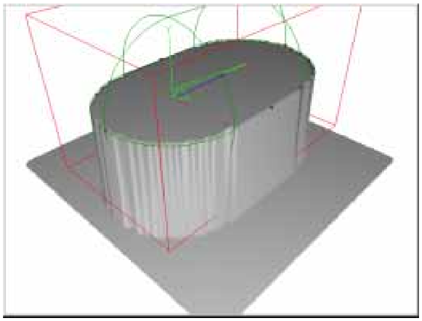
- the area within the minimum radius is rotated, but not distorted,
- the area between the minimum and the maximum radius is rotated and distorted, and
- the area outside the maximum radius remains completely unaffected.



Original object: Plane with Bone



Soft transition of edge (R-min = 0)
All points within R-max undergo a soft transition.



Hard (abrupt) edge (R-min = R-max)
All points within R-max get moved completely.

Tip:

If you are restricting bones by radii you also need to enable these restrictions for any sub-bones.

The rule is: either limit all bones from a certain level, or none.

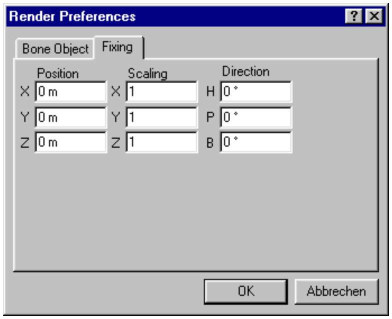
Strength

This specifies the effect that a bone has on a point relative to all other bones.

Scale strength with length

If you animate the size of a bone it can be useful to change the strength proportionately. That is what this option is for.

Fixing page



This page shows the position, size and direction of a bone in space at the time of fixing and lets you change the values.

It is possible to scale bones in an irregular manner, for example by setting irregular bone radii. But watch out: this distorts the sub-system, which may cause unwanted side-effects (see Chapter 5 - the Model tool).

Interactive control of bones:

Once you start using bones you'll be using them a lot. This is why we made it really easy for you to work with them. You can change the individual parameters directly in the editor, without having to re-open the attribute dialog every time. Continue reading if you want to find out more.

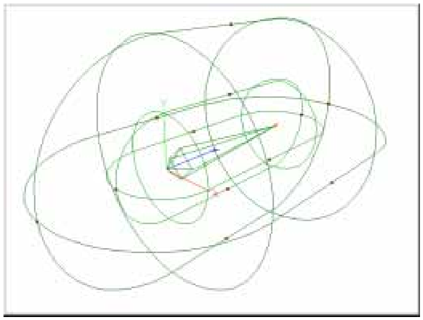
1. Create a new, empty document.

2. Create a bone object.

3. Look at the bone through the Editor camera.

   To get a better picture you may want to change to 4-Tile view and use Zoom.

A more detailed description follows.



Your bone won't quite look like the one in the picture yet—just hang on.

A rhombus shape starts at the origin of the bone, ending in an orange point. The distance between the origin and this point is the 'Length'. Before we start manipulating the various points, we should distinguish between the 'state' of the bone: activated (fixed), or not activated (see Chapter 11).

Bones not activated:

This means we are still in the adjustment phase.

Click on the bone end point. Hold down the mouse button while dragging the mouse. This changes the target point of the bone. The rotation occurs around its origin. At the same time, its length is being resized.

Now hold down the Shift key while moving the bone end point again. This causes only the length to change—no rotation occurs.

Bones activated (fixed):

This means we are in the modelling or animation phase.

Just as before, you can drag the orange handle in order to change the target point. Again, the rotation occurs around the origin, and the length changes.

Now hold down the Shift key and move the bone end point. This lets you scale the bone (i.e. its length and its radii) interactively. There is no rotation.

Creating a new bone in CINEMA 4D is the easiest thing in the world. Hold down the Ctrl key and drag the orange bone target point. Now drag the mouse away from where you clicked. This will create a new bone.

And, best of all, the new bone is automatically a child-bone and part of the hierarchy.

Let's now turn to the most striking characteristics of bones—the envelopes. Open the bone attributes dialog in the Object Manager and enable the 'Limit Radius' option. You will see an envelope straight away—that of the maximum radius.

You can grab the maroon-coloured handles on the lines. By dragging them you can resize the envelope (i.e. the maximum radius). But where is the minimum radius?

Since you have only just switched on the Radius option, the minimum radius is still set to its default setting of zero. You could open up the attributes dialog and change the setting there. But CINEMA 4D has a simpler way. Look closely at the line connecting the bone origin with the target point. You will see an additional handle, sitting in the centre.

You got it! It belongs to the minimum radius. Simply click on it and drag it, and you can see the minimum envelope in green.

If you want to work interactively with bones, we recommend the 4T view. You can set the length in top view, the maximum radius in frontal view and the minimum radius in side view.

You can see that manipulating bones in the Editor is very straightforward.

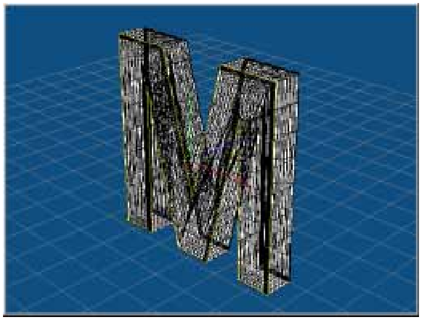
Tip:

The rhombus is visible with all bones. However, the handles and the radius limits are shown only when the bone is active.

Example:

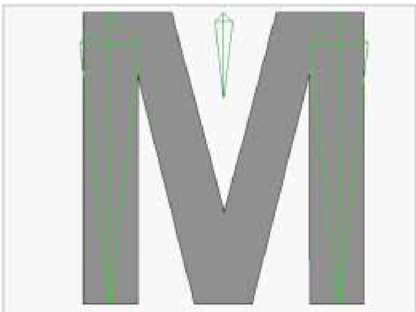
The idea in this mini-tutorial is to prepare a simple object—the letter M—for Inverse Kinematic animation, by using bones.

- Create a three-dimensional ‘M’ by making use of the Text and the Extrude Object tools.
- Subdivide the object to make three parts.



For Inverse Kinematics to work we need three bones.

- Create a bone at the top centre of the M. The length is immaterial.
- Rotate the bone -90 degrees (it wants to be pointing straight down).
- Create two sub-bones in the left and right bottom parts of the letter. Rotate them so they point downwards, too.



- In the Object Manager, drag-and-drop the bones skeleton onto the text so the bones know what they are meant to affect.
- Now let’s go for the Inverse Kinematics preparation. Assign the ‘Anchor’ attribute to the parent bone, and ‘Inverse Kinematics’ to the sub-bones (Object Manager: Function / New Icon).

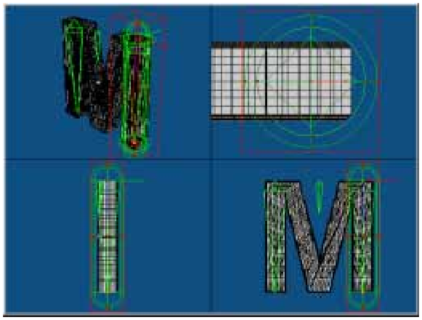
  You have the option of specifying angle limits.

It’s fair to say that, in this simple example, Inverse Kinematics does not make much sense. However, an understanding of this will help you when dealing with complex structures.

- Now open the bone radius limits for the two long bones. (Double-click on the bone type symbol in the Object Manager.) Then switch to 4-Tile view.

  R-min should be as big as the ‘thigh’ of the M. This means that the ‘leg’ can be moved without distortion later.

  R-max should be somewhat bigger than R-min so that you can achieve a soft transition from the leg to the body.

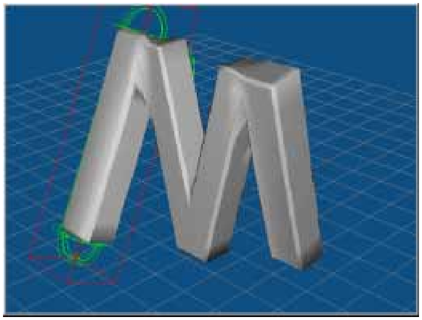


- In the Object Manager’s Function menu, select ‘Fix Bones’ to tell CINEMA 4D the starting position for the animation.

This function creates the activation symbols in the Object Manager. As soon as you now drag the handles of a bone, or change its values, the object will be affected.

The symbols can be removed or replaced by new fixed points.

- Finally, a leg of the M can be moved. Activate a leg bone. Switch to Rotate, limiting the rotation to the X axis—and there we go.



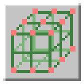
When a bone is rotated or moved, the points that are within the effective range of the bone move with it.

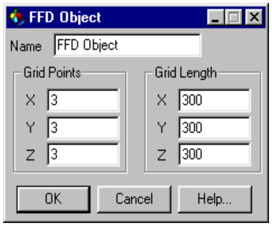
Exercises:

We don’t want to let you escape scot free without doing anything for yourself:

- Vary the parameters of a leg bone and try to predict what will happen. (If you cannot work it out easily for this example, use a plane object instead).
- Subdivide one leg of the M into thigh and lower leg so you end up with two rather than just one bone. Make sure you enable Inverse Kinematics.
- Use Inverse Kinematics.

4.12 FFD object





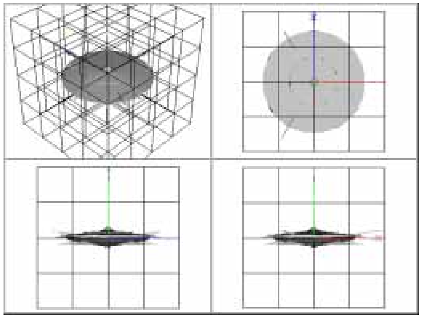
CINEMA 4D provides many ways of editing objects. Probably the most powerful and most flexible of these is FFD (Free Form Deformation).

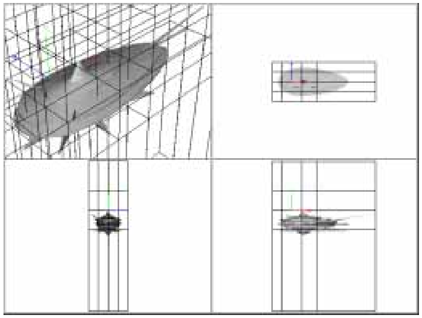
Usually, you can manipulate only one object at a time by using, for example, Distort, Crumple, etc. FFD allows you to change even the most complex of object groups.

An FFD object consists of a three-dimensional grid of a certain size (grid length) and a customisable number of grid points in the X, Y and Z direction. Each of these grid points is a ‘magnet’. If one or more of these points is edited by using the Point tool, the space within the grid also changes.

If an object or an object group (i.e. all the points associated with the object or the group) is spatially within this FFD grid, that object is deformed in real time as the grid is being distorted.

To give you some idea how this might work, look at the following illustrations. The first one shows object and FFD in the undistorted state; in the second one some grid points of the FFD have been moved.





For FFDs to affect objects, two conditions must be fulfilled:

1. The FFD must be on the same hierarchical level as the object to be distorted, or must be its child-object.
2. The FFD must be activated in the Object Manager. (Newly created FFDs are automatically activated.)

As soon as you extract a distorted object from the FFD-object group, it is reset to its original, undistorted state. (The original always remains intact.)

Alternatively, you can delete the activation symbol in the Object Manager.

This is how you do it:

1. Create the objects you want to deform.
2. Create one or more FFD objects.
3. Group objects and FFD objects within the Object Manager, or drag-and-drop the FFD onto the object in the Object Manager.
4. Distort the grid points of the FFD object to your heart's content. To do this, switch to 'Edit Points' mode.

Grouping FFD(s) and object(s) has the big advantage that you can let any number of FFDs affect any number of objects.

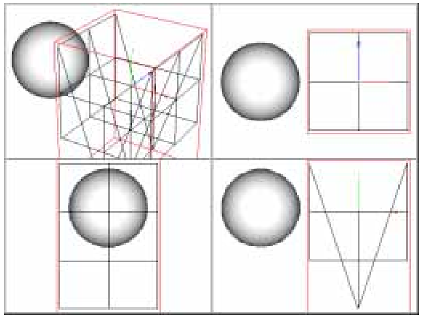
FFDs can be treated like ordinary objects. This means that you can group several FFDs and/or assign Inverse Kinematics to them.

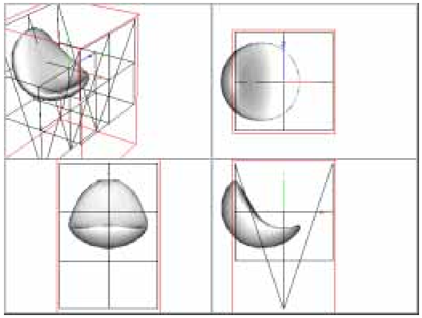
Animation using FFDs:

The true power of FFDs is unleashed when they are used with animation. It does not matter whether the FFD moves through the object, the object through the FFD or whether both are animated. Naturally, you do not have to restrict yourself to movement animations, you can also use rotation, scaling, etc.

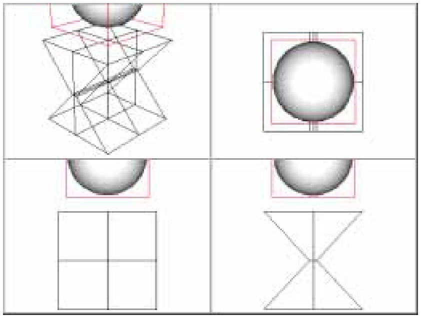
The following illustrations show the differences. Here, too, what you see first is the starting position, and then a time during the animation.

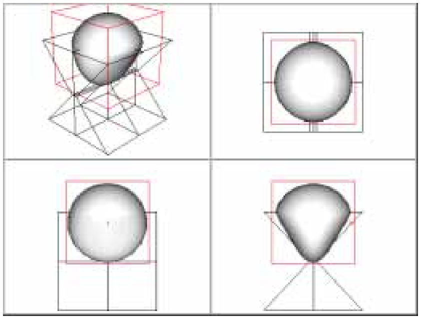
You could use the first animation (where the FFD moves over/through an object) for a car driving over a ball. The FFD would move along with the car wheel.





The second animation (where the object moves through an FFD) could simulate the effects of a black hole, a space ship during a warp or an hourglass.





It is possible to merge one FFD into another. To do this, use the morphing technique (see Chapter 14 - The Time Line). Make sure that all morphing FFDs have an equal number of grid points.

Take some time to look at the dolphin scene that is on your CINEMA 4D CD. This was animated by morphing the starting objects via several complex and time-intensive transitions. Using FFDs you can achieve the same result in a much simpler way. The object itself no longer needs to be manipulated: a moving and morphing FFD will cause the dolphins to move.

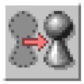
Tools Menu

Contents

5. The Tools Menu

5.1 Action

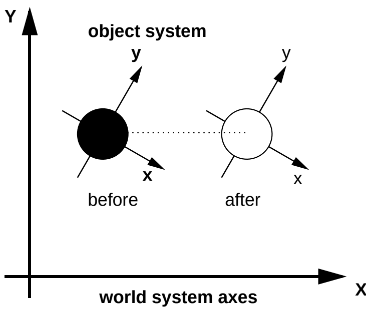
Move



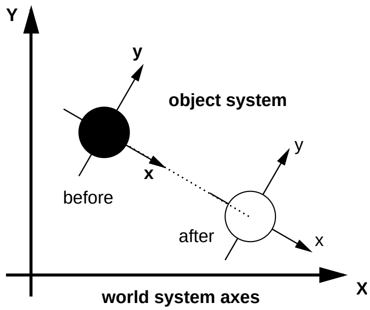
This command will let you place the active object or element anywhere in the work area.

When moving objects, CINEMA 4D distinguishes between the world coordinate system and the local object coordinate system (see Chapter 5.2—Coordinates).

This distinction is particularly noticeable when movement takes place in different axial systems and only the X axis is activated. Say you are moving a cuboid which stands askew in the global coordinate system. 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 choose the cuboid's object coordinate system, it will move along its object X axis.

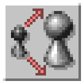


The X, Y and Z symbols allow you to lock certain axes. This can be useful, for example, when you have constructed an object that stands at floor level. If you now move it in one of the perspective views, it automatically changes its Y value and could, in the worst case, end up below the floor. By taking the precaution of locking the Y symbol the object remains standing on the floor and moves only in the other directions.

Left-right movement of the mouse while holding down the mouse button moves the object horizontally on the screen. Up/down movement moves it vertically. Keeping the right mouse button depressed 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. Left-right movement of the mouse moves the texture along its X axis, up-down movement moves the texture along its Y axis.

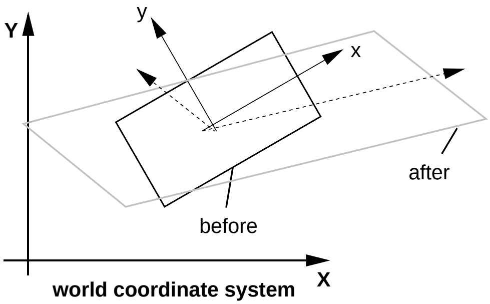
Scale



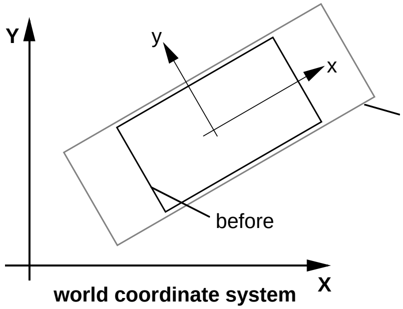
This command will let you resize the active object or element.

When in Scaling mode, 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 you are moving a cuboid which stands askew in the world coordinate system. 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 choose the cuboid's object coordinate system, the cuboid increases its size along its own X axis.



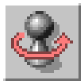
Scaling is performed by left-right movement of the mouse. You can hold down either mouse button.

When editing textures, mouse movements have a somewhat different effect. Left-right movement of the mouse resizes the texture along its X axis, up-down movement rescales it along its Y axis.

There are various ways of rescaling objects, either by rescaling an object, a model or the object axes (see Chapter 5.3 - Options). The first of these should be used with animations 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 constructions 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.

Rotate



This command will let you rotate the active object or element.

When rotating objects, CINEMA 4D distinguishes between the world coordinate system and the local object coordinate system. As long as the object lies parallel to the axes of the world coordinate system you will not notice a difference. But when the object is askew, it will be obvious (see Chapter 5.2 - Coordinates).

Left-right movement of the mouse while holding down the left mouse button will rotate the object around its Y axis. Up-down movement rotates it around its X axis, holding down the right mouse button causes rotation around the object's Z axis.

HPB System

The behaviour of the rotation is totally different, if in Preferences you have switched on the HPB system (see Chapter 1 - File / Preferences / General). Left-right movement will now change the heading, up-down movement changes the pitch and holding down the right mouse button while moving left or right will change the bank. The HPB angles here refer to the object's parent system.

Using the mouse:

You can use the mouse for moving, scaling and rotating. Left-right movement manipulates the X axis, back-and-forth controls the Y axis. For the Z axis you have to use the right mouse button.

Macintosh: *Use the Command key to simulate the right mouse button.*

You can toggle instantly between the left and right mouse buttons. If you are pressing the left button, press the right one before releasing the left, and vice versa.

Using the keyboard:

On the keyboard, use the directional (arrow) keys for moving, scaling and rotating.

+x	Right arrow
-x	Left arrow
+y	Up arrow
-y	Down arrow
+z	Shift + Right or Up arrow
-z	Shift + Left or Down arrow

If you are working with the Edit Camera tool selected (see below), it is the camera that is affected. In all other cases the object currently selected is moved, scaled or rotated.

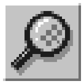
Tip:

Even if you rotate with the world coordinate system, the actual rotation is around the origin of the object or axis.

Tip:

Use the rotation grid for greater precision. This will allow you to rotate the object in steps of, say, 10˚.

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.

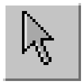
Alternatively, click once using the left mouse button. This will magnify the work area by 25%. If you wish to reduce it, hold down the Ctrl key while clicking.

Using the keyboard:

These are the keyboard shortcuts for the Zoom function:

+	Zoom In (magnify)
-	Zoom Out (reduce)

Selection



Use this tool to change to a different object. Simply click on a line of the object or spline in the Editor window.

When working with the point, edge or area tool you can use this function to draw a bounding box around the active object. This will activate all elements within that box.

To extend your selection, hold down the Shift key while clicking on additional elements or dragging the box.

To shrink your selection, hold down the Shift key while clicking a second time on already selected elements.

5.2 Coordinates

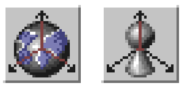
X Axis / Heading
Y Axis / Pitch
Z Axis / Bank

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 Preferences you have selected the HPB system, the HPB designators are valid. (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
Object System



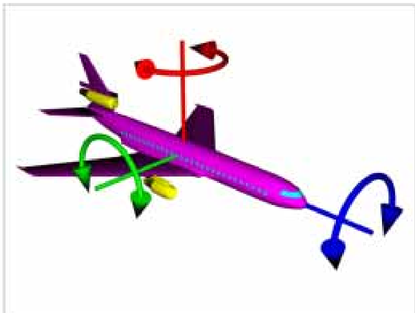
Here you can decide in which coordinate system an operation will take place.

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 in Preferences you have selected the HPB system, the rotation will be made in HPB angles, independently of the selected axis system. Internally CINEMA 4D uses the HPB system only.

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 dissociated. 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 File / Preferences / General.

Note, however, that even if HPB is deactivated, all numeric input in dialog boxes and in the Coordinate Manager is in HPB.

And finally:

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 modeller and animator (which interact only in the clumsiest 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 modellers 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!

5.3 Options

Camera

When you select this command you can edit the camera in the active Editor window. All subsequent actions affect this view. With two-dimensional views (XY, ZY, XZ) you can move and magnify the displayed area; with three-dimensional views (3D and 4T) you can change the Editor camera or the Object camera.

Using the mouse, you can move in the following ways:

Using 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: *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 axes 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.

Using Scale...

...the visible section of the scene can be resized. You do this by left/right moving the mouse 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 at program start is set to 1.0) is changed. In the perspective views it is the camera’s focal length that changes. Its default value at program start 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.)

Using Rotate...

... makes sense only if you are working with a perspective view. Two-dimensional views cannot be rotated.

When rotating the perspective view, certain mouse movements are allocated 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.

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.

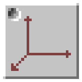
The current position of the active object in space is shown in the Coordinate Manager. That is where you can change any of the values individually.

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 being scaled. If you want to know what this means or why this is the case, read the section at the end of the Model option.

Tip:

Use the Objects tool for animations.

Object axes



Object axes play an important role in certain program features such as splines or hierarchical animations. It is necessary for object axes to be placed freely within the object, without affecting the points of the object. The Object axes tool can change only the axes of the active object.

The current position of the axes of the active object is shown in the Coordinate Manager, where you can change all values individually.

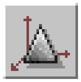
When rotating or moving the axes of a hierarchical object, all axes of the sub-objects must be adjusted. If these sub-objects have animation tracks, errors will occur in the animation, since the axes of the parent system will have changed. This is why, before creating the animation, it is so important 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. Object scaling also changes points and textures, but does not resize the axes.

Tip:

Use the Object axes tool for animation and Inverse Kinematics (moving the pivot or centre of rotation).

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 Coordinate 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 Edit Model, this operation cannot be undone.

Tip:

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.

Tip:

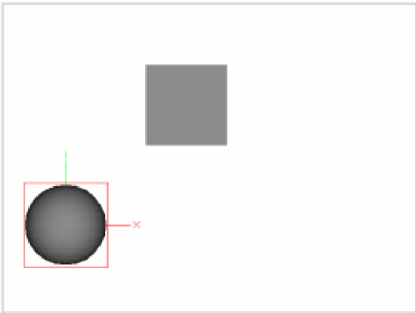
Use the Model tool during the construction process.

The difference between the Object tool and the Model tool:

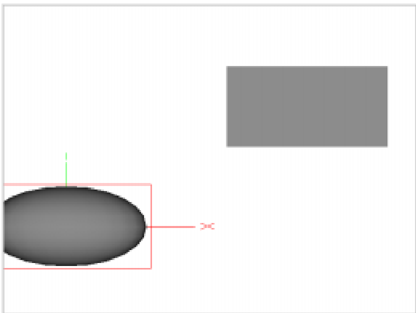
We strongly recommend you read this section else you may be in for some unpleasant surprises when you create animations.

Let’s start by putting the problem before you with the help of an example, then we’ll tell how you avoid the problem altogether and how you can correct it if does crop up.

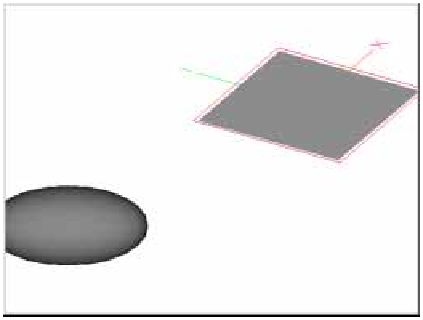
Our scene has two objects, a sphere and a cube. The cube is a child (sub-object) of the sphere. The axial length of both objects is 1/1/1.



We now activate the Object tool and scale the sphere along the X axis to 2/1/1. As you might expect, sphere and cube are now distorted.



We now rotate the cube around its Z axis. During the rotation you will observe an increasing and decreasing distortion.



The points of the cube no longer cycle through a circular trajectory while they rotate on the XY plane. Instead, the distorted parent system causes this to be elliptic.

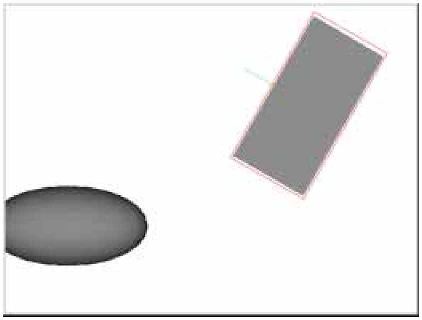
And that is where the problem lies. It invariably occurs when objects exist in a distorted parent system.

Adverse 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 modelling and animation. In this way, the user is not confronted with this problem, but instead has 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, select Objects / Structure / Reset Axes and select the options Axes Normals and Offsets.

In each case you get the expected result for the rotated cube:



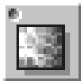
Tip:

If all this is a bit much to grasp, simply remember these rules:

Use the Model tool when constructing objects.

Use the Object tool when animating.

Texture



This allows you to edit the active texture. As soon as you select this tool, the object's texture gets drawn in white, with the mode of projection being taken into account (see Chapter 6: Texture).

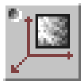
The texture is represented as a number of grid lines (dashes). Their axes are labelled in colour (X and Y). Since the texture is in two dimensions only (the image has no depth information), there is no Z axis.

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 Axes below).

The Move function lets you place the texture onto the envelope. 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.

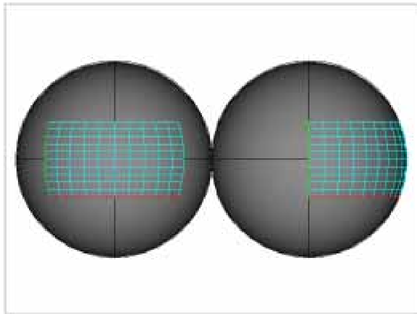
The data for X and Y referring to positioning and dimensions of the texture in the Coordinate Manager are always given as percentages, since the actual size is not relevant. A size of 100% for both coordinates means that the texture covers the cylinder, the sphere or the area completely.

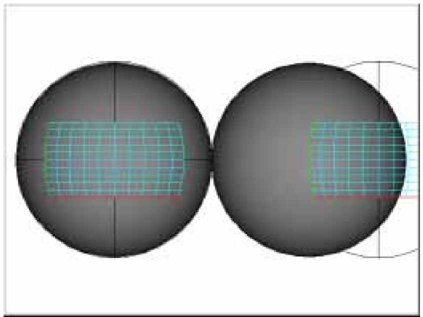
Texture Axes



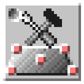
This tool allows you to edit the texture axes of the active texture. As soon as you select this tool, the texture with its envelope is displayed. You can move, scale and rotate the envelope in the usual fashion.

The difference between Edit Texture and Edit Texture Axes is illustrated by the following figures. In both cases, the movement is along the X axis, in the upper figure by using the Edit Texture tool (texture is moved on its envelope), in the lower by using Edit Texture Axes (the envelope itself is moved).





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 also now refers to the points rather than to the object.

As soon as the tool is selected, all points of the object are represented by small squares. Selected points are highlighted in colour.

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 point by means of a bounding box, choose the Selection tool or Select Area command. To deselect points, select them again by Shift-clicking.

To select all points, choose Edit / Select All. The reverse command is Deselect All.

You can achieve similar effects via the Edit menu of the Structure Manager. This provides you with the added feature of inverting a selection (deselecting all currently selected points and selecting all currently deselected ones).

To set new points, use Ctrl-click.

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.

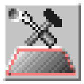
To delete the active point, use the Delete command from the Edit menu or use either the Del key or the Backspace key.

While editing a Hermite spline, when 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.

To summarise:

- Points can be placed dynamically.
- Holding down Shift lets you extend the selection or reduce it.
- The Selection tool allows you to drag a bounding box.
- 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.

Edges



Editing edges is almost the same as editing points. Activate an edge by clicking both its end points, one after the other. If the two points you click are not associated with an edge, nothing happens; otherwise the edge will become active. By holding down the Shift key you can include several edges in the selection. Alternatively, the Selection tool lets you drag a bounding box.

If you are (inadvertently) trying to activate an edge that happens to be already selected, Shift-clicking will deselect it. However, this action does not affect any of the other edges.

To set new edges, hold down the Ctrl key and click on two existing points, one after the other. This will connect the two with a line.

To delete active edges, use either the Delete command from the Edit menu, or the Del key or the Backspace key.

Triangles

Editing triangles is not that different from editing edges (see above). You activate a triangle by clicking all three corners.

To select several triangles at once, Shift-click. Alternatively, use the Selection tool to drag a bounding box around them.

If you are (inadvertently) trying to activate a triangle that happens to be already selected, Shift-clicking will deselect it. However, this action does not affect any of the other triangles.

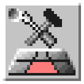
To set new triangles, hold down the Ctrl key and click on three existing points, one after the other. This will automatically create the necessary edges.

To delete active triangles, use either the Delete command from the Edit menu, or the Del key or the Backspace key.

Tip:

If you place several triangles side by side, double edges will automatically be removed. Subsequent optimising is not necessary.

Quadrangles



Editing quadrangles is similar to editing triangles (see above). You activate a quadrangle by clicking on three of the four corners. CINEMA 4D will automatically select the fourth point.

To select several quadrangles at the same time, Shift-click. Alternatively, use the Selection tool to drag a bounding box around them.

If you are (inadvertently) trying to activate a quadrangle that happens to be already selected, Shift-clicking will deselect it. However, this action does not affect any of the other quads.

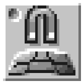
To set new quadrangles, hold down the Ctrl key and click on four existing points, one after another. This will automatically create the necessary edges.

To delete active quadrangles, use either the Delete command from the Edit menu, or the Del key or the Backspace key.

Tip:

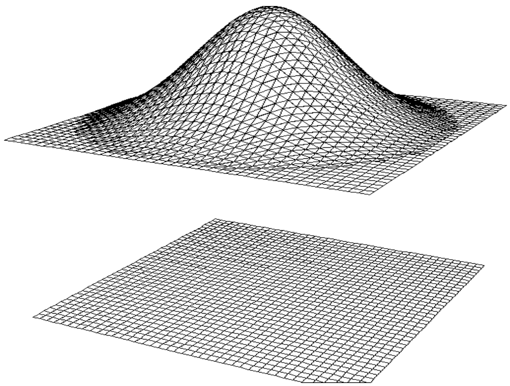
If you place several quadrangles side by side, double edges will automatically be removed. Subsequent optimising is not necessary.

Magnet



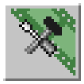
The Magnet is a very useful feature for creating free-form shapes. It even allows you to ‘pull’ individual points away from an object.

Use the Magnet tool by clicking anywhere on the active object and then dragging. All surrounding points follow the mouse pointer at a distance that depends on how close to the mouse pointer they are.



You can set this ‘dependency’ distance in the Magnet settings—use the Magnet command in the Options menu, which is described later in this chapter.

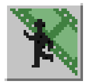
Animation



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.

If no keys are activated you can move, rotate and/or scale the animation path as a whole.

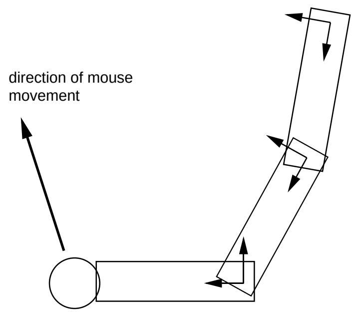
Inverse Kinematics



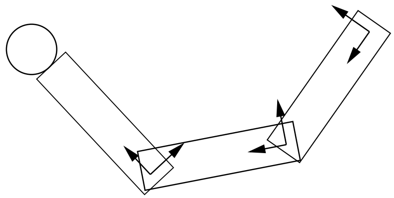
This tool makes it easy to place figures and their joints (for character animations). For example, you can grab a hand at the end of an arm and drag it to the required position and the arm attached to the hand will automatically follow to the point where the hand is then placed.

Inverse Kinematics is not only used for animation, it is also suitable for normal object construction, provided the objects are hierarchically organised and have been assigned the 'inverse kinematics' property (see The Object Manager).

When the mouse is moved, CINEMA 4D automatically computes the distance between the joints and keeps this constant.



This makes it impossible for the components of an arm to separate when any part of the arm is being dragged.



The best object for trying out this tool is the Figure (a Special Object in the Objects menu). It has an inbuilt hierarchical structure so you can experiment with Inverse Kinematics straight away.

Inverse Kinematics allows you to specify angle restrictions, preventing joints from rotating beyond certain values (see Chapter 10: Object Manager / Function / New Icon / Inverse Kinematics.)

In addition, you can define objects as anchors. These then do not move when Inverse Kinematics is applied (see Chapter 10: Object Manager / Function / New Icon / Inverse Kinematics.)

Inverse Kinematics always refers to the active object. The dragpoint is the origin of the object or, if the object has child objects, the origin of the first child object.

Using Inverse Kinematics for animation:

If you want to animate an object group or a hierarchically structured Bone skeleton by using Inverse Kinematics you need to bear in mind the following:

Inverse Kinematics refers only to the method of handling object hierarchies. In the first instance it has nothing to do with Inverse Kinematics animation (see Chapter 13: Time Line).

Proceed as follows:

1. Open the Time Manager, activate Position, Angle and Child objects and make a recording of the whole figure at time 0.

   This gives you a defined starting point which you can restore at any time.

2. Move the time slider to a new position in time.
3. Activate the last link in the hierarchical IK chain (for example the left hand, the right foot ...)
4. Activate the Inverse Kinematics tool and move the hand. Inverse Kinematics now comes into action.
5. Activate the top object in this chain, the one with the anchor icon (for example the shoulder, the upper part of the body ...).
6. Make a new recording of the position and angle for all child objects.
7. Repeat steps 2 to 6 until you reach the end of your animation.
8. Jump back to the start of the animation, choose a new IK chain (for example the right hand) and resume again with step 2.

Virtual Walkthrough

This feature allows you to interactively walk through the scene that you have created. It simulates the view from the cockpit of an aeroplane. You can use the mouse or the arrow keys on the keyboard as your joystick. The Virtual Walkthrough is particularly useful, for example, if you are an interior designer wishing to take your client through a house in real time. If you wish, you can simply immerse yourself in a virtual world of flight, by using autopilot.

How to navigate through the scene:

Mouse
Left/right pan and up/down tilt

Shift-click
Move left/right and up/down

Left mouse button
Accelerate

Right mouse button
Decelerate

Arrow keys
Left/right pan and up/down tilt

Shift-arrow keys
Move left/right and up/down

Plus key
Accelerate

Minus key
Decelerate

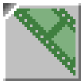
Spacebar
Stop

Any of these functions can be cancelled by pressing the Esc key.

Depending on the size of the scene it is possible for the screen redraw to block the Esc key for short periods of time. If this happens, keep the Esc key held down a little longer.

Macintosh: *You may use the Esc key or the normal Command + fullstop combination.*

5.4 Animation

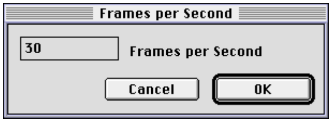


Selecting this icon from the Options toolbar opens a menu containing the following commands:

Record

Depending on the options selected in the Time Manager, this command creates keys for the current time.

Frames per second



Specify the frame rate to be used for the scene. This value affects the display in the Time Line and the Time Control.

Tip:

You may select different frame rates (independently of this one) when playing the animation via the Time Manager and when rendering.

Go to Time

This command changes the current Time. Alternatively, you can use the time slider in the Time Manager.

Position Track to Spline

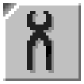
If applicable, this converts the position track of the active object into a spline.

Spline to Position Track

This will allocate a spline as a position track to the active object. Selecting the command will open a dialog into which you can enter the name of the spline that you want to be converted.

These two animation tools are ideally suited to fine-tuning a roughly recorded position track using the various spline editing tools (in CINEMA 4D's Structure Manager for example) and then converting it back into a position track.

5.5 Structure



Selecting this icon from the View toolbar opens a menu containing the following commands:

Animation Object

Sometimes, while animating an object, you may suddenly discover an object in an interesting intermediate state from which you might like to create a new object.

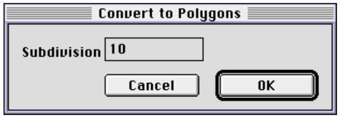
The Animation Object command will make a duplicate of an object as it is, there and then, at that moment in time. The difference between this and the standard Copy command is that the Copy command duplicates the entire animated object (animation track and all attributes included) whereas the Animated Object command duplicates only the object as it stands in its current state.

You might want to cut and paste this object into another CINEMA document and save it for future use. Alternatively you might want to use the Animation Object command on an animated object several times at different stages in an animation and use the resulting objects as the raw materials for a Morph object.

Tip:

This command does not work with object groups—each child (sub-object) must be converted separately.

Convert to Polygons



If you have created a NURBS (see Chapter 4) the only interactive manipulation you can carry out is with the splines defining the object. Modification of concrete grid points by using other tools (for example Magnet or Crumple) is not possible.

If you wish to apply these tools to an object you must first convert the object into polygons using this command.

‘Subdivisions’ allows you to specify the resolution of the polygons. If you choose 0, the program does an automatic subdivision for you, which for most applications is perfectly adequate.

Tip:

You can also convert intermediate phases of an animation (Melt and Explosion for example) into a polygon object if you wish to process them further.

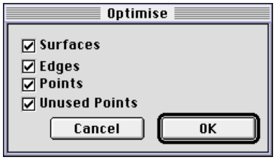
Align Normals

This command will let you align the normal vectors of an object uniformly. With any base objects created by CINEMA 4D the normal vectors are aligned by default. The command is particularly useful when you have created triangles by hand, which are not aligned and do not have a uniform position and you want to use the smoothing function on the surface (see Chapter 10: The Object Manager).

Tip:

You can verify the alignment of the normal vectors by using Display / Options (see Chapter 3).

Optimise



When you have combined an object from a number of triangles and quadrangles, for example by using the Connect command, you will usually have a few duplicates (triplicates, etc.) of points, edges and surfaces. This command will eliminate the duplicates. The appearance of the object will not usually be affected.

You need to watch out only for objects where certain edges have been duplicated on purpose. (Perhaps you have done this to produce ‘hard’ edges when using the smoothing option.)

‘Surfaces’ allows you to specify whether one-dimensional surfaces, i.e. surfaces that have one or more corners in common, should be eliminated.

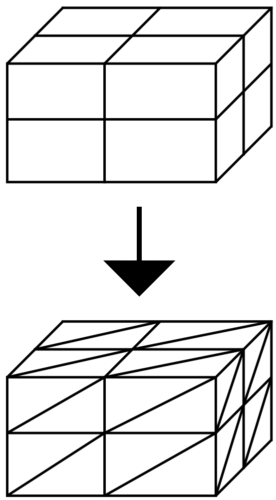
‘Edges’ allows you to specify whether multiple and unused edges should be eliminated.

‘Points’ allows you to specify whether duplicate points should be eliminated.

‘Unused points’ allows you to specify whether to eliminate points that are not used.

Triangulate

This command converts all the quadrangles of an object into triangles.



Make use of quadrangles as much as possible becausethe render more quickly, the takes up less memory and the give better results with Phong Shading. Furthermore, they are visually easier to work with.

Connect

In addition to combining several objects into an object group, CINEMA 4D also gives you the option of merging several objects to a single new object. You might, for example, have created a jug and a handle that you want to combine into one object that contains the surfaces, edges and points of both objects.

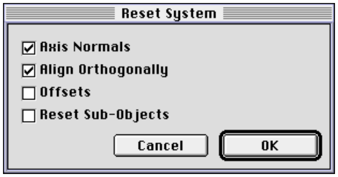
The command is available only if you have activated an object group. CINEMA 4D then combines all points, surfaces and edges to form a new object, which 'owns' the name and the parameters of the original objects.

Use this function only if you are completely certain that the objects really belong together. Once they are connected they can be separated only by hand and only then with great difficulty. Moreover, all parameters of the child objects, such as the animation sequences, will be lost in this process.

Tip:

CINEMA 4D can only connect polygons. Other objects (for example, light sources as child objects) are ignored. As with other commands, CINEMA 4D does not modify the originals, but works with a duplicate.

Reset System



This command will let you restore objects that have been distorted. Please also note the comments regarding the difference between the Object and the Model tools earlier in this chapter.

'Axes Normals' resets the lengths of the object axes to 1/1/1.

'Align Orthogonally' creates perpendicular object axes for distorted systems.

'Offsets' ensures the action restores only the axes, while leaving the points in their distorted state.

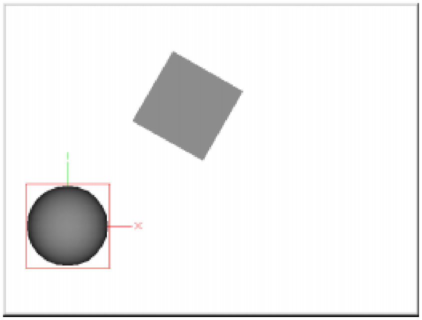
'Reset Sub Objects' also resets the axes of all sub-objects (child objects).

If the above seems a bit dry to you, here is an example to illustrate the point.

- Create a sphere around a cube.
- Make the cube a child object of the sphere (drag-and-drop in the Object Manager).
- Select the Object tool and scale the sphere along the X axis to 2 units.
- Select the cube and rotate it around its Z axis. It is now distorted.

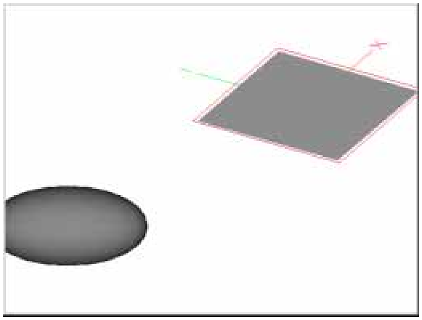
And now let's see what we can actually do with this function.

Begin by selecting only the Axes Normals command. Sphere and cube are no longer distorted.

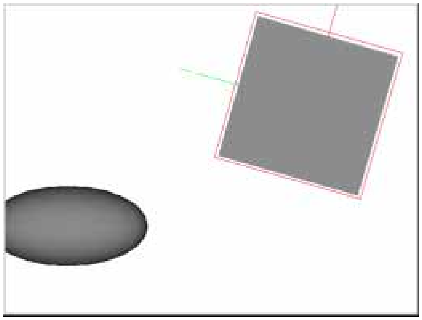


Undo the last step.

Decouple the cube from the hierarchy (drag-and-drop in the Object Manager). Its axes remain distorted. The X and Y axes no longer form a right angle.

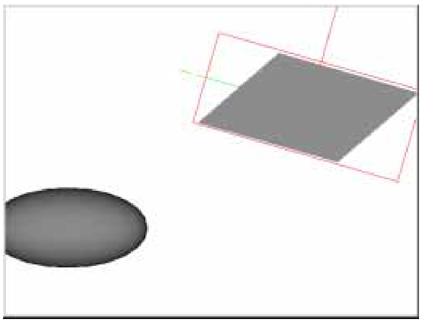


Now select only the Align Orthogonally command. The cube gets straightened out. But it does not yet have its original size, since Axes Normals was not selected this time round.



Undo the last step.

Select the cube once again and now select both the Align Orthogonally and the Offset commands. This time only the axes are being corrected; the points remain as they were because they are being ‘offset’ or ‘compensated’.



5.6 Plug-ins

CINEMA 4D comes with its own very powerful programming language which allows you to program new functions. These are plugged in to the existing CINEMA 4D menus when you launch the application. You will find Import and Export filters in the File menu and animation function in the Time Line’s Function menu. All other plug-ins go here. In order for them to be recognised by CINEMA 4D they need to be in the Plug-in directory in the CINEMA 4D startup folder.

Exceptions are the channel and volume shaders which are located in the Tex directory or are saved together with the scenes, since they cannot be plugged into the menus but are loaded into the Material Editor in place of texture images.

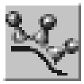
Reload Plug-ins

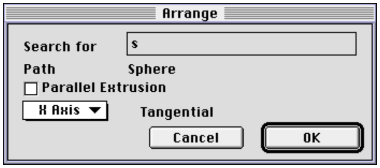
For those times when you have copied new plug-ins into the Plug-In folder and do not wish to quit and restart CINEMA 4D, this command instructs CINEMA 4D to reload the complete plug-in folder and to integrate any auxiliary programs into the menus.

Additional menu entries

These are the Options plug-ins. Those that are part of the standard package as delivered by MAXON are described in the Appendix.

5.7 Arrange





This command will let you arrange an object group along a spatial path. Any child objects are changed at the same time.

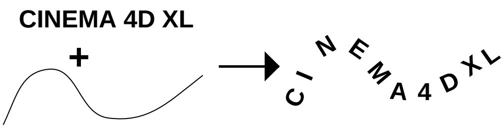
This is determined first by the sequence of the objects within the group. CINEMA 4D runs through the objects from top to bottom. When 'arranging' them, the first object goes to the beginning of the path, the last one to the end.

If you take the object group 'CINEMA 4D XL' as an example, this consists of a number of separate, three-dimensional characters, created by the Text command.

Say you have also created a polygon which looks like a flattened 'S'.

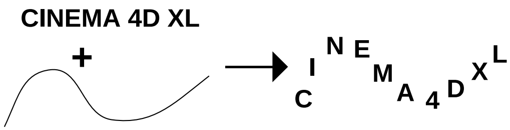
If you now select the Arrange command CINEMA 4D puts the first character ('C') at the beginning of the polygon, the letter 'A' in the middle and the last letter ('L') at the end.

The result is a logo which follows the curvature of the polygon.



Under 'Path' specify a spline along which the objects can be arranged. In addition you can specify which of the three object axes you want to be the tangent in relation to the path.

Usually, the Arrange command rotates objects in such a way that they follow the path. If you want to prevent this, activate Parallel Extrusion. This will ensure that the objects are not rotated.

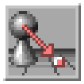


5.8 Align to Object

This command rotates the active object in such a way that its Z axis runs in the direction of the specified object.

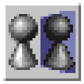
This command is particularly useful for aligning light sources or the camera to particular parts of a scene or to the entire scene.

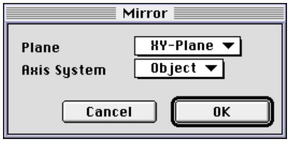
5.9 Align to Point



This command rotates the active object in such a way that its Z axis runs in the direction of the specified point.

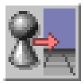
5.10 Mirror

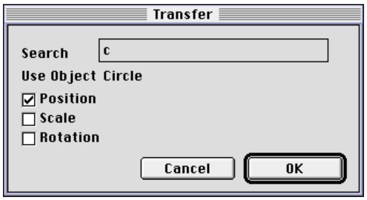




This command will let you mirror the points of an object against a ‘plane’, where the mirror plane always runs through the origin of the object coordinate system. ‘Axis system’ will allow you to specify whether the mirror plane is parallel to the world coordinate system or the object coordinate system.

5.11 Transfer

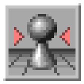


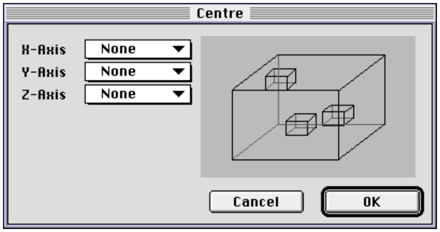


Sometimes it is useful for an object to adopt the same position or size as another. This command will let you copy these properties from another object. After selecting the command you can specify whether you wish to copy the position, size and/or direction.

Note that this refers to the actual size of the object.

5.12 Centre



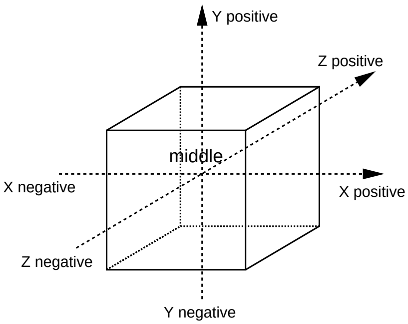


This command is very similar to the command in many wordprocessors where you have a choice of formatting text blocks with left or right justification, or centred between the margins.

The way the Centre command in CINEMA 4D works is very similar, only here you can centre objects in three-dimensional space.

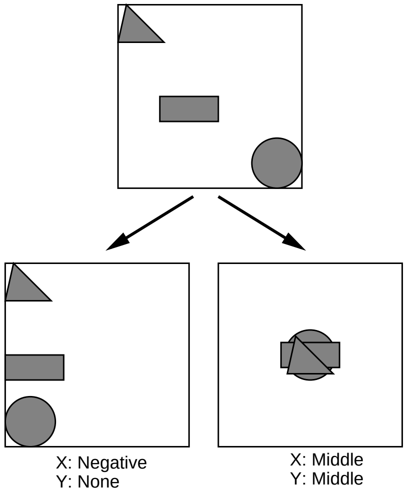
The function is available only when an object group has been selected. All child objects are affected.

As a first step, CINEMA 4D calculates the size of the object group in the object coordinate system of the active object. Think of these dimensions as a three-dimensional cuboid in space, which provides the reference points.

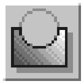


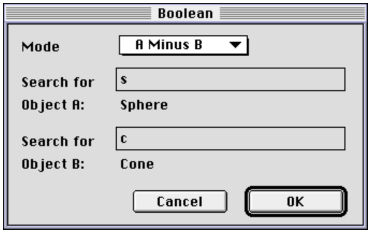
For each axis of the cuboid you can specify whether the sub-objects and the active object are to be centred along this axis (independently of the other axes) either at the positive or the negative end, or in the centre of the cuboid.

You can also choose not to centre.

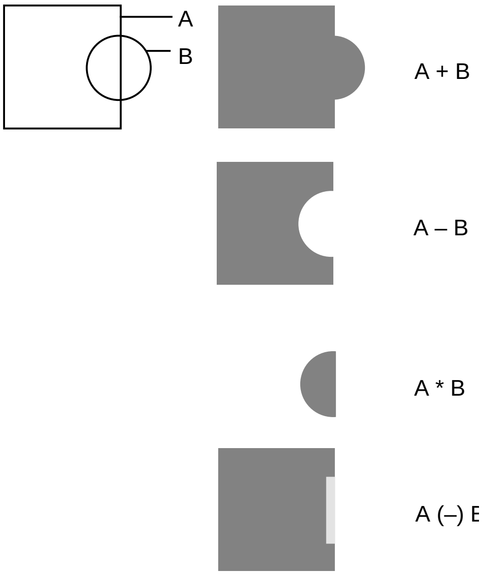


5.13 Boolean





CINEMA 4D provides you with a very powerful tool for creating complex objects: Boolean operators. These allow you to change your objects in all sorts of ways: cutting out holes, trimming corners, gluing bits on...



When using Boolean operations we recommend you use subdivided objects as they yield better results when finished off with the Smooth function.

Objects that you create using Boolean operations can occasionally end up with hard edges, even if you have used smoothing (Phong Shading). This is not a problem inherent in the Boolean operators, but a much more general one. When cutting several objects that are only slightly subdivided, this results in very long, thin triangles, which then prevent proper smoothing.

The solution is to subdivide the objects. This makes the newly created triangles much smaller and more regular, which has a favourable effect on the rendering process.

You *can* use Boolean operations on perfect spheres, even though in theory this should be impossible. To achive this, the perfect sphere is first converted into a surface sphere. Specify the degree of subdivision under ‘Segmentation’ on the Filters page of the Preferences.

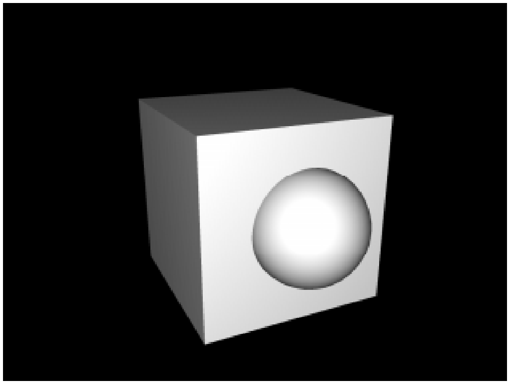
Tip:

It is also possible to use NURBS or real spheres with Boolean operations. The conversion to surface objects occurs automatically. If this is not fine enough, convert the Boolean object manually (see above).

There are four Boolean operations:

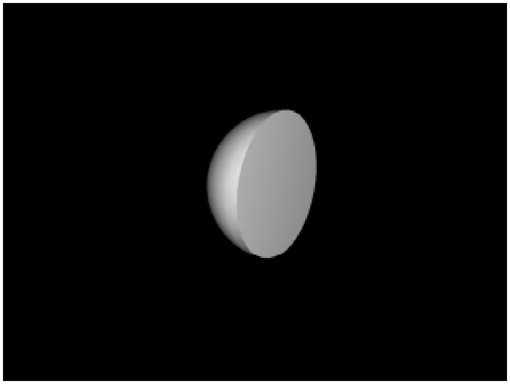
A Plus B

This command combines object (A) with object (B).



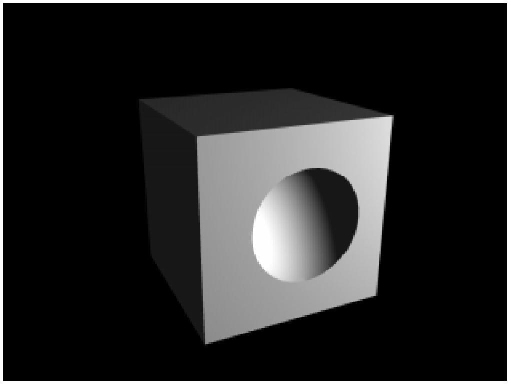
A Cut B

This creates the intersection of (A) and (B).



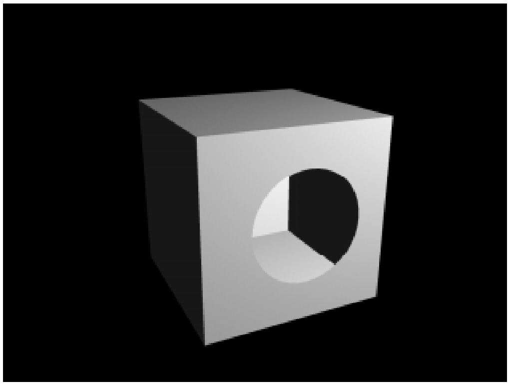
A Minus B

This command subtracts object (B) from object (A).



A Without B

This function is similar to A Minus B, but is not strictly speaking a Boolean operation. While it does cut holes into the active object, it does not shape these holes.

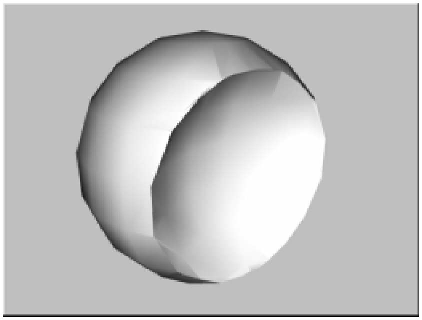


Tip:

When using boolean operations (which involve many mathematical computations) unfavourable triangle distributions may happen, resulting in shading artefacts.

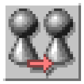
Example:

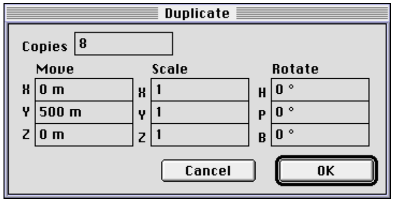
Generate two surface spheres, each with only a few subdivisione (e.g. 18). Subtract one from the other. At the edges you will see definite artefacts.



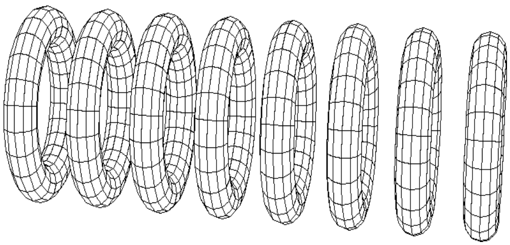
To prevent this happening, use more subdivisions on each sphere.

5.14 Duplicate





This command lets you create any number of copies.

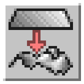


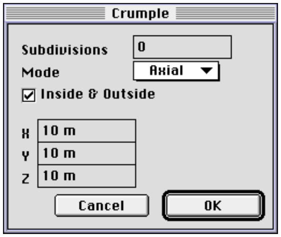
‘Copies’ specifies the number of copies you wish to create.

‘Move’ specifies the direction in which the duplicates are to be shifted.

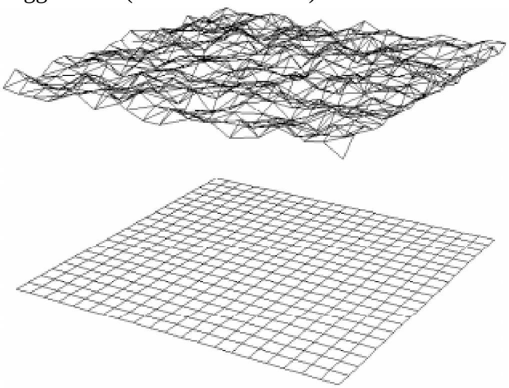
In addition to moving them, you also have the option of resizing (scaling) and/or rotating the duplicates. Imagine how easy it is to create a spiral staircase from a single cube!

5.15 Crumple





When attempting to simulate realworld objects you may want to do away with the usual clinical, mathematical appearance and use a somewhat more rugged look (see the illustration).



A handkerchief for example ought to be slightly crumpled. The Crumple function achieves this by shifting each point of an object by a random value.

The 'Mode' section of the Crumple dialog allows you to specify whether this randomised shift is to occur uniformly in all three dimensions (axial) or centrically (radial), starting from the object's origin.

You can enter movement values for the X, Y and Z component. These will specify the maximum degree and direction of the movement. A value of (0,10,0) specifies a random movement of no more than 10 units, only in the direction Y.

When the Crumple function is set to 'radial', the Y and Z components are locked. The X component then specifies the radial shift.

Crumpling of an object can be accompanied by a process of 'subdivision'. In theory, this is identical with to the Subdivide command (see below), although here you have the option of creating fractal structures.

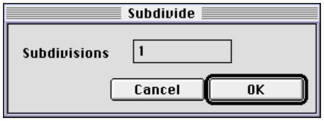
The basic principle of fractal mountains or clouds is an attempt to achieve a fine division of a relatively rough structure, shifting the subdivisions randomly by a certain value. The subdividing process is then repeated with the shift being only half the earlier one. You can repeat this as often as you like (if you have enough memory, that is) until from a simple quadrangle you have created a complex fractal mountain with many valleys and peaks.

With each subdivision the points are shifted by a random amount, which is half the previous amount. The starting value is specified under 'Move'.

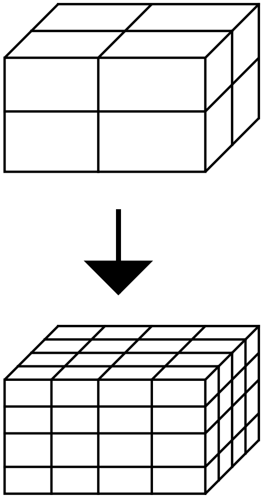
If you specify 0 for subdivisions the object is only crumpled.

If you deselect 'Outside and Inside' you can ensure that the shift occurs only in a positive direction, up to the maximum value. This allows you to crumple a sphere radially only on the outside, so that it has no indentations.

5.16 Subdivide



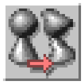
This command subdivides the triangles and quadrangles of the active object into smaller triangles and rectangles.

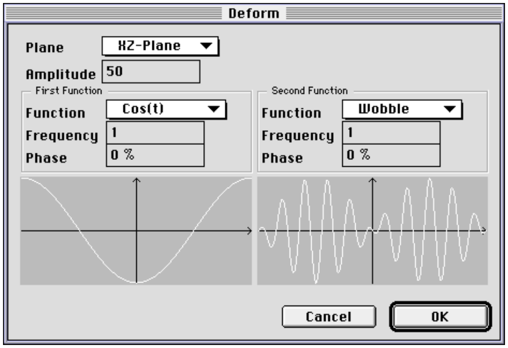


The ‘subdivisions’ value is the number of subdivisions. A single subdivision converts each triangle into four smaller triangles and each rectangle into four smaller rectangles.

This command is used mainly with objects that need to be manipulated with commands such as Crumple, Wrap and Deform.

5.17 Deform





This command lets you deform the surface of an object by using mathematical functions. You can for example deform a plane to create a wavy water surface by using a cosine function. There are many different functions available.

Before you can deform an object you first need to specify on which plane the deformation is to take place. If, for example, you have created an object on the XZ plane it makes sense to use that same plane also for the deformation.

Since a plane always has two dimensions in space you can stipulate two functions, which will deform the points of the object in a perpendicular direction.

CINEMA 4D begins by determining the size of the active object in the object coordinate system. It then calculates the position of each point, relative to the size dimensions. A point in the centre of the plane would have the coordinates (t1 = 50%, t2 = 50%)

Next, the functional values for t1 and t2 are calculated and then multiplied with each other and the amplitude. The result gives the movement perpendicular to the specified plane.

'Type' is the method of deformation.

XY-Plane, XY-radial
Shift perpendicular to the local XY plane

ZY-Plane, ZY-radial
Shift perpendicular to the local ZY plane

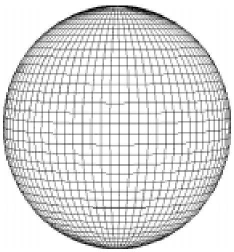
XZ-Plane, XZ-radial
Shift perpendicular to the local XZ plane

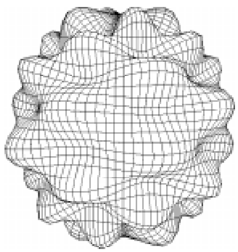
Sphere
Radial shift

Cylinder
XZ-radial shift

With plane deformations the points are always shifted perpendicular to the plane, while in other cases the movement is radial, starting from the object's origin. The first function always works parallel to the equator, the second in the longitudinal direction of the sphere's surface or the longitudinal axis of the cylinder respectively.

The option 'Sphere' is recommended when you are working with a spherical object. In our example below, a sphere has been covered with waves.





Radial plane deformations (XY-radial, ZY-radial and XZ-radial) are different from non-radial deformations in the sense that here the deformations are not evaluated in two dimensions. Instead, the second function takes the distance of a point from the object's centre and the first the angle relative to the object's centre.

This means for example that you can do a XZ-radial deformation on a plane by setting the first function to '1' and the second to 'cos'. This will result in a water surface that is rotationally symmetrical.

'Amplitude' specifies the extent to which the points are shifted. Do not choose values that are too high as this will cause the object to lose its original shape.

'Function' lets you select from a number of mathematical functions, whose curve is shown in the display window. If you do not want one of the dimensions of the plane to undergo a deformation, choose '1'.

If you use a function such as cosine you can specify the number of oscillations by entering the 'frequency'. Normally there is one such oscillation, but if you enter, say, the value 4, it will swing four times up and down.

By default, all functions start at the left front corner of the plane, i.e. in the position where the measurements of the objects reach their maximum negative coordinates. However, you are free to move the functions in the direction in which the function acts by using the 'phase' option. A phase value of 50% for example means that the function will begin in the centre of the plane instead of at the left. It will of course extend to the left, but by passing through the t values from -0.5 to 0.5, whereas with a phase setting of 0% it would run through 0.0 to 1.0.

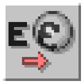
So that you can predict exactly what a particular function will produce, we have listed below all the formulae that CINEMA 4D uses for its movements. A is the amplitude, f the frequency and P the phase of the function. The t parameter, which goes from 0.0 to 1.0, indicates the position along one dimension of the plane.

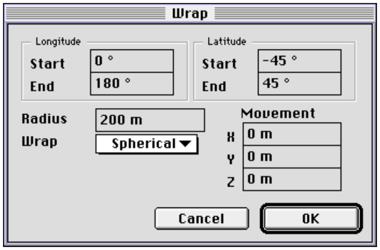
V is the result of the function. The first function is multiplied with the second, and the product multiplied with the amplitude. This is the value by which the point is moved.

Summary of all functions:

Constant	$V = 1.0$	
Line	$V = (t - P) * f$	
Amount	$V = \| (t - P) * f \|$	
Square parabola	$V = ((t - P) * f)^2$	
Cubic parabola	$V = ((t - P) * f)^3$	
Hyperbola 1	$V = 1.0 / ((t - P) * f)$	(Values greater than 1 are set to 1 and values smaller than -1 to -1)
Hyperbola 2	$V = 1.0 / ((t - P) * f)^2$	(Values greater than 1 are set to 1)
Cosine	$V = cos\ (21\ (t - P) * f)$	
Wobble	$V = sin\ (21\ (t - P) * f) * cos\ (21 * 10 * (t - P) * f)$	
Decreasing	$V = e^{-(t - P) * f} * cos\ (21 * 10 * (t - P) * f)$	
Square root	$V = sqrt\ (\| (t - P) * f \|)$	
Exponential 1	$V = e^{(t - P) * f}$	
Exponential 2	$V = e^{-(t - P) * f}$	
Exponential 3	$V = e^{\| (t - P) * f \|}$	
Sawtooth	This function is difficult to represent with a formula. As with the other functions, it can be phase shifted and depends on the specified frequency.	

5.18 Wrap

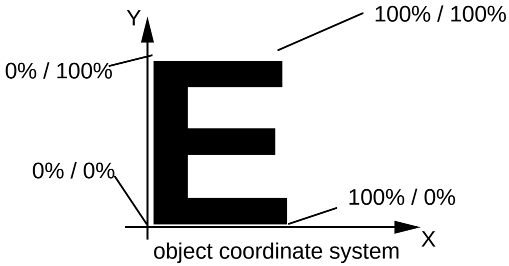




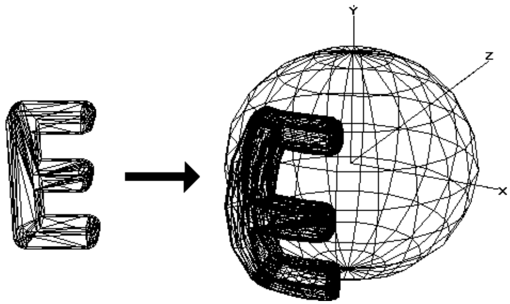
This command will let you wrap the active object or the active object group around a cylinder or a sphere. Unlike the 'Arrange' command—which arranges several objects along a path, thereby only shifting, rotating and scaling the individual objects without actually changing the points themselves—the Wrap command does affect the points themselves.

CINEMA 4D begins by determining the size of the object and the relative position of each point relative to that size. From the relative position it then calculates the new position on a sphere or a cylinder.

Try to think of the three-dimensional letter 'E', lying on the XY plane of the global coordinate system.



If you now use the Wrap command with the wrap type 'sphere', CINEMA 4D calculates for each point the relative X and Y position (in relation to the object coordinate system).



The upper left corner of the letter is in position (0%, 100%), the bottom right corner is (100%, 0%) and the upper right corner is in (100%, 100%).

CINEMA 4D now converts the percentage values for the X and Y dimensions into angles, i.e. longitude and latitude on the sphere. The result is a letter curved like the surface of a sphere.

CINEMA 4D always wraps objects so that the X axis of the object coordinate system forms the equator of the cylinder or the sphere.

Longitude

The start and end angles specify how far the object is to be wrapped around the cylinder or the sphere in a horizontal direction. A starting angle of 0% and an end angle of 180˚ wrap the object around half of the sphere or the cylinder, starting at the X axis of the coordinate system.

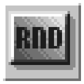
Latitude

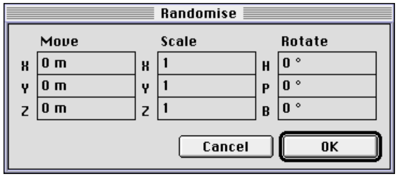
Here, you can only specify a start and an end angle for the wrap type ‘sphere’. In all other cases these entry boxes are not available. Just as with longitude you can specify the extent to which wrapping takes place.

In addition to the wrap you can specify a movement, i.e. if you want the points to be moved in a particular direction. For this purpose, use the shift vector. Otherwise, always use the values (0,0,0) here.

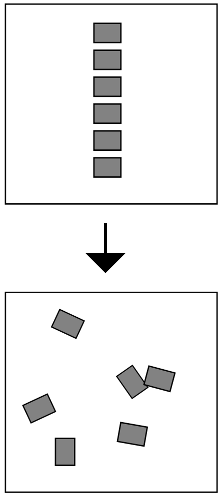
A movement, if specified, overlays the wrap. So, if you wrap a text around a cylinder and specify a shift by 100 units in direction Y, you get the text spiralling upward.

5.19 Random





This command will let you place a number of objects in a random fashion.



Use it, for example, to produce a forest by simply letting CINEMA 4D position the trees. To give the forest an even more realistic appearance you can make the trees rotate around their own vertical axes and resize them in a random fashion. When dealing with a large number of objects, this can save you a lot of time.

This function can be applied only to object groups and all the child objects that they contain.

Move

This is where you specify the maximum values by which the objects can be moved. A value of (100,0,0) means that the objects are moved by up to 100 units from their original position in the X direction of their own coordinate system, while Y and Z remain unaltered.

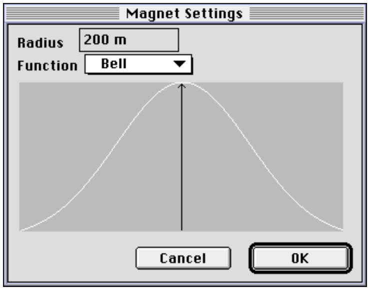
Scale

Here you specify the three maximum values by which an object may be scaled. A value of (3,1,1) means that the object may be resized along the X axis of its object coordinate system by a maximum of three times its original size. Its Y and Z values remain unchanged.

Rotate

Here you specify the three maximum values for rotating an object. The values (0°,85°,0°) mean that the pitch value of the object can be modified by up to 85°.

5.20 Magnet Settings



The Magnet function is extremely useful in connection with free forms for pulling points away from an object.

Select the Magnet tool and click anywhere on the active object, then drag the mouse. The points nearby now trail the mouse pointer at a certain distance. The ‘drag’ decreases with increased distance. You use the Magnet command to specify this dependency.

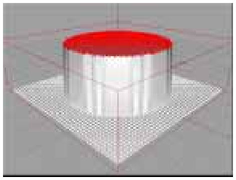
Radius

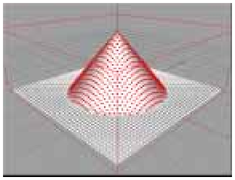
This is where you specify the effective range of the magnet. Points which are closer to the mouse pointer than the value specified here will be affected (see Chapter 5: Options / Option / Magnet).

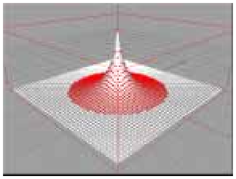
Function

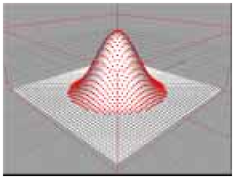
From the popup menu, select one of the many inbuilt mathematical functions.

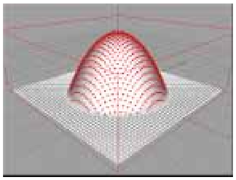
Here are a few examples of what you can do with the magnet.

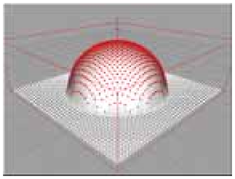

constant

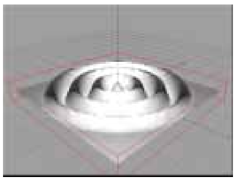

linear

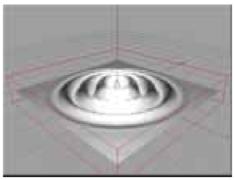

Needle

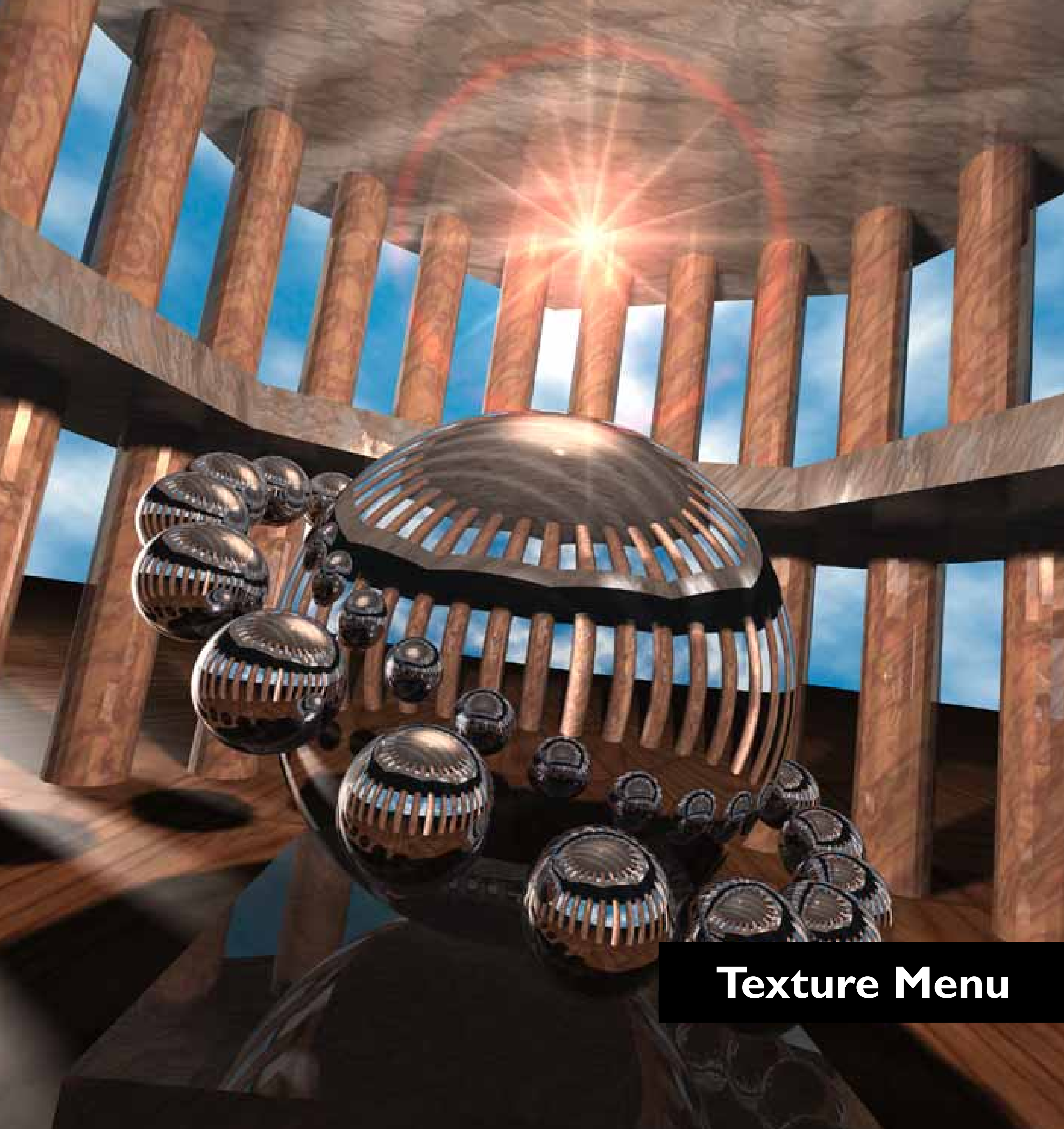

Bell


Parabola


Circle


Wave 1


Wave 2



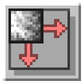
Texture Menu

Contents

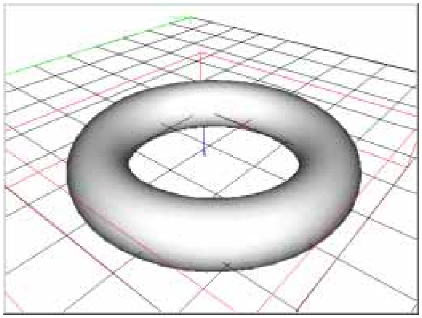
6. The Texture Menu

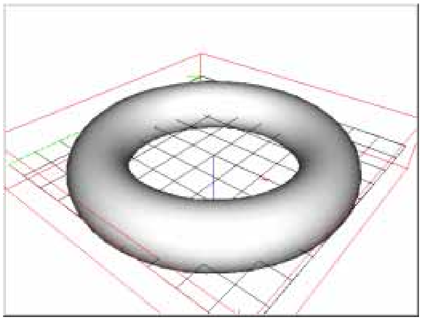
6.1 Adapt To

Object



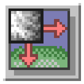
This command modifies the alignment of the texture axes and of the texture in such a way that the texture completely covers the active object.





After selecting this function the texture has a length of 100% in both the X and Y directions.

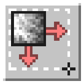
Image



This command is available only when surface projection is switched on.

The file selector opens for you to enter the name of an image. CINEMA 4D calculates its horizontal and vertical resolution (in pixels) and scales the size of the texture image accordingly. This ensures that the texture image uses exactly the same proportions as the selected image, thus avoiding distortion.

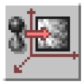
Region



Use the mouse to drag a bounding box. CINEMA 4D automatically sets the surface projection so that the size of the texture matches the specified region exactly.

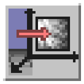
6.2 Align To

Object Axes



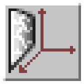
This command rotates the texture axes in such a way that they are parallel with the object axes.

World Axes



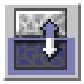
This command rotates the texture axes in such a way that they are parallel with the world axes.

View



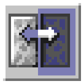
This command rotates the texture axes in such a way that the texture is perpendicular to the viewing perspective. For a 3D view this is the camera plane, for all other views it is the work surface.

6.3 Mirror Horizontally



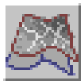
This command will let you mirror the texture in such a way that it is projected as its own mirror image (reflection along the Y axis).

6.4 Mirror Vertically



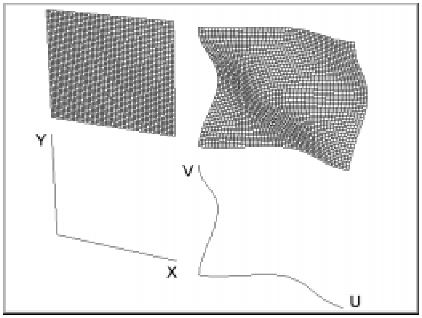
This command will mirror the texture in such a way that it is projected upside-down (reflection along the X axis).

6.5 Generate UV Coordinates



You are no doubt familiar with XY coordinates. The two axes are perpendicular to each other and continue as straight lines, one in a horizontal direction, the other vertical. However, in mathematics it is possible to use systems where the X and Y axes are bent, and to describe their coordinate points. To make a distinction, in such a system the letters U and V are used instead of X and Y.

You can see the difference in the illustration below. The same plane is shown in a normal XY system and in a 'bent' UV coordinate system.



But why this complication? Well, you must have noticed that the surface projection of a texture on a deformed object does not always match what you observe in nature. The effect is the same as if you were to project a slide on an arched surface. The more pronounced the arch, the stronger the distortion.

By using UV mapping you 'fix' the texture to the object surface before distorting it. This forces the texture to comply with any deformations that are applied to the surface.

Proceed as follows:

1 Create an object.

2 Assign a material to it.

3 Specify the projection type (sphere, cylinder, etc.)

4 Generate the UV coordinates.

5 Activate UV-Mapping from the properties.

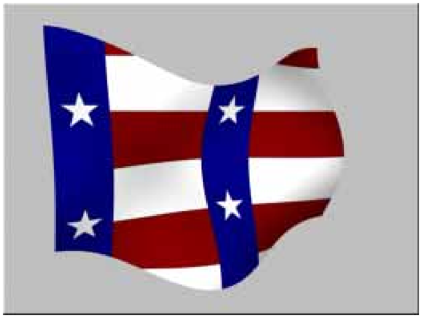
6 Distort the object.

This illustrates the point that you need to think about what materials and textures you are going to assign to an object, and about the way that object may be deformed, both before *and* during modelling.

Consider, for example, a walking bottle (see one of the animations that come with the program). If you want this to have a label which bends and deforms with the bottle's movements, you will have to apply a label texture to the bottle. You then need to set the UV coordinates from the Texture menu before changing the projection type to UV mapping. This will achieve the desired result.

Another example is shown below.

This is a flag fluttering in the wind. The texture has been applied four times to the surface. In the first figure, the 'conventional' surface projection has been used, in the second UV mapping has been applied.

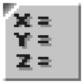


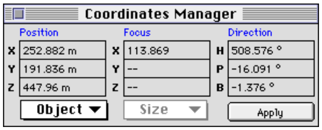
Windows Menu

Contents

7. The Windows Menu

7.1 Coordinates Manager





This opens the Coordinates Manager, a universal tool for manipulating all elements numerically.

For a detailed description of the Coordinates Manager refer to Chapter 8.

7.2 Material Manager

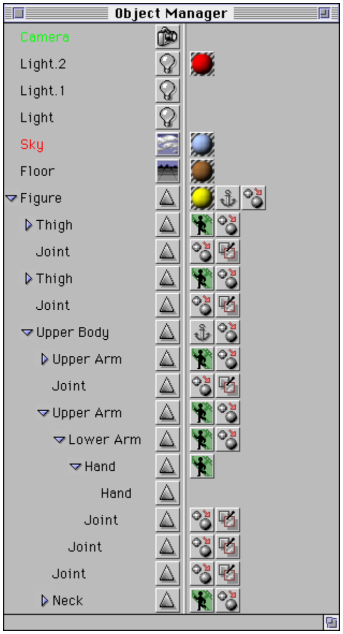
This opens the Material Manager which helps you organise all surfaces within a scene and displays previews of the materials used.

You can assign a particular material to an object by dragging the material and dropping it onto the object in the Object Manager.

It is also perfectly possible to drop a material on to an existing texture. This causes the material to be assigned to that texture.

The Material Manager is described in detail in Chapter 9, and the various texture projections in Chapter 10.

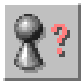
7.3 Object Manager

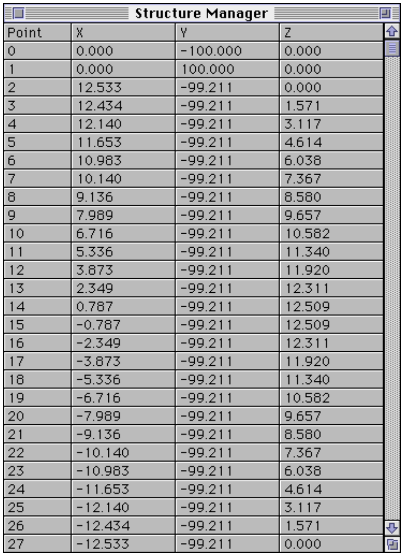


The Object Manager is the 'heart' of CINEMA 4D. It is used for activating objects, including those that are not visible in the Editor, changing the object hierarchy and manipulating the characteristics of objects.

For a detailed description of the Object Manager please turn to Chapter 11.

7.4 Structure Manager





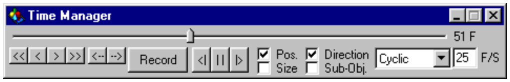
Structure Manager

Point	X	Y	Z
0	0.000	-100.000	0.000
1	0.000	100.000	0.000
2	12.533	-99.211	0.000
3	12.434	-99.211	1.571
4	12.140	-99.211	3.117
5	11.653	-99.211	4.614
6	10.983	-99.211	6.038
7	10.140	-99.211	7.367
8	9.136	-99.211	8.580
9	7.989	-99.211	9.657
10	6.716	-99.211	10.582
11	5.336	-99.211	11.340
12	3.873	-99.211	11.920
13	2.349	-99.211	12.311
14	0.787	-99.211	12.509
15	-0.787	-99.211	12.509
16	-2.349	-99.211	12.311
17	-3.873	-99.211	11.920
18	-5.336	-99.211	11.340
19	-6.716	-99.211	10.582
20	-7.989	-99.211	9.657
21	-9.136	-99.211	8.580
22	-10.140	-99.211	7.367
23	-10.983	-99.211	6.038
24	-11.653	-99.211	4.614
25	-12.140	-99.211	3.117
26	-12.434	-99.211	1.571
27	-12.533	-99.211	0.000

This opens the Structure Manager, which is used for constructing objects. All points, edges and areas of an object, including its UV and UVW coordinates, can be edited numerically.

For a detailed description of the Structure Manager please turn to Chapter 12.

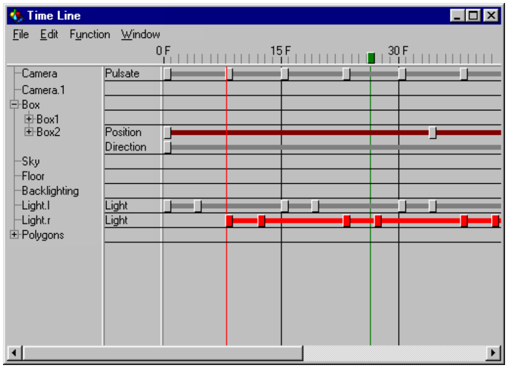
7.5 Time Manager



This opens the Time Manager, the control centre for key frame animations. It is used for defining the key positions for objects and for playing animations in real time.

For a detailed description of the Time Manager turn to Chapter 13.

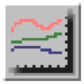
7.6 Time Line

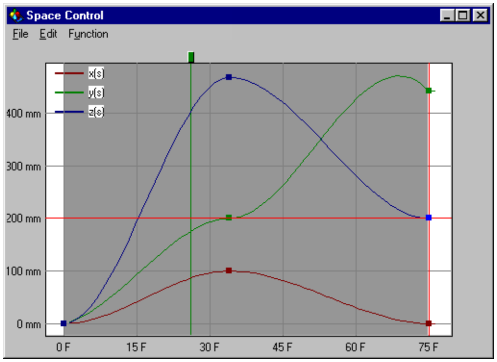


This opens the Time Line. This powerful tool provides you with everything you need for controlling animations in CINEMA 4D.

For a detailed description of the Time Line turn to Chapter 14.

7.7 Space Control

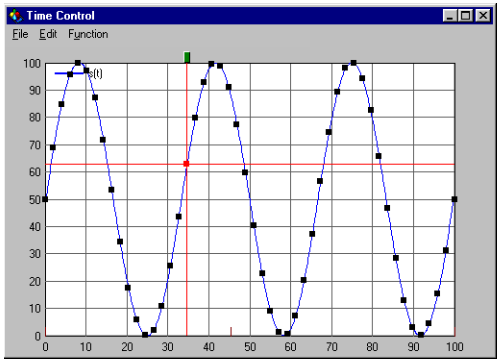




This opens the Space Control Centre. This is an auxiliary tool that allows exact spatial control over the animation parameters position, size and angle.

For a detailed description please turn to Chapter 15.

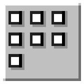
7.8 Time Control



This opens the Time Control Centre. This is an auxiliary tool that allows exact chronological control over animation sequences.

For a detailed description please turn to Chapter 16.

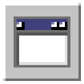
7.9 The Browser

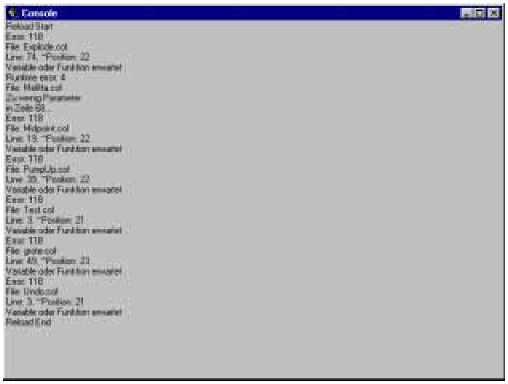


This opens the Browser, an auxiliary tool for collecting scenes, textures, materials, images and animations into well-organised libraries, and then making them accessible to CINEMA 4D.

For a detailed description of the Browser turn to Chapter 17.

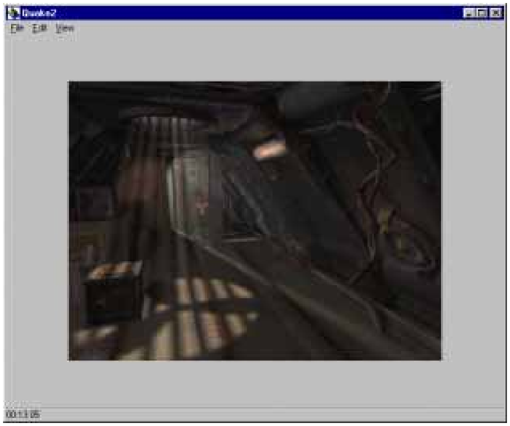
7.10 Console





C.O.F.F.E.E. has its own console window which is used for output information and control. All C.O.F.F.E.E. print commands are displayed here. Errors detected in a C.O.F.F.E.E. application are reported here by indicating the number and position.

7.11 Output



The Render Output window is completely integrated into the well known manager structure of the CINEMA 4D user interface.

This means that you can place the window anywhere on your screen and size it as you wish. This configuration will be saved in your Preferences file.

The Output window has its own menu bar. If you have not chosen to do so in Preferences/Render/ Save you can save the image from here. In addition, it is possible to fade in or fade out individual colour channels or to view the scene in greyscale.

The magnifying function allows you to evaluate the image quality in advance. Alternately you can fit the picture into the output window, irrespective of its original size.

None of these actions affect the actual rendered image.

7.12 Other Windows

All other windows show the name of loaded or newly created scene files. You can change between them by using the Tab key.

Tip:

If your screen becomes so crowded with windows that you can't see the wood for the trees, do the following:

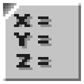
Windows: *Right-click on the clock in the Task list. From the menu that appears, choose 'Minimize All Windows'.*

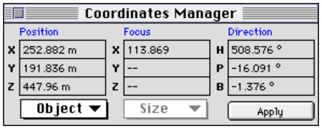
Macintosh: *Hold down the Option key and choose a different application (this can be the Finder). CINEMA 4D will then be hidden.*

Coordinates Manager

Contents

8. The Coordinates Manager





The Coordinates Manager is a universal tool for manipulating objects numerically. Depending on the particular function, it displays information about the position, size and angle of the active element. As soon as you select Apply, the changes become valid.

Use the dropdown menu at the bottom left for selecting how to interpret the local values. If ‘Object’ is chosen, all values belonging to the parent system are shown. If you change to ‘World’, a conversion to world coordinates takes place; you are given the position and the HPB angle within the world system. As a general rule, angle values are given only in the HPB system (see chapter 5 - World / Object System).

Use the dropdown menu at the bottom middle to determine which object sizes are to be displayed. ‘Size’ is the length of the axes in the object coordinate system. By default these are 1/1/1 units long.

‘Dim’ displays the dimensions of the selected object alone. ‘Size +’ shows the dimensions of the selected object including all its child objects.

The dimension or size also indicates values in world coordinates, but along the local axes. If for example a cube with sides of value 100 is lopsided, its size when given in world coordinates is still 100 units.

It is also possible to enter relative changes. CINEMA 4D comes with a Parser. It is possible for you to append ‘+100’ to an existing position value. This causes it to shift the selected element by 100 units from its original position. And this is only one of the many features that CINEMA 4D has to offer. Look in the Appendix for a summary of all supported operators, functions and constants.

As mentioned earlier, the type of information provided by the Coordinates Manager depends on the selected tool (option). If you have selected the Camera, you can enter the focal length of the lens in numerical form. The heading above each coordinate column is then adjusted accordingly.

Certain values can only be given in relation to others, not as absolutes. Think of the points of an object, for example. They can be rotated only in relation to something else, because they do not have their own axial system and the program cannot therefore know how far they have turned already. Therefore, you can indicate a relative rotation in the parent system’s HPB system. The relative angles are immediately returned to 0/0/0.

Note that when changing the object’s axes it is possible for the axes of the child object to be altered unintentionally.

Try not to use world coordinates when rotating animations. CINEMA 4D always has to convert world coordinates into local coordinates, which can cause the rotation sequence to change.

Material Manager

Contents

9. The Material Manager

By means of a preview picture and names in alphabetical order, this manager shows all the materials used in a document. If the name of a material is too long to fit in the display, it is abbreviated using a full stop.

A material picture is displayed as a sphere in front of a striped background. Based on the attributes given to the material, this image provides you with a fairly accurate representation of what the material will look like on an object.

When you activate an object, its active materials are shown as "pressed". You can therefore see at a glance which materials have been assigned to the object.

When a texture is active (selected in the Object Manager), only the material of the texture is shown pressed.

You can at any time grab a material with the mouse and place it on an object in the Object Manager by using drag-and-drop. When you drag the material onto a texture icon (see Chapter 11: The Object Manager), the old material in the texture is replaced with the new one. If, however, you drag the material onto the object name, a new texture is created and the relevant material selected.

(The next chapter is devoted to the various texture geometries.)

Independently of this you can activate a material using the mouse or the keyboard (use the cursor keys to cycle through the materials). The selection is shown by a red material name. All menu functions always affect the active material.

You can edit the active material by double-clicking on the preview picture or by pressing the Return key. Double-clicking on a material's name will open a dialog that will enable you to rename that material.

9.1 The File menu

New Material

Creates a new material with default settings. The new material is initially the same as the CINEMA 4D default material.

Open 3D-Shader

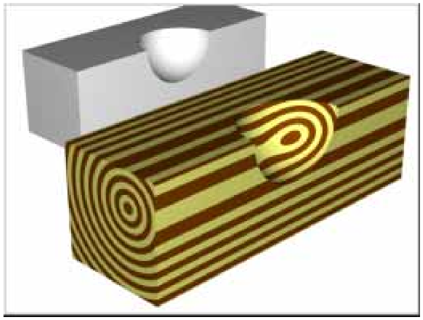
Shaders (also known as ‘procedural textures’) are mathematical algorithms that are far more powerful than traditional textures. For example, because they are computed they can stretch to infinity without any loss of resolution..

CINEMA 4D supports two-dimensional and three-dimensional shaders. The former are closely related to normal textures, the one difference being that their patterns are mathematically calculated. These 2D shaders are loaded into the Materials Editor in the same way as normal textures.

3D shaders are a different. They don’t simply cover the surface of an object, they penetrate it and fill its volume—that is, they are independent of an object’s geometry and of a texture’s projection.

This is particularly evident when you cut out a piece from an object. Whereas with a normal texture you will be able to see the plane formed by the cut very clearly, the structure of the 3D Shader will flow around these edges, giving the impression of a volume filled with material.

The illustration below shows how the texture flows from the front face, along the sides and into the hollow.



But that is by no means all that these powerful shaders can do. You could have, for example, a fog shader which does not simply fill a material with fog, but forms wisps of fog that can be individually animated. Many computer generated landscapes are not modelled but created by using a sophisticated 3D shader which can be applied to a very simple object (such as a cuboid).

As you can see, 3D shaders are pretty special. For this reason they cannot be loaded into a material; instead they are themselves the material.

The Open 3D-Shader command loads a 3D shader into the materials list. The usual file selector appears from which you can select the file. Internal shaders—shaders which are integrated into CINEMA 4D but called from outside—can be identified by their extension ‘.shv’. External, programmed, shaders have the extension ‘.cof’ (ASCII file) or ‘.cob’ (binary file).

To identify the C.O.F.F.E.E program as a 3D shader, a ‘_V’ is placed between the name and the extension (e.g. ‘Circle_V.cof’).

Load

This command lets you import saved materials. It is possible to import materials from other scenes—instead of entering the filename of a material, enter the name of the scene. All materials associated with that scene will then be loaded into the current materials list.

You must be careful with textures. CINEMA 4D expects to find all textures either in the local scene folder, or in a subfolder there named ‘Tex’, or in one of the 10 alternative paths (see Chapter 1 - File / Preferences). When you load materials from another scene this may cause confusion.

It is always best to copy the textures for a scene into that scene’s folder.

Save Material as

This command saves the active material. The usual dialog for saving files appears.

Save All Materials As

This command saves all materials of the active document, thus enabling you to create material libraries.

Close

This command quits the Materials Manager and closes its window.

9.2 The Edit menu

Undo

This command cancels the last function that was applied to the active material and restores the earlier state. You can use the command repeatedly to go back several steps.

Exceptions to this are the ‘Remove Duplicate Materials’ and ‘Remove Unused Materials’ commands (see below) which cannot be undone.

When deleting a material, all textures which have been assigned that material are instead given the default material. It is possible to ‘redo’ the material itself, but this will not restore the entry in the texture fields.

Redo

If you have inadvertently used Undo once too often, use Redo to restore the command you have just undone.

Cut

This command removes the active material and copies it onto the Clipboard from where it can be inserted again by using the Paste command.

Copy

This command copies the active material onto the Clipboard from where you can paste it back into the Material Manager as many times as you like.

Paste

This command pastes the material from the Clipboard back into the document.

Delete

This command deletes the active material without copying it onto the Clipboard.

9.3 The Function menu

Render Material

This command renders the preview picture of the active material. This is normally performed automatically, except when you import alien formats such as DXF or QuickDraw 3D.

Render All Materials

This function renders the preview pictures of all materials. This is normally performed automatically, except when you import alien formats such as DXF or QuickDraw 3D.

You can cancel the rendering process by pressing the Esc key. (Command+fullstop on a Macintosh.)

Edit

This command will let you edit and modify a single material. Alternatively, double-click on the preview picture of the material you wish to edit.

For a detailed description of the Materials Editor see Section 9.4.

Apply

This command creates a texture geometry on the active object and assigns to it the active material.

Alternatively, you can grab the material with the mouse and drag-and-drop it to the object in the Object Manager. When you drop the material onto a texture geometry icon, this replaces the old material with the new. If, however, you drop it on the object name, the program creates a new texture geometry for the material.

You can find a detailed description of the texture geometries in Chapter 10.

Tip:

You can prevent the automatic opening of the texture geometry dialog by holding down the Shift key when assigning a material to an object.

Rename

This command lets you rename the active material. Material names are always sorted alphabetically.

You can double-click on the name of the material below the preview picture to open the same dialog.

Delete Unused Materials

This command deletes all materials which have not been assigned to any object or texture key in the Time Line (see there - Texture animation).

This command is particularly useful when you have loaded a sizeable material library from which only a few materials are actually being used in the scene.

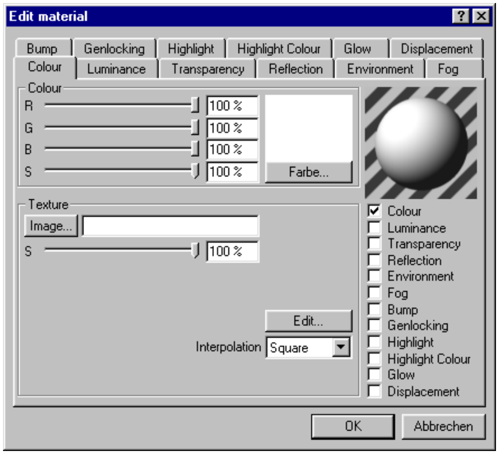
Remove Duplicate Materials

This command removes all materials which already exist (same name, same parameters).

9.4 The Material Editor

This Editor allows you to modify a material. CINEMA 4D’s material system is enormously flexibile, while at the same time being extremely easy to use.

Keep in mind that when you create a new material,initially—until you make changes—it will be the same as the default white material. Also keep in mind that when you create any new object it will be automatically assigned this default white material until you assign it a real one.



The Edit Material dialog is divided into four panes. In the top right-hand corner is the preview—a sphere lit by a light source, the same preview you will see in the Materials Manager when you have finished editing the material. This preview provides you with a fairly good visual representation of how your changes are affecting the material.

The various material parameters are spread across 12 dialog pages, one for each specific property. These properties can be selected and deselected using the checkmarks below the preview. The dialog pages are all very similar—you will find the same controls in the same places on each page.

Property	**Usage**
Colour	Surface colour.
Luminosity	Luminous colour.
Transparency	Degree of transparency.
Reflections	Mirroring.
Environment	Environment mirroring. (extremely fast rendering)
Fog	Fog effect.
Bump	Virtual surface irregularities.
Genlocking	Non-existence of material in certain places.
Highlight	Highlight.
Highlight Colour	Colour of the highlight
Glow	Halo around an object.
Displacement	Actual surface irregularities.

The Colour pane

Many pages allow you to specify a colour. The sliders behave in the way that you have defined in Preferences—you can choose between the HSV or RGB system and can set different upper limits.

Below the three colour sliders there is an extra one which lets you specify the strength (the overall brightness) of the colour. With the HSV system this slider is redundant (it is the same as V), but the strength of the colour is essential if you are working in RGB.

To the right of the sliders there is an area which displays the resulting colour and a button used to open the standard system colour dialog.

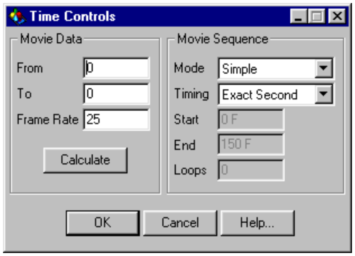
The Texture pane

If a property page contains a Texture pane, this is where you would specify a two-dimensional image, a 2D shader or an animation (AVI or QuickTime) as your texture. CINEMA 4D can import the following graphics file formats: JPEG, IFF-ILBM, TIFF, TGA, BMP and, on the Macintosh, PICT.

Below the fielname field is a slider for controlling the strength of the texture colour, and on the right there a preview of the texture image along with information about the dimensions and colour depth of the image. Clicking in the texture preview will copy the colour under the pointer to the Colour pane of the current properties page.

Below the texture preview there is an Edit button. This has different functions depending on the texture that is being used. If you are using a 2D shader then a special dialog will appear which allows you to change the settings available for that shader.

Instead of an image or a shader you could specify an animation (QuickTime movie, AVI or frame sequence). In this case, the Edit button will enable you to specify the time behaviour of the animation.



Movie data

In this area of the dialog you choose the frame rate for the animation texture. In the fields ‘from’ and ‘to’ you enter the start and end frames for the animation sequence. If both fields contain the same value, only the currently selected image is used as a texture. You can define the playback rate using the value in the ‘frame rate’ field.

Clicking on ‘Render’ triggers CINEMA 4D to automatically set up all the parameters of the animation. You do not need to know the duration of the animation; in single frame sequences the images with the lowest and highest image numbers are calculated automatically.

Example:

AVI movies (QuickTime Movie on the Macintosh) have 600 frames (0 to 599) and a frame rate of 15 frames per second. You can select any start and end frame; from image 70 to image 119 for example (or even from image 119 to image 70 if you like).

Movie sequence

In this part of the dialog you choose how the animation texture is handled in the animation.

In the ‘Mode’ field you choose how to play the animation. You can choose from ‘Simple’, ‘Cyclic’ and ‘Ping-Pong’.

Simple means that the texture stops when it reaches the last image of the animation texture.

Cyclic means that when the last image of the animation texture is reached, the sequence will begin again.

Ping-Pong means that when the last image of the animation texture is reached, the sequence will reverse towards the first image, then reverse again towards the last image, and so on.

With ‘Timing’ you choose the play mode. ‘Exact image’ means that for every rendered animation image one image of the animation texture is used. There are no ‘drop frames’, meaning no images of the animation are missing. If the frame rate of the animation texture differs from the frame rate of the movie this means that the movie runs slower or faster. ‘Exact second’ means that for every rendered animation second, one second of the animation texture (as chosen by the film parameters) is used. As a result the movie always runs with the same frame rate.

Select ‘Pane’ and CINEMA 4D fits the frame sequence to the beginning and end (scene animation) and the movie is played exactly once. This does mean, however, that the animation texture must either be stretched or compressed.

‘Loops’ means that the frame sequence runs the specified number of times from beginning to end. Specifying 1 results in a single repetition. Again you can choose from ‘Simple’ (makes no sense here), ‘Cyclic’ and ‘Ping-Pong’.

Example 1:

You would like to play a movie (AVI for Windows).

- Select the animation in the texture pane of the material editor. Open the Timing dialog, click on ‘Rendering’, close the dialog.

Result: The movie is played exactly once, second synchronised.

Example 2:

You would like to render and playback a movie exactly twice, starting with frame 25 and ending with frame 350.

- Select the animation in the texture pane of the material editor. Open the Timing dialog, click on ‘Rendering’.
- Select the ‘Ping-Pong’ mode; set ‘Timing’ to ‘Area’; enter Start ‘25’ and End ‘350’; set Loops to ‘1’ (a single repetition).
- Close the dialog.

Interpolation

OK, back to the material editor. 'Interpol' defines how the pixels of a texture image are interpolated when that image has to be enlarged or shrunk to fit the area on the object to which it has been applied.

If you select 'None' the pixels are taken directly from the texture. This method is extremely fast but not at all suitable when using small textures—low resolution images in other words—as it almost always results in poor quality pictures. However, the None setting *may* be perfectly fine for your requirements if you are using high resolution images for your textures, or if the texture is being applied only to a small object.

You will need to experiment with this, although keep in mind, especially if you are using lots of texture images, that high resolution images require a lot more memory than low res ones.

'Square' is the default setting. Here, when the image is being interpolated, it is not only the individual pixel that is looked at but also its neighbours, which gives much smoother transitions. Square interpolation is still very fast.

'Circle' interpolation is very similar to 'Square'. Here, each pixel of the texture image affects a circular range, which results in a more natural effect when the texture needs to be greatly enlarged.

You can obtain even better results by using 'Anti1' to 'Anti3'. These interpolation methods create an antialiasing effect which gives high quality results with hardly any 'flare', plus they are very stable from frame to frame—essential for animations.

Anti1 to Anti3 provide increasing smoothness but also need increasingly more time to calculate. Keep in mind that Anti3 really does smooth out all the edges in a texture image, it requires a *lot* more time than Anti1.

To summarise:

- 'Square' is the most frequently used interpolation method because it is quick.
- No interpolation *may* be useful if you need to save on computing time.
- Always select at least 'Circular' interpolation when using low res textures which will end up covering a considerable part of the screen.
- For animations and bump mapping use 'Anti1' if you can afford the computing time.
- 'Anti2' and 'Anti3' are recommended for use with low res texture images whose grainy pixel structure will require smoothing.

If on a properties page you have specified both a Colour and a Texture, the strengths are either multiplied (only on the Environment page) or added (all other pages). Ensure that the sum of the Colour and Texture strengths does not exceed 100%, as this will almost certainly result in the material having an unrealistic appearance.

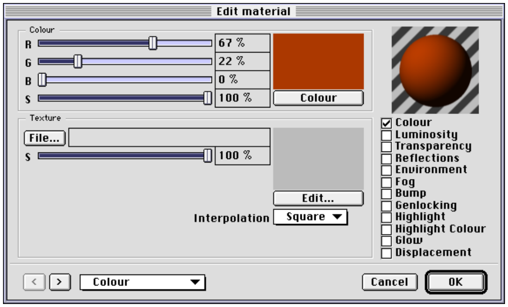
CINEMA 4D looks for texture images in predefined folders in a predefined order:

- A folder named 'Tex' in the CINEMA 4D folder.
- The folder which contains the current scene.
- A folder named 'Tex' inside the current scene's folder.
- In any one of 10 user-defined alternative folders (and their subfolders).

If a texture cannot be found during rendering, an alert message will appears containing the name of the missing texture, together with the names of the materials which require it. If you choose not to cancel the rendering process at this point, CINEMA 4D will proceed using the default material.

We now move on to a detailed description of the various material properties. In most cases we have added a typical example to illustrate the theory.

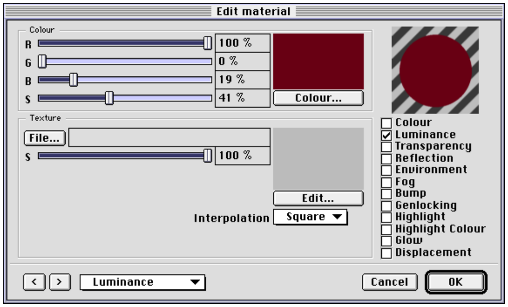
Colour page



Here is where you specify the colour of the material. The program will add the Colour strength (S) to the Texture strength; you should ensure that the combined strength of these does not exceed 100% as this will make the material unnaturally bright.

If all you want is the texture image—that is, the image as it is, no added colour—then set the Colour strength to 0 and the Texture strength to 100.

Luminosity page



Here you specify the base colour of the material, regardless of any lights, and you have the option of specifying a texture image. The strength and colour of the illuminant material may be influenced by the texture image. The brighter a pixel in the image, the stronger its own luminosity.

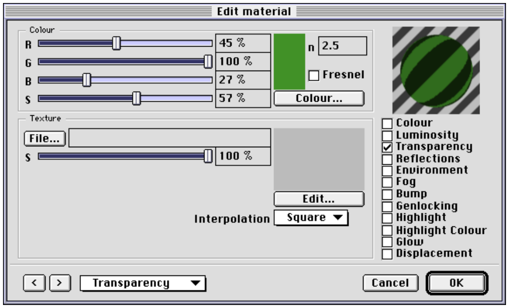
The strengths of Colour and Texture are added; you should ensure that the combined strength of these does not exceed 100% as this will make the material unnaturally bright.

Luminous materials are particularly suited to simulating neon writing or for applying to objects which have their own luminosity—the windows of a space station, for example.

Tip:

Although a luminous material is illuminant, it does not *illuminate*—no part of the scene will be lit by the material, and no shadows will be cast by it. To create a natural effect we recommend that you always combine a luminous object with a real light source.

Transparency page



This is where you define the material's transparency. The strengths of Colour and Texture are added; ensure the combined strength does not exceed 100%.

The transparency has the effect of a light filter. Black does not allow any light to pass through, pure white lets all light pass.

You can compare a transparency texture directly with a photographic slide. Red parts of the slide will let only red light pass, while clear (white) parts let all light through. No light at all passes through the black parts of the slide.

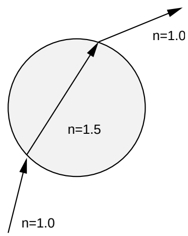
Transparent materials are used as light maps with light sources. If a light source is assigned a transparent texture, the light is filtered by the colour. You could use this effect, for example, to generate the shadows cast by a Venetian blind.

You may enter a refractive index *n* for a realistic simulation of glass or water. Naturally, this makes sense only if the material is transparent, otherwise the index has no effect. Here are some example refractive indices:

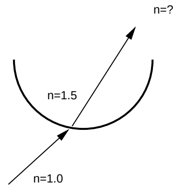
Material	Refraction index
Vacuum	1.000
Air	1.000
Water	1.333
Quartz glass	1.458
Benzene	1.501
Amber	1.550
Flint glass	1.613
Diamond	2.419

With objects that are not completely closed—a hemisphere for example—anomalies may occur in the picture. The reason for this is to be found in the procedure adopted by the raytracer in the rendering of transparency and refraction.

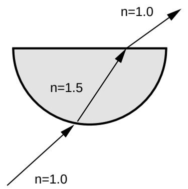
As soon as a ray hits a surface with transparency and refraction, the ray is first weakened and then deflected as it passes through the surface (see the illustration below). The ray is now within the object and continues until it hits another surface of the object, where it exits from it. Here it is deflected again in exactly the manner one would expect from a refracting object such as a glass sphere.



If you are using an open-ended transparent object, such as a hemisphere for example, the ray will enter the hemisphere but may never encounter a second surface at all (see illustration below).



In this case, the raytracer must assume that the ray is still inside the transparent object, although in reality it may already be well outside. Do not be surprised, therefore, if you get unexpected refraction effects when using open-ended transparent objects. We advise that you alter your objects in such a way that they are closed. You could, for example, give an open hemisphere a second wall or a cover (see illustration below).



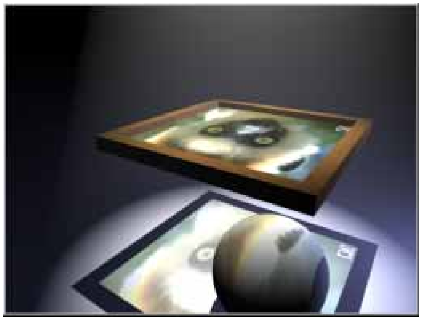
If Fresnel is disabled, the values entered on the Transparency and Reflection pages are used, irrespective of the viewing angle.

Otherwise the angle between the light ray and the surface is taken into account for the calculation of transparency and reflection. If, for example, you look at a glass pane, you will notice that it lets almost all light pass through when viewed vertically and shows virtually no reflection.

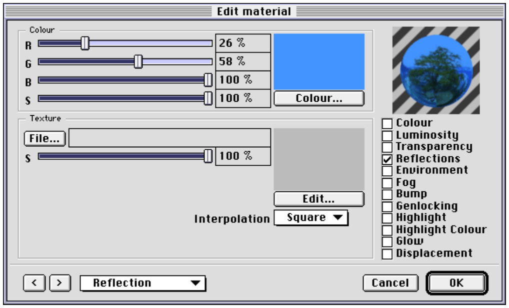
However, if you look at a glass pane or a lake from a flat angle, the entire environment will be reflected in it, and objects beneath the surface are invisible. The ratio of transparency and reflection changes continuously between these two viewing positions.

If, for example, you have entered the RGB values 80% red, 80% green and 80% blue for transparency at a refraction index of 1.5, the material will be 80% transparent and 0% reflective if viewed vertically, but 0% transparent and 80% reflective from a very low angle. If in addition you have entered values greater than zero for reflection, then these will always be added to the angle-dependent values.

The degree of transparency can be affected by a texture image. The brighter a pixel in an image, the more transparent the material at that position.



Reflection page



Here you can define the reflectivity of the material. The values entered here define for the entire surface how much the red, green and blue colour components are reflected.

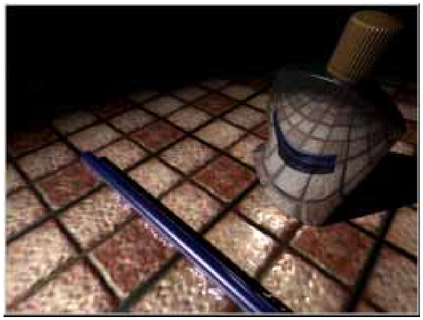
The strengths of the Colour and Texture parts are combined; for a natural look, ensure that the combined strength does not exceed 100%.

The degree of reflection is affected by the texture image. The brighter a pixel in the image, the more reflective the material at that point. This enables you to create surfaces with a very complex appearance. If, for example, you are using a checkerboard pattern with alternating black and white squares, the surface will alternately be non-reflective and 100% reflective. This results in a tile effect with alternately dull and reflective tiles.

The illustration below illustrates a number of different types of reflections. The bottle has been covered with a simple reflective material; this is why you can see in it the distorted rod.

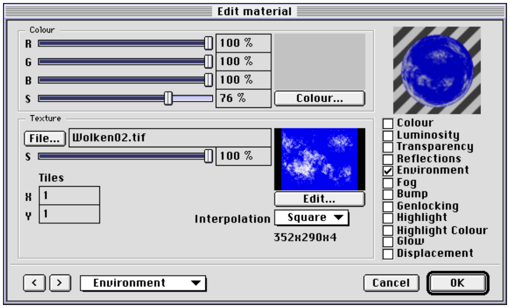
Looking more closely you can see that the bottle itself is reflected in the tiles.

And if you take an even closer look you will see that the reflection is visible only in the tiles, not in the joints. Here, an additional reflection texture has been used consisting of only a black (i.e. non-reflective) grid on a white background. To ensure that the colour and reflection textures match, the black-and-white texture was produced from the colour texture with the help of an image processing application.



This example illustrates that it is not enough to manipulate a single material property; if you want realistic appearances you need to manipulate and experiment with a number of properties.

Environment page



Here you can define the environment reflection of the material. Often a scene is too empty to be able to produce natural reflections. How many scenes have a realistic ground and a natural horizon? The environment texture can be used to correct this.

Environment reflections are particularly useful for creating metals. Metals have soft transitions from black to white on their surfaces, and this can be simulated by an environment texture.

Note that for the environment property the strengths of the Colour and Texture parts are multiplied with each other rather than added (as they are with all other properties).

The environment texture lies spherically around the object, parallel to the world axes. Use ‘Tiles’ to specify the number of projections for the environment reflection texture along the X and the Y axes. The number of tiles is independent of the tiles in the texture geometry (see the next chapter).

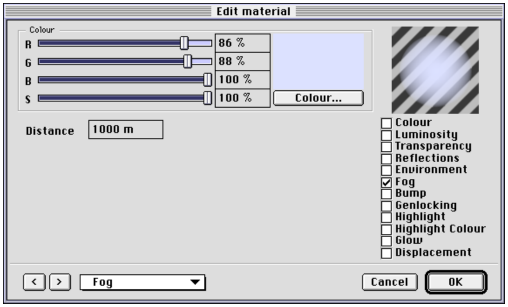
The reflections in the illustration above were achieved entirely with environment reflections.

Tip:

Environment reflections do not require the Render Picture function, which makes them extremely fast.

Note that environment reflections are computed in addition to any normal reflections.

Fog page



These parameters can be used to simulate realistic fog or gas clouds. Objects with such materials are transparent, but weaken the light shining through them, depending on their thickness.

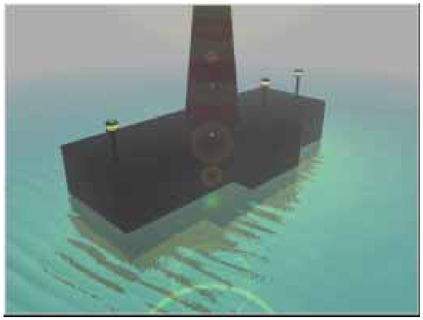
When a light ray enters fog it is weakened. This weakening is defined under Distance. The larger this value, the thinner the fog. Distance defines at what distance the light ray is completely weakened.

In addition to the weakening of the light, the fog's own colour is mixed in. The further you look into the fog, the more weakly the objects are visible, with the fog colour becoming stronger. At the Distance value entered, the fog colour is mixed in fully.

If, for example, you enter a Distance of 500, a light ray of originally 100% intensity will have an intensity of 50% after a distance of 250 units, and is extinguished after a further 250 units. The shorter the distance, the thicker the fog will appear. Additionally, half the fog colour is mixed in after 250 units, and the full fog colour after 500 units.

Fog objects can be used, for instance, for the simulation of smoke, mountain mist or clouds.

Fog objects should always be closed volume bodies. Open objects can lead to physically faulty pictures, since a light ray, once it has entered the object, will not encounter its surface a second time. In this situation the raytracer has to assume that the light ray is still inside the fog.

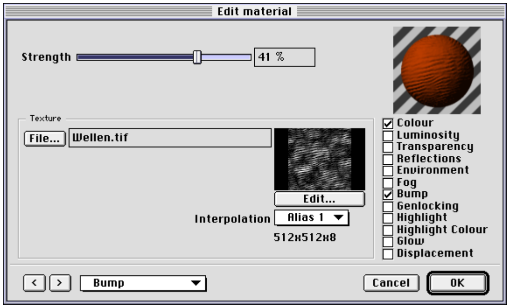


In the illustration above the scene was enclosed in a fog-filled cuboid; this is the only way to ensure that any existing background image remains visible. If instead you use the environment object, you will not be able to see the background.

Tip:

Fog uses the refraction index value specified on the Transparency page, and then it deactivates the transparency. Fog and Transparency cannot be rendered together; you can have either fog or transparency, but not both.

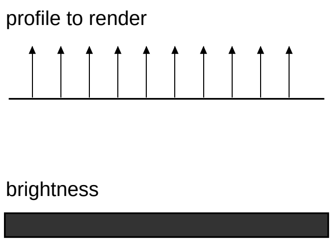
Bump page



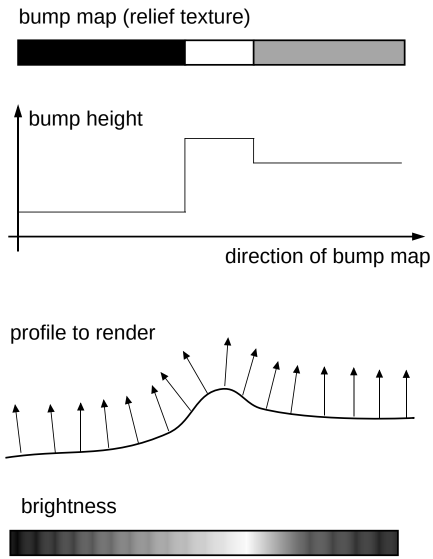
When you use a bump map you must always enter a texture since the height information is calculated from the grey values of a picture.

The strength of the relief can be regulated with the slider. This value defines how far the normal vectors deviate from their original directions when the relief is rendered. The higher the value, the rougher the surface will be. Be cautious with large values, though, because a material may no longer look aesthetically pleasing as a result of the extreme lighting jumps. A value of 20% should normally be sufficient. If you move the slider to the left you can select negative values. Negative values reverse heightening and deepening.

Here is an even surface, seen from the side:



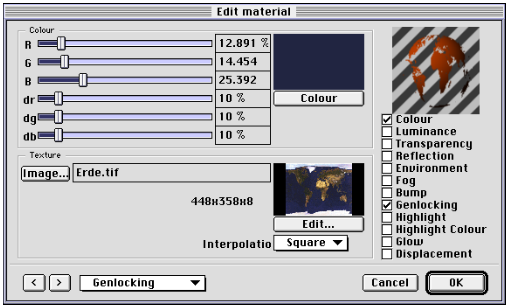
Since the same normal vector is used for the illumination of the entire surface, the area has a uniform brightness. If, however, you use a bump map, CINEMA 4D interprets the brightness values of the picture as height values of the surface, as illustrated below.



These height values are converted into a profile, the gradient of which determines the inclination of the normal vectors. Although the surface is actually smooth, the inclination of the normal vectors means that an apparently three-dimensional surface with a relief-like structure is rendered, with the brightness gradient illustrated above.

If you use a negative value, the opposite happens; bright pixels are indented, dark ones elevated.

Genlocking page



The parameters on this page are used to specifically cut out a colour range from a texture. The material will therefore be non-existent in the affected parts and any materials underneath become visible. This works in a similar fashion to an electronic genlocking device used for video postprocessing.

Under 'Colour' you select the colour value to be cut out, or alternatively click in the preview on the colour that is to be cut out.

'dr', 'dg' and 'db' are used for specifying colour deviations. This can be useful if you want to remove a colour range, or if your texture images have coloured borders that need removing. Similarly, 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 textureand the genlocking colour), and by adjusting these deviation sliders you can remove this border.

When the genlocking becomes effective on a particular part of the surface, the material underneath will become visible. If the object has no material underneath, the object will simply not be visible here.

If, for example, you want to insert the scanned image of a tree into a scene, first activate the colour option and select the picture of the tree as a colour texture. If you now render the picture, you will see the tree. However, the area around the tree will not yet be transparent but, for instance, blue (if the scanned picture had a blue sky as a background).

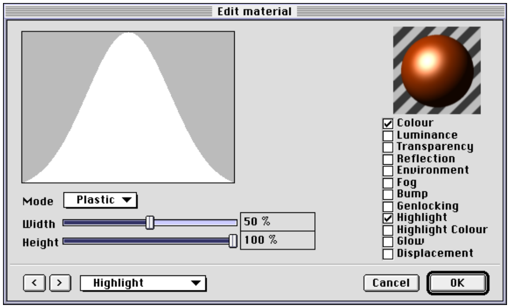
Select the Genlocking option now and go to the Genlocking page. Select the tree texture there, too. Then simply click on the area to be cut out—in our example the blue area around the tree.

CINEMA 4D immediately sets the colour sliders to this colour value and cuts out the background. If you render again, you should now see only the tree without the background.

In the illustration above 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.

A more detailed description of how to work with several materials can be found in the next chapter.

Highlight page



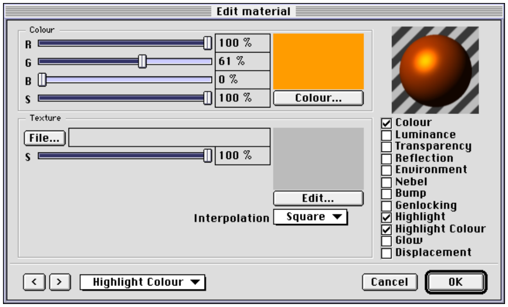
Here you can define the Width and Height of the highlight. If you want a matt surface you should select a broad and low highlight; for polished and shiny surfaces, however, a narrower and higher highlight will be appropriate.

You can also choose between two lighting models for the surface:

With Plastic the colour of the highlight is independent of the colour 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 colour of the highlight is calculated from the colour of the material using a quite complicated process. This lighting model is well suited to matt (i.e. not highly relective) metal surfaces such as silver, brass and gold.

Highlight Colour



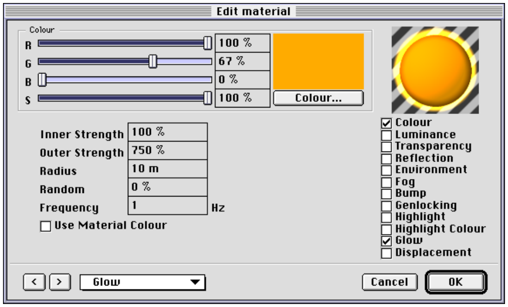
Here you can select the colour of the highlight. The strengths of the Colour and Texture parts are added; for a more natural look, ensure that the combined strength does not exceed 100%.

The Colour here is multiplied with the normal colour of the highlight. If, for example, you have a white plastic highlight, you can define its colour here directly.

The intensity of the highlight is affected by the texture image. 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 colour other than white adds to the realistic appearance of the material.

Glow page



This property enables you to create a glow—a kind of halo that emanates from the object.

'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 density has the same function as for visible light (see Chapter 4). However, it is not conical but follows the contours of the object's surface.

If random values are specified, the intensity of the glow in each animation frame is increased and decreased in a random pattern. The values stand for:

0%	=	no change
100%	=	maximum change

'Frequency' specifies how often you wish the glow to change. The amplitude of the change is given under 'Random'.

1 Hz	=	Glow reaches a new random value after 1 second.
25 Hz	=	Glow has a new value for each frame (for 25 bps), which causes a flicker.

Selecting 'Use Material Colour' causes the glow to be calculated on the basis of the material colour, rather than from the Colour specified here. If this option is turned off, the object colour and the glow colour will be mixed together—green objects, for example, will appear yellowish under a red glow.

Tip:

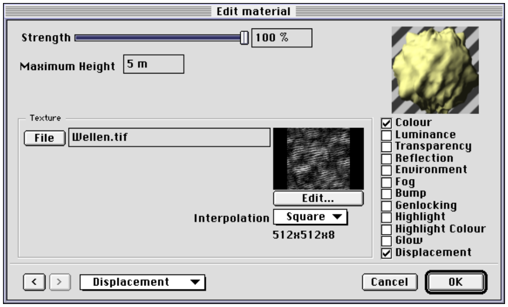
The glow you specify here does not act as a light! In other words, other parts of the scene will not be lit by the glow, nor will any shadows be cast.

Glows cannot be seen through transparent objects, nor in reflections.

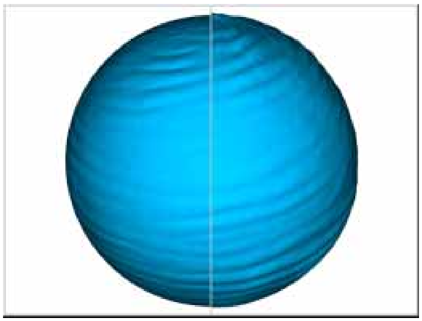
Glows are restricted to a maximum image resolution of 4,000 x 4,000 pixels.

When object motion blur is in use, applying glows to lights may result in an unwanted overlapping of colours.

Displacement page

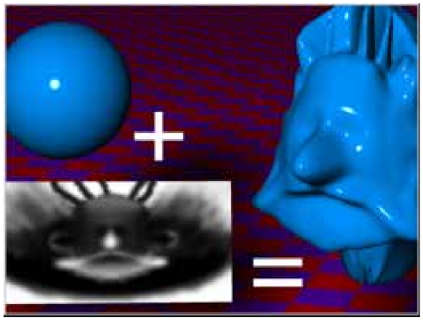


The Displacement property is similar to the Bump property, the difference being that here the object is actually (not just apparently) deformed. This difference is best seen at the edges of objects. Look carefully at illustration below.



A bump texture has been applied to the left half of the sphere, a displacement texture to the right. The bump region is characterised by a smooth edge, the displacement region has distinct deformities—as a consequence of the actual deformation, the shadows on the inside of the object's surface have changed slightly.

You can specify the intensity of the displacement with the slider. 'Max. height' is the distance from the object's surface, which must not be exceeded whatever the setting.

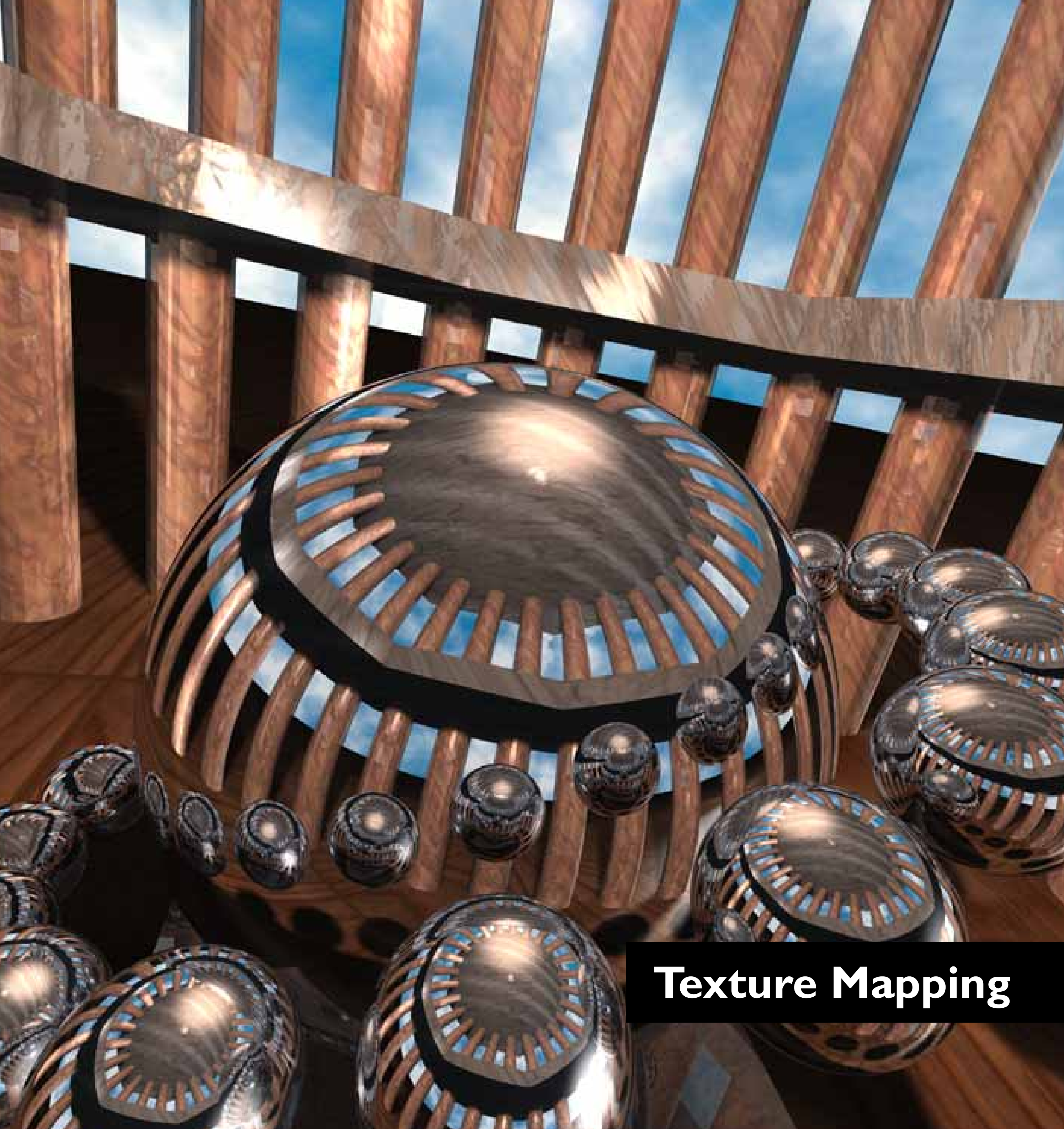


The illustration above illustrates that relatively complex models can be created using relatively simple means.

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.

Tip:

It is in the nature of the displacement effect that the materials must be finely subdivided for this effect to work.

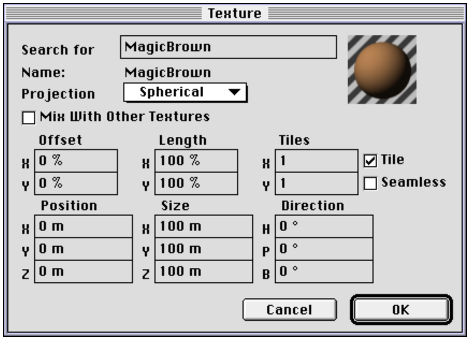


Texture Mapping

Contents

10. Texture Mapping

10.1 Texture Geometry



Let's say you have now modelled an object and created a material for it. If you assign this material to an object (see Chapter 9 - The Material Manager), the Texture dialog opens.

If there are no texture images among the properties of a material, or if you are working with a 3D shader, you can quit this dialog immediately (by clicking OK).

If, on the other hand, you have used a texture image somewhere in your material, you need to tell the program how to apply this. In other words, you need to specify the alignment, measurements, type of projection etc. for the texture.

The text box at the top contains the name of the material. If you want to change to another material, simply enter the name of that material—just type the first few letters; as soon as the correct name is located it will appear below the text entry entry line and a preview image will appear on the right.

At this point you might ask: 'Why do I need to go to the trouble of typing a name of a material? Wouldn't it be simpler to use the file selector?'

Well, imagine if at the start of a project you loaded lots of material libraries into the Material Manager—say 100 types of wood, 50 types of marble, 20 relief textures and 30 backgrounds. You now want to adjust the Mahogany texture. The file selector opens a huge long list. Where is it? ... Ah, must be here somewhere in the middle ... No, lost it, scroll back ...

We felt it would be quicker for you to type two or three letters of the name you want and let CINEMA 4D's powerful search function locate the material for you.

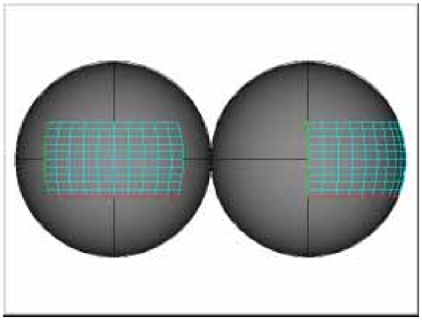
OK, back to the plot. With the Texture dialog for the material on the screen, you now select the type of projection from the dropdown menu and decide if the material is to be added to any other materials (a more detailed description of this follows a little later in this chapter) and you specify 'Offset' and 'Length' for the position and size of the texture image—these are the same values that you can adjust using the mouse in the Editor window with the 'Edit Texture' tool selected (see Chapter 5 - Options).

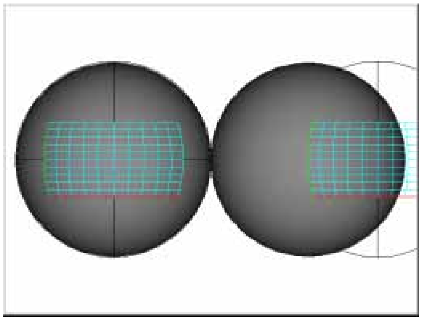
'Offset' is used for placing the texture on the 'envelope' (the texture geometry). 'Length' is for resizing the texture. The X and Y values for the position and dimensions of the texture are always given as percentages, since the actual size is not relevant. A value of 100% for both coordinates means that the texture fully covers its 'geometry'.

The input boxes on the right are for the tiling values. A more detailed discussion follows a little later.

The lower part of the dialog is for specifying the position, size and direction of the ‘geometry’—these are the same values that you can edit interactively by using the ‘Edit Texture Axes’ tool in the Editor (see Chapter 5).

The difference between ‘Edit Texture’ and ‘Edit Texture Axes’ can be seen in the following illustrations. In both a movement was performed in the X direction, in the upper one by using ‘Offset’ (the texture is moved against its ‘envelope’ or ‘geometry’), in the lower one with ‘Position’ (the geometry itself is moved).





Let’s now move on to the different ways of projecting textures onto objects and to the various texture geometries.

10.2 Mapping Types

Mapping is the way in which a texture image is projected onto a surface. This surface is independent of the object's surface, but it may have the same shape (sphere, cube, rectangle ...).

The texture is 'mounted' on a texture surface and this surface is then applied to the object.

The mapping is performed as if the texture were transparent, allowing light to penetrate through to the object's surface.

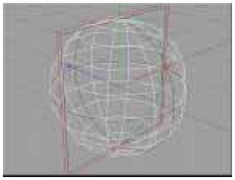
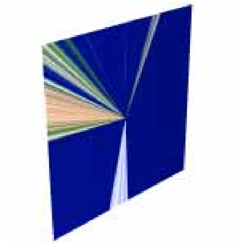
One exception to this is UV mapping (see later). Here the distortion is to the projection itself, in accordance with the changes to the object surface.

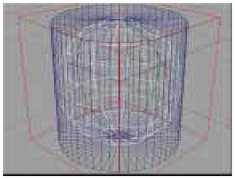
Not all projection types are equally suitable for each object shape. We will demonstrate this for the first three mapping methods: plane (flat), sphere and cylinder.

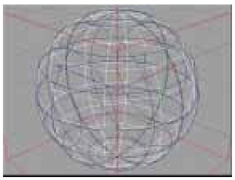
Change to a different mapping type by selecting it from the dropdown menu.

Sphere Mapping

When this projection type is enabled, the texture is projected radially (in the shape of a sphere) onto the object.

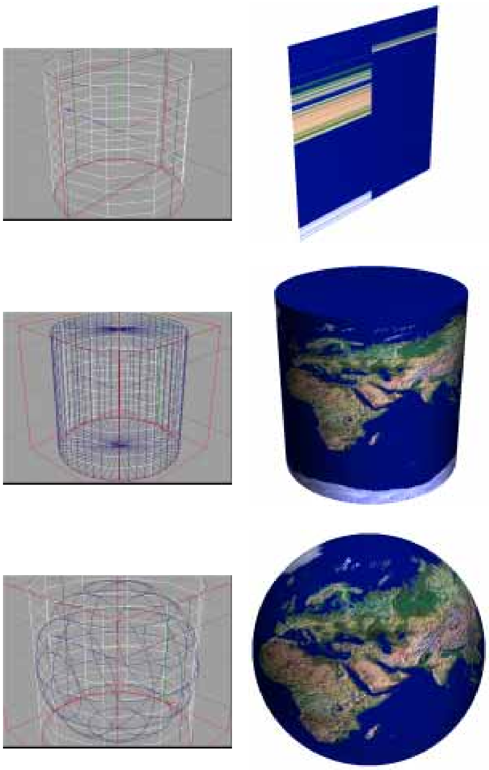



Spherical projection is not advisable for flat objects. You can see that the cylindrical object shows distortions on the flat cover.

Cylinder Mapping

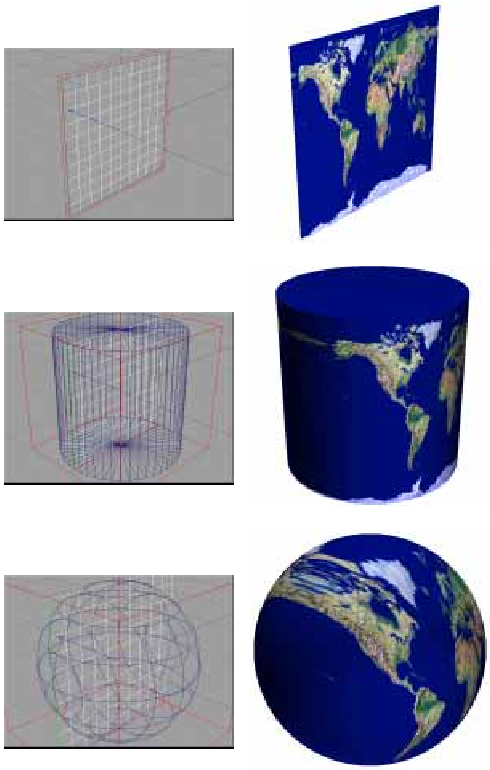
When this projection type is enabled, the texture is projected cylindrically onto the object.



Cylindrical projection is most unsuitable for flat objects. Even on spherical objects, distortions will result. Note that the topmost (and the bottom-most) pixel of the texture image on the cylinder are drawn inwards radially on the cover surfaces. You may want to use different textures for these separate objects.

Flat Mapping

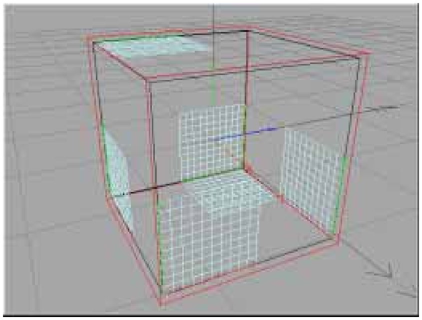
If you enable this projection type, the texture is mapped to the object in a planar fashion.

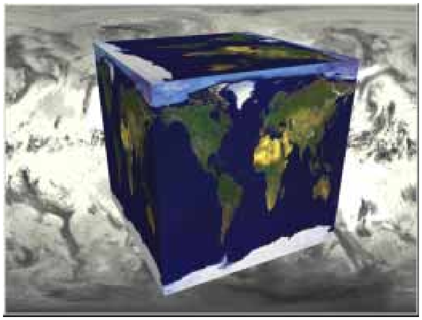


As you would expect, flat projection can really only be applied to flat objects. On circular or spherical objects it will result in distortions, as you can see in the illustrations above.

Cuboid Mapping

If you enable this projection type, the texture is applied to all six faces of a cube.

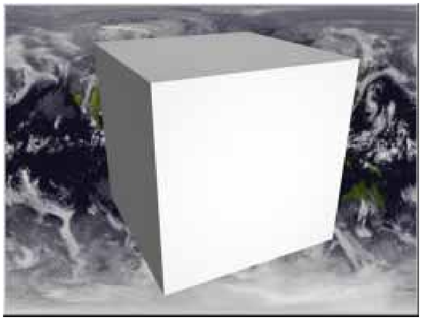


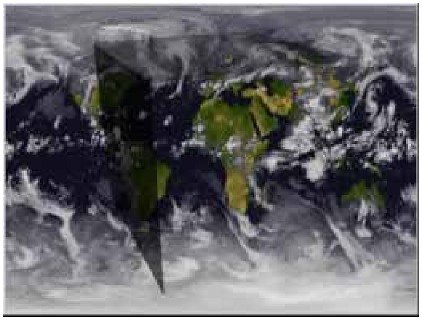


So that you can better see exactly where on the cube the texture is applied, we have halved the size of the texture in the picture at the top. In the lower picture, the dimensions are once again 100%.

Frontal Mapping

When you opt for this projection type the texture is always applied from the camera angle. The texture then coincides exactly with the front and background image (if Offset and Length are the same).





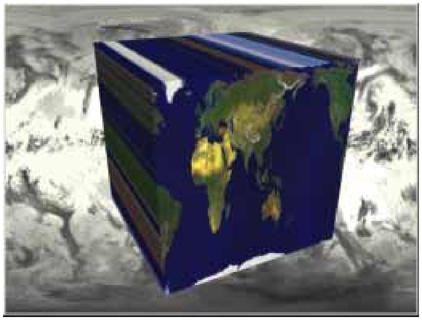
This mapping method produces spectacular effects. It is ideally suited to video compositing.

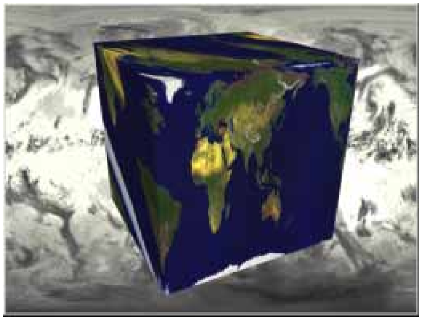
The second picture shows how frontal mapping makes the cube ‘vanish’, with only the shadows remaining. Instead of shadows you could have highlights or similar effects.

Try removing the background image and moving the cube with a position animation ...

Spatial Mapping

This is similar to 'flat' mapping. However, instead of a 'straight' projection to the back, here we have a slanted image, projected somewhat to the right and towards the top (as seen from the front).





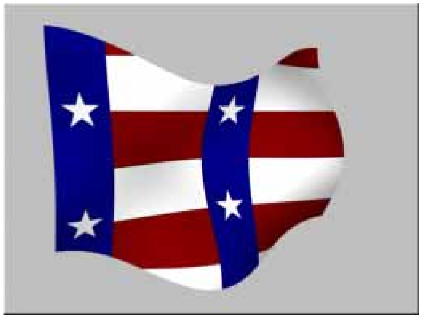
In the first picture, with flat projection, you can clearly see the stripes or bands. In the second, spatial mapping has been used. While you cannot really see the spatial 'spread', it is clear that the bands on the sides of the object have disappeared.

Spatial mapping is not really suitable for photographic images (such as the world map used here), since it tends to create distortion. Much better effects are obtained with plaster or marble.

UV-Mapping

If an object has UV coordinates (see Chapter 6), these can be used for texture projection. In this case, the texture geometry is 'nailed' to the object's surface and is then subject to all movements and distortions that the object undergoes.

In this way you can, for example, create an image of a page in a book which is being turned, with the texture following the curvature of the object. Many basic objects contained in CINEMA 4D have UV coordinates built in (e.g. Loft, Rotate ...).



The top picture uses conventional flat projection, the one below it, UV mapping in which you can see how the texture bends with the movements of the object.

Tip

UV mapping is particularly useful for animations, as it prevents the texture from ’slipping’.

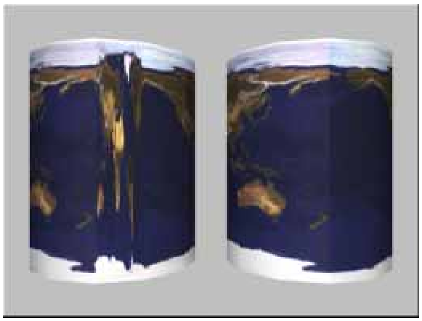
Another important point to note about UV-Mapping is that you must pay close attention to what you are doing with closed objects.

Example

Create a cylinder (appears with UV coordinates). Define a material with a colour texture and place it on the surface using the cylindrical projection. Now switch to UV-Mapping in the texture geometry dialog. (See Chapter 6 - Creation of UV coordinates.)

Open the UV properties in the Object Manager with a double click on the icon. You will find two options, ‘X cyclic’ and ‘Y cyclic’. The first is already activated.

Adjust your viewpoint to look at the back of the cylinder (where the edges of the texture come together) and render. Now turn off the ‘cyclic’ option and render again.



On the left you can see the result with ‘cyclic’ turned off, on the right with ‘cyclic’ turned on. In the former you can see that the texture has been flipped and forced into the last segment of the cylinder. Why?

It is because UV-Mapping influences the points of an object. Textures are fastened to objects at every point, beginning with the first point and ending with the last point. However, the last point is not in the same position as the first point—in other words, there is distance between the first and last points. (You can verify this in the Structure Manager.) Assuming the cylinder has 12 subdivisions, then there will be 2 x 12 points along the perimeter as well as 12 surfaces. (Create a similar plane and you will see that it has also 2 x 12 points but only 11 surfaces.)

When the ‘cyclic’ option is turned off, CINEMA 4D renders forwards for the points 0 to 12, but from point 12 to point 0 (from the last to the first point) it renders backwards—hence the flipped texture. With ‘cyclic’ turned on, CINEMA 4D renders forwards from point 0 to an imaginary point 13.

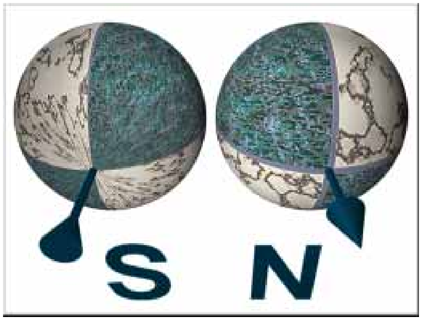
In this special case you must tell CINEMA 4D that an additional fastening point is necessary at the same position as the first point of the object. In this way CINEMA 4D will know that it is dealing with a cyclical, closed surface and that it must interpolate from the last point to the first one.

‘Y cyclic’ works in a similar way to ‘X cyclic’. Note that if the object is closed it makes sense to use both together.

Shrink Wrapping

With this texture projection type the centre of the texture is nailed to the north pole of a sphere and rest stretched tightly over it. The advantage is that the texture only comes together at the south pole, so that, unlike spherical mapping, there is no seam.

The texture image itself is not visible as a whole. Only a circular part of it (with the centre as the hub of the circle) is seen, while the rest is left out.



In the illustration above you can see how the texture meets at the south pole.

UVW Mapping

One type of mapping has not been mentioned so far. It does not appear in the dropdown menu but can be selected from the Object Manager, via the Function menu. This is UVW mapping.

The reason for UVW mapping being treated differently is that it does not apply to textures.

Even though, as with UV mapping (see Chapter 6 - Texture), coordinates are created, these are not two-dimensional, touching only the object's surface, but extend in three dimensions. What on earth do you need this for?

It is quite simple. UV coordinates help to prevent slippage of 2D textures in animations. But CINEMA 4D also works with three-dimensional textures, the 3D shaders. Here, nailing something down in two dimensions would have little effect.

We need to create nail coordinates. These are in effect a snapshot of the points of the active object. If the points are subsequently distorted, either during the animation or by the Structure Manager, the 3D shader can revert to the original points.

Moreover, UVW mapping can also play an important role in combination with the mapping types described earlier in this section. Take any object and cover it with textures, then enable UVW mapping. From then on, all models are calculated in relation to the time of the ’fixation’. Even things which usually hinder mapping (morphing, magnet, bones ...) can no longer change the object.

Tiling Texture

Enabling this option will cause infinite repetition of the texture image.

At first, this effect is not visible. However, if you reduce the texture in size (Edit Texture / Scale) it becomes evident.

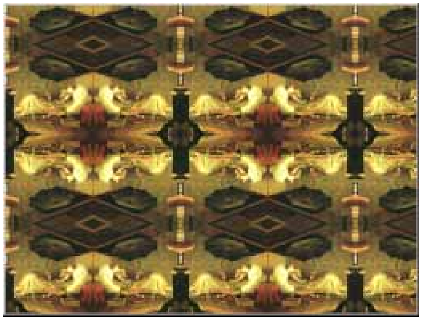
If this option is disabled, the texture image is simply ‘stuck’ to the surface (just like a sticker on a suitcase). If the object has other textures (materials - see later), these may be visible outside of the area taken up by the label. If there are none, the CINEMA 4D default material covers those areas.

Tip:

2D and 3D shaders are not tiled. They continue endlessly (with the option turned on) until the entire object is covered, without creating any seams. Whether or not a repetitive pattern occurs depends on how the shader has been programmed.

Seamless Tiling

If the ‘Seamless’ option is enabled, tiles are joined by mirroring them. This prevents seams being seen when using textures that cannot be arranged as seamless tiles.



In the above example, the same texture image was used as on the left, but this time with seamless tiling. Even if in this particular case the result is quite nice, this option is less suitable for images than for patterns.

There is one exception: the sky. Generally, images of clouds are placed on the sky. If you then pan through the landscape with your camera, sooner or later you will see hard edges. You can prevent this by specifying an even number for the tiles and enabling the Seamless option.

Number of Tiles

You can enter values for X and Y to determine how many times a texture image will be tiled within a texture. CINEMA 4D calculates the tile size on the basis of the current size of the texture. If, for example, you have scaled the texture in such a way that its size is 25% in direction X and 50% in direction Y, the texture will fit four times (1.0/0.25) in direction X and twice (1.0/0.5) in direction Y.

If you now change the X or Y number, this will also automatically change the size of the texture. For example, by changing the number to 3, the texture shrinks from 50% to 33%. You can see this immediately when you click OK to close the dialog.

Labels

OK, so now you know how to apply textures, how to enable and disable tiling and how to prevent seams. Just wait till you learn how to stick a label on a bottle!

This is how it's done:

- Open the Texture dialog.
- Disable tiling.
- Ensure that only one tile is created in both the X and the Y directions.

And that's all there is to it. Even though in most cases your texture will now cover the entire object, all you need to do is reduce its size.

The quickest way to do this is in the Editor. Enable the 'Scale' and 'Edit Texture' tools and shrink the texture. Then switch to 'Move' and position the texture where you want it.

Mostly this technique will cause a texture to become a little distorted. Don't despair, there is a trick. Open the Texture dialog and enter the dimension of your texture in the 'Length' boxes. Since the length must not exceed 100%, you may need to divide the values.

For example, if your texture is 800 x 600 pixels, you might specify the lengths like this:

X	Y	Conversion factor	
80	60	/ 10	
8	6	/ 100	
32	24	/ 100 x 4	etc.

10.3 Multiple Textures

CINEMA 4D lets you define as many materials or texture geometries on an object as you like. Again, think of the stickers on your suitcase. You have an object with a basic material (that's the suitcase) and stuck on it a variety of different materials (the stickers).

The original material that the suitcase is made from (aluminium, leather, cardboard ...) is no longer visible in the places that are covered by the stickers. And if you have too many stickers, they may overlap, with the top ones (partially) covering up the ones below. If you want to see an old sticker, you may have to remove a newer one, or cut a hole in it.

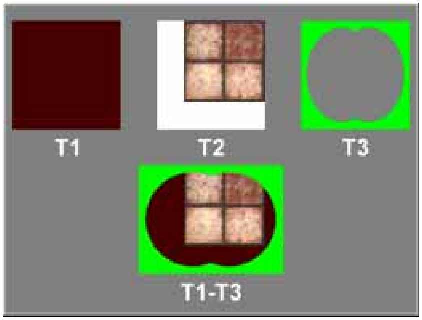
This works well as an analogy for CINEMA 4D. Your object has a basic material, on which can be placed a number of other materials. If you want to still see what is underneath, you must shrink the material that's on top. You do this by scaling the texture geometry and disabling tiling (see 'Labels', earlier in this chapter). If one material is completely covered by another but you want to still see the one that's underneath, then you have to cut a hole in the top one uising the Genlocking property.

So now you are left with the question: Which is the basic material of the object, and which is the topmost sticker?

That's simple. If you assign multiple materials, the Object Manager stores these as object attributes in the order in which they are assigned. The material on the extreme left is at the bottom, the material on the extreme right is at the top. You can change this order by using drag-and-drop.

Tip:

The Transparency material property does not allow underlying materials to show through. Instead you must use the Genlocking property.



In the above example, a simple colour was defined for material T1, a texture image for T2 (which was tiled and scaled slightly), while T3 had an area punched out by Genlocking.

In the Object Manager these textures are ordered T1-T2-T3, from left to right.

Since T3 (the topmost texture) has a hole in it (Genlock), the underlying materials T1 and T2 are visible, and since T2's texture has been shrunk, with tiling disabled—that's important because it stops the entire object surface from being covered—part of T1 is still visible.

Experiment:

Take a single quadrangle using 'plaster' or 'stone' as its basic material and turn it into a picture gallery uisng multiple textures (there are some paintings on the CD).

10.4 Additive Textures

Let's say you have a single quadrangle and a single striped texture and you are asked to make a relief with this texture covering the entire surface of the quadrangle. No problem. But then on this large relief you are asked to place another relief, using the same texture image, but smaller and rotated. Surely that's impossible!

Not at all, CINEMA 4D can do it.

The secret is the 'Mix with Other Textures' command, which is incredibly powerful. It allows new textures to be mixed in with existing ones so that property parameters are added.

The sum of the colours 100/0/0 (red) and 0/100/0 (green) will give 100/100/0 (yellow). But if the green colour has a strength of only 50%, this will mean that only 50% of that part is added, resulting in 100/50/0 (orange).

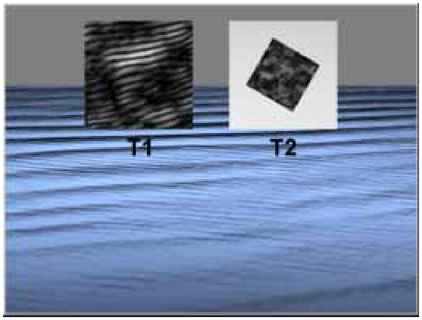
Impossible values are 'cut off' at the maximum—adding 100/0/0 and 100/100/0 will not return 200/100/0, but 100/100/0.

Certain parameters, such as Decrease in the Fog property and the refraction index in Transparency, are not added (otherwise two materials with a refraction index of 1 would result in a refraction index of 2); these are copied from the additive material only if Transparency or Fog is enabled.

Tips:

- You can add any number of textures.
- You can add the following properties: colour, transparency, reflection, bump, displacement and luminosity.
- Properties are evaluated only if they have a checkmark (enabled) for the particular materials. Even the Displacement property is additive.
- Genlocking punches out areas where the additive material is not to be added.
- You cannot add 3D shaders.
- Additive textures (those with a checkmark) must be located in the Object Manager to the right of the texture to which they are to be added.
- All textures to the right of the first additive texture, up to the next non-additive texture (unchecked), are added.
- The Transparency property does not allow any underlying materials to show through. Instead you must use the Genlocking property.

But now let's return to our example: the small, rotated relief on the large relief.



In the foreground above you can see the overlap between the coarse relief (T1) and the fine relief (T2). To better illustrate the scaling and rotation of the additive relief, tiling has been disabled for T2 (for the final render it has been enabled once again).

10.5 Mixed Textures

We have seen how multiple materials can be both used and added onto one object. Say we now want to combine these two techniques—multiple materials on one object, adding some of them to others.

Example:

Five textures—T1, T2, T3, T4 and T5—have been placed on our object. Their priority is from left (T1) to right (T5).

- T1 and T4 are ordinary materials.
- T2, T3 and T5 are additive.
- T3 and T4 have had genlocking applied.

Let's analyse what is happening to these materials:

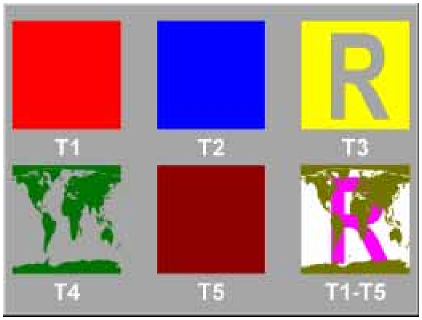
T2 and T3 are added to T1. Although T2 and T3 have higher priorities than T1 (further to the right in the Object Manager), they are still connected to it additively.

In those places where T3 has been punched out (genlocking), only T1 and T2 are added. In other words, T1, T2 and T3 are added only where T3 is not genlocked.

Since T4 has a higher priority than T1, T1 (and also T2 and T3) will not be visible; but T4 also has genlocking applied, which means that T1, T2 and T3 are visible through all areas in T4 that have been punched out.

In all parts of T4 where genlocking is not active, T4 and T5 are added.

The following pictures illustrate the above. Since colours are used here for mixing the materials, it will be well worthwhile viewing the PDF file we have supplied with CINEMA 4D.



T1 has the RGB values 100/0/0 (red); T2 is 0/0/100 (blue). Added together this gives 100/0/100 (magenta) and you see this colour at bottom right through the punched out 'R'.

T3 has the values 100/100/0. Added with T1 and T2 this would result in 200/100/100. But since no colour can be more than 100%, this value is reduced to the maximum of 100/100/100 (white).

T4 has the RGB values 0/100/0 and T5 is 100/0/0, both colours with a 50% strength. So T4 is dark green, T5 dark red. The combined colour is 50/0/50 (olive green), the colour you see in the world map.

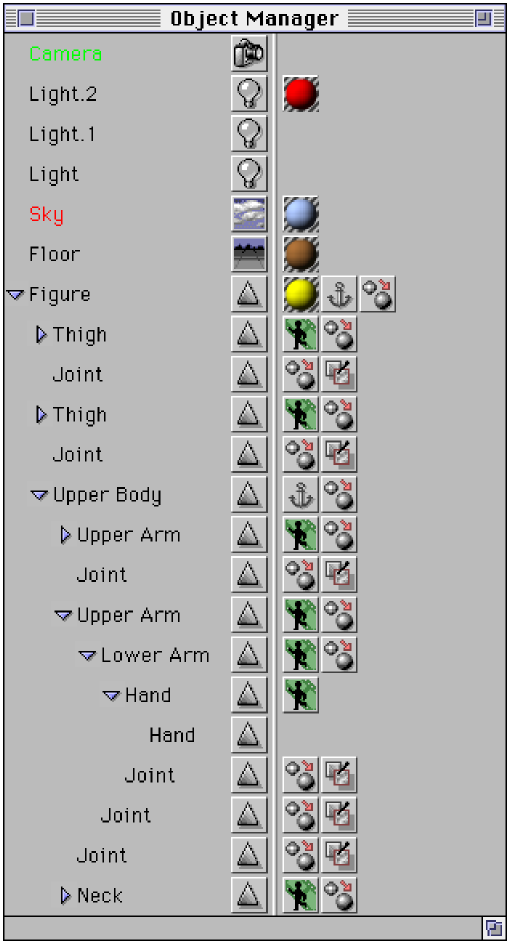
Experiment:

Try to reconstruct this example, or a similar one. Work out in your head what effect adding a new material or a new material property will have, then render each step and see if what you get is what you expected; if not, think about it again and try to work out what has actually happened.

Object Manager

Contents

11. The Object Manager



The Object Manager is the heart and soul of CINEMA 4D. It is used to activate objects (including those that are not visible in the Editor), change the object hierarchy and manipulate properties of objects.

The left half represents the object hierarchy as a tree structure. You can collapse and expand object groups, just as you can on the desktop of your system. Using drag-and-drop you can regroup and copy single objects or object groups. The appearance of the icon tells you what type of object you are dealing with. These object types will be described later on.

The right-hand side contains icons representing the object properties, such as material and view. Again, these properties can be moved and copied to other objects by using drag-and-drop. Properties will be described later in this chapter.

Click the right mouse button to open a context sensitive menu containing further options. (Macintosh users hold down the Apple key while you click.)

All menu commands within the Object Manager apply to the selected object.

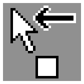
Drag-and-drop in the Object Manager

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.

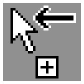
When working on the left-hand side of the Object Manager you can click on either the object name or the type symbol to the right; working within the right-hand half you click on a property icon.

To re-arrange objects:

Drag an object between two others or to the end of the list. While dragging, the mouse pointer has this appearance:

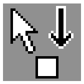


If you wish to move a duplicate, rather than the original, use Ctrl-drag and the mouse pointer will look like this:

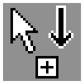


To change the object hierarchy:

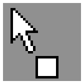
Drag the object on top of an existing one in the list. This makes the dragged object a child of the other. The mouse pointer will look like this:



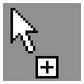
If you wish to create a duplicate, use Ctrl-drag and the mouse pointer will look like this:



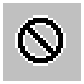
You can also use drag-and-drop in the right-hand half of the Object Manager. To assign the property of one object to another, drag the property icon onto the line of the other object. The mouse pointer will look like this:



If you wish to create a duplicate, use Ctrl-drag and the mouse pointer will look like this:



If an operation is not available, this symbol appears:

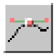
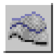
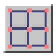
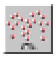
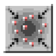
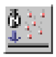
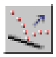
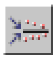


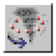
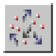
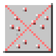
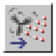
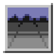
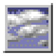
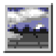
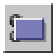
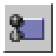
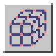
The table below lists the mouse editing features within the Object Manager.

Function	Action
Select object	Click on object
Rename object	Double-click on object name
Activate object type	Click on type icon
Edit object	Double-click on type symbol
Activate property	Click on property icon
Edit property	Double-click on property icon
Move object or property	Drag-and-drop
Copy object or property	Ctrl-drag-and-drop
Collapse/expand hierarchy	Click on icon before name, or press Return
Select previous/next object	Up/down arrow keys
Open menu	Right-click on name, type or property icon (Macintosh: Apple key and mouse button)

Every CINEMA 4D object has a type—a simple polygon or a complex particle system emitter, for example.

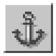
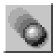
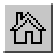
Double-clicking on a type icon opens the dialog for that type of object. These are described in chapter 4.

Type	Icon
Polygon	
Perfect sphere	
Spline	
NURBS-Extrude	
NURBS-Lathe	
NURBS-Loft	
NURBS-Sweep	
NURBS-Bézier	
Partikel-Emitter	
Particle-Attractor	
Particle-Gravity	
Particle-Deflector	
Particle-Friction	

Particle-Rotation	
Particle-Turbulence	
Particle-Destructor	
Particle-Wind	
Camera	
Floor	
Sky	
Light source	
Environment	
Foreground	
Background	
Bone object	
FFD object	

A CINEMA 4D object can have several properties. For example, it can be a material and have the ability to receive shadows.

Double-click on a property icon to open the dialog for that property.

Property	**Icon**
Display	
Smoothing	
Protection	
Shadow	
Textur e	
UVW coordinates	
UV coordinates	
Anchor	
Inverse Kinematics	
Activate	
Object motion blur	
URL address	

11.1 The File menu

Load Object

This command allows you to load any file that contains object information (DXF format, CINEMA 4D format, Illustrator path, etc.). All objects, including their materials and animation data, will be imported into your current document.

Save Object As

This command saves the active object. The standard Save dialog appears.

Display Attribute Icons

If you do not need the object type or attribute icons to be displayed, or if your work area is getting crowded, you can prevent them from being shown by using this command. You then see in the Object Manager just the object tree.

Close

This command closes the Object Manager and its window.

11.2 The Edit Menu

Undo

This command cancels the last change to the scene. By repeatedly using Undo you can retrace your steps.

Redo

When you have used Undo once too often, the Redo command will restore the last undone command.

Cut

This command removes the active object and copies it onto the Clipboard from where it can be inserted again by using the Paste command.

Copy

This command copies the active object onto the Clipboard from where you can paste it back into the document as many times as you like.

Paste

This command pastes the object from the Clipboard back into the document.

Delete

This command deletes the active object without copying it onto the Clipboard.

11.3 The Function Menu

Edit Property

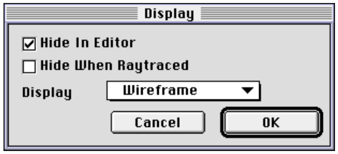
This command lets you edit the activated attribute of an object in a special dialog. Alternatively, you can simply double-click on the property icon to open the same dialog.

Yet another way of opening the Edit Property dialog is to double-click on the object in the Editor window. When editing splines you can click on their control points to open the dialog for editing the tangents.

New Property

This command lets you add a new property to an object.

Display



Hide in Editor

When this option is selected the object is no longer displayed in the Editor, although it will still appear in the render.

Hide in Raytracer

When this option is selected the object is displayed in the Editor (unless Hide is selected there also), but is not rendered.

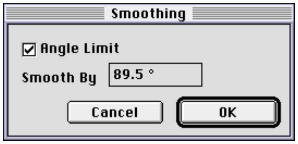
Display

CINEMA 4D lets you choose between different display modes for objects. (These were discussed in Chapter 3.) Ensure that in the Editor you have selected View / Display Mode / As preset. Only then does CINEMA 4D check the individual settings for each object.

The choices are Gouraud Shading, Flat Shading, Wireframe, Cuboid and Skeleton.

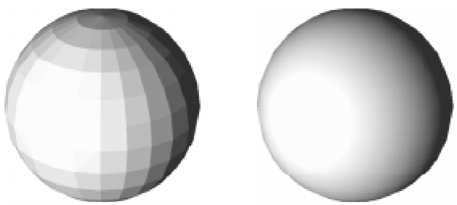
These display modes affectz all child objects of the active object.

Smoothing



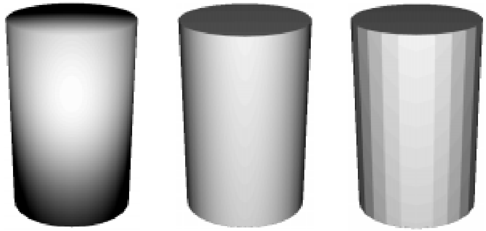
'Smoothing' (Phong Shading) is an inbuilt CINEMA 4D feature which gives a smooth, rounded appearance to the surface of objects that have been constructed from triangles and quadrangles. It is actually possible to make a sphere built from a hundred triangles, which will normally be faceted, appear almost indistinguishable from a perfect sphere.

The only visible difference is at the visual edge of the sphere, since the silhouette of an object that is not mathematically perfect always remains at best a little jagged.



The dialog lets you specify up to what angle smoothing should occur between two adjacent surfaces. Select the 'Angle Limit' option and enter a value for 'Smooth by'.

An example will illustrate this. A simple cylinder, with its structure connected and optimised, serves as the test object. The illustration below shows (from left to right) smoothing without angle limit, with an angle limit of 89.5˚, and no Smoothing.



When objects have been processed with the smooth function, CINEMA 4D has to assume that the surfaces—and therefore the normal vectors of the surfaces—are aligned uniformly. If this is not the case, anomalies may occur in the shading when rendering.

All the basic shapes in CINEMA 4D are aligned.

'Smoothing' is a good way to economise on computing time and memory. Using conventional methods you would have to subdivide a circular or spherical object into several thousand triangles to make it appear smooth.

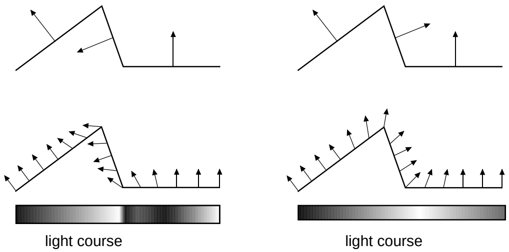
Note that 'Smoothing' is possible only if adjacent surfaces have points in common.

How smoothing works:

During rendering, for each surface which is to be lit the program creates a normal vector from its corner points. Brightness and colour of a point are calculated on the basis of the angles which the normal vector forms with the rays of the camera and the light sources.

Normally, two adjoining surfaces will have a 'hard' transition, since each surface has its own normal vector. This will cause 'brightness jumps' at the edges. Selecting the 'Smooth' option forces the normal vector to be interpolated, resulting in a soft transition from the one vector to the other.

When rendering without ‘Smoothing’ it is of no consequence whether the normal vector starts on one side or the other of a surface. However, when interpolation is involved, the normal vectors must be correctly aligned.



At top-left in the above illustration you see two surfaces meeting whose normal vectors are variously aligned (upwards and downwarda), even though they are all perpendicular to the surfaces. The smoothed result is shown below it. Some of the interpolated vectors are tilting to one side, some to the other, which causes unwanted black bands and spots on the illuminated surface.

On the right of the above illustration you can see how it should be done. The normal vectors of the surfaces all point to the same side. Interpolation causes them to incline as if the surface was truly curved, rather than angular, resulting in a soft transition.

Keep in mind that it is important to ensure that all normal vectors of an object point to the outside, or in at least the same direction. Newly created objects will have correctly aligned normal vectors and require no editing.

Tip:

If this problem occurs, use the Options / Structure / Align Normals command to correct it.

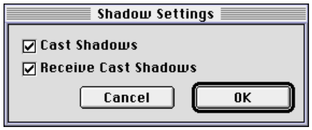
Protection

An object that is given the Protection property cannot be moved, rotated or scaled. This is particularly useful for cameras. Only too easily can it happen that you forget to switch from Object camera to Editor camera, and before you know it you have lost your settings ...

If you wish to make changes to a protected object, you must first remove the Protection property.

This property does not have a dialog .

Shadows



This attribute determines the shadow behaviour of an object. By default, any object created with CINEMA 4D casts shadows onto other objects and displays shadows cast by other objects on its own surface.

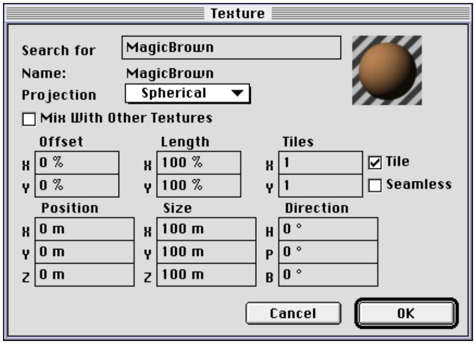
Cast Shadows

When this option is deselected the object casts no shadows. Take a close look at the Dolphin scene on the CINEMA 4D CD. The animals swim very slightly above the seabed; if they were to cast shadows, the scene would look unnatural.

Receive Cast Shadows

When this option is deselected, other objects no longer cast shadows onto this one. You can save much computing time by using this option. If for example you have placed your objects on a black floor, switch off the objects’ ‘Cast Shadows’ option or, alternatively, the floor’s ‘Receive Cast Shadows’ option.

Texture



The dialog associated with this function is described in detail in Chapter 10.

The command is used for creating a new texture, which initially is not assigned a material. If however you assign a material to an object, this automatically creates a texture.

To assign a material, enter into the 'Search for' text box the name of a material that is already loaded in the Material Manager.

Objects can be assigned any number of textures. If an object owns several, these may be re-arranged using drag-and-drop. The further to the right a texture is located in the Object Manager, the higher its priority. The texture on the extreme right covers all other textures unless it has space limitations or Genlocking.

Tip:

The texture geometry of an object will be the same for all hierarchical sub-objects. If a sub-object needs to have a different material to the others, it must be allocated separately to that sub-object.

Attention:

The above rule does not hold true for light sources. Instead you can automatically allocate gels for all other sub-lights.

UVW Coordinates

This command fixes a texture to an object. It will then undergo any movements or deformations that are applied to the object. This is particularly sensible and useful when working with Bones. Texture fixing is described in Chapter 10 - Texture projections.

This command does not have a dialog box.

UV Coordinates

This command defines how UV mapping acts on an object. This projection type is described in more detail in Chapter 10 - Texture projects.

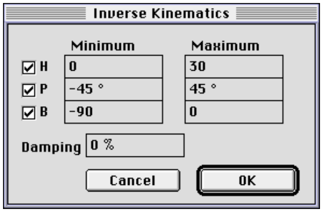
Anchor

When using Inverse Kinematics you do not always want all parent objects to be affected. In such a case, you can use this command to define an object as an anchor or starting point for a new Inverse Kinematic chain. This object then remains unaffected, and stays in place.

The human figure that is supplied with CINEMA 4D, for example, has its upper body defined as an anchor. This means that you can drag the hand, and the lower and upper arm, but not the figure itself.

This command does not have a dialog.

Inverse Kinematics



When using Inverse Kinematics, both within the Editor and in animations, it may be necessary to restrict the movement of joints to avoid unnaturally twisted arms and legs.

Heading, Pitch and Bank can each be specified separately by giving a minimum and a maximum value. In addition, you can specify a damping factor. The higher you set this, the more restricted is the movement of the joint.

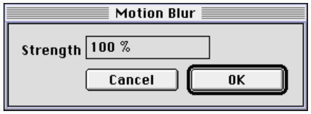
Activation

A number of CINEMA 4D features, such as FFDs and bones, need to be activated before they become effective. When first calling up FFD, this happens automatically.

The Activation command can switch these features on and off as you need them. To switch them off, simply delete the attribute icon. The object which has been distorted by bones or FFDs is then restored to its original state.

This command does not have a dialog box.

Motion Blur

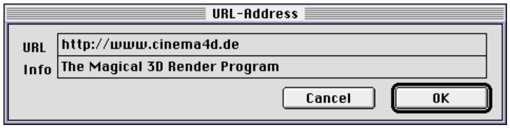


Use this command to assign to each object its own specific blur. To calculate object motion blur, this option needs to be selected in the Render Settings. ‘Strength’ indicates the degree of blurring. A value of 100% indicates that the object will be blurred over the entire interval between one frame and the next.

’Strength’ can be a negative value. This causes the object to be blurred in the opposite direction to the motion.

In order to achieve particularly strong blurring, you may set a value greater than 100%.

URL address



This attribute is used when creating virtual worlds for the World Wide Web. It assigns an Internet address to an object.

If you have a scene in the form of a VRML file, this can be displayed in a Web browser. Clicking on an object with the URL address attribute will load the linked page.

URL is the target address. Make sure you indicate a full address (including http://, ftp://, shttp://, …).

Under ‘Info’ enter the explanatory text that will appear when you move the mouse cursor across the object in your browser. The information appears in the same way as the tooltips do in CINEMA 4D.

Copy Property to Child Objects

This command should therefore be applied with caution, especially when you are working with large scenes because it will copy all active properties to *all* child objects of the active object.

If any of the child objects already have the same properties (but possibly with different settings), these will be irretrievably overwritten.

Delete Child Object Property

Think carefully before using this command because it has the opposite effect to the previous one. It irretrievably deletes the active property of the selected object and of all its child objects.

Edit Object

This command lets you edit the object type. The dialog is the same as described in Chapter 4 - Object. Double-clicking on the object icon will have the same effect.

If an object type cannot be edited (a polygon, for example), the Rename dialog appears instead (see below).

Rename Object

This command will let you change an object's name. Alternatively you can double-click on the object name to open the same dialog.

Group Objects

This command lets you combine several objects in the Object Manager into a new group. After selecting the command a crosshair appears allowing you to drag open a bounding box. In order to maintain the object hierarchy, all child objects are included.

Expand Object Group

This command ungroups objects that were part of a group, or dissolves the object hierarchy, by placing child objects on the level of the parent.

Note that just as Group Objects creates a group object, this command will delete it.

Use As Camera

This command turns the active object into the object camera. The view is from the object axis centre along the local Z axis.

This allows you, for example, to judge the lighting of a scene by looking through the various light sources. Note that you need to align point-shaped light sources to objects or object groups—unless, that is, you desperately feel the need to stare into empty space.

Information (Object)

This command displays important information about the active object: name, type, memory usage, number of points, edges, triangles and quadrangles, number of child objects.

Information (Scene)

This command displays important information about the scene as a whole: memory usage, number of objects in the scene, total number of points, edges and surfaces.

No object needs to be selected when you call up this function.

Search Active Object

You can select an object in the Editor window by clicking on it. It is possible however that the object you are after is deeply embedded in the structure

If you use this command, the tree structure of the Object Manager is expanded to show that particular object.

Fix Bones

If your bones are in the position from which you want to distort the object, you need to let CINEMA 4D know. Do this by calling this command, which will automatically set the activation symbol (see above) for all bones, starting from the active one.

Reset Bones

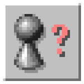
This command restores the original position of the bones and automatically deletes the activation symbol (see above) for all bones, starting from the active one.

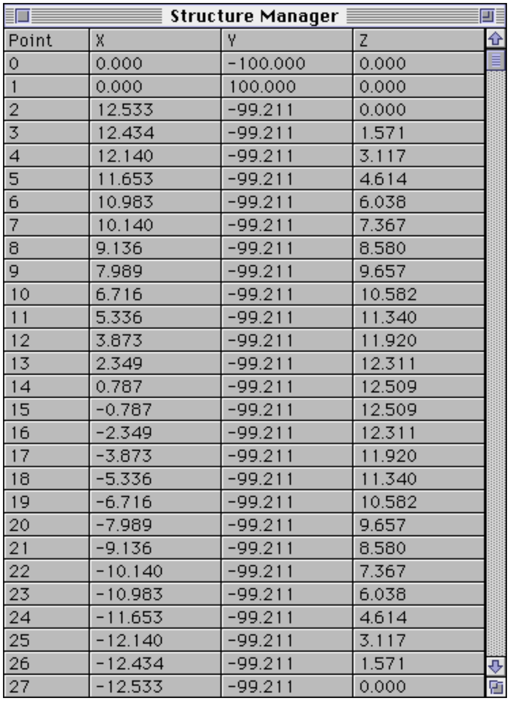
The distorted object will appears as it was when last fixed.

Structure Manager

Contents

12. The Structure Manager





Structure Manager

Point	X	Y	Z
0	0.000	-100.000	0.000
1	0.000	100.000	0.000
2	12.533	-99.211	0.000
3	12.434	-99.211	1.571
4	12.140	-99.211	3.117
5	11.653	-99.211	4.614
6	10.983	-99.211	6.038
7	10.140	-99.211	7.367
8	9.136	-99.211	8.580
9	7.989	-99.211	9.657
10	6.716	-99.211	10.582
11	5.336	-99.211	11.340
12	3.873	-99.211	11.920
13	2.349	-99.211	12.311
14	0.787	-99.211	12.509
15	-0.787	-99.211	12.509
16	-2.349	-99.211	12.311
17	-3.873	-99.211	11.920
18	-5.336	-99.211	11.340
19	-6.716	-99.211	10.582
20	-7.989	-99.211	9.657
21	-9.136	-99.211	8.580
22	-10.140	-99.211	7.367
23	-10.983	-99.211	6.038
24	-11.653	-99.211	4.614
25	-12.140	-99.211	3.117
26	-12.434	-99.211	1.571
27	-12.533	-99.211	0.000

The Structure Manager displays a list of all the points, edges, triangles and quadrangles that are part of the active object.

If the Edit Points tool is selected, the point number and the X, Y and Z coordinates are shown.

If the Edit Edges tool is selected, the edge number as well as the point numbers of the start and end points are shown.

If the Edit Triangle tool is selected, the triangle number as well as the three point numbers of the triangle are shown.

If the Edit Quadrangle tool is selected, the quadrangle number as well as the four point numbers of the quadrangle are shown.

If the Edit Texture tool is selected, and if UV coordinates have been created on an object, the number as well as the U and the V coordinates are shown.

If you select elements in the list, these are activated in the Editor, and vice-versa.

12.1 The File menu

New Element

Adds a new element to the object. Depending on the tool, this can be a point, an edge, a triangle or a quadrangle.

Load ASCII

CINEMA 4D can read point data from other applications, provided they are available as ASCII files and have this format:

<Number of points>
<X1 coordinate> <Y1 coordinate> <Z1 coordinate>
<X2 coordinate> <Y2 coordinate> <Z2 coordinate>
<X3 coordinate> <Y3 coordinate> <Z3 coordinate>
etc.

The following example creates a polygon with three points:

3
100.1 47.0 14.0
200.0 89.3 14.0
300.0 33.0 14.2

The three-dimensional coordinates of a point must be separated with a space. Each line must contain the coordinates of only one point. The lines must be separated with a Return character. The text line must not contain units such as ‘mm’ or ‘km’.

If the Structure Manager already shows point data, the freshly loaded ones are appended to the list.

Tip:

A cluster of points does not make a 3D object. You must manually describe the surfaces.

This is how it’s done:

- Choose the Edit Triangle or the Edit Quadrangle tool, depending on what shape you want to edit.
- Hold down the Ctrl key.
- Click in turn on the points that you want to define the new shape.

  After the third or fourth click, CINEMA 4D automatically creates a new triangle or quadrangle.
- Repeat these steps until your new object is ready.

Save All Points As ASCII

CINEMA 4D can export point data into other applications. They are output in the format shown in the previous paragraph.

All points of the object are saved.

Save Active Points As ASCII

This command works like the previous one, but saves only the active points.

World Coordinates

This lets you switch the display of point coordinates from local object to world coordinates. The local object coordinates relate to the axis system of an object, whereas the world coordinates determine the actual ‘global’ position.

Only Active Elements

If you have selected, for example, 10 points from an object that has several thousand, these are not necessarily side by side but may be scattered over a wide area. It is therefore nearly impossible to locate a particular point in the selection.

This command will display only the selected elements in the list and hide the rest, which makes editing considerably easier. Selecting the command a second time will restore the entire element list.

Tip:

Deselecting elements is not possible in this view.

Close

Closes the Structure Manager

12.2 The Edit Menu

Undo

Undoes the last command and restores the object to its previous state. You can retrace up to 10 commands.

Redo

Restores the state prior to the Undo command. You can restore up to 10 command in this way.

Delete

Deletes the activated elements.

Select All

Selects all elements.

Deselect All

Deselects all elements.

Invert All

Inverts the (de)selection of elements.

12.3 The Object Menu

Split

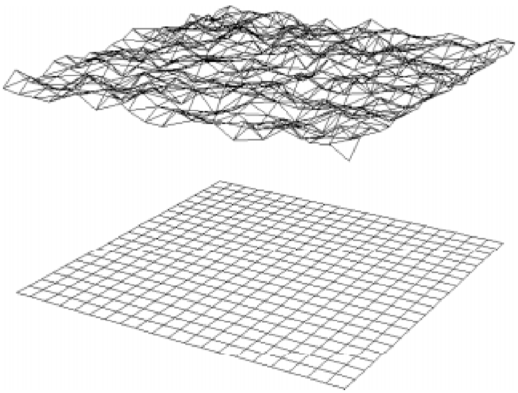
This command creates a new object from the selected elements. The active object remains intact.

If you have selected points, all these—and all edges and surfaces attached to them—are added to the new object. Equally, if you have selected edges, all attached points and surfaces are used. All activated elements and all parts that are completely attached to these form part of the new object.

This command is very useful for disassembling existing objects into their component parts.

Level

This command moves all active points to a common plane.

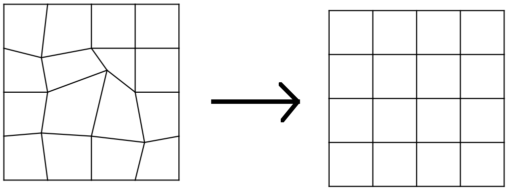


The points are moved only in the local Z direction so that they are on a common XY plane.

Align to Grid

In many cases, it is useful to position points precisely on a grid. If you have omitted to enable the Move Grid function in Preferences you can do this now. This command positions all points to grid intersections.

The dialog box lets you specify the grid width separately for the X, Y and Z axes.

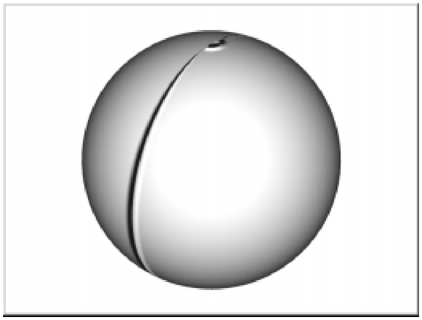


Reverse Normal

This command reverses the direction of the normal.

As was mentioned earlier (in the section on View / Display / Option / Back face culling) this depends largely on the alignment of the normals. If for example you draw the back of an object instead of its front, its normals will point in the wrong direction, i.e. towards the object's interior, and would have to be reversed.

Another function that relies on the alignment of the normals is the Smooth command within the Object Manager. Imagine a shaded object that has abrupt brightness 'jumps' (see the illustration: here, the surface normals of the squares of a hemisphere were intentionally reversed), one part of the surfaces will have their normals reversed. Select these triangles or quadrangles and reverse their normals.



Change to Spline

Using the point or edge tool select several points or edges of an object. The Change to Spline command will then convert the selection to a spline, where the point selected last is the start point of the spline.

12.4 The Splines Menu

Hard Interpolation

The tangents of the selected spline control points are set to zero.

Tip:

This command works only with Hermite splines.

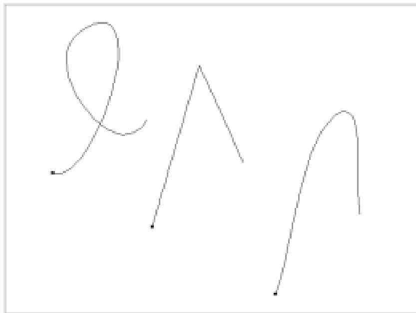
Soft Interpolation

This command does not undo the hard interpolation but re-creates the tangents so that a smoother curvature is achieved.

Tip:

This command works only with Hermite splines.

The following illustration shows an example of hard and soft interpolation.



The spline on the left is the original. In the centre, the three control points (start, centre, end) were selected and hard interpolation applied. On the right you see the result of converting from hard to soft interpolation.

Move Down Sequence

This command lets you decrease all point numbers by one: point 2 becomes point 1, the earlier point 1 becomes point 0, and so on. Point 0 becomes the last point.

Move Up Sequence

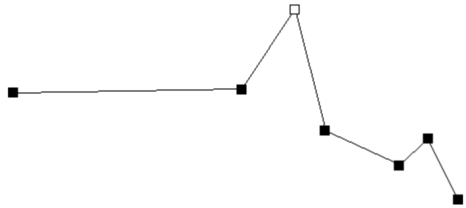
This is command is for increasing all point numbers by one: point 0 becomes point 1, the earlier point 1 becomes 2, and so on. The last point is point 0.

Reverse order

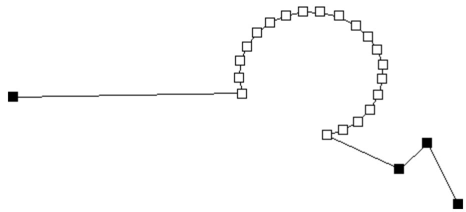
This command reverses the order of numbering so that the last point now becomes the first, and vice-versa.

Circular Arc

This command lets you insert a circular arc with a certain number of control points at any position of the spline. You need to select a single control point.

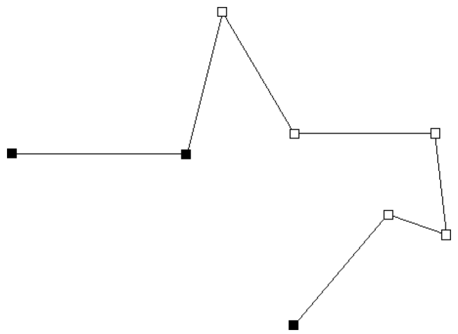


CINEMA 4D creates a circle which passes through the active point and its two neighbours. As you can see here, the circular arc begins at the previous point and ends with the succeeding one.



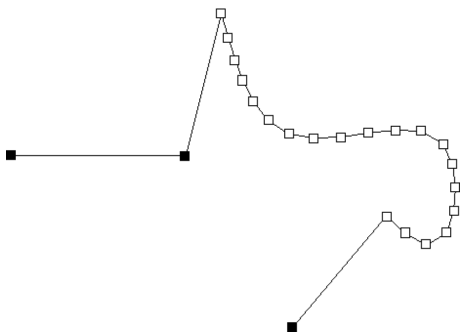
Round

This command lets you smooth, or 'round' a part of a polygon. Begin by selecting the points belonging to that part. The points must be contiguous.



Under 'Points' specify the number of points that will be used to smooth the curvature.

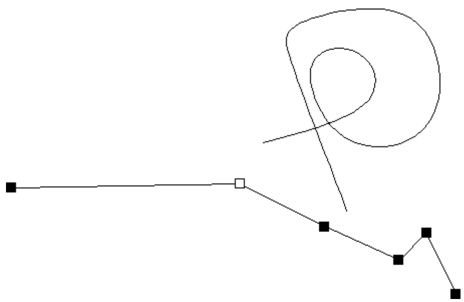
'Type' determines the method of rounding. The choices are linear, cubic, Akima, B-Spline and Hermite interpolation.

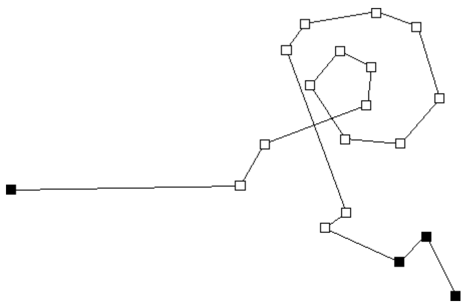


Insert

This command is used for adding a spline to another. To do this, select the insertion point on the first spline, then choose the Insert command. In the dialog that appears, enter the name of the spline you wish to insert.

The start point of the second spline is connected with the selected point of the first spline. The end point of the second spline is linked to the point on the first that comes next after the selected point. This is shown in the illustration.





If you select the end point of a spline, the second is simply appended, i.e. the end point of the first spline is linked to the start point of the second.

Level

This command lets you move all selected points of a spline to a common plane.

The points are moved only in the local Z direction so that they are on a common XY plane.

Align to Grid

Sometimes it can be helpful to set the points of a spline in such a way that they are on a grid. If you have not enabled the Move Grid in Preferences, you can do align all points to the points of the Move Grid by using this function.

You can specify the grid widths separately for the X, Y and Z axes by entering the values in the dialog.

Time Manager

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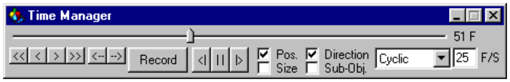
13. Time Manager



The Time Manager is the control centre for key frame animation. You use it for defining the key positions of objects and for playing animations in real time. It operates just like a video recorder.

Key frame animation makes creating animations simple and easy. First you define a particular point in time, then you place the objects, then you press the Record button. CINEMA 4D stores the data for position, size and location of the animated objects in a key. (The term 'keyframe' is sometimes shortened to just 'key'.)

A key frame is like an instant photo. It stores the current spatial location and other data of an object.

When several keys have been entered, CINEMA 4D can interpolate between them by using any temporal (time) resolution.

Even two keys are sufficient to generate a complete animation, although of course it may not be a particularly interesting one.

The Time Manager uses the following control buttons:

<<	go back one second
<	go back one frame
>	advance by one frame
>>	advance by one second
<–	jump to the previous key
–>	jump to the next key
Record	generate a key for the current object
<|	start reverse playback of animation
||	stop playback of animation
|>	start forward playback of animation

In addition, you can indicate what kind of keys you want to create. Usually keys are created for position, size and object angle. These may be switched off selectively, for example if you wish to restrict the animation to the object's position.

Tip:

If you wish to record an object's animation, switch to the Edit Objects tool. Do not use the Model tool (see Chapter 5).

If you wish to include not only the position of the selected object, but also that of its child objects (which is necessary, for example, with figures animated by inverse kinematics) enable the Sub option. Clicking on Recording will then create keys for the selected object as well as for all its child objects.

Nevertheless, in order to avoid the creation of many keys, which may be superfluous and will waste computing time, we recommend using this option only if you really need it. Keep in mind that as long as the child objects are not moved relative to the selected object there is no need to include their key frames.

When playing an animation in the Editor you can enter the playback speed at runtime (under frames per second). The speed selected here does not affect the frame rate of the document or of the animation calculation. It controls the playback speed only within the Editor.

Tip:

To set the frame rate of the document use Options / Animation / Frames per second; to set the rate for the frame calculation use File / Preferences / Render.

You also have control over what happens at the end of the animation. 'Simple' plays the animation from start to finish and then stops. 'Cyclic' restarts at the beginning, and 'Ping Pong' keeps going forwards and backwards. The animation in the Editor continues until you click Stop or launch the raytracer in the Editor window.

Tip:

Particle effects in the editor will look realistic only if continuing time sequence is selected. If you have selected to playback or play forward not in single steps, strange things may happen—particles flying behind the emitter and the like. This is not an error; the display behaves in this way because the position of each particle is calculated from the previous timestep.

Tip:

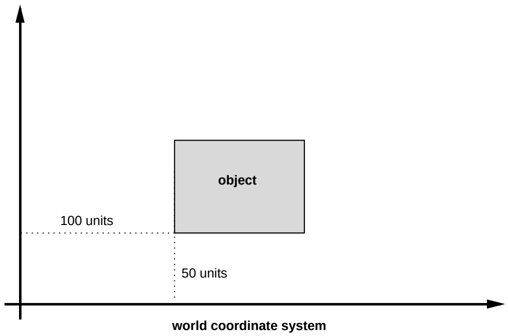
If the object does not have any keys when it is being recorded, keys as well as sequences are automatically generated. These are normally five seconds long (for 25 frames per second this will be 125 frames). By using the forward keys > and >> you can always jump to a point after those five seconds and continue recording there. This too will create a five second sequence. Several sequences may be merged by using the time bar functions.

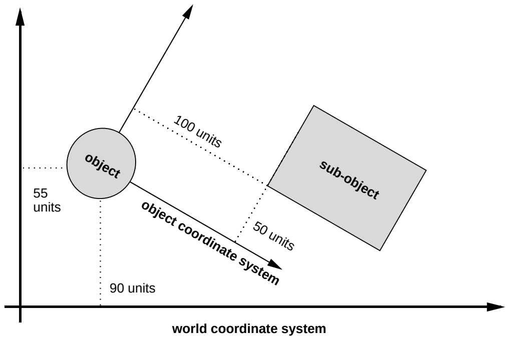
Here is how:

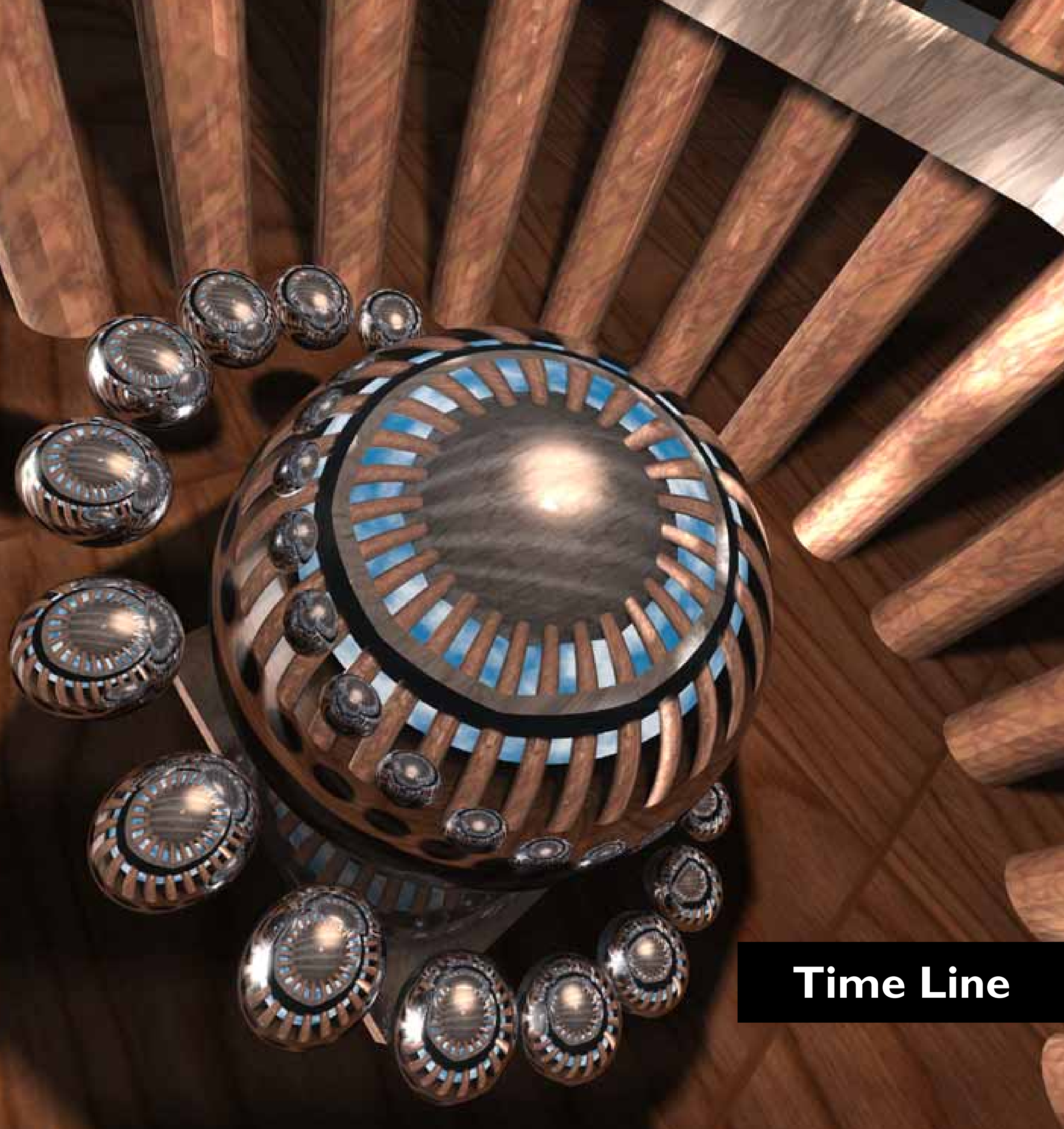
1. Create, for example, the special object Figure.
2. Select the Sub-Objects option in the Time Manager.
3. Click Record.
4. Drag the time slider to a different point in time.
5. Edit the figure by using the Inverse Kinematic tool or rotate the individual elements by hand.
6. Select the entire object and click Record.
7. If you now move the time slider back and forth the figure moves between the key positions.

The data for position, size and direction are identical to absolute values only for objects on the top level. The key data for child objects, on the other hand, always relate to the coordinate system of the parent object since this is the only way to create hierarchical animations.

While the values (100/50) of a position key associated with an individual object indicate its (absolute) position in the world coordinate system, these same values when applied to a child object would mean that it is shifted by 100 units along the X axis and by 50 units along the Y axis *relative* to the parent object coordinate system.


object
100 units
50 units
world coordinate system


object
100 units
sub-object
55
units
50 units
object coordinate system
90 units
world coordinate system



Time Line

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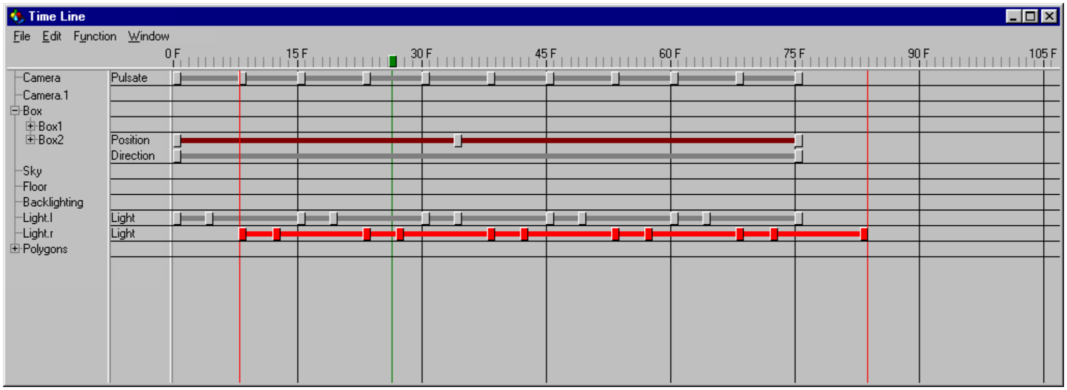
14. The Time Line



The Time Line is a powerful tool for organising and controlling animations in CINEMA 4D.

Just as in a musical score, the time sequence is shown horizontally across, but instead of musical notes you have keys. If you have worked with music software you are probably familiar with sequencers, which work in a very similar fashion.

On the left-hand side, you have the collapsible object hierarchy structure (similar to that in the Object Manager). The right-hand side is reserved for the animation files.

Each line, or row, is called a *track*. You use the tracks to determine which effect is to animate an object. This may be a simple change of position, a complex rotation or a very special effect, such an explosion, or a deformation.

A track contains one or more *sequences*. These specify at what time the animation will begin and when it will finish, i.e. the start and duration of an animation. Several sequences may follow on from each other, but not necessarily.

A sequence is filled with so-called keys, i.e. key positions. These indicate how an effect develops over time, for example a position change from the first to the second key. Certain effects need only one key (an explosion for instance), others two or more (a shift).

All built-in effects work hierarchically. In other words, if the parent object explodes, all its child objects will explode too—except if these child objects have their own effect tracks. If you are using plug-ins, the hierarchy depends on the programmer.

Each object can ‘own’ any number of tracks, sequences and keys. Just as in the Object Manager, here too the vertical position of a track determines whether it has priority or not. If for example a spline animation precedes a position animation, the object is first led along the spline.

The top line of the display is the time. Depending on what you selected in the Preferences this can be frames, seconds or SMPTE format. Each second is shown by a vertical line. If your data does not fit into the window, scrollbars along the right and/or along the bottom appear. You can use these to scroll the visible section of the Time Line.

You can customise the object and track display according to your own requirements. Just drag the separator to the left or the right, to make this region wider or narrower.

In the top left-hand corner of the Time Line window different information appears, depending on your action:

- Clicking on the green time slider will show the current time.
- Clicking on a sequence will show its length (duration).
- Clicking on a key will show the key time.

By clicking in the Time Line ruler at the top of the display you can set a new current time. Alternatively, you can do this by grabbing the green pointer and dragging it to a new position.

Working with the Time Line

It is important to note that menu commands always apply to the currently selected element in the Time Line. This can be a single key, a single sequence, a track or an object (in which case all tracks of an object will be selected).

You can select keys and sequences directly by clicking on them. To select a whole track, click on the track name. Similarly, select all tracks of an object by clicking on the object name.

Using the mouse it takes no time to create new tracks. Select an object and right-click in the track region. From the dropdown menu select the required track type.

You can create new sequences just as quickly. Hold down the Ctrl key, click on the position of an existing track where you wish the new sequence to start, and drag to the right.

Extending or shrinking sequences is another operation which is very simple. Click at the start or the end of a sequence, hold down the mouse button and drag the mouse to the left or the right.

You can also use the mouse to create new keys. Hold down the Ctrl key and click on the position in an existing sequence where you want the new key to be. This will open a window for you to enter the data.

You will have noticed that the Ctrl key is used to create a number of different things (points, surfaces, sequences, etc.).

If you wish to edit data and/or times of sequences and keys, you double-click on them. This opens the associated dialog (see the Function menu in this Chapter). Keys of position animations, for example, can also be edited interactively in the Editor window, by simply double-clicking on them.

Copy and move – Drag-and-drop

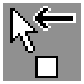
Duplicating and moving keys, sequences and tracks has been made very straightforward. It can all be done using the drag-and-drop method: simply drag the element to the new position in the Time Line and drop it there.

Tip:

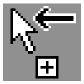
'Select' or 'activate' means to click on the element with the mouse. 'Drag' means to hold down the mouse button while you move the element. 'Drop' means to release the mouse button.

Changes take place dynamically, in real time, so you can see exactly what effect your action has had.

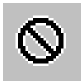
Try dragging an element (a track, a sequence, or a key) to a new position. This may be within the same object, or another. The mouse pointer now looks like this:



If you want to create a duplicate, hold down the Ctrl key while you drag. The mouse pointer then looks like this:



If an action is not possible, this symbol appears:



Tip:

- Keys may be moved or duplicated within a sequence or to a different one, which can be part of another object (as long as it has the same track type).
- Sequences can be moved or duplicated within a track or to the track of another object, provided this track exists already.
- Tracks can be moved and copied between objects.

One advantage of CINEMA 4D is that the animation of a particular scene is always the same at a particular time, independent of the last selected time, and thus is easy to manipulate.

Objects without keys cannot be animated. As soon as a key exists the values of this key are used. If there are several keys, interpolation calculates the value between them. If a time is set before the first key, the value of the first key is used, if a time after the last key is set, that value counts.

The special effects in CINEMA 4D, for example 'wind' or 'explosion' are somewhat different: They really need only one key and can do without a start and an end key (as required for position animations). A special effect continues until the sequence reaches its end or a second key, which marks the beginning of a new effect.

Tip:

You can view and assess all special effects within the Editor. Enable the 'Edit View' tool. All other tools show the object in its original state rather than animated.

14.1 The File Menu

Zoom In

Widens the Time Line display by a factor of 2.

Zoom Out

Narrows the Time Line display by factor of 2.

Close

Quits the Time Line and closes its window.

14.2 The Edit Menu

Undo

Undoes the last command and restores the object to its previous state.

Redo

If you have used ‘Undo’ by mistake, ‘Redo’ will cancel the effect of that command.

Delete

Deletes the active element. If object is selected, all tracks of the object are deleted.

14.3 The Function Menu

New Track

This menu contains all the animation features of CINEMA 4D. In principle, you can assign a track type to any object, whether this makes sense or not (for example exploding cameras, figures as environment suns, etc.).

This is not meant to challenge your imagination but is simply the result of CINEMA 4D being a totally open system. Nobody knows what type of animation effects the future might bring and which objects you may wish to assign them to.

The various tracks can be combined freely, and this can result in spectacular effects. Try exploding a moving, pulsating object!

This multitude of possibilities can cause problems. Let's say you have assigned a position change to an object. At the same time you want the object to move along a spline. This cannot work—you need to choose one or the other!

CINEMA 4D gives priority to the track that is at the top. So if spline precedes position, the object will move along the spline.

All animation effects of an object affect its child objects (if any). In other words, if you melt a human torso, the arms and legs will melt too, assuming they are child objects of the torso.

New track – Geometry

Position, Size, Direction

These tracks are created for key frame animations (recorded in the Time Manager). They are used for animating the position of objects in space.

The dialog of a position, size or direction key is the same as the Tangent dialog, which is described in Chapter 4 (Empty Spline).

Align to Path

When you have created an animation path for an object (say for a 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 key frames, with its Z axis aligned to the tangent of the path.

The object's X axis always stays parallel to the XZ world coordinates. The camera follows the natural motion path.

In addition, you can specify a bank angle which will allow the object to rotate around its Z axis.

Align to Object

It is quite common for the camera to follow the movement of an object in such a way that the object remains in the centre of the image. With the Align to Object option you need to set one single key, for which you enter the name of the object to be 'pursued'. The Z axis of the object to be aligned then follows the specified object.

It is even possible to set a mutual interdependency between objects. You may want to align the camera to an object, and the object to the camera.

This is not possible for two objects that are hierarchically linked (object and child object).

This effect requires only one single key frame element.

Inverse Kinematic

With Inverse Kinematics (IK), 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 a motorbike as the target object. The hand will then automatically keep pointing at the motorbike.

Depending on the object hierarchy, it may be 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 exhausted, 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 key frame. 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 requires only one key frame element.

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 key frame 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 key frame method.

Simply enter the name of a spline object for the key. The object will then follow the spline for the duration of the sequence.

This effect requires only a single key frame element.

Tip:

If a spline has its intermediate points set to 'equidistant', this is also taken into account for the spline animation. It means that the object follows the spline at a constant speed.

Tangential Spline

The Tangential spline animation works in a similar way to the simple spline discussed above.

However, here the object's Z axis follows the spline tangentially, just as with the Align to Path track.

Tip:

You also have the option, should you wish, of using a second spline. Both splines are then used as rails (as with the Sweep object, see Chapter 4). From the Object Manager, simply drop the guide spline into the spline that is used for the motion.

New track – Optical

Visibility

This is used to gradually fade an object in or out. Specify the degree of visibility as a percentage.

This effect is not directly visible in the editor, it becomes effective during rendering.

All modifiers and the emitter of the particle system can be controlled via the Visibility track, where:

0%	=	means: no effect, no particle emission
100%	=	means: maximum effect, maximum particle emission

Except with the Deflector, where

< 50%	=	means: no particle reflection
>= 50%	=	particle reflection

Texture

You can animate any number of textures and materials of an object simultaneously. The first track always refers to the first texture of an object, the second to the second, etc. If there is no texture for a track, nothing happens during animation.

You can animate all parameters of the texture. You may for example wish to have the label on a bottle of lemonade rotate around the bottle.

The material can also be animated. To do this, enter different materials in the texture keys—CINEMA 4D will then interpolate automatically between them. It is perfectly feasible to fade wood into marble, or glass.

Tip:

The *n*th Texture track affects the *n*th texture.

This means that if you want to animate the third (and only the third) texture, you need to create two (in this case, empty) texture tracks first.

Animated movies as textures

If you want to use an animated movie as a texture frame, for example for playing a digitised video on a TV screen within your picture, you must have sequentially numbered frames (frame0001, frame0002, etc.). Create two materials; for the first material enter the first frame (frame0001) as the texture name, and for the second material enter the last frame of the video (e.g. frame 0127). Then create a texture track and animate from material 1 to material 2. CINEMA 4D will calculate the intermediate frames.

AVI- animation. QuickTime-Movies as texture

CINEMA 4D lets you place existing AVI or QuickTime movies on surfaces. You simply specify the movie as the texture for the material. The movies then runs automatically from the animation start to the end. If you have indicated a texture sequence with a key, the movie runs from the first key to the last (or to the end of the sequence).

Tip:

Details can be specified in the Time Controls dialog (see Chapter 9 - The Material Editor).

New track – Parameter

Depending on the object type, here you can animate the special parameters of an object (for example focal length, light colour, lens flares, etc.).

Camera

This track lets you animate all parameters of the camera. If you place a key, the Camera dialog opens (see Chapter 4 - Camera).

If you set several keys with different values, a smooth fade occurs between them. Some of the effects are immediately visible in the Editor (e.g. focal length), others not until rendering (e.g. depth of field).

Light

This track lets you animate all parameters of a light source. When you place a key, the Light dialog opens (see Chapter 4 - Light source).

If you set several keys with different values, a smooth fade occurs between them. Some of the effects are immediately visible in the Editor (e.g. light colour), others not until rendering (e.g. lens effects).

Environment

This track lets you animate all parameters of the environment object. If you place a key, the Environment dialog box opens (see Chapter 4 - Environment).

If you set several keys with different values, a smooth fade occurs between them. Some of the effects are immediately visible in the Editor (e.g. sun), others not until rendering (e.g. fog).

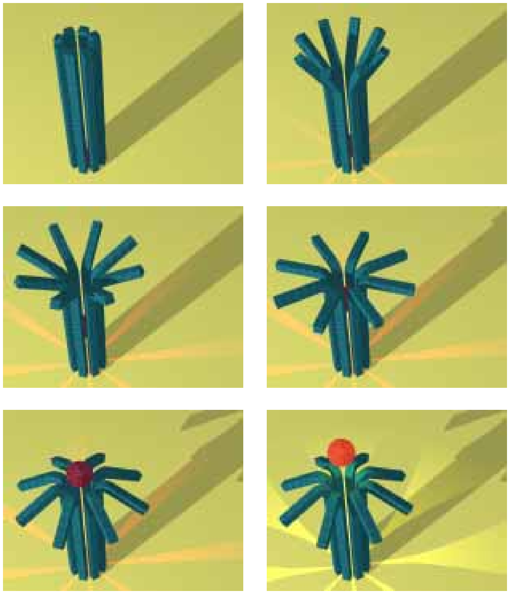
New track – Special effects

Bend

This animation effect lets you bend an object.

The effect of bending is determined by the alignment within the object coordinate system. It occurs along the positive Z axis in the direction of the Y axis. No bending takes place in negative Z direction.

‘Direction’ specifies the angle of bend.



To experiment, it is best to take a cube that is subdivided and test the bending behaviour with different axis positions. This will quickly make you aware of the different effect that you can achieve.

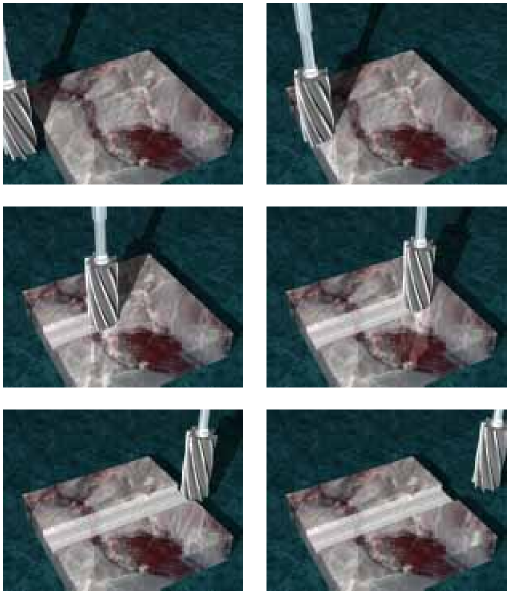
This effect requires a minimum of two key frame elements.

Boolean

This animation effect lets you simulate manufacturing processes. You can now show animated sequences of how holes are drilled or grooves are milled.

The Boolean dialog will open (see Chapter 5 - Boolean) for you to specify the objects and the actions.

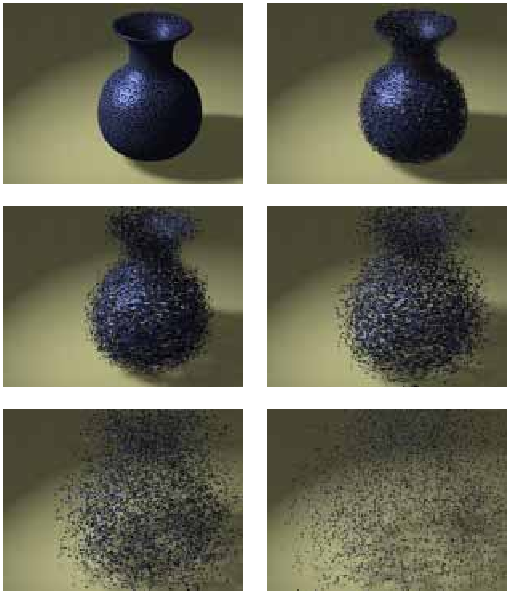
If you want this track to be animated you need a separate animation track. In the example below we have chosen ‘Marble block - groove’. The groove is also being moved slowly from left to right (simultaneously with the milling cutter).



You may be interested to know that the cutter in this example was created by using the Twist effect (see later in this chapter) and then converted to a polygon.

Explosion

As its name suggests, this effect simulates the explosion of an object.



This causes the individual surfaces of an object, which was formerly solid, to fly in all directions. Explosions look more effective if the object consists of a large number of triangles and quadrangles. If necessary, subdivide the object first.

You can specify the speed with which the surfaces are blasted from the centre of the object axis. The 'Angle speed' indicates whether and how fast the surfaces rotate around their own axes. If you want them to diminish in size towards the end of the animation, specify a value smaller than 1.0 for 'End size'. The 'Random' value specifies the degree of randomness of the motion. A random explosion has a more natural feel about it.

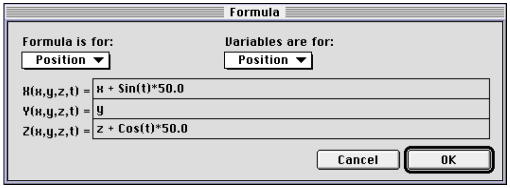
This effect requires only one key frame element.

Formula

This function is probably the most powerful—but also the most complex and complicated of all animation effects.

It lets you change objects by means of mathematical formulae. You can influence the position, the size, the angle (direction) and the points.

Setting a key will open a dialog.



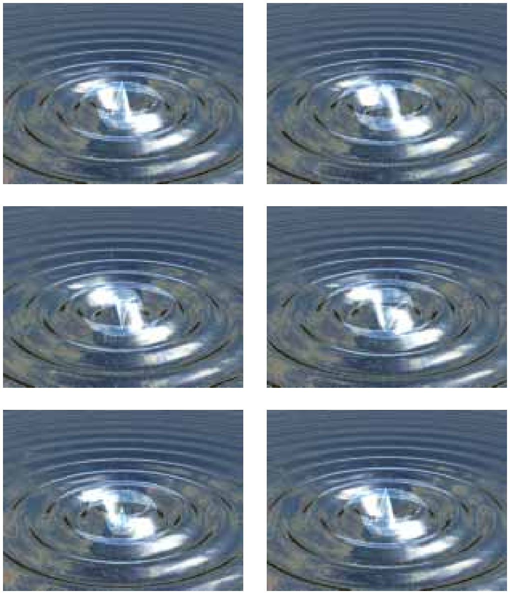
First, you use the menu at the top left ('Formula is for') to specify the 'target'. The Formula effect can optionally be used to change position, size, direction or all points.

Below there are three input lines for formulae X, Y and Z. These return the values for the above effects. The functions can depend on a number of variables. 't' is for time and needs to occur in at least one formula in order for any animation to take place. x, y and z can also be used (see below).

The Appendix contains a list of all available mathematical operators and functions.

Finally, use the 'Variables are for' menu to specify what the x, y and z variables are meant to stand for, for example position in x direction (if you are using x), size in z direction, etc.

This effect requires only one key frame element.



Notes on the Example:

- Circular waves are created whose amplitude diminishes over time.
- The water surface is a plane that has been subdivided.
- The variables refer to the points of the object.
- The formula affects the points of the object.
- The formulae used are:

  X(x,y,z,t) = x

  Y(x,y,z,t) = cos (sqrt (x*x+z*z) / 50 – 2*pi*t) * 250 / (1 + sqrt (x*x+z*z) / 200)

  Z(x,y,z,t) = z

If you are not a trained mathematician it may not be obvious why a particular formula is used in a particular place, and what effects this has.

Here is a brief explanation.

```
X = x
```

and

```
Z = z
```

mean that no change in the number of points must take place in the specified direction. The deformation over time is to be restricted to the Y direction. Now to

```
Y = cos (...) * 250 / ...
```

which means that the points will perform a cosine oscillation in Y direction. The amplitude of this deflection is 250 units.

Within this cosine function we define the direction and the speed:

```
sqrt (x*x + z*z) / 50
```

This defines a circle on the XZ plane, which means circular waves. The factor after the root limits the number of wave peaks and troughs on the plane. The smaller this value, the more waves.

```
- 2*pi * t
```

This controls the temporal deflection. The factor before the 't' variable indicates the frequency, i.e. the speed of the wave. If the sign is negative, the waves run from the centre towards the outside, if it is positive, they run towards the centre.

At the end of the formula we have

```
1 + sqrt (x*x + z*z) / 200
```

specifying the decrease of the amplitude. The '1' at the beginning is to prevent division by zero (in the case where x and z are both 0, i.e. at the origin). The root indicates that the decrease is to occur in a circular fashion on the XZ plane. The factor at the end is for correction purposes. The smaller it is, the faster is the decrease of the wave amplitude.

Tip:

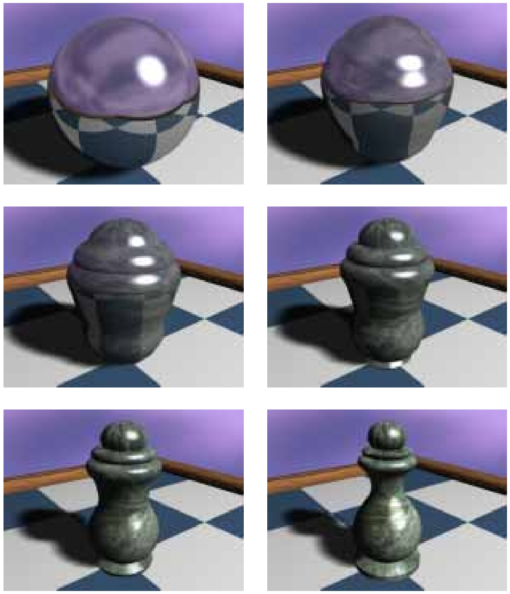
- Multiplication (... * 0.005) is quicker than division (... / 200).
- Multiplication (`x * x`) is quicker than working with powers (`x ^ 2`).

By the way:

The water surface was created with a material for which only the parameters ‘Reflection’ and ‘Fog’ were set.

Morphing

This function lets you gradually merge one object into another.



For this to work, it is best that both objects have the same number of points and edges. Otherwise you can get strange results.

For an object to morph between two stages (you can have as many stages as you like), you need to define a target object or end stage.

The best approach is to duplicate the original object. Then edit the points of the duplicate until it has the desired look. Specify the original object in the first and the duplicate in the second key of the Morph track.

If the morph stages are not used for rendering, group them in the Object Manager. You can then assign the ‘Hide in Editor’ and ‘Hide when Raytracing’ attributes, to keep things neat.

The active object itself must not be used as the morph object because this would make the animation irreversible.

Morphing can be used, for example, to animate a talking face. Start by creating the basic shape, then create a duplicate for each sound (phoneme) of the language, editing the shape of the mouth and the facial muscles to match the pronunciation.

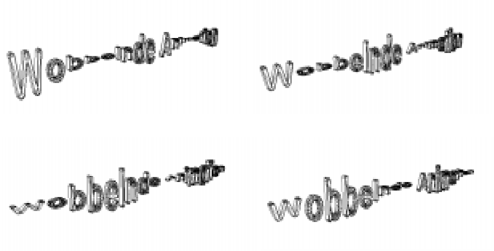
If you want the face to say a sentence, call up the morph keys with the phoneme objects in the correct sequence

Tip:

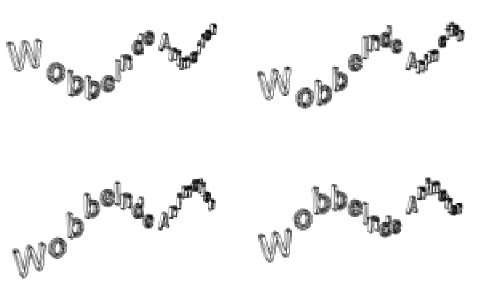
The above example shows a material animation (from chrome to marble) which occurs simultaneously with the morphing.

Pulsate

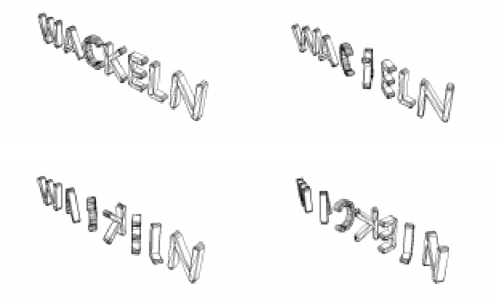
This effect can be used to change the size of an object cyclically.



The same can be done for position,



and direction.



The frequency (f) specifies how often the movement will occur.

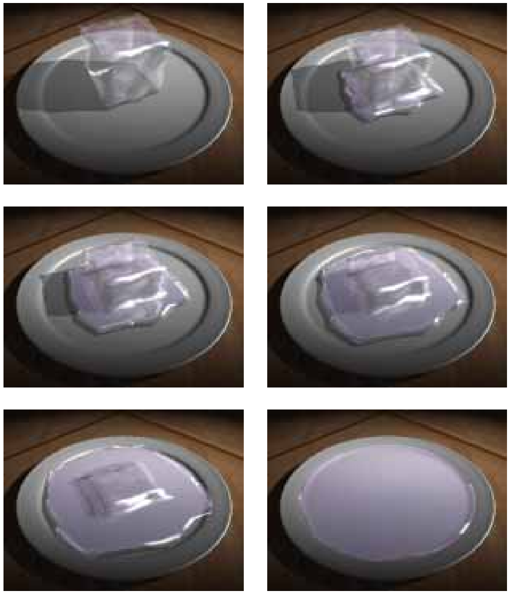
This animation effect takes into account the position of the key and of the sequence. It works like this:

- A Pulsate sequence causes an object to pulsate.
- If several objects are to pulsate differently (see the example pictures), each (child) object must have its own Pulsate sequence. (Best to make duplicates of one sequence by dragging-and-dropping.)
- To avoid all objects jumping around in the same way, phase-shift and fine-tune them.

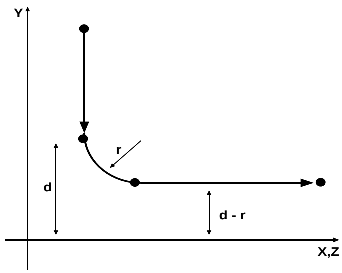
This effect requires only one key frame (per object).

Melt

This effect causes an object to begin melting at the origin of its Y axis. The points of the object move away radially from the lower end of its Y axis, creating the impression of a puddle forming around it.



At the same time, the points at the top of the object sink towards the bottom until finally all that remains is the puddle. This effect works particularly well for objects with many surfaces. If necessary, use the subdivide command.



The radius ('r') specifies the size of the circular arc which the points flow through before melting.

'Thickness' ('d') is the distance from the XZ plane of the object coordinate system from which the melting process is to start.

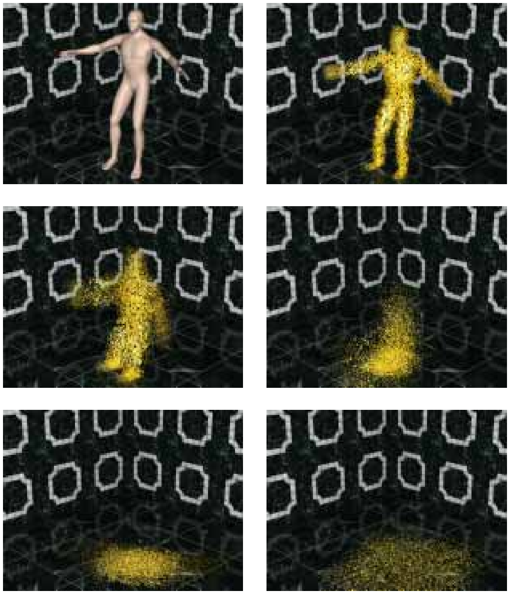
As a rule, objects melt radially towards the outside. By selecting 'Random' you can prevent this and create a jagged edge.

This effect requires only one key frame element.

Shatter

This effect causes an object to shatter into its individual surface components. In contrast to the explosion effect the parts all end up on the ground.

The ground (or floor) is the local XZ plane. So if you want a figure to shatter on the floor—as shown in the example—begin by moving the object axis system along the Y axis down to the floor level.



The 'Angle speed' indicates whether and how fast the surfaces rotate around their own axes.

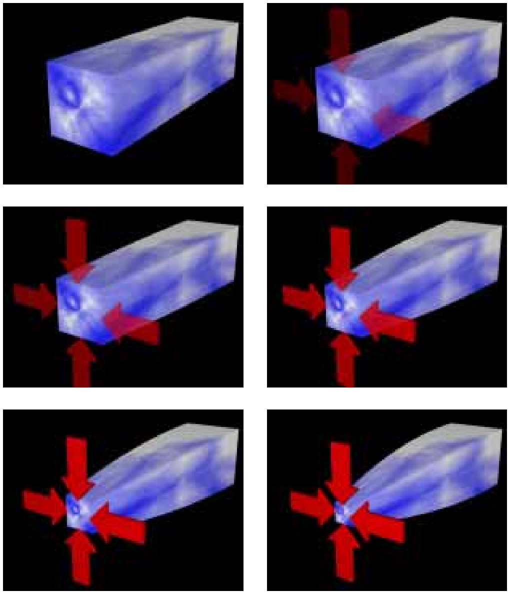
If you want them to diminish in size towards the end of the animation, specify a value smaller than 1.0 for 'End size'.

'Random' specifies the randomness of the motion of the individual shards.

This effect requires only one key frame element.

Taper

This effect causes the object to become thinner at one end, as if it was being squeezed.



The pressure is distributed along the local Z axis, in a positive direction, with forces being exerted from directions X and Y (arrows in the example).

‘Strength’ specifies the intensity of the pressure. 0% means no pressure, 100% is maximum pressure: the end surface shrinks to size 0.

If the ends were simply pushed together, the effect would be unrealistic. Use ‘Curvature’ to specify a parabolic pressure curve. The higher the value the more pronounced the parabola. A value of 0 means a linear increase in pressure.

This effect requires a minimum of two key frame elements.

Twist

This effect causes an object to twist along its Z axis.

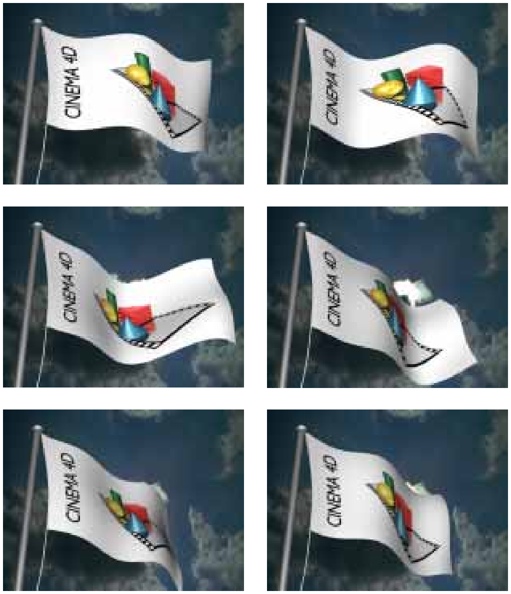
By combining this effect with the ‘Animation object’ structure tool you can produce spectacularly shaped objects, for example antique columns.

The milling cutter we used in the Boolean example was created in this way, as you can see from the above pictures. Both objects were rotated by 360˚ (left) and -360˚ (right).

This effect requires a minimum of two key frame elements—one for the start and one for the end angle of the rotation.

Wind

This effect lets you simulate the effect of moving air on surfaces.



The surface points move as if they were shaken back and forth by the wind. This is particularly suitable for flat objects, such as a flag, that have many surfaces. If necessary, subdivide the object.

The deflection of the points is always perpendicular to the XY plane of the object coordinate system. In other words: the wind blows in direction Z.

'Amplitude' specifies the maximum number of units the points can move from the resting position.

'Frequency' specifies how many times the object is to oscillate back and forth during the animation. The higher the value, the faster the movements of the flag.

'Turbulence' is the intensity of the wind and its impact on the surface.

The frequencies fx and fy determine the 'internal agitation' of the object, i.e. the number of waves that will move in direction X and Y on the object's surface.

You can create a special effect by enabling the 'Flag' option. Here, all points along the local Y axis remain still, but starting from here, flutter activity increases in both positive and negative direction.

This effect requires only one key frame element.

Notes on the example:

- The flag is a child object of the rope.
- In order for both to move, the rope was assigned the Wind effect.
- Additionally, the flag itself also has a Wind track, where:
  - the Flag option is enabled,
  - the object axis system is moved to the extreme left edge of the flag,
  - and slightly rotated around its X axis so that extra wind blows from underneath.
- Realistic animations can be achieved by setting not just one key, but several, and by changing the frequencies and the turbulence (in some cases in 'jumps'), in order to create gusts of wind.
- The flag itself is a subdivided quadrangle to which UV mapping has been assigned.

Vibration

All too often computer animations suffer from looking static and predictable. Using the Vibration effect you can add a certain randomness. If for example you are simulating a camera in a car driving across bumpy terrain, it looks much more realistic if the camera moves up and down in a random fashion.

You can specify separate amplitudes for position, size and direction. The higher the degree of randomness, the more pronounced the effect.

This effect requires only one single key frame.

Additional Animation effects

All animation effects described below are Plug-Ins which are added to the menu at startup. The ones that are part of the CINEMA 4D package are described in the Appendix.

New Sequence

This command creates a new sequence on the current track. A dialog appears for you to enter a start and an end time key.

Alternatively, you can create a new sequence directly from the Time Line. Hold down the Ctrl key while you click in the track, then drag the pointer to the right.

New Key

This command lets you create a new key in the current sequence. A dialog appears for you to enter the time.

You can then edit the key's data by double-clicking on it, or by using the 'Edit Data' command (see below).

Alternatively, you can create new keys directly in the Time Line display. Hold down the Ctrl key while you click in the sequence. This will create a key at that position and open its data dialog.

Delete Hierarchy

This command lets you delete elements of the same type within the current object and all its child objects.

Depending on whether you have selected a key, a sequence, a track or a complete object, the same elements of all child objects are deleted.

This can be very useful, for example if you have inadvertently recorded complex objects in the Time Manager with the ‘Sub-Objects’ option switched on.

Adjust

In many cases the left and right boundaries of a sequence do not coincide with the temporal position of the first and the last key. The Adjust command will take care of this.

If instead of a sequence you have selected an entire track, all sequences are adjusted to this track.

If instead of a track you have selected an object, all tracks of the object are adjusted.

Divide

Divides the current sequence into two parts. To do this, enter the time at which the division is to occur in the dialog.

Connect

When you have selected a sequence you can connect it with its neighbours. To do this, specify in the dialog whether this should be done in both directions (left and right).

If instead of a sequence you have selected an entire track, all sequences of that track are merged to a single sequence.

If instead of a track you have selected a whole object, all sequences of all tracks are linked to one single sequence each.

Scale

This command will recalculate a sequence or a track, thereby determining the length of the sequence and the new position of the individual keys.

If you have selected an object, all its tracks are scaled.

If you are scaling a single sequence, which is followed by another sequence, the former may be scaled only to the start of its successor.

Scale Document

This command will scale the entire document, i.e. all tracks of all objects.

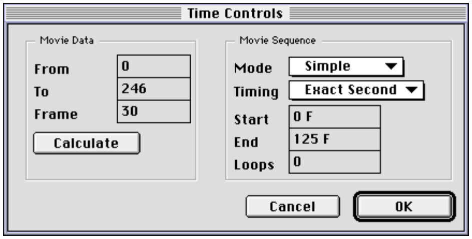
Edit Data

This command lets you edit the data values (position, direction, etc.) of a key. The dialog associated with the track will open.

Edit Time

This command lets you modify the time of the selected key numerically.

If you have selected a sequence, you can edit the time boundaries of the sequence.



Movie data

In this area of the dialog you choose the frame rate for the animation texture. In the fields ‘from’ and ‘to’ you enter the start and end frames for the animation sequence. If both fields contain the same value, only the currently selected image is used as a texture. Additionally you can define the playback rate using the value in the ‘frame rate’ field.

Clicking on ‘Render’ triggers CINEMA 4D to automatically set up all the parameters of the animation. You do not need to know the duration of the movie; in single frame sequences the images with the lowest and highest image numbers are calculated automatically.

Example:

AVI movies (QuickTime Movie on the Macintosh) have 600 frames (0 to 599) and a frame rate of 15 frames per second. You can select any start and end frame; from image 70 to image 119 for example (or even from image 119 to image 70 if you like).

Movie sequence

In this part of the dialog you choose how the animation texture is handled in the animation.

In the ‘Mode’ field you choose how to play the animation. You can choose from ‘Simple’, ‘Cyclic’ and ’Ping-Pong’. Simple means that the texture stops when it reaches the last image of the animation texture. Cyclic means that when the last image of the animation texture is reached, the sequence will begin again. Ping-Pong means that when the last image of the animation texture is reached, the sequence will reverse towards the first image, and then reverse again towards the last image, and so on.

With ‘Timing’ you choose the play mode. ‘Exact image’ means that for every rendered animation image one image of the animation texture is used. There are no ‘drop frames’, meaning no images of the animation are missing. If the frame rate of the animation texture differs from the frame rate of the movie this means that the movie runs slower or faster. ‘Exact second’ means that for every rendered animation second, one second of the animation texture (as chosen by the film parameters) is used. As a result the movie runs always with the same frame rate. Select ‘Pane’ and CINEMA 4D fits the frame sequence to beginning and end (scene animation) and the movie is played exactly once, which means that the animation texture must be enlarged or shrunk.

‘Loops’ means that the frame sequence runs *n* times from beginning to end. 1 results in one repetition. Again you can choose from ‘Simple’ (makes no sense here), ‘Cyclic’ and ‘Ping-Pong’.

14.4 The Windows Menu

Space Control

This opens the Space Control window. See Chapter 15 for a detailed description of the Space Control Manager.

Time Control

This opens the Time Control window. See Chapter 16 for a detailed description of the Time Control Manager.

Example 1:

You would like to play a movie (AVI for Windows).

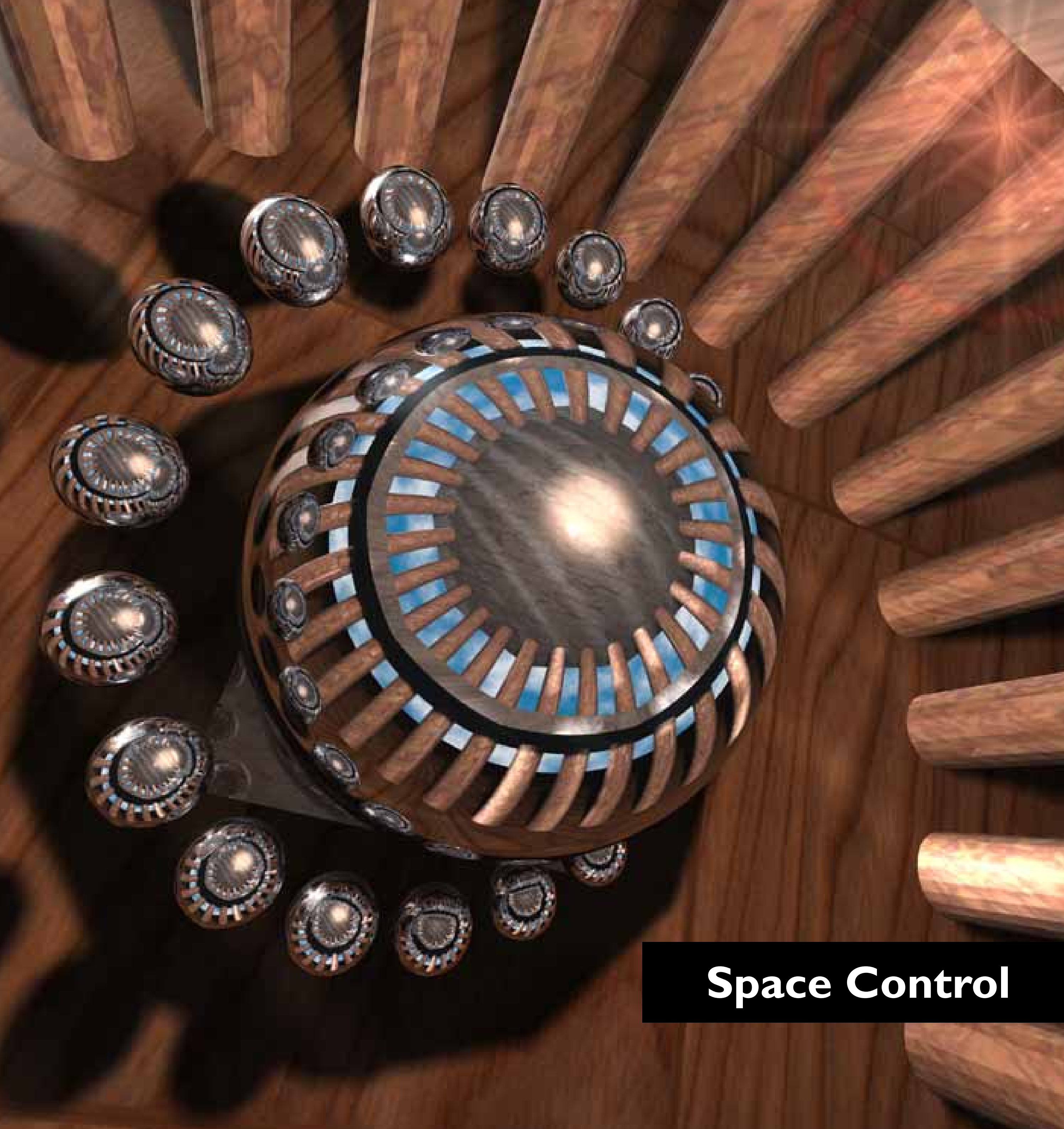
1. Choose the animation in the ‘Texture’ area of the material editor.
2. Open the ‘Timing’ dialog.
3. Click on ‘Rendering’.
4. Close the dialog.

Result: The movie is played exactly once, second synchronized.

Example 2:

You would like to render and playback a movie exactly twice, starting with frame 25 and ending with frame 350.

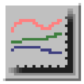
1. Choose the animation in the ‘Texture’ area of the material editor.
2. Open the ‘Timing’ dialog.
3. Click on ‘Rendering’.
4. Select the ‘Ping-Pong’ mode.
5. Set ‘Timing’ to ‘Area’.
6. Enter Start ‘25’ and End ‘350’.
7. Set Loops to ‘1’ (results in two playbacks).
8. Close the dialog

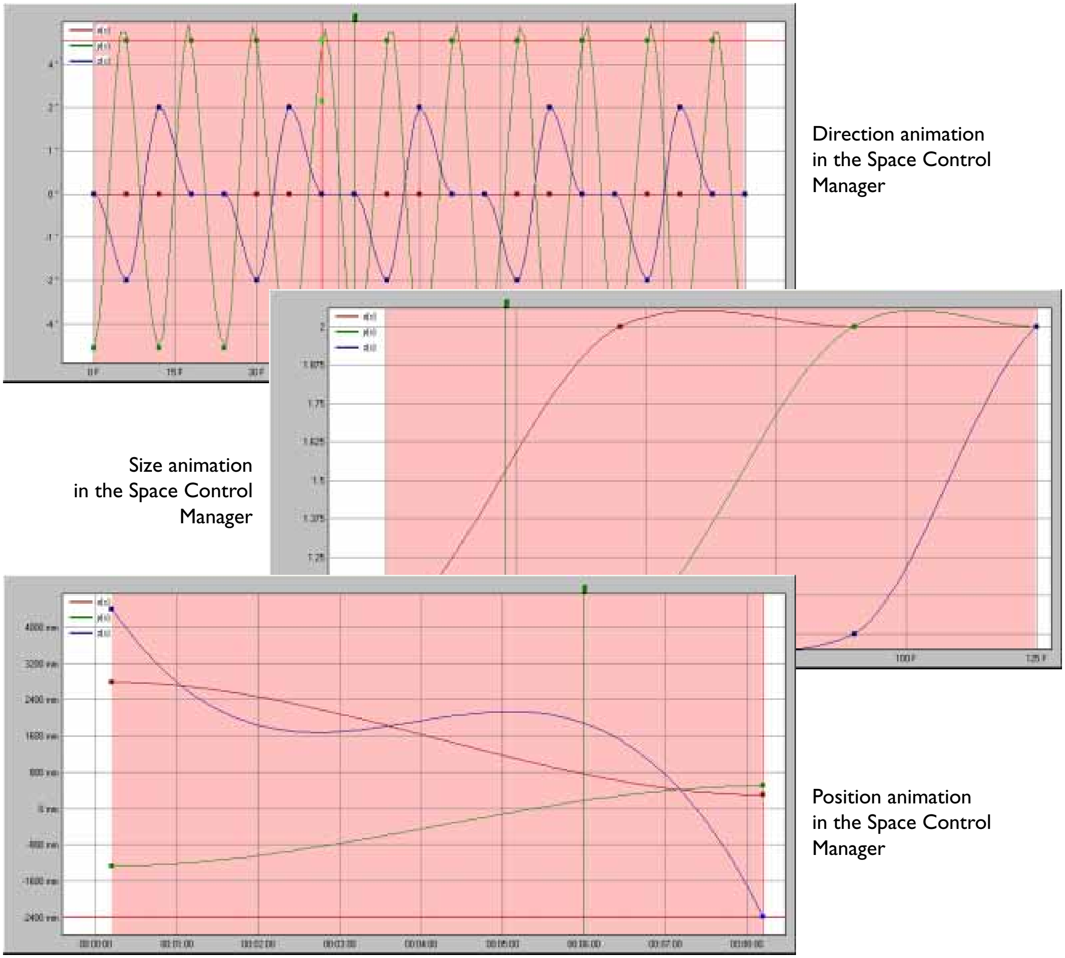


Space Control

Contents

15. The Space Control Manager





Direction animation in the Space Control Manager

Size animation in the Space Control Manager

Position animation in the Space Control Manager

The Space Control Manager is an auxiliary tool that helps you arrange the animation parameters—position, size and direction—in space. You access the Space Control Manager via the Windows menu in the Editor or via the Function menu within the Time Line.

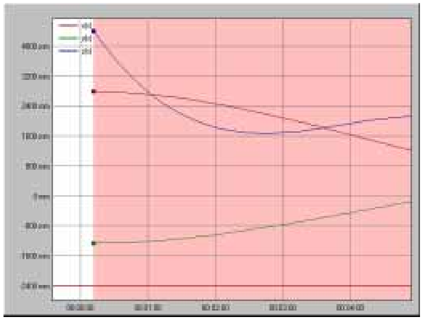
Space-time curves for the current animation sequence are shown in a graph. The range that this sequence occupies within the entire sequence is coloured; a green vertical line indicates the current point in time. You can shift this time indicator by dragging it using the button at the top.

The duration of the animation is shown horizontally (depending on what you have selected, this will be for frames or SMPTE); the coordinates for position (X – red, Y – green, Z – blue), direction (H – red, P – green, B – blue) or scaling (X – red, Y – green, Z – blue) are shown vertically. You may wish to refer to the figures on the previous page.

You can choose which curves to display by clicking on the appropriate bar of the sequence (position, size or direction).

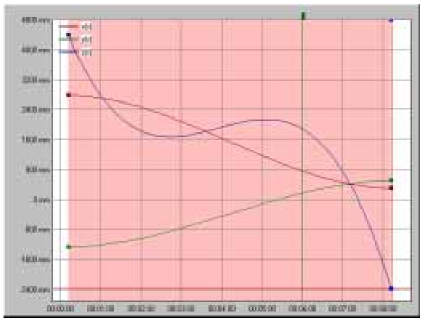
Navigating in the Space Control Manager:

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 (see further below). However, this can make the display very small and difficult to work with.



CINEMA 4D has a convenient way of changing the display. Click in the free region of the inner graph window. Hold the mouse button down and drag. This will move the window contents in real time.

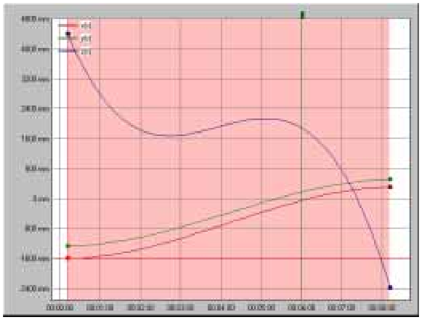
Of course you can also enlarge and reduce the display. Do this by holding down the right mouse button instead of the left.



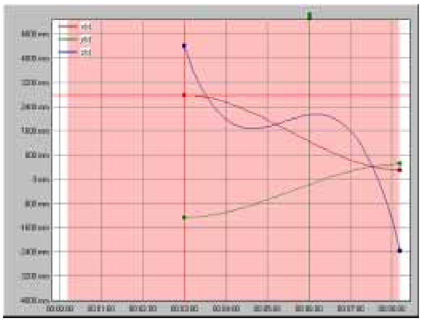
Working in Space Control:

Individual keys may be activated and moved by clicking on them. This allows you to change the time and also the value of a key.

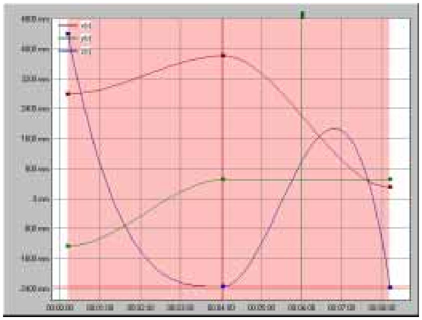
Use the left mouse button to move keys vertically. This is how you specify position, direction or size of an object at a particular point in time, and separately for each of the three axes.



Use the right mouse button to move keys horizontally. This is how you specify *when* an object will be at a particular position, in a particular direction or have a particular size. This applies to all three axes.



You can also add new keys within this animation manager. Hold down the Ctrl key while clicking in the inner graphics area. This will open a dialog into which you can enter values and tangents of the new key in numerical form.



It is possible also to edit existing keys. Double-click on a key to open the Values and Tangents dialog (see below, under ‘Edit Data’).

15.1 The File Menu

Overview

This command resizes the space graphs of the active sequence in such a way that they are fully visible within the window.

Default size

This command resets the space graphs to their default size.

Tangents

This shows the tangent lengths in addition to the space graphs. Those drawn vertically towards the top and the bottom, starting from the keys, can be moved interactively with the mouse.

The tangent running upwards refers to the curve to the left of the key, the one running downwards to the one on the right of the key.

Close

This command closes the Space Control window.

15.2 The Edit Menu

Undo

This command cancels the last change made to the current sequence.

Redo

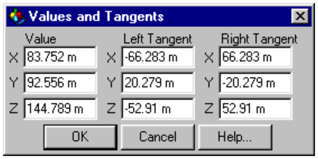
This command restores a change that was undone.

Delete

This command deletes the active key.

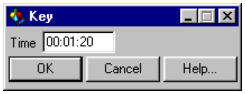
15.3 The Function Menu

Edit Data



This command opens a dialog that lets you change the data values for position, direction and tangents of a key numerically.

Edit Time



This command lets you change the time of a key numerically.

Hard Interpolation

All tangents of a sequence are set to zero, causing a linear interpolation of the Hermite spline.

Soft Interpolation

All key tangents are set in such a way as to allow a smooth and seamless animation.

Linearise

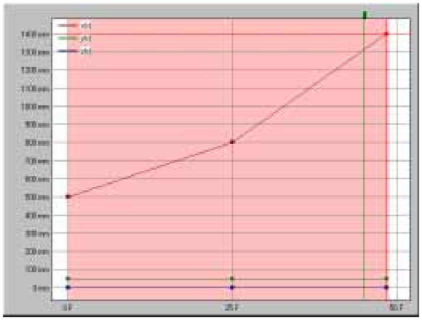
Because keys are often recorded at different times and places, it is quite normal for the spatial and temporal distances between them to be unequal. The result is an irregular movement with accelerations. If this is not what you want, you can use the Linearise command to eliminate these accelerations and achieve a constant speed.

The Linearise command shifts the keys of the position, size and direction sequences in time so that the values can be interpolated at an almost constant speed. This cannot be done *exactly*, as this would require the tangents to have zero length.

15.4 Mini-Tutorial

Using and understanding graphs is not that simple. Not everyone can remember the diagrams we were introduced to in our physics classes ... Still, this is basically what we have in the Space Control.

We will try to get you up and running by going through a few examples.



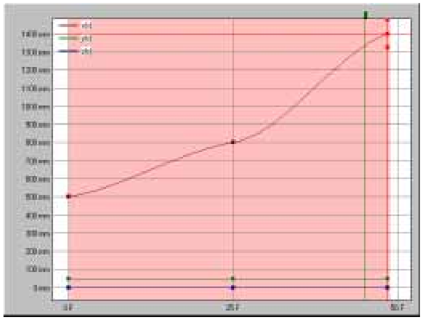
The first figure shows a typical Space Control graph. The green curve (second from the bottom) shows the time travelled by the Y value during the animation. The red curve (topmost) represents the X value, the blue one (bottom) is the Z value.

The example shows a position animation. This is why the left-hand side shows length values too. Within Space Control you may edit Position, Size and Direction.

The Space Control graph allows you to see the key data at a glance. In this case we have three keys whose values are 500/50/0, 800/50/0 and 1400/50/0.

The green vertical line at frame 45 indicates the temporal position, which is currently set in the Editor.

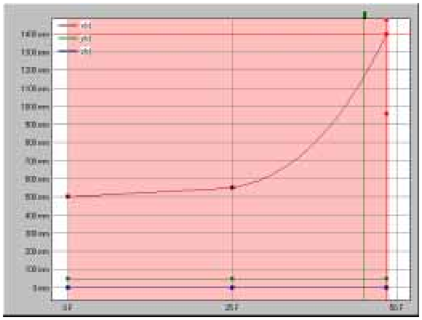
Interpolation between the keys is linear. (When creating the keys the tangent length was left at 0.) This is why the speed between the keys is constant (300 units per second and 700 units per second, for a frame rate of 25 frames per second).



In the second figure the ‘Soft Interpolation’ function has been used.

If you have activated ‘Tangents’ in the File menu, you will see little vertical markers at the keys. If you have edited polygons in the Editor (particularly Hermite splines) you will be aware of how tangents affect a path. Here in Space Control these tangents are also shown, albeit separately for X, Y and Z.

No tangents are shown for the green and the blue curves because for soft interpolation these are aligned to the neighbouring keys. Their Y and Z components are therefore 0 in this case.



Now take a look at the third figure. The second key has been moved to the new value of 550/50/0. At the same time linear interpolation was set up between the first and the second key. You do this by setting the right tangent for the first key and the left tangent for the second key to zero. (Use the Edit Data command or double-click on the keys.)

In order to achieve a smooth acceleration between the second and the third key, the right component of the second key was also set to zero and the left component of the third key was set to an X value of -500.

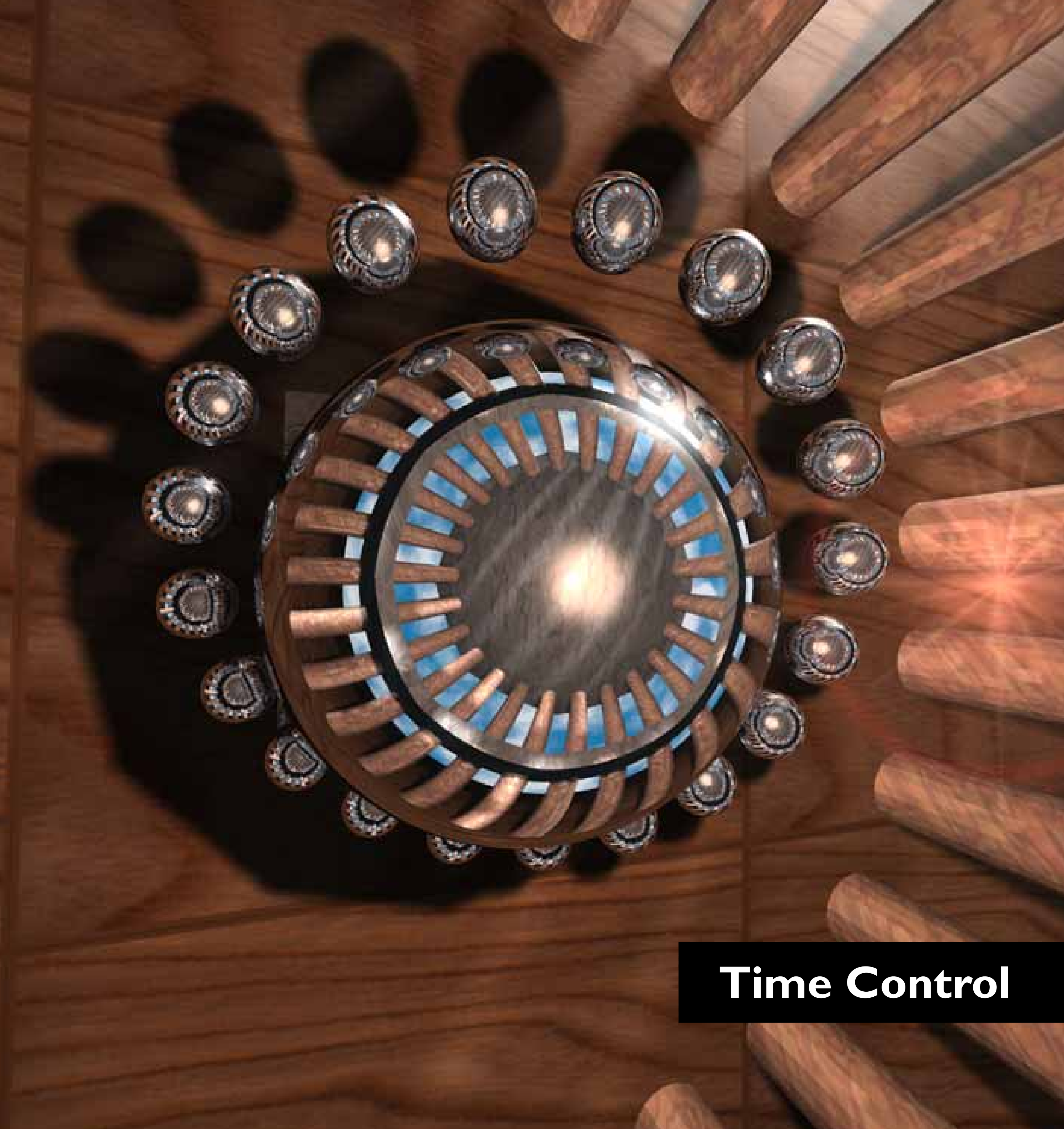
Editing tangents individually can also be performed by holding down the Shift key and dragging.

'Left' and 'right' do not here refer to the spatial position of the tangents (they run towards the top or the bottom), but indicate the temporal direction relative to the previous or the next key.

Note that it is possible for both tangents in the Time Control to point in the same direction. You can, for example, edit the tangents in such a way as to form a 'V'.

Summary

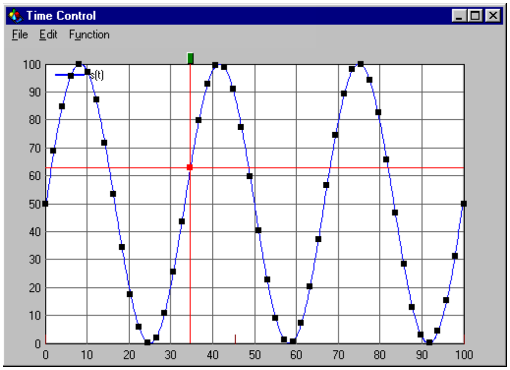
- The (left) mouse button changes the key data values (up/down movement).
- The right mouse button changes the temporal values (right/left movement).
- Linear Interpolation between two keys is achieved by setting the right tangent of the first key and the left tangent of the second key to zero.
- Acceleration is achieved by setting the right tangent of the first key to zero and the left tangent of the second key to a higher value.
- Deceleration can be achieved by setting the right tangent of the first key to a higher value and the left tangent of the second key to zero.
- The (left) mouse button changes the tangents dynamically, left and right side together.
- Holding down the Shift key at the same time allows you to edit the tangents separately.



Time Control

Contents

16. The Time Control



The Time Control Manager is yet another powerful tool. When you have defined a position sequence, and therefore the spatial movement of an object, you then have the option to also control the temporal movement—acceleration and deceleration. This is independent of position in space.

To access the Time Control Manager (just as with the Space Control Manager) use either the Windows menu in the Editor or the Time Line.

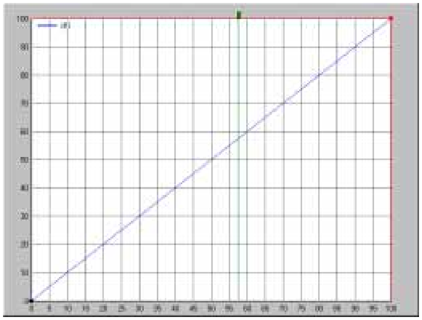
The information shown in the window always applies to the sequence that is selected in the Time Line, so ensure that you really have selected a sequence, and not the entire track or simply one key.

The graph shows the duration of the sequence horizontally, extending to the right. The position or state of the object is shown in the vertical. Both are shown as percentages.

Ctrl-clicking in the Time Control Manager creates a line that goes from 0% to 100%. (Here again the Ctrl key is used to create something …)

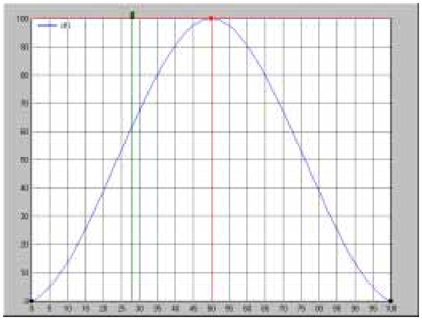
This means that the interpolation of any sequence (including materials, lights ...) will occur at a constant speed. Starting from 0% (with 0%), the interpolation increases to 100% at the end (100%). Thus, start and end are always 0%/0% and 100%/100%.

Imagine an object moving from A to B. At the start of the movement (point A) the object is at 0%/0%, i.e. no time has elapsed and the state (alignment and position) of the object is unaltered. At the end of the movement (point B) the object is at 100%/100%—time has elapsed and change has taken place.



Additional Ctrl-clicks can be used to set further control points in between, changing the straight line into a curve. This type of curve is known as a Motion Curve. Acceleration corresponds to the graph of a parabola, deceleration to that of a root function.

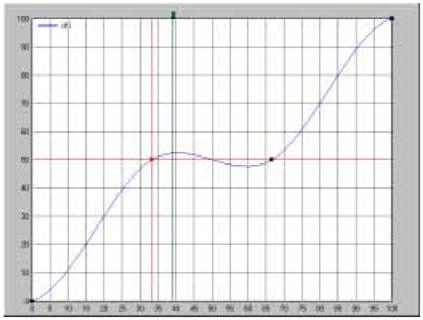
You are able to freely move a time key with your mouse. Double-clicking on a control point opens a dialog which allows you to enter key values numerically.



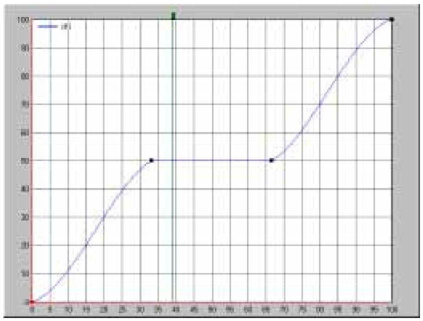
In the example above a new key was set halfway between two existing ones. The right end key was shifted from its 100%/100% position to 100%/0%. In the case of our previous example this means that the object now reaches position B halfway through the animation, then turns around and ends up back at start point A.

The figure shows that CINEMA 4D always ensures the smoothest possible animation sequence. The object is accelerated from position A, is decelerated in B, then accelerated again and at the end decelerated.

Unfortunately, this is not always the desired effect. Imagine you want your object to pause for a few seconds halfway through the animation and then resume its journey to B. The actions described so far will result in:



The result is that the object now does not pause at all, but instead swings around the middle of the motion curve. For there to be a proper pause between the second and the third key, the curve has to be horizontal. To achieve this, set two additional control points exactly above the existing ones.



The graph now has six time keys, with the points two and three, and four and five having identical values.

Since motion curves are completely independent of the type and length of a sequence and of the number of keys, they can be used universally and assigned to any animation sequences.

Using the drag-and-drop technique you can copy motion curves onto any sequence in the Time Line. Simply click somewhere in the Time Control window and drag the pointer to a sequence in the Time Line. As soon as a sequence has been assigned a motion curve, it is coloured in.

Since it is possible to save curves, setting up a library containing motion curves is very straightforward.

Important!

Evaluating curves is quite a complex mathematical task, and relatively time-consuming. We recommend that you use motion curves only when you really need to. (Note that a straight line from 0% to 100% without any intermediate points is also a motion curve.)

16.1 The File Menu

New

This command deletes the current contents of the graph window and restores the original state of the animation (i.e. without the motion curve).

Open

This command loads a previously saved motion curve into the Time Control Manager.

Save As

This command saves an existing motion curve to the hard disk. The files have the extension ’.fcv’ (Function CurVe).

Close

This command quits the Time Control Manager and closes its window.

16.2 The Edit Menu

Undo

This command undoes the last change on the time curve. Using it repeatedly will undo one command after another.

Redo

If you have undone a command and then changed your mind, Redo will restore the action.

Delete

This command deletes the active time key.

16.3 The Function Menu

Edit Data

This command opens a dialog in which you can numerically edit the data (time and state) of the active time key.

Alternatively, you can double-click on any of the keys in the graph window. Press the Enter key if you want to edit the current key; use the left and right arrow keys to go to the previous or the next key.

Insert Key

This command creates a new time key. A dialog appears for you to numerically edit the data of the active time key.

Linearise

This command attempts to restore a linear curve (0%/0% to 100%/100%) from any given motion curve.

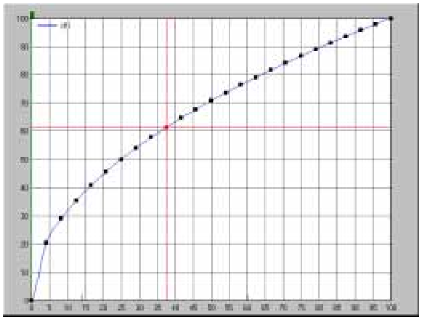
Formula

This powerful command lets you enter mathematical functions and convert them to motion curves.

For ‘s(t) =’ enter any mathematical expression. For a list of all functions and operators which CINEMA 4D supports, see the Appendix.

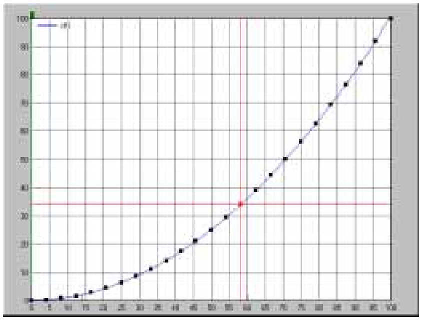
Under ‘Keys’ specify the number of control points from which to form the formula curve.

Here are three small examples of what you can do with the Formula command.



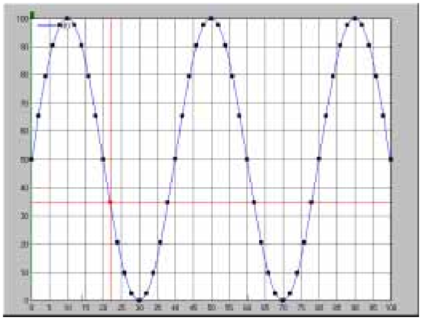
The figure above shows a curve typical for deceleration. It was created using the root function

```
s(t) = sqrt(t)
```



The figure above shows a curve typical for acceleration. It was created using the parabola function

```
s(t) = t * t
```



The figure above shows a curve typical for oscillation. It was created using the function

```
s(t) = 0.5 + 0.5 * sin(5*pi*t)
```

This function provides an animation where an object oscillates uniformly around its central position.

You might well ask how one gets to such a complicated formula. Well, it isn't actually that difficult. First, we create a sine:

```
sin(t)
```

Then we want to race across the entire animation five times, back and forth:

```
sin(5*pi*t)
```

As you can see, radians is used here (a complete revolution occurs in 2*pi). Now we decide that the oscillation should occur around the centre, i.e. at 50% (50/100 = 0.5), which means the sine needs to be shifted upwards:

```
0.5 + sin(5*pi*t)
```

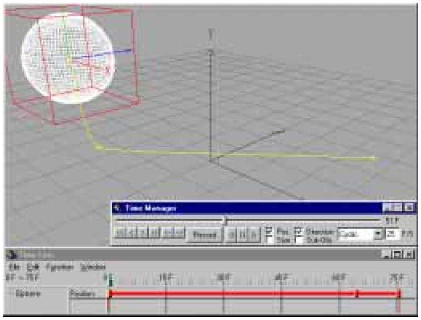
All we need to do now is to halve the amplitude to prevent the arcs from being cut off.

16.4 Examples

Before we come to the end of the this chapter we would like to demonstrate how powerful the Time Line really is.

Linearise

As you know, you can make any spline into a position track. The drawback is that it is quite likely that the interpolation between the spline control points may be incorrect. Take a close look at this:

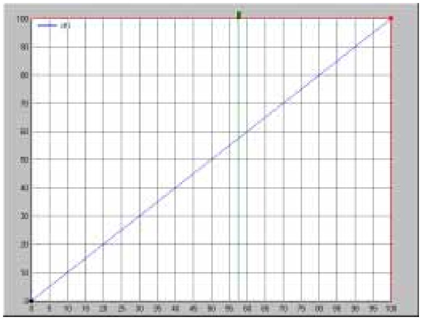


Between the first and the second keys lies a short distance, but a long time period, which means that the movement of the object is very slow. Between the second and the third keys the opposite is true: a long distance is covered in a very short time, i.e. the object travels very fast.

It does not seem feasible to get the object to travel at constant speed. Yet, this is precisely what you can do with CINEMA 4D and its superb time control.

This is how:

- Open the Time Line and activate the sequence in the position track.
- Open the Time Control.
- Ctrl-click in the window.
- Press the backspace key to delete the new time key.



And that's it! You now have your object travelling at a constant speed.

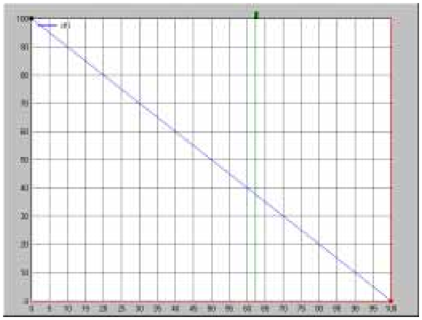
Implosion

You have encountered explosions in the Time Line—and that is one of the simpler exercises for CINEMA 4D—but what if you want to implode an object rather than explode it?

This is where you will be pleased you have this superb time control!

Here is how you do it:

- Open the Time Line and create an explosion for your object (define sequence and key).
- Activate the Explosion sequence.
- Open the Time control.
- Ctrl-click in the window.
- Press the backspace key to delete the new time key.
- Slide the first time key vertically upward. (Click on the key, then drag it and release the mouse button when you have reached the destination.) The key is now in position 0%/100%.
- Slide the second time key vertically downward, until it is in position 100%/0%.



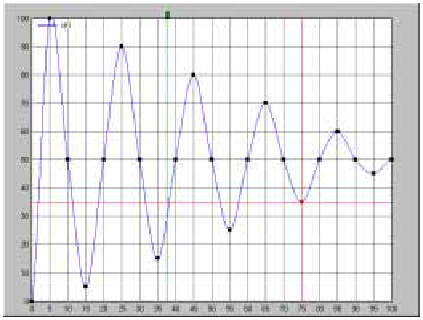
You've done it! Your object does not now explode from its original state 0% (completely intact) to state 100% (completely destroyed), but from 100% to 0%.

Oscillation

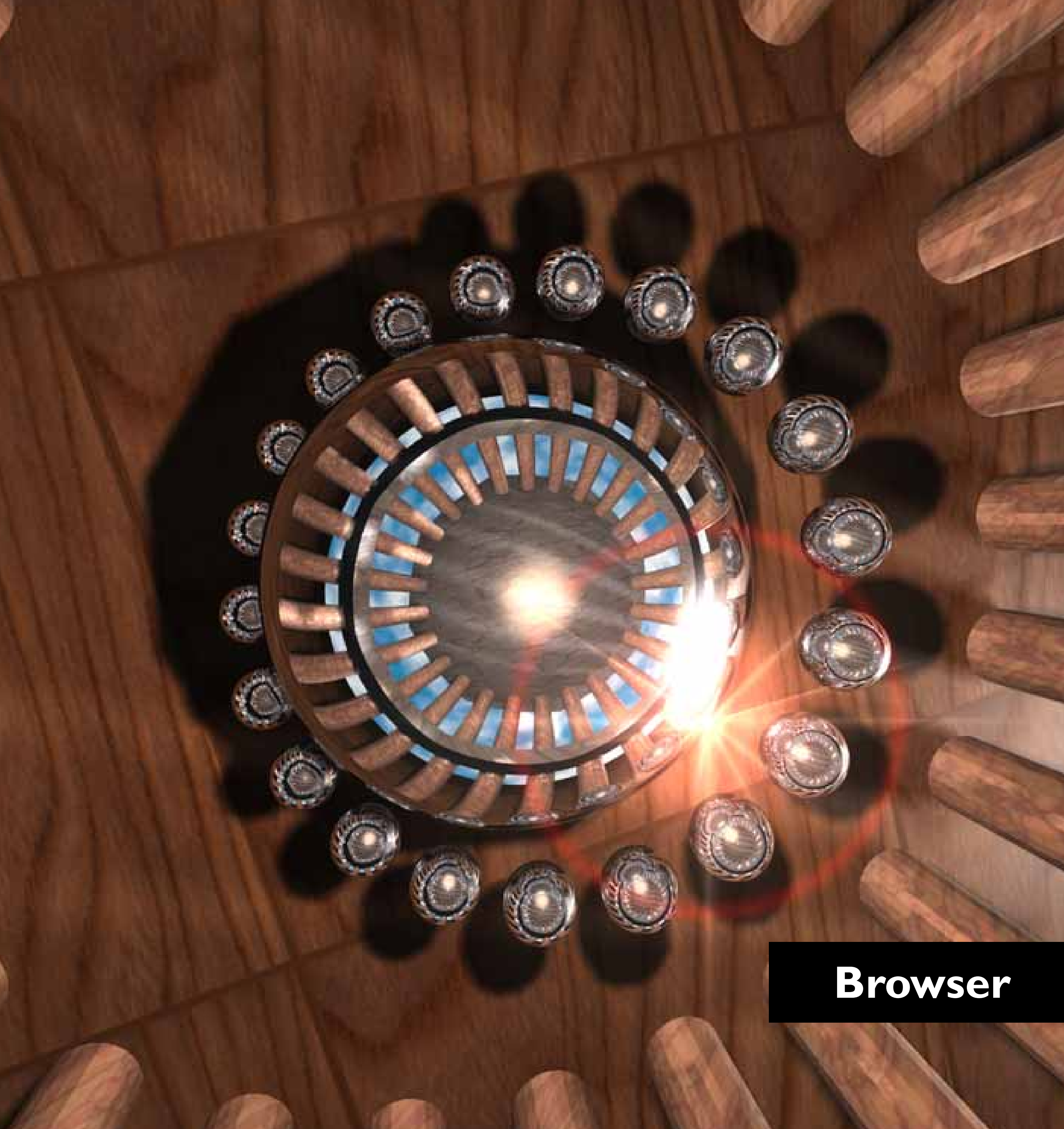
We have briefly touched on oscillation already. In nature, oscillating objects come to a rest after a while. CINEMA 4D, with its time control, can simulate this behaviour.

This is how you do it:

- Create a simple motion for an object. Let us use a position animation going from A to B, recorded by the Time Manager.
- Open the Time Line and activate the position sequence.
- Open the Time Control Manager.
- Ctrl-click in the window.
- Create additional time keys. (Keep Ctrl-clicking in the window.)
- Now move the individual keys to new positions until you obtain a graph similar to the one shown below. Make sure the first time key is at 0%/0% and the last at 100%/50%.



Great! That's it! Your object now oscillates from one end position back and forth, until after a while it comes to a standstill in its central position.



Browser

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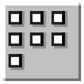
17. Browser



The Browser helps you to manage and organise all files that CINEMA 4D can deal with (images, animations, scenes, textures, materials). For a list of all 2D/3D object and scene formats which CINEMA 4D can understand, check Chapter 1 - Open; for a list of all 2D image and animation formats see the Appendix.

When used properly, the Browser is a powerful control centre for all 3D projects.

It makes sense to organise information into a number of image catalogues (one catalogue for sunsets, one for floor textures, one for the scenes of a movie...). You can even add notes to each of these archive catalogues, and search them using search criteria. It is possible, for example, to search for all files which were edited by Jonathan Black. (Who?)

How it's done

- First search the directory for all files that are supported by CINEMA 4D. Or, if you wish, restrict the search. For example, look only for images, or only for scenes.
- During the search the Browser automatically creates thumbnail previews. These give you a fairly good idea of what the image or the scene looks like.
- When the Browser has done its job, you can add comments, notes, copyright notices or similar to any of the files.
- Finally, save your database in a catalogue file and give it a meaningful name.

This is by no means everything the Browser can do for you. It develops it full potential only in combination with the various CINEMA 4D Managers. Depending on where you drag your preview thumbnail, you can create new materials, load scenes, play animations ...

Simply click on a preview thumbnail, hold down the (left) mouse button, move the mouse pointer over a Manager and release the mouse button. This is what has come to be known as drag-and-drop.

Drag-and-drop with the Browser:

- Image, animation - on Materials Manager:
  Creates a new material, containing the image as a colour texture.
- Image, animation - on object in Editor:
  Creates a new material, as above, but assigns this directly to the selected object.
- Image, animation - on object in Object Manager:
  Creates a new material, as above, but assigns this directly to the selected object.
- Image in the Output window:
  The image is displayed in the output window.

Tip:

The texture must be located in the CINEMA 4D search path, otherwise the preview image in the Materials Editor remains black.

- Scene - on Materials Manager:
  All materials (if applicable) belonging to the scene are imported to the materials list of the current scene.
- Scene - on Editor window:
  Program loads the scene.
- Scene - on Object Manager:
  Scene is imported into the current scene.
- Material - on Materials Manager:
  Material is being added to the materials list within the current scene.
- Material - on object in Editor:
  Material is added to the materials list and allocated immediately to the selected object.
- Material - on Object Manager:
  Material is added to the materials list and immediately allocated to the selected object in the Object Manager.

Tip:

If a texture that you pass to CINEMA 4D via the Browser is located outside the search path, the program asks whether you want to copy the file to the same location as the scene. This will allow CINEMA 4D to find textures automatically, without you having to worry about it.

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

But that isn't all:

- Double-clicking an image will display it in the output window.
- Double-clicking an animation calls up the animation player of your system and plays the file.
- Double-clicking a scene loads it into the Editor.
- Double-clicking a material file imports this into the current scene.
- Right-clicking a preview thumbnail opens a context menu from which you can access information about that image or scene or can get the Search dialog.

Tip:

To open the context menu on a Macintosh, hold down the Ctrl key while clicking the mouse button (this is called Ctrl-clicking).

17.1 The File Menu

New

Creates a new, blank catalogue. If one already exists in the Browser, it will be replaced with this one.

Open

Loads an existing catalogue into the Browser.

If a file named ‘template.cat’ exists in the CINEMA 4D start folder, CINEMA 4D automatically loads it when started.

Import File

Loads a single file (scene, image, material ...) into the current catalogue, while displaying a preview.

Import Folder

Loads the contents of a folder into the current catalogue. Depending on how the preferences were set up, subfolders will be searched or ignored.

Tip:

We advise against cataloguing complete CD-ROMs unless you have ample memory.

A little calculation will prove the point: A thumbnail picture with 80x60 pixels and a colour depth of 24 bit requires around 15KB of memory. So 1,000 objects on a CD—1000 catalogue images, that is—will require a minimum of 16MB of memory. And don’t forget to add a few MB for actually displaying this information in the Browser!

It therefore makes sense to create a number of smaller catalogues which are easier to manage.

Save

Saves the current catalogue. The catalogue is saved using the name indicated in the Save As dialog. This is also the name that appears in the title bar of the Browser window.

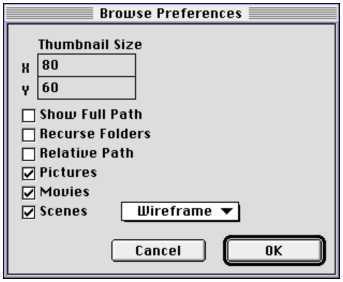
If you have not yet given a name to your catalogue (in which case the title bar displays ‘Untitled’), the Save command acts like Save As.

Save As

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

CINEMA 4D adds the extension ‘.cat’ to the filename.

Preferences



Thumbnail Size

Allows you to define (in pixels) the size of the preview images in the Browser. Changes become active immediately, even though recalculation does not occur till later. The images are simply scaled up or down (also compare Chapter 17.3 - Calculate All).

Show Full Path

This shows the complete path to an image, an animation or a scene in the Browser.

Recurse Folders

When this option is checked, the search includes subfolders.

Relative Path

Usually, when you store a preview image in a catalogue, the exact location of the Browser object is also saved. This is essential when you use the drag-and-drop technique to hand over objects to CINEMA 4D for processing.

Now imagine that you wish to compile a CD-ROM with additional materials (collection of objects, textures, etc.). Such collections are created locally, on a computer. If catalogues were created along these lines, they would all be unusable. They would look for objects on a particular computer, within a particular network, etc., rather than on the CD.

This option therefore ensures that paths are not stored as complete path names, but instead as relative paths, starting from the catalogue folder. It is from this location that the current catalogue folder and its subfolders are searched.

Tip:

This method works only if prior to searching you have named the catalogue (and thus assigned it a location) by using the Save As command (see above).

Frames

When checked, the Browser displays images. Image formats which are not supported by CINEMA 4D are ignored.

Movies

When checked, the Browser displays animations. Animation formats which are not supported by CINEMA 4D are ignored.

Scenes

When this option is checked, the Browser displays scenes. Scene formats which are not supported by CINEMA 4D are ignored.

Use the menu on the right to determine whether scenes are displayed in Wireframe, Gouraud shaded or Raytraced format. The latter calculates neither shadows nor transparencies, and only Floor and Sky reflections. Antialiasing is used for all scenes.

Close

Closes the Browser and removes the current catalogue from memory.

17.2 The Edit Menu

Delete

Removes all selected images from the catalogue. This does not affect the originals.

To select a preview image, click on it. To select several images, Shift-click on one after the other.

Select all

Selects all preview images in the current catalogue.

Deselect All

Deselects all selected preview images in the current catalogue.

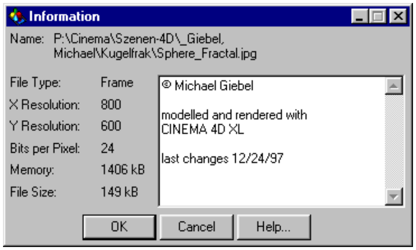
17.3 The Function Menu

Render All Materials

Causes a recalculation of all preview images in the catalogue.

This can be useful when you have changed in the image size in Preferences or when you have added or changed files in the folders.

Info



Opens an information window for the current preview, providing details about the full path, image resolution and colour depth.

Tip:

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

You may be surprised that the computer reports lack of memory even though you have only used small textures in a scene. The reason is that people forget that images—and to an even greater degree, animations—often use considerably more memory than you might guess from the space they occupy on your hard disk.

It is quite possible for a JPEG image that uses 1MB on disk to take up 10MB or more of memory. If you work with a few of these compressed files your memory can melt like ice cream in the Sahara.

You can monitor these values (file size and actual memory requirements) by looking in the Browser's Information window. This will prevent you from getting a nasty surprise.

The right-hand side of the Information window has a section for your own comments. Use this to write copyright information, latest changes and similar.

These comments can occupy multiple lines and can contain up to 255 characters. They are displayed in the Browser if you leave the mouse pointer on a preview for a little while—just as you have seen with the Tool palettes, an information box will pop up below the mouse pointer.

Entering multiple Text Lines

For Windows users this is not a problem, since multi-line entry fields are supported. Simply use the Enter key to place your insertion marker on the next line.

On a Macintosh you cannot press Enter since this will close the dialog.

Here is how to do it: Launch Simple Text and enter your lines into a Simple Text document. Select the entire text and copy it onto the Clipboard. Click in the comments field in the Browser information dialog and paste the text into it.

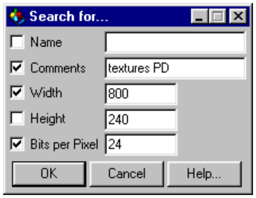
Tip:

It is possible to search by the contents of the comments field (see below). This effectively makes the Browser into a small image database.

Tip:

While searching a folder, if the browser finds a text file named 'Readme.txt' it will automatically copy the contents of that file into the information dialog of every thumbnail in the folder.

Search Path



This allows you to search the current image database in the Browser according to certain criteria or information.

Tip:

This command is also accessible via the context menu that appears when you right-click.

You may search the Browser by filename, comments or by images of a certain resolution and color depth. Simply place a checkmark in the appropriate box and enter the values you wish to use as criteria.

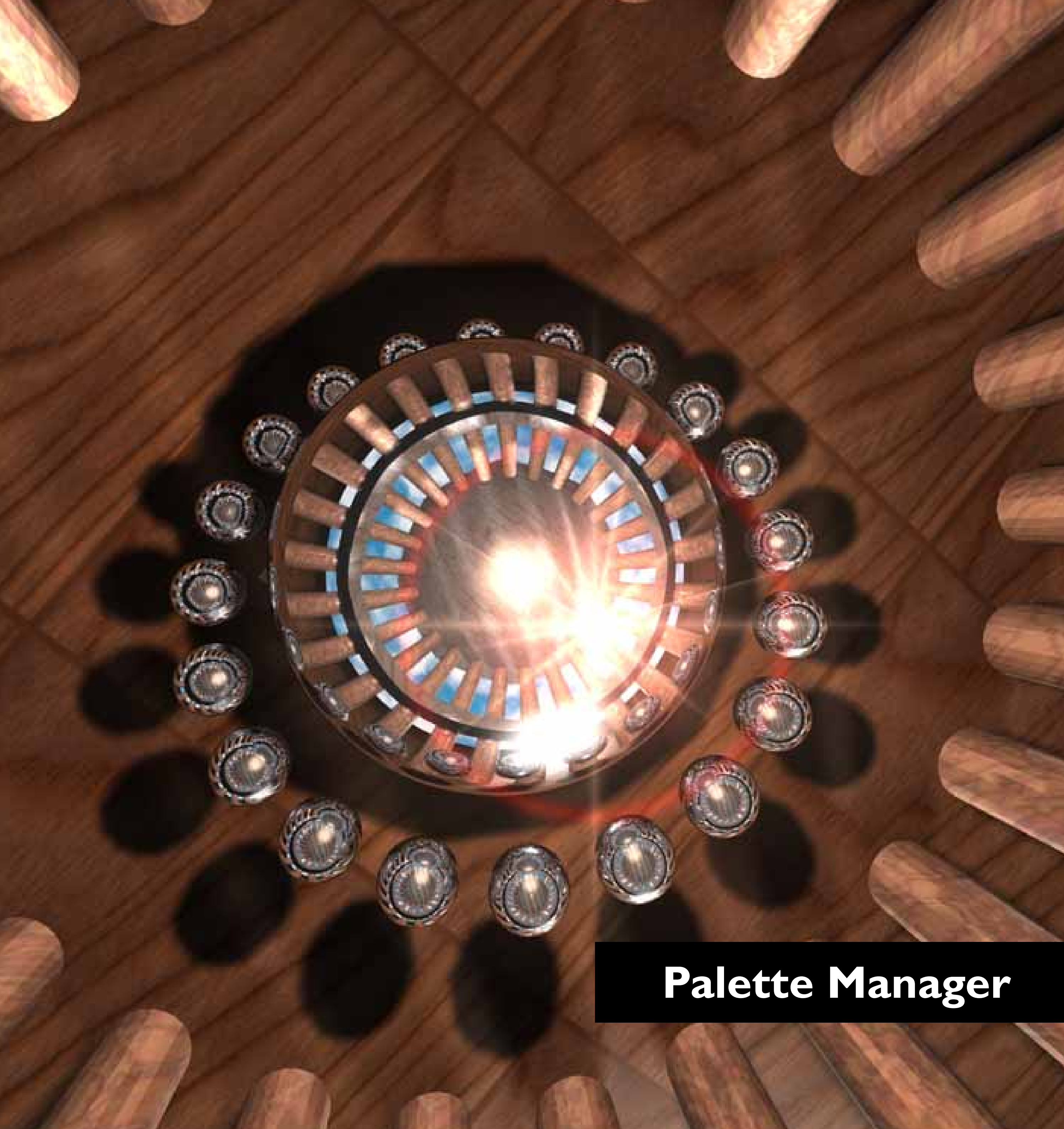
In the example shown above the search is for all files that are free textures, have a width of 800 pixels and a colour depth of 24 bits (TrueColor).

All available thumbnails are marked in the catalogue.

Sort By

Use the subentries in this menu command to determine the sort sequence of the current catalogue in the Browser.

The options are filename, file size, memory requirements, image width, image height or colour depth. Sorting is always in ascending order; the list starts with the smallest images and ends with the largest.



Palette Manager

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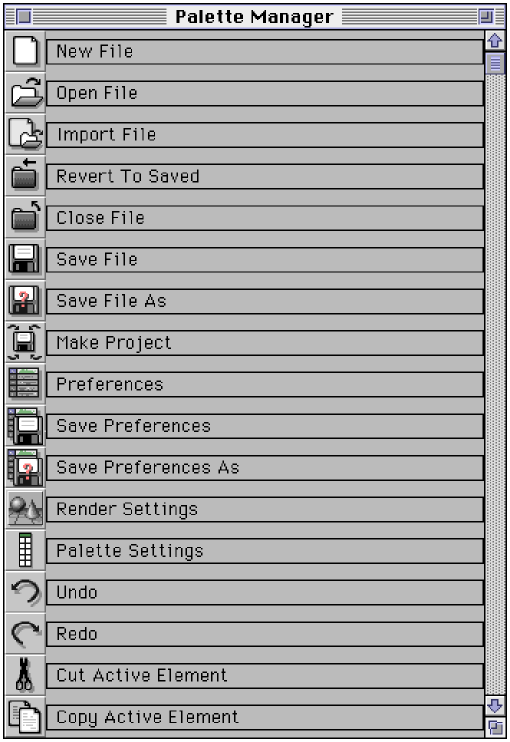
18. Palette Manager

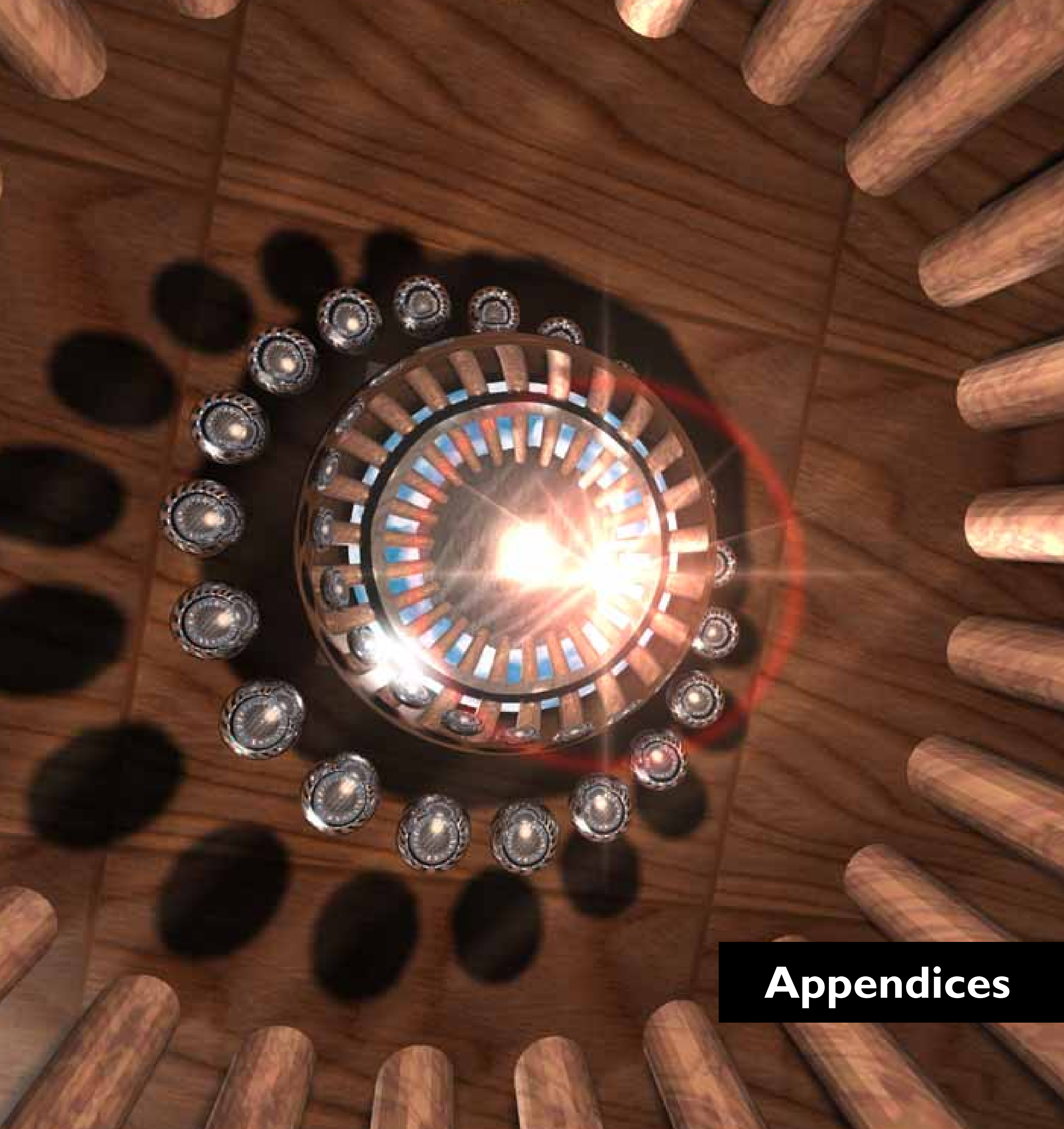


You will not find the Palette Manager in a CINEMA 4D menu. Instead, you access it via a popup menu: Right-click on any icon within a toolbar (on a Macintosh use the Apple key in combination with the mouse button). Then select the Palette Manager command.

Once the Palette Manager is open you will see a list with practically all the program functions. From here you can grab an icon, and drag-and-dropping it to the required place in any of the palettes. Use File / Save Preferences if you wish to save your new palette layout.

To delete icons from any of the palettes, hold down Ctrl while pressing Shift and click the icon you wish to delete. Or use the Delete Icon command from the popup menu.

Under Windows you can attach palettes internally and externally to the main window. This means that the palette is ‘docked’with the Editor window; the window frame disappears and the palettes take up less space. You may wish to restore a different layout by using the Undock command from the popup menu.



Appendices

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Appendices

A.1 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.

A.1.1 Image Formats

TIFF

Bit depths
1, 4, 8, 24

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.

Should you ever come across a TIFF image which CINEMA 4D cannot recognise, use a converter program (such as PaintShop Pro or Graphic Converter) in order to make it compatible.

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

Compressors
Uncompressed.

Note
Only TGA-1 is supported.

PICT

Note
This format is read and written only on the Macintosh platform. All PICT formats supported by the Macintosh operating system are also supported by CINEMA 4D.

BMP

Bit depths
1, 4, 8, 16, 24

Compressors
RLE-4, RLE-8.

Notes
This format is read and written only on PCs running Windows 95 and Windows NT. On a Macintosh, BMP files can be read only.

Most programs do not recognise the new 16 bit format (yet) and cannot therefore normally read such images created by CINEMA 4D.

JPEG

Bit depths
24

Compressors
Proprietary JPEG library.

Note
Greyscale JPEGs cannot be loaded.

A.1.2 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 and Windows NT.

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.

Caution
Alpha channels are integrated directly into the animation only if the compressor supports this. We are not currently aware of any such compressors for the AVI format.

QuickTime

Compressors
All Codecs (compressors) that are installed in the operating system are supported.

Notes
This format can be read and written only on Macintosh systems.

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 colours must be set to Million Colors +.

FLI/FLC

Note
These somewhat dated animation formats are not supported by CINEMA 4D because, apart from anything else, they are limited to 256 colours.

A.1.3 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, 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, highlight colour, highlight settings (are recalculated), transparency, luminance, colour texture, highlight 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 (see Chapter 1 - Preferences).
- So-called *target objects* loaded from 3DS (from cameras and light sources) become axes (dummy 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:
  Colour, Luminance, Transparency, Environment, Highlight, Highlight Colour, 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.

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.

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:
  Colour, Luminance, Highlight, Highlight colour, 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 colour, diffuse colour, specular colour, emissive colour, 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 colour texture, the luminance texture and the environment texture (in that order). Colour textures, even inline textures, are saved as files.
- WWW links/addresses are saved: when an object is selected in the 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.

A.2 Formula

The Formula Spline and Formula Animation functions give you a clue that CINEMA 4D can handle mathematical formulae. However, these are not the only places where you can use formula; in fact, wherever CINEMA 4D accepts a value (for example in the Coordinate Manager) you may use mathematical expressions instead of fixed values. CINEMA 4D will do the calculations for you!

The rest of this section is a list of all the units, operators, functions and constants that can be used in the program. You may use either a fullstop or a comma as a decimal separator, but do not use either of these to divide large numbers into groups of three digits (i.e. as a thousands seperator).

A.2.1 Units

CINEMA 4D gives you the option to use your own preferred unit of measurement, independently of what has been chosen in Preferences. You may use a space to separate the value from the unit.

km	kilometre	e.g. 23 km; 0.125km
m	metre	e.g. 13.23 m; 1000m
cm	centimetre	e.g. 11.5 cm; 328,275cm
mm	millimetre	e.g. 14 mm
um	micrometre	e.g. 678 um
nm	nanometre	e.g. 3.867 nm
mi	mile	e.g. 12.5 mi
yd	yard	e.g. 17.9 yd
ft	foot	e.g. 512 ft
in	inch	e.g. 0.125 in
B	frame no.	e.g. 0 B

Note

The only time the units really matter is when units are being converted, for example when you change the basic unit in Preferences from metres to millimetres. Even then it is really only a change of units, not a re-scaling of the objects.

A.2.2 Operators

The function parser has the most important arithmetic operators built in:

+	Addition	e.g. 144 + 14	=	158
–	Subtraction	e.g. 144 – 14	=	130
*	Multiplication	e.g. 144 * 2	=	288
/	Division	e.g. 144 / 12	=	12
MOD	Modulo	e.g. 123 mod 4	=	3
^	Power	e.g. 12 ^ 2	=	144
(	open bracket	e.g. 3 + 4 * 2	=	11
)	close bracket	e.g. (3 + 4) * 2	=	14

A.2.3 Functions

ABS	absolute value	e.g. abs(–123) = 123
SIN	sine	e.g. 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	e.g. log10(100) = 2
LOG	logarithm to base e	e.g. log(e) = 1
EXP	exponential function	e.g. exp(5) = 148,413
SQRT	square root	e.g. sqrt(144) = 12
SQR	square	e.g. sqr(12) = 144

Notes

Function arguments must always be bracketed. The number of opening brackets must equal the number of closing brackets.

Functions may be embedded:

```
sin(sqr(exp(pi)))
```

The argument of a trigonometric function is always interpreted in degrees. This means that `sin(2*pi)` does not mean computing the sine of 180°, but only of approx. 6.283°.

A.2.4 Constants

Two of the most important constants have been built in:

PI	Pi	e.g. pi = 3.142
E	Euler's number	e.g. e = 2.718

With all the above you should be able to define even the most complex of operations in a very precise way. And don't forget: you can combine them freely. For example, you could use:

```
2 km + exp (sin (4 mm * pi)) /
 ((sin (14 cm)) ^ 2 +
  (cos (14 cm)) ^ 2)
```

A.3 Shaders

The use of shaders is described in Chapter 9 (The Material Manager) and Chapter 10 (Texture Mapping). Here we will describe in more detail the ones that form part of the CINEMA 4D package.

As was mentioned earlier, shaders are programs that were programmed in the C.O.F.F.E.E. language, which is an integral part of the application. If you take a look at a shader in an editor you may find a line of this type:

```
SHADER2D 5479
```

This calls a 2D shader by its number. But where is the actual shader?

Well, all shaders supplied by MAXON are built into the program, with the exception of the so-called external C.O.F.F.E.E. shaders (extension '.cof'), which exist as source text but are loaded, just like the others, via the Material Manager or the Material Editor. Later in this appendix, in the chapter on the C.O.F.F.E.E. programming language, you will find a listing of such a shader.

Don't worry! It is enough to know that you can call each shader from the Material Manager or the Material Editor.

The following section contains details of 2D and 3D shaders and points out differences.

Note

External shaders are not covered here. Look for Readme files in Tex folders. If in doubt, simply experiment with the various parameters on a simple object.

A.3.1 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, for a particular material property such as Colour or Transparency. So these shaders fill an area on an object using a particular type of projection (see Chapter 10).

2D shaders are loaded in the Material Editor in place of bitmap textures or movies. They can be found in the Tex folder.

To edit a 2D shader, click the Edit button in the Material editor. If it is an animated shader it is shown moving in the preview.

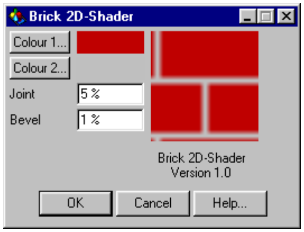
Note

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 dialog, or modify the tiling.

Conventions

- Built-in 2D shaders have the extension '.shc' (Channel Shader).
- External C.O.F.F.E.E. shaders have the extension '.cof' (ASCII) or '.cob' (binary).
- External 2D shaders can optionally have '_C' appended to their names (e.g. 'Wood_C.cof').

Brick



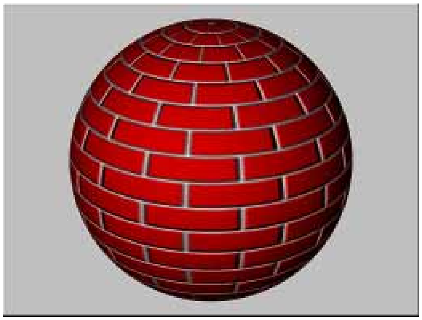
This shader generates complex brick patterns.

'Colour 1' determines the colour of the brick.

'Colour 2' determines the colour of the joints.

'Joint' defines the width of the joint relative to a UV unit.

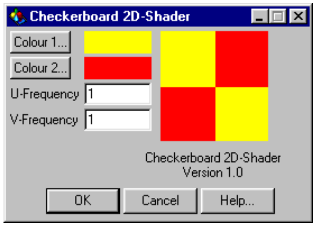
'Bevel' defines the width of the sloping edge between joint and brick.



Note

Specify the number of bricks via the texture tiling function.

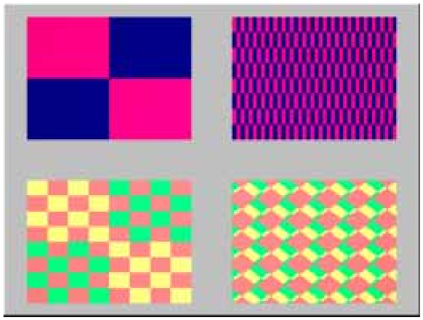
Checkerboard



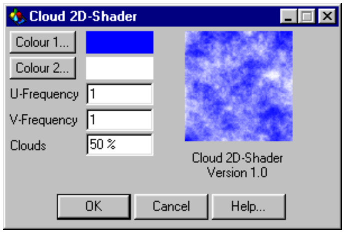
This shader creates checkerboard patterns. Here you can really go mad without destroying the atmosphere of your scene.

'Colour 1' and 'Colour 2' define the two colours of the squares.

'U frequency' and 'V frequency' determine the fineness of the structure. 1/1 creates radial interference, 1/0.25 elongated wave fronts. The greater the ratio, the higher the frequency of the turbulence.



Cloud



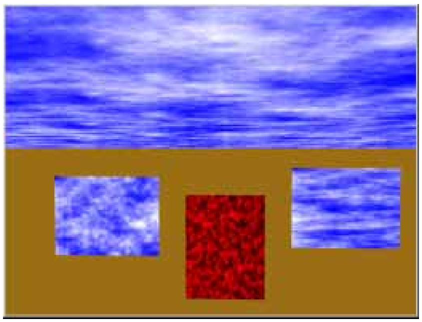
This shader simulates cloud patterns.

‘Colour 1’ defines the colour of the sky.

‘Colour 2’ defines the colour of the clouds.

‘U frequency’ and ‘V frequency’ determine the fineness of the structure. 1/1 creates radial interference, 1/0.25 elongated wave fronts. The greater the ratio, the higher the frequency of the turbulence.

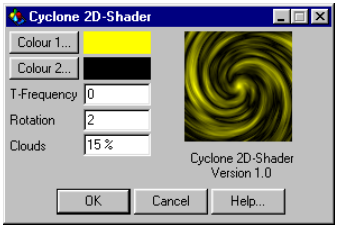
‘Clouds’ specifies the number of clouds in the sky.



Note

Using asymmetrical UV parameters to create elongated Cirrus clouds (for example: 1/0.25).

Cyclone



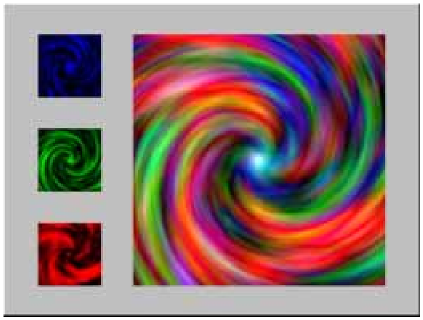
This shader simulates a cyclone.

‘Colour 1’ and ‘Colour 2’ define the minimum and maximum colour for the colour transition.

‘T frequency’ defines the timing of the cyclone rotation.

‘Rotation’ determines the angle of rotation (spin).

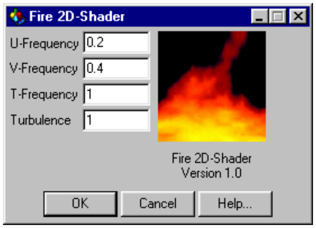
‘Clouds’ defines the volume of clouds.



Note

This shader is animated.

Fire



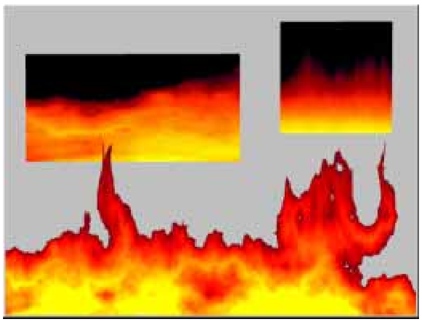
This shader simulates a wall of flames blown by wind.

'U frequency' and 'V frequency' determine the fineness of the structure. 1/1 creates radial interference, 1/0.25 elongated wave fronts. The greater the ratio, the higher the frequency of the turbulence.

'Turbulence' determines how violently the flames flicker..

'T frequency' determines the scaling factor for the timing.

2 doubles the speed of movement (i.e. the wind).
0 suppresses all wind.



Note

The wall of flames stretches infinitely in the U direction.

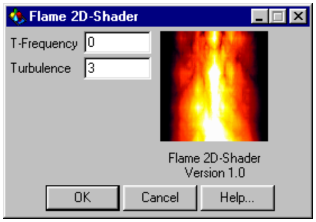
Note

Good flame materials can be created by using this shader both in the Genlocking and the Transparency properties. (In Genlocking, dr/dg/db should be set relatively high, approx. 30%.)

Note

This shader is animated.

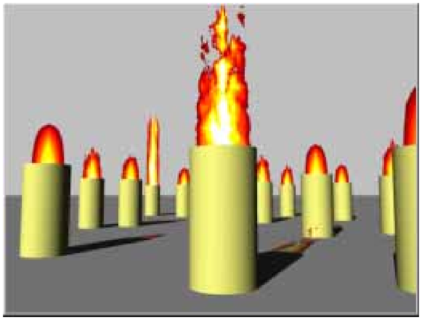
Flame



This shader simulates a single flickering flame of a candle.

'T frequency' determines the scaling factor for the timing.

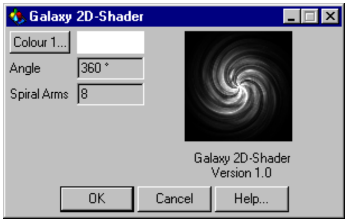
2 doubles the speed of movement (i.e. the wind).
0 suppresses all wind.



Note

This shader is animated.

Galaxy

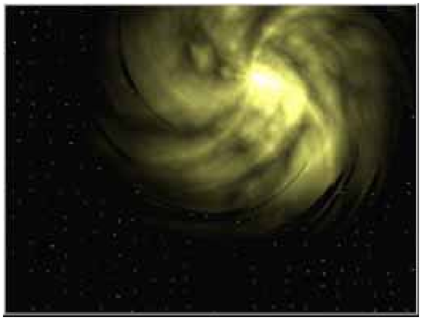


This shader simulates a galaxy with spiral arms.

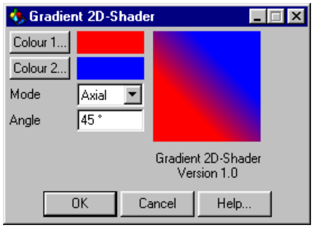
'Colour' is the colour of the star clouds.

'Angle' is the degree of rotation of the spiral arms.

'Spiral Arms' is the approximate number of spiral arms.



Gradient



This shader creates a smooth gradient between two colours.

'Colour 1' and 'Colour 2' specify the minimum and the maximum colour for the transition.

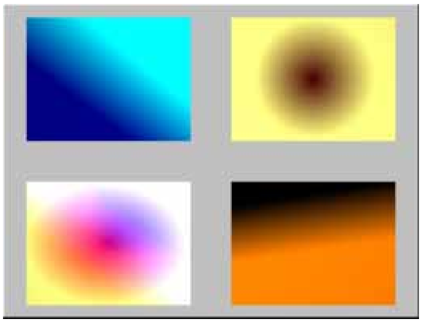
'Mode' is the type of gradient.

> Axial: Colour gradient in the range 0 to 1 along a line which is given by 'Angle' (see below).
>
> Radial: Gradient of 0.5/0.5 radially, towards the outside.

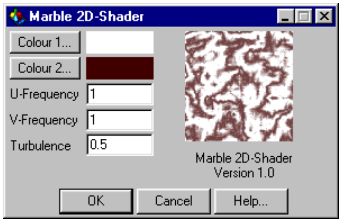
'Angle' is the direction of the (axial) colour gradient.

> 0 = X axis
> 45 = Angle bisection
> 90 = Y axis

etc.



Marble



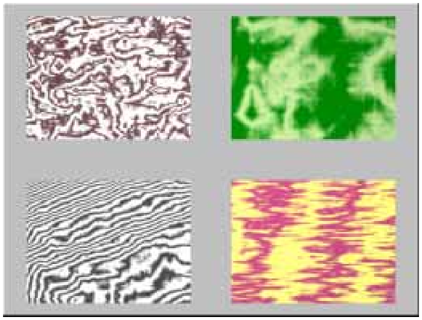
This shader generates marble structures.

'Colour 1' and 'Colour 2' define the marble colouring.

'U frequency' and 'V frequency' determine the fineness of the structure. 1/1 creates radial interference, 1/0.25 elongated wave fronts. The greater the ratio, the higher the frequency of the turbulence.

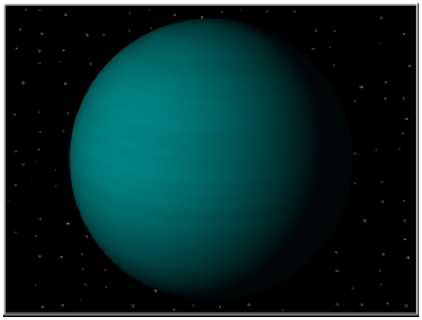
'Turbulence' determines the factor for the details.

> 0 = None

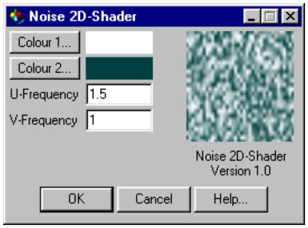


Neptune

This shader has no dialog. It simulates the planet Neptune with typical colouring and cloud patterns.



Noise

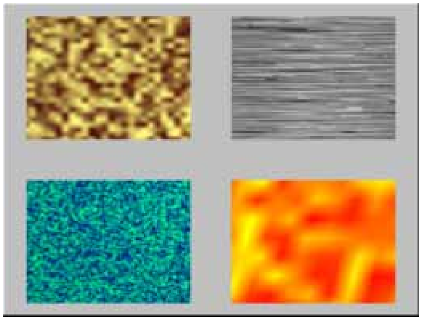


This shader generates a random pattern that can be used, for example, for sun surfaces and stone reliefs.

By overlapping several Noise shaders with different amplitudes and frequencies, you can create masses of interesting patterns.

‘Colour 1’ and ‘Colour 2’ define the minimum and maximum colour for the colour transition.

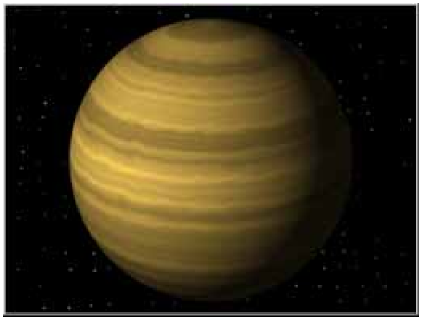
‘U frequency’ and ‘V frequency’ determine the fineness of the structure. 1/1 creates radial interference, 1/0.25 elongated wave fronts. The greater the ratio, the higher the frequency of the turbulence.



Saturn

This shader does not have a dialog box. It simulates the planet Saturn with typical colouring and cloud structures.

The texture is cyclic in the U direction.

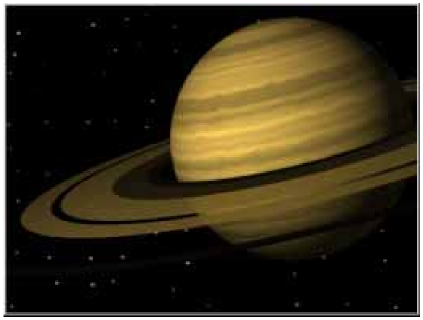


Note

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 the sphere—in other words, the Y axis should be scaled by about 0.85.

Saturnring

This shader has no dialog. It creates an astronomically correct simulation of the rings around Saturn—the D, C, B, A, F and G rings, with the Cassini and Encke gap.



Note

Saturn is approximately one third as wide as the width of the ring structure.

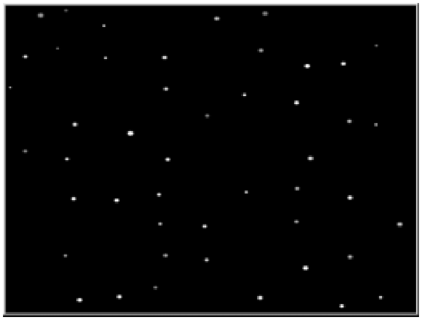
Note

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.

To have stars shine through the rings, switch on Genlocking with dr/dg/db <= 2%.

Starfield

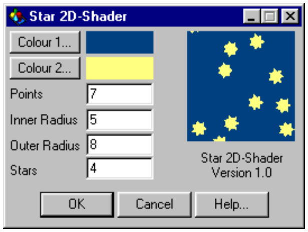
This shader does not have a dialog box. It simulates a starry night. The number of stars can be controlled by tiling the texture.



Caution:

If the stars are too small (caused by lots of tiling) they may be 'swallowed up' by strong antialiasing.

Stars



This shader creates a star-filled wallpaper.

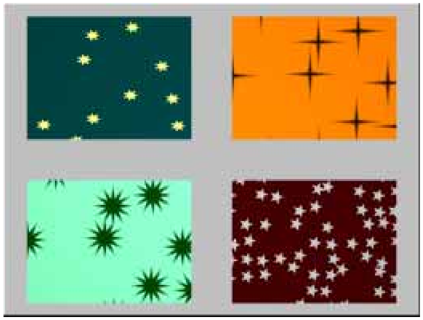
'Colour 1' is the colour of the wallpaper.

'Colour 2' is the colour of the stars.

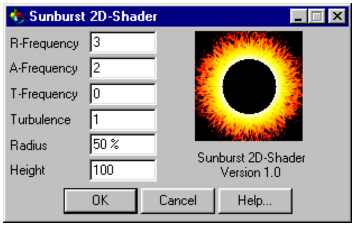
'Points' is the number of star tips.

'Inner radius' and 'Outer radius' determine the dimension of a star, given as a percentage of U/V, in the range 0/0 to 1/1.

'Stars' is the average number of stars per UV unit.



Sunburst



This shader generates sun flares and eruptions.

'R frequency' determines the radial frequency. (A value of 0 yields a lovely aurora.)

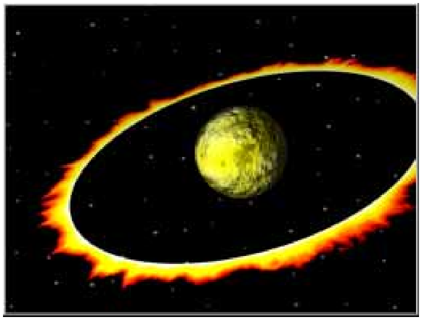
'A frequency' gives the angular disturbance. (0 gives individual layers.)

'T frequency' defines the movement of the sunburst: 2 doubles the speed, 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.

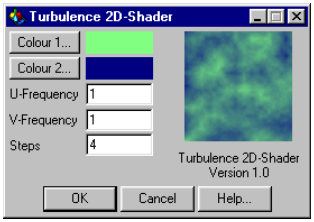
'Height' defines the width of the eruption region relative to the radius.



Note

This shader is animated.

Turbulence

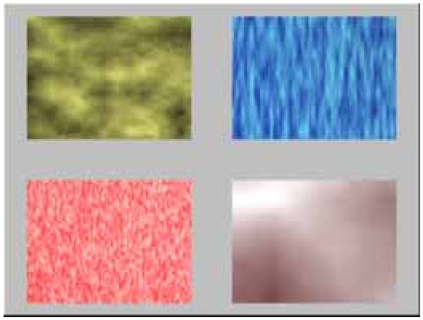


This shader creates coloured turbulences.

'Colour 1' and 'Colour 2' specify the ends of the colour transition

'U frequency' and 'V frequency' determine the fineness of the structure. 1/1 creates radial interference, 1/0.25 elongated wave fronts. The greater the ratio, the higher the frequency of the turbulence.

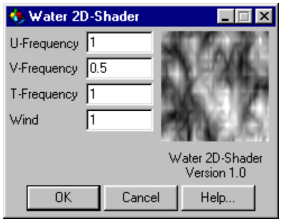
'Steps' specifies the number of iteration steps for generating a fractal turbulence. The more steps you have the more detail you obtain. With a setting of 1 the Turbulence shader is almost identical to the Noise shader.



Uranus

This shader does not have a dialog. It simulates the planet Uranus with typical colouring and cloud structure.

Water



This shader generates water surfaces and is ideal for use in a Material's Bump property page for simulating water surfaces perturbed by wind. It can simulate slight turbulences (ripples) and more significant ones (waves).

'T frequency' is the speed of the wind blowing over the surface of the water (e.g. 0 means no wind; 2 doubles the speed).

'Wind' specifies the amplitude of the wind—in other words,the effect the wind is having on the water surface.

Note

This shader is animated.

A3.2 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; instead, a 3D shader directly defines a material—or in other words, a 3D shader *is* the material.

For this reason, 3D shaders are loaded into the Material Manager in place of materials. They can be found in the Tex folder.

To edit a 3D shader, double-click on it in the Material Manager.

Note

Volume shaders that support this function participate in any distortion using UVW coordinates.

Note

All volume (3D) shaders can be applied to a 3D object very precisely either by changing the values in the Shades dialog or, often more simply, by adjusting the texture axes values (double click on the Texture attribute icon in the Object Manager).

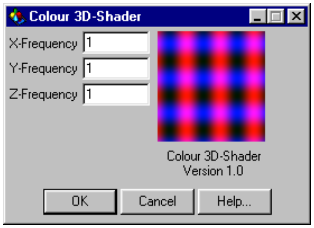
Note

A 3D shader will always adapt to the size of the 3D object to which it has been applied. There will be no edges or seams.

Conventions

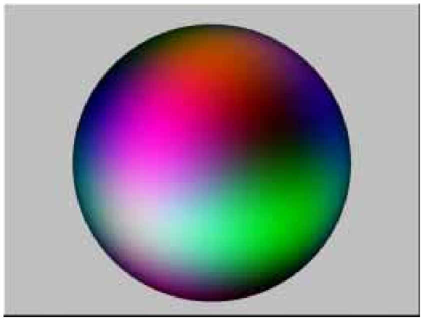
- Built-in 3D shaders have the extension ‘.shv’ (Volume Shader).
- External C.O.F.F.E.E. shaders have the extension ‘.cof’ (ASCII) or ‘.cob’ (binary).
- External 2D shaders can optionally have ‘_V’ appended to their names (e.g. ‘Wood_V.cof’).

Colour

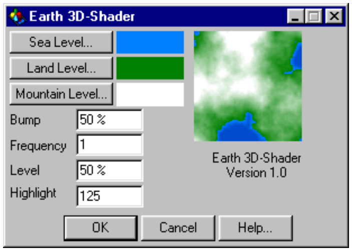


This colourful shader uses sine functions to cycle through the RGB colour range.

The X, Y and Z frequencies specify the behaviour of the colours: e.g. double values means twice as much detail; different values for X, Y and Z means asymmetrical behaviour.



Earth



This shader simulates a planet with mountains.

'Sea Level' determines the colour for areas which have a height of less than zero.

'Land Level' specifies the colour for medium height terrain.

'Mountain Level' specifies the colour for high terrain.

'Bump' gives the degree of bump mapping—0% means a smooth surface with only patches of colour (ideal if you need to camouflage an object). Note that water is always smooth; only land areas are covered with a relief (a bump map).

'Frequency' indicates the fineness of detail.

'Level' specifies the relationship between water and land mass.

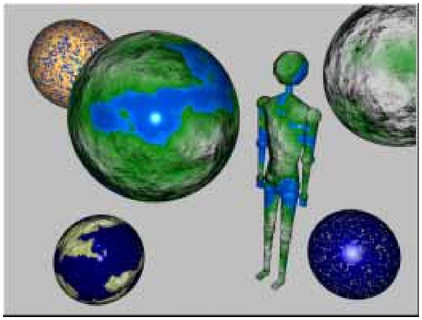
0% = practically all water
50% = equal parts of land and water
100% = practically all land

'Highlight' specifies the highlight factor.

0 = none
1 = large
50 = small
150 = very small, etc.

Note

The highlight appears only on water surfaces.



Fog

This shader simulates volumetric fog and volumetric light.

General

'Samples' defines the average number of samples that need to be computed per raytracing ray. The higher this number, the greater the quality but longer the calculation time.

Tip:

Start with low numbers, say 6 or 8. Increase this value only if you get disturbing artefacts 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 colour of the fog is all pervading. Light sources have no effect. However, this is usually sufficient to simulate fog in a fractal. With 'Volumetric' activated, all light sources 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.

Be warned again!

The 'Volumetric' option costs a tremendous amount of computing time.

The X, Y and Z frequencies determine the appearance of the fog: e.g. double the values to get twice as much detail; use different values for X, Y and Z for asymmetry.

Fog

'Colour' is the colour of the fog.

The pop-up allows you to control the fog intensity over distance.

Linear:	Linear decrease of fog intensity along the Y axis of the texture axis system.
Exponential:	Exponential decrease of fog intensity along the Y axis of the texture axis system.
None:	Constant fog density.

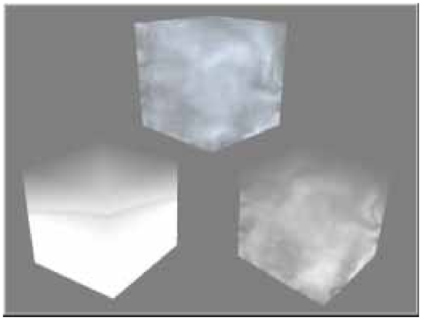
Turbulence

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).

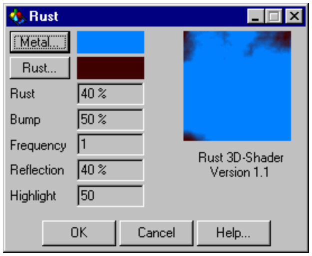
'T-Frequency' controls the speed of the swirling fog (0 = no movement).



Note

This shader is animated.

Rust



This shader simulates rusty patches on metal surfaces.

You may define the colours for the metal and the rust.

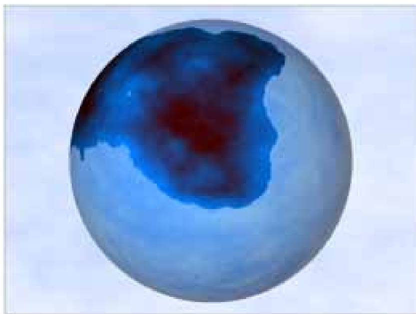
‘Rust’ specifies the size of the rust surface relative to the metal.

The rust is initially flat. It can be raised by optionally using the ‘Bump’ (relief) setting.

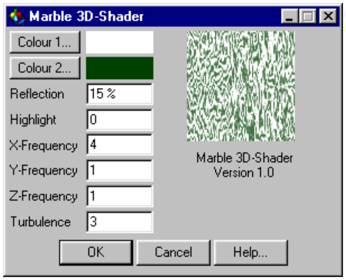
‘Frequency’ determines the degree of jaggedness.

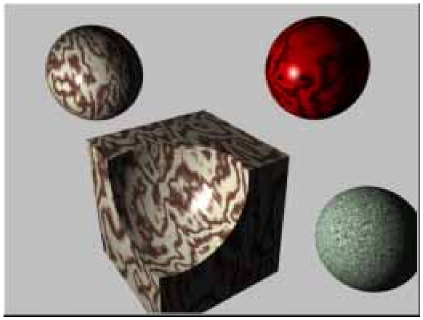
Define the degree of reflection with the ‘Reflection’ setting.

The rust-free areas are reflective and may be enhanced by an optional metallic highlight. ‘Highlight’ defines the size of this highlight.



Marble





This shader generates three-dimensional marble structures.

'Colour 1' and 'Colour 2' specify the colouring.

'Reflection' is the degree to which the environment is reflected in the marble.

Caution!

You will need to activate 'Reflections' in the Render Settings, and possibly reduce the Threshold from its default 15%.

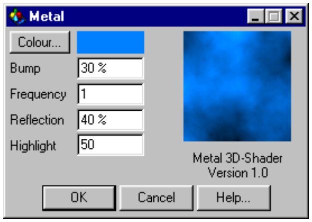
'Highlight' specifies the factor for the highlight.

0 = none
1 = large
50 = small
150 = very small, etc.

The X, Y and Z frequencies determine the detail of the marbles in those directions (e.g. double values mean twice as much detail; use different values for X, Y and Z for asymmetry.

'Turbulence' specifies the overall complexity of the marble (0 = no turbulence).

Metal



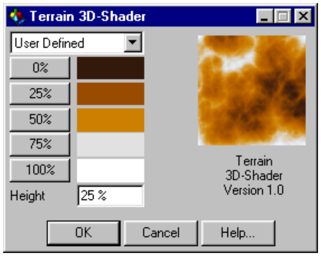
This shader simulates metallic surfaces.

'Colour' specifies the colour of the metal.

'Bump' and 'Frequency' define the roughness of the surface.

The surface is reflective and optionally takes a metallic highlight. The intensity of the reflection is determined by the 'Reflection' setting. 'Highlight' is the size of the highlight.

Terrain

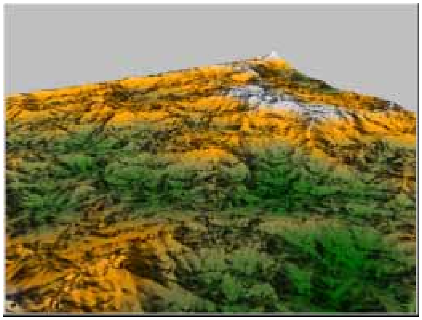


This shader generates virtual, fractal landscapes featuring mountains and valleys.

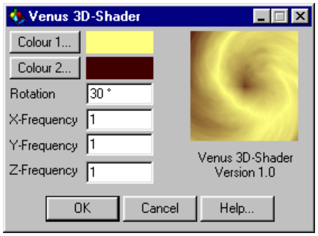
The popup menu at the top allows you to select from a list of predefined colour palettes.

The buttons below the popup menu let you assign different colours 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, for example, the fractal covers half the object.



Venus

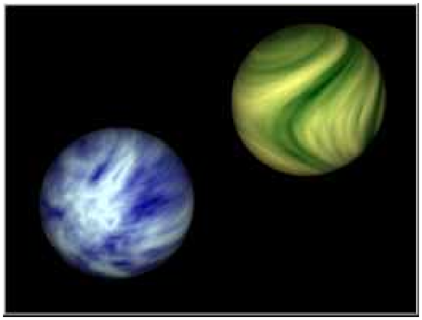


This shader simulates a gaseous planet with cloud structures being whirled around by the Coriolis stream.

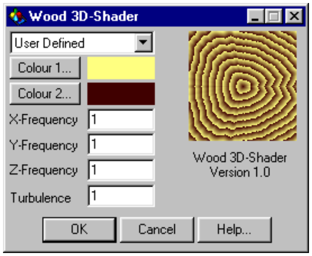
'Colour 1' and 'Colour 2' define the colours of the clouds.

The X, Y and Z frequencies determine the densities in those directions.

'Angle' determines the degree of whirl caused by the Coriolis stream.



Wood

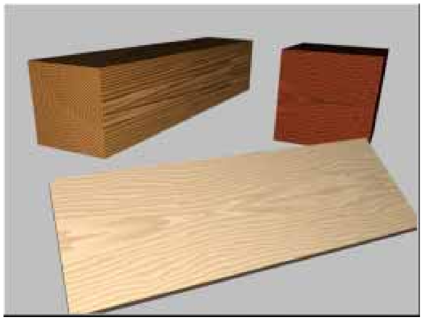


This shader simulates wood patterns.

The pop-up gives choices for the colour of the wood. 'Colour 1' and 'Colour 2' allow you to select custom colours.

The X, Y and Z frequencies determine the look of the wood. X and Y change the frequency of the rings in those directions; Z affects the grain—e.g. values of X=0.5, Y=1 and Z=1 will produce elliptical rings.

'Turbulence' determines the degree of irregularity (0 = exactly concentric rings).



A.4 Keyboard Shortcuts

A.4.1 Windows 95/NT

Editor

Keys without Modifier

0	Tools / Reload Plug-ins
1	Action / Selection
2	Action / Magnify
3	Action / Move
4	Action / Scale
5	Action / Rotate
A	Tools / Options / Animation
B	View / View / Active Object
C	Tools / Options / Camera
D	Tools / Options / Triangles
E	Tools / Options / Edges
F	Tools / Options / Magnet Settings
G	Select Area
H	View / View / Scene No Camera / Lights
I	Tools / Options / Inverse Kinematics
J	View / View / Standard
K	Tools / Animation / Record
L	Tools / Coordinates / Object System
M	Tools / Options / Model
N	Tools / Options / Magnet
O	Tools / Options / Object
P	Tools / Options / Points
Q	Tools / Options / Quadrangles
R	Tools / Options / Object Axis
S	View / View / Scene
T	Tools / Options / Texture
U	Tools / Options / Texture Axes
V	Tools / Options / Virtual Walkthrough
W	Tools / Coordinates / World System
X	Tools / Coordinates / X-Axis / Heading
Y	Tools / Coordinates / Y-Axis / Pitch
Z	Tools / Coordinates / Z-Axis / Bank
Del	Delete
←	Delete
Space	Toggle between camera and selected tool
Return	Toggle between Move/Scale/Rotate/ Magnify/Selection
Tab	Next document
Shift + Tab	Previous document
Plus	Camera zoom +25%
Minus	Camera zoom –25%

Using Ctrl as a Modifier

Ctrl-F4	Close File
Ctrl-0	Display / Skeleton
Ctrl-1	XY View – Front View
Ctrl-2	XZ View – Top View
Ctrl-3	ZY View – Side View
Ctrl-4	3D View – Perspective View
Ctrl-5	4T View
Ctrl-6	Display / Gouraud Shading
Ctrl-7	Display / Flat Shading
Ctrl-8	Display / Wireframe
Ctrl-9	Display / Bounding Box
Ctrl-A	Select All
Ctrl-B	Render Preferences
Ctrl-C	Copy to Clipboard
Ctrl-D	Deselect All
Ctrl-E	Preferences
Ctrl-F	Redraw
Ctrl-H	Import File
Ctrl-J	Display / As Preset
Ctrl-K	Display / Options
Ctrl-L	Set 3D Camera to Object
Ctrl-M	Render in New Window
Ctrl-N	New File
Ctrl-O	Open File
Ctrl-R	Render All

Ctrl-S	Save File
Ctrl-T	Render Active Object
Ctrl-U	Set 3D Camera to Editor
Ctrl-V	Paste from Clipboard
Ctrl-X	Cut to Clipboard
Ctrl-Y	Redo
Ctrl-Z	Undo

Using Alt as Modifier

Alt-F4	Quit Program
Alt-0	Coordinates Manager
Alt-1	Material Manager
Alt-2	Object Manager
Alt-3	Structure Manager
Alt-4	Time Manager
Alt-5	Time Line
Alt-6	Space Control
Alt-7	Time Control
Alt-8	Browser
Alt-9	Console

Output Window

Key without Modifier

Esc	Cancel Output/Rendering

Using Ctrl as Modifier

Ctrl-1	Fit to Size
Ctrl-2	Adjust Window to 12.5%
Ctrl-3	Adjust Window to 25%
Ctrl-4	Adjust Window to 50%
Ctrl-5	Adjust Window to 100%
Ctrl-6	Adjust Window to 200%
Ctrl-7	Adjust Window to 400%
Ctrl-8	Adjust Window to 800%
Ctrl-A	Alpha Channel
Ctrl-B	Blue Channel
Ctrl-G	Green Channel
Ctrl-O	Open File
Ctrl-R	Red Channel
Ctrl-W	Greyscale Image

Material Manager

Key without Modifier

Return	Edit Active Material
Cursor right	Next Material
Cursor left	Previous Material
Cursor up	Material one Row up
Cursor down	Material one Row down

Using Ctrl as Modifier

Ctrl-H	Load Material
Ctrl-N	New Material
Ctrl-O	Open 3D Shader
Ctrl-T	Render Material

Object Manager

Key without Modifier

Return	Fold in / out Object Group
Cursor right	Fold out Object Group
Cursor left	Fold in Object Group
Cursor down	Select next Object
Cursor up	Select previous Object

Using Ctrl as Modifier

Ctrl-H	Load Object
Ctrl-I	Object Info

Structure Manager

Using Ctrl as Modifier

Ctrl-A	Select All
Ctrl-D	Deselect All
Ctrl-H	Import ASCII
Ctrl-N	New Element

Time Line

Key without Modifier

Plus	Zoom In
Minus	Zoom Out

Using Ctrl as Modifier

Ctrl-F	Delete Hierarchy
Ctrl-K	Edit Data
Ctrl-L	Edit Time

Space Control

Using Ctrl as a Modifier

Ctrl-G	Overview
Ctrl-J	Default size
Ctrl-K	Edit Data
Ctrl-L	Edit Time
Ctrl-T	Tangents

Time Control

Using Ctrl as Modifier

Ctrl-K	Edit Data
Ctrl-N	New
Ctrl-O	Open

Browser

Using Ctrl as Modifier

Ctrl-A	Select All
Ctrl-B	Import Directory
Ctrl-D	Deselect All
Ctrl-E	Preferences
Ctrl-F	Search for
Ctrl-H	Import File
Ctrl-I	Info
Ctrl-N	New Catalog
Ctrl-O	Open Catalog
Ctrl-S	Save Catalog

Note

If within a Manager you press a key combination which it does not recognise (e.g. Ctrl-B in the Time Line), this is passed on to the Editor window (so in this case the Render Preferences will be opened).

If the Editor cannot identify the keyboard short-cut either, it will be ignored.

A.4.2 Macintosh

Editor

Keys without Modifier

0	Tools / Reload Plug-ins
1	Action / Selection
2	Action / Magnify
3	Action / Move
4	Action / Scale
5	Action / Rotate
A	Tools / Options / Animation
B	View / View / Active Object
C	Tools / Options / Camera
D	Tools / Options / Triangles
E	Tools / Options / Edges
F	Tools / Options / Magnet Settings
G	Select Area
H	View / View / Scene No Camera / Lights
I	Tools / Options / Inverse Kinematics
J	View / View / Standard
K	Tools / Animation / Record
L	Tools / Coordinates / Object System
M	Tools / Options / Model
N	Tools / Options / Magnet
O	Tools / Options / Object
P	Tools / Options / Points
Q	Tools / Options / Quadrangles
R	Tools / Options / Object Axis
S	View / View / Scene
T	Tools / Options / Texture
U	Tools / Options / Texture Axes
V	Tools / Options / Virtual Walkthrough
W	Tools / Coordinates / World System
X	Tools / Coordinates / X-Axis / Heading
Y	Tools / Coordinates / Y-Axis / Pitch
Z	Tools / Coordinates / Z-Axis / Bank
Del	Delete
←	Delete
Space	Toggle between Camera and selected Tool
Return	Toggle between Move/Scale/Rotate/ Magnify/Selection
Tab	Next Document
Shift + Tab	Previous Document
Plus	Camera zoom +25%
Minus	Camera zoom –25%

In combination with the Command key

⌘-0	Coordinates Manager
-1	Material Manager
-2	Object Manager
-3	Structure Manager
-4	Time Manager
-5	Time Line
-6	Space Control
-7	Time Control
-8	Browser
-9	Console
-A	Select All
-C	Copy to Clipboard
-F	Redraw
-N	New File
-O	Open File
-Q	Quit Program
-S	Save File
-V	Paste from Clipboard
-W	Close File
-X	Cut to Clipboard
-Y	Redo
-Z	Undo

In combination with Ctrl

Ctrl-0	Display / Skeleton
Ctrl-1	XY View – Front View
Ctrl-2	XZ View – Top View
Ctrl-3	ZY View – Side View

Ctrl-4	3D View – Perspective View
Ctrl-5	4T View
Ctrl-6	Display / Gouraud Shading
Ctrl-7	Display / Flat Shading
Ctrl-8	Display / Wireframe
Ctrl-9	Display / Bounding Box
Ctrl-A	Select All
Ctrl-B	Render Preferences
Ctrl-C	Copy to Clipboard
Ctrl-D	Deselect All
Ctrl-E	Preferences
Ctrl-F	Redraw
Ctrl-H	Import File
Ctrl-J	Display / As Preset
Ctrl-K	Display / Options
Ctrl-L	Set 3D Camera to Object
Ctrl-M	Render in New Window
Ctrl-R	Render All
Ctrl-T	Render Active Object
Ctrl-U	Set 3D Camera to Editor
Ctrl-Y	Redo

In combination with Alt

Alt-0	Display / Skeleton
Alt-1	XY View – Front View
Alt-2	XZ View – Top View
Alt-3	ZY View – Side View
Alt-4	3D View – Perspective View
Alt-5	4T View
Alt-6	Display / Gouraud Shading
Alt-7	Display / Flat Shading
Alt-8	Display / Wireframe
Alt-9	Display / Bounding Box
Alt-B	Render Preferences
Alt-D	Deselect All
Alt-E	Preferences
Alt-F	Redraw
Alt-H	Import File
Alt-J	Display / As Preset
Alt-K	Display / Options
Alt-L	Set 3D Camera to Object
Alt-M	Render in New Window
Alt-R	Render All
Alt-T	Render Active Object
Alt-U	Set 3D Camera to Editor
Alt-Y	Redo

Output Window

Keys without Modifier

Esc	Cancel Output / Rendering

In combination with Command key

-1	Fit to Size
-2	Adjust Window to 12.5%
-3	Adjust Window to 25%
-4	Adjust Window to 50%
-5	Adjust Window to 100%
-6	Adjust Window to 200%
-7	Adjust Window to 400%
-8	Adjust Window to 800%
-O	Open File
-. (Period)	Cancel Output / Rendering

Mit Ctrl-Taste

Ctrl-1	Fit to Size
Ctrl-2	Adjust Window to 12.5%
Ctrl-3	Adjust Window to 25%
Ctrl-4	Adjust Window to 50%
Ctrl-5	Adjust Window to 100%
Ctrl-6	Adjust Window to 200%
Ctrl-7	Adjust Window to 400%
Ctrl-8	Adjust Window to 800%
Ctrl-A	Alpha Channel
Ctrl-B	Blue Channel
Ctrl-G	Green Channel

Ctrl-R	Red Channel
Ctrl-W	Greyscale Image

In combination with Alt

Alt-1	Fit to Size
Alt-2	Adjust Window to 12.5%
Alt-3	Adjust Window to 25%
Alt-4	Adjust Window to 50%
Alt-5	Adjust Window to 100%
Alt-6	Adjust Window to 200%
Alt-7	Adjust Window to 400%
Alt-8	Adjust Window to 800%
Alt-A	Alpha Channel
Alt-B	Blue Channel
Alt-G	Green Channel
Alt-R	Red Channel
Alt-W	Greyscale Image

Material Manager

Keys without Modifier

Return	Edit Active Material
Cursor right	Next Material
Cursor left	Previous Material
Cursor up	Material one Row up
Cursor down	Material one Row down

In combination with the Command key

-N	New Material
-O	Open 3D Shader

In combination with Ctrl

Ctrl-H	Load Material
Ctrl-T	Render Material

In combination with Alt

Alt-H	Load Material
Alt-T	Render Material

Object Manager

Keys without Modifier

Return	Fold in / out Object Group
Cursor right	Fold out Object Group
Cursor left	Fold in Object Group
Cursor down	Select next Object
Cursor up	Select previous Object

In combination with Command key

-I	Object Info

In combination with Ctrl

Ctrl-H	Load Object
Ctrl-I	Object Info

In combination with Alt

Alt-H	Load Object
Alt-I	Object Info

Structure Manager

In combination with Command key

-A	Select All
-N	New Element

In combination with Ctrl

Ctrl-D	Deselect All
Ctrl-H	Import ASCII

In combination with Alt

Alt-D	Deselect All
Alt-H	Import ASCII

Time Line

Keys without Modifier

Plus	Zoom In
Minus	Zoom Out

In combination with Ctrl

Ctrl-F	Delete Hierarchy
Ctrl-K	Edit Data
Ctrl-L	Edit Time

In combination with Alt

Alt-F	Delete Hierarchy
Alt-K	Edit Data
Alt-L	Edit Time

Space Control

In combination with Ctrl

Ctrl-G	Overview
Ctrl-J	Default Size
Ctrl-K	Edit Data
Ctrl-L	Edit Time
Ctrl-T	Tangents

In combination with Alt

Alt-G	Overview
Alt-J	Default Size
Alt-K	Edit Data
Alt-L	Edit Time
Alt-T	Tangents

Time Control

In combination with Command key

-N	New
-O	Open

In combination with Ctrl

Ctrl-K	Edit Data

In combination with Alt

Alt-K	Edit Data

Browser

In combination with Command key

-A	Select All
-I	Info
-N	New Catalog
-O	Open Catalog
-S	Save Catalog

In combination with Ctrl

Ctrl-B	Import Directory
Ctrl-D	Deselect All
Ctrl-E	Preferences
Ctrl-F	Search for
Ctrl-H	Import File
Ctrl-I	Info

In combination with Alt

Alt-B	Import Directory
Alt-D	Deselect All
Alt-E	Preferences
Alt-F	Search for
Alt-I	Info
Alt-H	Import File

Note

If within a Manager you press a key combination which it does not recognise (e.g. Ctrl-B in the Time Line), this is passed on to the Editor window (so in this case the Render settings will be opened).

If the Editor cannot identify the keyboard short-cut either, it will be ignored.

A.5 CINEMA 4D Menu Structure

A.5.1 Editor

File

- New
- Open
- Import
- Revert To Saved
- Close
- Save
- Save As:
    - CINEMA 4D V5
    - Direct3D/DirectX
    - DXF
    - QuickDraw 3D
    - VRML 1
    - VRML 2
    - 3D Studio R4
    - Wavefront
- Save Project
- Preferences:
    - General
    - Render
    - Direct3D/DirectX
    - DXF
    - DEM
    - Illustrator
    - QuickDraw 3D
    - VRML 1
    - VRML 2
    - 3D Studio
    - Imagine
    - Lightwave
    - Wavefront
- Save Preferences
- Save Preferences As
- Palettes
- Quit

Edit

- Undo
- Redo
- Cut
- Copy
- Paste
- Delete
- Select All
- Deselect All
- Select Area

View

- XY - Front View
- XZ - Top View
- ZY - Side View
- 3D - Perspective View
- 4T - 4-Way View
- View:
    - Active Object
    - Scene No Camera/Lights
    - Scene
    - Standard
- Display Mode:
    - Gouraud Shading
    - Flat Shading
    - Wireframe
    - Bounding Box
    - Skeleton
    - As Preset
    - Options
- 3D-Camera:
    - Object
    - Editor
- Render Picture:
    - All
    - Active Object
    - Region
    - New Window
    - Batch Rendering
- Redraw

Texture

- Adapt To:
    - Object
    - Image
    - Region
- Align To:
    - Object Axes
    - World Axes
    - View
- Mirror Horizontally
- Mirror Vertically
- Generate UV-Coordinates

Window

- Coordinates Manager
- Material Manager
- Object Manager
- Structure Manager
- Time Manager
- Time Line
- Space Control
- Time Control
- Browser
- Console

Objects

- Empty Object
- 2D-Object:
    - Triangle
    - Quadrangle
    - Plane
    - Disc
- 3D-Object:
    - Platonic Object
    - Perfect Sphere
    - Surface Sphere
    - Cone
    - Pyramid
    - Cuboid
    - Torus
    - Cube
    - Cylinder
- Special Object:
    - Figure
    - Fractal
    - Relief Map
- Empty Spline
- Splines:
    - Circle Elements:
    - Curves:
    - Profiles:
    - Polygons:
    - Formula
    - Helix
    - Text
- Spline Object:
    - Extrude Object
    - Lathe Object
    - Loft Object
    - Skin Object
    - Pipe Object
    - Path Object
- NURBS:
    - Extrude NURBS
    - Lathe NURBS
    - Loft NURBS
    - Sweep NURBS
    - Bézier NURBS
- Particle System:
    - Emitter
    - Attractor
    - Gravity
    - Deflector
    - Friction
    - Rotation
    - Turbulence
    - Destructor
    - Wind
- Scene Object:
    - Camera
    - Floor
    - Sky
    - Light
    - Environment
    - Foreground
    - Background
- Bone Object
- FFD Object

Tools

- Action:
    - Move
    - Scale
    - Rotate
    - Magnify
    - Selection
- Coordinates:
    - X-Axis / Heading
    - Y-Axis / Pitch
    - Z-Axis / Bank
    - World System
    - Object System
- Options:
    - Camera
    - Object
    - Object Axes
    - Model
    - Texture
    - Texture Axes
    - Points
    - Edges
    - Triangles
    - Quadrangles
    - Magnet
    - Animation
    - Inverse Kinematics
    - Virtual Walkthrough
- Animation:
    - Record
    - Frames Per Second
    - Go To Time
    - Position Track To Spline
    - Spline To Position Track
- Structure:
    - Animation Object
    - Convert To Polygons
    - Align Normals
    - Optimise
    - Triangulate
    - Connect
    - Reset System
- Plug-ins:
    - Reload Plug-ins
- Arrange
- Align To Object
- Align To Point
- Mirror
- Transfer
- Centre
- Boolean
- Duplicate
- Crumple
- Subdivide
- Deform
- Wrap
- Randomise
- Magnet Settings

A.5.2 External Output Window

File	Edit	View
Open	Copy	Fit To Size
Save Picture As		12.5 %
TIFF		25 %
TGA		50 %
BMP / PICT		100 %
IFF		200 %
JPEG High Compression		400 %
JPEG Default Compression		800 %
Stop Rendering		Red
Close		Green
		Blue
		Alpha
		Greyscale

A.5.3 Object Manager

File	Edit	Function
Load Object	Undo	Edit Property
Save Object As	Redo	New Property:
Display Attribute Icons	Cut	Display
Close	Copy	Smoothing
	Paste	Protection
	Delete	Shadow
		Texture
		UVW-Coordinates
		Anchor
		Inverse Kinematics
		Activation
		Motion Blur
		URL-Address
		Copy Property To Child Objects
		Delete Child Object Property
		Edit Object
		Rename Object
		Group Objects
		Expand Object Group
		Use As Camera
		Information (Object)
		Information (Scene)
		Search Active Object
		Fix Bones
		Reset Bones

A.5.4 Material Manager

File	Edit	Function
New Material	Undo	Render Material
Open 3D-Shader	Redo	Render All Materials
Load	Cut	Edit
Save Material As	Copy	Apply
Dave All Materials As	Paste	Rename
Close	Delete	Remove Unused Materials
		Remove Duplicate Materials

A.5.5 Structure Manager

File
- New Element
- Import ASCII
- Save All Points As ASCII
- Save Active Points As ASCII
- World Coordinates
- Just Active Element
- Close

Edit
- Undo
- Redo
- Delete
- Select All
- Deselect All
- Invert All

Polygons
- Split
- Level
- Align To Grid
- Reverse Normals
- Convert To Spline

Splines
- Hard Interpolation
- Soft Interpolation
- Move Down Sequence
- Move Up Sequence
- Reverse Sequence
- Circular Arc
- Round
- Insert
- Level
- Align To Grid

A.5.6 Time Line

File
- Zoom In
- Zoom Out
- Close

Edit
- Undo
- Redo
- Delete

Function
- New Track:
  - Geometry:
    - Position
    - Scale
    - Direction
    - Align To Path
    - Align To Object
    - Inverse Kinematics
    - Spline
    - Tangential Spline
  - Optical:
    - Visibility
    - Texture
  - Parameter:
    - Camera
    - Light
    - Environment
  - Special Effects:
    - Bend
    - Boolean
    - Explosion
    - Formula
    - Morph
    - Pulsate
    - Melt
    - Shatter
    - Taper
    - Twist
    - Wind
    - Vibrate
- New Sequence
- New Key
- Delete Hierarchy
- Adjust
- Divide
- Connect
- Scale
- Scale Document
- Edit Data
- Edit Time

Window
- Space Control
- Time Control

A.5.7 Space Control

File	Edit	Function
Overview	Undo	Edit Data
Standard Size	Redo	Edit Time
Tangents	Delete	Hard Interpolation
Close		Soft Interpolation
		Linearise

A.5.8 Time Control

File	Edit	Function
New	Undo	Edit Data
Open	Redo	Insert Key
Save As	Delete	Linearise
Close		Formula

A.5.9 Browser

File	Edit	Function
New Catalog	Delete	Render All
Open Catalog	Select All	Info
Import File	Deselect All	Search For
Import Directory		Sort By
Save Catalog		File Name
Save Catalog As		File Size
Preferences		Width
Close		Height
		Colour Depth
		Memory

A.6 Programming

A.6.1 The C.O.F.F.E.E. Programming Language

C.O.F.F.E.E. is CINEMA 4D's object oriented programming language.

C.O.F.F.E.E. is not a macro or scripting language, but a full programming language, closely related to C^{++} and Java. Programmers who are familiar with these two have a headstart. All they need to do is get to know the function set that is available in CINEMA 4D. To help with this, obtain a Source Developer Kit from MAXON Computer (or contact your local CINEMA 4D distributor). If you intend to develop your own programs for CINEMA 4D, you should register as a developer.

This is necessary not just because of the SDK: CINEMA 4D addresses C.O.F.F.E.E. plug-ins via special code numbers which have to be unique. Imagine you have created a fantastic character animation tool, while someone else has created a new import filter, using the same code number. Your client has both of these programs on his computer—with neither of them working! So if you need to have unique code numbers for your projects, please register.

What benefits do you get from programming add-ons in C.O.F.F.E.E.?

It's simple. As you know CINEMA 4D is a multi-platform project. At the time of printing this manual versions exist for Apple Power Macintosh (Mac OS 7 and higher), Motorola PowerPCs, Intel-PCs (Windows 95 and Windows NT) as well as DEC Alpha. A version for SGI and other UNIX variants will become available. By creating your programs with C.O.F.F.E.E. you know that they will work on all these platforms. No need to worry about re-compiling or re-programming.

But how do you produce such a program, and how do you get CINEMA 4D to use it?

Well, for writing the program, you use any normal editor, either the one that came with your system or one that you have purchased. You then save your program as an ordinary text file in ASCII format.

To ensure that CINEMA 4D can locate your C.O.F.F.E.E. programs and can integrate them automatically, you must place them in the Plug-Ins folder in the Startup folder of CINEMA 4D. The sole exceptions to this rule are 2D and 3D Shaders—these can sit in the Tex folder, just like ordinary textures. If you look in these two folders you will find a few samples.

You can, if you want to, save C.O.F.F.E.E. programs elsewhere. In this case you need to call them by selecting File / Open. In this case they will not be automatically integrated into CINEMA 4D's menu structure.

Command Summary (Reserved Keywords)

Declarations

```
const
var
enum
class
extends
struct
public
protected
private
```

Allocating Objects, Arrays and Strings

```
new
```

Casts

```
int
float
vector
tostring
```

Program Structure

```
return
if
else
for
break
continue
do
while
switch
case
default
try
catch
```

Miscellaneous

```
super
this
```

Exceptions

```
ExOutOfMemory
ExDivisionByZero
ExBadType
ExOutOfRange
```

FPU

```
abs(number)
sin(number)
cos(number)
tan(number)
asin(number)
acos(number)
atan(number)
exp(number)
log(number)
log10(number)
sqrt(number)
floor(number)
ceil(number)
cosh(number)
sinh(number)
tanh(number)
pow(number)
```

Vector Funktions

```
vlen(vector)
vcross(vector,vector)
vnorm(vector)
```

Command Summary (Standard Functions)

Standard Functions

```
print(...)
println(...)
tostring(x,str)
evalute(str)

sizeof(x)
typeof(x)

time()
gc()

getclass(obj)
getparent(class)
instanceof(obj,class)

strins(str,str,int)
strmid(str,int,int)
stradd(str,...)
strset(str,int,int,int)
strstr(str,str,int)
strchr(str,int,int)
strcmp(str,str)

memins(mem,mem,int)
memset(mem,int,int,int)
memmid(mem,int,int)
memadd(mem,...)
memmem(mem,mem,int)

isdigit(int)
isalpha(int)
isalnum(int)
isspace(int)
ispunct(int)

mem2word(mem,int,int)
mem2uword(mem,int,int)
mem2long(mem,int,int)
mem2iee(mem,int,int)
mem2liee(mem,int,int)
word2mem(int,mem,int,int)
uword2mem(int,mem,int,int)
long2mem(int,mem,int,int)
iee2mem(float,mem,int,int)
liee2mem(float,mem,int,int)
```

File handling

```
->Open(int)
->Close()
->SetName(str)
->Read(mem,int)
->Write(mem,int)
->Kill()
->Len()
->SetPos(int)
->GetPos()
->FileSelect(int)
```

Differences from C and C^{++}

var

`var` declares a local or global variable. Variables are untyped and are typed by allocation. The available types are: Integer, floating point, vector, string and object. When passing variables as parameters to functions this rule applies: int, float and vector are passed by value; strings and objects/ structures are passed by reference.

```
var x;
var x,y,z;
...
```

Local variables may be initialised by using any expression.

```
var v=vector(1,2,3), x=12+56;
var o=new oop();
...
```

For global variables, only simple expressions can be used:

```
var x=1.0, b="Hallo";
var i=0;
```

const

`const` may only be used in combination with `var` for declaring global variables. Note that when using `const` you must initialise the variable! `const` variables can only be read:

```
const var morgen="Dienstag";
const var a=0,b=1;
```

class

In contrast to C^{++}constructors can return a value! As a matter of fact, only `NULL` or `this` are sensible in order to report success or failure. It is the programmer's responsibility to make sure that the constructors of parent classes are called up via `super()`. If no constructors are created, the program generates a default constructor which always returns `this`. Destructors always have the name FINALIZE. Since a garbage collection is at work internally they are superfluous and should not be used. When and in what order they are called is not defined. Destructors are automatically called for each instance. Classes can only ever be declared globally.

```
class Test
{
  private:
    var x,y;
  public:
    Test(a,b); // Constructor
    GetX();
    GetY();
};

Test::Test(a,b)
{
  if(a<b) return NULL;
  x=a;
  y=b;
}

Test::GetX()
{
  return x;
}

Test::GetY()
{
  return y;
}
```

struct

`struct` is a synonym for `class`, the difference being that the members are declared as `public` by default. Structures can only ever be declared globally and must be allocated via `new`.

enum

`enum` declares a global list of constant values. If individual enums are not initialised, they are numbered sequentially. There is no enum type. Enums can only ever be declared globally.

```
enum
{
  mountain,
  valley,
  town,
  village
};

enum
{
  ten=10,
  twenty=20,
  thirty=30
};
```

int

`int` makes a value into an integer. If this is not possible, a run-time error results.

```
var i=int(1.1);
x=int(i);
```

float

`float` makes a value into a floating point value. If this is not possible, a run-time error results.

```
var f=float(20);
x=float(f);
```

vector

`vector` makes a value into a vector or generates a vector. If this is not possible, a run-time error results.

```
var v=vector(1.0,3.1,4.0);
x=vector(i);
```

[ ]

Arrays and strings can only be created via `new`. Arrays are by nature untyped. When accessing an array or a string, the limits are verified.

```
var a=new(array,10);
var x=new(array,10,5);
var s=new(string,88);

for(i=0;i<10;i++) a[i]=1.0;
...
```

new

`new` is the universal allocator in C.O.F.F.E.E.! In contrast to what happens in C^{++}, in C.O.F.F.E.E. it is treated like an *ordinary* function:

```
class lall;

var obj=new(lall);
...
```

Parameters and constructors are given after the class to be allocated.

```
class test
{
  public:
    test(a,b);
    //Constructor with two parameters
}

obj=new(test,1,2);
```

`new` is also used for arrays and strings:

```
ar=new(array,10,10)
  // allocates an array of 10 times 10
str=new(string,20)
  // allocates a string with
  // 20 characters
...
```

The Standard Functions

print(...)
The elements that were passed on are output on the console:

```
print(12,"Hallo",12.5);
```

println(...)
As `print`, but with a 'newline' added.

tostring(x,str)
The element passed is converted to a string; the optional second parameter may contain a C format string as a model.

```
var s;
s=tostring(123);
...

var s;
s=tostring(123,"x");
...
```

evalute(str)
Evaluates a string and returns the result as a floating point value.

```
var e=evalute("12+15.2");
...
```

sizeof(x)
Returns the number of elements in a string, array or memory location.

typeof(x)
Returns the type of the element as an integer.

time()
Returns the time elapsed since system start in milliseconds (integer).

gc()
Triggers garbage collection.

(To be used for test purposes only.)

getclass(obj)
Returns the class of an object.

getparent(class)
Returns the parent class of a class.

instanceof(obj,class)
Returns 1 if the object is an instance of the class, otherwise 0.

strins(str1,str2,int1)
Inserts the string `str2` in string `str1`, at position `int1`.

strmid(str1,int1,int2)
Generates a new string using string `str1` starting from position `int1` with length `int2.`

stradd(str,...)
Generates a string containing all strings that were passed to the function.

strset(str1,int1,int2,int3)
Fills the string `str1` from position `int2` by using `int1` `int3` times.

strstr(str1,str2[,int1])
Locates string `str2` within string `str1` starting at position `int1.`

strchr(str1,int1[,int2])
Locates the character `int1` within string `str1` from position `int2`.

strcmp(str1,str2)
Compares string `str1` with `str2`, returning the result as an integer.

```
=0: str1==str2
<0: str1<str2
>0: str1>str2
```

memins(mem1,mem2,int1)
Replaces bytes `mem2` in bytes `mem1` starting at position `int1`.

memset(mem1,int1,int2,int3)
Fills bytes `mem1` from position `int2` with `int1` `int3` times.

memmid(mem1,int1,int2)
Generates a new byte array from bytes `mem1`, starting at position `int1` with length `int2`.

memadd(mem,...)
Generates a new byte array containing all byte arrays that were passed to the function.

memmem(mem1,mem2,int1)
Locates bytes `mem2` in bytes `mem1`, starting at position `int1`.

isdigit(int)
Returns 1 if `int` is a number; otherwise 0.

isalpha(int)
Returns 1 if `int` is a letter; otherwise 0.

isalnum(int)
Returns 1 if `int` is a number or letter; otherwise 0.

isspace(int)
Returns 1 if `int` is a space character; otherwise 0.

ispunct(int)
Returns 1 if `int` is a punctuation sign; otherwise 0.

mem2word(mem1,int1,int2)
Converts 2 bytes in `mem1` into a word format, from position `int1`, returning an integer. Parameter `int2` specifies whether the result of the conversion should be in Intel or Motorola format.

0=Motorola, 1=Intel

mem2uword(mem1,int1,int2)
Converts 2 bytes in `mem1` starting from position `int1` into an unsigned word format and returns this as an integer. Parameter `int2` specifies whether the result of the conversion should be in Intel or Motorola format.

0=Motorola, 1=Intel

mem2long(mem1,int1,int2)
Converts 4 bytes in `mem1` starting from position `int1` into a long format, returning an integer. Parameter `int2` specifies whether the result of the conversion should be in Intel or Motorola format.

0=Motorola, 1=Intel

mem2iee(mem1,int1,int2)
Converts 4 bytes in `mem1` from position `int1` in a IEE floating point format, returning a float. Parameter `int2` specifies whether the result of the conversion should be in Intel or Motorola format.

0=Motorola, 1=Intel

mem2liee(mem1,int1,int2)
Converts 8 bytes in `mem1` from position `int1` in a IEE floating point format and returns a float. Parameter `int2` specifies whether the result of the conversion should be in Intel or Motorola format.

0=Motorola, 1=Intel

word2mem(int1,mem1,int2,int3)
Converts `int1` in a 2 byte word format and inserts this in `mem1`, starting at position `int2`. Parameter `int3` specifies whether the result of the conversion should be in Intel or Motorola format.

0=Motorola, 1=Intel

uword2mem(int1,mem1,int2,int3)
Converts `int1` in an unsigned 2 byte word format and inserts this in `mem1`, starting at position `int2`. Parameter `int3` specifies whether the result of the conversion should be in Intel or Motorola format.

0=Motorola, 1=Intel

long2mem(int1,mem1,int2,int3)
Converts `int1` in a 4 byte long word format and inserts this in `mem1`, starting at position `int2` ein. Parameter `int3` specifies whether the result of the conversion should be in Intel or Motorola format.

0=Motorola, 1=Intel

iee2mem(float1,mem1,int1,int2)
Converts `float1` in a 4 byte IEE format and inserts this in `mem1`, starting at position `int1`. Parameter `int2` specifies whether the result of the conversion should be in Intel or Motorola format.

0=Motorola, 1=Intel

liee2mem(float1,mem1,int1,int2)
Converts `float1` in a 8 byte IEE format and inserts this in `mem1`, starting at position `int1`. Parameter `int2` specifies whether the result of the conversion should be in Intel or Motorola format.

0=Motorola, 1=Intel

The FILE Class

In C.O.F.F.E.E. access to files is via the FILE class. When a new file object is allocated with `new`, it already has a temporary filename. So if the file is used for saving intermediate results only, it can be opened direct by using `->Open()`.

If the filename is changed by using `->SetName()`, for security reasons, the files are always placed in the CINEMA 4D folder. For accessing files, use `->FileSelect()`.

Note

This concept offers maximum protection against viruses and similar risks. It eliminates unauthorised file access and self-modification of code.

–>Open(int)

Opens a file. The int parameter indicates whether access is required for reading (0) or writing (1). If successful, the function returns 1, otherwise `nil`.

–>Close()

Closes a file. If successful, the function returns 1, otherwise `nil`.

–>SetName(str)

Changes the filename of a file object that is *not open*. If successful, the function returns 1, otherwise `nil`.

–>Read(mem,int)

Reads `int` bytes into the byte array `mem`. Returns the number of the bytes that were actually read.

–>Write(mem,int)

Writes `int` bytes from the byte array `mem`. Returns the number of the bytes that were actually written.

–>Kill()

Deletes the file. If successful, returns 1, otherwise `nil`.

–>Len()

Returns the length of an OPEN file.

–>SetPos(int)

Sets the current position of an OPEN file to `int`. Returns the actual position within the file.

–>GetPos()

Returns the current position of the OPEN file.

–>FileSelect(int)

Opens a file. The `int` parameter indicates whether it is to be opened for writing (1) or reading (0).

A.6.2 Interfaces

C.O.F.F.E.E. alone may not always be enough. But CINEMA 4D offers you more.

If you want to, you can create your applications with any C/C^{++} compiler of your choice. Specially designed interfaces then give you access to the CINEMA 4D functions. These are made available in the form of a library which is part of CINEMA 4D's SDK.

Note however that when using an external compiler you will need to create a separate version for each individual platform, which may require some re-programming.

A.6.3 Examples

Undo.cof

This example shows a simple way of increasing or decreasing the number of undoable actions in CINEMA 4D (the ‘Undo depth’). At the same time it illustrates that C.O.F.F.E.E. can be used like a traditional scripting or macro language.

Take your favourite editor, type in the lines below and save the file as ’Undo1.cof’ in your CINEMA 4D startup directory. Then call up the program with the File / Open command.

```
main()
{
  var doc;

  doc = GetActiveDoc();
  doc->SetUndoDepth(20);
}
```

`main()` is the main routine of any C.O.F.F.E.E. program and is executed automatically when it is initialised. This can be the entire program, as in this example. On the other hand, it is also possible (as we shall see) to call up existing routines or to instruct CINEMA 4D from here to integrate a particular plug-in into a menu.

The first step sets up the `doc` variable. Since C.O.F.F.E.E. works with untyped variables there is no need to define a particular type (`int`, `float`, `double`, …).

The second step calls the `GetActiveDoc` function from the CINEMA 4D interface. This means that the previously defined variable affects the currently active scene. Moreover, the entire structure of the document is now accessible.

The third step calls the `SetUndoDepth` function and assigns it the value 20, thus increasing the number of undoable actions from the default number (10) to 20.

You may object that this is a rather roundabout way of doing things—and you are right. But there is a much easier way. The interfaces allow C.O.F.F.E.E. to access dialogs directly, thus making it possible to interactively change values (such as the number of undos).

We now extend our program and make it into a genuine little plug-in. Save your file as ‘Undo2.cof’ in the Plug-in folder of the CINEMA 4D startup directory, then launch CINEMA 4D.

```
Function(doc)
{
  var d;

  d = new(Dialog);

  d->SetTitle("Change number of Undo ops");
  d->SetData(0,"Number",FIELD_INTEGER,1,100,20);

  if (d->DoDialog())
    return doc->SetUndoDepth(d->GetData(0));
  else
    return FALSE;
}

main()
{
  RegisterMenuHook("Change number of Undo ops","Function");
}
```

Confused? Take a closer look, and you will see a few elements from the previous example. But let's do one thing at a time:

The obligatory `main()`function no longer contains the executable program code but instead a function which registers the plug-in under a particular name ('Change number of Undo ops'), thus causing it to appear as a menu option in CINEMA 4D (here under Tools / Plug-Ins).

In addition, the registering function defines the name of the C.O.F.F.E.E. function which is executed when the menu option is selected (here 'Function').

But what exactly happens in 'Function'? The call to `Function(doc)` at the start of the program makes the structure of the active scene available for editing.

First it creates the `d` variable. This is then filled with a new `Dialog` structure, which will subsequently cause a dialog box to appear.

This structure is initialised. `SetTitle` defines the dialog box title (Change number of Undo ops). `SetData` enables an input field (of maximum 10). The first digit determines the number of the field (0), the second its name (Number). The third specifies that only integers are permissible, and the next two parameters specify the value range (here from 1 to 100). The final parameter is the default value (20). This terminates the initialisation.

The `DoDialog` function opens the dialog. If this is successful, the SetUndoDepth function proceeds to change the number of undoable steps, otherwise an error message results. Since you have entered the value for the Undo depth yourself, this needs to be read out via the `GetData` function.

Checkerboard_C.cof

This next example shows the construction of a C.O.F.F.E.E. 2D shader. This type of program is best saved in the Tex directory, alongside all the other textures. Here is the program:

```
FillData(data)
{
  data->SetValue(0,10.0); // Number of tiles in X direction
  data->SetValue(1,10.0); // Number of tiles in Y direction

  data->SetValue(2,1.0);  // Colour 1 - Red component
  data->SetValue(3,0.0);  // Colour 1 - Green component
  data->SetValue(4,0.0);  // Colour 1 - Blue component

  data->SetValue(5,0.0);  // Colour 2 - Red component
  data->SetValue(6,0.0);  // Colour 2 - Green component
  data->SetValue(7,1.0);  // Colour 2 - Blue component
}

EditData(data)
{
  var d;

  d = new(Dialog);

  d->SetData(0,"X number",FIELD_FLOAT,0.01,100000,data->GetValue(0));
  d->SetData(1,"Y number",FIELD_FLOAT,0.01,100000,data->GetValue(1));

  d->SetData(2,"Red   1",FIELD_PERCENT,0.0,1.0,data->GetValue(2));
  d->SetData(3,"Green  1",FIELD_PERCENT,0.0,1.0,data->GetValue(3));
  d->SetData(4,"Blue  1",FIELD_PERCENT,0.0,1.0,data->GetValue(4));

  d->SetData(5,"Red   2",FIELD_PERCENT,0.0,1.0,data->GetValue(5));
  d->SetData(6,"Green  2",FIELD_PERCENT,0.0,1.0,data->GetValue(6));
  d->SetData(7,"Blue  2",FIELD_PERCENT,0.0,1.0,data->GetValue(7));

  d->SetTitle("Checkerboard");
  if (d->DoDialog())
  {
    data->SetValue(0,d->GetValue(0));
    data->SetValue(1,d->GetValue(1));

    data->SetValue(2,d->GetValue(2));
    data->SetValue(3,d->GetValue(3));
    data->SetValue(4,d->GetValue(4));

    data->SetValue(5,d->GetValue(5));
    data->SetValue(6,d->GetValue(6));
    data->SetValue(7,d->GetValue(7));
```

```
    return TRUE;
  }
  else
    return FALSE; // Dialog box could not be opened
}

GetOutput(data,p,n,time)
{
  var c1,c2;

  c1 = vector(data->GetValue(2),data->GetValue(3),data->GetValue(4));
  c2 = vector(data->GetValue(5),data->GetValue(6),data->GetValue(7));

  p.x = p.x*data->GetValue(0); // Scaling along X axis
  p.y = p.y*data->GetValue(1); // Scaling along Y axis

  p.x = p.x-floor(p.x);        // No of decimals along X axis
  p.y = p.y-floor(p.y);        // No of decimals along Y axis

  if (p.x>0.5)   // Right half of texture
  {
    if (p.y>0.5)
      return c1; // Top right tile
    else
      return c2; // Bottom right tile
  }
  else           // Left texture half
  {
    if (p.y>0.5)
      return c2; // Top left tile
    else
      return c1; // Bottom left tile
  }
}

main()
{
  RegisterChannelShader(30004,8,"FillData","EditData","GetOutput");
}
```

Pretty, don't you think? And all that, just to produce a 2-colour chequerboard. But it is easier than it looks.

As always, the most important part is the `main()` function. Here again, a registering function is called, this time for the 2D or Channel shader. The first value of this function is a unique identification number, preventing a mix-up with other plug-ins. In principle, you can use any number here, but this may conflict with a number that has already been used internally (see Appendix A.3) or by a third-party developer. We recommend therefore that you only use the numbers contained in your SDK (see below).

The next value specifies the number of variable memory locations of the data structures in the shader. (Only float values may be stored.) The parameters after that refer to the functions for initialisation, editing (e.g. entry, dialog box ...) and calculation, *in that order*.

`FillData` assigns default values to the eight memory locations by using `SetValue`. First, you have the number of the memory location, then the default value. The first two functions initialise the X and Y values (number of tiles on the texture), then the two tile colours, separated into their red, green and blue components.

`EditData` initialises and opens the dialog box. 8 of the 10 previously defined fields are used. The `if` instructions checks if the operation was successful.

Finally, `GetOutput` generates the chequerboard pattern. This function is called up by the Raytracer every time one of its rays hits a surface that is covered with this shader. The function contains several structures: the previously defined `data` structure with the preset values. `p` and `n` are `vector` structures as defined in the interface description (see C.O.F.F.E.E. language set at the beginning of this chapter), where `p` is the hit point of the Raytracer ray in the texture coordinates and `n` the normal vector of the surface at that point. `time` is a `float` value indicating the current time in seconds. (As you know, Shaders can also be animated.)

`n` and `time` are not used in this example, but must be included in the function's parameter list, since they are always supplied. But now to the function itself.

We start by creating two variables, `c1` and `c2`. Both are filled with colour values from the `data` structure. These must previously have been defined as `vector` because the colour components are considered separately, divided into red, green and blue. The components are read in from the memory locations that were initialised at the start. The argument of `GetValue` specifies the number of the memory location.

The next four lines specify the appearance (the colour geometry) of the Shader. As you know, we are trying to produce a chequerboard. The first two lines increase the number of tiles according to the values contained in memory locations 0 and 1—separated by X and Y components of the vector p. The Z component is ignored in this case, since we are working in 2 dimensions only (Channel Shader). The next two lines specify the number of digits after the decimal point for the two components. The `floor` function specifies the number of digits on the left side of the decimal point, which has to be deducted from the total, to yield the required value.

The number of digits after the decimal point specifies, more or less as a percentage value, at what point the ray hits the tile. Once we know where the Raytracer ray hits the tile, we need to find out what colour is visible at that point. This is done with the `if` instruction.

To begin with, the function checks whether the point is in the right (p.x>0.5) or the left half of the tile. To be sure it then tests, whether it is in the upper (p.y>0.5) or lower half. Depending on the quarter in which we land, either colour `c1` or `c2` is returned and the chequerboard created.

A.6.4 The C.O.F.F.E.E. SDK

MAXON Computer supports registered CINEMA 4D developers exclusively via its Web site:

```
www.cinema4d.com
```

This is where, among other things, you will find the SDK (Source Development Kit). In order to be recognised as a developer you need to register.

In addition to detailed descriptions of the programming language and the interfaces, the SDK also contains a compiler. This makes it possible for commercial plug-in developers to keep their source code secret.

Our developer support is a dynamic, continuous process. We are expanding and improving the interfaces with CINEMA 4D all the time, and adding to the feature set. Look out for announcements on the Internet.

A.6.5 Error Handling

As you have probably realised by now, programming in C.O.F.F.E.E. is easier than it might look at first. However, even the best of programmers is not immune from error. CINEMA 4D helps you find those bugs.

Let's use that best-known of all programs, Hello World, as an example:

```
main()
{
  println("Hello World!");
}
```

Write the program, save it somewhere and launch CINEMA 4D. From the Windows menu open the Console.

Start 'Hello World' by selecting File / Open. Watch the Console.

Now let's build an error into this program:

```
main()
{
  prontln("Hello World!");
}
```

You will have notice the typo in the function. Now launch the faulty program and watch the Console. CINEMA 4D has detected the error and displays:

```
[Function 'main']
Error 118
Line 3
Variable or function expected
```

This gives a good indication of the whereabouts of the error:

- It occurs within the `main()` function.
- It has the number 118 (see below).
- It arises in line 3 of the program text.
- This line contains neither a variable declaration nor a call to a function.

Now you just need to identify the typo (`prontln` is not a valid C.O.F.F.E.E. function). Correct it and you are done.

A.7 Movie Formats

A.7.1 Valid Movie Formats

from Greg McMurry's Digital Film Formats Page
(Common Formats Used by the Motion Picture Industry)

Industry Formats (in pixels)

Scanner Format	Aspect Ratio X to 1	Full width x height	Half width x height	Quarter width x height
Academy	1.37	3656 x 2664	1828 x 1332	914 x 666
Cinemascope	1.17	3656 x 3112	1828 x 1556	914 x 778
Full Aperture	1.32	4096 x 3112	2048 x 1556	1024 x 778
VistaVision Squeezed	0.67	4096 x 6144	2048 x 3072	1024 x 1536
VistaVision	1.33	4096 x 3072	2048 x 1536	1024 x 768

Other Formats (in pixels)

Scanner Format	Aspect Ratio X to 1	2k width x height	1k width x height	NTSC width x height
Academy	1.37	2048 x 1492	1024 x 746	646 x 471
Cinemascope	1.17	2048 x 1743	1024 x 871	646 x 550
Full Aperture	1.32	2048 x 1556	1024 x 778	646 x 491
VistaVision Squeezed	0.67	2048 x 3072	1024 x 1536	646 x 969
VistaVision	1.33	2048 x 1536	1024 x 768	646 x 484

Please Email me with additions and / or corrections
greg@gregssandbox.com

A.7.2 Additional Movie Formats

Film Formats Directory (www.comp.brad.ac.uk/research/gip/formats.html)

Last updated Saturday 28 June 1997.

Work on this page is still ongoing. Further film formats and processes will be added and existing entries amended as and when time permits.

Cinematographic Processes

Name	Originator	Year Introduced	Year Abandoned	Format	AR	Frame Area
Kinetograph	Edison/ W. K. L. Dickson	1889	1927	4-35	1.33:1	1.000x0.750
Eidoloscope	Woodville Latham & Sons/ W. K. L. Dickson	1895	1897	4-51	2.33:1	1.750x0.750
Demeny-Gaumont/Prestwich	Georges Demeny	1896	N/A	4-60	1.4:1	1.750x1.250
Viventoscope	Blair	1897	N/A	1-48	1.5:1	1.500x1.000
Veriscope	Enoch Rector	1897	N/A	5-63	1.66:1	1.875x1.125
Biograph	American Biograph Co./W. K. L. Dickson	1897	N/A	0-68	1.35:1	2.625x1.938
		1900	N/A	4-35	N/A	N/A
Lumière Wide Film	Lumière Brothers	1900	N/A	8-75	1.6:1	2.940x1.880
Cinéorama (a.k.a. Cinépanorama)	Raoul Grimoin-Sanson	1900	1900	10x4-70	360°	N/A
Pathé KOK/Pathescope	Pathé	1912	N/A	4-28	1.33:1	N/A
Panoramica	Filoteo Alberini	1914	N/A	5-70	2.52:1	N/A
		1924	N/A	10-35H	2.52:1	N/A
Widescope	J. D. Elms	1921	1925	2x4-35	N/A	N/A
Pathé Baby	Pathé	1923	—	1-9.5	1.33:1	N/A
16mm	Kodak	1923	—	1-16	1.37:1	0.404x0.295
Pathé Rural	Pathé	1926	N/A	1-17.5	1.33:1	N/A
Natural Vision	Radio-Keith-Orpheum	1926	1930	6-63.5	1.85:1	N/A
Hypergonar	Henri Chrétien	1927	1937	4-35A2.0	2.66:1	1.000x0.750

Polyvision	Abel Gance	1927	1927	3x4-35	N/A	N/A
Grandeur	20th Century Fox	1929	1931	4-70	2:1	1.890x0.886
Magnafilm	Paramount/ L. de Riccio	N/A	1930	4-56	2:1	N/A
Realife	M-G-M	1930	1931	4-70	2:1	N/A
Vitascope	Warner Brothers	1930	1930	5-65	2:1	N/A
Academy	Academy of Motion Picture Arts & Sciences	1932	—	4-35	1.37:1	N/A
Double-8	Kodak	1932	—	1-16	1.39:1	0.197x0.142
Cinerama	Cinerama Inc./Fred Waller	1952	1962	3x6-35	2.72:1	3x0.985x1.088
CinemaScope	20th Century Fox	1953	1967	4-35A2.0	2.66:1	0.937x0.735
Glamorama	N/A	1953	1953	10-35H	N/A	N/A
VistaVision	Paramount	1954	1961	8-35H	1.5:1	1.485x0.990
Todd-AO	Michael Todd/ American Optical Co.	1955	1992	5-65	2.2:1	2.072x0.906
Circarama	Walt Disney	1955	1961	9/11x1-16	360°	N/A
CinemaScope-55	20th Century Fox	1956	1958	8-55.625A2.0	2.35:1	1.430x1.824
Technirama	Technicolor	1956	1967	8-35A1.5H	2.26:1	1.496x0.992
Cinestage	N/A	1956	N/A	4-35A1.56	2.2:1	0.912x0.685
KinoPanorama	Russia	1957	N/A	3x6-35	2.7:1	N/A
M-G-M Camera-65	M-G-M	1957	1966	5-65A1.25	2.76:1	2.072x0.906
Super Technirama 70	Technicolor	1958	N/A	8-35A1.5H	2.42:1	1.480x0.915
CineMiracle	Louis de Rochemont	1958	1961	3x6-35	2.55:1	N/A
Smith & Karney 180°	Smith & Karney	1958	N/A	4-35	N/A	N/A
Circlorama	N/A	1958	1964	11x4-35	360°	N/A
Panavision	Panavision	1959	—	4-35A2.0	2.35:1	0.868x0.735
Super Panavision	Panavision	1959	N/A	5-65	2.35:1	N/A

Wonderama Arc 120	Technicolor	1960	N/A	5-65	2.64:1	N/A
Cine-System 3	U.S.A.F.	1960	N/A	1-3	1.33:1	N/A
Techniscope	Technicolor	1963	N/A	2-35	2.35:1	0.868x0.373
Ultra Panavision	Panavision/M-G-M	1963	1968	5-65A1.25	2.7:1	N/A
Dimension 150	Todd-AO/ 20th Century Fox	1963	1970	5-65	150°	N/A
Super 8	Kodak	1965	—	1-8	1.35:1	0.224x0.166
Super 16	Kodak	1970	—	1-16	1.65:1	0.488x0.295
IMAX	IMAX Corporation	1970	—	15-65H	1.43:1	2.740x1.910
Todd-AO 35	Todd-AO	1971	N/A	4-35A2.0	2.35:1	0.898x0.735
OMNIMAX	IMAX Corporation	1973	—	15-65H	Ovoid	2.740x1.980
Circlevision	Walt Disney	N/A	—	5x4-35	200°	N/A
Cinema 180	Omni Films	N/A	—	5-65	180°	N/A
Showscan	Douglas Trumbull	1984	—	5-65	N/A	N/A
Iwerks 870	Iwerks Entertainment	N/A	—	8-65	N/A	N/A
Ultra Toruscope	Torus Films	N/A	—	3x5-65	360°	N/A

Footnotes:

1. N/A signifies that verified information for this category is not currently available.
2. AR is an abbreviation for Aspect Ratio – the ratio of the width of the image to its height, expressed in the form x:1.
3. A dash in the year abandoned column indicates the format is still in use.
4. The frame area is expressed in inches.
5. The film format is expressed using the following notation:

    nxp-mmAc.cH

    Where nx, if present, is the number of film strips, e.g. 3x for Cinerama; p is the number of perforations in one film margin per frame (except centre perf. formats), e.g. 5 for Todd-AO; mm is the width of the film in millimetres, e.g. 55.625 for CinemaScope-55; Ac.c, if present, indicates that the image is anamorphically reduced on the film by compression factor c.c, e.g. A2.0 for CinemaScope; and H, if present, denotes a horizontally-running format, e.g. 8-35H for VistaVision.

Release Formats

Name	Originator	Year Introduced	Year Abandoned	Format	AR	Frame Area
Kinetoscope	Edison / W. K. L. Dickson	1894	1896	4-35	1.33:1	1.000x0.750
Vitascope	C. F. Jenkins/ T. Armat	1895	N/A	4-35	1.33:1	1.000x0.750
Cinématographe	Lumière Brothers	1895	N/A	4-35	1.33:1	1.000x0.750
Eidoloscope	Woodville Latham & Sons	1895	1897	4-51	N/A	N/A
Demeny-Gaumont/Prestwich	Georges Demeny	1896	N/A	4-60	1.4:1	1.750x1.250
Viventoscope	Blair	1897	N/A	1-48	1.5:1	1.500x1.000
Veriscope	Enoch Rector	1897	N/A	5-63	1.66:1	1.875x1.125
Biograph	American Biograph Co.	1897 1900	N/A N/A	0-68 4-35	1.35:1 N/A	2.625x1.938 N/A
Lumière Wide Film	Lumière Brothers	1900	N/A	8-75	N/A	N/A
Cinéorama (a.k.a. Cinépanorama)	Raoul Grimoin-Sanson	1900	1900	10x4-70	360°	N/A
Pathé KOK/Pathescope	Pathé	1912	N/A	4-28	1.33:1	N/A
Panoramica	Filoteo Alberini	1914 1924	N/A N/A	5-70 10-35H	2.52:1 2.52:1	N/A N/A
Widescope	J. D. Elms	1921	1925	2x4-35	N/A	N/A
Pathé Baby	Pathé	1923	—	1-9.5	1.33:1	N/A
16mm	Kodak	1923	—	1-16	1.34:1	0.380x0.284
Pathé Rural	Pathé	1926	N/A	1-17.5	1.33:1	N/A
Natural Vision	Radio-Keith-Orpheum	1926	1930	6-63.5	1.85:1	N/A
Magnascope	Paramount	1926	1953	4-35	N/A	N/A
Hypergonar	Henri Chrétien	1927	1937	4-35A2.0	2.66:1	1.000x0.750
Polyvision	Abel Gance	1927	1927	3x4-35	N/A	N/A
Grandeur	20th Century Fox	1929	1931	4-70	2:1	N/A

Magnafilm	Paramount/ L. de Riccio	N/A	1930	4-56	2:1	N/A
Realife	M-G-M	1930	1931	4-70	2:1	N/A
Vitascope	Warner Brothers	1930	1930	5-65	2:1	N/A
Academy	Academy of Motion Picture Arts & Sciences	1932	—	4-35	1.37:1	0.825x0.602
Double-8	Kodak	1932	—	1-8	1.36:1	0.182x0.134
Cinerama	Cinerama Inc./ Fred Waller	1952	1972	3x6-35	2.72:1	3x0.985x1.088
CinemaScope	20th Century Fox	1953	1957	4-35A2.0	2.55:1 2.35:1	0.912x0.715 0.898x0.715
Glamorama	N/A	1953	1953	10-35H	N/A	N/A
VistaVision	Paramount	1954	1961	8-35H	1.5:1	1.485x0.991
Todd-AO	Michael Todd/ American Optical Co.	1955	—	5-70	2.2:1	2.072x0.906
Circarama	Walt Disney	1955	1961	9/11x1-16	360°	N/A
CinemaScope-55	20th Century Fox	1956	1958	8-55.625A2.0 4-35A2.0 4-35A2.0	2.35:1 2.55:1 2.35:1	1.430x1.824 0.912x0.715 0.839x0.715
Technirama	Technicolor	1956	1967	4-35A2.0	2.55:1 2.35:1	0.912x0.715 0.839x0.715
Cinestage	N/A	1956	N/A	4-35A1.56	2.2:1	0.912x0.685
KinoPanorama	Russia	1957	N/A	3x6-35	2.7:1	N/A
M-G-M Camera-65	M-G-M	1957	1966	5-70A1.25 5-65A1.25 4-35A2.0 4-35A2.0	2.76:1 2.76:1 2.55:1 2.35:1	2.072x0.906 2.072x0.906 0.912x0.715 0.839x0.715
CineMiracle	Louis de Rochemont	1958	1961	3x6-35	2.55:1	N/A
Smith & Karney 180°	Smith & Karney	1958	N/A	4-35	N/A	N/A
Circlorama	N/A	1958	1964	11x4-35	360°	N/A

Super Technirama 70	Technicolor	1958	N/A	5-70 4-35A2.0	2.2:1 2.35:1	N/A 0.839x0.715
Panavision	Panavision	1959	—	4-35A2.0	2.35:1	0.839x0.715
Super Panavision	Panavision	1959	N/A	5-70 4-35A2.0	2.2:1 2.35:1	N/A 0.839x0.715
Wonderama Arc 120	Technicolor	1960	N/A	4-35	2.64:1	N/A
Cine-System 3	U.S.A.F.	1960	N/A	1-3	1.33:1	N/A
Techniscope	Technicolor	1963	N/A	4-35A2.0	2.35:1	0.839x0.715
Ultra Panavision	Panavision/M-G-M	1963	1968	5-70A1.25 4-35A2.0	2.7:1 2.35:1	N/A 0.839x0.715
Dimension 150	Todd-AO/ 20th Century Fox	1963	1970	5-70 4-35A2.0	150° 2.35:1	N/A 0.839x0.715
Super 8	Kodak	1965	—	1-8	1.36:1	0.215x0.158
Super 16	Kodak	1970	—	1-16	1.66:1 1.85:1	0.464x0.2806 0.464x0.2516
Todd-AO 35	Todd-AO	1971	N/A	4-35A2.0	2.35:1	0.839x0.715
IMAX	IMAX Corporation	1970	—	15-70H	1.43:1	2.740x1.910
OMNIMAX	IMAX Corporation	1973	—	15-70H	Ovoid	2.740x1.980
Circlevision	Walt Disney	N/A	—	5x4-35	200°	N/A
Cinema 180	Omni Films	N/A	—	5-70	180°	N/A
Showscan	Douglas Trumbull	1984	—	5-70	N/A	N/A
Iwerks 870	Iwerks Entertainment	N/A	—	8-70	N/A	N/A
Ultra Toruscope	Torus Films	N/A	—	3x5-70	360°	N/A

Footnotes:

1. N/A signifies that verified information for this category is not currently available.
2. AR is an abbreviation for Aspect Ratio – the ratio of the width of the image to its height, expressed in the form x:1.
3. A dash in the year abandoned column indicates the format is still in use.
4. The frame area is expressed in inches.

5. The film format is expressed using the following notation:

   nxp-mmAc.c

   Where nx, if present, is the number of film strips, e.g. 3x for Cinerama; p is the number of perforations in one film margin per frame (except centre perf. formats), e.g. 5 for Todd-AO; mm is the width of the film in millimetres, e.g. 55.625 for CinemaScope-55; Ac.c, if present, indicates that the image is anamorphically expanded from the film by expansion factor c.c, e.g. A2.0 for CinemaScope; and H, if present, denotes a horizontally-running format, e.g. 8-35H for VistaVision.
6. Super 16 prints are rarely made. Dimensions given refer to extraction areas for blowing up to 35mm release prints.

A.8 Support

What do you do when you're stuck, the manual does not have the answer and you don't get anywhere by experimenting? That's probably the time when you are thinking of contacting Technical Support.

We would like to say a few words here about support, since this can sometimes cause misunderstandings and irritation.

MAXON Computer, and its distributors worldwide, will be happy to help you with any problems that you encounter. To ensure this can be achieved effectively, here are a few tips concerning the procedure:

- Contact MAXON (or your local distributor) in writing, or better still by e-mail.

  We have telephones, of course, but solving problems with a complex program like CINEMA 4D is rarely straightforward and quick. The lines are usually busy, anyway.

- DO NOT mix support enquiries with something else, for example with an order.

  Orders need to be filed for tax purposes and your sales enquiry will stand little chance of getting to the right people.

- When trying to obtain help by fax, be patient. Do not expect a solution in five minutes.

  We operate a strict queueing system. Support enquiries are dealt with in the order in which they arrive.

- Give us a telephone number and the times you can be reached there.

  Occasionally we may need to contact you to get some more details.

- Forward sample scenes in which the problem occurs.

  'When I subtract one object from another I end up with a mess...'

  Such complaints are not helpful and will probably be ignored. CINEMA 4D has been extensively tested and we are confident that no such general problem persists.

- Try to let us have a complete description of the steps that led to the problem, without writing a 10-page novella—yes, we have had that, too!

  'I built an object and then I went into the Raytracer, and ...'—see above.

- Send rendered images.

  Tell us what settings are in force in the particular window.

- Keep your sample scenes as small as possible.

  If the problem, for instance, shows up only on the wheelcap of a car, *we do not need to know the rest*.

- Don't forget to send us a full description of your hardware configuration.

  'I have Macintosh / PC / SGI' is *not* enough.

  If you have system updates or new hardware drivers installed, tell us about those too.

  If you have access to the Internet, use the existing support form (which you will find on our web pages).

- Tell us what other programs and system extensions you are running concurrently with CINEMA 4D.

- Do not despair if the answer takes a little while.

  We will require time to get to the bottom of things. Sometimes we will even need to involve the programmers.

- If the program crashes, it will display an error message on the screen. Let us know the exact—*the exact*—wording.

  Under Windows you do not only get the error message, but many additional details. These you may as well forget because they don't throw any light on the situation. They are as useful as the famous Mac message: 'Application Unknown has quit unexpectedly because of error -1'.

- If you have access to the Internet, look through the FAQs (Frequently Asked Questions) first. *This may very well save you further trouble*.

- Please understand that we cannot undertake any subcontracting:

  'I am sending you a CD with textures and models. Please create an animation which will then transfer smoothly from my video card to my video recorder ...'

  Quite clearly, this type of service goes beyond the duties of a support group and your request will almost certainly be ignored.

A.9 Recommended Reading

A.9.1 General 3D Literature

DON FOLEY, MELORA FOLEY
Animation and 3D Modelling on the Mac
Peachpit Press, 199, approx. 150 pages
ISBN 0-201-88420-8

Tutorial for Infini-D; all colour; large number of pictures: useful also for CINEMA 4D; provides many ideas for projects.

MARK GIAMBRUNO
3D Graphics & Animation
New Riders Publishing, 1997, approx. 540 pp.
ISBN 1-56205-698-0

Useful for anyone working with 3D software; numerous examples and an extensive tutorial.

DAVID KALWICK
3D Graphics, Tips, Tricks, & Techniques
AP Professional, 1996, approx. 480 pp.
ISBN 0-12-394970-X

Covers all topics belonging to 3D computer graphics and animation; contains many application-independent tips and step-by-step instructions.

ISAAC VICTOR KERLOW
The Art of 3-D Computer Animation and Imaging
Van Nostrand Reinhold, 1996, 412 pp.
ISBN 0-442-01896-7

An introduction into everything to do with 3D computer graphics.

CRAIG LYN
Macintosh 3D Handbook
Charles River Media, 1996, approx. 490 pp.
ISBN 1-886801-17-7

A very good book that goes beyond pure 3D design and rendering. Because of its numerous tutorials it is also interesting for non-Mac users.

GEORGE MAESTRI
Digital Character Animation
New Riders Publishing
ISBN 1-56205-559-3

Very good title, shedding light on all aspects of 3D character animation (Inverse Kinematics, FFDs, Bones, ...), starting from modelling to finished movies.

ANDREW REESE
Looking good in 3D
Ventana Publishing
ISBN 1-56604-494-4

How to create successful images and animations.

A.9.2 3D File Formats

KEITH RULE
3D Graphics File Formats
Addison Wesely, 1996, approx. 530 pp.
ISBN 0-201-48835-3

For programmers. Full descriptions of VRML, RAW, TrueSpace, DXF (including ACAD R13), WTK-NFF, POVRay and others.

A.9.3 3D Programming

Mike Bailey (Editor)
Introduction to Computer Graphics
SIGGRAPH 97, Course Notes #10

A short and concise introduction into the mathematical foundations of 3D programming (vector and matrix calculations ...).

Ebert, Musgrave, Peachey, Perlin, Worley
Texturing and Modelling
AP Professional, approx. 330 pp.
ISBN 0-12-228760-6

Very good book, particularly for programmers. Has an excellent description of what you can do with shaders (from smoke to fractal landscapes)—and how to program them.

Foley, van Damm, Feiner, Hughes
Computer Graphics – Principles and Practice
Addison-Wesely, 1996, approx. 1180 pp.
ISBN 0-201-84840-6

The Bible for computer graphics programmers. A shorter version is also available (Introduction to Computer Graphics).

Georg Glaeser
Fast Algorithms for 3D-Graphics
Springer, 1994, approx. 300 pp.
ISBN 3-540-94288-2

For programmers.

J. Hart, D. Ebert (Organizers)
New Frontiers in Modeling and Texturing
SIGGRAPH 97, Course Notes #14

Illustrates the various possibilities of texture projections and their implementation.

Donald Hearn, M. Pauline Baker
Computer Graphics – C Version
Prentice Hall, 1997, ca. 650 S.
ISBN 0-13-578634-7

A very informative work for programmers, describing the mathematics of 3D graphics; extensive bibliograhpy.

Jaap A. Kaandorp
Fractal Modelling – Growth and Form in Biology
Springer, 1994, approx. 200 pp.
ISBN 3-540-56685-6

Explains the mathematics of 2D and 3D fractals; with pseudo program code.

H. Meinhardt
The Algorithmic Beauty of Sea Shells
Springer, approx. 200 pp.
ISBN 3-540-57842-0

For programmers. Describes the mathematics required to achieve various shapes of shells, including their textures.

P. Prusinkiewicz, A. Lindenmayer
The Algorithmic Beauty of Plants
Springer, approx. 230 pp.
ISBN 0-387-94676-4

For programmers. Describes the mathematics required to create various plant forms (flowers, shrubs, trees ...).

F. X. Sillion, C. Puech
Radiosity – Global Illumination
Morgan Kaufman Publishing
ISBN 1-55860-277-1

Throws light on this very time-intensive method of raytracing.

JOHN VINCE
3-D Computer Animation
Addison-Wesely, 1992, approx. 360 pp.
ISBN 0-201-62756-6

Deals with the mathematics of 2D and 3D geometry, of rendering and animation; extensive bibliography.

ALAN WATT, MARK WATT
Advanced Animation and Rendering Techniques
Addison-Wesely, 1992
ISBN 0-201-54412-1

Very good book for programmers, covering all programming aspects of rendering and animation.

A.9.4 General Programming

LES PIEGL, WAYNE TILLER
The NURBS Book
Springer Verlag
ISBN 3-540-55069-0

Good book, covering all mathematical aspects of NURBS.

A.10 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, Bevelling
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 & 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.

Modeller
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 Capturing
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.

Plug-in
Separate add-on which is integrated into the main application at launch and is then called from within it. Plug-ins 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).

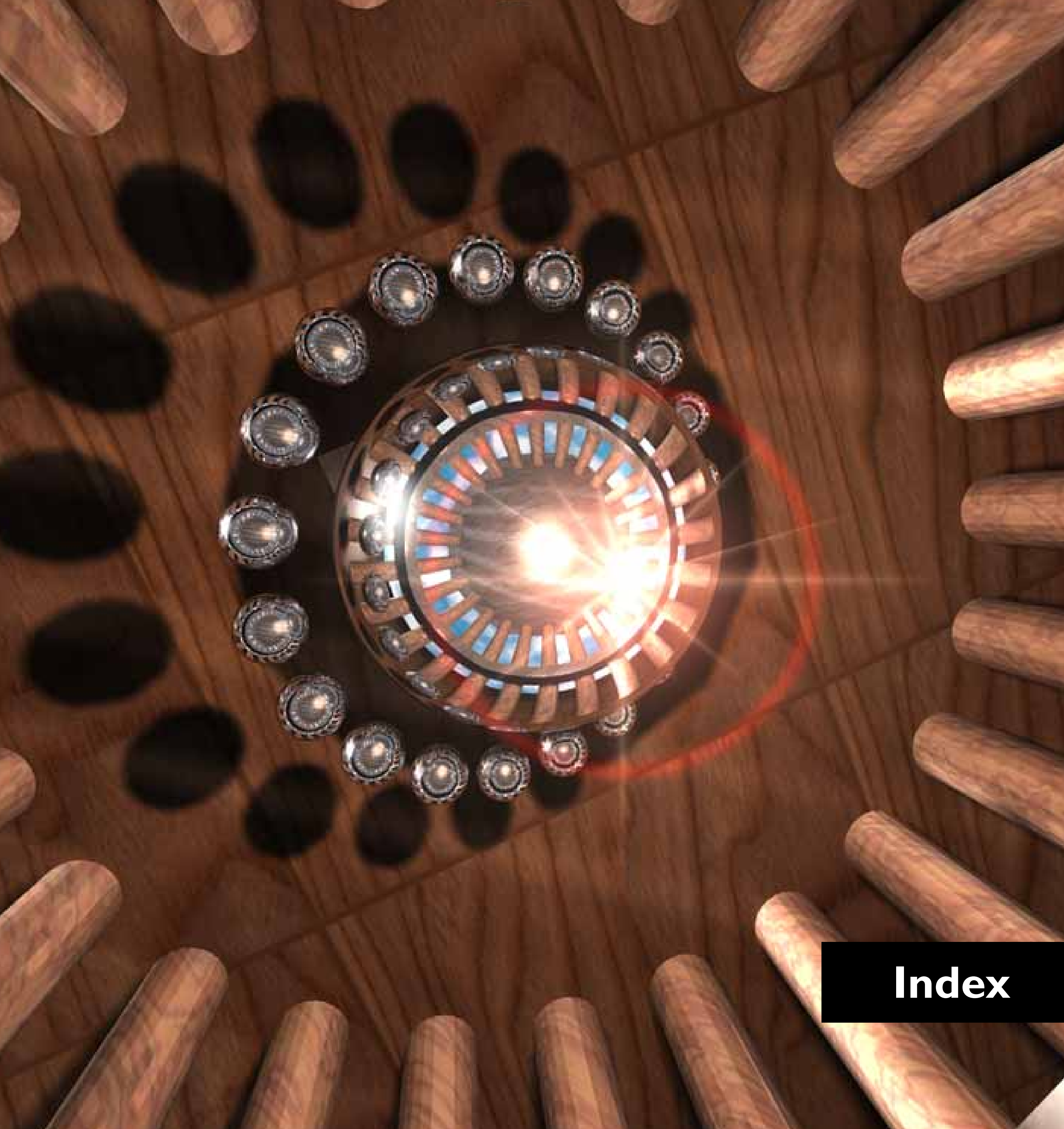
Volumetric Lighting
Special lighting technique, which calculates shadows within visible light.

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.

Walk Through
Same as Fly-Through—flying through the created scene. Most programs do this by using a camera animation. In CINEMA 4D it is done ’virtually’, i.e. without having to create a special animation. The movement is controlled interactively via the keyboard.

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.



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