

**SmartFractal**

<b>COLLABORATORS</b>
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	<i>TITLE :</i> SmartFractal		
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## Chapter 1

# SmartFractal

### 1.1 SmartFractal user manual

Smart Fractal V1.3  
by  
Avogadro Simone  
V 1.3 release in 30/1/95

#### USER'S MANUAL

Chapter1: General informations  
Chapter2: Menu controls  
Chapter3: Other options  
Chapter4: Miscellaneous infos

What's new with SmartFractal, why should you use it ?  
Shareware note

I hope you like Smartfractal and find interesting images that meet your sense of beauty.

Simone Avogadro

### 1.2 Shareware informations

IMPORTANT :-) THIS PRODUCT IS SHAREWARE, IF YOU USE AND LIKE IT PLEASE SEND \$10 TO THE AUTHOR.

#### SHAREWARE ~~~~~

The programs and files in this distribution are freely distributable. They may be freely distributed as long as no more than a nominal fee is charged to cover time and copying costs. Smartfractal 1.3 is distributed as non-crippled shareware, it is fully functional. You can try and test it as long as you like, if you then decide to support the author then send the shareware fee to him.

This program is distributed in the hope that it will be useful, but

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WITHOUT ANY WARRANTY; without even the implied warranty of MERCHANTABILITY or FITNESS FOR A PARTICULAR PURPOSE. The author cannot be held responsible for any damage caused directly or indirectly from the program. If you do not agree these conditions simply do not use the program, anyway you may still redistribute it providing you meet the conditions given above.

In particular I would like to note that Smartfractal does a considerable amount of calculations while running so do not rely on time-critical applications working properly, generally they should, but non system-friendly or tricky ones will probably fail.

Send money by EuroCheck (only in Italian lire!) or cash! It's impossible for me to cash in foreign checks, even if the amount is in Italian lire. Please state the version of Smartfractal you have. If you use it and like it, please consider registering. Registering is the only way to keep shareware developers developing :-)

If you also wish to get the next update (v2.0 is due for july/august 1995) please send enough postage for me to send you one disk. If you cannot get dollars I will also accept pounds (10\$ vs about 5£). Anyhow let me know your opinion even if you decide not to register!

#### DISTRIBUTION

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Smartfractal should be available both on the Internet (particularly look into the Aminet sites in dir "/gfx/fract") and on the Fidonet. Smartfractal distribution comprehends the following files :

|                          |                         |
|--------------------------|-------------------------|
| Prefs (dir)              |                         |
| Lyapunov                 | Lyapunovial.5           |
| Standard1.3              | Standard2.0             |
| Volterra-Lotka           |                         |
| Spots (dir)              |                         |
| Weird (dir)              |                         |
| Burst.spot               | Flame.spot              |
| MagicJulia2.prefs        | MagicJulia2.spot        |
| MagicJuliaCircles.prefs  | MagicJuliaCircles.spot  |
| MagicMandelCircles.prefs | MagicMandelCircles.spot |
| MagicVolterra.prefs      | MagicVolterra.spot      |
| MagicVolterra2.prefs     | MagicVolterra2.spot     |
| MagicVolterra2b.prefs    | MagicVolterra2b.spot    |
| RandomDots               |                         |
| InvertedJulia (dir)      |                         |
| ButterFly.spot           | Shuriken.spot           |
| InvertedMandelbrot (dir) |                         |
| Base.spot                | Side.spot               |
| Lyapunov (dir)           |                         |
| Bay.spot                 | FingerTip.spot          |
| LowFingers.spot          | RainWay.spot            |
| InvertedJulia (dir)      |                         |
| Dendride.spot            | InnerRev.spot           |
| PseudoDendride.spot      | SmallRevert.spot        |
| Mandelbrot (dir)         |                         |
| Dendride.spot            | Dendride2.spot          |
| Eyel.spot                | EyePupil.spot           |
| Eyes.spot                | EyeVein.spot            |
| Flower.spot              | Flower1.spot            |
| FlowerSpiral.spot        | InternalDomains1.spot   |

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InternalDomains2.spot
SeaHorse.spot
SmallMandelbrot2.spot
Spider.spot
SpiralBracesMand.spot
Valley.spot
Julia (dir)
Dendride.spot
Dragon.spot
External'S'.spot
FullDendride.spot
Inner1.spot
LittleSon.spot
MagicSpiral.spot
OneTwoThree.spot
SandSpiral.spot
SeparatorII.spot
Smooth2.spot
Smooth4.spot
Stardust.spot
SurfaceMagicZoom.spot
WavesZoom.spot
Volterra (dir)
Base.spot
Braces.spot
Bubbles2.spot
BubblesLimitFP.spot
BubblesZoomFP.spot
Core.spot
Cyclon.spot
Flare.spot
Hedgehog.spot
Leech2.spot
RainbowShell.spot
Shell.spot
Variation1.spot
LogZoom.spot
SmallMandelbrot.spot
SonOnTheLine.spot
SpiralBraces.spot
TopArea.spot
DendrideSaga.spot
Dragon2.spot
Flower.spot
Hook.spot
Linear.spot
LowIter.spot
OneMoreDendride.spot
Quirky'S'.spot
Separator.spot
Smooth1.spot
Smooth3.spot
Spirals.spot
SurfaceMagic.spot
Waves.spot
Wired.spot
BiDivergence.spot
Bubbles.spot
BubblesLimit.spot
BubblesUnzoom.spot
Colorwheel.spot
Core2.spot
Divergence.spot
HalfWay.spot
Leech.spot
Manta.spot
SeaHorse.spot
Spirals.spot
Variation2.spot
Colors (dir)
Aurora.cols
Green&Blue.cols
Lemon.cols
PinkMadness.cols
CyclingMadness.cols
Iceberg.cols
Lemon2.cols
Sunburst.cols
.info
SHAREWARE.DOC.info
SmartFractal.doc
SmartFractal.guide.info
SmartFractal.iff
Spots.info
SHAREWARE.DOC
SmartFractal
SmartFractal.doc.info
SmartFractal.HiRes.info
SmartFractal.info

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#### LIBRARIES

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Smartfractal makes use of ReqTools library V38, you need it if you want to run SmartFractal (it's not included in the distribution). ReqTools is Copyright (c) by Nico François. You can find the complete ReqTools package both on the Fido and on the Internet ("/util/libs").

## 1.3 SmartFractal general informations

### Chapter 1: The philosophy of the program

This chapter contains all the informations needed to use Smartfractal. It briefly illustrates the main features of the program and gives the user tips on how to obtain some beautiful images. Also gives some basic informations on what the fractals are.

- 1.1 What's a fractal ?
- 1.2 Introduction to Smartfractal
- 1.3 What's different (and some background story)
- 1.4 Some known spots
- 1.5 Other goodies

## 1.4 Program control with the menu strip

### Chapter 2: The program's menu

This chapter explains the meaning and the use of the various voices found in the menus. By reading it you'll be able to use SmartFractal at best.

- 2.1 Project
  - 2.1.1 Informations
  - 2.1.2 Loading/saving files
  - 2.1.3 Importing from other programs
  - 2.1.4 Setting the priority
  - 2.1.5 Exiting the program
- 2.2 Controls
  - 2.2.1 Graphic controls
  - 2.2.2 Methods tuning
  - 2.2.3 Zoom control
  - 2.2.4 Misc controls
  - 2.2.5 Buffers
- 2.3 Math
  - 2.3.1 Editing parameters
  - 2.3.2 Selecting the fractal type
  - 2.3.3 Determining the type of math
  - 2.3.4 Regenerating the image
- 2.4 Colors
  - 2.4.1 File operations
  - 2.4.2 Palette editor
  - 2.4.3 Choosing the rendering methods !!
  - 2.4.4 Cycling

## 1.5 Other features not available via menus

### Chapter 3: Other features

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- 3.1 Commands of the toolbar
- 3.2 Keyboard commands
- 3.3 Preferences and setup

## 1.6 Miscellaneous informations on SmartFractal

### Chapter 4: Miscellaneous informations

- 4.1 How to contact the author
- 4.2 Improvements
- 4.3 Known bugs
- 4.4 History
- 4.5 People I wish to thank
- 4.6 Bibliography

## 1.7 Introduction to fractals

### 1.1 What's a fractal ?

A fractal is ... Ehrm... It's a fractal! Just kidding, if you don't know what a fractal is you will still be able to use Smartfractal but maybe you will not understand the meaning of some of the options. I won't explain in depth what a fractal is as this would require too much space and this is not the purpose of this documentation. However there are some simple things about fractals anyone can understand even without reading whole (sometimes boring) books of math. First of all the name: Fractals, what does this name mean? Basically this refers to the fact that measuring the number of dimensions of one of these 'things' with some modern math techs (measuring the Hausdorff's dimension) would give a 'weird' number (maybe an irrational number or a fraction, so 'fractal'). This means that the thing you see on a 2-dimensional sheet of paper has a different dimension (Eg.:  $\log(4/3)$ ). Fun, and so? Well, that's difficult to interpret but this usually derives from the fact that these objects are defined by means of infinite recursion and so you can cut 1/4 of the object and it will occupy 1/3 (!!!) of the space of the original (that's the case of the Kock's curve that you can find on the books used in secondary schools). We talked about recursion, together with infinity it is one of the 'secrets' of fractals, the beauty of these object derives from the fact that you can theoretically zoom-in forever and always discover new zones, all of them will look like the ones you saw before but will always be somewhat different. The graphical representation of fractals is done iterating a mathematical formula and studying its behaviour for each single point. As we cannot afford to examine an infinite number of values for each point on the screen we usually stop after a finite number of iterations, the higher the number of steps before stopping, the more precise the drawing will be. The fractals you can explore with Smartfractal are all point-based, this means that the color of a single point depends only on the behaviour of that single point. For each point we study the convergence/divergence of a series defined by the type of fractal and by the point itself, we say that the point is in the set if the series converges, otherwise we say that it's out of the set. The deeper we go into the set and the harder will be to determine if a point generates a series that diverges or converges and

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so the higher will be the number of iterations needed to obtain an acceptable image of that zone.

## 1.8 Brief overview on SmartFractal

### 1.2 Introduction to Smartfractal

The very first time you will run Smartfractal (Smart from now on) you will probably want to setup the preferences as the default behaviour of Smart is to use parameters acceptable on the most basic machine (like my A500 :-), just browse the control menu to set the desired number of colors, the correct image size and the most suitable number of iterations, if you don't know what this means then you'd better read the whole 1st chapter before beginning for better results. Now go to the colors menu and set the internal and the external coloring methods (these are peculiar to Smart!), now choose the fractal type you prefer and save the preferences in the 'S:' directory, call them 'SmartFractal.prefs'. Done? O.K. You just finished the basic setup! From now on Smart will start with your preferences. Maybe you now want to zoom in, if so just click in the center of the zone you want to zoom, adjust the box size with the gadgets on the right side and click on the zoom gadget (or select the zoom option in the control menu), Smart will start to calculate that area. After a certain number of zooms you will probably decide to zoom out, just select the unzoom menu! If you cannot find anything beautiful you may decide to render pre-determined zones, if so just read paragraph 4!

## 1.9 What makes SmartFractal different

### 1.3 What's different (and some background story)

What you have been doing up to now was possible even in the most basic fractal generator, so what does Smart do that others don't? I chose to write Smart after re-reading a book talking about fractals, the pictures on that book looked somewhat nicer than the ones I could generate with the available programs. The main difference was that these pictures were also colored internally, this gave them a totally different look. I was disappointed not to have a program to do that, unfortunately the tech used to color that pictures was really time consuming and would have slowed down the generation of images to an unacceptable rate even on 68040 machines, so I gave off for some time. Sometime later I happened to look again at that book and noticed that some figures used a tech to draw the external part that was quite simple to implement but still I could not find any program able to do that, what a shame, I thought, but then I had an idea: Why not to create my own rendering tech for the internal zones and use the one seen in the book for the external ones? I began to program and in less than a week I discovered that my techs worked quite good, I just had to write everything except from the rendering routines, but I were so happy that the things went on by themselves. Some months after (I had some exams to do so I left the project for some time) I stumbled into a disk with the word "Smartfractal" written on it, I picked it up, created the user interface, added many features and after a hard work I came up with the very first beta version. Some month have passed

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from that day and with the new versions I have added anything I could find useful to the program. The program you are using now is the result of a hard work and so I would appreciate any form of encouragement as I am human too :-). Just write a postcard if you really do not think to be worth supporting me ;-( that postcard will let me know that there's people out there that appreciates my work !

## 1.10 How to have look around nice fractals

### 1.4 Some known spots

If you ever happened to read a book about fractals surely you'll have desired to render the same pictures, apart from the problem mentioned in the previous paragraph, sometimes the informations on how to get that pictures are omitted! So I decided to include a directory containing the preference files needed to render some very known images and some less known ones that I think to be worth a look! If you want to render such zones just select 'Prefs->Load spot' and than look into the 'Spots' directory in the same directory of Smart. You'll notice that the spots are divided according to the type of fractal. If you want to render an image never seen on books just enter the 'Volterra' dir and load the 'Seahorse' spot! Other unknown spots are found in the dirs of the inverted sets (by now Julia, Mandelbrot and Julia parameter plane), you can also find some beautiful spots in the 'Weird' directory, these are funny images obtained by setting 'not too meaningful' parameters, most of them can be considered interference images, because of this most of the spots in the 'Weird' drawer should be loaded as preferences.

## 1.11 Other available material

### 1.5 Other goodies

On suggestion I added two new directories: 'Colors' and 'Prefs', they do contain some pre-defined colors for both AGA and non-AGA machines and the basic preferences for the different types of fractals.

## 1.12 The main menu

### 2.1 Project

This menu contains all the controls concerning general operations.

#### 2.1.1 Informations

There are two voices giving informations in this menu. The first one is "info", it gives informations on the type of fractal that is currently set, the window being drawn, the number of colors, iterations and the type of math that had been used to render the current image (useful in case you are using the "auto" mode), it also states if the selected fractal is parametric and if it's parametric it shows the value of the parameters,

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also present the configuration found by Smart (CPU+FPU+AGA support), also if you turned buffers on you'll find here the amount of mem taken by buffers. The second voice giving informations is "about", this shows the program name, version and revision, a shareware message and my contact address.

- 2.1.2 Loading/saving files
- 2.1.3 Importing from other programs
- 2.1.4 Setting the priority
- 2.1.5 Exiting the program

This is the simplest thing, just select "Quit" and you will see a requester come up to ask you if you really want to exit, just select yes and you will terminate Smart. If you are using an Unregistered version of Smart a requester will pop-up asking you to register (sorry, it's the rule :-).

## 1.13 File operations

- 2.1.2 Loading/saving files

With the "project" menu you can either save the current situation (comprehending all of the preferences) together with the image being displayed, or save only the current settings (comprehending the window position, fractal type, math, colors etc.). If you want to save everything (ie.: Image+settings) choose the "save" option directly in the main menu, the situation will be saved as a standard iff image followed by a special field added by Smart to be able to recall the infos about that image. Once you want to recall that situation just select "load" in the main menu and the situation will be restored. If you want to save/load just the situation but not the image choose the voice "prefs" and then select "load" or "save". Note that you CANNOT recall only the situation (saved with the "prefs" voice) using the "load" in the main menu, this is the case of the spots present in this package, you must use the "load spot" option from the "prefs" voice. Before saving the whole image you can go to the options and turn iff compression on/off, note that if you are saving to an autocompressing device you'd better leave it off as the standard iff compression method is run-length 1, that's quite inefficient. Please note that if you load an image saved with Smart in an art package and then save it back the package will NOT retain the information about the fractal so you won't be able to reload it with Smart, so when you do retouch an image do not save it over the original or you'll not be able to reload it with Smart!

## 1.14 Importing alien prefs

- 2.1.3 Importing from other programs

From V1.3 Smart offers you the option to import from other programs your favourite spots, just select "Prefs->Import" and pick the data file, actually Smart supports the following formats: Mandelmania, MisterM,

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Lyapunovia, MandelA (this is now 100% as I had to guess the format :-), if you use a program other than these you may try anyway to import as many programs do use Mandelmania-like data files. If this fails and you have want me to add an other format simply write to me.

## 1.15 Priority selection

### 2.1.4 Setting the priority

The project menu has a "Priority" voice, it will pop-up a requester asking a number in range -10..+10, this will be the Smart's priority. The higher the number, the higher the priority. If you want to do something else while drawing fractals you'd better set this to -1, this way most programs will have higher priority and will give prompt response to your inputs. In some cases it may be useful to set it to lower values but this should be rare. You may use positive values to speed up a bit, but this will be a really little bit. Be aware that setting a priority higher than 5 may cause some you some problems as all standard programs will be unresponsive while Smart will be calculating (and with fractals this might take a lot!).

## 1.16 Program setup

### 2.2 Controls

This menu contains all the controls concerning the aspect of the image and giving controls about the zoom method and options.

- 2.2.1 Graphic controls
- 2.2.2 Methods tuning
- 2.2.3 Zoom control
- 2.2.4 Misc controls
- 2.2.5 Buffers

## 1.17 Gfx setup

### 2.2.1 Graphic controls

There are four voices controlling the appearance of the image on the screen. The first one is "Size", this enables you to set the size of the image to render, there are 4 predefined sizes and a "custom" option. If you chose the "custom" option you'll get a requester, if you are using Kickstart V2.0+ you'll get a ScreenMode requester and you'll be able to select any available resolution (comprehending any non-standard resolution available via third-party Monitor Types) and number of colors, please note that you's better NOT select special modes or non-proportional modes unless you want to make some weird tests (non-proportional modes are 1280x512 and 640x256), so if you want to create a backdrop for the Workbench you should select Laced-Hi Res and than convert the image to non-laced hi res with a graphic package (Dpaint will do). If you are using

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KS1.3 or less you'll get a string requester and you'll be able to enter the desired vertical size, the horizontal one will be determined by the "aspect" option, if you choose a vertical size lesser than or equal to 256 the screen size will be 320x256 and your selection will affect only the size of the image. If you choose a number greater than 256 you'll also set the size of the screen, remember that the screen will always have a 5/4 aspect (that's the default on PAL machines), if you choose a vertical size greater or equal to 400 you'll get a hi-res interlaced screen. The second voice influencing the image is "aspect", you can select either "square" or "rectangular" to set the aspect to 4:4 or to 5:4 (like the screen). Then there is the "colors" option, you can there choose the number of colors on the screen, please note that Smart will try to open the screen with the desired number of colors even if your machine has not the capability to display them, this will blank the screen if you select 64 colors (that's extra half bright) or more and hi-res on a non AGA machine with KS1.3, this causes you not to be able to see anything on the screen, the only solution is to terminate the drawing pressing Amiga-X and after a while pressing return, then press Amiga-Q and finally 'Y' to quit Smart. Surprisingly selecting 256 colors on KS1.3 in low-res will result in just 32 being displayed but 8 being stored in memory, so you can draw and then store 256 color images that you'll be able to display on AGA machines or with video enhancers. Please note that some resolutions will slow down significantly the drawing on non-AGA machine, that's not a bug, it's due to the internal multiprocessing architecture of the amiga that assigns too few time to the 680x0 (ie.: that's the case of 16 color hi-res where the machine almost stops). Then there is the "title" toggle, with this one you can turn on/off the screen title (if you turned it off, selected a full screen image and turned on autozoom then use Amiga-N and Amiga-M to move the screen to front/back without zooming).

## 1.18 methods

### 2.2.2 Methods tuning

In this menu you can set two options to control the methods to render the image, both of them will give you control on the accuracy of the representation. The first one is "Depth", with this voice you can select how many iterations to take before deciding that a point generates a series that converges. Keep this number high to have a more accurate representation of the image, keep it low to have a fast one, note that the deeper you go into the image the higher will have to be this number to get a realistic representation. If you have yet completed the image and raise the number of iterations a requester will pop-up asking if you want to update instead of redrawing, if the internal color is solid and the Buffer is on will be able to choose either "Fast" or "Exact", unless the number of iterations is too high you'd better select "Exact", if the internal color is not solid but the buffer is on you'll be able to select only "Exact" or no update. The second voice concerning representation is "Blocks", it allows you to set how big the blocks will be and so how many passes will the image take to complete, from V1.3 of Smart you may also select "Tessellate". If you turn tessellation on the screen will be divided in two blocks, each block will be divided into two smaller blocks and so on, this may introduce a BIG error in some cases and may be error-free in others, the problem is that with this mode an area surrounded by pixels of the same color is considered to be filled with that color, this would be

true if pixels had no size, but may cause approximation in real life. You may also select to use the 'traditional' blocks, this gives you control on the degree of approximation in drawing the image, the bigger the blocks, the faster will be the rendering and the more you are like to lose some details. This option should be used with care as it has a big potential, there are zones where setting the blocks to 8x8 will not affect the quality of the image but will speed up its generation more than 10 times, in other zones even setting the 2x2 option will give you a quite inaccurate representation of the image and will not be significantly faster than the pixel-perfect 1x1 mode. There is no way to tell what the best block size is, generally 4x4 should not affect significantly the image integrity but will give a great speed improvement. If you use the 8x8 option be careful to set a higher number of iterations to compensate the possible imprecisions.

## 1.19 zoom

### 2.2.3 Zoom control

There are four voices concerning zooming in this menu. The first one is "zoomrate", it allows you to set how much you will zoom, that is how much of the zone around the point you selected will be zoomed. The second one is "autozoom", just select "on" or "off". If you turn it on each time you want to zoom you'll just have to click in the center of the zone you wish to zoom and the zoom will take automatically place even if you did not select the voice "zoom". The voice "zoom" is used when the autozoom feature is off to zoom in a zone, just select this voice and then click in the center of the zone you want to see, if you want to cancel the zoom just click outside of the image or press the right mouse button. The last option "unzoom" lets you zoom off the current image, just select it and the image will be recalculated automatically without further actions.

## 1.20 Misc controls

### 2.2.4 Misc controls

There are four more toggles providing generic controls on the setup. This toggles are "Autoredraw", "Pack iff", "Be quiet" and "Toolbar", the first one let's you disable the auto-update function that redraws the image after any change in the settings, when this is off the redraw will happen only if the screen had been rebuilt and the image disappeared. The second toggle is to turn on/off the iff compression (see above for more infos). When the "Be quiet" switch is on you won't be prompted before overwriting existing files and you won't be presented a requester once the drawing had terminated (this will also turn off the screen-to-front feature). The last toggle is "Toolbox" and when activated (by default) will turn on the toolbar.

## 1.21 Buffer politics

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### 2.2.5 Buffers

The last option in this menu is "Buffers", you may turn it off or on as all toggles. When you turn it on you'll get a requester asking if you want full buffering or 3DOnly buffering. If you select "3DOnly" you'll be able to see the 3D Overlay once the drawing has been completed, and will also be able to use the Update functions (more iterations of different type of coloring), turning on "3DOnly" will not slow down significantly the calculations (about 0.5-8 secs). If you select a "Full" buffer, you'll get by default the 3D Buffer but you'll also get the color buffer, when it is active you may change the internal/external coloring method and get the screen updated immediately, this will unfortunately slow down the drawing a lot, from 2 to 40 secs !!! . If you know in advance that the drawing will take a big amount of time and have enough memory you'd better turn full buffer on, else, if you are just browsing, you'd better turn on only the 3DBuffer. Please note that the buffers are allocated when you start drawing so don't worry if the info window says that there's no buffer, also note that turning the buffers off will also free the allocated mem immediately.

## 1.22 math

### 2.3 Math

This menu contains all the voices that involve direct control of mathematical aspects of the drawing.

- 2.3.1 Editing parameters
- 2.3.2 Selecting the fractal type
- 2.3.3 Determining the type of math
- 2.3.4 Regenerating the image

## 1.23 parameters

### 2.3.1 Editing parameters

As Smart features parametric fractals (Julia, Volterra-Lotka, Julia Parameter plane and Lyapunov space) it also enables you to specify the value of these parameters. Julia, JuliaPP and Volterra do use 2 parameters, in the Julia sets the parameter is a complex number and indicates a point of the corresponding Mandelbrot set, if while examining the Mandelbrot set you wish to pick a point and set the Julia parameters to that point just select the "set point" voice and click in the Mandelbrot set on the point you wish to use (Tip: just after setting the point switch to the Julia set, you'll get a view of the same window as it appears in the Julia set and it will look similar to the region you picked the point from, the nearer to the point you'll go the lesser the differences will be :-). However you may know some values (maybe you have a book) and want to introduce them manually, if so just choose the "edit~point" option and you'll get a requester asking for the real part of the parameter and then for the imaginary one. If you changed your mind and

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no longer want to edit the parameters just hit return twice. Maybe you got also the coordinates of the window you have to zoom, if so just choose the "edit~window" voice and enter the value you wish to use (once again press return to keep the actual values). Note that the window requester will not allow you to specify all the four values as you may have expected, this is because Smart does not want you to get weird image aspect (after all who wants a Mandelbrot set that looks deformed ??). A different approach should be used for Lyapunov space, here you may set the sequence and the color divide. The color divide is a number that says how much should the palette be spread around, the higher, the lesser you'll be like to see the same color used twice, the lower, the more you'll be able to distinguish potential of points. To set the color divide just select "edit point", you'll be prompted a number (by default the old value). The second parameter is the sequence to be used generating Lyapunov space, this is a sequence of 'A' and 'B' (no matter the case), each letter in this sequence has the following meaning : 'A' means that the 'x' value should be used in the iteration, 'B' means that the 'y' value should be used. So if you select 'ABB' the first iteration will use 'x' as parameter, the second and third will use 'y' and then the sequence will repeat (the fourth will use 'x', the fifth and sixth will use 'y' etc...). So don't use a sequence with more letters than the iterations as this has no meaning, also note that even if the number of iterations should be big to let the succession converge you may leave it low to get nice pictures (this is what's done in Lyapunovia), after all you want to create nice pictures, if you wanted to examine population dynamics you'd have used something less fun !

If you want to make a 3DOverlay or have made it yet and want to change it's appearance you may "Set 3D Opts", you'll be asked level % of the plateau and the reduction, the first means how many iterations will be in the graduated part (if you set 50% and have 719 iterations the points exiting with 0-359 iterations will have different heights and the points with 360-719 iterations will be part of the plateau). The reduction level is used to adjust the height of the 3DOverlay, by default it will be :  $\text{height} = (\text{maxiterations} * (\text{level}\%)) / \text{Reduction}$ .

## 1.24 fractaltype

### 2.3.2 Selecting the fractal type

This is easily done by selecting the "set fractal" voice and then by choosing the fractal you prefer. Mandelbrot and Julia are the classical ones found in almost any fractal generator, Volterra-Lotka is fractal taken from the book I have (see bibliography for more informations), Inverted Mandelbrot and Inverted Julia are the Mandelbrot and Julia sets projected into an inverted space (again see bibliography). Then there are Julia Parameters plane and Inverted Julia Parameters Plane, Mandelbrot is the Julia Parameters Plane of the origin of the Gauss plane (0+0i), here you may choose to generate Parameter Planes of other points. Finally there's Lyapunov Space, this one is like the one found in Lyapunovia and is basically the logistic equation for a single population drawn changing the maximum population between an iteration and the other (see previous paragraph). When you set the fractal type you may want either to redraw (Mandelbrot->Julia->JuliaPP) or to restart (Mandelbrot->Volterra->Lyapunov etc...), a requester will pop-up, just select what you prefer.

## 1.25 mathtype

### 2.3.3 Determining the type of math

While exploring fractals one of the most important problems is to choose a precision that enables to draw an image that is free of defects, but at the same time it's important not to exaggerate not to slow down too much the calculation (I won't tell how long does a double precision image take to render in 640x512 on an A500 but know that I care too much for my computer to risk leaving it on the whole night). So you'll surely comprehend that the more precisions are available the better it is. Some programs (ehrm... Actually I know only of Mand2000 that's a commercial program!) do offer special routines to handle almost any precision but you'll usually find that even on fast machines (68040 33Mhz I mean!) any precision higher than the extended FPU precision will result quite too slow to use in non-background situations. Smart offers you 6 different precisions, they are (in order from the fastest to the most precise): Turbo integer, integer, big integer, floating point, double precision and extended FPU precision. The first five are available to anyone on any machine, the sixth one is only available to FPU owners and 68040 owners with fpu-patches (see below). Smart offers you to do the selection work for you, just choose the "auto" option and you'll never have to worry about the type of math used (Tip: when drawing the starting image of an inverted Julia force the precision to integer, the zones near to the borders will be pixelized but the effect may be fine (I like it!) and it will also be faster (unless you have an FPU!), Smart had been designed to be as precise as reasonable so I did not set that tip into the program as default). Please note that if you are drawing a zone on the border of an inverted Julia that is quite big (the set not the region!) Smart may get confused and select the wrong precision, you'll notice it as you'll get a pixelization effect! In these cases you can use the other options of the "precision" voice to force Smart to use a specific precision, note that you cannot force the Turbo integer precision as it's useful only on some occasions and Smart will activate it automatically while using the 'auto' mode, also note that if you don't have an FPU and try to force the FPU routines Smart will complain, if you decide to go ahead anyway expect your machine to crash as I wrote the FPU routines in assembler using directly the coprocessor instructions and not the library calls that are too slow (but useful if you need to write a single source that uses either the emulation routines either the FPU, in this case I wrote a separate code for processor-based calculation and so there's no reason to use libraries). Tech note on how Smart decides the precision to use: While developing Smart I assumed that anyone owning an FPU also owns a processor that will compute faster in integer (and turbo integer!) than the FPU (that's true if you have a 68020 or more, if you have a FPU and a 68010 or less always force the precision to FPU, by the way: why did you do such a strange thing as connecting a 32 bit FPU to a 16 bit bus ?). Note to 68040 owners: Before using Smart you must run a system patcher to trap the line-f exceptions generated by the FPU instructions not supported by 68040 internal FPU, once done this (you probably yet installed it in the startup :-)) you can safely run Smart and enjoy your machine's FPU speed!, if you don't install the patch you'll still be able to use Smart but you won't be able to use FPU mode.

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## 1.26 redraw

### 2.3.4 Regenerating the image

There are two options to regenerate the image, the first one is "redraw" and will redraw exactly the selected window with the selected parameters, this is useful when after changing the coloring methods you want to regenerate the image with the new routines. The second option is "restart" and as you'll have guessed selects the default starting window for the selected type of set before redrawing. If the 3DBuffer is active but you closed the 3DOverlay window and want it back, just edit 3DParameters, keep them as they are and you'll get the 3DOverlay back.

## 1.27 colors

### 2.4 Colors

As beauty is a subjective idea people may wish to change the appearance of the fractals on the screen, this menu does this but it also allows you to select the coloring methods of internal and of the external part of the various sets. Note that this is not just an exterior change as the different methods give different informations on the behaviour of the single points.

- 2.4.1 File operations
- 2.4.2 Palette editor
- 2.4.3 Choosing the rendering methods !!
- 2.4.4 Cycling

## 1.28 fileop

### 2.4.1 File operations

The two voices "save" and "load" allow you to save and load the whole color palette used by the program (all 256 colors) in iff format so that you'll be able to use palettes edited in your favourite drawing package.

## 1.29 palette

### 2.4.2 Palette editor

Just choose "edit" from the menu and you'll be faced with the standard color requester of the ReqTools library, freely edit the palette and then choose 'ok' or 'cancel' to confirm the changes or to discard them.

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## 1.30 Here lies the magic of SmartFractal!

### 2.4.3 Choosing the rendering methods !!

As I wrote before, this is the main difference with all the other fractal generators I could find on Amiga, Smart can assign a color also to points internal to the set !. There are two menus concerning this options, the first one is "external" that allows you to specify the type of coloring you want in the external regions. Here you have six choices: "Solid", "Smooth", "Binary", "2Binary", "Checked1" and "Checked2". The first one will assign to all the points not in the set the same color. The second one will assign the usual coloring that's based on the speed of divergence (this evidences the level curves). The third one is the one I talked about in chapter one, this is a simple method that assigns to each point outside the set a color depending on where the point was when it exited the limit circle of divergence, the color depends on the argument of the complex number, this brings in evidence the Hubbard's angles of various point of the Mandelbrot and Julia sets. The fourth method is a personal variation of the third that's based on a different assignment of the colors depending on the argument. The fifth and sixth are obtained by mixing the "Smooth" and "Binary" options, they are very impressive if cycled, otherwise they look almost like "Smooth". The second voice concerning coloring (and the most important in my opinion :-)) is "internal" that lets you specify five types of coloring, they are: "Solid", "Logarithmic", "Smooth type 1", "Smooth type 2" and "Logarithmic type 2". The first one works as the corresponding one in the external menu, the second, third and fourth one give you an idea of how much difference there is in the module of point end of its (probable) attractor, the fifth one gives you an idea of how far the point is from its attractor. The second and the fifth adopt a logarithmic scale so to allow you to see with the same precision attractors of different orders, the third and fourth do adopt a corrected proportional method, that's less efficient than the logarithmic scale but it's more colorful and in some cases gives you more informations. The most significant method in terms of math is the fifth one that does its better to evidence the internal level curves (that's how fast a point gets near to its attractor), this is the most similar to the one I found on the book I wrote about in the previous chapter, I cannot be sure if it's the same but I believe it to be, the real problem is the nature of the attractors that present a periodical nature, to evidence the biggest number of attractors the number of iterations should be equal to  $((K!)-1)$  that's a number too high even with  $K=10$  ( $K=10 \rightarrow$  depth should be  $= 3628799$ , too big for me!). This is a common problem with all the internal coloring methods, if you use it just select at least an odd number (that's due to the fact that on some fractals, like Mandelbrot, the main attractor (that's  $0+i0$ , the origin of Gauss' plane) is present in all the periodical orbits so that if you choose an even number all the point will look to be part of the domain of the origin!).

## 1.31 cycling

### 2.4.4 Cycling

From V1.1 Smart offers the cycling option, you can use the voices of the "Cycle" item to turn on/off cycling, select the direction of cycling

(forward or backward) and to speed up or slow down the cycling of the colors. You can change the direction of cycling while it's on without any problem. If you stop the cycling the colors will remain the ones of the moment you stopped it, if you want to revert to the original palette select the "Reset" option, if you want to let the actual palette be fixed just select 'Edit' and click on "Ok" without modifying anything.

## 1.32 What can be done with the toolbar

### 3.1 Commands of the toolbar

From V1.2 on Smart features a toolbar that holds buttons for some of the most used commands, it also offers a couple of functions NOT available from the menu. The top two gadgets are used to increase/decrease the size of the zoombox (and so to control the zoomrate), the two just below allow to zoom/unzoom and the first of the next line let's the user hide the zoombox (not available from menu). The one immediately on the right let's the user turn on/off the coordinate display option, when this option is active if the cursor passes on the image the coordinates of the underlying point will be displayed, this is really useful while using the 'Set point' option. The four buttons below these ones allow the user to turn on/off the color cycling, change its direction, speed up or slow down it. There are than two icons to show the information box and the about message. The last two buttons will let the user save/load everything.

## 1.33 Keyboard commands

### 3.2 Keyboard commands

Many menu options do have a keyboard shortcut, and can so be used via keyboard, however there is a simply trick available only from keyboard, if autozoom is off and the zoombox is visible you can use the arrow keys to move it around the image.

## 1.34 Program setup

### 3.3 Preferences and setup

If you want Smart to start with your configuration as default you may save your preferences as "SmartFractal.prefs" either the "S:" directory either in the same directory of Smart, note: if you run Smart from SHELL you'll have to save the preferences in the 'current' directory, I.E.: if you are in directory "HD1:Utils/" and Smart is in directory "HD2:Utils/Math/SmartFractal" (and it is the path) you can run Smart by typing "SmartFractal", but if your preferences are not in "HD1:Utils/" Smart won't use them. So if you frequently use Smart from SHELL you'd better place the preferences in the "S:" directory. An other feature that will surely be appreciated by someone is that you can use any image obtained with Smart as default one, just save it as "SmartFractal.iff" in the same directory of Smart (the notes for SHELL users about preferences are still

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valid).

Another feature that SHELL users will appreciate is that from V1.1 Smart will auto-detach from the current process, running in background and letting you close the Shell whenever you want without having to quit Smart.

## 1.35 How to contact me

### 4.1 How to contact the author

Well, if you have been reading the document you'll probably have also the program and my contact address but anyway here it is:

Mail to:           Simone Avogadro  
                  viale Rimembranze, 33  
                  Appiano Gentile  
                  22070 (CO)  
                  ITALY

E-mail on Internet to: [simonea@varano.ing.unico.it](mailto:simonea@varano.ing.unico.it)

If you cannot access the internet but have access to the Fidonet you can use a gateway to Internet, if you don't know how to do that ask your sysop, as I don't have direct access to Fidonet I cannot tell you how to do it (sorry:-), but note that this method is slow (usually it takes a month or more for the mail to arrive to me!).

There are no known bugs in Smart but I can't tell if there are not bugs or if we simply don't now about them :-}, if you find any bug please report it to me, possibly with a clear description of how to recreate it (please state the machine configuration you have, etc.). Reporting bugs helps me to keep the program safe so, expecially if you found a nasty one, report it to me as soon as possible.

## 1.36 Possible future improvements

### 4.2 Improvements

Here I give a list of improvements that I'd like to add to Smart if I have time (Ie: If I successfully take my exams) and if I feel Smart to be appreciated (feedback is important, even an E-mail makes the difference!):

- o Make use of MUI library for 2.0 users
  - o Support for xpklibrary de/compression
  - o A "Pickup" menu so that you can stop drawing, save the partial work and than pickup your work later (very useful for time-consuming drawings!)
  - o A speedup buffer, so you can zoom faster
  - o Faster rendering routines
  - o Better color cycling feature
  - o 3D mapping of fractals (spherical and continuous axonometrical)
  - o More types of fractals
  - o More coloring techs
-

Changes that will take a bit more to be done:

- o Arexx support (I got the documentation for it and I will do it as soon as I have enough time)
- o Real-time zoom (like Mand2000)

As you see I have a lot of ideas and so there are a lot of possibilities, let me know your preferences and if you have any proposal for special features not mentioned here (please don't just say: "I want Smart to draw in real time, support custom fractals and display images directly on my Virtual reality glasses" :-).

## 1.37 Know bugs

### 4.3 Known bugs

There's only a known bag so far, if you use KS1.3 you may happen to see timings like 0:00:00. I'm sorry for this, under KS1.3 the timing functions of the OS are quite inaccurate and I didn't want to write own timing functions (lazy guy :-).

There's another problem, some precisions may contrast with some drawing options, so far Volterra and Lyapunov won't work with BigInteger math so Smart overrides these modes and switches to Float. If you use Tessellation you won't be able to use Float as Smart will override your options and switch to Double, this should not be a problem as the use of Float is quite restricted, infact the difference between BigInteger a Float is little, so probably you'd have to switch to Double quite soon (a couple of zooms).

This final one is not a bug but rather an advice. From V1.2 the info window also displays infos on the machine it detects, CPU+FPU are OK but I don't know a SAFE way for identifying AGA and so it detects KS3.0+ (AGA support) and not the chipset.

## 1.38 History of the program

### 4.4 History

V1.0 in 14/6/94 : First release

V1.1 in 18/7/94 (Internal) : Never released but really stable.

- When run from CLI/SHELL it now auto detaches and goes in background
- Added two voices to Prefs menu to load separately Options and Spots
- Added the option to compress images with standard Iff method
- Added color cycling
- Added "Be Quiet" toggle
- Added the zoombox

V1.2 in 20/9/94 : No known bugs.

- Added support for any system monitor with a standard Screenmode requester
- Added a toolbar to make interaction more immediate and intuitive :->
- Added new fractals "JuliaPP" and "Inverted JuliaPP"
- Added 64 bit integer math, about 3-4 times faster than "float" and

90% of the times with equivalent precision, made separate versions for 68000-010 and 68020+

- Added the ability to show cursor coordinates on the screen title
- Fixed a bug in V1.1 that caused some problems with packed iff
- Now Smart asks for confirmation before overwriting existing files this feature can be disabled with the 'Be Quiet' switch
- Fixed a bug that didn't allow to use more than 65535 iterations with FPU precision
- Micro-buffering almost halves the time taken to render quite uniform areas.

V1.3 in 20/1/95 : No known bugs.

- Added the option to import alien preferences, support for: Mandelmania, MisterM, Lyapunovia, MandelA (not 100%).
- Rewrote some FPU stuff, now 5-10 % faster!
- Added a new set type: Lyapunov Space
- Added 3D buffer, allowing 3D overlay (quite primitive but still better than nothing :-)
- Added Color buffer, lets you change the coloring method without having to redraw (when active about 2-40 secs slower :-< ).
- Added "Auto update", if you raise the number of iterations you'll be able to redraw only a minor part (Idea from Mand2000 :-)
- Added a new drawing mode: Tesselate (Like MisterM, FractInt and others), about 20-40% faster !
- New 3.0 Look even for KS1.3 owners!
- Finally fixed the 24Bit color support, now you can use 24 Bit colors in all of their glory!
- Fixed problem with Autoscroll (not active in V1.2!).
- Added AmigaGuide documentation.
- Added some new spots.
- Added a timig feature, now you know exactly how long it took to complete the image
- Added option to set program priority

## 1.39 People who helped me

### 4.5 People I wish to thank

Oh, well, there's a lot of people I should thank, so in no particular order: Mom, dad and my brother for supporting me and being patient, my friends for their interest and then in particular:

Stefano Volponi for correcting the errors in this text (as you'll have supposed English is not my native language!)

Donato Corvi for beta-testing on his fat A1200+68030 33Mhz+68882 48Mhz FPU +8Meg 32Bit fast. Also for letting me work at his home in an attempt to fix a nasty bug with FPU (finally I caught it!). Most of the awesome new spots found in V1.2 are due to his research.

Cristiano Preda for beta-testing on his monster (A2000+8Meg 32bit fast, 68040 30Mhz, 2Meg Merlin graphic adapter), and for procuring me the iff documentation.

Other people I wish to thank:

Fabrizio Sala (sysop of Fast Enough BBS) for spreading (I hope!) Smart on Fidonet

Nico François for developing the ReqTools library (req.library is cool but reqtools is cooler!) (if you want to know more about Reqtools read the SHAREWARE.DOC file)



Enrico M. Ferrari for paying attention to SmartFractal and for his review on MC MicroComputer  
And all the others I forgot!

## 1.40 References books on fractals

### 4.6 Bibliography

The book I wrote about many times in this text is:  
H.O.Peitgen - P.H.Richter, "The Beauty of Fractals, Images of Complex Dynamical Systems", 1986, Springer Verlag - Berlin, Heidelberg, New York.

If you have a secondary school preparation and like math you'll be able to comprehend the principles explained in this book and even if you don't understand mathematics you'll find the Interventions very interesting as they are comprehensible by anyone and express interesting philosophical considerations; you'll also find an interesting appendix on how to write simple programs to generate fractals, if you are a bit more advanced there's a section commenting some advanced techs you'll surely find interesting (even if some do require too much computational power to adapt them for our amigas). If you are Italian (As I am!) you'll also find the Italian translation of this book, it's called "La Bellezza dei Frattali" and is published by Bollati-Boringhieri, I found it to be a good translation not presenting problems with traslation of mathematical therms (thanks to the work of Umberto Sampietri).

If you want to read something more practically-oriented you should try to procure old numbers of "Scientific American" (or translations) that featured interesting articles about fractals and non-deterministic dynamics.

If, instead, you are more interested in the mathematical aspect you should search for a book of B.Mandelbrot that's considered the father of the modern theory of fractals. I just mention the most known:

Benoit.B.Mandelbrot, "The Fractal Geometry of Nature", 1982, Freeman, San~Francisco.

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