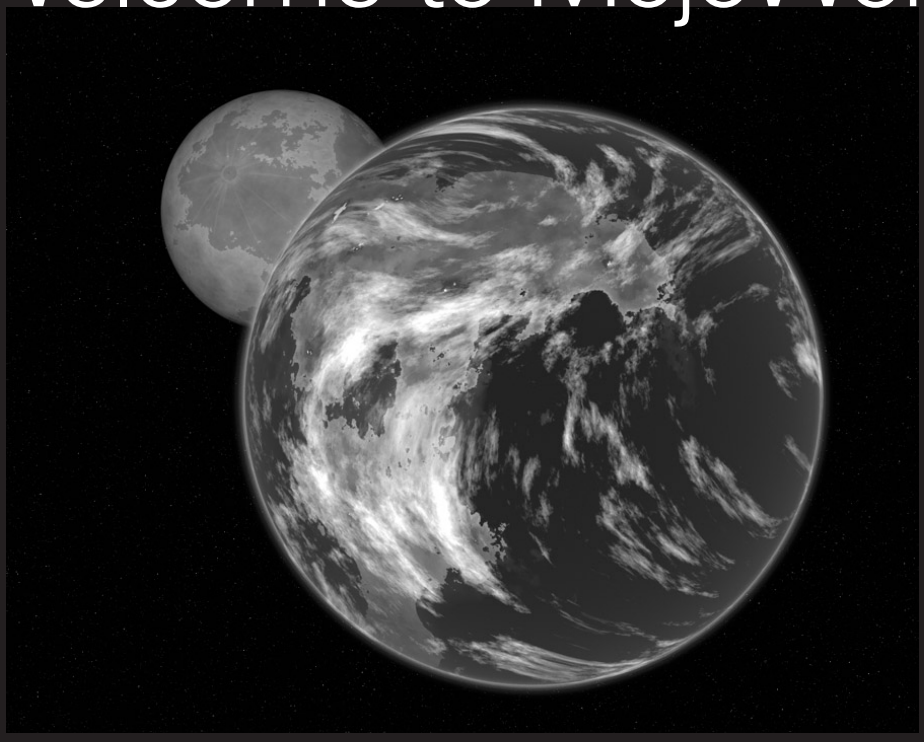
Welcome to MojoWorld



mojo: magic, the art of casting spells —the Oxford English Dictionary

"Any sufficiently advanced technology is indistinguishable from magic." —Arthur C. Clarke

Since 1988 I have dreamed of exploring fractal planets. I knew that these planets were out there, existing in the timeless truth of mathematics. How to image them was fairly clear, in concept at least. But doing so in any reasonable way was beyond the pale of our current technology at the time. Besides, what good would they be if you needed a supercomputer to access them? I wanted you to be able to get to them at home, using the computer you already have there.

The time has finally arrived when MojoWorld is feasible. Sure, it takes a fast computer, but no faster than what they'll sell you at your local computer store today. The future has caught up with my dream at last. And now I present you with MojoWorld version 1.0. It is a tentative first step into cyberspace, the alternate reality that exists only in your computer. Welcome to my dream worlds…

—Dr. F. Kenton "Doc Mojo" Musgrave

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Prologue



What is MojoWorld 1.0 Near Space?

MojoWorld 1.0 Near Space™ is a window on a parallel universe. No kidding. This window looks out on planets that exist in a universe we call Parametric Hyperspace™. These planets are, by default, about the size of planet Earth, and have just as much detail. Anyone can explore these worlds with MojoWorld's real-time interface. Experienced users can create and explore an infinite variety of new worlds, and use them in projects from graphic arts to special effects for blockbuster Hollywood movies. We can all share them in the MojoWorld Online Community.

MojoWorld™ is more than just software, it is a human experience. It is the root of a world-wide Internet community of people who share the yearning to create, explore, and share their discoveries of beauty and wonder. It is the beginning of an endless adventure as we explore this parallel universe, in ways that will with each passing year become more fascinating, believable and compelling as technology advances.

MojoWorld Transporter™ and MojoWorld Generator™

MojoWorld 1.0 Near Space consists of two products: the free MojoWorld Transporter and the full-blown MojoWorld Generator.

MojoWorld Transporter is Pandromeda's simple and intuitive exploration tool that allows you to roam any MojoWorld planet in real-time. You can render your discoveries with unprecedented beauty, create super-realistic animations, and morph entire planets with

PROLOGUE

MojoWorld Transporter. You can change the time of day locally and the time of year globally. Best of all, you can create travelogues that document your travels and discoveries, and share them with others.

MojoWorld Transporter exists to set everyone free in the MojoWorld universe. It is available as a free download at www.pandromeda.com.

MojoWorld Generator is Pandromeda's planet building software. MojoWorld Generator provides unprecedented power, flexibility and control with some of the most advanced models of natural phenomena ever seen in any computer graphics application. MojoWorld Generator also provides an excellent, user-friendly introduction to the complex discipline of 3D graphics.

MojoWorld Generator is Pandromeda's revenue-generating product. It is intended to provide the means for us to keep pursuing the Dream.

The MojoWorld UI

MojoWorld Generator has a unique 3-level user interface: The Transporter Interface, The Generator Interface, and the Professional Interface or Pro UI.

The Transporter Interface is a very simple interface designed to give you a sense of the power of MojoWorld in a way that is so transparent as to require almost no documentation. It is the same interface that is featured in the free MojoWorld Transporter. By default, MojoWorld Generator launches into the Transporter Interface. Once you start using the Generator Interface MojoWorld remembers which UI you were using last and will launch into that the next time you start it up.

The Generator is the interface that artists will use most. It allows you to manipulate the many dimensions of the Parametric Hyperspace, add moons, atmospheric effects, and much, much more. The Generator will do everything the majority of MojoWorld users will ever want to do. However, for the real experts and hard-core enthusiasts there's the Pro UI.

Rather than being a completely separate user interface, the Pro UI represents a hidden, additional level of complexity to the Generator Interface. With the Pro UI, expert users can directly manipulate the mathematical functions that create MojoWorlds. MojoWorld has a modular, open software architecture that allows its functionality to be extended by any competent graphics programmer. Thus MojoWorld is a program that can be extended and improved for years to come—by the user community as well as the

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Pandromeda engineers—without running up against inherent limitations or needing a complete rewrite. Indeed, MojoWorld is designed to be the testbed for engineering cyberspace.

Portability

MojoWorld is a cross-platform application. The MojoWorld UI looks identical whether you're using it under a Macintosh, Windows, or Linux operating system.

To find out more about MojoWorld 1.0 Near Space and to keep in touch with recent news and developments visit our web site, www.pandromeda.com, regularly!

Unique Features of MojoWorld 1.0 Near Space:

- ***The ability to model entire planets***, not merely a finite patch of terrain. As a natural result all of your scenes have a global context. Just like landscape photography here on Earth, your images are only a tiny part of the whole. Better still: *you or anyone else can go back to that place any time* and improve the scene or explore the planet further. Incredible!
- ***The ability to explore planets in real time.*** You can stroll sedately on the surface, fly over mountains, plains and seas, or launch into orbit for a global view–and return just as easily to any point on the planet.
- ***Rendering with pixel-level detail at any resolution***. MojoWorld has practically infinite detail. You can start out in space looking at the whole planet and zoom in to see features fractions of a millimeter across–*anywhere* on the planet.
- ***An unprecedented variety of synthetic terrains and the world's most advanced procedural texture engine.*** The MojoWorld Texture Editor is the most sophisticated terrain modeler ever, creating an amazing variety of fractal terrains and textures.
- ***A potent three-level user interface*** for everyone from the novice to the Hollywood effects professional. MojoWorld is designed to help you grow your expertise: You can go from graphics neophyte to effects pro just by learning and mastering MojoWorld.
- ***The powerful, free MojoWorld Transporter*** allows anyone to explore MojoWorlds, render scenes and movies, and create and share travelogues. MojoWorld Transporter provides a worldwide audience on the Internet, right here on Earth, for your creations, discoveries and adventures.
- ***Continents with river networks***–a MojoWorld exclusive. It took our resident astrophysicist, Prof. Jim Bardeen, to pull this off!
- MojoWorlds feature ***realistic, spherical planetary atmospheres.***
- MojoWorlds can have ***multiple moons with true three-dimensional relief.***

- MojoWorld Generator provides ***tools to define the functionality of the MojoWorld Transporter Hyperspace Mixer sliders.*** These sliders can be rigged to control *anything* in a MojoWorld. The snowline, sea level, cloudiness, ruggedness of the terrain–you name it!
- MojoWorld Transporter and Generator both ***render QuickTime movies and QuickTime VR panoramas*** that you can share with the MojoWorld online community.
- ***The MojoVox™ chat utility*** allows you to ask questions and share creations and discoveries, instantly, with other registered owners of MojoWorld Generator.
- ***Import capability for widely used 3D file formats*** including 3DS, OBJ, LWO, and DXF allowing you to populate your MojoWorlds with whatever objects you model in your other 3D graphics programs.

The Roots of MojoWorld

It all started with Benoit Mandelbrot, the world's most famous living mathematician and the father of fractal geometry, the new branch of mathematics that makes MojoWorld possible. Mandelbrot made the first images of fractal mountains in the 1970's. In the early 1980's, Mandelbrot and Richard Voss made the first realistic fractal landscape imagery. In the late 1980's Doc Mojo and Mandelbrot brought such images to the level of fine art. In 1993 Doc Mojo Musgrave earned his PhD from the Yale computer science department for this work. His dissertation, "Methods for Realistic Landscape Imaging," remains the comprehensive road map for writing computer programs to create and render fractal landscapes. Mandelbrot calls Doc Mojo "the first true fractal-based artist."

From the late 1970's through today researchers like Loren Carpenter, the late Alain Fournier, and a host of others have been advancing the technology of making realistic synthetic landscapes both for the academic community and Hollywood. In 1994 Doc Mojo and his colleagues wrote "Texturing and Modeling: A Procedural Approach." This book, Doc Mojo's dissertation and lots of academic papers document the knowledge and techniques that make MojoWorld possible. Since the late 1980s, Dr. Musgrave has been the acknowledged world's leading expert and visionary in the field. He served as Director of Advanced 3D Research at MetaCreations from 1997 to 1999, where he worked on Bryce 4.0. In December 1999 Dr. Doc Mojo formed the company FractalWorlds, which became Pandromeda, Inc. a year later.

Pandromeda's first release, MojoWorld 1.0 Near Space, represents the apex of technology in the field of fractal landscapes and a step further on Doc Mojo's personal quest: "To continue to create unprecedented artworks and synthetic worlds, to contribute to the fields of visual communication and the development of the computer as a novel artistic

medium and process, and to continue to push the state of the art in synthetic imagery and digital effects."

MojoWorld 1.0 Near Space is just a beginning. Just as MojoWorlds themselves represent a context for synthetic terrains, they will also have a context of their own. Later versions of MojoWorld will feature a solar system of MojoWorlds, then a galaxy of such MojoWorld systems. Then we'll put these galaxies into clusters in a virtual universe. This universe will be the place where you go to access all the information on all the world's computers: *cyberspace*.

No matter how advanced the version, MojoWorld will always be just the beginning of the unveiling and exploration of the parallel universe that is cyberspace. Everything you've ever seen in this world or any other is a candidate for inclusion in MojoWorld. There's way more stuff to put in there than there is time in our lives to put it in. This dream has no end…

Personal Profiles of Key Players

Dr. F. Kenton "Doc Mojo" Musgrave, *CEO/CTO*: Doc Mojo is the world's leading authority on synthetic landscape imagery. He literally wrote the book on the subject. He worked with Benoit Mandelbrot while earning his PhD at Yale University. He has served as Director of Advanced 3D Research at MetaCreations, Principal Software Engineer at Digital Domain, and Senior Scientist at Bethesda Softworks/Zenimax. He created digital effects for films such as *Titanic*, *Star Wars*, and *Apollo 13*. He taught at Yale and George Washington Universities. MojoWorld is Doc Mojo's personal artistic vision, and represents the culmination of over 15 years of his ground-breaking research.

The Honorable R. Kenton Musgrave, *Chairman of the Board*: Judge Musgrave sits on the United States Court of International Trade. He brings to Pandromeda decades of experience as Vice President and General Counsel in corporations such as Mattel, Vivitar, and Ringling Bros. Circus.

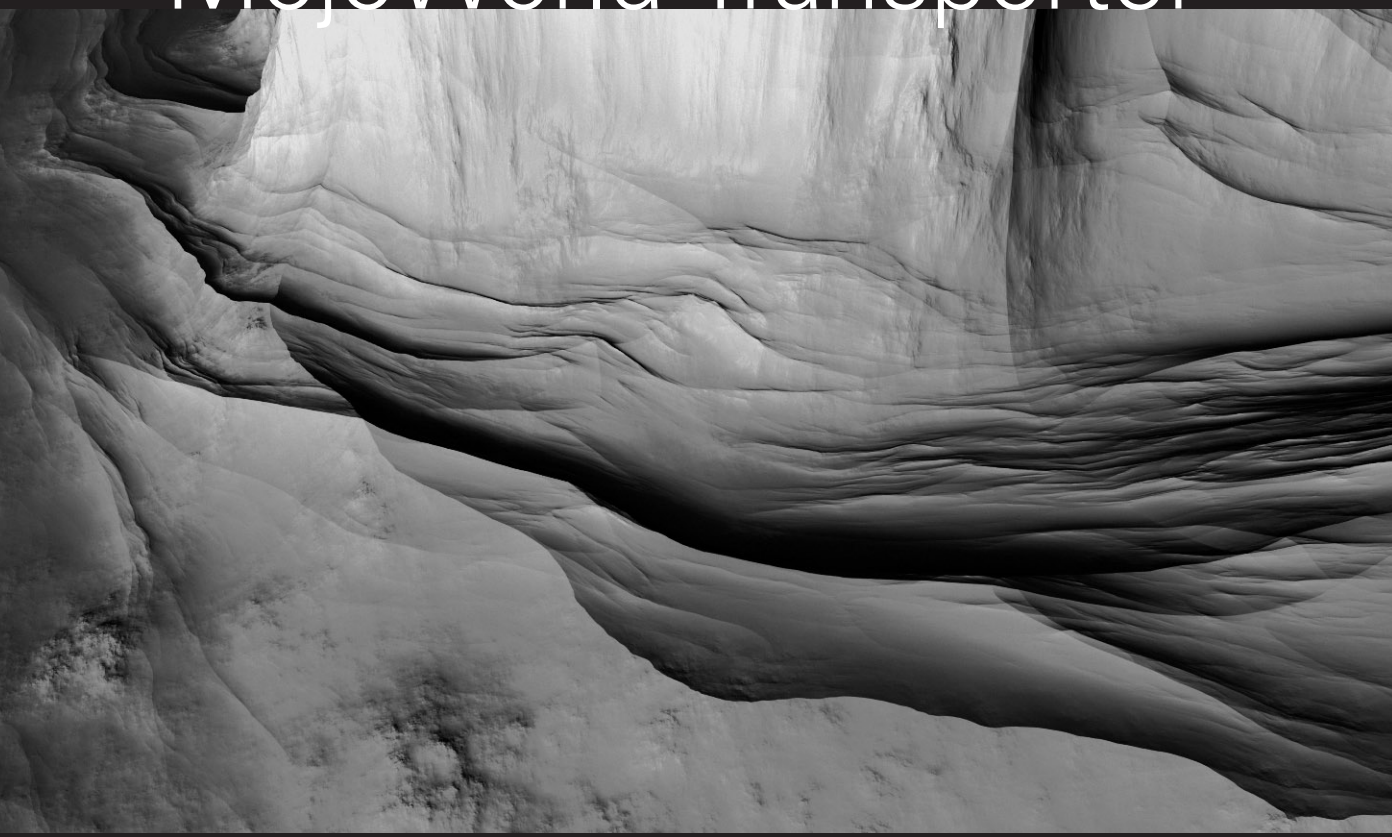
Craig McNaughton, *Principal Software Architect*: Mr. McNaughton is one of New Zealand's top computer animation programmers. He has years of experience in high-end, production computer graphics animation and special effects and was part of the world-beating New Zealand team that won the prestigious ACM Student Programming contest in 1991.

PROLOGUE

Professor Kent Oberheu, *Principal User Interface Architect*: Prof. Oberheu is a top-flight digital artist and user interface visionary. Prof. Oberheu is in charge of UI design and corporate graphics at Pandromeda. Kent won the Grand Prize in the Mac World Art Show in 2000 and displayed two pieces in the prestigious SIGGRAPH 01 Art Show.

Professor James Bardeen, *Software Scientist*: Prof. Bardeen is an astrophysicist who worked out the original theory of black holes with Stephen Hawking. Bardeen is an expert in the mathematical intricacies of random fractals, the heart of MojoWorld technology. He extended his unique river models to provide the drainage networks for entire MojoWorld continents.

MojoWorld Transporter



The Transporter Interface

The Transporter is MojoWorld's simplest user interface. It allows you to explore MojoWorld planets, save your favorite destinations, change the time of day and year, render scenes, make movies, and record travelogues to share with the MojoWorld Online Community. The Transporter Interface in the MojoWorld Generator™ product is essentially the same interface as the free MojoWorld Transporter™ product.

This chapter covers the Transporter Interface in three sections. We begin with a brief overview of all of the tools visible in the main interface screen. The second section explains how to explore MojoWorlds using a variety of locomotion Modes. A flying tutorial is included to get you going as quickly as possible. The third section describes the Panel Tools that allow you to save planet settings, alter time, record travelogues, record movies, render images, and pinpoint your location on the planet's surface.

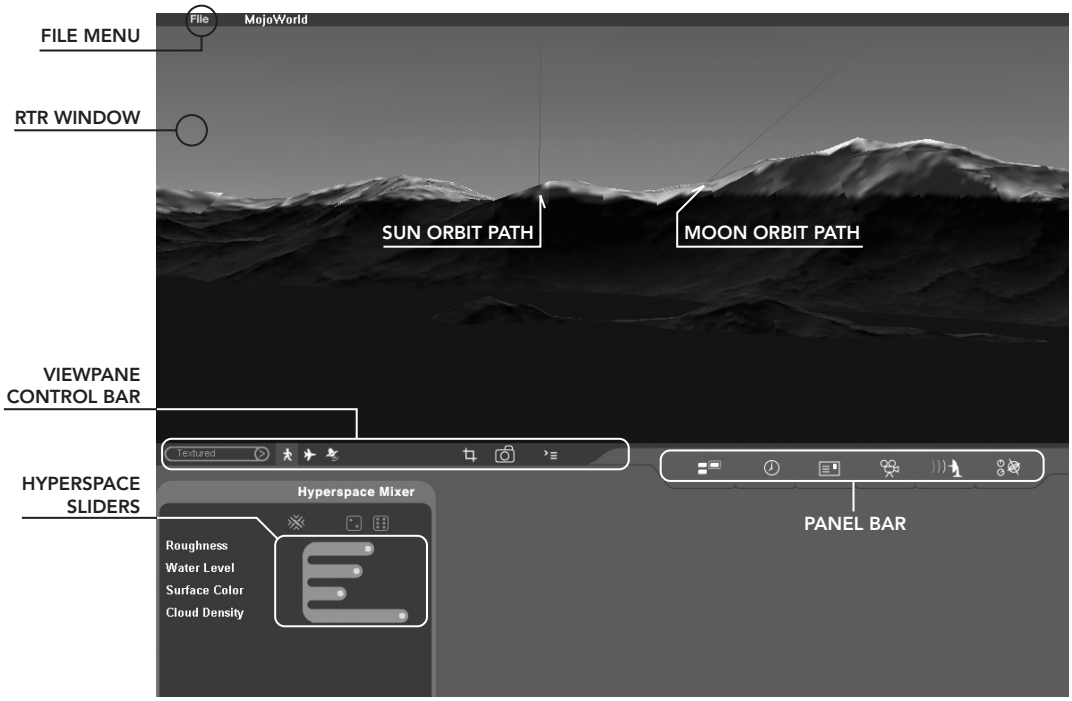
Many of the tools and concepts that you learn in the Transporter Interface will assist you greatly when you move on to the Generator Interface.

How To Get to The Transporter

The first time you start MojoWorld Generator the Transporter Interface is what you see, as by default MojoWorld Generator launches into the Transporter Interface. However, when you restart MojoWorld it returns to the interface from which you last quit.

To get to the Transporter from the Generator Interface follow the menu path: Menu Bar>File>Go To Transporter.

Overview of the Transporter Interface



Menu Bar

The menu bar consists of a single menu, the File menu.

Open...

Allows you to open .mjw files. When you open a new .mjw file, a new MojoWorld appears in the RTR Window after the pause required to perform a Hyperspace Jump. Sample world files (.mjw) appear on the MojoWorld Generator CD. New MojoWorlds are also available at www.pandromeda.com.



Save
Allows you to save changes you have made to your MojoWorld in the Hyperspace Mixer and Time panel. Save also saves your Render Queue, Log and current movie, but it does not save any rendered images.

Save As...
Same as above, but allows you to change the filename.

Info...
Version information for MojoWorld 1.0 Near Space.

Go To Generator (MojoWorld Generator only)
Quits the Transporter and opens the Generator Interface. You will not be asked to save your file when you change between interfaces. The view in the RTR Window is the same, though the size and shape of the RTR Window changes.

Quit
Quits the program. If you have performed any actions other than to move around the MojoWorld you will be prompted to save your file.

RTR Window (RTR)
The large window in which you view the MojoWorld is called the Real Time Render (RTR) Window. It can display the camera view while you navigate around the MojoWorld, or it can display a still rendering after you have clicked on the Camera button to render the current scene.

ViewPane Control Bar
The ViewPane Control Bar is immediately below the RTR Window. It contains tools for exploration and rendering. When the current scene is being rendered, the ViewPane Control Bar becomes the Rendering Status Bar (see the section on the Rendering Status Bar in this chapter). This is indicated by a change in the color of the toolbar from gray to black.

Items in the ViewPane Control Bar include:

Preview Style



This drop-down list box changes the display in the RTR Window between textured and wireframe. Wireframe is faster and can provide smoother animation.

Walk Mode (Red when selected).



Allows leisurely exploration via controls on the keyboard. For a list of the controls see the Exploration section of this chapter. In Walk Mode, the camera follows the contours of the terrain, maintaining a constant height above the it. Walk Mode is the easiest way to explore a MojoWorld.

Fly Mode (Red when selected).



Allows smooth camera motion that simulates flying. The mouse controls most of the navigation. Unlike Walk Mode, the contours of the terrain do not affect the camera. When you fly level your path follows the curvature of the planet. Fly Mode is there to provide smooth camera paths for animations.

UFO Mode (Red when selected).



Very much like Fly Mode, but your speed depends upon your altitude. The further from the planet you are, the faster you go. UFO Mode is there for making animated zooms in and out from planets.

Crop Window (Red when selected)



The Crop Window is used to render a detail in the RTR Window. Clicking this button opens the Crop Window, which you can position anywhere on the RTR Window using the gray bars. You can resize the Crop Window using the red resizing boxes in the corners. Once the Crop Window is in position, click on the Camera icon to render only the part of the scene contained in the Crop Window.

Camera



The Camera button starts a photo-realistic rendering of the current scene at the render quality selected in the Render Options Menu (the default quality setting is Low). You should select options in the Render Options Menu before beginning a rendering of the current scene. When the Transporter Interface renders a scene, the ViewPane Control Bar turns black and displays a different set of controls. This new control bar is called the Rendering Status Bar, and it is described after the Render Options Menu.

Rendering

In MojoWorld, there are two ways to view the planet: either in the RTR, or using the Photorealistic Renderer. The RTR is designed for interactive exploration. It's always real-time, and it's always drawing the world as fast as it can. Because MojoWorlds are so complex, it can only render an approximation of what the final MojoWorld will look like. However, if you stop exploring and give it more time to work, that approximation will get better and better, and will end up showing a fairly accurate view of the planet. There are some things the RTR can't display though, including atmospheric effects, clouds, and the really fine detail that make MojoWorlds so fascinating. To see these effects, you must use the Photorealistic Renderer. That renderer doesn't work in real time, and is a lot slower than the RTR. However, it can capture the detail of every feature of the MojoWorld, down to the size of a single pixel in the image–or even smaller, if you want. The different render settings for the Photorealistic Renderer tell it how much detail to show. As you increase these settings, the renderer takes longer to create the image, but will examine the planet ever closer, finding every nook and cranny that can be seen and capturing every detail in the textures. For large renderings of complex MojoWorlds this rendering can take quite a long time, but by using the Uplink Queue you can get MojoWorld to do the rendering while you catch up on your sleep.

Render Options Menu

Low, Medium, Normal, High, and Maximum are the render quality settings. Low is the default. Shadows are turned on in the High and Maximum setting, and off in the Low, Medium, and Normal settings. As the quality of the render increases, the images show more detail, and the render time increases.



Add to Log...

This selection creates a new log entry for the current view. See the section on the Log panel later in this chapter for more details.

Process Later...

This selection creates a new Uplink Queue entry for the current view. See the section on the Uplink Queue panel later in this chapter for more details.

Render Status Bar



This toolbar contains the tools to save and close the render display. The render status and progress is displayed beneath the Render Status Bar.

A rendering of a still image or a single frame of a movie goes through specific phases. These phases are reported in the Rendering status area. The phases are:

Starting Render - Unless the world file is very complex, this phase goes by very quickly.

Preprocessing Scene - In this phase, the terrain is being computed and diced up into manageable chunks for the renderer.

Rendering - The main phase of rendering an image. The rendering process creates the image in rows, starting from the lower left corner and proceeding to the upper right. The row of orange dots in the Status Bar fills in as each 10 percent of the image is completed.

Redoing Blocks - As the render progresses, it flags 'problem' blocks that may need to be redone due to missing terrain. Sometimes these missing bits are very small, only a pixel or two. Other times the missing parts can encompass most, or even all of a block. This second pass runs from the upper right to the lower left, although not in as orderly a fashion as in the first render pass. Also, the percentage completed is not a percentage of the whole image but only of those blocks that were flagged as problem blocks. Often there is no visible change to the image during this process, but the renderer still performs this pass just to be sure.

Tidying - This part runs very quickly and does some behind-the-scenes cleanup of memory used during rendering.

Render Completed - This indicates that you can now save the image and carry on exploring.

Save to File

Opens a Save dialog to save the currently displayed rendering. This saves the image as a PNG file by default. Other options include BMP, JPEG, TGA, and TIFF. Saving this file saves only the rendered image not the MojoWorld (.mjw) file.



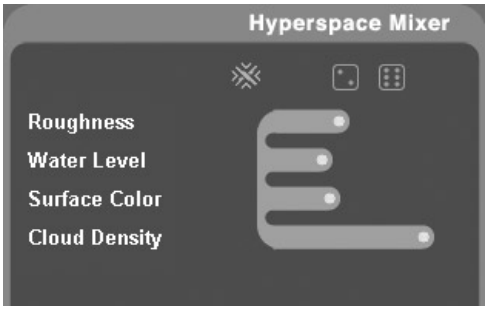
Close Icon

Closes and cancels the currently displayed rendering and returns to the Transporter Interface. You will be prompted to save the rendered image, if the rendering is completed.

IMPORTANT NOTE: No tools outside the Render Status Bar function until the current rendering is closed.

Hyperspace Mixer

The area below the ViewPane Control Bar contains the Hyperspace Mixer. The Hyperspace Mixer contains a set of orange sliders that change the global parameters of the MojoWorld in ways specified by the MojoWorld's author. (There are no sliders there, if the author did not specify any.)



The default world, default.mjw, has four sliders in the Hyperspace Mixer. They affect the default world in the following ways:

Roughness: Controls the height and ruggedness of the terrain
Water Level: Controls sea level
Surface Color: Changes the color of the terrain, but not the snow
Cloud Density: Varies the amount of cloud cover

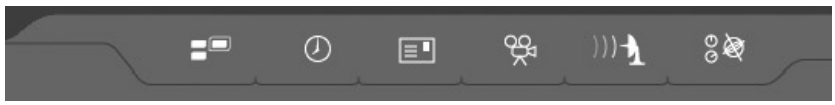
You can move a slider by dragging anywhere on the bar.

Jump

Clicking the Jump button initiates a Hyperspace Jump to the modified MojoWorld. This means that the changes you have made in the Hyperspace Mixer come into effect. The RTR Window displays the MojoWorld specified by the new settings, after the pause required for all Hyperspace Jumps. After you have changed the slider settings you must click on the Jump button to see those changes in the RTR Window.

Randomize

You can randomize the slider settings by clicking on either of the dice. The die showing two pips induces only a small amount of random change on each slider. The die showing six pips can cause very large changes in the positions of each slider. To view the changes, make a Hyperspace Jump by clicking on the Jump button.



Panel Toolbar

Below and to the right of the RTR Window is the Panel Toolbar. When a toolbar icon is selected the corresponding control panel appears in the area directly below the Panel Toolbar.

Settings Panel

Save and manage a list of named Hyperspace Mixer slider combinations.

Time

Change the time of day and the season of the year.

Log

Save and manage a list of named hyperspace coordinates with comments. Coordinates include the location of the camera, time settings and Hyperspace Mixer slider configuration. Log entries may also contain Movies.

Movie

Record and playback a path you walked or flew around a MojoWorld.

Uplink Queue

This queue manages batch rendering jobs. It allows many renders to be queued up for automatic, unattended processing.

Navigation Console

This panel provides tools to assist your in your travels around the planet. There is a compass and displays for pitch, roll, horizon and altitude, useful in Fly Mode. The GPS (Global Positioning System) graphically displays your location on the MojoWorld surface.

EXPLORATION

To explore a MojoWorld, choose one of the locomotion Modes. The locomotion Modes are Walk, Fly and UFO. Select the locomotion mode by clicking on the icon required, or by using the keyboard. Walk Mode is the default.

i	Walk mode	
o	Fly mode	
p	UFO mode	

You may use the keyboard or choose the icon for the locomotion mode you want.

Walk Mode

Walk Mode allows you to move around the surface of a MojoWorld in a leisurely manner. The camera follows the contours of the terrain at a fixed height above it, as if you were walking on stilts. In Walk Mode your speed increases with altitude, so if you really want to get around the MojoWorld quickly, go up high, and if you want fine control, get down low.

m	Up	w	↑	Forward
n	Down	s	↓	Reverse
q	Roll left	a	←	Left
e	Roll right	d	→	Right

The primary controls are on the keyboard.

To look around in Walk Mode either drag the mouse in the RTR Window or open the Navigation Console on the Panel Toolbar and move the compass and artificial horizon with the mouse.

Fly Mode

Fly Mode allows you to move the camera as if it were an airplane. The controls model the behavior of an airplane to enhance this experience. (It's really a little more like a helicopter, as you can hover.) There is some specialized terminology associated with flight; definitions of terms such as "roll, "pitch," "yaw," and "crabbing" appear in the Glossary of this manual.

Using Fly Mode can be quite challenging, at first. After reading about the controls below, you may wish to go to the Flying Tutorial to get some basic instruction.

Keep in mind that the Fly and UFO Modes are there more for laying down smooth camera animation paths than for getting around in MojoWorlds. But flying around for its own sake can be endless fun too!

There are three sensitivity modes for the controls in Fly and UFO Modes:

Gentle
The controls respond gently and your top speed is limited. This is the best Mode for your first flights. If you take your hands off the controls, you automatically return to a straight and level flight path.

Intermediate
The controls are more responsive. There is only moderate auto-leveling if you take your hands off the controls.

Extreme
The controls are very responsive. There is no auto-leveling. This Mode simulates a VSTOL (vertical/short take-off and landing) jet fighter.

UFO Mode



UFO Mode is very similar to Fly Mode, except that the velocity of the camera is dependent on its altitude above the planet. Also, the camera does not track the horizon in straight and level flight, rather, it will fly off into space. This Mode is useful for making smooth animations in which you zoom in to the MojoWorld from space. Without this Mode, you would most likely punch right through the MojoWorld when you zoomed in, because when you got close, you'd be going too fast!

Controls for the Fly and UFO Modes

Important note for Macintosh Users: Since you have only one mouse button, hold the Control key down when you click to simulate the right-click. In the following section read right-click as control-click.

Panic Buttons

The Space Bar
Hitting the space bar during flight causes the camera's motion to stop instantly. The camera remains facing the direction in which it was traveling when you hit the bar. Think of the space bar as your main "panic button."

The L key

Hitting the 'l' key in flight causes the camera to level out instantly. This is a useful key for recovery from over-enthusiastic maneuvering. Remember that if you are in Gentle Mode your flight path levels out smoothly if you release the controls, or "go hands-off."

The B key

Hitting the 'b' key during flight causes the camera to instantly pop to a point 10,000 meters (~30,000 feet) above the planet at your current global position. The camera returns to a level and stationary position.

w	↑	Forward
s	↓	Reverse
a	←	Left
d	→	Right
n		Down
m		Up

These keys control acceleration in the various directions.

Forward/Reverse Velocity and Acceleration

The 'w,' 's,' ↑, and ↓ keys control camera velocity and acceleration. To accelerate forward or backward, simply depress the appropriate direction key. The longer you hold it down the faster you accelerate. Release the key when you want to maintain your current velocity. Holding down the Control ('Ctrl') key when hitting these keys gives you smaller velocity increments; holding down the Shift key gives you larger increments.

Left and Right

The 'a,' 'd,' ←, and → keys control left and right movement. To accelerate left or right, simply depress the appropriate direction key. The longer you hold it down, the faster the camera accelerates. Release the key when you want to maintain the current velocity. Holding down the Control ('Ctrl') key when hitting these keys gives you smaller velocity increments; holding down the Shift key gives you larger increments.

Yaw

The right mouse button controls yaw, or rotation back and forth around the camera's "up" axis. The difference between the Yaw and Left and Right controls is that Yaw rotates the camera, while the Left and Right controls cause a sideways "crabbing" motion, without such rotation.

TIP: Once you learn how to turn using the left mouse button, the Yaw control becomes largely superfluous.

The Left Mouse Button
The left mouse button controls pitch and roll.

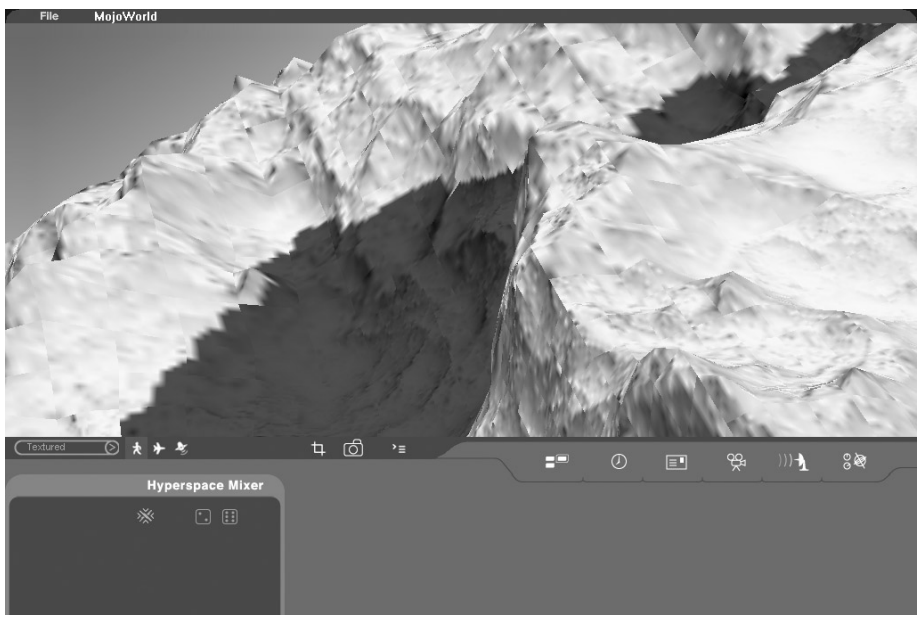
Pitch
Pitch is rotation of the camera around its left/right axis. In the airplane analogy, it is rotating the nose up and down. In terms of a moving camera, pitch points the camera up and down.

Control pitch by dragging up and down with the left mouse button. The further you drag from the mouse-down point, the faster the camera pitches.

IMPORTANT NOTE: Dragging down pitches the camera up, and vice versa. This may seem backwards at first, but that's the way real airplanes work. "Pulling back on the stick" makes you go up, and vice versa.

Roll
Roll is clockwise or counterclockwise rotation around the axis of the direction of view. This corresponds to an airplane tilting its wings right or left, or the camera tilting right or left.

Control roll by dragging right or left with the left mouse button. The further you move the cursor from the mouse-down point, the faster the camera rolls.



Turning

Turning an airplane gracefully is an acquired skill that takes some practice. To turn in Fly Mode, follow these steps:

- First start moving forward (or backward).
- Left mouse down in the RTR Window.
- Roll over a little by dragging gently left or right.
- Now "pull back on the stick" by dragging down GENTLY.
- Now you're turning!
- Move gently back to the mouse down point to terminate your turn.

The hardest thing about learning to fly is LEARNING NOT TO OVER-CONTROL. Use very slow and gentle mouse movements until you really know what you're doing. Stroke the controls as smoothly and gently as you would a sleeping viper, and you'll do just fine.

IMPORTANT NOTE: Most real airplanes are set up so that when you roll, the nose yaws over in the same direction. This causes the airplane to begin to spiral down. You maintain altitude—and turn at the same time—by pulling back on the stick. The less advanced MojoWorld flight modes work the same way.

Putting All the Flying Controls Together: Flying Tutorial

When you combine all the above controls the motion becomes very smooth and natural, just the way you want it when you record a camera path for rendering an animation.

This brief flying tutorial helps you to put the controls together. Practice for a while, and soon you will be flying like an expert without having to think about what you're doing. But remember: it does take practice, so you can expect to be out of control at first, and to take some time before you can maneuver in the way you want.

Remember your Panic Buttons: the space bar, 'l' and 'b' keys.

1. Click on the Fly Mode and select the Gentle sensitivity option.

2. Move the cursor to the middle of the RTR Window and then press and hold down the left mouse button.

   Gently move the mouse left and right. This is rolling. Notice how the further you move from the mouse-down point, the faster the camera rolls.

   Practice this until you can return to level easily.

Return the cursor to the center of the screen (you should be stationary, if not press the 'b' key) and hold the left mouse button down again. This time gently move the mouse up and down. This is how you change the pitch. Again, the further you move from the center the faster the camera moves. It is also important to note that if you move the mouse up you pitch down. The opposite is also true. If you are not familiar with flight simulators or real airplanes, this can be unsettling, but you'll quickly get used to it. Real airplanes have always worked this way.

Press the 'b' key to reset your altitude and orientation.

3. Control velocity with the keyboard controls.

Press the 'w' key to start forward motion. Hit it again to increase your speed. If you hold the 'w' key down the camera will accelerate rapidly—try it. In Gentle Mode, when the camera reaches a certain maximum velocity it will no longer accelerate. In Intermediate and Extreme Mode you can go much faster.

IMPORTANT NOTE: In Fly Mode, you will follow the curvature of the planet when flying level. If you fly straight and level in UFO Mode, you will fly off the MojoWorld and out into space. Try it. Notice that in UFO Mode camera speed is dependent on distance from the planet: the farther away you are, the faster you go.

Press the 'b' key to reset your altitude and orientation.

This time use the 'w' key to accelerate gently, then try to return to a stop using the 's' key.

Press the 'b' key to reset your altitude and orientation.

Now we will put these motions together.

4. From a stationary position, increase the pitch a little so that you do not crash right into the terrain (see step 2).

Gain some initial forward velocity (see step 3).

When you are comfortable with your speed move the cursor to the middle of the RTR Window and hold the left mouse button down. Now try turning slowly to the right (if there are no mountains to crash into there!). Gently roll to the right (slowly move

the mouse right). Notice that your nose will start to drop, so compensate by increasing the pitch (moving the mouse down). To fly smoothly, keep the mouse button depressed.

When things get out of control, hit 'b' and start over.

5. Try a turn to the left. Then try to string some turns together. Watch out for those mountains! With practice you will be skimming over, around and between them.

Keep practicing. Use the space bar and the 'l' and 'b' keys liberally. Attaining mastery of flying generally requires tens of hours of practice. The more practice you get, the better pilot you become. Top Gun pilots have hundreds of hours of training and practice!

Flying Tips

- Start slowly.
- Use slow and gentle mouse movements.
- If the things get out of hand, hit the space bar or the 'b' or 'l' keys.
- If you lose sight of the planet hit the 'b' key.
- If the terrain is upside down and has changed color, you may have punched through the planet's surface—now you're flying inside the planet! Hit the 'b' key to get back above the surface.
- Learn and use the Navigation Panel described in the next section.

Once you are flying comfortably, chances are you will want to record and render out your first MojoWorld animation, which is about the coolest thing you can do with MojoWorld!

TRANSPORTER PANEL TOOLS

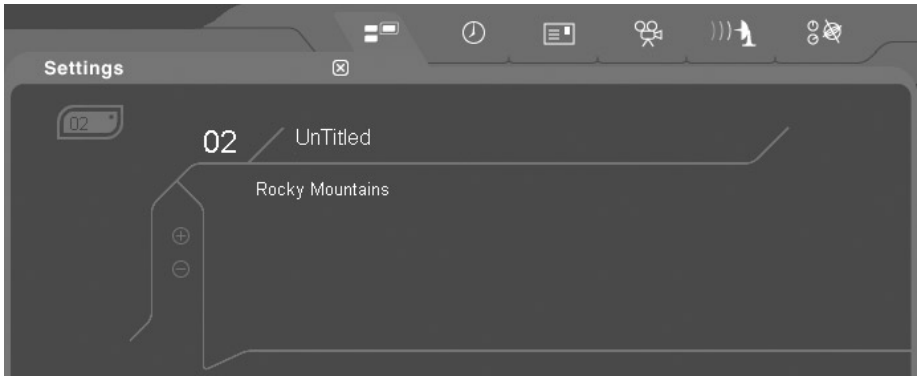
This section deals with the control panels activated in the Panel Tools.

They are explained in the order that they appear on the screen, except that the Movie panel is described before the Log panel. This is because you need to understand the Movie tools before you can make full use of the Log.

The close icon is common to all the Transporter Panels. Use it to close a panel, or simply click on another panel tool to change a panel. 

Settings Panel

The Settings panel is used to save named combinations of Hyperspace Mixer slider settings. When you have settings you would like to save, open the Settings panel and click on the plus sign. A new setting is created using the next available number. Change the default name by highlighting the title with the mouse and typing in your chosen name. Likewise, the default description of 'Enter Description Here...' can be changed by highlighting the area with the mouse and typing in a new description. As each new setting is added, a numbered button appears to the left of the title and description area. If there are more settings than can be shown in the list, the scroll tab on the far left scrolls the list of settings. The button corresponding to the selected setting is outlined.



To select a new setting, click the numbered button. This displays the new slider settings in the Hyperspace Mixer area. The RTR will not display the new MojoWorld settings until you make a Hyperspace Jump with the Jump button in the Hyperspace Mixer area.

If the Hyperspace Mixer sliders are moved after selecting or adding a setting, the Settings panel reverts back to its default state.

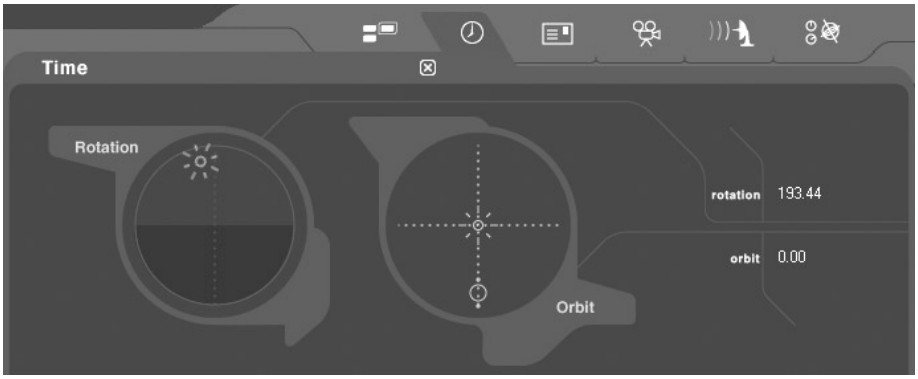
To delete a selected setting click the minus sign.

Time Panel

You can use the Time panel to change the time of the day and the season of the year on a MojoWorld.

Use the Rotation Indicator to rotate the planet on its axis. From the position of the RTR Window on the MojoWorld's surface it appears as if the sun and moon(s) revolve around the planet. As you move the sun icon around the Rotation Indicator the sun and moon(s) rises and sets in the RTR Window.

Use the Orbit Indicator to simulate how the seasons on the MojoWorld surface at the location of the camera change as the planet orbits the sun.



Movie Panel

The Movie panel allows you to create movies and animations. You can record the path of the camera in Walk, Fly or UFO Mode and then render out to a sequence of still frames or a QuickTime movie. Walk is the least desirable Mode for a movie because the camera follows the terrain thereby producing a "bumpy" animation that's hard to watch. For nice, smooth animations, use the Fly or UFO Mode.

When you enter the Movie panel for the first time, only the record button is active. When you click the Record button, it turns red and the Stop button becomes active. Recording stops when either the Stop or Record buttons are clicked.

You can also use the 'r' and 't' keys to start and stop recording.



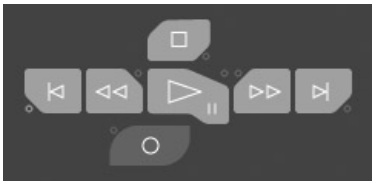
The Timeline in the Movie panel represents the entire duration of recording time. The ends of the Timeline can be dragged with the mouse to clip off the beginning and end of the recording. You may wish to do this to avoid rendering the initial few seconds when you're getting your animation going, or the last few seconds when the best part is over.

When you have recorded a movie, the Movie Camera tool activates. It enables you to access a menu with the options 'Add to Log...' and 'Process Later...' these options are explained in the Log panel and Uplink panel sections.

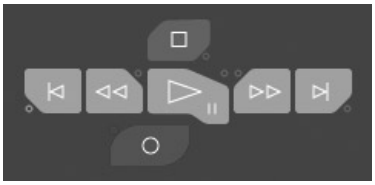
The Reset button deletes the current movie and resets the panel to its original state where only the Record button is active and the Timeline is empty.

Movie Tutorial

1. Open the Movie panel by clicking the Movie panel icon on the Panel bar.



2. Click the Record button.



3. The Record button turns red. The Stop button becomes active.

4. Explore in any desired motion Mode. When recording in Fly Mode you may prefer to start the Mode and get some forward speed before recording.

5. Click the Stop button to stop recording. All the other Movie controller buttons become active.



6. Review the movie. Use the fast rewind button to return the slider to the beginning. Click on the play button to play back the movie. Use the forward and reverse buttons to skip over or replay parts as you wish.

7. If you want to cut off portions of the beginning and end of the movie that you don't like, drag the endpoints of the Timeline to shorten the range of the slider.



8. Once a timeline has been recorded, the Movie Camera icon inside the Panel activates. It enables you to access a menu with the options 'Add to Log...' and 'Process Later...' These options are explained in the following two sections.

Log Panel

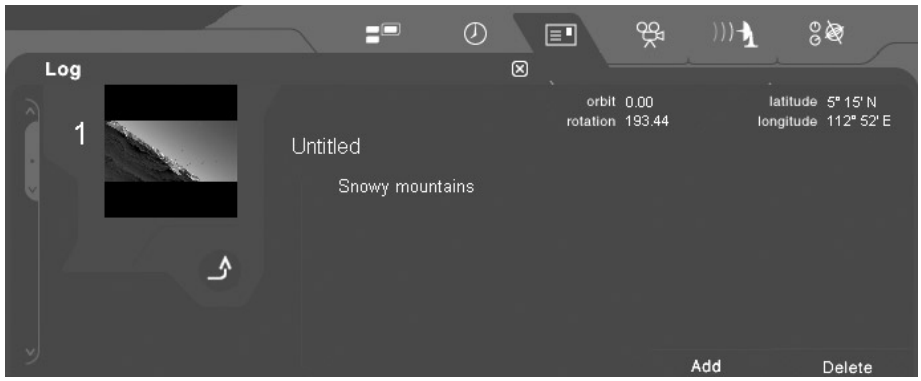
The Log panel is where you can build your own MojoWorld travelogues to share with your friends in the MojoWorld Online Community. These travelogues can include still images, movies and text. When you save a Log entry the camera position, time, and Hyperspace Mixer settings are also saved.

Use the Add button in the Log panel to add a still image. Still images can also be saved in the log through the 'Add to Log...' menu item in the Render Options Menu on the ViewPane Toolbar (ViewPane Toolbar>Render Options Menu>Add to Log...). Movies can be added to the Log from the Movie panel (Movie Panel>Movie Camera Icon>Add to Log...).

Each log entry stores the date, time, location and the complete state of the MojoWorld. This allows the log in a single .mjw file to contain entries from completely different worlds.

Log entries can be given names and descriptions. These are the notes you take on your travels in Parametric Hyperspace. Think of it as the National Geographic article you're writing. A small thumbnail is saved along with each log entry. The icon that appears in the lower left corner of the thumbnail area is different depending on whether the log entry is a still image or a movie. If it is a still image, the icon is a Jump logo. Clicking this icon sets the RTR scene to match the log entry. If the log entry is a movie, the icon is a Play button icon. When clicked, the movie plays back in the RTR Window. Additional movie controls

are available in the log thumbnail to jump to the beginning or end of the movie as well as a red timeline controller to move forward or backward along the timeline.

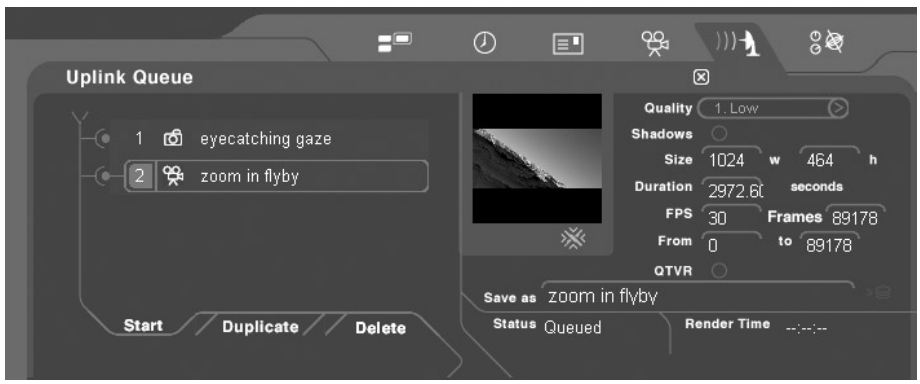


Uplink Panel

The Uplink Queue manages batch render jobs. It allows many renders to be queued up so that they can be processed unattended. We call it the Uplink Queue as a spacecraft metaphor: It always takes time to uplink to a space probe to transmit back to Earth the images it has recorded. Think of the time it takes MojoWorld to render movies and high-quality stills as the time it takes a space probe to transmit such data across deep space to Earth. You can start the Uplink Queue rendering, go to sleep, and see what it's done in the morning.

Still images are added to the Uplink Queue from the ViewPane Toolbar (ViewPane Toolbar>Render Options Menu>Process Later...).

Movies are added to the Uplink Queue from the Movie panel (Movie Panel>Movie Camera Icon>Process Later...).



The left half of the Uplink panel shows the batch list. Each list item is made up of four items: the status icon, the batch ID, the camera type and a file name.

The status icons are as follows:

Queued: will be processed when the batch is run.

Unqueued: will not be processed when the batch is run.

Completed: already processed, will not be processed again.

The status of a queue item can be toggled between queued and unqueued by clicking on the status icon. Once a queue item has been completed, the status icon is no longer active.

The batch ID is a sequential number. It is assigned when the Uplink Queue item is created and it cannot be changed. The batch ID is red when the list item is selected.

The camera type icon appears as either a still camera or a movie camera depending on whether the queued item is a still image or a movie. This cannot be changed.

The right half of the Uplink panel displays information for the selected batch item.

Quality Setting List Box

Choose from the five render qualities that match those found in the Render Options Menu. Shadows are turned on in the High and Maximum setting, and off in the Low, Medium, and Normal settings. As the quality of the render increases the images show more detail and the render time increases.



Shadows Checkbox

Turns shadows on or off. This overrides the shadow setting defined by the quality setting defined by the selection in the Quality Settings List Box. Shadows take time to compute, so you can speed up higher quality renderings by turning shadows off.

Size

You can specify the resolution, in pixels, of the rendered image or movie here. QuickTime VR panoramas use the larger of the two numbers to determine resolution.

NOTE: The resolution is limited for the various rendering modes—still, animation and QTVR—in the free Transporter.

Duration
Displays the length, in seconds, of a movie previously recorded in the Movie panel. You can speed up or slow down your animation by changing this number.

Frames Per Second
You can modify the number of frames per second in a movie that will be rendered and saved to disk. This will change the number of image files if you save a movie in image files format. It will also affect the rendering time for the movie. The default is 30. Try using a smaller number for rendering quick previews of movies.

Total Frames
This specifies the total number of frames for the entire movie clip. This number is simply the frames per second multiplied by the duration. MojoWorld computes this number, and it cannot be modified directly.

From
This specifies a range of frames to render. This can be useful if you want to break up a render job, or render only part of a movie.

QTVR
Instead of rendering a still image of the view in the RTR Window, the QTVR button allows you to create a Cubic QuickTime Virtual Reality panorama centered on the camera's location. The QTVR button renders six still images and merges them on the faces of a cube centered at the camera's location. This panorama, once rendered, can be viewed in three dimensions as an immersive environment using the QuickTime 5 player included on the MojoWorld Generator CD and as a free download from www.apple.com/quicktime. You can rotate the camera around 360 degrees, and zoom in on the image.

The Pandromeda web site, www.pandromeda.com, has such QTVR panoramas for you to explore. They really give you a sense of "being there" in a MojoWorld, without running the MojoWorld program.

Where you see a Jump button by an image in the Pandromeda galleries, clicking it will initiate downloading of the Transporter Coordinates file that will take you to that place in MojoWorld Transporter or Generator.



Save as
Opens a save file dialog to choose a location for the rendered file.

The filename before the Save icon can be modified. This filename can affect the output of the rendering. If the filename has the extension .mov then it saves the file as a QuickTime movie. If the filename has no extension then the output of the rendering is saved as a series of still images in the PNG format, with numerical names. To modify the format, simply change or append the extension.

The Uplink Queue can save to the following file types for still images: PNG, JPEG, BMP, TGA, and TIFF. Movies can only be saved in the QuickTime .mov format. QTVR panoramas can be saved either as completed QTVR panoramas, by specifying .mov, or as six separate still image files, by specifying PNG, JPEG, BMP, TGA, or TIFF.

Status
The Status field shows the status of the Queued item. The status can be toggled between queued and unqueued by clicking on the status icon portion of the Queue list item in the left portion of the Uplink panel.



Start
To start a batch render, click the Start button. Click the Skip button to cancel the current image and continue with the rest of the queue. Click the Stop button to stop the queue completely.

Duplicate
To duplicate a queued item, select it then click the Duplicate button. When duplicating a Queue item that has already been processed, the duplicate item receives Queued status.

Delete
To delete a Queue item, select a Queue item to delete then click the Delete button.

A final note about the time of day and adding movies to the Uplink Queue: The time of day used for the movie is the time of day that is set when the Process Later menu item is used to add the movie to the Uplink Queue. This may produce some surprising results if the movie is not added to the queue immediately after recording. It can also be used to

create two nearly identical movies, one where the flight goes through the scene at high noon, and a second where the exact same flight path goes through the same scene with the sun low to the horizon.

Navigation Panel

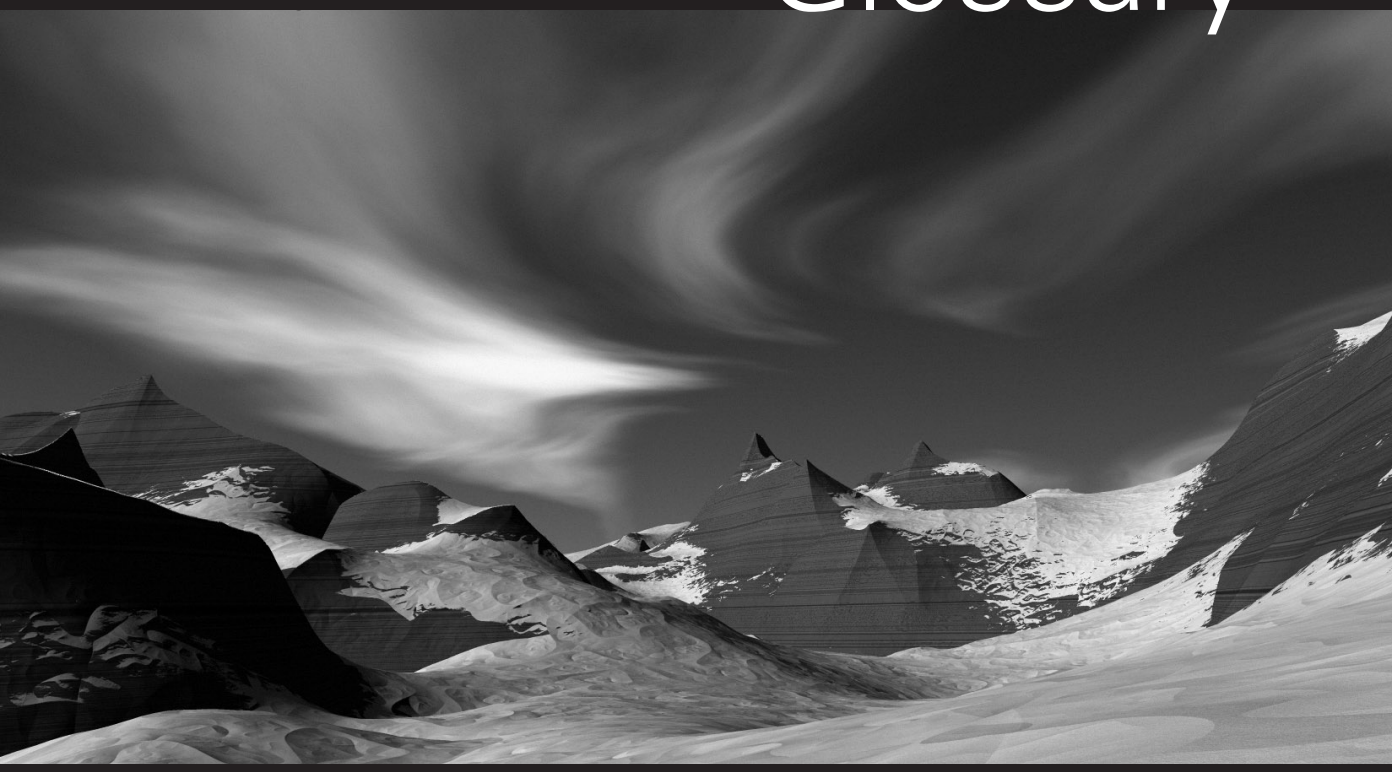
The tools in this panel are a compass dial, a pitch and roll artificial horizon indicator, an altimeter and the GPS. Any movement in the RTR Window changes the readings on these instruments. Likewise, you can change the settings on the instruments in the panel and the RTR Window will change accordingly.



The small circle on the GPS graphically represents your location on the planet surface. This circle can be moved if you wish the RTR Window to jump to another place on the planet.



Glossary



AGL

Altitude above ground level. Ground level is the terrain surface directly below the point in question. This can be above or below the planet's radius.

Aliasing

Aliasing is a term for certain artifacts in digital renderings that occur along sharp edges and where the detail in the model or texture being rendered is too fine. Aliasing appears as jagged edges in the first case and noise in the image in the second. That noise is particularly annoying in animations, where it appears as "sizzling," particularly in the background. MojoWorld goes to great lengths to avoid aliasing. If you have a problem with "sizzling" in MojoWorld animations, try using fractals with the Detail parameter set to a negative number such as –2.0 or –3.0. For more details see Antialiasing.

Ambient Light

Ambient Light has no direction or source, but is distributed evenly throughout space. Ambient Light reflected from an object has equal intensity regardless of surface orientation.

Animation
In MojoWorld a fully rendered QTVR or flight path is referred to as an animation. Compare with Movie.

Antialiasing
Antialiasing refers to the processes used to reducing aliasing and the result of their application. Effective antialiasing may be achieved by reducing the high frequencies prior to rendering, and increasing the number of samples taken during rendering. See Aliasing.

ASL
Altitude above Sea Level. The height of a point above the surface of a MojoWorld Ocean. See Sea Level.

Basis Function
A Basis Function provides the shape from which a fractal is built. This shape is usually very simple, compared to a fractal. (If not, it will most likely alias badly.) The shape of the basis function is very important to the qualitative "look and feel" of a fractal built from it.

Blending
The process of combining two effects to produce a third. In MojoWorld this is most commonly used to describe the way in which Leaves on Texture and Material Trees are combined.

BMP
An image file format. Commonly used by the Windows Operating System.

Color Dot
A specialized MojoWorld Editor used to select colors. See the Editors section in the Generator Interface chapter for specific details.

Control Stack
A graphical representation of the parameters of an object being edited. Each parameter in the Control Stack has a controller widget specific to the type of information that parameter represents. If the parameter is driven by a texture or function graph, the controller will invoke the Texture Editor or Function Graph Editor.

Crabbing
Side to side movement without facing in the direction of the movement—the way a crab walks.

Crossover Scale
A characteristic scale, or size, at which some character of a fractal changes. In MojoWorld the change may involve the cessation of fractal detail, a change in basis function, or a change in domain distortion.

Curve
A filter applied to a value to change its range or magnitude. It is commonly applied to a fractal before final output. Curve filters are created in the Curve Editor, using methods similar to the Bezier curves that you may be familiar with in other graphics programs. All values along the horizontal axis correspond to a single output value.

Degrees
A unit of measurement for angles. There are 360 degrees in a circle. See also Radians.

DEM
Digital Elevation Model. A terrain file format devised by the US Geological Survey (USGS). DEMs have higher resolution in height values than do 8 bit grayscale images. DEMs invariably contain measured elevation data from real planets, usually Earth.

Diffuse
Diffuse reflection, or reflection from a diffuse material, scatters light equally in all directions without regard to the angle of illumination. The intensity of diffuse reflection varies with the angle of illumination.

Distorted Fractal
An elaborate fractal function featuring domain distortion with viscous damping and one to three basis functions at different scales. Designed to be useful in zooms into MojoWorlds, where you might want the character of the planet to change at different scales. Generally very expensive, in terms of computation time.

Domain Distortion
Altering the character of a function by adding the output of another function to the input of the first, before processing that input. Has the result of "pinching" and "stretching" the output of the distorted function. Generally very expensive, in terms of computation time.

DXF
A common object file format supported by MojoWorld 1.0.

Field of View (FOV)
In MojoWorld this refers to the horizontal angular range visible in a camera's frame. Different MojoWorld cameras may have different fields of view.

Filter
A function that remaps the output of another function in order to change its shape or visual character. Typically specified with a modifiable curve in the Curve Editor.

FOV
See Field of View

Fractal
A visually complex function constructed by repetition of a given basis function over a range of scales.

Fractal Dimension
A numerical value specifying the "roughness" of a fractal.

Function
A logical/mathematical device that maps input numbers and strings to arbitrary output values. This usually has a visual interpretation such as a fractal, a curve, a terrain or a texture.

Function Fractal
A fractal function that builds a fractal using a function graph to specify the basis function. It is generally slow and prone to aliasing.

Function Graph
A graphical representation of a tree of function nodes, the combination of which determines the character of some feature, e.g., the terrain or clouds of a MojoWorld.

Function Graph Editor
MojoWorld's Pro UI that allows you to build more or less arbitrary functions out of combinations of simpler functions or "Nodes." The Function Graph Editor is very powerful, but can be confusing without a good understanding of the mathematics behind the function nodes. Check the Pandromeda Web site for tutorials on using the Function Graph Editor.

Function Node
See Node.

Gain (multifractal functions)
Scales the magnitude of the basis function in a multifractal construction. Smaller values of gain lead to smoother results, larger values to rougher results.

Generator
Term used in MojoWorld to refer to either the commercial MojoWorld 1.0 Near Space product or the most commonly used user interface within that program, the Generator Interface.

Generator Interface
The User Interface in MojoWorld 1.0 that provides a wide range of editors for navigating the many dimensions of Parametric Hyperspace to create and discover synthetic worlds. It is much more versatile than the Transporter Interface and less abstract than the Pro UI.

Global Parameters
The set of parameters controlling all aspects of the MojoWorld planet. Accessed via the hot buttons in the Generator Interface.

Gradient
A color control consisting of a range of colors. Used by the Material and Texture Editors to produce different colors at different texture values.

Gradient Perlin
A basis function that smoothly interpolates random slopes defined on regularly spaced points in a grid. It can suffer significant artifacts from the underlying regular grid.

Height Field
A height field is a terrain model that has no overhangs. It usually consists of a set of height values defined at points on a regular grid, like graph paper. Rather than using such fixed-resolution height fields, MojoWorld features continuous height fields with unlimited detail.

Heterofractal
A fractal function the roughness of which varies with altitude above or below a given value of "sea level." Mathematically speaking, it is a primitive multifractal.

Hot Buttons
A set of red buttons that appear in the hot button area when objects are selected. Each type of object has its own set of hot buttons.

HSL
Acronym for the hue, saturation and luminosity color space. HSL colors are specified with three numbers between 0.0 and 1.0. A Color Picker palette does the work of converting the values. The Hue parameter represents a hue angle on a color wheel where 0.0 is red, 0.333 is green and 0.666 is blue. The Saturation parameter represents how rich the color is, where 0.0 is no color at all and 1.0 is fully saturated color. The Light parameter represents how close to black (0.0) or white (1.0) the color is. Compare with RGB.

Hyperspace
See Parametric Hyperspace.

Hyperspace Slider
One of the sliders in the Transporter UI that lets you alter the features of a MojoWorld.

Hyperspace Mixer
The set of Hyperspace Axis sliders created in the Generator Interface to be used in the Transporter UI. These sliders give Transporter users access to a relatively small part of the staggeringly huge Parametric Hyperspace in which all MojoWorlds reside.

Hyperspace Jump
The result of changing any parameter values other than camera settings, requiring recomputation of an entire MojoWorld. It literally refers to travelling to another destination in Parametric Hyperspace.

Icon
An icon is a small picture that indicates that another window is available but is not currently open, or visible on the screen.

Internet Relay Chat (IRC)
Internet Relay Chat provides a way of communicating in real time with people from all over the world. It consists of various separate networks of IRC servers that allow users to connect to IRC. A user runs a "client" program to connect to a server on one of the IRC networks. Once connected to an IRC server on an IRC network, you will usually join one or more "channels" and converse with others there. MojoVox is based on IRC.

IRC
See Internet Relay Chat

Jump
The name of an icon in MojoWorld and the action that occurs when a Jump button is clicked. A Jump button initiates moving to another point in Parametric Hyperspace. See Parametric Hyperspace.

Kickstand
A UI feature on a Texture Tree that appears underneath a texture Leaf. It contains three dropdown list boxes and a button to access output curves.

Kernel
The shape or bitmap "rubber stamped" at random points by the sparse convolution basis function.

Lacunarity
The gap in spatial frequency between successive instances of the basis function in a fractal construction.

Leaf
A functional unit of a Texture or Material Tree. Leaves are combined in various ways to create new textures and materials. See Tree and Blending.

LWO
LightWave Object File. An object file format created by NewTek and supported by MojoWorld.

Marker Flag
A non-rendering object that can be placed on MojoWorld planets to mark locations of interest.

Material
Surface properties in MojoWorld relating to color and response to illumination.

Material Leaf
A leaf on the Material Tree. See Tree and Leaf.

Material Tree
A structure in the Material Editor consisting of leaves and combination nodes connecting those leaves to create a wide variety of materials. See Material, Tree and Leaf.

.mjw
The file extension used to identify MojoWorld World Files. See World File.

Monofractal
A fractal function with uniform behavior through space and time. Mathematically speaking, a monofractal is a fractal function with stationary statistics.

MojoVox
The MojoWorld IRC client that allows users chat in real-time on the Internet. See IRC and MojoWorld Online Community.

MojoWorld
A planet specified by a given set of parameter values (not including the camera settings); also, shorthand for the various MojoWorld products.

MojoWorld File
See mjw.

MojoWorld 1.0 Near Space
The full name of the MojoWorld 1.0 products MojoWorld Generator and MojoWorld Transporter. We call it "Near Space" because MojoWorld 1.0 models a single planet. Later releases will model solar systems, galaxies and entire universes.

MojoWorld Generator
The full MojoWorld authoring tool featuring a 3-level user interface. See Generator.

MojoWorld Online Community
The collective term for all MojoWorld users on the Internet and the communication and support structures available to them. The MojoWorld Online Community includes MojoVox, the Pandromeda Web site (www.pandromeda.com), all independent web sites, chat rooms, mailing lists and bulletin boards, and Pandromeda online technical support. See MojoVox.

MojoWorld Transporter
The free MojoWorld "browser" that allows you to explore MojoWorlds and the subspace spanned by the Hyperspace Axes in the Transporter UI, and to image, animate and document your travels and discoveries.

.mov
A file extension used to identify QuickTime file formats. See QuickTime.

Movie
The recording of a camera path through a MojoWorld. Compare with Animation.

Multifractal
A fractal function the character of which varies in complex ways through space and time.

Node
Refers to Function nodes, the building blocks of Function Graphs in the MojoWorld Function Graph Editor.

Noise
A basis function used alone, without iterating it to create a fractal.

OBJ
A common object file format supported by MojoWorld 1.0.

Octave
One iteration of a fractal; a single instance, at a given scale, of the basis function used to create a fractal.

Onset
The scale at which domain distortion begins to diminish in the distortion fractals.

Panorama
A three dimensional interactive scene as rendered in QTVR format. See QTVR.

Parameter
Any of the numbers or strings used to control what a function does.

Parameter Area
The large work area of a MojoWorld Editor. This is where the Trees and Control stacks appear, or anything that allows you to directly manipulate parameters.

Parameter Bomb
A way of altering or replacing the parameters for a local area of a MojoWorld planet, ocean or atmosphere. Parameter Bombs provide local control in MojoWorlds.

Parametric Hyperspace
The high-dimensional space of possible parameter values that can specify a MojoWorld. There are as many dimensions as there are possible parameters and function combinations, i.e., on the order of millions to infinite.

Parametric Subspace
The part of Parametric Hyperspace spanned by a given set of Hyperspace Axes in the Transporter UI.

Perlin
A very fast basis function. Often called "Perlin noise;" in MojoWorld referred to as a "Perlin Basis" for reasons of mathematical clarity. Named after Ken Perlin, one of the key inventors of the methodology MojoWorld is based on.

Pitch
Rotation around the left/right axis. Pitch can be thought of as the tilting of the nose of an airplane up or down. See the Fly controls in the Transporter Chapter for the specific use of "pitch" in MojoWorld.

Pixel
A picture element comprising of a single color value in an image.

Plug-in
A file containing program code that extends MojoWorld functionality. MojoWorld features an open architecture that allows third parties to write plug-ins to help extend MojoWorld to do whatever the MojoWorld community desires, freeing MojoWorld development from the intrinsic limitations of the Pandromeda engineers.

PNG
The default MojoWorld image file format.

Point of View
The "eye point" or location of the camera.

Primitive
The collective name for anything you can add to the RTR scene that will appear in the final rendering. This includes imported objects.

Procedural
A model, texture or other effect that is not stored explicitly but rather computed on the fly by evaluating a procedure, or piece of computer code, that evokes the desired behavior. Procedures are controlled by parameter values. Proceduralism trades memory efficiency for increased computation time, gaining some flexibility in the results as they can be sensitive to the context, such as camera field of view and resolution. MojoWorld is highly procedural in nature. It thereby gains unprecedented camera mobility and rendering detail and quality, at the cost of rather long rendering times.

Pro UI
The MojoWorld Professional User Interface or Function Graph Editor.

QuickTime
Apple Computer's QuickTime product. QuickTime 5 is included on the MojoWorld 1.0 CD. Use QuickTime to view movies and QTVR panoramas rendered in MojoWorld. See QTVR.

QTVR
QuickTime Virtual Reality is Apple Computer's format for interactive panorama "movies." MojoWorld can export in the Cubic QTVR format, which requires QuickTime 5.

Radial Fog
A planetary atmosphere the density of which varies with radius.

Real Time Renderer (RTR)
The large window in both the Transporter and Generator Interfaces that renders scenes in real-time. When the camera remains stationary the quality of the image increases with time.

Render
To create a two-dimensional image of a three-dimensional scene.

Rendering
The resulting image.

RGB
Acronym for the red, green and blue color space in which the human visual system operates. RGB color values are specified in MojoWorld with three numeric values between 0.0 and 1.0. Setting the Red and Green parameters both to 1.0 and the Blue parameter to 0.0 mixes red and green light to produce yellow light. (If you're not familiar with mixing colors in RGB space, it can take some getting used to.) Usually a Color Picker palette assists you in setting these values interactively. There are a few places in the Pro UI where colors may need to be entered numerically. Compare with HSL.

Ridged Multifractal
A special-case multifractal built from a basis function with ridges. Yields an interesting terrain with ridges and extremely spiky peaks.

Roll
Rotation clockwise or counterclockwise around the view direction.

RTR
See Real Time Renderer.

Sea Level
Sea level corresponds to the surface of the ocean on a MojoWorld planet. ASL is zero at sea level. If a MojoWorld has no ocean, sea level is the base planet radius. See ASL.

Shininess
Determines the size of the specular highlights on a material.

Sparse Convolution
A basis function that places overlapping copies of a specified shape, or kernel, at random points in space. The most computationally expensive of the MojoWorld basis functions.

Specular
Specular color takes into account surface orientation and the positions of the light source and camera in determining material highlights.

Spotlight
A light source that has a position and direction. Spotlights generally have a central cone of full-intensity illumination and a region of continuous falloff of illumination between that cone and another specifying the complete extinction of the spotlight or darkness.

String
A sequence of alphanumeric characters such as a file name.

Stow
An area in the main Generator Interface for temporary storage of minimized Editors. All Generator editors have a Stow button that minimizes the editor into the Editor Stow area, where it is identified by an icon representing its editor type.

Subspace
See Parametric Subspace.

Terrain
The synthetic landscape comprising the "land" surface of MojoWorld planets. Used specifically to refer to the "solid" surface of the planet, as opposed to ocean or sea surface.

Texture
Usually refers to something that modulates the color of a surface. "Texture" is a very general term in MojoWorld, as the functions that specify and control almost every aspect of MojoWorld planets can all be referred to as "procedural textures." Textures are often combined in complex ways in MojoWorld, as by driving an input parameter of one function or texture with the output of another. Called "functional composition," this technique can create an endless variety of complex and subtle effects.

Texture Leaf
A leaf of a Material Tree. See Leaf and Tree.

Texture Tree
A structure in the Texture Editor that specifies single or multiple textures in leaves that are combined in various ways to create a final, composite texture. This tree structure is designed to combine ease of use with flexibility in the result. See Leaf, Texture and Tree.

TIFF
A common image format supported by MojoWorld 1.0.

Translation
Moving an object without rotation or scaling.

Transporter Interface
The simple user interface in MojoWorld 1.0 Near Space. The Transporter Interface is designed to facilitate exploration of MojoWorlds, with easy imaging, animation and documentation of your travels. While it may seem overly simplified to seasoned Generator users, keep in mind that this is the interface of the free Transporter that gives everyone in the world access to your Generator creations. When you design great MojoWorlds with wonderful Hyperspace Axes, the world is your audience–and you never know what someone else might find for you on your own worlds! They and the subspace spanned by your Hyperspace Axes are far too big for you alone to explore thoroughly, so you might as well get help from the MojoWorld community. See also Generator Interface and Pro UI.

Transporter
See MojoWorld Transporter and Transporter Interface.

Tree
A hierarchical structure that starts at a root node and branches out through other nodes. The final nodes are called leaves. "Tree" is used in MojoWorld to refer to the structures in the Material and Texture Editors. See also: Material Editor, Texture Editor and Leaf.

Uplink
A spacecraft metaphor for MojoWorld's PhotoRealistic, non-real time renderer. Just as real space probes take time to transmit detailed imagery back to Earth, MojoWorld takes time to "recover" detailed imagery from its worlds. "Uplink" is synonymous with "render" using the Photorealistic Renderer.

Value Perlin
A basis function that smoothly interpolates random offsets from regularly spaced points in a grid. It is the fastest Perlin basis, but it suffers significant artifacts from the underlying regular grid.

Value/Gradient Perlin
A basis function that smoothly interpolates both random slopes and random offsets from regularly spaced points in a grid. The highest-quality of the Perlin basis functions.

Variable Value/Gradient Perlin
A basis function consisting of Perlin noise built from user-specified relative amounts of value and gradient Perlin noises. Useful for very subtle effects, particularly in multifractals.

Viscosity
In the distortion fractals, the scale at which domain distortion disappears completely.

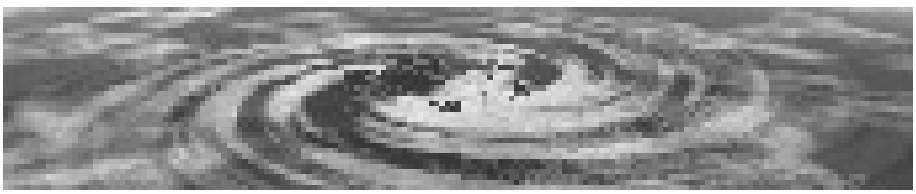
Viscous Damping
A concept borrowed from turbulent flow, whereby domain distortion diminishes and eventually disappears at successively smaller scales.

Voronoi
A basis function that divides space into a set of cells and returns some function of the distance from the center of the cell to the nearest cell edge. The cell centers are a set of random points in space. Edges are defined by the perpendicular bisector of the line connecting the cell center point and a neighboring cell center point. That neighboring point can be specified to be the first, second, third, or fourth closest neighboring cell center point.

Wireframe
A representation of the MojoWorld objects as line segments. The lines delineate polygon boundaries. Useful to speed up real-time rendering of very complex MojoWorlds, among other things.

World File
MojoWorld (.mjw) files sometimes referred to as World Files. See mjw.

Yaw
Rotation about a camera's "up" axis.



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