



# Rendering

Version 6



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While every attempt was made to clarify in the documentation the differences between how Maya operates on the IRIX and Linux platforms, you may encounter subtle differences.



# Table of Contents

<b>1</b>	<b>About rendering and renderers</b>	<b>13</b>
About	Rendering	13
	Hardware, software, and vector rendering	14
	<b>Renderers</b>	<b>15</b>
	Maya Software renderer	15
	Maya Hardware renderer	16
	mental ray for Maya renderer	17
	Maya Vector renderer	22
How do I?	<b>Select a renderer</b>	<b>25</b>
	Select a renderer	25
	mental ray Output window messages	26
<b>2</b>	<b>Camera set up</b>	<b>27</b>
About	<b>Cameras</b>	<b>27</b>
	Viewing cameras vs. rendering cameras	27
	Maya camera types	27
	<b>Motion blur and depth of field</b>	<b>28</b>
	Focus and blur	28
	fStop (aperture) and shutter speed/angle	28
	mental ray for Maya motion blur	29
	Motion blur	30
	<b>Framing objects with a camera</b>	<b>30</b>
	Camera aim	30
	Angle of view (focal length)	32
	Safe display regions for TV production	33
	Clipping planes	34
How do I?	<b>Create and use a camera</b>	<b>35</b>
	Create a camera	35
	Adjust a camera's attributes	35
	Make a camera renderable	36
	Turn scene view guidelines on or off	36
	Adjust depth of field	37

## Table of Contents

	<b>Look through (select) a camera</b> . . . . .	<b>38</b>
	Select the current scene view's camera . . . . .	38
	Look through another camera . . . . .	38
	<b>Frame your scene</b> . . . . .	<b>39</b>
	Move a camera to another location . . . . .	39
	Aim a camera . . . . .	39
	Look at selected objects . . . . .	40
	Frame selected objects . . . . .	40
	Frame all objects . . . . .	40
	Frame part of a scene . . . . .	40
	Save sequential camera movements . . . . .	41
<b>3</b>	<b>Tessellation and Approximation</b> . . . . .	<b>43</b>
About	Tessellation and approximation . . . . .	43
	<b>Maya tessellation</b> . . . . .	<b>44</b>
	Primary vs. secondary tessellation passes . . . . .	44
	NURBS surface, poly, and subD tessellation . . . . .	44
	<b>Approximation in mental ray for Maya</b> . . . . .	<b>45</b>
	Approximation . . . . .	45
	Approximation nodes . . . . .	45
	Approximation styles . . . . .	47
	mental ray for Maya geometry types . . . . .	48
How do I?	<b>Tessellate objects</b> . . . . .	<b>49</b>
	<b>Tessellate NURBS surfaces</b> . . . . .	<b>49</b>
	View Maya tessellation settings for an object . . . . .	49
	Adjust NURBS tessellation settings . . . . .	50
	Determine which objects to tessellate . . . . .	51
	Display NURBS tessellation triangles . . . . .	51
	Use span-based tessellation . . . . .	51
	<b>Tessellate polygonal surfaces</b> . . . . .	<b>52</b>
	Adjust polygonal tessellation . . . . .	52

## Table of Contents

	<b>Tessellate subdivision surfaces</b> . . . . .	<b>52</b>
	Display subdivision surface tessellation triangles . . . . .	52
	Adjust subdivision surface tessellation . . . . .	52
	<b>Work with mental ray for Maya approximation</b> . . . . .	<b>52</b>
	Create an approximation node . . . . .	52
	Assign an approximation node . . . . .	53
	Edit an approximation node . . . . .	54
	Override approximation settings . . . . .	54
	<b>Control Fine approximation triangles</b> . . . . .	<b>55</b>
	Setting Fine approximation cache limit . . . . .	55
	Control Fine approximation triangles . . . . .	55
	Tweak Approximation node settings . . . . .	56
	<b>Create approximation nodes</b> . . . . .	<b>61</b>
	Create, edit, assign approximation nodes . . . . .	61
	Obtain quads for subdivision surfaces . . . . .	61
Reference	<b>Windows and Editors</b> . . . . .	<b>62</b>
	Approximation Editor . . . . .	62
	Surface Approximation settings (Attribute Editor) . . . . .	62
<b>4</b>	<b>Visualize and render images</b> . . . . .	<b>67</b>
About	<b>Rendering methods</b> . . . . .	<b>67</b>
	Interactive Photorealistic Rendering (IPR) . . . . .	67
	Render View rendering . . . . .	71
	Batch renders from within Maya (UI) . . . . .	72
	Command line renders . . . . .	72
	Exporting .mi files . . . . .	72
	<b>Render output</b> . . . . .	<b>73</b>
	File formats . . . . .	73
	File name syntax . . . . .	78
	File output location . . . . .	79
	Pixel aspect ratio . . . . .	80
	Resolution . . . . .	80
	Frames vs. Fields . . . . .	80

## Table of Contents

	Color, Depth, and Mask (alpha) channels . . . . .	82
	Pre Render MEL and Post Render MEL scripts . . . . .	82
	<b>Layers and passes . . . . .</b>	<b>83</b>
	Advantages and tips . . . . .	83
	Mask and depth channels . . . . .	84
	Render layers . . . . .	85
	Render passes . . . . .	87
How do I?	<b>Visualize scenes and render images . . . . .</b>	<b>89</b>
	A typical rendering workflow . . . . .	89
	Choose a rendering method . . . . .	90
	<b>Set scene options . . . . .</b>	<b>92</b>
	Open the Render Global Settings window . . . . .	92
	Render all or some objects from a camera . . . . .	93
	Set the rendered image file format . . . . .	93
	Set file name syntax . . . . .	93
	Set rendered images output location . . . . .	95
	Set the resolution and pixel aspect ratio . . . . .	95
	Enable color, depth, and mask channels for rendered images . . . . .	96
	Create and view depth files . . . . .	96
	Modify a mask channel . . . . .	97
	Specify frame or field rendering . . . . .	98
	Run Pre Render MEL or Post Render MEL scripts . . . . .	99
	Adjust anti-aliasing . . . . .	99
	Adjust output image filtering . . . . .	101
	Create and load a plug-in multi-pixel filter . . . . .	101
	Set raytracing quality . . . . .	102
	Set motion blur . . . . .	103
	Maya software . . . . .	104
	Set IPR options . . . . .	105
	Set paint effects rendering options . . . . .	105
	Create render layers . . . . .	105
	Create renderable passes . . . . .	106

## Table of Contents

	<b>Visualize a scene</b> . . . . .	<b>107</b>
	Visualize interactively with IPR . . . . .	107
	See shading and lights in a scene view . . . . .	110
	Test render a low-res still or frame . . . . .	111
	Test render a low-res animation . . . . .	111
	Render selected objects . . . . .	112
	Render a region of your scene. . . . .	113
	<b>Perform final renders from within Maya</b> . . . . .	<b>114</b>
	Render a single frame . . . . .	114
	Batch render a still or animation . . . . .	115
	Render with several processors . . . . .	116
	<b>Perform command line rendering</b> . . . . .	<b>117</b>
	Command line render. . . . .	117
	<b>Export .mi files.</b> . . . . .	<b>118</b>
	To export a .mi file and render with mental ray. . . . .	118
	<b>Render multiple scenes</b> . . . . .	<b>119</b>
	Render multiple scenes . . . . .	119
What went wrong?	Troubleshoot:Image plane displays black swatch . . . . .	119
	Troubleshoot:Displacement is not displayed . . . . .	119
	Troubleshoot:Software-rendered is too bright . . . . .	119
	Troubleshoot: Multi-UVs for NURBS don't software render. . . . .	119
	Troubleshoot:Rendered image doesn't match may not match interactive window display . . . . .	120
	Troubleshoot: Projection texture swims over an animation. . . . .	121
	Troubleshoot:Transparent blobby surface rendering anti-aliasing problem . . . . .	121
	Troubleshoot:memory exceptions . . . . .	121
	Troubleshoot:mental ray for Maya renders look different than they did before . . . . .	121
	Troubleshoot:mental ray for Maya renders look different than Maya renders . . . . .	122
	Troubleshoot:Highlight artifacts close to object edge. . . . .	124
	Troubleshoot:Background surfaces show through . . . . .	124
	Troubleshoot:Objects vibrate when an animation is rendered as fields . . . . .	124

## Table of Contents

	Troubleshoot:2D Motion Blur problems . . . . .	124
	Troubleshoot:Troubleshooting Surfaces (Maya software) . . . . .	126
	Troubleshoot:Edits in the Texture Editor don't update in IPR. . . . .	128
	Troubleshoot: Looping renders . . . . .	129
<b>5</b>	<b>Quality, render speed, diagnostics. . . . .</b>	<b>131</b>
About	<b>Image quality and render speed . . . . .</b>	<b>131</b>
	The speed/quality tradeoff . . . . .	131
	Anti-aliasing and flicker . . . . .	131
	Artifacts . . . . .	132
	Render speed . . . . .	132
	Maya render diagnostics . . . . .	133
	mental ray for Maya diagnostics . . . . .	133
How do I?	<b>Improve rendered image quality . . . . .</b>	<b>134</b>
	Adjust scene anti-aliasing parameters (Maya software) . . . . .	134
	Adjust per-object anti-aliasing parameters . . . . .	134
	Reduce artifacts and flicker . . . . .	134
	<b>Increase render speed . . . . .</b>	<b>135</b>
	Increase overall rendering speed . . . . .	135
	Increase surface rendering speed . . . . .	136
	Increase shadow rendering speed . . . . .	137
	Increase camera views render speed . . . . .	138
	Global illumination and caustics . . . . .	138
	Final Gather . . . . .	139
	<b>Reduce render memory usage . . . . .</b>	<b>139</b>
	Cache texture tiles using BOT (block ordered texture) . . . . .	139
	Delete information not relevant to the renderer . . . . .	140
	Render parts of a scene separately . . . . .	140
	<b>Decrease file size (Maya Vector renderer) . . . . .</b>	<b>140</b>
	Strategies to decrease vector render file size. . . . .	140



## Table of Contents

	<b>Diagnose scene problems</b> . . . . .	<b>141</b>
	Run diagnostics. . . . .	141
	mental ray for Maya error handling and diagnostics . . . . .	142
	Sample diagnostic messages . . . . .	142
<b>6</b>	<b>Network rendering</b> . . . . .	<b>145</b>
About	<b>Maya network rendering</b> . . . . .	<b>145</b>
	<b>Maya network rendering</b> . . . . .	<b>145</b>
	Maya network rendering . . . . .	145
	Computer preparation . . . . .	145
	<b>mental ray for Maya network rendering</b> . . . . .	<b>146</b>
	Parallel network rendering . . . . .	146
	Terminology . . . . .	146
	What do I need? . . . . .	147
	Configuration files . . . . .	147
How do I?	<b>Render across a network</b> . . . . .	<b>148</b>
	<b>Network render with Maya software</b> . . . . .	<b>148</b>
	Network render with Maya software. . . . .	148
	<b>Network render with mental ray for Maya.</b> . . . . .	<b>149</b>
	Before you begin (mental ray for Maya network rendering) . . . . .	149
	Set up a master machine with mental ray for Maya . . . . .	149
	Verify which hosts file is being read . . . . .	150
	Change the set of slaves used for mental ray for Maya renders . . .	151
	Set up a master machine with mental ray standalone (method 1). .	151
	Set up a master machine with mental ray standalone (method 2). .	152
	Slave machine setup . . . . .	153
	Submit a job to render over the network . . . . .	154
What went wrong?	<b>Network rendering with mental ray for Maya</b> . . . . .	<b>155</b>
	Troubleshoot:Can't I install the rayserver service or edit the services file? . . . . .	155
	Troubleshoot:I have everything correctly set up, but I still can't network render. . . . .	156
	Troubleshoot:Mac OS X machines . . . . .	157

## Table of Contents

### 7 Window, menu, and node descriptions . . . . . 159

Reference	Render Global Settings window . . . . .	159
	Common tab . . . . .	159
	Resolution . . . . .	162
	Maya Software tab . . . . .	165
	mental ray tab . . . . .	184
	Maya Hardware tab . . . . .	207
	Maya Vector tab . . . . .	211
	Render View menu bar . . . . .	224
	Render View toolbar . . . . .	230
	Rendering Flags window . . . . .	231
	Use the hardware render buffer . . . . .	233
	Hardware Render Buffer global settings . . . . .	236
	Hardware Render Buffer menus . . . . .	242
	<b>Menus . . . . .</b>	<b>245</b>
	<b>File . . . . .</b>	<b>245</b>
	File > Export All, Export Selection (mental ray) . . . . .	245
	<b>Modify . . . . .</b>	<b>247</b>
	Modify > Convert Displacement to Polygons . . . . .	247
	<b>Create . . . . .</b>	<b>247</b>
	Create > Cameras > Camera . . . . .	247
	Create > Cameras > Camera and Aim . . . . .	252
	Create > Cameras > Camera, Aim, and Up . . . . .	252
	<b>Window . . . . .</b>	<b>252</b>
	Window > Rendering Editors > Render View . . . . .	252
	Window > Rendering Editors > Hardware Render Buffer . . . . .	253
	Window > Rendering Editors > Render Globals . . . . .	253
	Window > Rendering Editors > Hypershade . . . . .	253
	Window > Rendering Editors > Rendering Flags . . . . .	253
	Window > Rendering Editors > Shading group attributes . . . . .	253
	Window > Rendering Editors > Multilister . . . . .	253
	Window > Rendering Editors > mental ray > Approximation Editor . . . . .	254
	Window > Rendering Editors > mental ray > Custom Text Editor . . . . .	254

## Table of Contents

<b>Rendering menu set</b> . . . . .	<b>254</b>
<b>Render</b> . . . . .	<b>254</b>
Render > Render Current Frame . . . . .	254
Render > Redo Previous Render . . . . .	254
Render > IPR Render Current Frame . . . . .	254
Render > Redo Previous IPR Render . . . . .	254
Render > Test Resolution . . . . .	254
Render > Render Diagnostics . . . . .	255
Render > Batch Render . . . . .	255
Render > Cancel Batch Render . . . . .	256
Render > Show Batch Render . . . . .	256
Render > Save Distributed Render . . . . .	256
Render > Render Using > Maya Hardware . . . . .	256
Render > Render Using > Maya Software . . . . .	257
Render > Render Using > Maya Vector . . . . .	257
Render > Set NURBS Tessellation . . . . .	257
Render > Render Using > mental ray . . . . .	265
<b>Panel menus</b> . . . . .	<b>265</b>
<b>View</b> . . . . .	<b>265</b>
View > Select Camera . . . . .	265
View > Camera settings . . . . .	265
View > Camera Attribute Editor . . . . .	269
View > Camera Tools . . . . .	275
View > Image plane . . . . .	278
<b>Nodes</b> . . . . .	<b>279</b>
<b>Object-specific render attributes (Attribute Editor)</b> . . . . .	<b>279</b>
Render Stats . . . . .	279
<b>Tessellation</b> . . . . .	<b>282</b>
NURBS objects tessellation . . . . .	282
<b>Index</b> . . . . .	<b>283</b>

## **Table of Contents**

# 1 About rendering and renderers

## About

## Rendering



Rendering is the final stage in the 3D computer graphics production process.

Though the wider context of rendering begins with shading and texturing objects and lighting your scene, the rendering process ends when surfaces, materials, lights, and motion are processed into a final image or image sequence.

### Visualization vs. the final render

As you build your scenes (shade and texture objects, light scenes, position cameras, etc.), you'll want to visualize your scene many times before you produce the final rendered image or image sequence. This process may involve (depending on your particular project) creating and setting up additional cameras.

Visualize a scene during early iterations to detect and correct image quality problems or to estimate and reduce the amount of time the final render takes *before* you spend time performing the final render.

When you are satisfied with the results of your scene during test renders, you can perform the final render.

You can visualize and final render a single frame, part of an animation (multiple frames), or an entire animation in Maya.

## 1 | About rendering and renderers

About > The key to successful rendering

### The key to successful rendering

The key to rendering is finding a balance between the visual complexity required and the rendering speed that determines how many frames can be rendered in a given period of time.

Rendering involves a large number of complex calculations which can keep your computer busy for a long time. Rendering pulls data together from every sub-system within Maya and interprets its own data relevant to (for example) tessellation, texture mapping, shading, clipping, and lighting.

Producing rendered images always involves making choices that affect the quality (anti-aliasing and sampling) of the images, the speed with which the images are rendered, or both.

The highest quality images typically take the most time to render. The key to working efficiently is to produce good-enough quality images in as little time as possible in order to meet production deadlines. In other words, choose only the most economical values for options that let you produce images of acceptable quality for your particular project.

### Hardware, software, and vector rendering

#### Software rendering

Software rendering produces images of the highest quality, letting you achieve the most sophisticated results.

Computation occurs on the CPU, as opposed to hardware rendering, which relies on the machine's graphics card. Because it is not restricted by the computer's graphics card, software rendering generally is more flexible. The trade-off, however, is that software rendering is generally more time consuming.

Exactly what you can render depends on which software renderer you use and its particular limitations.

Maya has the following software renderers:

- The Maya software renderer  
To find out about Maya's software renderer, see "Maya Software renderer" on page 15.
- mental ray for Maya  
To find out about mental ray for Maya, see "mental ray for Maya renderer" on page 17.

### Hardware rendering

Hardware rendering uses the computer's video card and drivers installed on the machine to render images to disk. Hardware rendering is generally faster than software rendering, but typically produces images of lower quality compared to software rendering. In some cases, however, hardware rendering can produce results good enough for broadcast delivery.

Hardware rendering cannot produce some of the most sophisticated effects, such as some advanced shadows, reflections, and post-process effects. To produce these kind of effects, you must use software rendering.

Maya has the following hardware renderers:

- The Maya hardware renderer  
To find out Maya's hardware renderer, "Maya Hardware renderer" on page 16.

**Note** For information about the Hardware Render Buffer, see "Hardware Render Buffer" on page 233.

### Vector rendering

Vector rendering lets you create stylized renderings (for example, cartoon, tonal art, line art, hidden line, wireframe) in various bitmap image formats and 2D vector formats.

Maya has the following vector renderers:

- The Maya vector renderer  
To find out Maya's vector renderer, "Maya Vector renderer" on page 22.

## Renderers

### Maya Software renderer

Maya's software renderer is an advanced, multi-threaded renderer. It is based on a rendering technology that is built directly into Maya's dependency graph architecture, which means its feature nodes can be intimately connected with any other feature in Maya. It provides artists with an excellent general purpose rendering solution with very broad capabilities.

## 1 | About rendering and renderers

### About > Maya Hardware renderer

It is a hybrid renderer, offering true raytracing plus the speed advantages of a scan-line renderer. The Maya software renderer, while not slow, tends to favor quality and wide breadth of capability over raw speed.

The Maya software renderer supports all of the various entity types found within Maya including particles, various geometry and paint effects (as a post render process) and fluid effects. It also has a robust API for the addition of customer-programmed effects.

The Maya software renderer features IPR (Interactive Photo Realistic rendering), a tool designed to allow you to make interactive adjustments to the final rendered image, and which greatly enhances rendering productivity. Most importantly, the nature of Maya's integrated architecture allows complex interconnections, like procedural textures and ramps that govern particle emission and other unpredictable relationships that are capable of producing stunning visual effects.

## Maya Hardware renderer

Maya's hardware renderer presents a seamlessly integrated rendering solution that leverages the ever increasing power of next-generation graphics cards to render frames.

Benefits include an intuitive workflow to generate hardware rendered images for previews, specific passes, and hardware rendered particles. You can render and display images using the Render View, which lets you compare images during the shading and lighting tasks.

The user experience and the visual quality of the final images significantly surpass that of the Hardware Render Buffer. You can produce broadcast-resolution images in less time than with software rendering. In some cases, the quality may be good enough for final delivery.

The hardware renderer uses Maya's existing interface and workflow for assigning shaders, textures, particles, light linking, and so on.

To prevent the windows of other applications from interfering with the rendering of the image, you can perform off-screen batch rendering.

## Highlights of supported features

Supported features include:

- Integrated rendering workflow and interface.
- Polygons and NURBS geometry.
- Multiple textured channels.
- Advanced transparency.
- Hardware particles.



## 1 | About rendering and renderers

### About > Supported hardware and platforms

- Instancing.
- Point, Directional, Spot, and Ambient Light types.
- Any number of lights.
- Light linking.
- Per-vertex and per-pixel shading effects.
- Multi-pass and multi-sampling anti-aliasing.
- File textures for any supported channel.
- On-the-fly procedural and shading network conversions.
- Specular highlights.
- Bumps.
- Reflections.
- Shadows.
- Motion blur.
- RGB color, alpha matte (mask), and Z depth output.
- Command line rendering.
- Render diagnostics. Warnings for unsupported primitives, shaders, and light types and light features are provided.

### Supported hardware and platforms

Only specific hardware and platform combinations are supported by hardware rendering. For more information, see:

[http://www.alias.com/qual\\_charts](http://www.alias.com/qual_charts)

### mental ray for Maya renderer

mental ray for Maya offers all the features traditionally expected of photorealistic rendering and includes functionality not found in most rendering software.

mental ray for Maya allows interactive and batch mental ray rendering from within the Maya user interface. With the help of built-in shaders supporting almost any effect available in Maya, mental ray for Maya allows the rendering of scenes created within Maya or their export into the mental images file format (.mi).

(For detailed information on the mental ray standalone application, see the *mental ray reference User Manual* and the *mental ray Shaders Guide*, available from the Maya help.)

## 1 | About rendering and renderers

About > Known differences

**Note** In Maya 5.0, the Render Global settings were unified, so some of the mental ray for Maya derive from Maya' settings (from versions previous to Maya 5.0) no longer exist.

You may need to modify some older files for which 'derive from Maya' was set by setting the mental ray for Maya render global settings. See "Open the Render Global Settings window" on page 92 for more information.

After you load the mental ray plug-in (and select mental ray as the renderer), the Render menu lists available menu items for mental ray for Maya. As well, the Attribute Editor contains a mental ray section in which you can edit attributes that are used exclusively when rendering with mental ray for Maya.

To load the mental ray for Maya plug-in, see the note in "Select a renderer" on page 25.

### IFF File format

The IFF image support in mental ray permits both color and depth information written into a single file. This requires the proper parameters to be set in the Render Global Settings (Depth Channel [Z Depth] in the Image File Output section must be turned on).

### File Export

mental ray for Maya can also be used in Maya as a file exporter. When you export a Maya scene file to the proprietary mental images (.mi) file type, the file export simply writes a .mi file to disk with the given name. Additional options are available in the user interface to control ascii or binary mode export and file-pre-frame creation for animations.

See "Exporting .mi files" on page 72.

### Geometry Types

Maya supports three types of geometry: polygonal (Polygon Mesh), free-form objects (NURBS curves/surfaces), and subdivision surfaces.

### Known differences

The native Maya and mental ray renderers may produce different results in certain situations. For more details, see "Troubleshoot:mental ray for Maya renders look different than Maya renders" on page 122.

### Shading Networks and Nodes

A shading group in Maya defines the material, volume, and displacement shaders, along with the list of lights used in the illumination calculation for renderable objects. Such a shading group can directly be translated into a .mi material.

For more information on mental ray for Maya shaders, see *“mental ray for Maya Shaders”* in the *Shading* guide.

### Global illumination, Caustics, Final Gather, and HDRI

For information and procedures, see *“Indirect (global) vs. direct illumination”* on page 11 in the *Lighting* guide.

#### Global illumination

mental ray for Maya can render with Global illumination, the technique used to capture indirect illumination (the natural phenomenon where light bounces off anything in its path until it is completely absorbed).

#### Caustics

mental ray can render with Caustics, the light effects that caused by specularly reflected or refracted light, like the shimmering light at the bottom of a pool of water.

#### Final gather

mental ray for Maya can render with Final gather (a method of global illumination) to create very (or purely) diffuse scenes where the indirect illumination changes slowly.

#### Support for HDR images

mental ray for Maya supports HDR images as file textures.

#### Direct light with mental ray for Maya Area Lights

The main purpose of area light sources is to generate more realistic lighting, resulting in soft shadows. This is achieved by using one of four primitives (rectangles, discs, spheres, and cylinders) as light sources with nonzero area.

For more information about mental ray for Maya areas lights, see *“mental ray Area Light”* on page 15 in the *Lighting* guide.

### Scene rendering

mental ray for Maya 6.0 is based on the mental ray 3.3 rendering core.

## 1 | About rendering and renderers

### About > Scene rendering

- The preview image output is visible in the Maya Render View window. For more information, see “Render View rendering” on page 71.
- The rendering settings can be further manipulated using the Render Global Settings window. For more information, see “Render Global Settings window” on page 159.
- The ongoing rendering can be interrupted at any time using the Escape key (as with Maya’s native renderer), and mental ray progress is printed in the Output Window (Windows) or the Console (IRIX and Linux). For more information, see “Perform final renders from within Maya” on page 114.
- Batch rendering is supported. When Render > Batch Render is selected, the current scene is stored in a temporary Maya file and a background mental ray render process is launched. Interactive and batch rendering processes can run in parallel, if enough memory is available. For more information, see “Batch render a still or animation” on page 115.

### Parallelism

mental ray for Maya supports both host and network parallel rendering. It renders identical output on all common and widely-used platforms. For network rendering, it performs best in a client-server setup, where it takes care of load balancing and network communication reduction.

For information on mental ray for Maya network rendering, see “mental ray for Maya network rendering” on page 146.

### Animations

When rendering animation files or previewing animations inside Maya, mental ray for Maya exploits incremental changes. This means it determines if scene elements actually have changed between frames and just processes those changes, thus accelerating the render cycle. The check is based on Maya information and includes both geometry (plus instances) and shading nodes. If no changes are detected, the corresponding object or shader is not updated in subsequent frames and do appear animated.

Incremental changes are not used if animations are exported as *file per frame*.

### mental ray object rendering flags

You can control how particular objects contribute to certain rendering stages by setting per-object rendering flags in the object’s Attribute Editor.

### Motion Blur

For information about mental ray for Maya motion blur, see “mental ray for Maya motion blur” on page 29.

### Customizations

(For mental ray advanced users only.)

The Custom Text Editor can be used to create and attach custom text to certain scene entities. This replaces the internally created .mi output with the custom text. Using the Custom Text Editor you can integrate custom mental ray shaders into Maya.

To use the Custom Text Editor, see *"Custom mental ray text"* on page 45 the *Shading* guide.

mental ray for Maya checks and reads special custom attributes on certain Maya nodes and uses them for customized scene processing. Additionally, it adds its own custom nodes to Maya for convenient handling of mental ray extensions.

All of these customizations are located in the Custom Entities section of the Render Global Settings window. For descriptions of the mental ray for Maya Custom Entities attributes, see *"mental ray tab"* on page 184.

#### Warning

To reduce the potential of unpredictable results, the processing of such entities is disabled by default for the integrated preview rendering in Maya.

Turn on Custom Entities at your own risk. It is, however, enabled for the .mi file export to create customized scene files for external rendering.

#### Custom mental ray text

mental ray for Maya supports a method to produce custom text in the output stream written to the .mi file. This is for text-only integration of custom mental ray shaders within Maya; it allows for the creation of special-purpose Maya nodes that hold customized mental images (mi) text.

#### Custom vertex data

mental ray for Maya checks Maya polygonal meshes for additional dynamic (custom) attributes that supply per vertex data. This data is exported as additional mental ray texture spaces for shader access.

For more information about custom vertex data, see *"Custom vertex data"* on page 49 in the *Shading* guide.

## 1 | About rendering and renderers

About > Error handling and diagnostics

### Error handling and diagnostics

mental ray for Maya checks for errors in a Maya scene and recognizes various operating system errors. You can use diagnostics to help you diagnose issues with samples and photon maps.

For more information on mental ray for Maya diagnostics, see "mental ray for Maya error handling and diagnostics" on page 142.

### Maya Vector renderer

(Windows and Mac OS X)

You can use the Maya Vector renderer to create stylized renderings (for example, cartoon, tonal art, line art, hidden line, wireframe) in various bitmap image formats (for example, IFF, TIFF, and so on) or in the following 2D vector formats:

- Macromedia Flash (non-interactive) version 3, 4 or 5 (SWF)
- Adobe Illustrator version 8 (AI)
- Encapsulated PostScript Level 2 (EPS)
- Scalable Vector Graphics (SVG).

To select the Maya Vector renderer, see "Select a renderer" on page 25.

To set options for the Maya Vector renderer, see "Render Global Settings window" on page 159.

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#### Example Animations

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helicopter.swf



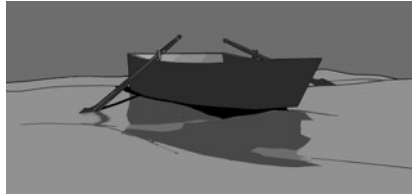
flowers.swf

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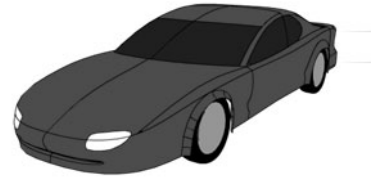
## 1 | About rendering and renderers

About > Maya Vector renderer

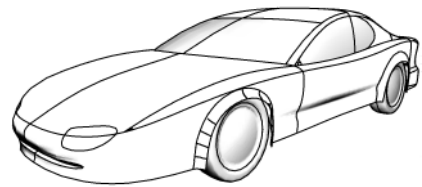
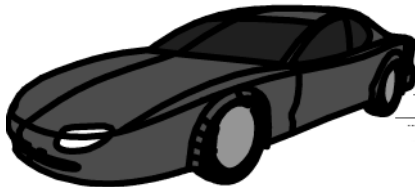
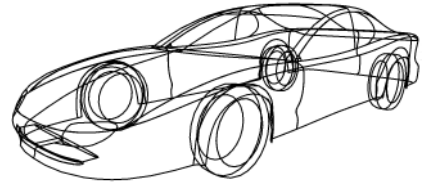
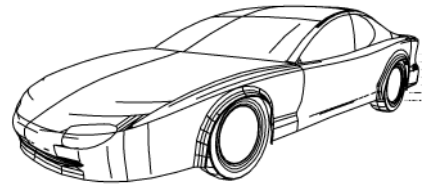
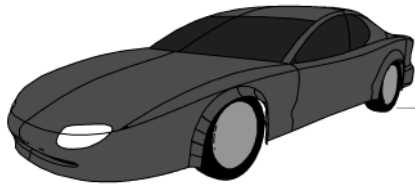
### Example Animations



boat.swf



car.swf



**Note** The Maya Vector renderer cannot render certain Maya features (see "Maya features that do not vector render" on page 24).

**Note** If you are rendering SWF or SVG files for online delivery make sure you read "Strategies to decrease vector render file size" on page 140. Otherwise you may create files that are too large for online delivery.

## 1 | About rendering and renderers

About > Maya features that do not vector render

### Maya features that do not vector render

The Maya Vector renderer cannot render the following Maya features.

<b>Maya Feature</b>	<b>Notes</b>
Bump maps	Not rendered.
Displacement maps	Not rendered. Use Modify > Convert > Displacement To Polygons to convert displacement maps to polygons for rendering.
Fluid effects	Not rendered. Use Modify > Convert > Fluid To Polygons to convert fluid effects to polygons for rendering.
Image planes	Not rendered.
Lights	Only point lights are used during rendering. Only the following light attributes are considered during rendering: light location, light color, Emit Specular, Use Depth Map Shadows, Use Ray Trace Shadows.
Maya Fur	Not rendered.
Multiple UVs	Not rendered.
Paint effects	Not rendered. Use Modify > Convert > Paint Effects To Polygons to convert paint effects to polygons for rendering.  Some Paint Effects may not render as expected. Many Paint Effects brushes use a transparency texture on a single polygon to achieve an effect (for example, the outline of a leaf). However, the Maya Vector renderer only supports per object transparency.
Particles	Not rendered.
Post-render effects	Not rendered. (Post-render effects include motion blur, fog, glows, and so on.)



## 1 | About rendering and renderers

How do I? > Select a renderer

Maya Feature	Notes
Shaders	Anisotropic, Lambert, Blinn, Phong and Phong E shaders should produce expected results. Other Maya shaders may produce unexpected results.  mental ray shaders and custom shaders are not rendered.  Multiple shaders assigned to a single NURBS or subdivision surface are not rendered.
Textures	Texture rendering is limited by the Fill Style and the number of polygons. Fill styles that fill individual polygons (Full Color and Mesh Gradient) render textures more accurately than other fill styles, and models that contain more polygons render textures more accurately than models with fewer polygons.

## How do I? **Select a renderer**

### Select a renderer

To find out more about Maya renderers, see "Renderers" on page 15.

When you select a renderer, Maya's user interface is automatically configured to use the renderer. For example, if you render the current frame, Maya uses the renderer to process the image and display it in the Render View. Or, if you press the Display Render Globals Setting window button, the Render Global Settings window appears, showing the Common tab and tab that corresponds to the selected renderer.

#### To choose the renderer

- Do one of the following:
  - Click Render > Render Using, then choose the renderer.
  - Select the renderer from the drop-down list in Render View (Rendering > Rendering Editors > Render View).
  - Select the renderer from the drop-down list in the Render Global Settings window.

## 1 | About rendering and renderers

How do I? > mental ray Output window messages

**Note** The mental ray renderer and the Maya Vector renderer are plug-ins that are loaded by default. If you do not see them listed in Render > Render Using, choose Window > Settings/Preferences > Plug-in Manager and make sure the Mayatomr and/or VectorRender plug-ins are loaded.

### To specify the default renderer

- Click Window > Settings/ Preferences > Plug-in Manager.
- Select the Rendering category, then set the Preferred Renderer option.

## mental ray Output window messages

The following messages appear in the Maya's Output window at start-up:

- `mental ray for Maya 6`  
identifies the version for mental ray for Maya.
- `mental ray: version 3.3.0.655, 29 Jan 2004`  
`Windows_NT_4.0_x86`  
identifies the version of mental ray standalone libraries that mental ray for Maya is based

# 2 Camera set up

## About

## Cameras

### Viewing cameras vs. rendering cameras

Whenever you look at your scene in Maya, whether you are building your scene or ready to render images, you are looking through a camera. Think of it as being a director on a movie set and looking through a camera lens. Your field of view is restricted to what you can see through that lens.

By default, Maya has four cameras that let you view your scene in a panel: the perspective camera and the three orthographic cameras (side, top, front) that correspond to the default scene views. You look through these cameras (panels) as you model, animate, shade, and texture objects. (For more information about views, see *"Main window"* on page 18 in the *Basics* guide.)

Typically, you don't use these default cameras to render a scene; you create one or more perspective cameras from which to render. The only difference between a rendering camera and any other camera (default or created) through which you can view your scene is a flag that allows it to render the scene.

For more information on the kind of cameras you can create, see *"Maya camera types"* on page 27.

To create a camera, see *"Create a camera"* on page 35.

### Maya camera types

Maya cameras have certain advantages over real world cameras, giving you more creative freedom. For example, because Maya cameras are not restricted by size or weight, you can move cameras to *any* position in your scene, even inside the smallest objects.

### Static and animated cameras

Three types of cameras help you create both static and animated scenes.

- Use a Basic camera for static scenes and for simple animations (up, down, side to side, in and out), such as panning out of a scene. See *"Create > Cameras > Camera"* on page 247 for more details.
- Use a Camera and Aim camera for slightly more complex animations (along a path, for example), such as a camera that follows the erratic path of a bird. See *"Create > Cameras > Camera and Aim"* on page 252 to set its options.

## 2 | Camera set up

About > Focus and blur

- Use a Camera, Aim, and Up camera to specify which end of the camera must face upward. This camera is best for complex animations, such as a camera that travels along a looping roller coaster. See "Create > Cameras > Camera, Aim, and Up" on page 252 to set its options.


### Motion blur and depth of field

#### Focus and blur

The process of recording what you see through a real-world camera is simple: you press the button that opens the shutter, which lets light through the aperture, which in turn exposes the film to light, recording what you see.

A camera's exposure settings determine depth of field (the region of sharp focus), and whether or not subject matter is crisp or blurred by motion.

Especially if you using photography based images in your scene (such as live action footage), you may need to work with some camera settings. You set these and other settings, such as the film back or focal length, in:

- The selected camera's Attribute Editor. See "Adjust a camera's attributes" on page 35.
- As options for a camera as you create it. See "Create > Cameras > Camera > " on page 247.

#### fStop (aperture) and shutter speed/angle

In real-world photography, together the *fStop* and *shutter speed* (or *shutter angle* for film cameras) determine how much light is exposed to film. However, fStop and shutter speed also determine what is in focus, to a certain extent, but for very different reasons.

The length of time light is allowed to pass through the camera lens to the film is determined by the shutter speed. The higher the speed, the shorter the exposure time, the less light exposed to the film.

The amount of light that is allowed to pass through the camera lens to the film is determined by the camera's aperture setting (also known as the fStop). The wider the aperture, the more light exposed to the film.

**Note** A still camera's shutter speed performs the same function as a film camera's *shutter angle*. The shutter angle is a metal disk that is missing a pie-shaped section. This disk sits between the lens and the film, and rotates at a constant rate. When the missing section is in front of the film, it allows light from the lens to pass through and expose the film.

The larger the angle of the pie-shaped section, the longer the exposure time, and moving objects appear more blurry. For more information, see "Shutter Angle" on page 250.

### Shutter speed/angle determines motion blur

Motion blur gives the feeling of motion. Motion blur is determined by the shutter speed. The slower the shutter speed (sometimes deliberately done), the harder motion is to stop. That is, fast motion (such as a moving car) appears motion blurred at slower shutter speeds. At higher speeds, the moving car is 'stopped' and therefore in focus.

To set motion blur in Maya, see "Motion blur" on page 30.

For information on mental ray for Maya's motion blur, see "mental ray for Maya motion blur" on page 29.

### Aperture determines Depth of Field (DOF)

Depth of field is the region of sharp focus in a photograph. Depth of field is determined by the camera's aperture setting. At wide aperture settings (for example, at fStop  $f/2$ ), the depth of field is shallow, and more of the foreground and background (that brackets the area in sharp focus) is out of focus. At narrow aperture settings (for example, at fStop  $f/22$ ), the depth of field is deep, and more of the foreground and background is *in* focus.

To adjust a camera's fStop to affect the depth of field, see "Adjust depth of field" on page 37.

## mental ray for Maya motion blur

In mental ray for Maya, you can choose between Linear and Exact Motion Blur. Motion Blur in mental ray for Maya blurs everything: shaders, textures, lights, shadows, reflections, refractions, and caustics.

The Linear mode results in instance motion; shape changes are not considered. The Exact Mode additionally exports motion vectors for every vertex of the moving object. Use it to motion blur objects with deforming shape. This mode requires more translation and render time.

## 2 | Camera set up

About > Motion blur

The linear mode just exports instance motion performed on transform nodes, any shape changes (even linear movements) are not considered.

The Shutter, Shutter Delay setting of the Maya camera determines the actual motion blur path length. You can modify other settings, such as Motion Blur By, to further control the final motion blur calculation. Find these settings in the "Motion Blur" on page 190 (in the Render Global Settings window).

### Motion blur

Motion blur can be turned on and off on a per-object basis. If some surfaces in the scene don't move, or move only slightly, do not motion blur them. Being selective about what you motion blur can decrease rendering times. (See also 2D Motion Blur global attributes information about 2D motion blur.)

### Framing objects with a camera

#### Camera aim

Aim a camera to frame objects in your scene.

To look through a camera, see "Look through (select) a camera" on page 38.

To frame your scene in other ways, see "Frame your scene" on page 39.

#### Camera tools

Camera tools let you reposition the camera in different ways.

##### Tumble

Revolves the camera around a center of interest (such as a particular object), or the camera's pivot point (which, by default, is the center).

To adjust the way in which the Tumble tool works, see "View > Camera Tools > Tumble Tool >

##### Track

Slides the camera horizontally or vertically in space.

To adjust the way in which the Track tool works, see "View > Camera Tools > Track Tool >

## Dolly

Moves the camera into the view, or backs the camera out of the view. When you use the Dolly tool, you change the perspective; that is, objects far from the camera change in relative size at a slower rate than objects which are close to the camera. Compare to Zoom (see "Zoom" on page 31).


You can use the Dolly tool in a perspective view or an orthographic view.

To adjust the way in which the Dolly tool works, see "View > Camera Tools > Dolly Tool > " on page 276.

**Tips** You can also use platform-specific keyboard combinations for most camera tools. See "Selection, tools, and actions" on page 17 in the *Basics* guide for details.


## Zoom

Changes the focal length (viewing angle) on the camera. The Zoom tool does not change perspective like the Dolly tool does; all objects in the frame change size at the same rate. The camera doesn't move, but the effect is similar. To move in or out of the view without changing the viewing angle, see Dolly.

To adjust the way in which the Zoom tool works, see "View > Camera Tools > Zoom Tool > " on page 277.

## Roll


Rotates the camera around its horizontal axis, down the barrel of the lens.

To adjust the way in which the Roll tool works, see "View > Camera Tools > Roll Tool > " on page 277.

## Azimuth Elevation

Revolves the camera around a point of interest in perspective view only.

The angle of a camera's sight line relative to the ground plane is called its *elevation*; the angle of a camera's sight line relative to a plane perpendicular to the ground plane is called its *azimuth*.

To adjust the way in which the Azimuth Elevation tool works, see "View > Camera Tools > Azimuth Elevation Tool " on page 278.

## Yaw-Pitch

*Points* the camera up or down (pitch, also called tilt), or left or right (yaw, also called pan) without moving the camera. The scene in the camera's view appears to move in the opposite direction.

## 2 | Camera set up

### About > Angle of view (focal length)

To *move* the camera up or down or side to side, use the Track tool.

To adjust the way in which the Yaw-Pitch tool works, see "View > Camera Tools > Yaw Pitch Tool > □" on page 278.

### Fly

Flies the camera through the scene with no constraints. The Fly Tool lets you navigate your scene as if you were playing a 3D first-person perspective game.

To use the Fly Tool, Ctrl+drag up to fly forward and down to fly backward. To change the camera direction, release the Ctrl key and drag.

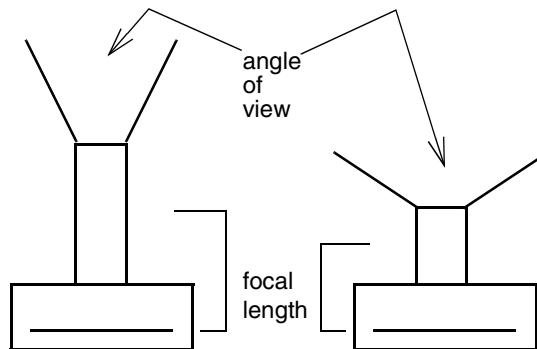
**Tip** Tumble, track, and dolly are available while the Fly Tool is active.

## Angle of view (focal length)

For every shot, you decide how big an object appears in the frame. For example, should a shot include an entire character or just its head and shoulders? There are two ways to make an object larger in the frame. You can either move the camera closer to the object (see "Dolly" on page 31) or adjust the lens to a longer focal length (see "Zoom" on page 31).

The focal length of a lens is the distance from the center of the lens to the film plane. The shorter the focal length, the closer the focal plane is to the back of the lens.

Lenses are identified by their focal length. Focal length is expressed in millimeters or, on occasion, in inches (1 inch is approximately 25mm).



The object's size in the frame is directly proportional to the focal length. If you double the focal length (keeping the distance from the camera to the object constant), the subject appears twice as large in the frame. The size of

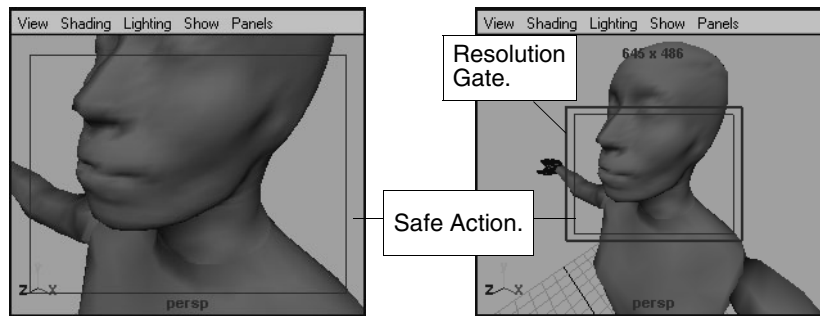


the object in the frame is inversely proportional to the object's distance from the camera. If you double the distance, you reduce the size of the object by half in the frame.

## Angle of view

As you adjust the camera's focal length, the angle of view narrows and expands. This is what causes objects to get larger or smaller in the frame. As you extend the focal length, the angle of view gets narrower. As you shorten the focal length, the angle of view gets larger.

## Safe display regions for TV production



You can display a guideline that indicates a region within which you should keep all action or text if you plan to display the rendered images on a television screen. Action and text within these guidelines is visible on every television.

Different TV manufacturers use different tubes and put them in different boxes, so there's a difference in what gets displayed; safe action and text region are broadcast standards that assure action or text (respectively) is visible. Safe text is 80% of the screen because the sensitivity to logotypes (fonts) is much higher than the sensitivity to objects moving; that is, at the 10% edge of the tube, text appears warped. Safe action is 90%.

To turn the safe action or safe title border on or off, see "Turn scene view guidelines on or off" on page 36.

## Safe action

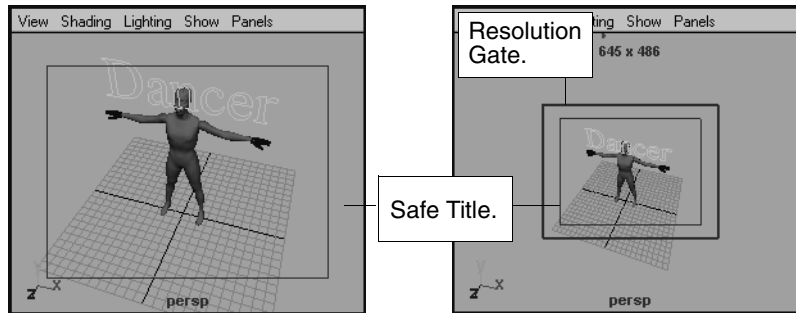
The safe action view guide represents 90% of the rendering resolution (the resolution gate).

## 2 | Camera set up

About > Safe Title

### Safe Title

The safe title view guide represents 80% of the rendering resolution (the Resolution Gate). For example, in this image, the title *DANCER* does not fit within the Safe Title area. Track the scene until the title fits within the border.



### Clipping planes

Near and far clipping planes are imaginary planes located at two particular distances from the camera along the camera's sight line. Only objects between a camera's two clipping planes are rendered in that camera's view. Any parts of objects in the scene closer to the camera than the near clipping plane, or farther from the camera than the far clipping plane, are not rendered.

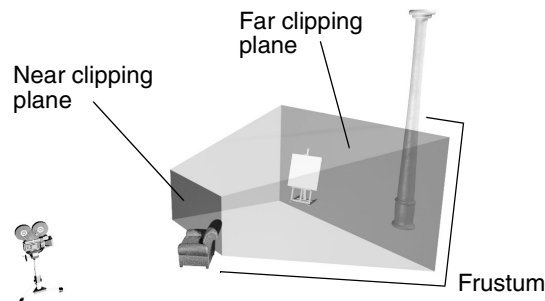


Image courtesy of  
The Art of Maya

If part of an object is in front of the *near* clipping plane, then only the part of the object beyond the near clipping plane is rendered. If part of an object is beyond the *far* clipping plane, the entire object is rendered, including the part beyond the far clipping plane.

A completely opaque object which is behind the far clipping plane is clipped. If that object's transparency is greater than 0, the part behind the far clipping plane is clipped.

**Note** For Maya software rendering, if refractions are toggled on, an object that intersects the far clipping plane is not clipped regardless of the transparency value.

For more information on how to work with clipping planes, see "Clipping planes" on page 34.

## How do I? **Create and use a camera**

### Create a camera

To learn more about Maya cameras, see "Maya camera types" on page 27.

#### **To create a new camera**

- 1** Select Create > Cameras > Camera *Type* > , where *Type* is the type of camera.

To find out about the type of cameras, see "Maya camera types" on page 27.

The Create Camera Options window appears.

**Note** If you've previously set the options for the type of Camera you want to create, you can just select the camera type; you don't have to set its options each time.

- 2** Set the camera options, then click Create.

For a description of the camera options, see "Create > Cameras > Camera" on page 247.

### Adjust a camera's attributes

A camera's attributes describe various properties of the camera, including angle of view, focal length, and depth of field.

## 2 | Camera set up

How do I? > Make a camera renderable

### To adjust a camera's attributes

- 1 Select the camera. To select a camera, see "Look through (select) a camera" on page 38.  
The camera's Attribute Editor appears (unless it's been hidden). If it does not, click View > Camera attributes.
- 2 Set attributes.  
For a description of the attributes, see "View > Camera Attribute Editor" on page 269.

## Make a camera renderable

By default, your scene has only one renderable camera (the original perspective camera) that can render all objects in your scene.

If you add another camera to your scene and want to make it renderable (or you would like to make one of the default orthographic cameras renderable), you must set this camera to renderable. You can have multiple renderable cameras.

To learn more about rendering, see the Rendering book.

### To make a camera renderable

- 1 In the selected camera's Output Settings section of the Attribute Editor, turn on Renderable.

**Note** Alternatively, you can turn off Renderable in the Output Settings section of the Attribute Editor for the cameras you do not want to render from.

**Note** For Maya software rendering, you can also select a camera (or several cameras) to render from when you render from a shell or command line. Use Render and the -cam option.  
See "Command line renders" on page 72 for information about command line rendering.

## Turn scene view guidelines on or off

You can turn view guidelines on or off so that you can correctly determine safety boundaries for certain types of information: safe action and text for TV broadcasts, or render borders.

**Tip** You can display several view guides at the same time by opening the camera's Attribute Editor (View > Camera Attribute Editor), and turning on options in the Display Options section.

To learn more about the safe action and safe title border or the resolution gate, see "Safe display regions for TV production" on page 33.

#### **To turn the safe action border on or off**

- Click View > Camera Settings > Safe Action.

#### **To turn the safe title border on or off**

- Click View > Camera Settings > Safe Title.

#### **To display the Resolution Gate view guide**

- Select View > Camera Settings > Resolution Gate from the view's menu bar.

The resolution gate and the resolution values appear.

## Adjust depth of field

You can view the calculated distance of the camera from the object and apply that value to the Focus Distance for the camera to achieve Depth of Field effects in the Camera's Attribute Editor.

For information on depth of field, see "Focus and blur" on page 28.

**Note** To create an image that has wider depth of field (more area in front of and behind the subject that is in focus) use high fStop values, such as f16, f22, f32. To achieve narrow depth of field (less area in front and behind the subject that is in focus) use low fStop values such as f2.8, f4 or f5.6.

For more information on fStops, see "fStop (aperture) and shutter speed/angle" on page 28.

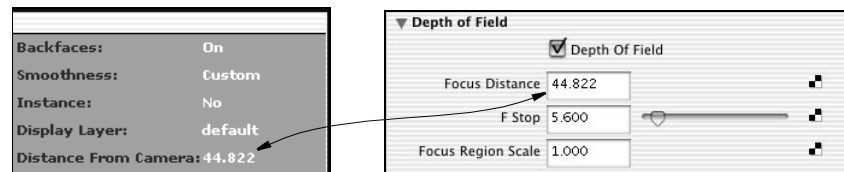
**Note** Depending on the fStop and Focus Region Scale values, parts of the object may or may not be in focus.

## 2 | Camera set up

How do I? > Select the current scene view's camera

### To ensure the center of an object is in focus for Depth of Field

- 1 Select the object in the view.
- 2 Make sure Object Details is turned on in the Heads Up Display menu. (Object Details is on by default). Notice the Distance to Camera value.
- 3 Use the Distance to Camera value as the Focus Distance value in the Depth of Field section for the current Camera.



If you select multiple objects, Maya uses the center of their bounding box to calculate the distance from the camera.

### Look through (select) a camera

#### Select the current scene view's camera

Select the current scene view's camera to show the camera's Attribute Editor (unless it's been hidden) or to aim the camera *while you are looking through it*.

For more information about scene views, which are in fact cameras, see "Viewing cameras vs. rendering cameras" on page 27.

#### To select the current view's camera

- In the view, click View > Select Camera.

### Look through another camera

If you have more than one camera, you can switch the camera with which you are viewing the scene to another one.

#### To look through a camera

- Do one of the following:
  - To look through a camera that is selected, click Panels > Look Through Selected.
  - To look through another camera, click Panels, then select the camera name from either the Perspective or Orthographic submenus.

## Frame your scene

### Move a camera to another location

You can display a camera as an object in a view and use the standard manipulators to move it. This is like holding a camera through which you are *not* looking and moving it from one place to another (from a bag to a table for example); your hands are the manipulator. Moving a camera this way is particularly useful if you want to see the camera's path or adjust frustum or clipping planes, for example.

To move a camera *while looking through it*, see "Aim a camera" on page 39.

#### To move a camera


- Select the camera, then use the Move tool. For more information on the Move tool, see the Basics book.

### Aim a camera

You can aim the current view's camera with camera tools. Aiming is like holding the camera up to your eye, then pointing up, down, or moving yourself around your subject matter to frame objects in the scene. To find out more about the ways in which you can aim a camera, see "Aim a camera" on page 39.

To move a camera through which you are not looking, see "Move a camera to another location" on page 39.

#### To use a camera tool

- 1 In the view, do one of the following:
  - Click View > Camera Tool, select the tool you want to use, then drag the cursor to use the tool.
  - Click View > Camera Tool > , set the options, then click close.
  - For a description of the tool settings, see "View > Camera Tools" on page 275.

**Tip** You can use the keyboard combinations to Tumble, Track, and Dolly the camera. See "Selection, tools, and actions" on page 17 in the Basics guide for details.

## 2 | Camera set up

How do I? > Look at selected objects

- Tips
- If you change the default settings in the camera tool options windows, remember to press the Reset Tool button to reset the tool defaults for the next operation.
  - Select View > Default Home if you zoom and tumble the view repeatedly and then need to see the default camera's view.

### Look at selected objects

#### To look at selected objects

- Select View > Look At Selection.

The camera moves to show selected objects in the center of the camera's view.

### Frame selected objects

#### To look at and fill the view with selected objects

- Select View > Frame Selection (or press the hotkey f).

The camera moves to fill the camera's view with selected objects

### Frame all objects

#### To look at and fill the view with all objects in a scene

- Select View > Frame All (or press the hotkey a).

The camera moves to fill the camera's view with all objects in the scene (including lights and cameras, if their icons are displayed in the view).

### Frame part of a scene

#### To look at and fill the view with a region of a scene

- Ctrl+Alt+drag over the region.

The camera moves to fill the camera's view with the selected region.



### Save sequential camera movements

You can write all camera movements to the Script Editor (the MEL Journal) to let you undo or redo camera movements or copy camera movements to use them for other cameras or scenes.

#### **To turn the Journal on or off**

- In the view panel, click View > Camera Settings > Journal.

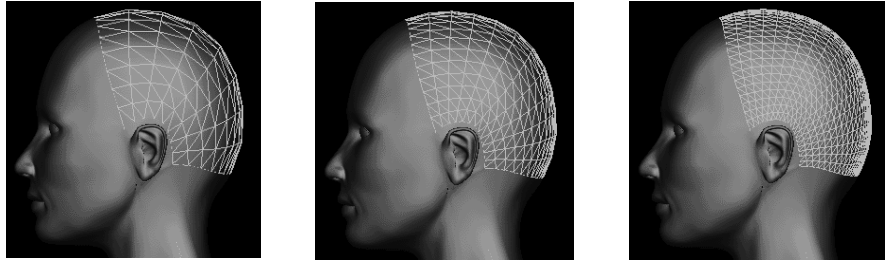
## **2 | Camera set up**

How do I? > Save sequential camera movements

# 3 Tessellation and Approximation

## About

### Tessellation and approximation



Tessellation (called approximation in mental ray for Maya) is the process renderers use to convert NURBS surfaces (or displacement mapped polygon meshes) to triangles. Triangles determine how smooth an object looks at closer distances to you (the camera). When poorly tessellated objects are close to the camera, they appear faceted; when they are further away, they don't.

### When to adjust tessellation

Because (most) renderers can only render triangles, tessellation is a necessary and automatic step that occurs at render time. However, you need to adjust tessellation settings when objects aren't smooth enough, which typically happens as objects come close to the camera or if objects are displacement mapped.

Tessellation settings determine how many triangles are used, where the triangles are concentrated, and what size they are. Numerous and concentrated triangles increase the memory requirements (which in turn decrease performance) of the renderer, so you must adjust tessellation settings to strike a balance between smooth edges (quality) on objects that are closer to the camera and renderer performance (the time it takes to render).

Tessellation strategy always is to adjust the settings, per-object (not globally), only high enough to achieve a smooth surface. Distant and less-important objects can have lower tessellation settings than objects closer to the camera.

### 3 | Tessellation and Approximation

About > Primary vs. secondary tessellation passes

## Maya tessellation

### Primary vs. secondary tessellation passes

Primary tessellation is a first pass through the geometry that creates a specific number of triangles in the U and V directions of the surface; it places triangles evenly all over the surface, regardless of curviness or displacement).

Secondary tessellation (also called Adaptive tessellation) is a second pass that creates more triangles only where needed.

With Maya software rendering and hardware you can set basic and advanced tessellation settings.

Basic tessellation (for novice users) performs both primary and secondary tessellation:

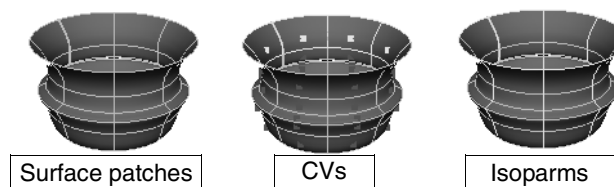
- curvature tolerance affects the chord height ratio of the secondary attributes
- u/v divisions affects the number U/V, and uses per-span # of isoparms

If basic tessellation doesn't provide you with the required results, choose advanced tessellation, and make adjustments accordingly.

### NURBS surface, poly, and subD tessellation

You don't need to adjust tessellation for polygon meshes or subdivision surfaces unless those surfaces are displacement mapped.

A NURBS surface is composed of one or more patches. (For more information on NURBS surfaces see "NURBS" on page 13 in the NURBS Modeling guide.) During rendering, each patch is divided into an appropriate number of triangles to approximate the true shape of the surface.



You can set NURBS tessellation on all or selected objects (see "Render > Set NURBS Tessellation > □" on page 257), or on an individual basis by selecting an object and adjusting the settings in the object's Attribute Editor.

## Approximation in mental ray for Maya

### Approximation

Approximation (called tessellation in Maya; see “Tessellation and approximation” on page 43) is the process mental ray for Maya uses to convert NURBS surfaces (or displacement mapped polygon meshes) to triangles. Triangles determine how smooth an object looks at closer distances to you (the camera). When poorly tessellated objects are close to the camera, they appear faceted; when they are further away, they don’t.

When rendering with mental ray for Maya, a set of approximation settings must be specified for each piece of geometry.

By default mental ray for Maya derives approximation settings from Maya’s tessellation settings. This produces results close to the look of Maya software rendered scenes, and is useful for those familiar with the behavior of those settings.

Alternatively, you can specify approximation settings more precisely for mental ray for Maya by using an approximation node.

### Derive from Maya (default approximation) settings

- If only Basic tessellation (see “Primary vs. secondary tessellation passes” on page 44) is used, mental ray for Maya bases tessellation on the Curvature Tolerance attribute setting of the NURBS surface.
- If the Advanced tessellation attributes are used but none of the secondary tessellation controls are active for an object. Parametric approximation is derived from Maya’s primary tessellation controls. Otherwise, mental ray for Maya’s LDA approximation method is applied with values calculated from Maya secondary tessellation controls.

Primary tessellation creates a base triangulation, which is further tessellated until the secondary set of conditions are met. mental ray for Maya’s Parametric approximation method is comparable to Maya’s primary tessellation; the length/distance/angle (LDA) method is comparable to Maya’s secondary tessellation.

### Approximation nodes

Approximation nodes give you more precise control over all of mental ray for Maya approximation features, some of which Maya cannot access. For example, you can use Approximation nodes to specify separate tessellation settings for surfaces, trim curves, and displacement maps.

### 3 | Tessellation and Approximation

#### About > Approximation nodes

As an example, consider a simple flat NURBS surface with a complex trim curve. For such a case, you would specify a low-quality surface approximation in conjunction with a high-quality trim curve approximation. mental ray would then ensure that the surface is approximated with only a few triangles except around the trim curves, where many triangles would be used to ensure a smooth edge.

The same analogy applies to a simple surface with a complex displacement map. For that case, you might apply a low-quality regular surface approximation in conjunction with a high-quality displacement approximation, to ensure that triangles are added only to areas where they are needed to capture the complexity of the displacement map.

<b>This node type...</b>	<b>Does this...</b>	<b>To only this type of geometry...</b>
Surface Approximation	Determines how NURBS surfaces are tessellated into triangles for rendering.	NURBS surfaces
Trim Curve Approximation	Controls the tessellation of trim curves on NURBS surfaces.	NURBS surfaces with trim curves
Displacement Approximations	Controls the tessellation of displacement maps on a surface. Whereas ordinary Surface Approximations only tessellate based on the underlying surface, Displacement Approximations additionally take into account features of the displacement map when tessellating.	NURBS or polygonal surfaces with displacement maps
Subdivision Approximation Available only if the mental matter (tm) library is loaded.	Control render-time smoothing of polymesh surfaces.	polygonal surfaces

## Approximation styles

An approximation style is the general subdivision scheme mental ray for Maya uses to break the surface into triangles. Some approximation styles work by repeatedly cutting the entire surface from end to end, while others are capable of adding triangles in a more localized fashion.

mental ray for Maya provides a few standard approximation styles (Grid, Tree, and Delaunay) and the Fine approximation style.

The standard approximation styles use as few triangles as possible to approximate a surface to achieve the quality you define in the approximation settings.

### Fine approximation

Fine approximation subdivides very complex surfaces (especially detailed displaced surfaces) into a large number of roughly uniformly-sized small triangles in order to guarantee a smooth result. To deal with the large number of triangles mental ray for Maya breaks the surface up into independent sub-objects that are each tessellated and cached separately, generating the triangles without consuming excessive amounts of memory.

This approximation style only supports the Spatial approximation method, which specifies the size of triangles to be generated.

**Note** Fine approximation cannot be used together with merging and connections (that is, when surfaces are stitched, there may be holes along the stitch.

<b>Geometry type</b>	<b>Can I use Fine approximation?</b>
polygon displacement	yes
NUBRS surface displacement	yes
subdivision surface displacement	yes

### 3 | Tessellation and Approximation

About > mental ray for Maya geometry types

<b>Geometry type</b>	<b>Can I use Fine approximation?</b>
NURBS surface approximations	yes
curves	no (because they are not tessellated to triangles)

#### How Fine Approximation works

To allow for Fine approximation, the granularity of mental ray for Maya's cache manager is reduced, whereby smaller units are formed by splitting objects into smaller sets. These sets can be individually tessellated without excessive memory requirements.

Fine approximations support a small subset of approximation techniques since the other styles exist only to trade off triangle counts vs. quality, which is no longer a problem for fine approximations:

### mental ray for Maya geometry types

Maya supports three types of geometry: polygonal (Polygon Mesh), free-form objects (NURBS curves/surfaces), and subdivision surfaces.

#### NURBS (free-form curves and surfaces)

Free-form NURBS curves and surfaces in Maya are supported by mental ray for Maya. These surfaces, which can have a boundary and several holes, are expressed as trim and hole curves in the mental images surface definition.

#### Polygonal meshes

Maya polygonal meshes are exported as mental images polygon objects and support features like vertex sharing, holes, and displacement refinement. Displacement mapping can be applied to meshes. The special displacement properties for polygon surfaces are controlled in much the same way as NURBS surfaces.

Polygonal meshes that consist only of triangles or quadrangles can be exported as a subdivision surface base mesh for mental ray rendering.



## 3 | Tessellation and Approximation

### How do I? > Subdivision surfaces

To export a polygonal mesh for rendering, you must create and attach a Subdivision approximation node to the mesh. This node lets you further control the subdivision process and quality. Additionally, you can create and attach a Displace Approximation node to support the displacement of the mesh.

If mental ray for Maya encounters a Subdivision approximation node, it is exported as a mental images subdivision surface base mesh (including textures and motion vectors, but without normals) instead of a simple polygonal mesh.

If the conversion fails (because other than triangles/quadrangles were found), an error message is printed and the mesh is exported as usual.

### Subdivision surfaces

Maya's subdivision surfaces are supported in mental ray for Maya as long as the base mesh is made up of only quads.

The support for subdivision surfaces includes hierarchical edits, hierarchical material assignments, edge and vertex full creases only, uncreases, texture reference objects, deformation motion blur, and derivatives (for bump mapping and texture filtering). Unlike Maya, however, mental ray for Maya can handle only quadrilateral base meshes (a number of Maya standard subdiv shapes are therefore rejected), and UV coordinates can only be specified on the base mesh (level 0).

To prepare subdivision surfaces not directly supported (for example, where the base mesh does not contain only quads), see "Obtain quads for subdivision surfaces" on page 61.

## How do I? Tessellate objects

### Tessellate NURBS surfaces

### View Maya tessellation settings for an object

See "Primary vs. secondary tessellation passes" on page 44 for information on Maya's default tessellation settings.

#### To view Maya tessellation settings for an object

- 1 Select the object whose tessellation settings you want to view.
- 2 Open the Attribute Editor (CTRL+a).
- 3 Click the shape tab (for example, nurbsSphereShape1).

### 3 | Tessellation and Approximation

How do I? > Adjust NURBS tessellation settings

The shape node's attributes appear.

- 4 Expand the Tessellation section.

## Adjust NURBS tessellation settings

**Note** Some of the advanced tessellation parameters can dramatically increase rendering times.

Because the tessellation of NURBS surfaces has nothing to do with the material assigned to the surface (unless the surface is displacement mapped), you can start adjusting tessellation early in the process, anytime after the object is modeled.

### To adjust tessellation on NURBS objects

- 1 Determine which objects in the scene you have to adjust tessellation settings.  
See "Determine which objects to tessellate" on page 51.
- 2 Display the tessellation triangles so you can visualize your adjustments.  
See "Display NURBS tessellation triangles" on page 51.
- 3 Select the object(s) for which you want to adjust tessellation.  
If you want to apply settings to All surfaces, skip this step.
- 4 Select Render > Set NURBS Tessellation >  to open the Set NURBS Tessellation window.
- 5 Choose either Selected Surfaces or All Surfaces (see Selected Surfaces, All Surfaces).
- 6 Switch the Tessellation Mode from Automatic (default) to Manual Mode.  
(You can also adjust some of the Automatic tessellation settings to optimize the default settings. See "Automatic Mode settings" on page 258.)
- 7 Select either Basic or Advanced tessellation.  
Always start with the Basic settings. Basic lets you adjust a smaller number of settings that automatically determine some of the more advanced settings.

**Note** Some of the advanced tessellation parameters can dramatically increase rendering times, so choose them wisely.

### 3 | Tessellation and Approximation

#### How do I? > Determine which objects to tessellate

- 8 Test render to see the results.
- 9 Fine-tune the adjustments you've just set until you reach an adequate level of smoothness.

**Tip** To prevent overtessellation of objects, use the Use Smooth Edge attribute in the Render > Set NURBS Tessellation window to increase tessellation only along the edge of the object.

## Determine which objects to tessellate

What models are going to be used are usually determined during the pre-production phase of a project. Based on storyboards, you will know their positions in the scene and distance to the camera.

Determine which objects never get close to the camera and which ones either are (for static images) or do (for animated objects).

- If an object is far from the camera at all times, decrease the default settings.
- If the object is middle distance away from the camera, leave the default settings.
- If the object gets close to the camera at some point during the scene, increase the tessellation settings a little more, but only enough to achieve an acceptable level of smoothness.

## Display NURBS tessellation triangles

### To display tessellation triangles

- 1 Select the NURBS surface(s) you want to see.
- 2 In the Tessellation section of the NURBS object's Attribute Editor, turn on Display Render Tessellation.

## Use span-based tessellation

### To use span-based tessellation

- In the Tessellation section of the surface's Attribute Editor, turn on Enable Advanced Tessellation and set Mode U and Mode V to Per Span # of Isoparms. Guidelines are as follows:

### To use span-based tessellation

- Turn on Smooth Edge. Open the Options section of the Attribute Editor to access the Smooth Edge check box.

### **3 | Tessellation and Approximation**

How do I? > Adjust polygonal tessellation

#### **Tessellate polygonal surfaces**

##### **Adjust polygonal tessellation**

###### **To set polygonal tessellation**

- 1** Select the polygonal object for which you want to set tessellation.
- 2** Click Window > Attribute Editor Tessellation section to adjust the attributes.

#### **Tessellate subdivision surfaces**

##### **Display subdivision surface tessellation triangles**

###### **To see subdivision surface tessellation triangles**

- 1** Select the object
- 2** Click Modify > Convert > Subdiv To Polygons to convert the subdivision surface to a polygonal surface to use as a temporary visualization object.

##### **Adjust subdivision surface tessellation**

###### **To set subdivision tessellation**

- 1** Select the subdivision object for which you want to set tessellation.
- 2** Click Window > Attribute Editor Tessellation section to adjust the attributes.

#### **Work with mental ray for Maya approximation**

##### **Create an approximation node**

- 1** Select the geometry to which you want to assign an approximation node.  
For compatible geometry types, see "Approximation nodes" on page 45.
- 2** Click Window > Rendering Editors > mental ray > Approximation Editor.

The Approximation Editor opens. For more information on the Approximation Editor see, "Approximation Editor" on page 62.

## 3 | Tessellation and Approximation

### How do I? > Assign an approximation node

- 3 Click the Create button for the type of approximation node you want to create.

For descriptions, see "Approximation nodes" on page 45.

The approximation node is created and assigned to the selected geometry.

#### Related topics

- ❖ "Approximation nodes" on page 45
- ❖ "Assign an approximation node" on page 53
- ❖ "Edit an approximation node" on page 54

## Assign an approximation node

**Note** When you create an approximation node, it is automatically assigned to selected geometry. Use this procedure to assign already created approximation nodes to newly selected geometry.

- 1 Select the geometry to which you want to assign an approximation node.  
For compatible geometry types, see "Approximation nodes" on page 45.
- 2 Click Window > Rendering Editors > mental ray > Approximation Editor.  
The Approximation Editor opens. For more information on the Approximation Editor see, "Approximation Editor" on page 62.
- 3 From the dropdown list for the type of approximation node, select the node you want to assign.  
For descriptions, see "Approximation nodes" on page 45.
- 4 Click Assign.  
The approximation node is assigned to the selected geometry.

#### Related topics

- ❖ "Approximation nodes" on page 45
- ❖ "Create an approximation node" on page 52
- ❖ "Edit an approximation node" on page 54

### 3 | Tessellation and Approximation

How do I? > Edit an approximation node

## Edit an approximation node

**Note** When you create an approximation node, it is automatically assigned to selected geometry. Use this procedure to assign already created approximation nodes to newly selected geometry.

- 1 Click Window > Rendering Editors > mental ray > Approximation Editor.  
The Approximation Editor opens. For more information on the Approximation Editor see, "Approximation Editor" on page 62.
- 2 From the dropdown list for the type of approximation node, select the node you want to edit.  
For descriptions, see "Approximation nodes" on page 45.
- 3 Click Edit.  
The approximation node's Attribute Editor opens.
- 4 Edit the attributes

#### Related topics

- ❖ "Approximation nodes" on page 45
- ❖ "Create an approximation node" on page 52
- ❖ "Edit an approximation node" on page 54

## Override approximation settings

For complex scenes, many different approximation nodes with unique settings may be needed to ensure accurate and efficient renderings.

When previewing such scenes, you can temporarily lower the tessellation quality to produce low-quality renderings more quickly with global (scene-wide) overrides.

#### To override approximation settings

- 1 Click Window > Rendering Editors > Render Globals.  
The Render Globals Settings window opens. For more information, see "Render Global Settings window" on page 159.

In the mental ray Options (Quality) settings, the Overrides > Tessellation tab provides controls for specifying surface and displacement approximations to use for rendering. When specified, these settings

### 3 | Tessellation and Approximation

#### How do I? > Setting Fine approximation cache limit

override all approximation assignments in the scene. Selecting None will cause mental ray for Maya to once more respect the approximation assignments in the scene.

## Control Fine approximation triangles

### Setting Fine approximation cache limit

Fine displacement critically depends on the specification of a cache size limit, because otherwise the fine tessellation results would not flow through the cache but accumulate until memory runs out. mental ray has a default cache limit of 512 MB.

A good choice is half the amount of physical RAM, or 500-800 MB on 32-bit machines, whichever is smaller. If the number is too large, the operating system may run out of virtual address space; if it is too small, mental ray will perform too many cache flush operations.

## Control Fine approximation triangles

Choose one of the following techniques to control fine displacement. These help you avoid the risk of accidentally creating billions of triangles until memory runs out, without juggling a large number of displacement-mapping parameters.

When you use Fine approximation, you must choose one of these techniques:

#### view length

Specifies that all triangles should be subdivided until they are smaller than *edge* pixel diagonals. The *edge* value is typically around 0.5, or 0.25 or even 0.1 for very high quality. This technique is recommended for all fine approximations.

#### length

Specifies that the triangle edge length should stay under *edge* units in the object's object space. The *edge* parameter needs more careful tuning than in the view-dependent case, and very high values defeat the purpose of fine approximation.

#### parametric

Tessellates a free-form surface such that all microtriangles have the same size. This results in very regular meshes but is harder to optimize, and may use significantly more memory.

This lets you define triangle size as a fraction of the surface size, instead of in object or screenspace mode.

### 3 | Tessellation and Approximation

How do I? > Tweak Approximation node settings

## Tweak Approximation node settings

For each approximation setting, there are various settings, including tessellation method and style, that determine how the renderer tessellates objects at render time. You can manually change these settings or choose from a list of presets to simplify the process.

### Approximation method

#### Parametric approximation

Subdivides each patch of the surface into equal-sized pieces in the U direction and V direction.  
Regular parametric

Curves are subdivided into equal pieces by the parametric approximation and into subdiv equal pieces by the regular parametric approximation.

For displacement mapped polygons and displacement mapped surfaces with a displace statement regular parametric has the same meaning as parametric in the approximation. For displacement mapped polygons the  $u\_subdiv$  constant specifies that each edge in the triangulation of the original polygon is subdivided for the displacement  $2u\_subdiv$  times. If a displace approximation is given for a displacement mapped surface, the initial tessellation of the underlying geometric surface is subdivided in the same way as for polygons. For example, a value of 2 leads to a fourfold subdivision of each edge. Non-integer values for the subdivision constant are admissible. Nothing is done if the expression above is smaller than 2 (if  $u\_subdiv < 1$ ). The  $v\_subdiv$  constant is ignored for the parametric approximation of displacement maps.

### Length/distance/angle (LDA) approximation

specifies curvature-dependent approximation according to the criteria specified by the Length, Distance, and Angle attributes.

### Spatial approximation

A special case of an LDA approximation that specifies only the length attribute and optionally the view attribute.

### Curvature



### 3 | Tessellation and Approximation

#### How do I? > Tweak Approximation node settings

A special case of LDA approximation, equivalent to the distance attribute, the angle attribute, and optionally the view attribute statement.

#### Approximation Style

Tree, Grid, and Delaunay approximation algorithms are available for surface approximation only; they have no effect on curve approximations. Parametric approximation always uses the Grid algorithm; all other Approximation methods can any style but Tree is the default.

Grid	Tessellates on a regular grid of isolines in parameter space.
Tree	Tessellates in a hierarchy of successive refinements that produces fewer triangles for the same quality criteria.
Delaunay	Creates a successive refinement that maximizes triangle equiangularity. Delaunay triangulation creates more regular triangles but takes longer to compute.

#### U Subdivisions, V Subdivisions

These values are used by the Parametric approximation and Subdivides each patch of the surface into equal-sized pieces in the U direction and V direction. Regular parametric approximation methods. They specify how many times each patch (for Parametric) or surface (for Regular Parametric) should be subdivided in the U and V directions

#### Min, Max

When using the Length/distance/angle (LDA) approximation adaptive approximation method, these attributes can be used to control the minimum and maximum number of times that triangles in the tessellation are subdivided. The Max Subdivisions parameter is especially useful for preventing runaway situations where the approximation method wants to add many triangles to an area where they will not greatly improve the quality of the tessellation.

You can obtain good results with a Max Subdivisions value as low as 3. Generally, each subdivision level can increase the triangle count by a factor of 4, so raising the Max Subdivisions from 3 to 4 can produce 4 times as many triangles. Raising it to 5 can produce 16 times as many triangles, raising it to 6 can produce 64 times as many triangles, and so on.

### 3 | Tessellation and Approximation

#### How do I? > Tweak Approximation node settings

##### Max triangles

This setting only applies to the Delaunay approximation type. It determines the maximum number of triangles that the final tessellation may contain.

##### Grading

Applies only to Delaunay Approximation style.

Varies the density of triangles around the border of the surface, allowing for a smooth transition between a fine curve approximation and coarser surface approximation. It prevents a large number of tiny triangles at the trimming or hole curve to abruptly join very large triangles in the interior of the surface.

The angle constant specifies a lower bound related to the degree of the minimum angle of a triangle. Values from 0.0 to 30.0 can be specified. Small values up to 20.0 are recommended. The default is 0.0. High grading values require you to specify a maximum number of triangles (see Max triangles) to prevent too many triangles or endless mesh refinement.

##### Length

Subdivides the surface or curve so that no edge length of the tessellation exceeds the edge parameter. Edge is given as a distance in the space the object is defined in, or as a fraction of a pixel diagonal in raster space if the view keyword is present. Small values such as 1.0 are recommended.

For Tree and Grid approximation the Min, Max and Min, Max values (if specified), specify the minimum and maximum number of recursion levels of the adaptive subdivision. Min enforces a minimal triangulation fineness with no tests. Edges are further subdivided until they satisfy the given criterion or the max subdivision level is reached.

The defaults are 0 and 5, respectively; 5 is a very high number. Good results often occur with a maximum of 3 subdivisions.

For Delaunay approximation, Min, Max specifies the maximum number of triangles of the surface tessellation. This number is exceeded only if required by trimming, hole, and special curves because every curve vertex must become part of the tessellation regardless of the specified maximum.

For displacement mapped polygons and displacement mapped surfaces, length limits the size of the edges of the displaced triangles and ensures that at least all features of this size are resolved. Subdivision stops as soon as an edge satisfies the criterion or when the maximum subdivision level is reached.

### 3 | Tessellation and Approximation

#### How do I? > Tweak Approximation node settings

##### Distance

Specifies the maximum distance between the tessellation and the actual curve or surface. The value of `dist` is a distance in the space the object is defined in, or a fraction of a pixel diagonal in raster space if the `view` statement is present.

As a starting point, a small distance such as 0.1 is recommended. For Tree and Grid approximation the `min` and `max` parameters, if present, specify the minimum and maximum number of recursion levels of the adaptive subdivision. For Delaunay approximation, the number `max` following the keyword `max` specifies the maximum number of triangles of the surface tessellation.

For displacement mapped polygons and displacement mapped surfaces with a `displace` approximation statement the distance criterion cannot be used in the same way because the displaced surface is not known analytically. Instead, the displacements of the vertices of a triangle in the tessellation are compared. The criterion is fulfilled only if they differ by less than the given threshold. Subdivision is finest in areas where the displacement changes. For example, if a black-and-white picture is used for the displacement map the triangulation will be finest along the borders between black and white areas but the resolution will be lower away from them in the uniformly colored areas. In such a case one could choose a moderately dense parametric surface approximation that samples the displacement map at sufficient density to catch small features, and use the curvature-dependent `displace` approximation to resolve the curvature introduced by the displacement map. Even if the base surface is triangulated without adding interior points, as if its trim curve defined a polygon in parameter space, it is still possible to guarantee a certain resolution by increasing the `min` subdivision level. Only the consecutive subdivisions are then performed adaptively.

##### Angle

The `angle` statement specifies the maximum angle in degrees between normals of adjacent tiles of a displaced polygon or the tessellation of a surface or its displacement or between tangents of adjacent segments of the curve approximation. Large angles such as 45.0 are recommended. For tree and grid approximation the `min` and `max` parameters, if present, specify the minimum and maximum number of recursion levels of the adaptive subdivision. For Delaunay approximation, the number `max` following the keyword `max` specifies the maximum number of triangles of the surface tessellation.

### 3 | Tessellation and Approximation

How do I? > Tweak Approximation node settings

Any Satisfied

View dependent

Controls whether the edge argument of the length and spatial statements and the dist argument of the distance and curvature statements are in the space the object is defined in or in raster space.

Turn this on to express the Length and Distance attribute values in pixels instead of object-space units (the default). The advantage of using view-dependent values is that objects that are close to the camera receive many triangles, while objects that are far away (or not visible at all) are approximated much more coarsely.

**Length** If the View Dependent attribute is turned on, this value is specified in pixels, otherwise it is specified in object-space units. The Length criterion is especially useful in conjunction with view dependency. For example, a view-dependent value of Length = 0.5 means subdivide until all triangles are no bigger than half a pixel in the resulting image. If the Length attribute is set to 0.0, this criterion is ignored by the tessellator.

**Distance** If the View Dependent flag is turned on, this distance is expressed in pixels, otherwise it is expressed in object-space units. The lower the value, the more closely the tessellated surface will match the exact NURBS surface. Small values such as 0.1 work well (with view dependency disabled). If the Distance attribute is set to 0.0, this criterion is ignored by the tessellator.

Spatial

The Spatial approximation method is the same as the Length criteria from the Length/Distance/Angle method. Using this method, the mesh will be subdivided until all triangles are less than a certain size, determined by the Length attribute. This value is expressed in either pixels or object-space units, as determined by the View Dependent flag. This method is the only one available when using the Fine approximation type.

Sharp

Controls normal-vector calculations. If set to 0.0, mental ray for Maya uses the interpolated normal, as specified by the base surface, modified by displacement if available. If set to 1.0, mental ray for Maya uses the geometric normal to achieve a sharp faceted look

### 3 | Tessellation and Approximation

How do I? > Create, edit, assign approximation nodes

#### Create approximation nodes

#### Create, edit, assign approximation nodes

##### To create an approximation

- 1 Select Window > Rendering Editors > mental ray > Approximation Editor to open the Approximation Editor window.
- 2 Select the object.
- 3 Click the Create button next to the desired approximation type (Surface, Trim Curve, or Displace).

An approximation node is created and assigned to the selected object. The Attribute Editor is opened with the new approximation node's attributes.

##### To edit an approximation

- 1 Open the Approximation Editor if it's not already open (Window > Rendering Editors > mental ray > Approximation Editor).
- 2 Select the object if it's not already selected.
- 3 Click the Edit button in the Approximation Editor.

##### To assign an approximation to another object

- 1 Open the Approximation Editor if it's not already open (Window > Rendering Editors > mental ray > Approximation Editor).
- 2 Select the object if it's not already selected.
- 3 Select the desired approximation from the approximation type drop-down list and click the Assign button next to the approximation type drop-down list.

#### Obtain quads for subdivision surfaces

For more information about mental ray for Maya geometry types, see "mental ray for Maya geometry types" on page 48.

##### To get quads everywhere in a rejected subdivision surface

- 1 Select Subdiv Surfaces > Collapse Hierarchy > .
- 2 Set Number of levels to 1.
- 3 Click Apply.

## Reference Windows and Editors

### Approximation Editor

#### Derive from Maya

The default setting for mental ray for Maya approximation (see also “Derive from Maya (default approximation) settings” on page 45). This setting uses the Fine displacement approximation setting. This advanced technique produces memory-efficient tessellations that capture extremely fine details in displacement maps. By default, the algorithm is set to use a view-dependent technique that tessellates details as small as 1 pixel across.

### Surface Approximation settings (Attribute Editor)

The following settings appear when an approximation node is selected in the Approximation Editor, or when an object to which an approximation node has been assigned is selected in the scene view.

Most of these settings are similar to other types of approximation nodes: trim curve, and displacement approximations.

#### Presets

This dropdown list provides many useful preset tessellation settings.

You can select an item from this list to load the preset values for the approximation node's attributes. You can use these settings as-is, or as a starting points for tweaking. By default, the Presets tab is set to Custom, which means that you have control over all approximation attributes.

#### Parametric Grid (Low/Medium/ High Quality)

Uses the *Parametric* approximation method to tessellate a surface into triangles. With this method, each patch (area between isoparms) is subdivided into a fixed number of triangles.

Use this preset to produce tessellations where triangles are distributed roughly according to the spacing of isoparms on the surface, with closer isoparms producing higher triangle densities.

### 3 | Tessellation and Approximation

#### Reference > Surface Approximation settings (Attribute Editor)

Regular Grid  
(Low/Medium/  
High Quality)

Uses the *Regular Parametric* approximation method, where the surface as a whole is subdivided into a fixed number of triangles (instead of each patch, as is the case with the Parametric method).

Use this preset to ensure an even triangulation over surfaces where the spacing of isoparms is uneven.

Angle Detailed  
(Low/Medium/  
High Quality)

Uses an adaptive tessellation method in which more triangles are added to areas of high curvature. The goal of this method is to add triangles where they are needed to capture sharp features, while at the same time using just a few triangles in large, flat areas where they are not needed.

Pixel Area (Low/  
Medium/High  
Quality)

Tessellates surfaces based on their size (in pixels) in the final rendered image. Surfaces that are close to the camera will be tessellated heavily, while surfaces that are far away from the camera will receive coarser tessellations. The goal of this preset is to focus the most attention on surfaces that are more significant to the final image.

#### Approx Style

Determines the general subdivision scheme that is used to break the surface into triangles. For examples, see "Approximation styles" on page 47.

Grid

Works on a grid of isolines that allows subdivision only by adding more isolines. Since isolines always run from one edge of the surface to the opposite edge, and since only whole isolines can be added, this produces regular triangle meshes which can sometimes contain many more triangles than necessary.

Tree

Specifies a hierarchical subdivision style that allows local subdivisions without affecting other areas. The local subdivisions are similar to the Grid method, but do not cross over to other surface patches.

Delaunay:

Specifies a mesh refinement technique based on Delaunay triangulation, which attempts to maximize triangle compactness and to avoid thin

### 3 | Tessellation and Approximation

Reference > Surface Approximation settings (Attribute Editor)

triangles. Triangle vertices are generally not restricted to rectangular isoline grid points as in the Grid and Tree styles. The Delaunay style is supported only for free-form surfaces (NURBS), not for polygons. The "Max Triangles" and "Grading" attributes can be used to fine-tune tessellations using the Delaunay style.

**Fine** Subdivides surfaces into a large number of roughly uniformly-sized small triangles in order to guarantee a smooth result. To deal with the large number of triangles resulting from this approximation style, mental ray breaks the surface up into independent sub-objects that are each tessellated and cached separately. This allows the tessellator to generate a large number of triangles without incurring a huge memory cost. This approximation style is similar to the one used by Pixar's Renderman software, and only supports the "Spatial" approximation method, which specifies the size of triangles to be generated.

#### Approx Method

Determines the criteria that the tessellator uses for determining when to subdivide a part of the surface. Some approximation methods simply break the surface into a fixed number of triangles, while others use adaptive criteria to iteratively add more and more triangles until some condition is satisfied.

**Parametric** This method is driven solely by the "U Subdivisions" and "V Subdivisions" attributes. Each patch is subdivided into N triangles, where

$$N = (U \text{ Subdivisions}) * (V \text{ Subdivisions}) * \text{degree}^2 * 2$$

Thus, with U Subdivisions set to 1.333 and V Subdivisions set to 4 on a degree-3 NURBS surface, each patch will be subdivided into  $1.333 * 4 * 3 * 3 * 2 = 96$  triangles.

**Regular Parametric** This method is also driven solely by the "U Subdivisions" and "V Subdivisions" attributes. With this method, though, the surface as a whole is subdivided into N triangles, where

$$N = (U \text{ Subdivisions}) * (V \text{ Subdivisions})$$



### 3 | Tessellation and Approximation

#### Reference > Surface Approximation settings (Attribute Editor)

With this method, the density of triangles will be constant over the entire surface, unlike the Parametric method, which tessellates each patch independently.

Length/  
Distance/Angle

This is an adaptive approximation method, meaning that the tessellator continually subdivides the surface until certain criteria are met. There are 3 criteria:

**Length:** Subdivide until no triangle has an edge longer than a certain length. The **Length** attribute is used to specify this desired edge length. If the **View Dependent** attribute is turned on, this value is specified in pixels, otherwise it is specified in object-space units. The Length criterion is especially useful in conjunction with view dependency, for example a view-dependent value of Length=0.5 means subdivide until all triangles are no bigger than half a pixel in the resulting image. If the Length attribute is set to 0.0, this criterion is ignored by the tessellator.

**Distance:** Subdivide until the resulting triangles are at no point further than a certain distance away from the exact NURBS surface. The Distance attribute is used to specify the desired distance. If the View Dependent flag is turned on, this distance is expressed in pixels, otherwise it is expressed in object-space units. The lower the value, the more closely the tessellated surface will match the exact NURBS surface. Small values such as 0.1 work well (with view dependency disabled). If the Distance attribute is set to 0.0, this criterion is ignored by the tessellator.

**Angle:** Subdivide until the normals of neighboring triangles form an angle of less than a certain tolerance. The Angle attribute specifies the angular tolerance. The Angle value should be chosen carefully, as small values can cause the number of triangles to increase rapidly. 45 degrees is a good starting point. If this value is set to 0.0, then this criterion is ignored by the tessellator.

There are several other attributes that influence the Length/Distance/Angle approximation method:

### 3 | Tessellation and Approximation

Reference > Surface Approximation settings (Attribute Editor)

**View Dependent:** When enabled, means that the Length and Distance attribute values are assumed to be expressed in pixels. Otherwise, these values are assumed to be expressed in object-space units. The advantage of using view-dependent values is that objects that are close to the camera will receive many triangles, while objects that are far away (or not visible at all) will be approximated much more coarsely.

**Any Satisfied:** When more than one of the Length/Distance/Angle criteria are enabled, this flag determines when subdivision will stop. If Any Satisfied is enabled, then subdivision stops when any one of the criteria is satisfied (i.e. triangles are smaller than a certain size **OR** distance from the surface is less than a certain amount **OR** angles between triangles are less than a specified amount). If Any Satisfied is disabled, then subdivision continues until *all* criteria are satisfied (i.e. triangles are smaller than a certain size **AND** distance from the surface is less than a certain amount **AND** angles between triangles are less than a specified amount).

**Spatial** The Spatial approximation method is the same as the Length criteria from the Length/Distance/Angle method. Using this method, the mesh will be subdivided until all triangles are less than a certain size, determined by the **Length** attribute. This value is expressed in either pixels or object-space units, as determined by the **View Dependent** flag. This method is the only one available when using the Fine approximation type.

**Curvature** This approximation method is the same as the Distance and Angle criteria from the Length/Distance/Angle method. This method is included for backwards compatibility only.

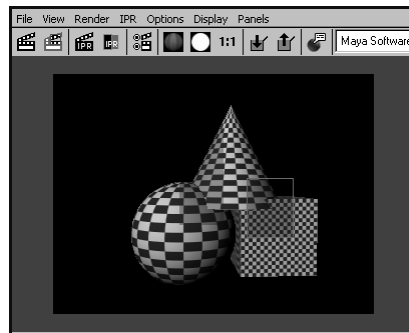
# 4 Visualize and render images

## About

## Rendering methods

### Interactive Photorealistic Rendering (IPR)

IPR is available only for Maya software rendering.



IPR, a component of the Render View rendering, lets you preview and adjust lights, shaders, textures, and 2D motion blur quickly and efficiently.

IPR is ideal for visualizing your scene as you work because it almost immediately shows the changes you make. You can also pause and stop IPR rendering and select several rendering options to be included or excluded from the IPR process. IPR works a little differently than regular software rendering; if you need to know more about how it works, see "How IPR works" on page 67.

IPR doesn't support all software renderable features (for example, raytracing or production quality anti-aliasing are not supported). See "IPR Limitations" on page 69.

### How IPR works

When you start an IPR session, Maya computes the initial IPR image, which is a *deep raster* format that contains more than just the final picture. Maya performs all the visibility calculations (only once), and stores the results in a file in the `iprImages` directory.

An IPR image is an IFF image with additional data. It is larger than a regular image file because it stores both visibility and shading data:

- Visibility calculations compute where items are located in the scene, or what is visible to the camera (or to the light, for depth maps for shadowing) at each pixel in the image.

## 4 | Visualize and render images

About > How IPR works

- Shading calculations compute what color is displayed at each pixel of the image.

**Note** An IPR image is not part of the scene file; it only represents what the scene looks like from a specific camera or light, at a specific time. You can re-use an IPR image as you work on the scene, but remember that the IPR image may be out of sync with the scene as you adjust it and move objects in the views.

The data in this format is used to efficiently adjust shading and lighting parameters in an interactive way.

To adjust IPR options, see "IPR Options" on page 180.

**Note** For advanced users:  
You can batch process IPR images ahead of time from the command line, so you can then adjust several frames of the same animation, in which the visibility data may vary from frame to frame.  
See "To batch render IPR files" on page 109 for details.

It takes longer to perform an IPR render than it does to perform a software render because more information is written to disk. The IPR image contains the information needed to perform the shading calculations for each pixel in the image as you adjust scene parameters.

When you select a region to adjust, Maya loads all the necessary information into memory for all the pixels in the selected region.

As you modify scene attributes, Maya re-computes the shading calculations and the selected region in Render View updates.

Since none of the visibility calculations have to be re-computed at this stage, tuning updates much faster than a full software rendering.

IPR images can be very large (for example, at NTSC Video resolution, a single IPR image could be up to 60MB). Make sure you have adequate disk space for your IPR image before you perform an IPR Render.

**Note** An IPR default light source (created during IPR rendering) works in a similar way to the software renderer's default, default light source.

- The IPR default light source is removed from the scene as soon as the IPR session is terminated (for example, when you click the IPR stop button).
- The IPR default light source is not saved with the scene, preventing you from accidentally adding the IPR default light to the saved scene.

For more information, see *"Default lighting in Maya"* on page 15 in the *Lighting* guide.

### IPR Limitations

For more information on IPR, see *"Interactive Photorealistic Rendering (IPR)"* on page 67.

#### Visibility limitations

Any change to an attribute that affects the visibility calculation, such as changing the camera angle, adding or removing a surface, or transforming CVs on a surface, requires another IPR render before you can see the effect of that change. Attributes that affect visibility are:

- Transformations applied to an object or camera (like moving an object or zooming the view, since moving an object or the camera may change what is visible at each pixel). This does not include lighting changes; they are supported.

#### Adding or removing surfaces, UV mapping values

If you add surfaces to or remove surfaces from the scene, or if you change the UV mapping values for a texture, you must perform another IPR render before you see the change. Examples of these kinds of changes include:

- When you select a new group of faces on a polygonal surface, even if the surface is already in the scene. In IPR, selecting a new group of faces to texture is equivalent to creating a new surface.
- Turning Fix Texture Warp on/off changes how UV mapping values are generated in an IPR render. This situation is analogous to modifying polygon UVs by changing their placement.
- Editing UVs in the texture window.

## 4 | Visualize and render images

About > IPR Limitations

### Changing image planes, shadow maps, background color

If you make changes to shadow map resolution, image planes, or background color, you must manually update the IPR tuning region (select IPR > Update Shadow Maps or IPR > Update Image Planes/Background).

### Features not supported by IPR

- raytracing effects (for example, transparency, reflection, refractions)
- particles
- 3D motion blur
- anti-aliasing: adaptive shading, multi-pixel filtering
- global override of Enable Depth Maps attribute (in the Render Global Settings window) does not function properly
- output to IFF (deep raster)

### Image plane limitations

- only supports file mode, not texture mode.
- Changes to file mode do not IPR render properly unless you turn on “Update Image Planes/Background” per change.

### Shader and Texture limitations

- Use Background shader is not well supported because it relies on raytracing.
- Modifying, adding, or deleting a displacement map applied to the geometry requires re-rendering.
- Turning on advanced filters (such as quadratic, cubic, or Gaussian) in the file texture requires re-rendering. Much more information needs to be stored into the IPR image, unless the render was originally generated with the advanced filter turned on.

### Geometry changes that require IPR re-rendering

- Adding or deleting geometry.
- Transforming or morphing geometry.
- Changing tessellation.
- Turning on/off Fix Texture Warp for the surface, or modifying any Fix Texture Warp attributes.

### Shadow changes that require IPR re-rendering

If you move a light, the shadow does not update.

Changes to the light’s attributes require the depth map to be regenerated if the shadows are to be correct in the following cases:

## 4 | Visualize and render images

About > Render View rendering

- Transforming the light.
- Turning on/off Use Auto Focus.
- Changing a Spot light's cone angle or penumbra attribute values.

**Tip** Consider using directional lights for preview rendering, especially when using IPR. These lights are easy to transform to get the initial light effect you need. Maya's default light is the directional light.

### Glow limitations

- Light glow intensity may appear different because the light glow occlusion is computed at the time of the IPR generation. If the light is moved where the light glow occlusion changes, an inaccurate glow intensity could result.
- Shader glow may look different because the IPR region (not covering the entire scene) produces a different auto-exposure normalization.

### Others

- Changing blur-by-frame does not update the IPR unless you re-render.
- 2D motion blur won't be exactly right because you work on a smaller region.

## Render View rendering

If you want to render a single frame (or a single frame of an animation), render it in Render View. Advantages include the following:

- easy to use
- Maya UI
- you can see the render as it occurs
- you can interrupt the render at any time

**Note** Large scenes or image files may run out of memory. In this case, use batch rendering to reduce memory usage.

To render in Render View, see:

- "Test render a low-res still or frame" on page 111.
- "Perform final renders from within Maya" on page 114.

## 4 | Visualize and render images

About > Batch renders from within Maya (UI)

### Batch renders from within Maya (UI)

If you want to render an animation, start a batch render from within the Maya UI. (You can also render a single frame this way.) Advantages include the following:

- easy to use
- you can continue to use the Maya UI
- you can start a batch render while you continue to work within Maya
- you can interrupt the render at any time from within Maya

To start a batch render from within Maya, see "Perform final renders from within Maya" on page 114.

For more detailed information on batch rendering, see "Overview of batch rendering" on page 93 in the Rendering Utilities guide.

### Command line renders

You can render from a command line if you want to render an animation or single frame.

Advantages include the following:

- works with single images and animation
- uses less memory than having all of Maya (UI) running
- can be scripted
- can be integrated into a rendering pipeline (render farms)
- for Maya software rendering, you can override render globals using command flags (for other renderers, you must also write a MEL script).

### Exporting .mi files

#### Scene Export Optimization Controls

Several controls let you manually optimize the process of exporting scenes to .mi format. The translator now recognizes a specific set of dynamic attributes that you can add to nodes to control how they are exported.

To export a .mi file, see "To export a .mi file and render with mental ray" on page 118.

You can accelerate the process of exporting scenes to .mi format by disabling deformation checking for objects that are known to be static over an animation (buildings, for example), and by disabling tangent vector export for objects that do not use bump mapping or other tangent-based shading effects.



### miDeformation

Controls whether or not the translator tries to detect deformation of an object.

To support per-object control of deformation determination and motion vector calculation of shape nodes, this dynamic attribute of type boolean is recognized. It overrides the global Export Shape Deformation option and either marks the current shape for or excludes it from deformation motion blur. Two common scenarios are supported:

- disable deformation globally but enable it for specific shapes
- enable deformation globally but disable it for specific shapes

### miTangents

Controls export of tangent vectors on objects.

To support per-object control of tangent vector calculation for polygon meshes and NURBS surfaces, this dynamic attribute of type boolean is recognized. It overrides the global Export ... Derivatives options and marks or ignores the current shape accordingly for tangents computation. Two common scenarios are supported:

- disable tangents globally but enable them for specific shapes
- enable tangents globally but disable them for specific shapes

The tangents are first order derivatives supplied as mental ray bump basis vectors. They are required for mayabase shader filtering and bump mapping purposes.

**Note** The command, `mayaexport_with_mr`, which is available on all platforms via a shell, allows you to perform an export from a Maya scene to an `.mi` file for rendering with mental ray standalone. For information on how to use the `mayaexport_with_mr`, type `mayaexport_with_mr -h` in a shell.

## Render output

### File formats

Maya can save rendered image files in several standard image file formats.

## 4 | Visualize and render images

### About > Bitmap vs. vector

By default, Maya saves rendered image files in the Maya Image File Format (Maya IFF). The Maya IFF is the most efficient format, in which no data loss occurs. All other file formats are translated from the Maya IFF format.

For information about the File format syntax, see "File name syntax" on page 78.

To set the file format, see "Set the rendered image file format" on page 93.

### Bitmap vs. vector

Maya can render and save an image in either bitmap or vector format. A bitmap image uses pixels (colored squares) arranged in a grid to describe the image. When you zoom into a bitmap image, you can see the jagged edges of individual pixels. Common bitmap formats include TIFF, GIF and BMP.

A vector image uses vectors (lines and curves) to describe the image. When you zoom into a vector image, lines and curves remain smooth. Common vector formats include SWF (Flash), AI (Adobe Illustrator) and SVG (Scalable Vector Graphics).

<b>Note</b>	If Image Format is SWF or SVG, an animation renders as a single file. Otherwise, an animation renders as a series of sequential files.
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<b>Note</b>	EPS files (generated by any application) do not import correctly into non-Adobe products (such as the Flash authoring application). EPS files import correctly into Adobe products. (SWF and AI files import correctly into the Flash authoring application.)
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### Details of supported file formats

Adobe Illustrator (ai)	This file format is available on Windows and Mac OS X only, and only when using the Maya Vector renderer. Adobe Illustrator (version 8) file format. When rendering to Adobe Illustrator format, the background color is always white.
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## 4 | Visualize and render images

About > Bitmap vs. vector

Alias PIX	<p>This file format is available on IRIX, Linux and Windows only.</p> <p>Alias pix file format. Maya saves the image, mask, and depth channels as separate files.</p>
AVI (avi)	<p>This file format is available on IRIX and Windows.</p> <p>On IRIX, the support is limited to approximately five codecs that SGI licensed from Microsoft (or other vendors) around 1996.</p> <p>On Linux, IMF does not support movie files.</p> <p>On Windows, IMF can handle only uncompressed AVI files.</p> <p>Microsoft Audio Video Interleaved movie file format. Maya can store a sequence of images in an AVI file. Maya only renders out uncompressed AVI files because anything else is lossy.</p>
Cineon (cin)	<p>This file format is available on IRIX, Linux and Windows.</p> <p>Cineon image file format. Maya does not create a mask file or channel.</p> <p>This is a format typically used for digital film, however, Maya does not use the 10 bit log encoding standard.</p>
Encapsulated PostScript (eps)	<p>Encapsulated PostScript file format.</p> <p>An EPS file can contain both bitmap and vector image information.</p> <p>When using the Maya Vector renderer (Windows and Mac OS X only), the rendered EPS file consists of a vector image.</p> <p>When using bitmap renderers, the rendered EPS file consists of a bitmap image. Maya saves the image and depth channels as separate files. (Maya does not create a mask file or channel.)</p> <p>When rendering to EPS format with the Maya Vector renderer, the background color is always white.</p>
GIF (gif)	<p>This file format is available on IRIX, Linux and Windows.</p> <p>Graphics Interchange Format typically used for web. Maya saves the image and depth channels as separate files. (Maya does not create a mask file or channel.) GIF images may be up to 8 bits (256 colors) in depth and are always compressed.</p> <p>Animated GIFs are not supported.</p>

## 4 | Visualize and render images

### About > Bitmap vs. vector

JPEG (jpg)	<p>Joint Photographic Experts Group file format. Maya saves the image and depth channels as separate files. (Maya does not create a mask file or channel.) The JPEG format is standard for compressed still images. JPEG uses DCT and offers data compression of between 5 and 100%. Three levels of processing are defined: baseline, extended, and lossless. Maya supports only JPEG formats containing RGB information; Maya does not support JPEG formats containing CMYK information.</p> <p>Compression is controlled by the environment variable <code>AW_JPEG_Q_FACTOR</code>. Setting it to 1 gives the lowest quality (most compression) and setting it to 100 gives the highest quality (least compression). The default value is 75.</p>
Macromedia Flash (swf)	<p>This file format is available on Windows and Mac OS X only, and only when using the Maya Vector renderer.</p> <p>Macromedia Flash Player (version 3, 4 or 5) file format (non-interactive).</p>
Maya IFF (iff)	<p>Maya Image File Format with 8 bits per color and mask channel. Additional channels (e.g. depth, motion vector data) are stored as floating point data.</p> <p>Maya saves the image, mask, and other channels in one file.</p>
Maya16 IFF (iff)	<p>Maya Image File Format with 16 bits per color and mask channel. Additional channels (e.g. depth, motion vector data) are stored as floating point data.</p> <p>Maya saves the image, mask, and other channels in one file.</p> <p>Not available when using the Maya Vector renderer.</p>
MacPaint (pntg)	Mac OS X only.
Photoshop (ps)	Mac OS X only. Adobe PhotoShop file.
PNG (png)	Mac OS X only.
Quantel (yuv)	<p>This file format is available on IRIX, Linux and Windows.</p> <p>Quantel image file format. Maya saves the image and mask channels in one file. The Quantel format outputs to YUV. Maya can only output Quantel format images at NTSC, PAL, or HDTV resolutions; if you select a different resolution, Maya saves rendered images in Maya IFF.</p>
QuickDraw (pict)	Native Macintosh file format.

## 4 | Visualize and render images

About > Bitmap vs. vector

QuickTime Image (mov)	<p>This file format is available only on IRIX and Mac OS X.</p> <p>On Mac OS X, all QuickTime image formats are supported, including any user-written or user-added QuickTime plug-in formats. For the Maya software renderer and the Maya Hardware renderer, QuickTime output supports over 20 different compression codecs for batch rendering and Playblast.</p> <p>Apple QuickTime movie file format. Maya can store a sequence of images in a QuickTime file.</p>
RLA (rla)	<p>This file format is available on IRIX, Linux and Windows.</p> <p>Wavefront image file format. Maya saves the image, mask, and depth channels in one file.</p>
Scalable Vector Graphics (svg)	<p>This file format is available on Windows and Mac OS X only, and only when using the Maya Vector renderer.</p> <p>Scalable Vector Graphics file format.</p> <p>When rendering to SVG format, the background color is always white.</p>
SGI (sgi)	<p>Silicon Graphics Image file format with 8 bits per color channel. Maya saves the image and mask channels in one file, and the depth channel as a separate file.</p>
SGI16 (sgi)	<p>This file format is available on IRIX, Linux and Windows.</p> <p>Not available when using the Maya Vector renderer.</p> <p>Silicon Graphics Image file format with 16 bits per color channel. Maya saves the image and mask channels in one file, and the depth channel as a separate file.</p>
SGI Movie	<p>This file format is only available on IRIX and Linux.</p> <p>SGI movie file format. Maya can store a sequence of images in an SGI Movie file. Maya only renders out uncompressed SGI Movie files as these are the most general for reading into other applications.</p>
SoftImage (pic)	<p>This file format is available on IRIX, Linux and Windows.</p> <p>SoftImage image file format. Maya saves the image and mask channels in one file, and the depth channel as a separate file.</p>
Targa (tga)	<p>Targa image file format. Maya saves the image and mask channels in one file, and the depth channel as a separate file.</p> <p>Not all Targa formats are supported.</p>

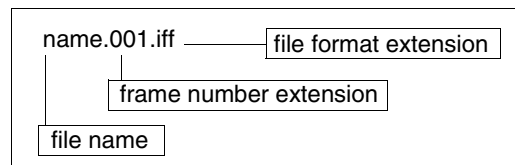
## 4 | Visualize and render images

About > File name syntax

Tiff (tif)	<p>Tagged-Image File Format with 8 bits per color channel. Maya saves the image and mask channels in one file, and the depth channel as a separate file. Maya generates TIFF files that use TIFF 6.0 compression. To generate uncompressed TIFF files, set the environment variable <code>IMF_TIFF_COMPRESSION = none</code> before starting Maya. (For more information on environment variables, see <i>"Setting environment variables using Maya.env"</i> on page 3 in the <i>Basics</i> guide.)</p> <p>Use uncompressed TIFF files when you intend to read the images into an application that requires uncompressed images or that supports the TIFF 4.0 standard.</p>
Tiff16 (tif)	<p>Not available when using the Maya Vector renderer.</p> <p>Tagged-Image File Format with 16 bits per color channel. Maya saves the image and mask channels in one file, and the depth channel as a separate file. Maya generates TIFF files that use TIFF 6.0 compression. To generate uncompressed TIFF files, set the environment variable <code>IMF_TIFF_COMPRESSION = none</code> before starting Maya. Use uncompressed TIFF files when you intend to read the images into an application that requires uncompressed images or that supports the TIFF 4.0 standard.</p>
Windows Bitmap (bmp)	<p>Windows bitmap image file format. RGB only. Doesn't support paletted images.</p> <p>Maya saves the image and depth channels as separate files. (Maya does not create a mask file or channel.)</p>

### File name syntax

The name of rendered image files can consist of three separate components: file name prefix, frame number extension, and file format extension. A combination of these three components is referred to as the file name *syntax*.



#### file name prefix

The base name for all image files in a scene.

## 4 | Visualize and render images

About > File output location

### frame number extension

Represents the frame at which the image was rendered.

### file format extension

Represents the file format of rendered images (see also "Set the rendered image file format" on page 93).

You can control how Maya names rendered image files in the Render Global Settings window. Whenever you change the file name, format of the frame number extension, or the file format extension, Maya updates the preview file name at the top of the Render Global Settings window. You can arrange the name, number extension, and format extension in different orders, with or without dot.

To set the file name, the frame number extension, or the file format extension, see "Set file name syntax" on page 93.

**Note** Using "." to delineate animated file texture names, may cause the wrong frame to be used for texture mapping.

Maya parsable, animated file textures should be of the form `xxx.ext.###`, where `xxx` is the filename, `ext` is an optional file extension (`sgi`, `tif`, `iff`, and so on), and `###` is the frame number.

It is also possible to use file textures of the form `xxx.###.ext`. We do not support `xxx###.ext` (without the "." between `xxx` and `###`), nor `xxx.yyy.###.ext` (but `xxx_yyy.###.ext` is fine).

## File output location

By default, Maya saves rendered images to the *images* directory of the current project. You can, however, change the location to save in any directory.

To set the file output location, see "Set rendered images output location" on page 95.

**Note** If you are rendering images with a mask or depth channel and the file format of rendered images does not support mask or depth channels, Maya may save the mask channel as a separate file in the *mask* directory of the current project, and the depth channel as a separate file in the *depth* directory of the current project.

## 4 | Visualize and render images

About > Pixel aspect ratio

### Pixel aspect ratio

A rendered bitmapped image file consists of numerous rectangular *pixels* (picture elements). The size of a rendered image is measured by the number of pixels it contains horizontally and vertically, and by the aspect ratio of individual pixels (whether pixels are square or rectangular).

Most display devices (for example, a computer monitor) have square pixels, and their Pixel Aspect Ratio is 1. Some devices, however, have non-square pixels (for example, NTSC video has a Pixel Aspect Ratio of 0.9).

To set the pixel aspect ratio, see “Set the resolution and pixel aspect ratio” on page 95.

### Resolution

Image resolution is the total pixel size of a bitmap image. For example, 720 x 486 for NTSC video output. Display resolution is the number of pixels in 1 inch on the screen. Display resolution is measured in pixels per inch (ppi). Most monitors have a display resolution of about 72 ppi. If your output is for print, consider a display resolution of around 300 ppi.

To set the pixel aspect ratio, see “Set the resolution and pixel aspect ratio” on page 95.

**Note** The terms pixels per inch (ppi), and dots per inch (dpi) are often interchanged freely. Pixels per inch, however, applies only to screen resolution, which display images in pixels. Dots per inch, applies only to paper-based images, which are printed with dots of color.

### Frames vs. Fields

Only the Maya software renderer supports field rendering.

Motion picture film and video simulate motion by displaying a continuous sequence of images or frames. There are, however, important differences in the way film and video systems display individual frames which may affect how you render images.

To render as frames or fields, see “Specify frame or field rendering” on page 98.



## 4 | Visualize and render images

About > Video system fields

### Video system fields

Most video systems display an individual frame in two stages—by illuminating half of the phosphors on a television screen (in NTSC every odd row beginning with the first row), and then illuminating the remaining half of the phosphors (every even row beginning with the second row). These two half-frames are known as *fields* and the process of displaying the two fields alternately is called *interlacing*.



Image courtesy of  
The Art of Maya

NTSC and PAL video systems both use interlaced fields. NTSC video systems display 30 frames per second, or 60 fields per second; PAL video systems display 25 frames per second, or 50 fields per second.

Because video systems display an individual frame in two

stages, if you render images as frames (that is, in one stage) and then display them on a video system, fast moving objects may appear jerky or choppy. If post-production process or final presentation formats involve interlaced video systems, render images as fields. (If your animation does not contain fast moving objects, you could try rendering images as frames.)

To properly view a frame or an animation rendered as fields, you must interlace the two fields together.

### Motion picture film frames

Motion picture film projectors display an entire frame in one brief instant by shining light through the film. Most motion picture film systems display 24 or 25 frames per second.

## 4 | Visualize and render images

About > Color, Depth, and Mask (alpha) channels

If your post-production process and final presentation format do not involve interlaced video systems, render images as frames.

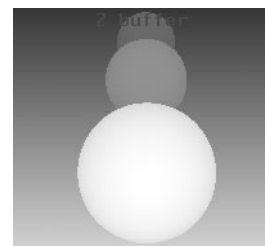
### Color, Depth, and Mask (alpha) channels



Color channels



Mask channels



Depth channels

Each pixel in a bitmap image contains three color channels, each of which represent the amount of red, green, or blue in the image. Each pixel might also have an alpha (mask) channel to achieve transparency and a depth channel that represents the distance from the camera.

By default, Maya generates an image file with three color channels and a mask channel.

To enable specific channels to rendered images, see "Enable color, depth, and mask channels for rendered images" on page 96.

**Note** Mask channels and depth channels are mainly used for compositing, so if you don't plan on compositing rendered images, you don't have to generate mask or depth channels (or files) during rendering.

The file size increases if an image contains a mask or depth channel. The computation time may also increase.

For information about mask and depth channels and files, see "Mask and depth channels" on page 84.s

### Pre Render MEL and Post Render MEL scripts

In some situations, you may want Maya to run a specific MEL command or script before rendering each frame, and another MEL command or script after rendering. For instance, if your scene contains a very large complex surface, which you do not want to work on, you could run a MEL command before rendering to display the surface (so it renders), and run another MEL command after rendering to hide the surface.

## 4 | Visualize and render images

About > Advantages and tips

To run Pre Render MEL scripts or Post Render MEL scripts, see “Run Pre Render MEL or Post Render MEL scripts” on page 99.

**Note** If you need to use multiple sets of quotations in the pre frame MEL or post frame MEL fields in Render Global Settings window, be sure to use \" for every quotation mark except the first and last. For example,

```
print("Time to render my Maya scene, called\"bingo.mb\"");
```

### Layers and passes

#### Advantages and tips

You can render individual objects, groups of objects on layers, or attributes (passes) of your scene, then combine them using a compositing system. Compositing is the process of combining multiple images into one.

(You can also render global illumination passes separately. )

To set up layers and passes, see “Set up layers and passes” on page 105.

#### Advantages of rendering in layers and passes

Rendering separate objects in layers and passes takes more time and effort to plan, but it offers the following advantages:

- More creative freedom.  
For example, you can render different layers with different render options. You can then color correct or add special effects to each rendered layer in a compositing application.
- Flexibility to accommodate unanticipated requests for changes.  
For example, you can change a ceramic vase to a glass vase without re-rendering the entire scene.
- Increased speed to meet production schedules.  
For example, you can quickly render the foreground layer where most changes occur, instead of the whole scene or background, where objects tend to be static. You can also render smaller portions of large scenes, reducing the load on computer memory.

#### General tips for rendering for compositing

- Plan to separate a scene into elements early in the production process.

## 4 | Visualize and render images

### About > Mask and depth channels

- If you plan on compositing rendered images, make sure the scene's background is black. To change the color of the background, see the Lights and camera's chapter.
- Understand the type of image that compositors require: pre-multiplied or not.

### Premultiplied images

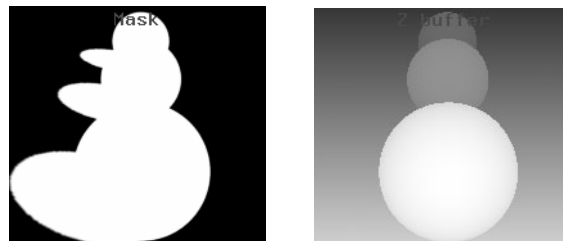
When an image is stored not only with the three basic color channels but also with the alpha channel, the presence of the alpha channel can modify the color channels to some degree. For example, typically the color channels have been multiplied by the value of the alpha channel to take transparency into consideration.

Some compositors (as well as games engines) can use pre-multiplied images; others require separate image and alpha information, especially when they want to separate object color data from background color data. By default, Maya pre-multiplies images, but you can turn pre-multiplication off.

To turn pre-multiplication on or off, see "Pre-multiply" on page 176.

### Mask and depth channels

During rendering, Maya software can generate an image file that contains color channels (RGB), a mask channel (RGBA), a depth channel (RGBZ) or a combination of the three (RGBAZ). For more information on color channels, see "Color, Depth, and Mask (alpha) channels" on page 82.



Some image formats cannot include embedded mask or depth channels; in these cases, Maya generates a separate mask or depth file.

By default, Maya generates an image file with three color channels and a mask channel. Mask channels and depth channels are mainly used for compositing. You can control the types of channels Maya includes in rendered image files. For instance, if you don't plan on compositing rendered images, you don't have to generate mask or depth channels during rendering.

To turn channels on or off, see “Enable color, depth, and mask channels for rendered images” on page 96.

### Mask channels

A *mask* channel (or alpha channel) defines where an image is opaque or transparent. Opaque regions of the objects are white, semi-transparent regions are gray, and transparent regions are black.

Use a mask channel to layer images for compositing software. For instance, you can use the mask channel of an image as a matte to composite an object (without its background) with another image.

### Depth channels

A *depth* channel (or Z depth or Z buffer channel) provides 3D information about an image. It represents the distance of objects from the camera.

Depth channels are used by compositing software. For instance, you can use the depth channel to correctly composite several layers while respecting the proper occlusions.

Maya stores depth values as  $-1/z$ . These represent the near and far clipping values.

### Arranging objects in order in 3D space

When you render in layers the compositing application must be able to tell which part of which object goes behind or in front of another one. Alpha channels do not contain this information, so you can use the Black Hole mode of the Matte Opacity feature in Maya to produce cutout regions composite correctly. See “Modify a mask channel” on page 97.

### Render layers

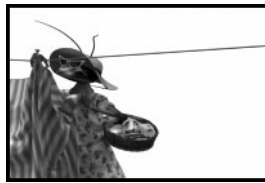
When you render in layers you render objects separately.

Rendering objects in layers is the process of separating objects into layers, then producing a different image for each layer. For example, the following scene was rendered as two separate elements—foreground and background character—and composited with a background image.

To set up layers and passes, see “Set up layers and passes” on page 105.

## 4 | Visualize and render images

About > Display vs. Render Layers



Foreground character



Background image



Background character

Composited scene



Consider the following strategies:

- render each object separately.
- render static objects (once for the entire animation) and moving objects separately.
- render foreground objects and background objects separately.
- render groups of interacting objects separately.
- render objects and shadows separately.
- render surfaces and volumetric effects (environment fog, light fog, particle effects, and volume shaders) separately.
- render objects and shadows independently. For instance, you can render an object so it does not cast shadows, but can receive shadows cast by other objects.

**Note** If you are raytracing a scene, it may be difficult to render elements of a scene separately because objects need to reflect and refract other objects.

### Display vs. Render Layers

If you create your entire scene on one layer (default), you can separate objects onto different Render layers before you render. If, during the modeling and animation phases you divided your scene into display layers, you can render these display layers separately.

## 4 | Visualize and render images

About > Render passes

To divide your scene into layers (or see if it already is divided), see “Set up layers and passes” on page 105.

You can also select specific objects to render or you can use a clipping plane to render only near (foreground) objects or far (background) objects.

For more information about clipping planes, see “Clipping planes” on page 34 in the *Rendering* guide.

### Render passes

When you render in passes, you render attributes of your scene differently. Rendering in passes gives you precise control over the color of objects and the shadows that fall on them.

Typically you render in passes to render various attributes, such as color, shadows, highlights, of your scene separately. You can fine-tune a scene without re-rendering it by modifying different passes in a compositing program.

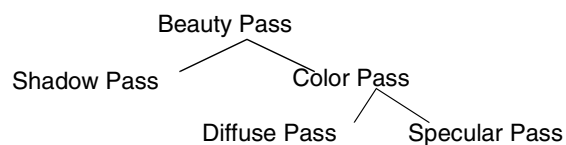
To set up render passes, see “Set up layers and passes” on page 105.

### Beauty pass

This is the default pass. The Beauty image is automatically produced by the renderer if Render Passes is disabled in the Render/Layer Pass Control section of the Render Global Settings window.



It produces a complete rendering of the components produced by a shadow pass and a color pass. Because the color pass produces a complete rendering of the components produced by a diffuse pass and a specular pass, a beauty pass ends up producing a complete rendering of *all* possible components.



## 4 | Visualize and render images

### About > Color pass

If you need to tweak shadows independently in a compositing package or paint application, run the color and shadow passes separately.

### Color pass

Produces only the color component of the image. No shadow information is produced.

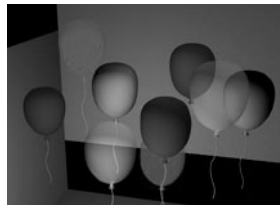
A color pass is subdivided into a diffuse and specular pass.

### Shadow pass

Produces only the shadow component of the image. No color information is produced.

### Diffuse pass

Only diffuse shading is performed. The diffuse pass contains the diffuse and ambient information and is modulated by color, transparency, and Diffuse Coeff (diffuse coefficient).



### Specular pass

Only specular shading is performed. The specular component is modulated differently depending on the type of material associated with the object. Phong, PhongE, Blinn, and Anisotropic materials produce specular contributions differently. On a Phong material, the specular pass can be modulated using cosine power, and specular color.



In this example, Phong, PhongE, Blinn, and Anisotropic materials are used.

**Note** No mask or alpha channel is produced for the Specular Pass, additively compositing a specular pass is recommended.



## 4 | Visualize and render images

### How do I? > Custom shadow and reflection passes

#### Custom shadow and reflection passes

You can also create custom shadow and reflection passes with the useBackground material which catches shadow and/or reflections. When the shadow pass is rendered, a black image is created with mask channel that contains the shadow information. A compositor can work with this channel to blur, lighten, darken, etc., the look of the shadows. When the reflection pass is rendered, an RGB image is created with a white mask in the mask channel.

To use the Use Background material to catch shadows and reflections, see *"Catch shadows for an alpha channel"* on page 73 in the *Lighting* guide.

## How do I? Visualize scenes and render images

### A typical rendering workflow

The exact workflow steps and the order in which you perform them vary. Rendering is an iterative process in which you tweak lights, textures, and cameras; adjust various scene and object settings; visualize your changes; then, when you are satisfied with the results, you render your final images.

Having shaded and textured objects in your scene (see *"Surface shading"* on page 15 in the *Shading* guide), set up lights (see *"Light and shadow in the real world"* on page 7 in the *Lighting* guide), and set up renderable cameras (optional, see *"Viewing cameras vs. rendering cameras"* on page 27), generally you do the following:

#### To render a scene

- 1 Decide which renderer you want to use, and set scene options for it:
  - For detailed information about each of Maya's renderers, see *"Renderers"* on page 15.
  - To select a renderer, see *"Select a renderer"* on page 25.
  - To learn more about some of the scene options you can set, see *"Set scene options"* on page 92. For detailed descriptions of the scene options, see *"Render Global Settings window"* on page 159.
- 2 If you plan to composite your work, you can render your scene in layers and passes.  
See *"Set up layers and passes"* on page 105.
- 3 Make any required per-object adjustments:

## 4 | Visualize and render images

How do I? > Choose a rendering method

- To adjust the surface quality (tessellation) of objects, see “Tessellate objects” on page 49.
  - To adjust per-object settings; for example, settings for lights, cameras, objects, see information on the particular object you want to adjust.
- 4** Test iterations of your scene to visualize your the changes you make materials, textures, lights, cameras, and objects.
- To visualize your changes as you make them, see “Visualize a scene” on page 107.
  - To diagnose scene problems, see “Diagnose scene problems” on page 141.
  - To optimize rendering speed image quality, see “Image quality and render speed” on page 131.
- 5** When you are satisfied with the results, render the final images.
- See “Perform final renders from within Maya” on page 114.
  - See “Perform command line rendering” on page 117.

## Choose a rendering method

### Visualize a scene

Though you can render a scene to see what it looks like, visualizing your scene in the following ways can be faster:

To...	Do this...
See changes to a still image or a single frame of an animation as you make them.	Use Interactive Photorealistic Rendering (IPR) IPR updates the display to show your most recent change, but there are limitations to what you can see. For more information, see “Interactive Photorealistic Rendering (IPR)” on page 67.

## 4 | Visualize and render images

How do I? > Perform a final render

To...	Do this...
See what a still image or single frame of an animation (or a region of it) looks like as the render occurs.	Use Render View, especially Render Region. Render View has fewer limitations than IPR, so you can see more, but it takes longer to render. Render regions of a scene to reduce the amount of time you spend visualizing the scene. For more information, see "Render View rendering" on page 71.
See lights, objects and textures in the scene view without rendering.	Use hardware texturing. This does not actually perform a render; it just lets you see an approximation of what your scene looks like when rendered. For more information, see "See shading and lights in a scene view" on page 110.
See what a fully rendered still image, single frame of an animation, or an animation looks like quickly.	Render at lower resolutions For more information, see "Test render a low-res still or frame" on page 111 and "Test render a low-res animation" on page 111.

### Perform a final render

To render...	Do this...
A still image or single frame of an animation	Use Render View. For more information, see "Render a single frame" on page 114.
A still image or single frame of an animation, or an animation	Batch render For more information, see "Batch render a still or animation" on page 115.

## 4 | Visualize and render images

How do I? > Open the Render Global Settings window

To render...	Do this...
A still image or single frame of an animation, or an animation	Command line render For more information, see "Command line render" on page 117.

### Set scene options

## Open the Render Global Settings window

The settings you use to produce your final rendered image or sequence of images depend on a number of factors, including:

- the renderer you use
- the medium to which you are outputting
- whether you are rendering in layers and passes for compositing
- whether you are preview rendering or producing the final rendered image(s)

**Note** The changes you make in the Render Global Settings window affect the entire scene. Often, it makes sense to adjust settings on a per-object setting.

Render globals for the Hardware renderer, the mental ray for Maya renderer, the Maya software renderer, the Maya Vector renderer are available from the Render Globals Settings window.

The Common tab of the Render Global Settings window contains the attributes common to most of the renderers, which decreases the number of parameters you need to modify when switching between renderers. Settings specific to the chosen renderer are available in a another tab.

For detailed descriptions of the settings in the Render Global Settings window, see "Render Global Settings window" on page 159.

### To open the Render Global Settings window

- Do one of the following:
  - Click Window > Rendering Editors > Render Globals.
  - Click the Display Render Globals Window button on the main toolbar or in Render View.
  - Choose Options > Render Globals in Render View.

## 4 | Visualize and render images

### How do I? > Render all or some objects from a camera

You can edit settings in the Common tab and the renderer-specific tab. For more information, see "Render Global Settings window" on page 159.

## Render all or some objects from a camera

By default, your scene has only one renderable camera (the original perspective camera) that renders all objects in your scene. You can change this to render only selected (active) objects in your scene.

If you add another camera to your scene and want to make it renderable (or you would like to make one of the default orthographic cameras renderable), you must set this camera to renderable (see "Make a camera renderable" on page 36).

### To render only active objects in your scene

- 1 In the Image File Output section of the Render Global Settings window, select the camera from the Camera drop-down list.
- 2 Select Render Active from the Render Objects drop-down list.

## Set the rendered image file format

Maya can save rendered image files in one of several standard image file formats. By default, Maya saves rendered image files in the Maya Image File Format (Maya IFF).

For a comprehensive list of supported file formats, see "File formats" on page 73.

**Note** For image formats that cannot include mask or depth channels, Maya generates a separate mask or depth file.

### To set the file format of rendered images

In the Image File Output section of the Render Global Settings window, select the Image Format from the drop-down menu.

## Set file name syntax

For information on the file name syntax, see "File name syntax" on page 78.

## 4 | Visualize and render images

### How do I? > Set file name syntax

**Note** You can also set the file name of rendered files when you render from a shell or command line, using `Render` and the `-im` option. See “Perform command line rendering” on page 117 for information about command line rendering.

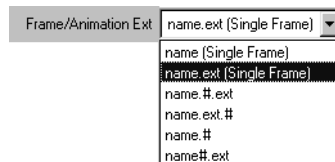
#### To set the file name (syntax) for rendered images

- In the Image File Output section of the Render Global Settings window, set:
  - File name prefix, (for example, *rocket*)

Option	Example
name	<i>rocket</i>
name.ext	<i>rocket.iff</i>
name.#.ext	<i>rocket.1.iff</i>
name.ext.#	<i>rocket.iff.1</i>
name.#	<i>rocket.1</i>
name#.ext	<i>rocket1.iff</i>

#### Important

- If you select an option that **does not** contain #, Maya renders a *single frame*.
  - If you select an option that **does contain** #, Maya renders an image sequence (*animation*). The top of the Render Global Settings window provides feedback for the output files.
- Frame/ Animation Ext to the combination and order of base name (*name*).



## 4 | Visualize and render images

### How do I? > Set rendered images output location

- File format extension (*ext*).
- Frame number extension (#) you want rendered files to have.
- Start Frame to the first frame you want to render and End Frame to the last frame you want to render.
- By Frame to the increment between frames you want to render.
- Frame Padding to the number of digits you want in frame number extensions.

#### To use a custom file format extension for rendered images

The file format extension is the standard file format extension for the current Image Format setting. To change that, in the Modify Extension section of the Render Global Settings window, turn on Use Custom Extension and type the extension you want to use.

### Set rendered images output location

For information on image file location, see "File output location" on page 79.

#### To set the location where rendered images are saved

- 1 From the main Maya window, select File > Project > Edit Current.
- 2 In the Project Data Locations section of the Edit Project window, change the directory for Images and click Accept.

**Tip** You can also set the location where rendered files are saved when you render from a shell or command line using *Render* and the *-rd* option.  
See "Perform command line rendering" on page 117 for information about command line rendering.

### Set the resolution and pixel aspect ratio

You can select from a list of preset render resolutions, or set the resolution options manually.

For details on resolution, see "Resolution" on page 80.

For details on pixel aspect ratio, see "Pixel aspect ratio" on page 80.

## 4 | Visualize and render images

How do I? > Enable color, depth, and mask channels for rendered images

### To set the resolution and pixel aspect ratio of rendered images

- In the Resolution section of the Render Global Settings window, select a preset Render Resolution (for example, 640 x 480).

If you do not see an appropriate preset Render Resolution, you must set the following attributes manually to output to an unlisted device.

- *Width, Height*
- *Pixel Aspect Ratio*

### Enable color, depth, and mask channels for rendered images

Color channels, depth and mask channels are generated by default. Each pixel in an image may consist of channels representing the amount of red, green, and blue, mask, depth in the image. If channels have been turned off, you can turn them back on.

For more information about mask channels, see “Mask and depth channels” on page 84.

**Note** During bump or displacement mapping, if an image file contains a mask channel, the mask channel is used for displacement and bump mapping. If the mask channel is absent, the luminance of the RGB is used to displace and/or bump map.

If you prefer to use the luminance information as the alpha, turn on the Alpha Is Luminance attribute (in the Color Balance section of the file texture’s Attribute Editor).

### To enable a channel to rendered images

- 1 In the Image File Output section of the Render Global Settings window, select the camera from which you want to render from the Camera drop-down list.
- 2 Do any of the following
  - Turn on RGB Channel (Color)
  - Turn on Alpha Channel (Mask)
  - Turn on Depth Channel (Z Depth)

### Create and view depth files

The depth channel represents the distance of objects from the camera.



## 4 | Visualize and render images

How do I? > Modify a mask channel

### To create a Depth file

- 1 Turn on Depth Channel (Z Depth) in the Render Global Settings window.
- 2 Open the renderable camera's Attribute Editor in which you want to create a depth file.  
Select View > Camera Attribute Editor from the current view. See "View > Camera Attribute Editor" on page 269.
- 3 In the camera's Attribute Editor, select a Depth Type from the Output Settings section (Closest or Furthest Visible Depth).

### To view depth channels

- 1 View the animation file using FCheck.  
See the "Overview of FCheck" on page 63 in the Rendering Utilities guide for information on FCheck.
  - IRIX, Linux and Windows
- 2 Press z to see the depth channel.
  - Mac OS X

FCheck does not let you view the z-depth data of an .IFF file. To view z-depth data, use a non .IFF file format and then view the z-depth data stored in the separate file.
- 3 If the output format is not IFF or RLA, Maya writes a separate depth file containing a black RGBA image with depth values.

## Modify a mask channel

For Maya software and mental ray for Maya.

### To increase or decrease the mask value for an object

- In the Matte Opacity section of an object's material Attribute Editor, set Matte Opacity Mode to Opacity Gain and adjust the Matte Opacity value.

During rendering, Maya first generates the mask channel, then multiplies the mask values for the object by the Matte Opacity value. For example, if Matte Opacity is 1, the mask values for the object remains unchanged; if Matte Opacity is 0.5, the mask values for the object are half their original values.

### To set the mask value for an object to a constant value

- In the Matte Opacity section of an object's material Attribute Editor, set Matte Opacity Mode to Solid Matte and adjust the Matte Opacity value.

## 4 | Visualize and render images

### How do I? > Specify frame or field rendering

If the object is transparent, any objects behind it appear in the mask channel.

During rendering, Maya first generates the mask channel, then sets the mask values for the object to the Matte Opacity value. For example, if Matte Opacity is 1, the mask values for the object are 1; if Matte Opacity is 0.5, the mask values for the object are 0.5.

#### To set the mask value for an object to zero

- In the Matte Opacity section of an object's materials Attribute Editor, set Matte Opacity Mode to Black Hole.

During rendering, Maya first generates the mask channel, then sets the mask values for the object to 0. If the object is transparent, any objects behind it will *not* appear in the mask channel.

## Specify frame or field rendering

Motion picture film and video simulate motion by displaying a continuous sequence of images or frames.

When you render images as frames, Maya generates one image file for each time frame of an animation. By default, Maya renders images as frames.

When you render images as fields, Maya generates two image files for each time frame of an animation, one for each field. Maya renders a frame at time "x" by rendering one field at time "x" and one field at time "x+0.5".

For information on the differences between film and video systems see, "Frames vs. Fields" on page 80.

To properly view a frame or an animation rendered as fields, you must interlace the two fields together.

<b>Tip</b>	The settings you use for rendering images as fields may depend on the video standard you are using for the images, and how fields interlace together (for example, NTSC or PAL).  Before you render an animation as fields, perform a test render and use the test rendered images through your entire post-production process.
------------	---

#### To render images as fields for Maya software rendering

- Choose the Field option from the Maya Render Global Settings window. Interlacing is automatic.

## 4 | Visualize and render images

How do I? > Run Pre Render MEL or Post Render MEL scripts

### To render images as fields for anything other Maya software rendering

- 1 In the Render Global Settings window, set the By Frame value to 0.5. This results in twice as many frames being rendered.
- 2 Turn on the Renumber Frames Using option and set Start Number and By Frame values to 1.
- 3 Interlace the resulting images using a third-party solution.

### To interlace two fields together on IRIX and Linux

See "interlace" on page 83 in the Rendering utilities guide.

## Run Pre Render MEL or Post Render MEL scripts

### Important!

When you render a scene from within Maya, make sure you *do not* specify a MEL command or script that includes delete operations or you may accidentally delete objects in your scene.

### To run a MEL command or script before or after rendering

In the Render Options section of the Render Global Settings window:

- Enter a MEL command or execute a script to run before rendering each frame in the Pre Render MEL attribute box.
- Enter a MEL command or execute a script to run after rendering each frame in the Post Render MEL attribute box.

### Set scene rendering quality

## Adjust anti-aliasing

**Note** You may not need to adjust quality settings for an entire scene. Adjusting settings on a per-object basis is often more efficient and has less of an impact on rendering speed.

For more information on aliasing artifacts and strategies on how to fix them, see "Improve rendered image quality" on page 134.

## 4 | Visualize and render images

How do I? > mental ray rendering specifics

### mental ray rendering specifics

- Manually adjust the following:
  - Quality.
  - Sampling Quality.
  - for production quality:
    - Min samples = 0
    - Max samples = 2
  - Filter = Triangle or Gauss

### Maya software rendering specifics

The options in the Presets drop-down list and the Edge Anti-aliasing drop-down list drive each other; when you change one, the other changes, and values for the Anti-aliasing subsections are automatically filled in. You can fine tune any of these settings.

Do one of the following:

- In the Anti-Aliasing Quality section of the Render Global Settings window, select a preset.
- In the Anti-Aliasing Quality section of the Render Global Settings window, select Custom, then manually adjust the settings in Number of Samples, Multi-pixel Filtering, and Contrast Threshold.

### Maya Hardware rendering specifics

The options in the Presets drop-down list drive values for other settings in the Quality section of the Render Global Settings window. You can fine tune any of these settings.

Do one of the following:

- In the Quality section of the Render Global Settings window, select a preset.
- In the Quality section of the Render Global Settings window, select adjust any of the settings in the section.

## Adjust output image filtering

**Tips** In most cases, you should test render a file texture in Render View when filtering because you may not be able to see the results in the views or in Attribute Editor swatches.

When bump mapping, set Filter to a low value (under 0.1). Filter is primarily used for anti-aliasing textures—distant surfaces are blurrier. This may cause a bump map to become smoother when further away. If you want the bumps to be smooth, use a small Filter Offset value for a constant blur.

### **To fix a noisy procedural texture that appears to shift and swim during an animation**

- Increase the Filter and/or Filter Offset values to achieve a slightly blurred effect and reduce the sharpness that causes the swimming.
- Create a file texture (see *"Convert a texture or shading network to a File Texture"* on page 83 in the Shading guide), then increase the Filter and/or Filter Offset values to achieve a slightly blurred effect and reduce the sharpness that causes the swimming.
- Increase the Shading Samples value.

## Create and load a plug-in multi-pixel filter

Maya software only.

### **To create a plug-in multipixel filter**

The Plug-in Filter Weight attribute is connected with the plug-in filter node and its value will be used as the filter weight. The filter does not have to be normalized.

You can define a plug-in DG node with at least two input attributes and one output attribute with a float type. The input attributes require the short name X and Y. The output attribute has to be connected to the Plug In Filter Weight attribute in the renderQuality node.

When the plug in filter type is selected, the plug-in node is evaluated multiple times with different x and y weights, ranging in [-1..1]. The plug-in filter should be defined in the normalized domain [-1..1,-1..1]. The filter width change only affects the mapping of the normalized filter to the pixel coverage.

## 4 | Visualize and render images

How do I? > Connect a plug in multipixel filter

### To load a plug-in multipixel filter

The following assumes you have already created a multipixel filter plug-in.

- 1 Copy the filter plug-in *.so* (IRIX and Linux), or *.dll* (Windows), or *.lib* (Mac OS X) file to:
  - IRIX and Linux: `/maya/bin/plugin`
  - Windows: `drive:\Program Files\Alias\Maya6.0\bin\plugin`
  - Mac OS X: `/Applications/Maya 6.0/Application Support/plugin` or to a directory where the Plug-in Manager can read them
- 2 In Maya, click Window > Settings/Preferences > Plug-in Manager.
- 3 Load the plug-in you created.

### Connect a plug in multipixel filter

#### To connect a plug-in multipixel filter to the Plug In Filter Weight

- 1 In the Script Editor, create a plug-in node by typing:  

```
createNode <yourPluginNodeType>
```

A node will be created for the plug-in.
- 2 Select the plug-in node by typing in the script editor:  

```
select <yourPluginNodeType>
```
- 3 With the plug-in node selected, open the Connection Editor (Windows > General Editors > Connection Editor).
- 4 Load the plug-in node to the left side of the Connection Editor.
- 5 Repeat steps 1 and 2 to load the `defaultRenderQuality` or user-created `renderQuality` node to the right side of the Connection Editor.
- 6 Connect the plug-in node's weight to the `defaultRenderQuality Plug In Filter Weight` attribute. You can now use the multipixel filter plug-in.

#### Set raytracing quality

### Set raytracing quality

*Raytracing* is a type of rendering where the path of individual light rays are calculated between the camera and the light source. To find out more about how to raytrace to produce shadows, see "*Raytraced shadows*" on page 34 in the Lighting guide.

## 4 | Visualize and render images

### How do I? > Set motion blur

To find out more about how to raytrace to produce reflections, see *"True reflections"* on page 283 in the *Shading* guide.

**Note** You may not need to adjust quality settings for an entire scene. Adjusting settings on a per-object basis is often faster and has less of an impact on rendering speed.

To set raytracing quality, adjust the settings in the Raytracing Quality section of the Render Global Settings window.

#### **Set motion blur**

### Set motion blur

When you render an animation, motion blur gives the effect of movement by blurring objects in the scene. For more information on motion blur, see *"Focus and blur"* on page 28.

#### Maya software rendering specifics

Only Maya software supports both 2D and 3D motion blur.

To set motion blur, work with the settings Motion Blur section of the Render Global Settings window.

**Note** You may not need to adjust quality settings for an entire scene. Adjusting settings on a per-object basis is often faster and has less of an impact on rendering speed.

#### Maya hardware rendering specifics

Supports only 3D motion blur.

To set motion blur, work with the settings Motion Blur section of the Render Global Settings window.

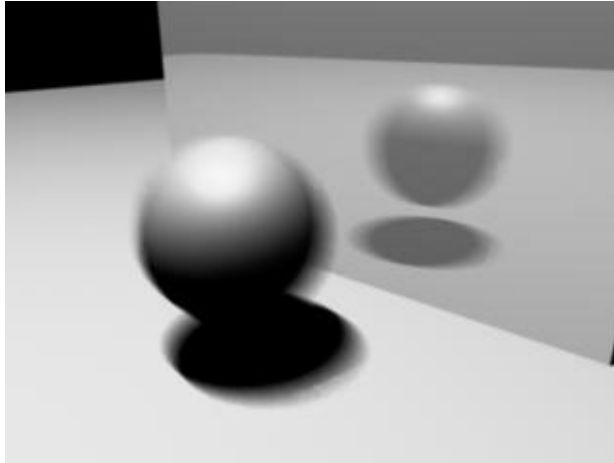
#### mental ray rendering specifics

Supports only 3D motion blur.

To set motion blur, in the Quality section of the Render Global Settings window set Quality to an option that includes Motion Blur, then work with the settings in the Motion Blur section of the Render Global Settings window.

## 4 | Visualize and render images

How do I? > Maya software



Example of motion blur  
Image by Tim Rowlandson

### ***Set memory and performance options***

## Maya software

### Set tessellation options

Though tessellation is determined on a per-object basis, you can manage how Maya handles the tessellation settings for the scene.

By default, Maya optimizes the tessellation settings for surfaces by storing (caching) geometry information to reduce the amount of memory used; tessellating identical surfaces only once to save time and disk space; reusing tessellation for the generation of depth maps; and calculating the bounding box scale that you define for all displacement-mapped surfaces to make rendering faster.

For more information on tessellation, see “Tessellation and approximation” on page 43.

You can turn these optimization settings on or off in the Memory and Performance section of the Render Global Settings window.

For tessellation settings for mental ray for Maya, see “Approximation in mental ray for Maya” on page 45.



### Set raytracing

Though raytracing quality is set by the options in the Raytracing Quality section of the Render Global Settings window (see "Set raytracing quality" on page 102), you can set scene optimization options in the Memory and Performance section of the Render Global Settings window.

For more information on raytracing, see "*Raytraced shadows*" on page 34 in the Lighting guide.

### Set multiple processors

You can control the number of processors for interactive rendering. To render with multiple processors, see "Network render with Maya software" on page 148.

#### ***Set IPR options (Maya software)***

### Set IPR options

You can control which elements are included in IPR renders in the IPR section of the Render Global Settings window.

For more information IPR renders, see "Interactive Photorealistic Rendering (IPR)" on page 67.

#### ***Set paint effects rendering options***

### Set paint effects rendering options

See "*Paint Effects Rendering Options*" on page 234 in the *Paint Effects, Artisan, and 3D Paint* guide.

#### ***Set up layers and passes***

### Create render layers

To render objects separately in layers, you must first create render layers, then set them as renderable. You can render attributes of your entire scene or layers of your scene in separate passes too.

For more information about layers and passes, see "Layers and passes" on page 83.

## 4 | Visualize and render images

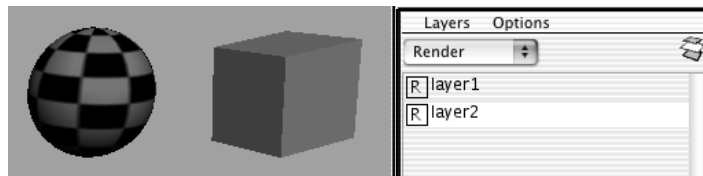
How do I? > Create renderable passes

**Note** For Maya software rendering, you can also render an individual layer when you render from a shell or command line, using `Render` and the `-l` option.  
See "Perform command line rendering" on page 117 for information about command line rendering.

### To create a render layer in the Layer Editor

The Layer Editor is located under the Channel Box.

- 1 Select Render from the drop-down menu.
- 2 Select Layers > Create Layer.



### To set whether a render layer is Renderable

- 1 Select a render layer from the Layer Editor, then choose Layers > Edit Selected Layer(s).

The Edit Layer window appears for the selected render layer.

- 2 In this window, you can rename the layer (in the Name box), click the check box to determine if it is Renderable (on by default), then save the setting. A check mark indicates what is rendered in Render View.

If Renderable is on:

- Objects that are not included in a renderable render layer are not rendered; each layer is treated as if it came from a separate scene. Use the Relationship Editor (Window > Relationship Editors > Render Layers) to see which objects are included in which render layer.
- When you perform an IPR test render, all layers with renderable attributes turned on are rendered into Render View.
- In batch mode, you can enable attributes so that each layer is rendered to a separate file for off-line compositing.

## Create renderable passes

### To determine which passes are renderable in a render layer

## 4 | Visualize and render images

### How do I? > Visualize interactively with IPR

- 1 Select a layer in the Layer Editor, then choose Layers > Layer Attributes. The Attribute Editor for the selected render layer appears.
- 2 Choose the Render Pass Options you want to render.
- 3 Select Focus to switch the selection of the layers you created and change their render pass settings if necessary.

### Visualize a scene

## Visualize interactively with IPR

Maya software only.

When you drag a marquee (render region) around the entire scene or part of the scene, the IPR image begins to update. If you change lights, shadows, materials, textures, and post processes (special effects) such as glow and fog, you can see the results of your changes interactively.

For detailed information on IPR rendering, see "Interactive Photorealistic Rendering (IPR)" on page 67.

**Note** The amount of memory used during an IPR session may be considerable. The upper-right corner of Render View displays how much memory is being used for the current IPR tuning region.

### To visualize scene adjustments interactively

- 1 Do one of the following:
  - Click the scene view you want to render, then click the IPR Render button (from the Status Line or from within Render View if it is open). The scene appears in Render View, and an IPR image is created.
  - To load an existing IPR file, select File > Open IPR File, then select the file.
- 2 Marquee select a region within the IPR rendered image in Render View.

**Note** You must select a region to adjust before you start to modify rendering attributes. The region you select determines the amount of memory required by IPR to re-render the adjusted region.

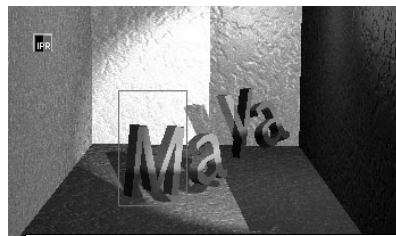
## 4 | Visualize and render images

How do I? > Pause, cancel or save an IPR render

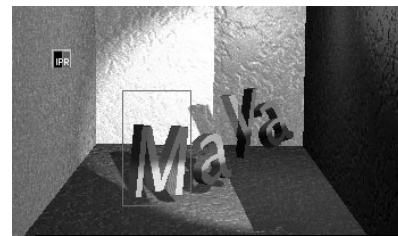
- 3 Adjust the scene, for example, add lights or modify materials and texture attributes.

The selected region of the IPR image updates as you adjust the scene.

- To render another view instead, select IPR > IPR Render in Render View and select a view from the drop-down menu.
- If you change the view (such as tumble or zoom, or add new elements to the scene) and want to update the result, click the Redo Previous IPR Render icon in Render View or from the Render menu in Maya's main menu bar.
- If you only want to change certain elements such as lighting or textures and do not change the view, simply drag a marquee around the object or part of the object you want to update. The results in Render View are immediate.



Drag a marquee around the area you want to change.



Changes you make are shown immediately.

**Tips** After you marquee select a region, you can drag materials and textures onto objects within the region, just as you can make connections by dragging swatches from Hypershade onto surfaces in the views.

### Pause, cancel or save an IPR render

#### To pause an IPR render

- Press the pause button.

#### To cancel an IPR render

- Press Esc.

The IPR render stops. You cannot adjust a cancelled IPR Render; you must perform a complete IPR Render to adjust a region.

## 4 | Visualize and render images

How do I? > Batch render IPR files

### To save an IPR file

**Note** Because an IPR file saves the deep raster information in addition to the visible color information, an IPR file can be very large. Ensure you have sufficient disk space.

- Select File > Save IPR File. The Save IPR File window displays. Type the name of the file and click Save IPR File.

### Batch render IPR files

You can batch render IPR files from the command line.

For more information about batch rendering or command line rendering, see "Batch renders from within Maya (UI)" on page 72 and "Command line renders" on page 72.

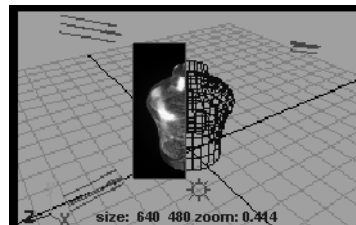
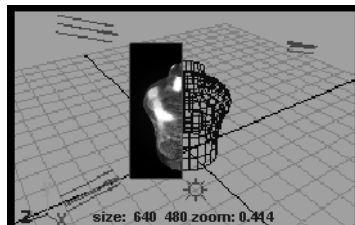
### To batch render IPR files

- In a shell or command line, type:

```
Render -r sw -ipr true <scene>
```

See "Batch rendering from the command line" on page 93 in the Rendering Utilities guide for details about batch rendering.

- Notes**
- You cannot batch render IPR files from within Maya.
  - Batch rendering to produce IPR files is *not* multi-threaded.

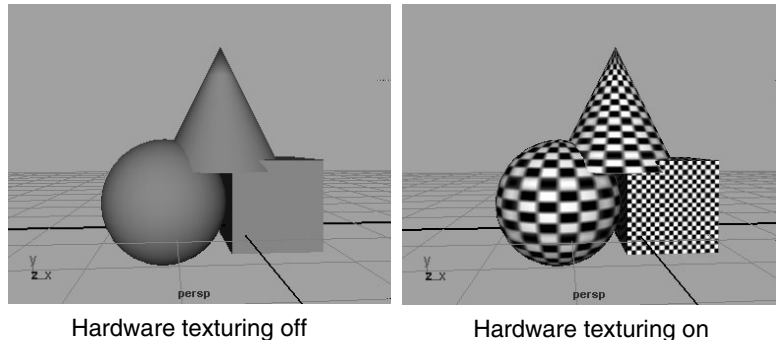


## 4 | Visualize and render images

How do I? > See shading and lights in a scene view

### See shading and lights in a scene view

Maya's scene view



Hardware texturing, a Maya feature that you can easily turn on or off, lets you to see approximations textures, lights and objects in your scene in a scene view.

What you see depends directly on the settings you make in the Render Global Settings window and per-object settings you change. What you see is not necessarily what appears in the final render, but it gives you a good idea.

**Note** If you are using a File texture that uses MirrorUV and the resolution of the hardware rendered texture in the viewport appears degraded, use the following environment variable:  
`MAYA_HW_FILE_TEXTURE_RESOLUTION_OVERRIDE`

**Tip** To see the resolution boundaries in the scene view, turn on the Resolution Gate. For more information, see "Turn scene view guidelines on or off" on page 36.

#### To see textures, lights, and objects in a view port

- 1 In the scene view, select Shading > Smooth Shade All.
- 2 Select Shading > Hardware Texturing (or press the hotkey 6).
  - To use all lights in the scene, select Lighting > Use All Lights (or press the hotkey 7).

## 4 | Visualize and render images

### How do I? > Test render a low-res still or frame

- To see a more accurate preview result (which may take a little longer), adjust the Hardware Texturing attributes in the object's material's Attribute Editor.

**Note** When you play an animation with just Hardware Texturing turned on, each of the necessary file textures are read in one at a time and the animation speed is choppy.  
Use Hardware Texture Cycling to load file textures into memory only once for faster interactive animation (but this uses a lot of memory).

### Test render a low-res still or frame

The time Maya takes to software render a scene is directly proportional to the resolution: the larger the resolution, the more time it takes.

If you want to get a feel for the final rendered look quickly, you can render of a still image or single frame of an animation. Typically, a resolution half to a quarter of the size lets you get a good feel for the software rendered look.

**Note** To ensure the best quality display of your rendered image, select the 1:1 (the real size) option in Render View before you render.

#### To test render a still image

- 1** From Render View (Window > Rendering Editors > Render View), click Options > Test Resolution, then select a resolution.
- 2** Select the camera view you want to render from the Render > Render submenu.

Maya renders the scene and displays the image as it renders in Render View.

- To cancel the render, press Esc.
- To re-render the frame, select Render > Redo Previous Render.

### Test render a low-res animation

If you want to get a feel for the final rendered look quickly, you can render of an entire animation (or a few selected frames) at a lower resolution.

## 4 | Visualize and render images

How do I? > Render selected objects

Typically, a resolution half to a quarter of the size lets you get a good feel for the software rendered look. (As you get closer to achieving the final look during an animation, test render a few specific frames at the final resolution too.)

### To test render an animation with Maya software rendering

- From a shell or command line, type:

```
Render -r <renderer> <options> <scene>
```

using the following options:

-s <start_frame>	The first frame of the animation to render.
-e <end_frame>	The last frame of the animation to render.
-b <by_frame>	The increment between frames to render.
-x <image_x_resolution>	The horizontal resolution of the rendered images.
-y <image_y_resolution>	The vertical resolution of the rendered images.

For example, if an animation begins at frame 1 and ends at frame 100, and the final image resolution is 640 x 480, and you want to test render with Maya software the animation by rendering every ten frames, type:

```
Render -r sw -s 1 -e 100 -b 10
```

If you want to test render the animation by rendering with mental ray for Maya every frame at half the final resolution, type:

```
Render -r mr -s 1 -e 100 -b 1 -x 320 -y 240
```

For a complete list of Render options, in a shell or command line, type:

```
Render -r <renderer> -help
```

## Render selected objects

**Tip** Render at 1:1 resolution for fastest feedback.



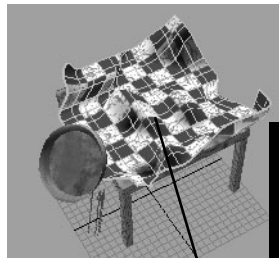
## 4 | Visualize and render images

### How do I? > Render a region of your scene

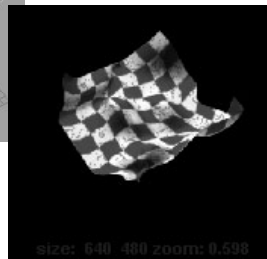
You can isolate specific objects to render. *You cannot use this method when IPR rendering.*

#### To render selected surfaces

- 1 Select the objects you want to render.
- 2 In the Image File Output section of the Render Global Settings window, set Renderable Objects to Render Active.
- 3 Render the scene.



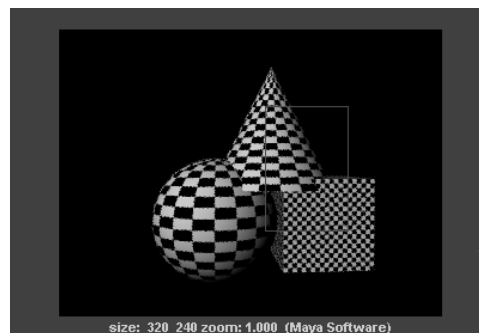
In the scene view, only the table cloth is selected.



In Render View, only the selected surface is rendered

**Tip** You can display a wireframe snapshot of your scene to use as a guide to select a region of your scene to render. In Render View, select **Render > Snapshot >** and select the camera (view) you want to capture.

### Render a region of your scene



## 4 | Visualize and render images

### How do I? > Render a single frame

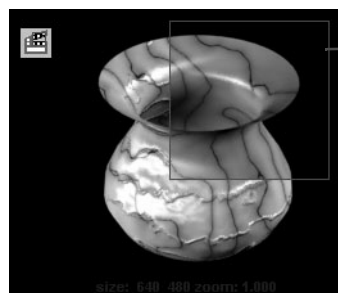
Render View lets you render a specific portion of your scene at any resolution so that you can get a feel for the changes you make as you shade, light, and texture objects.

Unlike rendering at a lower resolution, a process which reduces the size of the entire image, rendering a region can help you make changes more efficiently and quickly to the specific regions of interest at full resolution.

**Tip** If you turn on Auto Render Region (Options > Auto Render Region), the changes you make appear as you draw the marquee anywhere in Render View. Only the marquee'd area of the surface re-renders showing the results of the adjustment.

#### To render a region of your scene

- 1 Marquee select the area that you want to render in Render View.
- 2 If there is no representation of your scene in Render View for you to marquee select Render > Snapshot > and select the camera (view) you want to capture.
- 3 Click the Render region button or select Render > Render Region.



Marquee select a region, make changes to the scene, then click the Render region button.

(Alternatively, set Auto Render Region to see the changes as you make them.)

#### Perform final renders from within Maya

##### Render a single frame

When you render or re-render a single frame from Maya's main window, the render appears in Render View. For more information about using Render View, see "Render View rendering" on page 71.

The image is automatically saved to the `images` directory of the current project.

## 4 | Visualize and render images

How do I? > Batch render a still or animation

**Note** Navigation in the Render View panel is like most other Maya view panels. You can zoom and track the view using the same keyboard shortcuts.

### To render a frame from within Maya

- From the main Maya window, click the Render Current Frame button, or select Render > Render Current Frame.

Maya renders the scene from the current scene and displays the image as it renders in Render View.

To cancel an in-progress render, press Esc.

### To re-render a frame from within Maya

- From the main Maya window, select Render > Redo Previous Render.

Maya renders the scene from the previous camera and displays the image as it renders in the Render View window.

### To cancel the render

- Press Esc.



## Batch render a still or animation

**Note** By default, Maya renders the current frame of your scene. To render an animation, you must specify the start and end frames of the animation you want to render in the Render Global Settings window.

On IRIX and Linux you can select a remote host on which to render the current scene.

### To batch render from within Maya

- Click Render > Batch Render to batch render.
- To cancel the render, click Render > Cancel Batch Render
- To show the image being rendered, click Render > Show Render.

**Note** To set batch render options, select Render > Batch Render >  to open the Batch Render window. For a description of the batch render options, see "Render > Batch Render > " on page 255.

## 4 | Visualize and render images

How do I? > Render with several processors

### Render with several processors

You can render a scene on a computer that has more than one processor and make use of some or all of its available processors.

**Note** We recommend that you use a single processor when batch rendering a scene that contains a spotlight, material transparency, and raytrace shadows.

#### To render on a computer with several processors from within Maya

- 1 From the Maya window, select **Render > Batch Render >** .  
The Batch Render window displays.
- 2 To use all available processors on your computer for rendering, turn on **Use all available processors**.
- 3 To use only some of the available processors on your computer for rendering, turn off **Use all available processors** and set **Number of Processors to Use** to the number of processors you want to use.
- 4 Click **Batch Render**.  
Maya renders the animation.

#### To render on a computer with several processors from a shell or command line (Maya software rendering only)

- Type:

```
Render -r sw -n <# of processors to render on>  
<scene>
```

(If you do not use the `-n` option, only one processor is used for rendering.)

Examples (for Maya software rendering only):

To use one processor for rendering, type:

```
Render <scene>
```

To use two processors for rendering, type:

```
Render -n 2 <scene>
```

To use *all* processors on your computer for rendering, type:

```
Render -n 0 <scene>
```

## 4 | Visualize and render images

How do I? > Command line render

### Perform command line rendering

#### Command line render

Your scene file determines whether you render a single frame or an animation. You can render from a shell or a command line. Before rendering, you may want to close all applications, including Maya, to maximize the amount of memory available for rendering.

When you render from a command line, you can set flags that override some of the Render Global settings, saving time during test renders.

#### To get quick renderer-specific information, type

```
Render -r rendername -help
```

where rendername is the name of the renderer:

- `mr` = mental ray
- `sw` = software renderer
- `hw` = hardware renderer
- `vr` = vector renderer
- `file` = the file within which the renderer is specified

**Note** If you get help on a file (`-r file -help`), only the flags common to all renderers, not a specific renderer, are shown. If you want renderer-specific information, you must specify the renderer.

All flags are described with a short description. Each flag corresponds to the appropriate section of the Render Globals Settings Window. See the Render Globals Settings documentation for more detailed information on each option.

#### To obtain a complete list of command line Render options, from a shell or command line type:

```
Render -help
```

#### To render a scene with a specific renderer from a shell or command line

- Type:

```
Render -r <rendername> <options> scene
```

## 4 | Visualize and render images

How do I? > To export a .mi file and render with mental ray

**Tip** You may need to provide the `-proj` flag when issuing the render command to specify where the scene file is located. For example, type:

```
Render <options> <projName> scene -proj
```

### To render a scene with the renderer specified in the file from a shell or command line

Whichever renderer is specified in the file is used to render the scene.

- Type:  

```
Render -r file
```

**Note** Only the flags common to

### Export .mi files

To export a .mi file and render with mental ray

#### To export a .mi file and render with mental ray

**Note** The command `mayaexport_with_mr` which is available on all platforms via a shell, command line, or terminal, allows you to perform an export from a Maya scene to an .mi file for rendering with mental ray standalone. For information on how to use the `mayaexport_with_mr`, type `mayaexport_with_mr -h` in a shell.

- 1 Select File > Export All.
- 2 Choose a file name and path and click Options.  
The Export All Options window appears.
- 3 Select mentalRay as the file type.  
There are File Type Specific Options in the Export All Options window you can use to control file naming schemes and other details.
- 4 Click Export All.
- 5 From a IRIX or Linux shell, DOS window, or Terminal, type:  

```
mentalrayrender mi file
```

## 4 | Visualize and render images

### What went wrong? > Render multiple scenes

where `mi_file` the name of the file that was exported.

For information export options, see "File > Export All, Export Selection (mental ray)" on page 245.

**Note** The script prompts you to set your `SPM_HOST`, `MAYATOMR`, and `RAY` environment variables if they are not set already.

### Render multiple scenes

#### Render multiple scenes

You can either write a batch script that starts renders in succession or use a third-party management solution.

## What went wrong?

### Troubleshoot:Image plane displays black swatch

An Image plane not connected to a camera displays black swatch. Once connected to a camera, the swatch will function properly.

### Troubleshoot:Displacement is not displayed

The *Display render tessellation* option does not display displacement mapping.

In the main Maya window, select `Shading > Displacement to Polygon` to preview the effect of your tessellation and displacement together, then discard the generated polygon object when you are finished previewing.

### Troubleshoot:Software-rendered is too bright

By default, Point and Spot lights have no decay. Open the light's Attribute Editor and change the Decay Rate, or use Maya's Decay Regions (for spot lights only) to control the decay.

### Troubleshoot: Multi-UVs for NURBS don't software render

Multi-UVs defined for NURBS are currently not respected when software rendering.

## 4 | Visualize and render images

What went wrong? > Troubleshoot:Rendered image doesn't match may not match interactive window display

### Troubleshoot:Rendered image doesn't match may not match interactive window display

In rare cases, a rendered image may not match what is displayed in the interactive window. This may be caused by different Dependency Graph solutions if nodes are evaluated in a different order.

The most common occurrences are: renders that are divided among multiple machines produce inconsistent results; an arbitrary frame within an animation range is rendered alone; or rendering with motion blur produces different results than rendering without motion blur.

Scene elements which may produce undesirable render matching include:

- Any dependency graph cycle
- Animated `nodeState` on any node
- Animated transform limits
- The multi-chain IK solver
- Expressions that modify values based on a previous value. For example:  $tx = tx + 1$
- Expressions that conditionally set values. For example: `if (ty > 5) tx = ty`
- Expressions that execute commands (or create or delete Maya nodes). For example: `sphere`
- Particle/softbody solutions (because of timestep changes)
- Geometry Constraint nodes (because they go to the point on the target geometry that is closest to the current point)
- Any constraint where the sum of the target weights is zero
- Aim, tangent, or normal constraint or `lookAt` nodes with the `worldUpType` attribute set to `None`
- Aim, tangent, or normal constraint or `lookAt` nodes with the `upVector` co-linear with the `aimVector`
- IK with an animated `solverEnable` value.

### Workaround

The renderer can invoke a MEL procedure just before you render a frame. (You specify this script in the Render Globals > Render Options > PreRender Mel text field.) You can use this procedure to force evaluation at the intervening skipped frames.

To use a MEL script:

- 1 Put the MEL script (named `preFrameProc.mel`) in your Maya scripts directory.



## 4 | Visualize and render images

What went wrong? > Troubleshoot: Projection texture swims over an animation

- 2 Under Render Globals > Render Options, type *preFrameProc* in the PreRender Mel field.

If motion blur is on, you may need to bake the animation.

### Troubleshoot: Projection texture swims over an animation

Projection texture with *useLocal*, can swim over an animation.

Turn on Use Local on all upstream textures to work around this.

### Troubleshoot: Transparent blobby surface rendering anti-aliasing problem

With transparent blobby surface rendering, anti-aliasing may be poor, even at the highest-quality settings. Such cases include intersecting transparent blobby surfaces and transparent blobby surfaces behind transparent geometry. To fix this, increase the particle samples in Render Globals.

### Troubleshoot:memory exceptions

On some 32-bit machines (including Irix, Windows, and Linux) virtual memory is restricted to 1.6 Gbs (or thereabouts). It doesn't matter if you have hundreds of giga-bytes of physical memory or swap, no process can grow larger than this size. Maya may encounter a memory exception and report that there is still lots of memory available.

### Troubleshoot:mental ray for Maya renders look different than they did before

#### Some older derive from Maya settings no longer apply

Because of the (as of Maya 5.0) unified render global settings (see "Open the Render Global Settings window" on page 92), some of the mental ray for Maya *derive from Maya* settings no longer exist. You may need to modify some older files for which *derive from Maya* was set by setting the mental ray for Maya render global settings.

For known differences between mental ray for Maya and Maya, see "Troubleshoot:mental ray for Maya renders look different than Maya renders" on page 122.

## 4 | Visualize and render images

What went wrong? > Troubleshoot:mental ray for Maya renders look different than Maya renders

### Troubleshoot:mental ray for Maya renders look different than Maya renders

The following sections describe known differences between Maya and mental ray for Maya and provide hints on how to handle those cases:

#### Scanline Only Rendering

Scanline only rendering is the default render mode in Maya. Since scanline rendering is limited in various aspects, it may show artifacts when used together with the following: motion blur, volume rendering, shadow tracing, and others. Raytracing should be turned on if render problems appear.

#### Displacement

mental ray uses an adaptive tessellation approach to better fit the details of the displacement map. The initial tessellation (for NURBS: after surface approximation) is further subdivided to fit secondary criteria, controlled by the displace approximation settings. By default, mental ray for Maya creates appropriate settings that lead to curvature dependent subdivision of the triangles, one form of feature-based displacement mapping. You can change these settings by creating or selecting a custom displace approximation node in the Approximation Editor. For more information on Approximation Nodes, see "Approximation nodes" on page 45).

#### Shadow Mapping

If the mental ray shadow map attributes on Maya lights are disabled, mental ray for Maya derives most parameters for shadow maps from Maya's depthmap settings, although most control values are not comparable. This causes different results, especially when modifying the filter values to achieve soft shadows. For sharp shadows the Dmap Filter Size should be set to 0. Other controls, like Use Mid Dist Dmap and Use Dmap Auto Focus are not used to derive mental ray shadowmap values.

For information about the way mental ray for Maya handles shadow mapping, see "*Shadow in Maya*" on page 31 in the *Lighting* guide.

#### Bump mapping

The bump mapping implementation in the mental ray shaders may handle the Filter settings in the bump nodes slightly differently compared to Maya. This filter usually produces view-dependent bump mapping details, but might not be appropriate in animations. As soon as the filter has been disabled by setting the Filter value to zero, the Filter Offset determines the bump map lookup, both in Maya and mental ray. This leads to comparable bump mapping render results that are not view-dependent.

## 4 | Visualize and render images

What went wrong? > Troubleshoot:mental ray for Maya renders look different than Maya renders

### Matte Opacity

Transparent objects produce an appropriate alpha channel in the final image according to Maya's Matte Opacity settings. However, some restrictions apply:

- The mental ray colorclip modes and the premultiply setting affect the matte result. The default colorclip mode Raw ensures best compatibility with Maya, especially when using the BlackHole opacity mode, or when sliding the Matte Opacity value towards zero in OpacityGain and SolidMatte modes.
- The mental ray colorclip modes other than Raw may change the color or alpha value before storing it in the framebuffer, which can be used to produce nice effects.
- The BlackHole opacity mode may cause different results in the color channel when rendered with mental ray; reflections may still show up.

For more information on transparency, see "*Surface texture*" on page 15 in the *Shading* guide.

### Depth-of-Field

This effect is supported with a mental ray lens shader, not as an output filter as in Maya. Therefore, it is dependent on the global sampling settings in mental ray. Raising the minimum or maximum sampling level improves quality and but slows down the rendering accordingly. On the other hand, as a true 3D effect, it won't show any artifacts with problematic scenes, where output filters are not able to produce correct depth-of-field blurring.

### Render Layers

When assigning a group to a render layer, mental ray for Maya assumes all the members of the group also belong to that layer and inherit its attributes. However, Maya allows members of the group to be assigned to different layers than the group parent.

### Particle system translation and rendering

Particle types for software rendering are supported on all platforms for rendering with mental ray. To render particles, a new mayabase shader library is required, which is also provided for all platforms. Particle data are also exported to .mi files. These files cannot be rendered on machines with different byte ordering (big end or little end) than the machine where Maya has been used (for example, mixing IRIX and Windows). Particle translation and rendering is limited and may not be able to handle large particle counts. Light linking is not supported with particles. However, software particles and particle instancing should work together seamlessly.

## 4 | Visualize and render images

What went wrong? > Troubleshoot:Highlight artifacts close to object edge

### Troubleshoot:Highlight artifacts close to object edge

If you have tessellated an object with the Use Smooth Edge attribute and you get artifacts in highlights along curved parts of the surface close to an edge, don't use this attribute. This caused the curvature in the surface to be slightly different closer to the edge, which doesn't work for strong highlights.

### Troubleshoot:Background surfaces show through

Especially in large scenes that have objects close together, background surfaces may appear to show through nearby surfaces. This is a result of how the camera's clipping planes determine depth position of geometry. To fix this problem, see "Clipping planes" on page 34.

### Troubleshoot:Objects vibrate when an animation is rendered as fields

For Maya software rendering only.

The settings you use for rendering images as fields may depend on the hardware or software settings you are using with the images, and how they interlace fields together (for example, the interlace utility, compositing software, or frame buffer device). Before you render an animation as fields, perform a test render and use the test rendered images through your entire post-production process (see "Batch render a still or animation" on page 115 and "Test render a low-res animation" on page 111).

Even though Maya automatically sets these options depending on whether the Resolution is NTSC or PAL, if you encounter problems in the animation where objects vibrate up and down, change the Zeroth Scanline setting and test render the animation again. If this does not solve the problem, or if objects in the animation vibrate left to right, try different combinations of Field Dominance and Zeroth Scanline, and test render the animation until the problem is solved.

### Troubleshoot:2D Motion Blur problems

For Maya software rendering only.

## 4 | Visualize and render images

What went wrong? > If dark halos display around the objects

### If dark halos display around the objects

Try the following:

- Make sure the background color is black
- Make sure Smooth Color is turned on if there is fog in the scene.

### Moving transparent objects with a background

The background is also blurred in this case even though it should not be. The solution is to blur the transparent object separately and composite with the rest of the scene. This workaround can be difficult for complex scenes with lots of transparency, or for transparent particles.

### Detailed background behind moving objects

Some details may be lost because assumptions must be made about the background area occluded by the moving objects. The solution is to blur the moving objects without the background and then composite the results.

### Rotating objects

May not look exactly right, because assumptions about what the back sides of these objects should look like must be made. Try using 3D motion blur.

### Objects entering from outside the image or leaving the image

The edges of frames may not get the correct detail, because assumptions must be made about the object color that is just outside a frame. The solution is to render a slightly larger image which covers the original image and then crop it to the desired size.

### Rendered results from 3D and 2D are quite different

Try not to mix the rendered images from two different kinds of blurring operations.

### Tuning 2D motion blur with IPR

When tuning 2D motion blur with IPR, automatic updates are not always done correctly. Tune an attribute of a material or light to force a correct update, or marquee the tuning region to force an update.

## 4 | Visualize and render images

What went wrong? > 2D motion blur artifacts

### 2D motion blur artifacts

2D motion blur can cause artifacts when rendering in scenes with fog, or solid objects in front of transparent ones, or if the background color is not black.

There are three possible workarounds:

- Take out transparent objects, fog, glow, and background color from the scene. Render the 2D blur and composite those elements back into the scene.
- Set the Smooth Value to 0. In the command line, this is `-m 0`. This solution is to skip the smooth-mask operation. The image may look more aliased as a result.
- Turn on Smooth Color. In the command line, this is `-r 1`. This solution uses a different smoothing algorithm. The image may look more blurry as a result.

### Troubleshoot: Troubleshooting Surfaces (Maya software)

#### To fix faceted surface edges or profile



Do any of the following:

- Run Set NURBS Tessellation.
- Make sure Automatic is set in the Render > Set NURBS Tessellation window.
- Turn on Smooth Edge for the surface (or turn on Smooth Edge and increase Smooth Edge Ratio).
- Increase Curvature Tolerance for the surface and U Division Factor/ V Division Factor for the surface (to the *lowest* values that produce acceptable results).

#### To fix aliased surface edges or profile



For Maya software and mental ray for Maya.

## 4 | Visualize and render images

What went wrong? > Troubleshoot:Troubleshooting Surfaces (Maya software)

If you do not plan to composite the rendered image, turn on Premultiply in the Render options section of the Render Global Settings window.

### To fix flickering thin surfaces



For Maya software only.

- Do the following:
  - In the Render Global Settings window, turn on Use Multi Pixel Filter.
  - Turn on Geometry Antialiasing Override for the surface, and increase the Antialiasing Level (try 3, 4, or 5).

### To fix flickering textures or popping displacements



**For solid textures**, make sure Use Min Screen is off for the surface and Mode U and Mode V are not set to Best Guess Based on Screen Size.

For image file textures or textures with noise, Increase Filter Offset (to the *lowest* value that produces acceptable results).

**For image file textures**, set Filter Type to Quadratic for the texture.

### To fix outlines around 2D motion blurred surfaces



For Maya software only.

- Do either of the following:
  - Remove transparent objects, fog, and/or glow, and set the background color to black. Render the scene, then composite the elements you removed with the rendered image.
  - In the Render Global Settings window, set Smooth Value to 0 and turn on Alpha/Color.

## 4 | Visualize and render images

What went wrong? > Troubleshoot:Edits in the Texture Editor don't update in IPR

### To fix grainy or flickering highlights



For Maya software only.

- Do either of the following:
  - Make sure "Use Min Screen" is off for the surface and Mode U and Mode V are not set to "Best Guess Based on Screen Size".
  - Use a Blinn material instead of a Phong or PhongE material.

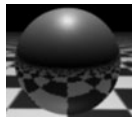
### To fix jagged edges or jagged or sharp textures on motion blurred surfaces



For Maya software only.

- In the Anti-aliasing Quality section of the Render Global Settings window, set Presets to 3D Motion Blur Production.

### To fix jagged surface edges, textures, or shadows in raytraced reflections or refractions



For Maya software only.

- In Render Global Settings window, set the Anti-aliasing Quality to Contrast Sensitive Production (Highest) quality, then turn on Shading Samples Override for the reflecting/refracting surface, and increase Shading Samples (to the *lowest* value that produces acceptable results).

## Troubleshoot:Edits in the Texture Editor don't update in IPR

Edits you make in the texture editor don't update in IPR. You must re-render the scene.



## 4 | Visualize and render images

What went wrong? > Troubleshoot: Looping renders

### Troubleshoot: Looping renders

Cycles in a render node network cause the renderer to loop forever. A cycle is when two or more nodes mutually depend on each other for their information.

Do not construct a render node network with cycles. If you create a cycling render node network accidentally, break one or more of the cycles using the Connection Editor before you render.

#### **4 | Visualize and render images**

What went wrong? > Troubleshoot: Looping renders

# 5 Quality, render speed, diagnostics

## About

### Image quality and render speed

#### The speed/quality tradeoff

Producing rendered images always involves making choices that affect the quality (anti-aliasing and sampling) of the images, the speed with which they are rendered, or both.

#### Related topics

- ❖ "Anti-aliasing and flicker" on page 131
- ❖ "Artifacts" on page 132
- ❖ "Render speed" on page 132

#### Anti-aliasing and flicker



Image courtesy of the Art of Maya

Jagged or stair-cased edges in pixel-based images or flickering surfaces in an animation are aliasing artifacts.

Aliasing artifacts result from *point sampling*, a process used in all computer graphics applications that determines the information about each pixel. Aliasing artifacts can result at various stages during any rendering process.

Anti-aliasing is the process of removing or reducing these artifacts. Because there are many kinds of aliasing, such as grainy surfaces, flickering, and jagged edges, there are as many approaches to controlling or fixing these problems. You can make adjustments to a number of settings to decrease or eliminate aliasing artifacts and flicker. See "Reduce artifacts and flicker" on page 134.

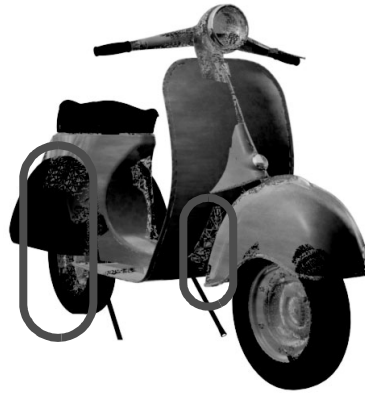
Most solutions to control aliasing are time-consuming and increase render times. Try to find the solution that gives you the best balance between image quality and performance.

## 5 | Quality, render speed, diagnostics

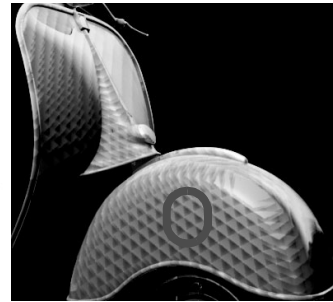
About > Artifacts

### Artifacts

Images courtesy of The Art of Maya



Clipping plane artifacts



Depth map shadow artifacts

Artifacts can show up as unintentional blotches, bands or cross-hatches on surfaces. Textures can flicker or crawl on surfaces from frame to frame during animations.

### Clipping plane artifacts

Especially in large scenes that have objects close together, background surfaces may appear to show through nearby surfaces. This is a result of how the camera's clipping planes determine the depth position of geometry; the problem results from the limited precision used to store depth information. It is mainly influenced by the following camera parameters: near clip distance, far clip distance, and camera angle.

### Render speed

You can make adjustments to a number of settings to increase the speed with which the scene, surfaces, and/or shadows render, and the speed with which camera render the scene. To find out about strategies to increase rendering speed, see "Increase render speed" on page 135.

### Reduce memory

In some cases, you can also reduce the memory used by the render to decrease rendering times. See "Reduce render memory usage" on page 139.

### Reduce file size (Maya Vector renderer)

Complex scenes and certain Maya Vector Render Global Settings can produce very large SWF or SVG files that are unsuitable for online delivery.

If you are using the Maya Vector renderer to create SWF or SVG files for online delivery, you can modify your scene and adjust the Maya Vector Render Global Settings to produce the best compromise between image quality and file size. See "Decrease file size (Maya Vector renderer)" on page 140.

### Maya render diagnostics

The *Render Diagnostics* tool lets you monitor how well you optimize the scene for rendering and watch for limitations and potential problems that may occur. For example, surfaces that are far away or blurred may not require the same level of visual accuracy or photo realism as surfaces close to the camera. You can speed render times and reduce memory usage if you know what the renderer is doing.

Run Render Diagnostics after you adjust objects and before you render to obtain valuable information about how you can improve performance and avoid limitations. You can run the diagnostics while experimenting with rendering settings, or before you start the final rendering.

### Hardware render diagnostics

Hardware render diagnostics traverse the shading network and geometry to flag those features which are not supported in the same way as they are in software rendering. Render diagnostics also examines your graphics hardware to determine its level of support.

### Related topics

❖ "Run diagnostics" on page 141.

### mental ray for Maya diagnostics

mental ray supports a number of diagnostic modes that help you visualize and optimize the rendering process. They modify the output image to include grid lines or dot patterns that indicate coordinate spaces or sampling or photon densities. These graphs help you detect insufficient or excessive sampling densities, and tune parameters such as numbers of photons or sampling and contrast limits.

For more information, see "Diagnostics" on page 197.

## 5 | Quality, render speed, diagnostics

How do I? > Adjust scene anti-aliasing parameters (Maya software)

### How do I? Improve rendered image quality

#### Adjust scene anti-aliasing parameters (Maya software)

Maya separates edge aliasing parameters from shading aliasing parameters to give you more control over image quality and performance.

You can adjust anti-aliasing settings for edges, shading, multipixel filtering, and motion blur in the Anti-Aliasing Quality section in the Render Global Settings window.

For details on the settings, see “Set scene rendering quality” on page 99.

#### Adjust per-object anti-aliasing parameters

##### Maya software rendering

You can correct the flickering of very small objects by increasing the visibility samples in the selected object’s Attribute Editor.

#### Reduce artifacts and flicker

Unlike anti-aliasing techniques, you cannot adjust the settings in the Render Global Settings window to reduce artifacts and flicker. Instead, you can fix shadow artifacts, clipping plane artifacts, or animation flicker independently.

#### Shadow artifacts (Maya software rendering)

Raytraced shadows are susceptible to the terminator effect, a self-shadowing error that results from tessellation (triangles that approximate a smooth surface). To fix raytraced shadow artifacts, increase the tessellation.

For more information on tessellation, see “Maya tessellation” on page 44.

#### Clipping plane artifacts (Maya software rendering)

Clipping planes help Maya to determine how far and near objects are relative to the camera. By default, cameras have Auto Render Clip Plane turned on so that Maya can sort geometry as accurately as possible. If objects seem to inter-penetrate each other, turn off Auto Render Clip Plane and set the Near Clipping Plane to 1.0.

For more information on clipping planes and these settings, see “Clipping planes” on page 34.

### Animation flicker

For Maya software rendering and Maya hardware rendering

During rendering, Maya filters textures. If textures flicker or crawl along objects in your scene from frame to frame, consider using a lower resolution file texture, or, if you are not using a file texture, adjust the Filter settings in the Effects section of the texture's Attribute Editor.

For more information about texture filtering, see *"Texture filtering"* on page 29 in the *Shading* guide.

### Increase render speed

#### Increase overall rendering speed

##### To make a scene render faster

- Diagnose the scene to find ways to render the scene faster using Render > Run render diagnostics. You can use this tool to monitor how well you optimize the scene and to search for limitations and potential problems that may occur. For more information on render diagnostics, see *"Diagnose scene problems"* on page 141.
- Perform scene optimizations:
  - Click File > Optimize Scene Size >  to turn options on or off to optimize everything in the scene and to remove unused or non-valid elements. See *"File > Optimize Scene Size"* on page 237 in the *Basics* guide for more information about this window.
  - For Maya software rendering, use Block ordered texture set up. See *"Cache texture tiles using BOT (block ordered texture)"* on page 139.
  - If the scene contains objects with construction history and you no longer need it, delete it. See the *"Construction history"* on page 105 in the *Basics* guide for details.
- Avoid memory swapping by:
  - Closing all applications before rendering to maximize the amount of memory available for rendering (including Maya if rendering from a shell or command line).
  - Setting the TEMP or TMPDIR variable as the location for temporary render cache files: -TMPDIR (IRIX and Linux) or -TEMP (Windows and Mac OS X) to make plenty of room for temporary rendered files. Make sure that the value of those variables points to a local, fast hard drive, not a network drive.

## 5 | Quality, render speed, diagnostics

### How do I? > Use average BSP (mental ray for Maya) settings

- For Maya software and mental ray for Maya, Test Resolution (Render > Test Resolution) lets you select a reduced resolution to test render the scene. For more information on test rendering strategies, see "Visualize a scene" on page 107.
- For Maya software, if the scene contains several identical surfaces (for example, multiple spheres), use Optimize Instances in the Render Global Settings window to improve rendering performance.
- Turn off motion blur if you don't need it (the Vector renderer has no motion blur). For the Maya software renderer, use 2D motion blur instead of 3D motion blur when possible. See 2D Motion Blur global attributes and 3D Motion Blur in the Render Global Settings window for details.

### Use average BSP (mental ray for Maya) settings

When mental ray for Maya raytraces, it calculates the effects using an average of the depth and the average of the leaf size settings of the BSP.

To speed up subsequent renderings, you can render instead with the average settings (instead of your initial settings).

Find the averages in Maya's Output Window after you render the scene the first time (with 'progress messages' turned on), then change the settings in the Memory and Performance section.

#### Example averages found in the Output Window

- RCI 0.2 info : main bsp tree statistics:
- RCI 0.2 info : max depth : 40
- RCI 0.2 info : max leaf size : 114
- RCI 0.2 info : average depth : 22
- RCI 0.2 info : average leaf size : 7
- RCI 0.2 info : leafnodes : 8185
- RCI 0.2 info : bsp size (Kb) : 393

### Increase surface rendering speed

- Use single-sided instead of double-sided surfaces (which is the default) on the object's Attribute Editor. The biggest speed gain is for the Maya hardware renderer.
- Tessellating large surfaces requires a lot of memory, so use several small surfaces instead of one large surface when you can. The renderer is more efficient with smaller surfaces.
- For Maya software rendering and Maya hardware rendering, use bump mapping instead of displacement mapping.



## 5 | Quality, render speed, diagnostics

### How do I? > Increase shadow rendering speed

- For Maya software rendering, make bump maps flatter. To do this, reduce the value of the Alpha Gain attribute, which smooths the bump map and reduces the number of samples of adaptive shading. This technique only works when Edge Anti-aliasing is set to Highest Quality. The texture bump looks flatter when the Alpha Gain is lower.
- For Maya software rendering, turn on Use Displacement Bounding Box when using displacement maps.
- For Maya software rendering, use layered textures when possible, instead of a Layered Shader. (See *"Layered shaders"* on page 24 and *"2D and 3D textures"* on page 25 in the *Shading* guide for details.)
- For Maya software rendering and mental ray for Maya, if you are raytracing the scene, set the Reflection Limit and Refraction Limit to the lowest values that produce acceptable results.
- For Maya software rendering, in the Render Global Settings window on IRIX and Linux, Use File Cache avoids re-tessellation of the same surface during rendering. Turn on Use File Cache to store geometric data in a separate file in a location that you specify (the default location is `/usr/tmp`, but you can set a new location by typing `setenv TMPDIR xxx`, where `xxx` is the name of the directory where this file is output).

## Increase shadow rendering speed

### To make shadows render faster

- For Maya software and mental ray for Maya, use depth map shadows instead of raytraced shadows.
- For surfaces that do not need to cast shadows, turn off Casts Shadows.

### To make depth map shadows render faster

- Set the Dmap Resolution to the lowest value that produces acceptable results. (For shadow casting spot lights, first reduce the Cone Angle to the lowest value that produces acceptable results.)
- Turn on Use Dmap Auto Focus (or set the Dmap Focus to the lowest value that produces acceptable results. See Dmap Focus, Dmap Width Focus) *and* set the Dmap Resolution to the lowest value that produces acceptable results.
- For Maya software rendering, set the light's Dmap Filter Size to the lowest value that produces acceptable results. A Dmap Filter Size value of 2 or more is usually sufficient. For mental ray for Maya, adjust the Resolution, Samples, and Softness settings under the light's Shadow Map section.

## 5 | Quality, render speed, diagnostics

How do I? > Increase camera views render speed

- For Maya software rendering, Set Fog Shadow Samples to the lowest value that produces acceptable results.
- For Maya software rendering, set Disk Based Dmaps to Reuse Existing Dmap(s).
- For Maya software rendering, if a point light does not have to produce shadows in the light's positive or negative X, Y, or Z directions, turn off the appropriate Use Dmap attributes: Use X+ Dmap, Use X- Dmap, Use Y+ Dmap, Use Y- Dmap, Use Z+ Dmap, or Use Z- Dmap. S
- For Maya software rendering, if the scene contains NURBS surfaces, in the Memory and Performance Options section of the Render Global Settings window, make sure Reuse Tessellations is on (the default setting).

### **To make raytraced shadows render faster (for Maya software rendering and Maya hardware rendering)**

- If the Light Radius (or the Light Angle for directional lights) is greater than 0, set Shadow Rays to the lowest value that produces acceptable results. See Shadow Radius, Light Radius, Light Angle for details.
- Set Ray Depth Limit to the lowest value that produces acceptable results.

## Increase camera views render speed

For Maya software rendering.

You can make camera views render faster by *not* selectively focusing the camera, or by selectively focusing the camera so more objects are in focus.

### **To make camera views render faster**

- Turn off Depth Of Field, or increase the F Stop.

## Global illumination and caustics

### **Specify objects to participate in global illumination and caustics**

By default all objects participate in photon tracing for global illumination and caustics. Typically, not all are required for you to achieve the look you want. You can specify exactly which objects cast and/or receive photons to reduce the rendering load.

### Final Gather

Final Gather is view dependent and is recalculated for each frame in a sequence. You can store final gather results so that later frames can use the results from a frame rendered earlier to speed up the Final Gather rendering process.

#### Reduce render memory usage

To reduce the memory used by the renderer, perform the following pre-render optimizations to produce a smaller and more efficient file.

### Cache texture tiles using BOT (block ordered texture)

For Maya software rendering only. (For mental ray for Maya search BSP in the online documentation.)

For more information on file textures, see *"File textures"* on page 27 in the *Shading* guide.

When you render, scripts, scenes, textures, etc., are loaded into RAM. If all available RAM is used, the machine may hang or experience swapping problems. To reduce the load on RAM during render time, you can convert your textures to Block Ordered Textures (BOT), which are essentially tiles. (For more information on tileable images, see *"File textures"* on page 27 in the *Shading* guide). With BOT files, a small cache of texture tiles are kept in RAM; when Maya needs more during render time, it goes to disk to find them.

The BOT cache is a fixed amount of approximately 250KB in RAM and efficiently caches textures.

- BOT is not recommended for all texture files, but you notice the difference in speed when rendering high resolution textures.

### Use the BOT pre-render setup

A new and optimized scene file is generated and is ready for the renderer when you use the BOT pre-render setup.

For more information, type the following:

```
maya -optimizeRender -help
```

```
maya -optimizeRender [options] mayaFile optimizedMayaFile
```

where *mayaFile* is the Maya file to be optimized and *optimizedMayaFile* is the name of the optimized Maya file.

## 5 | Quality, render speed, diagnostics

How do I? > Delete information not relevant to the renderer

The following options can be used:

-botRes 'int'	Resolution for which BOT files are produced. If this flag is not used, a default botRes of 512x512 is used.
-botLoca 'name'	Directory in which BOT files reside (default is in the same directory as the original file).
-help	Prints the help message.
-noBOT	Avoid BOT creations.
-noCleanup	Avoid cleaning up non-rendering related data.

### Delete information not relevant to the renderer

You can reduce memory in the Maya file by deleting information not relevant to the renderer. Sometimes extra information is only needed when editing the scene, or it contains currently unused items saved for future uses.

### Render parts of a scene separately

You can render parts of a scene separately and composite the rendered images. For more information on rendering in layers and passes for compositing, see "Layers and passes" on page 83.

### Decrease file size (Maya Vector renderer)

#### Strategies to decrease vector render file size

If you are using the Maya Vector renderer to create SWF or SVG files for online delivery, you may need to modify your scene and adjust the Maya Vector Render Global Settings to produce the best compromise between image quality and file size. Complex scenes and certain Maya Vector Render Global Settings can produce very large SWF or SVG files that are unsuitable for online delivery.

If you are using the Maya Vector renderer to create SWF or SVG files for delivery via CD-ROM, DVD, or network, or to create AI, EPS or bitmap images, then you do not usually need to be as concerned about file size.

Use the following guidelines as a starting point to help you reduce the size of rendered SWF and SVG files. See "Maya Vector tab" on page 211 for more information on how the various options affect file size.

## 5 | Quality, render speed, diagnostics

How do I? > Run diagnostics

- Reduce the complexity of your scene: Consider removing minor elements of your scene. Reduce the number of triangles in polygonal and subdivision surfaces. Reduce the tessellation of NURBS surfaces.
- Reduce the number of frames in an animation.
- Reduce the Frame Rate of an animation.
- Choose an appropriate Fill Style based on the objects in your scene. Some fill styles produce results of equal quality, but different file sizes, for certain types of objects. Avoid using Full Color or Mesh Gradient as they always create large files.
- Turn on Combine Fills and Edges (SWF only).
- Increase the Curve Tolerance value.
- Set Svg Animation to Script (SVG only).
- Turn on Compressed (SVG only).
- Decrease the Detail Level.
- Set Edge Style to Outline instead of Entire Mesh. (For more edge detail, turn on Edge Detail.)
- Turn off Hidden Edges.
- Turn off Show Back Faces. If a surface does not render because it is facing away from the camera, manually reverse the surface's normal.

### Diagnose scene problems

#### Run diagnostics

##### To run render diagnostics

- Do either of the following:
  - From the main Maya window, select Render > Render Diagnostics.
  - From the Render View window, select File > Render Diagnostics.

Maya opens the Script Editor and displays a list of potential problems in the scene.

## 5 | Quality, render speed, diagnostics

How do I? > mental ray for Maya error handling and diagnostics

### mental ray for Maya error handling and diagnostics

#### Error messages

mental ray for Maya checks for errors in a scene and recognizes various operating system errors. If an error is detected, a message appears in Maya's script editor. If a critical error is found, mental ray for Maya aborts the current process.

The message verbosity can be changed by selecting a different Export Verbosity option in the Render Global Settings window. When using the interactive renderer mental ray for Maya prints messages to the Output Window (Windows) or the Console (IRIX and Linux). When batch rendering with mental ray for Maya, a log file is created. If severe errors are encountered during database access of mental ray, the final rendering doesn't get started.

#### Diagnostics

You can use diagnostics to help you diagnose issues with samples and photon maps. You can specify Diagnose Grid and Grid Size, as well as Diagnose Photon Density or Irradiance. See "Diagnose scene problems" on page 141.

### Sample diagnostic messages

The following are some of the diagnostic messages Maya software rendering displays:

- Motion blur and raytracing are both turned on. (Reflections, refractions and shadows are not motion blurred.)
- You have motion blur turned on. Be aware that particles, lights and shadows do not motion blur. As well, motion blurred shadows may produce artifacts.
- You have specified output to the Quantel format. In previous versions of Maya, this format only outputs to NTSC/PAL/HDTV resolutions, and does not output to fields. If the above restrictions are not met, rendering defaults to IFF image output.
- You have specified output to the Cineon format. This format does not render out a mask channel.
- You have specified a fractional animation by-frame step. This results in images over-writing each other for fractional frame counts. Please remember to turn on the modify-extension.
- Near/far clipping values are too far apart. You may encounter numerical imprecision resulting in incorrect renders.

## **5 | Quality, render speed, diagnostics**

How do I? > Sample diagnostic messages

- There are no renderable cameras in the scene.

## **5 | Quality, render speed, diagnostics**

How do I? > Sample diagnostic messages



# 6 Network rendering

## About

### Maya network rendering

#### Maya network rendering

#### Maya network rendering

Network rendering is the distribution of the rendering process across more than one machine (sometimes called a render farm). For example, you can divide an animation into sequences and render each sequence on a different computer. You can also control when and on which computer to render. Rendering across a network of computers is often referred to as *distributed rendering*.

You can manage network rendering in two ways:

- Manually. See "Render across a network" on page 148.
- Automated, provided by a third-party solution.

Related topics:

- "Computer preparation" on page 145
- "Network render with Maya software" on page 148

### Computer preparation

Maya network rendering requires a network of properly configured computers.

**Tip** Network rendering may read and write numerous files over the network simultaneously. Make sure your network bandwidth can handle the traffic. Consider rendering files locally on each render node, then transferring them to the final destination.

### File Access

All files, scenes, and textures you use must be stored in locations accessible to each render workstation. This can be achieved by doing either of the following:

- Providing the files to all the render workstations from a central file server. File permissions must be adjusted for your environment.
- Transferring the files to each render workstation's local storage.

## 6 | Network rendering

About > Plug-ins

### Plug-ins

Make sure all render workstations used to render a scene containing plug-ins have those plug-ins installed, and that each render workstation has a valid license for those plug-ins. If a render workstation does not have a license for a plug-in being used, you may find that every frame it processes fails.

**Tip** It's a good idea to cache data in the scene to prevent unwanted differences between frames, computers, effects, and so on.

**Note** There are numerous third-party solutions that provide solutions for network rendering. This guide gives a minimum workflow only. Please check our Conductor Partners for available solutions.

### mental ray for Maya network rendering

#### Parallel network rendering

Parallel network rendering allows you to distribute the rendering of each frame in your scene across multiple machines on your network. This requires standalone mental ray rendering licenses and can be invoked while working within Maya (in the Render View or batch rendering) and also from the command line with Maya or the mental ray standalone renderer.

#### Related topics:

- "Terminology" on page 146
- "What do I need?" on page 147
- "Configuration files" on page 147
- "Before you begin (mental ray for Maya network rendering)" on page 149

#### Terminology

When using mental ray for Maya, *master* refers to the machine that is submitting the parallel network render requests interactively, via batch or command line, and *slave* refers to an individual machine with mental ray standalone on the network that receives and performs part of a parallel network render and sends the information back to the client.

Any machine with mental ray standalone can be a *master*, a *slave* or both at the same time.

**Note** While it is not recommended, you can mix and combination of IRIX, Linux, Windows, and Mac OSX machines as *masters* and *slaves*.

You can also mix any combination of IRIX, Linux, Windows, and Mac OS X machines as clients and servers.

### What do I need?

If you want to render Maya scenes (.mb or .ma) from within Maya or batch render with Maya, you need to install mental ray for Maya on all server machines and mental ray standalone on all slave machines.

If you want to render native mental images (.mi) scenes from the command line using the mental ray standalone renderer, you need to install mental ray on all master and slave machines.

### Configuration files

To specify which network render slave machines a master uses, mental ray for Maya and mental ray standalone use different configuration files:

- mental ray for Maya uses a file called `maya.rayhosts`
- mental ray standalone uses a file called `rayhosts`

#### **maya.rayhosts**

mental ray for Maya looks for `maya.rayhosts` in the following directories:

- user's Maya preference directory
- user's Maya application directory
- user's home directory

#### **maya.rayrc**

mental ray for Maya looks for `maya.rayrc` in the following directories:

- user's Maya preference directory
- user's Maya application directory
- user's home directory
- `$MAYA_LOCATION/mentalray`

## 6 | Network rendering

How do I? > Network render with Maya software

- directory from which the plugin was loaded

## How do I? Render across a network

### Network render with Maya software

### Network render with Maya software

Before you begin, you must have networked workstations. See your system administrator if workstations are not networked.

#### To render on several computers

- 1 Install Maya on each machine.

We recommend that you pare down the installation to the minimum requirements. For instance, you do not have to load all options on each machine when installing (for example, documentation).

- 2 Initiate render commands on each render workstation.

This can be achieved manually by the Command Line Render command. To automate it, use simple scripting capabilities. See the Command Line Render Help (`render -h`) for more options.

For example,

If you have a 100-frame scene and want to distribute the rendering across 4 render workstations, type:

`Render -s 1 -e 25 filename` for the first render workstation.

`Render -s 26 -e 50 filename` for the second render workstation.

`Render -s 51 -e 75 filename` for the third render workstation.

`Render -s 76 -e 100 filename` for the fourth render workstation.

**Tip** Using `-rep`

You can use the `-rep` flag on the Render command to automate Maya software networked rendering.

### Render on several IRIX and Linux computers

You can use Dispatcher to render on several IRIX and Linux computers. See "Overview of Dispatcher" on page 15 in the Rendering Utilities guide for more information.

How do I? > Before you begin (mental ray for Maya network rendering)

### Related topics

- "Maya network rendering" on page 145

## Network render with mental ray for Maya

### Before you begin (mental ray for Maya network rendering)

Before you begin, you must have networked workstations. See your system administrator if workstations are not networked.

You can set up masters using mental ray standalone or mental ray for Maya, using different method to specify which hosts to use as network render slaves.

**Note** If you have multiple versions of mental ray standalone installed (not recommended), each must have their own TCP port number in the services file to avoid conflict.

For example:

```
mi_ray3_0maya4_0 7051/tcp
mi_ray3_1maya4_5 7052 and 7053/tcp
mi_ray3_2maya5_0 7054/tcp
```

### Related topics

- "Parallel network rendering" on page 146
- "Submit a job to render over the network" on page 154

## Set up a master machine with mental ray for Maya

### To set up a master machine with mental ray for Maya

- Create a file called `maya.rayhosts` and put it in one of the following directories (They are searched in order and the first `maya.rayhosts` file that is found is used):
  - Maya 6.0 prefs folder:

(Windows) %USERPROFILE%\My Documents\maya\6.0\prefs/users/fred/Library/Preferences/

(Mac OS X) /users/username/Library/Preferences/Alias/maya/6.0/Prefs

## 6 | Network rendering

How do I? > Verify which hosts file is being read

(IRIX and Linux) `$HOME/maya/6.0/prefs`

- Maya Application folder:

(Windows) `%USERPROFILE%\My Documents\maya`

(IRIX and Linux) `$HOME/maya`

(Mac OS X) `/Applications/Alias/maya/6.0`

- User's home directory:

(Windows) `%USERPROFILE%` or `%HOMEDRIVE%\%HOMEPATH%` (usually `c:\`)

(IRIX, Linux, and Mac OS X) `$HOME`

`%USERPROFILE%` or `%HOMEDRIVE%\%HOMEPATH%` (on Windows)

- Directory of Maya 6.0 installation folder.

`/usr/aw/maya6.0/mentalray` (on IRIX and Linux)

(Windows) `C:\Program Files\Alias\maya6.0\`

(Mac OS X) `/applications/Alias/maya6.0/`

### Related topics

- "Parallel network rendering" on page 146
- "Submit a job to render over the network" on page 154

## Verify which hosts file is being read

### To verify which hosts file is being read

- 1 Turn on Info Messages in the Translation section of the Render Globals Setting window (with the mental ray renderer selected). During a render, messages similar to the following are output to the Script Editor:

```
// Info: (mental ray) : loading startup file C:/
Program Files/Alias/Maya 6.0/mentalray/maya.rayrc
// mental ray for Maya: using rayhosts file C:/
Documents and Settings/user1/My Documents/maya//
maya.rayhosts
```

### Related topics

- "Parallel network rendering" on page 146
- "Submit a job to render over the network" on page 154

How do I? > Change the set of slaves used for mental ray for Maya renders

### Change the set of slaves used for mental ray for Maya renders

#### To change the set of slaves being used for mental ray for Maya renders

- Close Maya, modify the appropriate `maya.rayhosts` file, and restart Maya.

#### Related topics

- "Parallel network rendering" on page 146
- "Submit a job to render over the network" on page 154

### Set up a master machine with mental ray standalone (method 1)

#### To set up a master machine with mental ray standalone - method 1

- 1 Create the file. Each line of the file should specify the name of a machine to be used as a network render slave.
- 2 Place the file in one of the following locations:
  - Place a file called `.rayhosts` in the home directory of the current machine. On IRIX, Linux, and Mac OS, X the home directory is specified by the `$HOME` environment variable. On Windows machines, it is specified by `%HOMEDRIVE%\%HOMEPATH%` (on most machines, this is `C:\`).
  - Place a file called `.rayhosts` in the current directory, for example, from where the render will be invoked. A `.rayhosts` file in the current directory overrides one in the machine's home directory.

## 6 | Network rendering

How do I? > Set up a master machine with mental ray standalone (method 2)

**Note** To verify which hosts file (if any) is being read, and what network render slaves are being contacted, use the `mentalrayrender` command with a verbosity setting of 4 or higher. For example, running

```
D:\> mentalrayrender -v 4 test.mi
```

could produce the output:

```
MAIN .0 info : mental ray, version 3.2
```

```
MAIN .0 info :
```

```
[...]
```

```
MAIN .0 info :
```

```
MAIN 0.0 info : version 3.2, 4 Dec 2002
```

```
MAIN 0.0 info : compiled on: Windows NT 4.0, x86
```

```
MSG 0.0 info : reading hosts file C:\\.rayhosts
```

```
MSG 0.0 info : connecting host foobar1:7054
```

```
JOB 0.0 info : started thread 0 on foobar1 now known as  
host 1
```

```
MSG 0.0 info : connecting host foobar2:7054
```

```
JOB 0.0 info : started threads 0,1 on foobar2 now known as  
host 2
```

```
.....
```

This indicates that the hosts file `C:\.rayhosts` was read, and that it specified network render slaves `foobar1` and `foobar2` for use in this rendering. The started thread 0, 1... messages indicate that the slaves were successfully contacted.

### Related topics

- "Parallel network rendering" on page 146
- "Submit a job to render over the network" on page 154
- "Set up a master machine with mental ray standalone (method 2)" on page 152

## Set up a master machine with mental ray standalone (method 2)

### To set up a master machine with mental ray standalone - method 2

- Use the `-hosts` option with the `mentalrayrender` command, for example:

```
mentalrayrender -hosts machine1 machine2 sceneFile.mi
```



This uses *machine1* and *machine2* as render slaves. This overrides any *.rayhosts* files on the master machine.

#### Related topics

- “Parallel network rendering” on page 146
- “Set up a master machine with mental ray standalone (method 1)” on page 151
- “Submit a job to render over the network” on page 154

## Slave machine setup

All slave machines require mental ray standalone.

### To set up a slave on Windows

When you install mental ray standalone, the installation automatically sets up your machine as a server to receive network render requests. If you are encountering problems with network rendering follow the steps below:

- 1** Ensure there is a *rayrc* file in the mental ray installation directory (C:\Program Files\mental images\mental ray). This file is automatically created during a default installation.
- 2** Ensure that the *Ray3\_3maya6\_0 Server* service is installed and running.  
To verify this, go to the Services window from the Administrative Tools and check to see if the *Ray3\_3maya6\_0 Server* service exists and is started.  
If the *Ray3\_3maya6\_0 Server* service exists but is not started, go to step 5.
- 3** If the *Ray3\_3maya6\_0 Server* service does not exist, edit the services file located at C:\WINNT\system32\drivers\etc\services, and make sure the following line exists:  

```
mi-ray3_3maya6_0 7054/tcp
```

  
7054 represents the port number. Make sure the port number is the same on the master machine and all slave machines.
- 4** Open a command prompt window and type the following:  

```
ray3_3maya6_0server /install
```

  
*ray3\_3maya6\_0server* should automatically be in your path and is located in the bin directory of the mental ray installation.
- 5** Double-click the *Ray3\_3maya6\_0 Server* service in the Services Window (Administrative Tools in the Control Panel) to start it.

## 6 | Network rendering

How do I? > Submit a job to render over the network

When the service successfully starts, the machine is ready to receive network render requests.

### To set up a slave on IRIX, Linux, and Mac OS X

The mental ray standalone installer does not set up your machine as a slave automatically. You need to follow the steps below on all IRIX, Linux, and Mac OS X machines with administrative privileges.

**1** In a shell type:

```
/usr/local/mi33/bin/netsetup -s
```

You are prompted for the name of the SPM license server. It defaults to the local host.

**2** Type in the SPM license server name if it is other than the default local host and then press Enter.

The machine is now ready to receive network render requests.

### Related topics

- "Parallel network rendering" on page 146
- "Submit a job to render over the network" on page 154

## Submit a job to render over the network

Once you are set up, the process of rendering over the network is fully automatic so that every render you invoke from a client machine is automatically distributed over the network.

### To network render a Maya scene within Maya on a master machine

Ensure that the `maya.rayhosts` file has the name of all mental ray network rendering slaves you wish to use (see "Set up a master machine with mental ray standalone (method 1)" on page 151).

- 1** Start Maya, open a scene and select Render > Render using > mental ray Renderer.
- 2** Select Render > Render Frame.
- 3** To verify that the slave machines are being used, in the Render Global Settings window (Window > Rendering Editors > Render Globals), go to the mental ray tab and in the Translation section, select Progress Messages from the Export Verbosity drop-down list.

You should see messages in the script editor telling you which slave machines were connected and which machine is being used to render particular tiles.

What went wrong? > Troubleshoot:Can't I install the rayserver service or edit the services file?

### To network render a Maya scene with Maya from the command line on a master machine

Ensure that the `maya.rayhosts` file has the name of all mental ray network rendering slaves you wish to use (see "Set up a master machine with mental ray standalone (method 1)" on page 151).

- 1 From a command prompt window, change to the directory where your Maya scene resides.
- 2 Type the following

```
Render -r mr sceneName.mb
```

### To network render with a mental images (.mi) scene with mental ray standalone on a master machine

Ensure that the `maya.rayhosts` file has the name of all mental ray network rendering slaves you wish to use (see "Set up a master machine with mental ray standalone (method 1)" on page 151).

- 1 From a command prompt window, change to the directory where your `.mi` file resides.
- 2 Type the following:

```
mentalrayrender myFile.mi
```

- 3 To get progress messages to show how the slave machines are being used, type the following command:

```
mentalrayrender -verbose 5 myFile.mi
```

#### Related topics

- "Parallel network rendering" on page 146

## What went wrong?

### Network rendering with mental ray for Maya

#### Troubleshoot:Can't I install the rayserver service or edit the services file?

Ensure you have administrator (or root) privileges on the machine.

## 6 | Network rendering

What went wrong? > Troubleshoot:I have everything correctly set up, but I still can't network render

### Troubleshoot:I have everything correctly set up, but I still can't network render

One possibility is that the network port number you are using is already being used by another service. Ensure that there is no other entry in the services file that is using port 7054. If that port number is already taken, you need to pick a new available port number and use that same number for all master and slave machines that are to work together.

You may need to edit the services file located at:

(IRIX, Linux, and Mac OS X) `/etc/services`

(Windows) `C:\WINNT\system32\drivers\etc`

and make sure the following line exists:

```
mi-ray3_3maya6_0 7054/tcp
```

7054 is the port number. Make sure the port number is the same on the master machine and all slave machines.

You may need to edit a file called the rayd file located in the mental ray 3.3 installation bin directory. Fill in the name of your SPM License server and uncomment the `setenv SPM_HOST` line.

(IRIX and Linux with versions of Redhat prior to 7.2) You may need to edit the `inetd.conf` file located at `/usr/etc/inetd.conf` and make sure the following line exists:

```
mi-ray3_3maya6_0 stream tcp nowait nobody /usr/local/mi32/bin/rayd rayd
```

You may need to restart the inetd service by typing the following:

```
% killall -v -HUP inetd
```

(Linux only with version of Redhat 7.2 and 7.3) You may need to edit the services in the `xinetd.d` directory. See "To check your xinetd configuration on Linux" below.

#### To check your xinetd configuration on Linux

**1** In a Linux shell type:

```
ls /etc/xinetd.d
```

There should be a file named `mi-ray3_3maya6_0`.

**2** If there is not, become root, create the file using a text editor and enter the following text:

```
# description: mental ray for maya network  
rendering service mi-ray3_3maya6_0
```

### What went wrong? > Troubleshoot:Mac OS X machines

```
{
    flags          = REUSE
    socket_type    = stream
    user           = nobody
    wait           = no
    server         = /usr/local/mi32/bin/rayd
    log_on_failure += USERID
}
```

**3** Save the file.

**4** In order for `xinetd` to find the newly configured service, you need to restart it or send it a signal.

- Restarting `xinetd` can be undesirable because it affects a number of network services. To restart `xinetd`, type:

```
/etc/init.d/xinetd restart
```

- To reconfigure `xinetd` without restarting it, find out the process id of `xinetd` by executing:

```
ps -e | grep -v grep | grep xinetd
```

You should see a line similar to this:

```
980 ?          00:00:02 xinetd
```

The first number is the process id of `xinetd`.

If the system is RedHat 7.2, `xinetd` re-reads its configuration on receipt of the `USR2` signal. For RedHat 7.3 it re-reads its configuration on receipt of the `HUP` signal. So for a RedHat 7.3 system where `xinetd`'s process id is 980 you would execute:

```
kill -HUP 980
```

`xinetd` should have found the new service and you should be able to send it render requests from another node on the network.

## Troubleshoot:Mac OS X machines

On Mac OS X the Maya installer sets up your machine as a master for the user who installed Maya

### To install settings on a Mac OS X machine for a user other than the user that installed mental ray

**1** The user should log in to the Mac OS X machine.

**2** Open a Terminal window and type:

```
sh /Applications/Alias/maya6.0/bin/setup defaults.sh install
```

## 6 | Network rendering

What went wrong? > Troubleshoot:Mac OS X machines

### **To remove settings on a Mac OS X machine for a user other than the user that installed mental ray**

**1** The user should log in to the Mac OS X machine.

**2** Open a Terminal window and type:

```
sh /Applications/Alias/maya6.0/bin/setup defaults.sh remove
```

# 7 Window, menu, and node descriptions

## Reference **Render Global Settings window**

### Render Global Settings window

Render globals (scene settings) for the Maya Hardware renderer, the mental ray for Maya renderer, the Maya Software renderer, the Maya Vector renderer are consolidated into one Render Globals Settings window.

Use the settings in this window to set scene-wide render options. Especially when used in conjunction with per-object render settings (see the particular object or render subject matter for details), the render global settings give you a great deal of control over quality of rendered images and the speed with which they are rendered.

To open the Render Global Settings window, see "Open the Render Global Settings window" on page 92.

### Common tab

The common tab contains settings that are common to all renderers. For information on the Common tab, see "Common tab" on page 159.

### Render-specific tabs

The other tab changes, depending on which renderer is selected.

- For information on the Maya Software tab, see "Maya Software tab" on page 165.
- For information on the Maya Hardware tab, see "Maya Hardware tab" on page 207.
- For information on the mental ray for Maya tab, see "mental ray tab" on page 184.
- For information on the Maya Vector tab, see "Maya Vector tab" on page 211.

### Common tab

For information on the render global settings, see "Render Global Settings window" on page 159.

Not all options are available for all renderers.

## 7 | Window, menu, and node descriptions

Reference > Image File Output

### Image File Output

The name of rendered image files can consist of three separate components: file name, frame number extension, and file format extension. A combination of these three components is referred to as the file name *syntax*.

For more information about the file name syntax, see "File name syntax" on page 78.

For more information about the file formats, see "File formats" on page 73.

#### File Name Prefix

Lets you specify the base name for rendered images.

**Note** When choosing basic file names for an animation, avoid using periods; use underscores instead. For example, use:

```
xxx_yyy.iff.1
```

instead of

```
xxx.yyy.iff.1
```

#### Frame/Animation Ext

The format (syntax) of rendered image file names.

#### Image Format

The format for saving rendered image files. See also "File formats". The default setting is Maya IFF.

#### Start Frame, End Frame

Specifies the first (Start Frame) and last (End Frame) frames to render. Start Frame and End Frame are only available if Frame/Animation Ext is set to an option containing # (see also Set file name syntax). The default value for Start Frame is 1; the default value for End Frame is 10.

#### By Frame

The increment between the frames you want to render. By Frame is only available if Frame/Animation Ext is set to an option containing #. The default value is 1.

If you use a value less than 1, make sure the Renumber Frames Using option is turned on. Otherwise, many frames will appear to be missing when they are just being overwritten.



### Frame Padding

The number of digits in frame number extensions. For example, if Frame/Animation Ext is set to *name.ext*, and Frame Padding is 3, Maya names rendered image files *name.001*, *name.002*, and so on. The default value is 1.

### Renderable Objects

Controls whether Maya renders all objects (Render All) or only selected objects (Render Active) for the camera selected in the Camera option's drop-down list *provided the selected camera has been set to renderable in the camera's Attribute Editor*. The default setting is Render All.

### Camera

By selecting a camera from this list, you can turn on or off the RGB, Alpha, or Mask channels for that camera.

- If your scene has only one renderable camera (for example, the perspective camera, which is by default the only renderable camera in a new scene), whatever camera is selected in this drop-down list becomes the renderable camera. In other words, the newly selected camera becomes the renderable one in your scene (the default perspective camera becomes unrenderable).
- If, however, you have more than one renderable camera in your scene (for example, if you've created a second perspective camera), by selecting another camera from this list, you *do not* automatically make the newly selected camera renderable. Selecting this other camera just lets you turn on or off the its RGB, Alpha, or Mask channels.

You can make the second (or any number of cameras) renderable in the Output Settings section of the selected camera's Attribute Editor. Any subsequent cameras you make renderable are shown as *[renderable]* in this list.

### Channels

RGB Channel (Color)	Controls whether rendered images contain a color channel. The default setting is on.
Alpha Channel (Mask)	Controls whether rendered images contain a mask channel. The default setting is on.
Depth Channel (Z Depth)	Controls whether rendered images contain a depth channel. The default setting is off.

## 7 | Window, menu, and node descriptions

Reference > Custom Filename Extension

### Custom Filename Extension

#### Use Custom Extension

You can use a custom file format extension for rendered image file names by turning on Use Custom Extension, and entering the extension in the field. This extension replaces the standard extension based on file format, such as .IFF, .GIF, etc.

### Renumber Frames

Lets you change the numbering of rendered image files for an animation. The Renumber Frames attributes are only available if Frame/Animation Ext is set to an option with # (such as name#.ext).

#### Renumber Frames Using

If on, Maya uses the frame number extensions beginning at Start Number and increasing by By Frame for rendered image file names.

#### Start Number

The frame number extension you want the first rendered image file name to have.

#### By Frame

The increment between frame number extensions you want rendered image file names to have.

### Resolution

The Resolution attributes control the resolution and pixel aspect ratio of rendered images.

For more information about resolution, see "Resolution" on page 80.

---

**Note** The resolution limit for the Vector renderer is 1600x1600.

---

---

**Note** When rendering larger than 6k x 6k resolutions, Maya requires large amounts of memory if the saved output image is one of: tiff, SoftImage, Alias-PIX, JPEG, EPS, or Cineon.

In such cases, you can render to any other Maya supported image format, and use conversion tools (such as imgcvt) to convert those images to the desired format.

---

## 7 | Window, menu, and node descriptions

Reference > Resolution

### Presets

Select a film- or video-industry standard resolution. When you select an option from the Presets drop-down menu, Maya automatically sets the Width, Height, Device Aspect Ratio, and Pixel Aspect Ratio.

You can also add a Presets option to output to an unlisted device.

<b>Render Resolution</b>	<b>Width</b>	<b>Height</b>	<b>Device Aspect Ratio</b>	<b>Pixel Aspect Ratio</b>
Custom	any	any	any	any
320x240	320	240	1.333	1.000
640x480	640	480	1.333	1.000
1k Square	1024	1024	1.000	1.000
2k Square	2048	2048	1.000	1.000
3k Square	3072	3072	1.000	1.000
4k Square	4096	4096	1.000	1.000
CCIR PAL/Quantel PAL	720	576	1.333	1.066
CCIR 601/Quantel NTSC	720	486	1.333	0.900
Full 1024	1024	768	1.333	1.000
Full 1280/Screen	1280	1024	1.333	1.066
HD 720	1280	720	1.777	1.000
HD 1080	1920	1080	1.777	1.000
NTSC 4d	646	485	1.333	1.001
PAL 768	768	576	1.333	1.000
PAL 780	780	576	1.333	0.984
Targa 486 (tga)	512	486	1.333	1.265
Targa NTSC (tga)	512	482	1.333	1.255
Targa PAL (tga)	512	576	1.333	1.500

## 7 | Window, menu, and node descriptions

Reference > Render Options

### Maintain Width/Height Ratio

When on, Maya automatically updates the Height when you set the Width (or the Width when you set the Height). If off, Maya updates the Device Aspect Ratio (if Lock Device Aspect Ratio is off and it does not update the Height or Width. Maintain Width/Height Ratio is on by default.

### Width, Height

The width and height of the image you want to render, measured in pixels. The ratio of the width and height is the *image aspect ratio*.

### Lock Device Aspect Ratio

Not available for mental ray for Maya.

If off, Maya updates the Pixel Aspect Ratio. When on, Maya updates the Device Aspect ratio when changing the width or height. The default setting is off.

### Device Aspect Ratio

The aspect ratio of the display device on which you view the rendered image. The *device aspect ratio* represents the *image aspect ratio* multiplied by the *pixel aspect ratio*.

### Pixel Aspect Ratio

The aspect ratio of the individual pixels of the display device on which you are viewing the rendered image.

For more information about the pixel aspect ratio, see "Pixel aspect ratio" on page 80.

Pixel Aspect Ratio is not available when using the mental ray renderer.

## Render Options

### Enable Default Light

Not available for Vector Rendering.

Turn the default lighting on or off during rendering.

For more information about Maya's default lighting, see "Default lighting in Maya" on page 15 in the *Lighting* guide.

### Plug-in Format

If you are using an IMF plug-in (to render images in a format that is not supported by Maya), enter the plug-in name in the Plugin Format field.

### Pre Frame MEL, Post Frame MEL

A MEL command or script to run before rendering each frame (Pre Frame MEL), or after rendering each frame (Post Frame MEL).

For more information Pre Frame MEL scripts and Post Frame MEL scripts, see "Pre Render MEL and Post Render MEL scripts" on page 82.

**Note** If you need to use multiple sets of quotations in the pre frame MEL or post frame MEL fields in render globals, be sure to use \" for every quotation mark except the first and last.

```
print("Time to render my Maya scene, called\"bingo.mb\"");
```

**Note** Do not enter the .mel extension when entering the name of the script. You get an error message similar to the following:

```
Error: Cannot link to "name.mel". Check number and types of arguments expected on procedure definition.
```

## Maya Software tab

For information on the render global settings, see "Render Global Settings window" on page 159.

### Anti-aliasing Quality

Controls how Maya anti-aliases objects during rendering.

For more information about anti-aliasing and image quality, see "Anti-aliasing and flicker" on page 131.

### Quality

Select a preset anti-aliasing quality from the drop-down list. When you select a preset, Maya automatically sets all Anti-aliasing Quality attributes. The default setting is Custom.

Custom	When you change anti-aliasing attributes that do not match any of preset attribute values, Maya automatically sets Presets to Custom.
Preview Quality	When test rendering scenes (fastest).
Intermediate Quality	When test rendering scenes to produce slightly better quality than preview quality.

## 7 | Window, menu, and node descriptions

### Reference > Edge Anti-aliasing

Production Quality	When testing or final rendering scenes that do not contain 3D motion blur or low-contrast scenes.
Contrast Sensitive Production	When testing or final rendering high-contrast scenes (such as when you raytrace a scene. Also useful for anti-aliasing noisy bump maps).
3D Motion Blur Production	When testing or final rendering scenes that contain 3D motion blur.

### Edge Anti-aliasing

Controls how the edges of objects are anti-aliased during rendering. Select a quality setting from the drop-down menu. The lower the quality, the more jagged the object's edges appear, but the faster the render; the higher the quality, the smoother the object's edges appear, but the render is slower.

When you select an Edge Anti-aliasing quality from the drop-down list, Maya automatically sets all Anti-aliasing Quality attributes (in the subsections).

Low Quality	Fastest anti-aliasing setting. For each rendered pixel, two points are analyzed and used to determine which part of the object is visible, producing low quality edge anti-aliasing.
Medium Quality	For each rendered pixel, eight points are analyzed and used to determine which part of the object is visible, producing medium quality edge anti-aliasing.  Although a little slower, produces moderately good edge anti-aliasing. This can be good for test rendering moderately complex scenes.
High Quality	For each rendered pixel, thirty-two points are analyzed and used to determine which part of the object is visible, producing high quality edge anti-aliasing.  Can be used for testing as well as production rendering.
Highest Quality	Highest Quality anti-aliasing computes the image in two passes, looking for color contrasts within pixels and in surrounding pixels, such as highlights. The

## 7 | Window, menu, and node descriptions

### Reference > Number of Samples

first pass is the High Quality computation—the second pass looks for color contrast in the results of the first pass. In the regions where color contrast is high (for example, in regions containing highlights), more shading samples are taken.

Improves on the High Quality and is excellent for picking up highlights that may be missed by a single pass (when you use High Quality).

## Number of Samples

### Shading

The number of shading samples for all surfaces. This option works in conjunction with Shading Samples, an attribute available from the Render Stats section of a surface's Attribute Editor. Shading Samples sets the number of times Maya shades in a pixel. For details, see Render Stats and Shading Samples.

### Max Shading

Not available if you choose Preview Quality from the Presets menu as the Anti-aliasing Quality.

The maximum number of shading samples for all surfaces. This option works in conjunction with Max Shading Samples, an attribute available from the Render Stats section of a surface's Attribute Editor. Max Shading Samples sets the maximum number of times a pixel is shaded during the second pass of a Highest Quality render. The higher the number, the longer the rendering takes, but the more accurate the resulting image.

### 3D Blur Visib.

The number of visibility samples Maya takes to accurately compute a moving object's visibility as it passes over another object

- |             |  |
|-------------|--|
| <b>Tips</b> | <ul style="list-style-type: none"><li>• 3D Blur Visib and Max 3D Blur Visib, are associated with Max Visib Samples available in the 3D Motion Blur section of a surface's Attribute Editor. For details, see 3D Motion Blur.</li><li>• 3D Blur Visib. and Max 3D Blur Visib. are only available when you turn 3D Motion Blur on in the Motion Blur section of the Render Global Settings window.</li><li>• Max Visib Samples is the maximum number of times a pixel is sampled for visibility when Motion Blur is turned on.</li></ul> |
|-------------|--|

## 7 | Window, menu, and node descriptions

### Reference > Multi-pixel Filtering

#### Max 3D Blur Visib.

The maximum number of times a pixel is sampled for visibility when Motion Blur is turned on.

#### Particles

The number of shading samples for particles. This option works with Shading Samples, an attribute available from the Render Stats section of a surface's Attribute Editor. Shading samples sets the number of times Maya shades each fragment in a pixel. See Render Stats and Shading Samples for more details.

## Multi-pixel Filtering

Multipixel filtering blurs or softens the entire rendered image to help eliminate aliasing or jagged edges in rendered images, or roping or flicking in rendered animations.

These options are only available when the "Edge Anti-aliasing" quality is set to either High Quality or Highest Quality.

#### Use Multi Pixel Filter

If on, Maya process, filters, or softens the entire rendered image by interpolating each pixel in the rendered image with its neighboring pixels, based on the Pixel Filter Type and the Pixel Filter Width X, Y settings.

**Note** If you are rendering fields, Maya does not filter rendered images, even if Use Multi Pixel Filter is on.

#### Pixel Filter Type

Controls how much the rendered image is blurred or softened when Use Multi Pixel Filter is on. There are five preset filters to choose from—Box Filter (very soft), Triangle Filter (soft), Gaussian Filter (only slightly soft), Quadratic B-Spline Filter (the filter used in Maya 1.0) and Plug-in Filter. The default is Triangle Filter.

To use a custom filter, select Plug-in Filter.

To create a plug-in filter, "Create and load a plug-in multi-pixel filter" on page 101.



### Pixel Filter Width X, Y

Controls the filter width used to interpolate each pixel in the rendered image when Use Multi Pixel Filter is on. If larger than 1, it uses information from neighboring pixels. The larger the value, the more the image is blurred. The valid range is 1 to 3. The default value is 2.2.

**Tip** The Pixel Filter Width X and Pixel Filter Width Y values do not need to be the same; however, to blur the rendered image equally in both directions, these values should be the same.

### Contrast Threshold

Determines adaptive sampling. Controls the number of shading samples taken during the second pass computation when Edge Anti-aliasing is set to Highest Quality.

#### Red, Green, Blue

Each color channel is evaluated and if the contrast of the neighboring pixel exceeds the threshold, more samples are taken. The valid range is 0 to 1. The default values are 0.4 (Red), 0.3 (Green), and 0.6 (Blue). If Presets is set to Contrast Sensitive Production, the default values are 0.2 (Red), 0.15 (Green), and 0.3 (Blue).

**Tips**

- Reducing RGB values sometimes bring out interesting features in rendered images (for example, small highlights or shadow boundaries), but can also increase rendering times.
- In relatively colorless images that exhibit shading aliasing (for example, gray shadows that look roppy), try setting Red to 0.3, Green to 0.2, and Blue to 0.5.

### Coverage

Only available when 3D Motion Blur is on.

Controls number of Visibility Samples taken during 3D motion blur computation. If visibility variation exceeds the threshold, more samples are taken. For example, reducing this number helps the renderer detect the change of visible objects in a pixel (but also increases rendering times). The valid range is 0 to 1. The default value is 0.125.

### Field Options

Use these options to control how Maya renders images as fields.

## 7 | Window, menu, and node descriptions

### Reference > Field Options

To find out more about frames and fields, see "Frames vs. Fields" on page 80 and "Specify frame or field rendering" on page 98.

#### Render

Controls whether Maya renders images as frames or fields, which is useful for output to video.

**Note** You can use interlace (IRIX and Linux), or fieldAssembler (Windows), or a compositing or NLE application (Mac OS X) to interlace the fields. See "*interlace*" on page 83 in the Rendering Utilities guide for details on interlacing.

Frames	Renders regular frames.
Both Fields, Interlaced	Renders both odd and even fields (for video) and automatically interlaces the results into a full frame.
Both Fields, Separate	Same as above, except no interlacing occurs. The result is a sequence of odd and even field images.
Odd Fields	Renders odd fields only.
Even Fields	Renders even fields only.

#### Field Dominance

Controls whether Maya renders Odd Fields at time  $x$  and even fields at time  $x+0.5$ , or Even Fields at time  $x$  and odd fields at time  $x+0.5$ .

**Note** If the Render Field Option is set to Frames, the Field Dominance options are not available. If set to Both Fields Interlaced, Maya sets the appropriate field dominance based on the format standard (NTSC or PAL).

#### Zeroth Scanline

(For advanced users only.)

Controls whether the first line of the first field Maya renders is at the top of the image or at the bottom.

**Note** If the Render Field Option is set to Frames or Both Fields, Interlaced, the Zeroth Scanline options are not available. Maya chooses the appropriate setting based on the format standard, NTSC or PAL.

### At Top/At Bottom

At Top is on by default. If you encounter problems in an animation where field order appears wrong (for example, objects vibrate up and down), change the Zeroth Scanline setting and render the animation again. If this does not solve the problem, or if objects in the animation vibrate left to right, try different combinations of Field Dominance and Zeroth Scanline, until the problem is solved.

### No Field Extension

The attributes in this section do not take effect if the fields are interlaced automatically.

No extension is added to odd and even field file names.

### Default Field Extension (o and e)

The attributes in this section do not take effect if the fields are interlaced automatically.

Maya saves the two field image files by adding an *e* (for even fields) and an *o* (for odd fields) onto the frame number extension or file name. For example, `name.001e.iff` and `name.001o.iff`. This is the default setting.

### Custom Extension

The attributes in this section do not take effect if the fields are interlaced automatically.

Set on to specify custom extensions to add to odd and even field file names. For example, if you type *x*, the result is `name.001x.iff`.

**Odd Field** The extension to add to odd field file names.

**Even Field** The extension to add to even field file names.

## Raytracing Quality

Controls whether a scene is raytraced during rendering, and controls the quality of raytraced images. When you change these global settings, the associated material attribute values also change. The resulting value is the smaller value of the two attribute settings.

## 7 | Window, menu, and node descriptions

### Reference > Raytracing Quality

For more information about raytracing, see *"Depth map and raytraced shadows"* on page 32 in the *Lighting* guide.

#### Raytracing

If on, Maya raytraces the scene during rendering. Raytracing can produce accurate reflections, refractions, and shadows (this can increase rendering times considerably, so try to use sparingly).

#### Reflections

The maximum number of times a light ray can be reflected. The valid range is 0 to 10. The default value is 1. For details, see Reflection Limit.

#### Refractions

The maximum number of times a light ray can be refracted. The valid range is 0 to 10. The default value is 6. For details, see Refraction Limit.

**Tip** If refractions turn black, make sure the refraction limits is set to a high enough value and that Visible in Refractions is turned on for the object in the Attribute Spreadsheet (Window > General Editors > Attribute Spreadsheet) and the Rendering Flags window (Window > Rendering Editors > Rendering Flags).

#### Shadows

The maximum number of times a light ray can be reflected and/or refracted and still cause an object to cast a shadow. A value of 0 turns off shadows.

For example, if the Shadows value is 2, only light rays that have been reflected and/or refracted once cause an object to cast a shadow. The valid range is 0 to 10. The default value is 2.

#### Bias

If the scene contains 3D motion blurred objects and raytraced shadows, you may notice dark areas or incorrect shadows on the motion-blurred objects. To solve this problem, set the Bias value between 0.05 and 0.1. If the scene does not contain 3D motion blurred objects or raytraced shadows, leave the Bias value as 0. The valid range is 0 to 1. The default value is 0.

### Motion Blur

When you render an animation, motion blur gives the effect of movement by blurring objects in the scene. You can turn Motion Blur on or off for objects. Maya uses the relationship between the Shutter Angle and Motion Blur attributes to determine how much blur is applied to an object.

For information about how a camera's shutter speed/angle affect motion blur, see "*Motion blur*" on page 30 in the *Cameras* guide.

#### Motion Blur

If on, the 3D Motion Blur Type is enabled as well as Blur By Frame. This means that moving objects appear blurred. If off, moving objects appear sharp. Motion Blur is off by default.

#### Motion Blur Type

The method Maya uses to motion blur objects.

- |    |  |
|----|--|
| 2D | 2D motion blur is a post-process; Maya blurs each object in the image after rendering the entire image based on the object's <i>motion vector</i> (its speed and direction). |
| 3D | 3D motion blur is similar to real-world motion blur, but takes longer to render than 2D motion blur. The default setting is 3D.  |

#### Blur By Frame

The amount moving objects are blurred. The higher the value the more motion blur is applied to objects. For example, if you motion blur by 1 frame, blur is calculated based on the motion of objects from one frame to the next; if you motion blur by 4 frames, blur is calculated based on the motion of objects every four frame lengths, during which time much motion is detected, and therefore much blur is applied. The default value is 1. The amount that moving objects are blurred is also based on the Shutter Angle of the camera. The length of the frame is determined by:

$$(\text{Shutter Angle}/360) * \text{Blur by Frame}$$

The Shutter Angle can be modified in the Special Effects section of the Camera's Attribute Editor.

#### Blur Length

Scales the amount that moving objects are blurred. The valid range is 0 to infinity. The default value is 1.

## 7 | Window, menu, and node descriptions

Reference > Motion Blur

### Blur Sharpness

The sharpness of motion blurred objects. The larger the Blur Sharpness, the more spread out the blur. The valid range is 0 to infinity. The default value is 1.

### Smooth

Alpha/Color Sometimes, anti-aliasing performed by the Smooth Value attribute can fail and produce artifacts corresponding to edges in the alpha channel of the unblurred image. For example, when bright opaque objects pass in front of dark light fog. Turning on Alpha or Color in such cases eliminates artifacts by additionally blurring the objects.

### Smooth Value

The amount Maya blurs motion blur edges. The larger the value, the more the motion blur is anti-aliased. The valid range is 0 to infinity. The default value is 2.

- |             |   |
|-------------|---|
| <b>Tips</b> | <ul style="list-style-type: none"><li>• Increasing the Smooth Value may also blur the edges of static objects, so if you do not want this effect, set Smooth Value to 0.</li><li>• You may not want extra blurring all the time, so only use this attribute when necessary. You can also try setting Smooth Value to 0, which results in less anti-aliasing, but that may only be acceptable in some situations.</li><li>• For objects shaded with the Ramp Shader, 2D Motion Blur provides better results than 3D Motion Blur (artifacting), but the Smooth attribute must be set to Color, not Alpha.</li></ul> |
|-------------|---|

### Keep Motion Vectors

If on, Maya saves the motion vector information for all visible objects with the rendered image but does not blur the image. This lets you blur the rendered images using the vector data with other 2D blur software (for example blur2d).

If off, Maya blurs the rendered image but does not save the motion vector information. Keep Motion Vectors is off by default.

### Use 2d Blur memory Limit

You can specify the maximum amount of memory used by the 2d blur operation. Maya uses whatever memory is available to finish the 2d blur operation.

### 2D Blur memory Limit

You can specify the maximum amount of memory the operation uses. If Motion Blur is on and the Motion Blur Type is set to 2D, the Use 2d Blur Memory Limit is on by default and provides a default memory limit of 200 MB. This default limit should be sufficient to eliminate most problems. However, you can specify the size of the memory cap (in MB) in the field provided.

## Render Options

### Post Processing

#### Environment Fog

Creates an environment fog node. Environment fog (a Volumetric material) is used to simulate the effect of fine particles (fog, smoke, or dust) in the air. These particles affect the appearance of the atmosphere and the appearance of objects in the atmosphere. See also Environment Fog.

For more information on Environment Fog, see *"Environment Fog"* on page 148 in the *Shading* guide.

#### Apply Fog in Post

Only render the fog as a post-process. When on, you can set the **Post Fog Blur**.

---

**Note** The results of this option cannot be seen in IPR.

---

### Camera

#### Ignore Film Gate

If on, Maya renders the area of the scene visible in the Resolution Gate. If off, Maya renders the area of the scene visible in the Film Gate and the region outside is rendered background color. See Camera Settings and Film Gate for information on how to viewing the film gate boundary interactively. Ignore Film Gate is on by default.

## 7 | Window, menu, and node descriptions

Reference > Render Options

### Lights and Shadows

#### Shadows Obey Light Linking

If on, shadow casting surfaces only cast shadows from shadow casting lights with which they are linked. If off, all shadow casting surfaces cast shadows from all shadow casting lights, even if they are not linked together. Shadows Obey Light Linking is on by default.

#### Enable Depth Maps

If on, Maya renders all depth map shadows for all lights which have depth map shadows turned on. If off, Maya does not render depth map shadows. Enable Depth Maps is on by default.

### Color/Compositing

#### Gamma Correction

Color corrects rendered images according to the following formulas. The default value is 1 (no color correction).

$$R = 255 \times \left( \frac{R}{255} \right)^{\text{gamma\_correction}} \quad \text{if } R > 255, \text{ then } R = 255$$

$$G = 255 \times \left( \frac{G}{255} \right)^{\text{gamma\_correction}} \quad \text{if } G > 255, \text{ then } G = 255$$

$$B = 255 \times \left( \frac{B}{255} \right)^{\text{gamma\_correction}} \quad \text{if } B > 255, \text{ then } B = 255$$

#### Clip Final Shaded Color

If on, all color values in the rendered image are kept between 0 and 1. This ensures that no parts of the image (for example, foreground objects) are overexposed. If off, color values in the rendered image may be greater than 1. Clip Final Shaded Color is on by default.

#### Jitter Final Color

If on, the image color is jittered to reduce banding.

#### Premultiply

If this option is on (default), premultiplication takes place (see "Premultiplied images" on page 84). If this option is off, the premultiply threshold option is enabled.

If on, Maya renders objects so that they are *not* anti-aliased against the background. For example, a pixel on the edge of an object is not mixed with the background color. (In TIFF terms, Maya generates unassociated alpha.) If off, Maya anti-aliases objects against the background. Premultiply is off by default.



**Tip** If you are rendering images for film or video, turn Premultiply off. If you are rendering images for a video game, turn Premultiply on.

### Premultiply Threshold

If this option is enabled (when the default premultiply is turned off), per-pixel color values are output only if the pixel's alpha channel value is above the threshold set here.

Controls the amount of edge anti-aliasing in a matte if Premultiply is on. If you are rendering images for use in a video game, and you are using 8 or 16 bit color, set Premultiply Threshold to 1 for smooth matte edges, with no jagged edges. The default value is 0.

## Memory and Performance Options

The Memory and Performance Options attributes help you optimize rendering to make scenes render faster.

For more information on render speed and image quality, see "Image quality and render speed" on page 131.

### Tessellation

Helps manage how Maya handles tessellation information for surfaces.

**Use File Cache** Enables the storing of geometry information into a "cache" file in the directory specified by the system's TEMP (Windows and Mac OS X) or TMPDIR (IRIX and Linux) environment variable to reduce the amount of memory used to store geometric data. Turning on this option lets the renderer perform its own swapping.

## 7 | Window, menu, and node descriptions

### Reference > Memory and Performance Options

**Note** Use File Cache helps to prevent maxing out memory bandwidth and disk space when you are rendering a heavy scene on a multi-processor machine.

Before rendering very large, type:

IRIX and Linux:

```
setenv TMPDIR NAMEOFDIR
```

Windows:

```
SET TEMP=NAMEOFDIR
```

where *NAMEOFDIR* is the location of a partition with a lot disk space.

**Note** In the *Maya.env* file, enter `TEMP = defaultPath`, where *defaultPath* is the pathname of the new temporary directory.

- (IRIX and Linux). If `TMPDIR` is set, Maya uses that directory unless it has write permission problems, in which case Maya defaults to `/usr/tmp`. If still not able to write to `/usr/tmp`, a warning message appears.
- (Windows). If `TEMP` is set, it uses that directory provided it's writable. If it's not writable, a warning message appears.
- (Mac OS X). If `TEMP` is set, Maya checks for write permissions, and the directory if not writable, it defaults to using the `Documents/temp` directory under your Home directory. If not able to write to `Documents/temp`, a warning message appears.

If the above still fails to find a temporary directory, a final attempt is made to set the current directory you are working in as the temporary directory.

#### Optimize Instances

If on and the scene contains several identical surfaces (for example, instanced surfaces or identical surfaces created independently), Maya tessellates only one of them, saving time and disk space. Optimize Instances is on by default.

#### Reuse Tessellations

If on, Maya temporarily saves tessellation information to disk for each frame.

## 7 | Window, menu, and node descriptions

### Reference > Memory and Performance Options

This is useful if a scene contains depth map shadows. For example, Maya tessellates surfaces when generating the depth map for a light (and saves the tessellation information to disk), and then re-uses the tessellation information when generating depth maps for other lights and when rendering the frame. (Maya removes the tessellation information from disk, and recalculates it for the next frame.) Reuse Tessellations is on by default.

**Note** Reuse Tessellations is an I/O-bound process that can max out the bandwidth when running multiple render jobs on the same machine. Reuse Tessellations is useful when running up to four jobs on a multi-processor machine. You can try turning off Render Globals > Use File Cache.

#### Use Displacement Bounding Box

Rendering can take a long time when you use displacement mapping because before rendering tiles, Maya tessellates all the displacement-mapped surfaces and calculates their bounding boxes. When you turn on Use Displacement Bounding Box, Maya calculates the bounding box scale that you define for all displacement-mapped surfaces. This makes rendering faster. When off, Maya pre-tessellates all the displacement-mapped objects before rendering. See Bounding Box Scale for details.

#### Ray Tracing

Helps control raytracing. For information on raytracing attributes, see Raytracing Quality.

For more information on raytracing, see *"Depth map and raytraced shadows"* on page 32 in the *Lighting* guide.

#### Recursion Depth

Determines how many levels of recursion to use for the raytracing voxel data structure of the rendering. For very complex scenes, this should be set to 2 or 3. For less complicated scenes, a setting of 1 should be fine. The default is 2.

#### Leaf Primitives

Determines the maximum number of triangles to allow in a voxel before going to the next recursive level. The default is 200.

## 7 | Window, menu, and node descriptions

Reference > IPR Options

### Subdivision Power

Represents the power that the number of triangles in a voxel is raised to in order to calculate how many voxels should be created when recursion is required. The default is 0.2500, which should be appropriate for most scenes. For extremely complex scenes or scenes with complex parts, this value can be increased slightly.

### Multi-Processing

Multi-threaded interactive rendering is available for the Render View. It provides the same kind of performance gain for the batch renderer. The number of CPUs to use for interactive rendering and IPR are set separately. Maya saves the value you set with the scene.

For more information, see “Network render with Maya software” on page 148.

### Use All Available CPUs

By default, all available CPUs are used. If off, the slider below the option is enabled.

### Num. CPUs to use

The slider can be dragged from values 1 to 8, but larger values up to 256 can be entered if needed. Entering a value of 0 or turning the option on enables all CPUs for interactive rendering.

**Note** If you want a Multi-Processor batch render, set the number of processors to use in the Batch Render window, or use the `-n` flag (for Maya software rendering), for command line rendering.

**Note** If IPR is in use, the number of CPUs cannot be changed until the current IPR session is closed. The following warning appears:

```
// Warning: IPR will need to be closed before this  
change in CPUs will take effect. //
```

### IPR Options

These attributes determine which shading elements are saved to disk when you perform an IPR render. This can save time and disk space.

For more information on IPR, see “Interactive Photorealistic Rendering (IPR)” on page 67.

## 7 | Window, menu, and node descriptions

Reference > Render Layer/Pass Control

### Render Shading, Lighting and Glow

Determines whether to process shading, lighting and glow characteristics of the next IPR Render.

### Render Shadow Maps

Depth map shadows are included in IPR renders.

Turn on to show depth map shadows in the scene and be able to update them when tuning. Because generating a depth map is a time-consuming and processor-intensive operation (like a full rendering from the light's point of view), IPR does not automatically generate depth maps when you adjust attributes.

**Notes** Attributes in the first part of the Depth Map Shadow Attributes section of a light's Attribute Editor affect how the depth map is created; you must select IPR > Update Shadow Maps to see the effect of changes you make to these attributes.

Attributes in the second part of the Depth Map Shadow Attributes section of a light's Attribute Editor affect how the depth map is used; you can adjust these attributes, and see the results immediately in your IPR session.

### Render 2D Motion Blur

Turn on to adjust 2D motion blur for the next IPR Render. *Only 2D motion blur is tunable.*

## Render Layer/Pass Control

For more information on render layers and passes, see "Layers and passes" on page 83.

**Note** For render layer and pass control, Maya Software rendering and mental ray for Maya rendering share settings. So, any changes you make here are automatically applied to the same section in the mental ray for Maya tab.

### Enable Render Layers

Tells the renderer to render only the layers for which renderable is turned on. In interactive mode, all layers with renderable turned on are rendered into a single image. In batch mode, each layer is output to a file named:

*camera\_filename\_layername\_passname.ext*

## 7 | Window, menu, and node descriptions

### Reference > Paint Effects Rendering Options

#### Enable Render Layer Passes

Available when Enable Render Layers is turned on.

Allows you to render individual passes for each layer.

When you select this option, the Render Pass Management Spreadsheet appears, where you can type 'on' or 'off' to specify which passes you want to render. For information about passes, see "Layers and passes" on page 83.

#### Enable Global Passes

Available when Enable Render Layers is turned off.

Allows you to render passes for the entire scene. When you select this option, the Render Pass Management Spreadsheet appears, where you can type on or off to specify which passes you want to render. See Enable Render Layer Passes for a description of the types of passes.

#### Output to Subdirectories

Places files from each separate layer and/or pass into their own directory, and any given directory only contains files from the specific layer or pass. Files are named:

```
.../layerName/passName/camera_filename_layername_passname.ext
```

## Paint Effects Rendering Options

For more information about Paint Effects, see "Painting in Maya" on page 17 in the *Paint Effects, Artisan, and 3D Paint* guide.

The following describes only render options for the Paint Tool.

#### Enable Stroke Rendering

Turn on to render the Paint Effects strokes in the scene. If off, the scene renders without strokes. This option is turned on by default.

#### Oversample

Renders the Paint Effects at double resolution for better anti-aliasing.

#### Oversample Post Filter

Applies a weighted filter to the oversampled image for better smoothing.

## 7 | Window, menu, and node descriptions

### Reference > Paint Effects Rendering Options

**Note** The Oversample and Oversample Post Filter options are particularly useful when rendering Paint Effects fur or hair. Also the new Mesh Brush Type requires oversample be used to anti-alias the tube edges if you don't convert the Paint Effects to polygons.

#### Only Render Strokes

Turn on to render *only* the Paint Effects strokes in the scene. You may want to render the strokes separately from the rest of the scene, then composite the strokes with the scene. See For more information about Paint Effects, see *"Painting in Maya"* on page 17 in the *Paint Effects, Artisan, and 3D Paint* guide for details.

#### Read This Depth File

**Note** When you render strokes only, you must also specify an .IFF file in the Read This Depth File field (see next). The file can be empty. It does not have to have depth.

If compositing the rendered scene with rendered Paint Effects strokes, type the location and name of the depth file for the rendered scene. Use the absolute path name (for example, /h/username/rainyday.iff (IRIX and Linux), or c:\username\rainyday.iff (Windows), or /username/rainyday.iff (Mac OS X)).

If rendering an animation and have an animated input file, place the # character where the frame number is in the source input files. For example, for files foo1.iff, foo2.iff, and so on, enter foo#.iff. For files foo1, foo2, and so on, enter foo#. When you render, the # character is replaced with the current frame number.

For more information about Paint Effects strokes, see *"Painting in Maya"* on page 17 in the *Paint Effects, Artisan, and 3D Paint* guide.

## 7 | Window, menu, and node descriptions

Reference > mental ray tab

**Note** It is best to supply a depth file and allow Maya Paint Effects to do the compositing rather than attempt to composite Paint Effects as a post process using a compositor. Maya Paint Effects uses a multi-layer depth and RGB buffers to perform the compositing with the scene and can achieve a much better composite than a post process compositor can achieve.

Also, if you do not supply a depth file (an .IFF file with depth information), Paint Effects strokes that are behind objects in your scene are rendered. Maya does not overwrite your existing images supplied as a depth file—the output is named as shown at the top of the Render Global Settings window.

### mental ray tab

For information on render global settings, see “Render Global Settings window” on page 159.

#### Presets

When you select a Preset here, settings in the applicable sections in the mental ray tab are automatically set (for example, PreviewGlobalIllum turns on Global Illumination and sets other defaults in the Caustics and Global Illumination section).

Use these settings as a starting point for rendering your image at a given quality and with a certain effect.

Draft	Gives you a relatively good indication as to what scene will look like while taking the least amount of processing time.
Draft motion blur	Gives you a relatively good indication as to what scene will look like, with motion blur, while taking the least amount of processing time.
Preview	Slightly better than Draft, takes a little more processing time, but achieves a good balance between quality and time.
PreviewCaustics	Slightly better than draft (but includes caustics), takes a little more processing time, but achieves a good balance between quality and time.
PreviewFinalGather	Slightly better than draft (but includes final gather), takes a little more processing time, but achieves a good balance between quality and time.



## 7 | Window, menu, and node descriptions

Reference > Anti-Aliasing Quality

PreviewGlobalIllum	Slightly better than draft (but includes global illumination), takes a little more processing time, but achieves a good balance between quality and time.
PreviewFur	Slightly better than draft (but renders fur without motion blur), takes a little more processing time, but achieves a good balance between quality and time.  If you want to render motion blur with fur, Filter Width and Filter Height.
PreviewMotionBlur	Slightly better than draft (but includes motion blur), takes a little more processing time, but achieves a good balance between quality and time.
Production	Use this when testing the final rendering or rendering the final image(s) that do not contain motion blur.
ProductionMotionBlur	Use this when testing the final rendering or rendering the final image(s) that contain motion blur.

### Anti-Aliasing Quality

Controls how mental ray for Maya anti-aliases objects during rendering.

For more information about anti-aliasing and image quality, see "Anti-aliasing and flicker" on page 131.

#### Number of Samples

##### Min Sample Level

This is the guaranteed minimum number of samples per pixel used when processing an image. Based on Contrast Threshold (adaptive) settings, mental ray for Maya will increase these samples as needed.

##### Max Sample Level

This is the absolute maximum number of samples per pixel used when processing an image.

## 7 | Window, menu, and node descriptions

Reference > Anti-Aliasing Quality

### Multi-pixel Filtering

#### Filter

This is processing performed on the results of the sampling to blend pixels into a coherent entity. Black and white = noisy. Filtering looks at neighboring info and unifies the two.

**Box Filter**            The fastest way to get relatively good results.

**Triangle (default)**    More processor intensive than box, but offers even better results.

**Gaussian Filter**     Produces the best results, but is the slowest to render.

**Mitchell, Lanczos**    Mitchell (clip) and Lanczos (clip) are alternatives to Gaussian that offers slight variations in contrast (tends to increase). Mitchell increases less than Lanczos.

Because “plain” Lanczos and Mitchell may produce negative values the new filter types are “clipped” variants to ensure positive values. The filtered result samples are clipped to the min/max range of input samples. The final pixel in the image will therefore not contain any out-of-range values produced by the filter, as might be the case for regular Mitchell and Lanczos filters.

#### Filter Width

Controls the filter width used to interpolate each pixel in the rendered image. The larger the value, the more info from neighboring pixels. The larger the value, the more the image is blurred. The value should be at least 1.

#### Filter Height

A multiplier on the final value of the image.

#### Contrast Threshold

Lowering these values increases sampling (up to the Max Sample Level), which results in higher quality but longer processing time. Depending on the actual contrast of the image, you may not be able to get better results (that is, results are limited by the amount of contrast).

### Sample Options

#### Sample Lock

Locks the location in which you sample within pixels. When turned on, this option ensures that the sub-pixel samples occur at the same location within in each pixel, which is important to help eliminate noise and flickering results. Turn it off only if you get sampling problems, such as moire patterns.

#### Jitter

Reduces artifacts by introducing systematic variations into sample locations. Without jittering, samples are taken at the corners of pixels or subpixels; jittering displaces the samples by an amount determined by lighting analysis.

## Raytracing

### Ray Tracing

If on, mental ray for Maya raytraces the scene during rendering. Raytracing can produce the most physically accurate reflections, refractions, shadows, global illumination, caustics and final gather.

### Reflections

The maximum number of times a ray can be reflected off reflective surfaces.

See also Max Trace Depth.

### Refractions

The maximum number of times a ray can be refracted through non-opaque surfaces.

See also Max Trace Depth.

**Tip** If refractions turn black, make sure Refraction is set to a high enough value.

### Max Trace Depth

While the Reflections setting and Refractions setting each set the maximum number of times a ray can reflect or refract (respectively), this setting sets total number of penetrations that can occur regardless of whether the penetration is a result of reflection or refraction.

## 7 | Window, menu, and node descriptions

### Reference > Shadows

example, if reflections = 5, refractions = 5, but max depth trace = 4, then any combination of reflection and refraction bounces can take place, up to a maximum of 4.

#### Shadow Trace Depth

The maximum number of times a shadow rays will penetrate a non-opaque object.

#### Scanline

Scanline rendering is used as a faster way (in most cases) of rendering. By default, mental ray for Maya uses this option when possible; however, in some cases, you may want to turn it off to force mental ray for Maya to raytrace (such as when you want to use less memory).

On, Off	Turn scanline rendering on or off
OpenGL	Attempts to optimize the rendering further with OpenGL graphics hardware in your workstation
Rapid	A substantially faster motion blur algorithm alternative.

#### Faces

Determines whether to render double-sided or single-sided for the entire scene.

Both	Works especially well if volume effects are used.
Front	Only front-facing (that is, the side whose normal vectors face away from) are rendered.
Back	Only back-facing are rendered.

## Shadows

#### Shadow Method

Off	Disables all shadows.
Simple	Enables simple shadows, which are standard for the provided libraries. This is the most efficient of the three shadow modes.  If shadows overlap because multiple objects obscure the light source, the order in which these objects are considered (and their shadow shaders are called) is undefined. If one object completely obscures the light, no other obscuring objects are considered.
Sort	Enables shadow sorting.

## 7 | Window, menu, and node descriptions

Reference > Shadows

Similar to Simple, it ensures that the shadow shaders of obscuring objects are called in the correct order, object closest to the illuminated point first. This mode is slightly slower but allows custom shadow shaders to record information about obscuring objects. If no such custom shader is used, this mode offers no advantage over simple shadow on.

### Segments

Like Sort, the shadow shaders are called in order. Shadow rays are traced much like regular rays, passing from one obscuring object to the next, from the light source to the illuminated point; each such ray is a shadow segment.

Use this mode if you want volume effects (like fluids, particles, fur and smoke) to cast shadows.

This mode requires support from the shadow shader, which must use the `mi_trace_shadow_seg` function to cast the next shadow ray segment.

### Shadow Maps

#### On/Off

Turns shadow maps on or off.

Shadow map parameters are specified for each light source. The default is off because shadow maps, while often significantly faster, always assume opaque objects.

#### opengl mode

Causes mental ray for Maya to use OpenGL acceleration (if available with your graphics hardware) when rendering shadow maps.

The same limitations apply as mentioned with the Scanline option. Shadow maps rendered with this option contain slightly different information from those generated with the regular (On) algorithm, and the soft areas of shadows tend to be smaller. Some areas may incorrectly be determined to not be in shadow.

When OpenGL rendering of shadow maps is enabled, only the local workstation (master) participates since the computation cost of the map is so small that the networking overhead would be more costly.

### Rebuild Shadow Maps

Determines whether all shadow maps are recomputed.

## 7 | Window, menu, and node descriptions

### Reference > Motion Blur

If this option is off (the default) shadow maps are loaded from files or reused from previously rendered frames if possible. If this option is on, no shadow map is reused (that is, everything is recomputed).

#### Motion Blur Shadow Maps

Determines whether shadow maps should be motion blurred so that moving objects cast shadows along the path of motion.

Turning this option off (default is on) can cause shadow maps to render slightly faster. (Note that since shadow maps do not deal with transparent objects and motion blurring introduces a form of transparency at the edges, shadow map shadows can appear too large in the direction of motion if the object moves quickly.)

#### Motion Blur

See also "mental ray for Maya motion blur" on page 29.

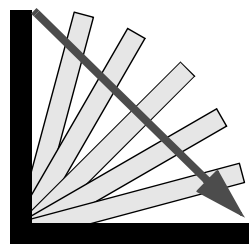
#### Calculation

See also "mental ray for Maya motion blur" on page 29.

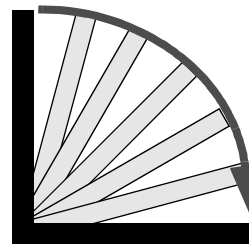
#### Motion Blur

Turns motion blur on (linear or exact) or off. Linear only considers the position of objects at the Shutter beginning and end point (open and close points), then does a linear interpolation based on the objects to simulate. It is fast but limited.

Exact is slower to render, but gives true (that is, exact) motion blur results.



Linear motion blur



Exact motion blur

#### Motion Blur By

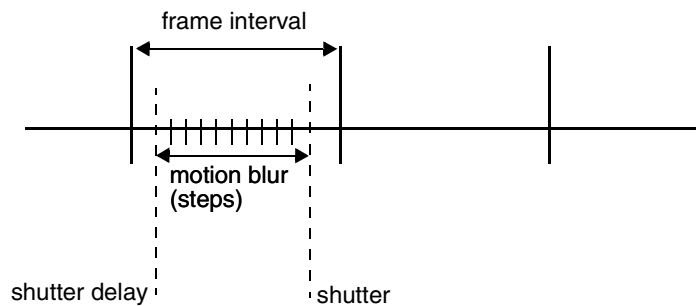
This is a multiplier used to amplify the motion blur effect. Increasing this value reduces the realistic results achieved, but may produce an enhanced effect if that's what you want to achieve.

The higher the value, the longer the time interval used in the motion blur's computation.

### Shutter, Shutter Delay

**Note** The mental ray for Maya renderer draws its shutter setting from here in the Render Globals Settings window, unlike the Maya renderer (for which the shutter setting is on the camera).

Defines the point at which the shutter closes within the frame interval to control motion blurring.



The camera shutter opens at time `delay3.1` and closes at time `shutter`. The defaults are both 0.0. If `shutter` is equal to `delay`, motion blurring is disabled; if `shutter` is greater than `delay`, motion blurring is enabled. The normal range is (0, 1), which uses the full length of the motion vectors or motion vector paths3.1. It can be useful to set `delay3.1` and `shutter` both to 0.5, which disables motion blurring but renders with an offset of one half frame, which allows bidirectional post-blurring in an output shader.

### Time Contrast R

These settings determine a threshold for adaptive time sampling. Lower values cause more time samples, which result in more accurate motion blur but increased render times.

### Motion Steps

See also diagram in "Shutter, Shutter Delay" on page 191.

If motion blurring is enabled, mental ray can create motion paths from motion transforms, much like multiple motion vectors on vertices can create motion paths.

## 7 | Window, menu, and node descriptions

### Reference > Caustics and Global Illumination

This option specifies how many motion path segments should be created for all motion transforms in the scene. The number must be in the range 1 to 15. The default is 1.

## Caustics and Global Illumination

### Caustics

Turn caustics on or off (default). Caustics are produced only by light sources for which photon emission is enabled. The material shader (which must have a non-zero diffuse component) that receives the caustics must be set to receive caustics.

### Caustic Accuracy

Controls the number of photons used to estimate the caustic brightness. The default is 64. Higher settings (up to 100 to start, tested in small increments) larger numbers make the caustic smoother.

### Caustic Radius

Controls the maximum distance at which mental ray for Maya considers photons for caustics. When left at 0 (the default), mental ray for Maya calculates an appropriate amount of radius, based on the bounding box size of the scene. If the result is too noisy, increasing this value (to 1 to start, then by small increments up to 2) decreases noise but gives a more blurry result. To reduce the blur, you must increase the number of caustic photons (Caustic Accuracy) emitted by the light source.

### Caustic Filter Type

Controls the sharpness of the caustics.

Filtering increases the weight of photons that are close to the point of interest, and reduces the amount of blur at the edges of a caustic.

**Box** Generally makes caustics look sharper. It is faster, but less precise.

**Cone** Generally makes caustics look smoother. It is more precise, but slower.

### Caustic Filter Kernel

The bigger the kernel, the softer the caustic.

### Global Illumination

Use this to turn on or off (default) Global illumination, a process that allows for indirect lighting and effects like color bleeding. The default is off.



## 7 | Window, menu, and node descriptions

### Reference > Caustics and Global Illumination

Global illumination is computed only for light sources for which photon emission is enabled.

#### Global Illum Accuracy

Change the number of photons used to compute the local intensity of global illumination. The default number is 64; larger numbers make the global illumination smoother but increase render time.

#### Global Illum Radius

Controls the maximum distance at which mental ray for Maya considers photons for global illumination. When left at 0 (the default), mental ray for Maya calculates an appropriate amount of radius, based on the bounding box size of the scene. If the result is too noisy, increasing this value (to 1 to start, then by small increments up to 2) decreases noise but gives a more blurry result. To reduce the blur, you must increase the number of global illumination photons (Global illumination Accuracy) emitted by the light source.

#### Photon Volume Accuracy

Controls how the photon map is used to estimate the intensity of caustics or global illumination within a participating medium. It applies to photon volume shaders, which compute light patterns in 3D space, such as volume caustics created by focused shafts of light cast by objects acting as lenses.

#### Photon Volume Radius

Controls the maximum distance at which mental ray for Maya considers photons for a participating medium.

#### Max Reflection Photons

Use this to limit the number of times a photon will reflect in a scene (after the first bounce, which is taken care of by direct illumination). It works in conjunction with Max Photon Depth.

#### Max Refraction Photons

Use this to limit the number of times a photon will refract in a scene (after the first bounce, which is taken care of by direct illumination). It works in conjunction with Max Photon Depth.

#### Max Photon Depth

Use this to limit the number of times a photon will bounce around (reflect or refract) after the first bounce (which is taken care of by direct illumination) in a scene.

## 7 | Window, menu, and node descriptions

Reference > Final Gather

Default is 5, but correct value depends on how many surfaces the photon must go through or bounce off of before hitting a diffuse surface to stop. For example, if a photon goes through 6 transparent surfaces, the default 5 would produce incorrect results. After the depth trace limit has been met, photons are not reemitted and instead are absorbed.

Custom shaders may override these values.

### Photon Map File

Specify the photon map file that mental ray for Maya should use as the current photon map. It will be loaded and used without computing a new photon map. If the photon map file does not exist, one will be created and saved.

### Photon Map Rebuild

If a filename is specified for the photon map (in Photon Map File), the map is loaded and used (providing the file exists). If this option is turned on, any existing file will be ignored, and the photon map will be recomputed and an existing file will be overwritten. The default is off. In other words, if you want to build a map, turn this option on; if not, turn this option off and specify the file to be used in Photon Map File

### Direct Illumination Shadow Effects

This should be turned ON if you use transparent shadows with Global illumination and/or caustics.

## Final Gather

### Final Gather

Use this to turn Final gathering for global illumination on or off. The default is off. Final gathering is a different means of calculating indirect illumination. For more information, see *"Final gather"* on page 27 in the Lighting guide.

### Precompute Photon Lookup

This option (which also turns on Final Gather) causes photon tracing to compute and store an estimate of the local irradiance at every photon location. This means that far fewer final gathering points are required because the photon map carried a good approximation of the irradiance in the scene -- mental ray for Maya can estimate irradiance with a single lookup, instead of many photons. In this case, photon tracing takes longer than before and requires slightly more memory, but rendering is faster.

### Final Gather Rays

Controls how many rays are shot in each final gathering step to compute the indirect illumination. The default is 1000 per sample point, but this tends to be high for test renders (renders can take hours). Test rendering at lower values, usually 100 or 200, is sufficient; higher values are required for final renders. Increasing the value reduces noise but also increases the rendering time.

**Note** When the number of Final Gather rays is changed, the Final Gather File is always ignored and new Final Gather rays are emitted.

You can see, in the Output window, when this happens:

- RCFG 0.2 info: finalgMap/test1:final gather options differ from ones currently used, content ignored.
- RCFG 0.2 info: overwriting final gather file "finalgMap/test1"

### Min Radius, Max Radius

Max Radius and Min Radius control the size of the sampling region within which Final Gather rays search for irradiance information from other surfaces.

With the default values, Maya calculates values that seem appropriate based on scene dimensions to speed up the render, but this calculation doesn't allow for complex geometry. Generally, enter a value that is 10% of scene's overall dimension for the Max Radius, then enter 10% of that for Min Radius. Make further adjustments based on scene geometry detail, how the geometry is arranged in the scene, and how the render looks. For example, use these settings to achieve better diffuse detailing in nooks and crannies in your scene.

### Filter

Use this to control how Final Gather uses a speckle elimination filter to prevent samples with extreme brightness from skewing the overall energy stored in a Final Gather sampling region.

Neighboring samples are filtered so that extreme values are discarded in the filter size. By default, the filter size is 1. Setting this to 0 disables speckle elimination, which can add speckles but will better converge towards the correct total image brightness for extremely low accuracy settings. Size values greater than 1 eliminate more speckles and soften sample contrasts. Sizes greater than 4 or so are not normally useful.

## 7 | Window, menu, and node descriptions

Reference > Final Gather

### Falloff Start, Falloff Stop

Use these settings to limit the reach of indirect light for Final Gather (but not photons). If no object is found within a distance of start, the ray defaults to the environment color. Objects farther away than stop from the illuminated point will not cast light.

### Trace Depth

Use this option to specify the number of subrays for the final gather render. The default is 0, which means that indirect illumination computed by final gathering cannot pass through glass or bounce off mirrors, for example. A depth of 1 would allow a single refraction or reflection. Typically, a depth greater than 2 is not necessary.

### Trace Reflection

Use this to limit the number of times subrays will reflect in a scene. It works in conjunction with Trace Depth.

### Trace Refraction

Use this to limit the number of times subrays will refract in a scene. It works in conjunction with Trace Depth.

### Final Gather File

This is the file that stores the Final Gather results that mental ray for Maya can use for irradiance lookups. You can re-use Final Gather results from a frame rendered earlier, or from a previous scene render:

- If no filename is specified and Final Gather Rebuild is turned on, rendered results are placed in a default file.
- If you specify previously non-existent filename, the rendered results are placed in the file with that name.
- If you specify an existing filename here, and Final Gather Rebuild is turned on, the specified file is overwritten with the newly rendered Final Gather results.
- If you specify an existing filename here, and Final Gather Rebuild is turned off, the newly rendered results are appended to the existing file. (This means that the file may grow without bounds.)

### Final Gather Rebuild

If this is on (default), any previously generated Final Gather file is ignored and all final gather points are recomputed. See Final Gather File for more information about the file.

If this file is off, Final Gather is forced to use the results from a previous Final Gather render.

**Tip** If you are rendering out a still image and are not changing the Final Gather settings, turn this attribute off to save rendering time.

**Tip** If you are rendering out a camera animation sequence, you may be able to use previous frames' Final Gather results (that is, you can turn this attribute off), depending on how the irradiance changes during the animation.  
However, if objects in the scene move, this option must be on.

### Preview Final Gather Tiles

If turned on, this setting lets you see tiles as they render. That is, you can see the image as it renders.

## Diagnostics

### Diagnose Samples

Shows how spatial supersamples were placed in the rendered image, by producing a grayscale image signifying sample density. This is useful when tuning the level and the contrast threshold for spatial supersampling.

### Diagnose Grid

Renders a grid on top of all objects in the scene, in object, camera, or world space. Gives you an idea of the scene scale and rough estimates of distances and areas.

### Grid Size

Defines the size of the grid (in Diagnose Grid).

## 7 | Window, menu, and node descriptions

Reference > Features

### Diagnose Photon

#### Photon Density

Shows a false color rendering of photon density on all materials. This is useful when tuning the number of photons to trace in a scene, and to select the optimum accuracy settings for estimation of global illumination or caustics. It also works well in combination with the Grid Mode.

#### Diagnose BSP

Shows the cost of creating and traversing the BSP tree used for raytracing. Both the depth and the leaf size can be visualized. If the diagnostic image shows that mental ray has been operating near the limit in large parts of the image (indicated by red or white pixels), this helps tuning the BSP parameters in the options block.

## Features

Turn these options off, to globally disable the following features in your scene.

## Overrides

Use these options to globally override per-object settings for tessellation, caustics, and global illumination.

### Tessellation

Use these options to create and assign a Surface and/or Displace approximation globally to the scene.

### Caustics/Global Illumination

Turn caustics and global illumination generators and receivers on or off for the entire scene.

## Contours

For more information about these options, see *"Integrated contour rendering"* on page 272 in the What's New guide for Maya 6.0.

### Custom shaders

Use these options to connect Contour Store and Contour Contrast shaders.

## Image Based Lighting

Create an IBL node to render sky-like (infinite distance) illumination and/or reflection.

For more information on Image Based Lighting and the IBL node, see *"Rendering Image-Based Lighting (sky-like illumination)"* on page 282 in the What's New guide for Maya 6.0.

### Framebuffer Attributes

#### Data Type

Select the kind of information the framebuffer contains.

#### Gamma

Use this setting to apply gamma correction to rendered color pixels to compensate for output devices with a nonlinear color response.

All R, G, B, and alpha component values are raised to  $1/\text{overgamma\_factor}$ . The default gamma factor is 1.0, which turns gamma correction off.

#### Colorclip

Controls how colors are clipped into a valid range [0, 1] before being written to a non-floating point frame buffer or file.

In all modes, the RGB components are clipped as specified by the desaturate option. The RGB and alpha modes ensure that the resulting color is a valid premultiplied color.

RGB (default)	RGB is first clipped to [0, 1] and alpha subsequently to $[\max(R, G, B), 1]$ . Use RGB if the alpha channel is considered less important than preserving the RGB color and intensity.
Alpha mode	Alpha is first clipped to [0, 1] and RGB subsequently to [0, A]. Alpha mode is intended for alpha compositing, where the alpha channel is more important than the absolute color value to preserve correct transparencies.
Raw	RGB and A are both clipped to [0, 1] independently of each other. Use Raw mode only if no layering based on alpha is going to take place. This mode turns Premultiply on, so use it with care because shaders might receive colors that cannot be composited in standard ways.

#### Interpolate Samples

#### Desaturate

If a color is output to a frame buffer that does not have 32-bit (floating-point) precision, and its RGB components are outside the range [0, max], mental ray clips the color to this legal range.

## 7 | Window, menu, and node descriptions

Reference > Memory and Performance

If desaturation is turned off (on by default), the individual components are simply clipped into range. Otherwise, mental ray tries to maintain the brightness of the color by moving it towards the grayscale axis of the color cube, until the RGB components are in the legal range. max is determined by the colorclip mode.

### Premultiply

If this option is on (default), premultiplication takes place (see "Premultiplied images" on page 84).

If on, Maya renders objects so that they are *not* anti-aliased against the background. For example, a pixel on the edge of an object is not mixed with the background color. (In TIFF terms, Maya generates unassociated alpha.)

The premultiply off option instructs mental ray to always store colors unpremultiplied into frame buffers and files. This option is ignored if the colorclip raw mode is in effect.

### Dither

mental ray for Maya supports 8, 16, or 32 bits per color component. In some cases, 8 bits per pixel, as supported by all popular picture file formats, can cause visible banding when the floating-point color values calculated by the material shader are quantized to the 8-bit values used in the picture file. Dithering mitigates the problem by introducing noise into the pixel such that the round-off errors are evened out. Note that this can cause run-length encoded picture files to be larger than without dithering. Dithering is turned off by default

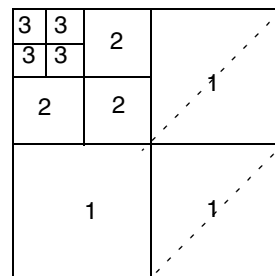
## Memory and Performance

Contains options for managing memory and performance during mental ray for Maya rendering.

### Acceleration Method

BSP (default)

Nested voxels





## 7 | Window, menu, and node descriptions

### Reference > Memory and Performance

The BSP (binary space partitioning) acceleration method recursively subdivides 3D space into a nested set of voxels, small boxes with triangles in them. It is efficient, but careful attention should be given to the size and depth parameters, which can have a large impact on speed and memory usage.

See also "Use average BSP (mental ray for Maya) settings" on page 136.

**Grid** The Grid acceleration method subdivides on a regular grid in space. Its memory usage is more predictable, but it may be slower if the geometry is not evenly distributed in the scene.

#### BSP Size

Determines the maximum number of triangles in one bsp voxel. If you decrease this number, you will have more voxels and a heavier bsp structure, resulting in higher memory usage and better performance.

#### BSP Depth

Determines the maximum number of voxel subdivisions.

#### Grid Resolution

If the hierarchical grid algorithm is used, this option sets the number of grid voxels.

mental ray for Maya can use subgrids to subdivide voxels with many triangles, so that scenes with dense concentrations in specific areas do not need force the increase of the global number of voxels just to capture the regions of high density. A grid resolution of 2 lets the grid algorithm degenerate to an octree algorithm.

#### Grid Max Size

If the hierarchical grid algorithm<sup>3.1</sup> is used, this option sets the maximum number of triangles in a grid voxel. If there are more, and the grid depth permits it, the voxel is subdivided into a subgrid. Note that size int must really be an integer; a floating-point value causes the statement to be ignored and a warning to be printed.

#### Grid Depth

If the hierarchical grid algorithm<sup>3.1</sup> is used, this option sets the number of recursion levels. If a voxel of a grid contains too much detail, it is subdivided by a subgrid for that voxel, which adds another level. The default is 2 for two levels (subdivided voxels cannot be subdivided again).

## 7 | Window, menu, and node descriptions

Reference > Memory Limits

### Task Size

Please refer to the mental ray User Manual, available from the Maya help, for more information about this setting.

## Memory Limits

### Physical Memory

Physical Memory defaults to 800 in mental ray for Maya. A guideline is to set it to 80% of physical memory. (In this case, we assume 1 GB. If you have more, increase this value accordingly.)

## Translation

Contains options for specifying the settings and items to be included when rendering a Maya scene with mental ray for Maya.

### Export Verbosity

Messages equal to or below the selected severity are displayed, both from the translation process (in the script editor) and mental ray (in the console window). If progress messages are enabled (at the very least), then the Maya progress bar updates accordingly during standard and lightmap rendering.

### Export Exact Hierarchy

Tries to preserve the DAG hierarchy during processing. This produces additional mental ray instgroup entities. There are certain unresolved material inheritance issues in this mode, but it works well in the general case. Deeply nested DAG hierarchies may be translated much faster compared to the standard Maya iterator mode that always flattens the DAG. Default is off.

### Export Full Dagpath

Uses the full DAG path names instead of the shortest possible name for mental ray scene entities. This is not required to generate a valid scene, but ensures reproducible names even if DAG entity names are reused in Maya. On the other hand, with deeply nested DAG hierarchy names, you may exceed the maximum supported name length in mental ray. Default is off.

### Export Textures First

Collects all file texture references in the scene first. This ensures that missing texture files are reported early in the process, but may slow down scene processing depending on the number of file textures being used. It may also write out textures references that are never used in the shading graph, because it doesn't perform a complete scene graph traversal for performance reasons. Default is on.

### Export Particles

Lets you export particles.

### Export Particle Instances

Lets you export particle instances.

### Export Fluids

Lets you export fluids.

### Export Post Effects

Lets you export post effects.

### Performance

(Performance options are within the Translation section.)

Please refer to the mental ray User Manual, available from the Maya help, for more information about this setting.

### Prune Invisible Parts

Ignore invisible scene entities during processing completely. They are not part of the final mental ray scene. This option needs to be turned off to export primary invisible scene objects that contribute to rendering in other ways, for example, casting shadows. Default is on.

If you animate the visibility, this option must be turned off.

### Optimize Vertex Sharing

This is to produce a more compact vertex representation (vertex lists) for meshes that exhibit a lot of vertex sharing. Only first-level sharing is exploited in mental ray for Maya.

### Export Shape Deformation

Compare actual geometry to determine any kind of shape deformation during animation and motion blur, required to produce exact motion blur information and support incremental changes in mental ray. If none of these conditions are true, turning this off may speed-up scene processing. Default is on.

### Export Polygon Derivatives

Calculate and export first order derivatives for polygons. This is required for bump mapping and shader filtering to producer comparable results to Maya. Default is on.

### Export Nurbs Derivatives

Enable calculation of first order derivatives for NURBS objects in mental ray. This is required for bump mapping and shader filtering to produce comparable results to Maya. Default is on.

## 7 | Window, menu, and node descriptions

Reference > Translation

### Customization

(Customization options are within the Translation section.)

Please refer to the mental ray User Manual, available from the Maya help, for more information about this setting.

### Render Globillum Global Pass

If this setting is enabled and if render pass enabled (in the last section of this tab), then mental ray for Maya can render global illumination and caustics in a separate pass from direct illumination.

### Photons Obey Light Linking

Photon emission respects relationships between lights and objects defined by light linking. Default is off.

### Optimize Raytrace Shadows

If global illumination or caustics is on, to be physically correct, any shadow shader in your scene is ignored. However, in cases where you need the shadow shader to work together with global illumination (for example, with colored or transparent shadows), enable this setting.

### Export State Shader

This should only be turned off when exporting to .mi file and only the standard mental ray base shaders are used exclusively (for example, when no Maya shaders are used). Default is on.

### Export Light Linker

This controls the export of the Maya light linker node. Default is on.

### Export Maya Options

This enables the export of special options as mental ray user data, to control several advanced Maya features performed in the mayabase shaders. Default is on.

### Export Custom Colors

Common mental ray shaders often use 4-component RGBA color parameters instead of the usual 3-component Maya color compounds. With this option enabled all custom nodes are provided with full RGBA colors, with the alpha component set to 1.0 (fully opaque). Default is off.

### Export Custom Text

This should only be turned on for .mi file export to recognize and translate Custom Text nodes. It is automatically turned off for the integrated rendering if Preview Custom has been turned off.

### Export Custom Data

If enabled, special custom attributes on polygon meshes are recognized and exported as vertex user vectors to mental ray.

### Export Custom Vectors

This option enables recognition of an optional `miCustomMotion` boolean dynamic attribute on geometry shape nodes. If such an attribute has been found then motion vectors are always generated and exported, even if they are of zero length. This is required for certain mental ray shaders that are allowed to perform motion blur calculation in the shader, for example for displacement motion blur.

### Export Custom Motion, Motion Object Output, Motion Back Offset

Allows adaptations of the start and end time steps where motion blur information is captured. The default corresponds to Maya, where the scene is evaluated half of the shutter interval times the Motion Blur By value moved back and forth from the current frame time. When this is turned on, you can set Motion Object Output and Motion Back Offset.

## Preview

Contains options for specifying what to include in a preview render in Render View.

Please refer to the mental ray User Manual, available from the Maya help, for more information about this setting.

### Preview Animation

Render subsequent frames of the set animation range and preview all intermediate images inside Render View.

### Preview Motion Blur

Calculate and preview render motion blur if enabled in the Render Globals. The Preview Animation option doesn't need to be turned on for this to work.

### Preview Render Tiles

Updates the Render Preview window in regular time intervals to show render progress. If this is turned off, only the final image is shown at the end of rendering.

### Preview Custom

Preview render custom text and vertex data. It requires custom shaders and its declarations to be loaded first. It's off by default.

## 7 | Window, menu, and node descriptions

Reference > Custom Entities

### Custom Entities

Contains controls for creating and managing custom global text, textures, and scene element text.

Please refer to the *mental ray Shaders Guide*, available from the Maya help, for more information about this setting.

### Custom Globals

These allow for the customized output of version, link, and include statements. If these text boxes are empty, mental ray for Maya generates the usual default statements that are required for rendering Maya scenes. Otherwise, it expects a space separated list of entries, which are exported in the appropriate section of the mi stream instead of the defaults.

In the version text box, the first entry is written as the min version, the second entry as the max version statement.

The *include* text

```
base.mi mayabase.mi
```

in the text box results in:

```
$include "base.mi"  
$include "mayabase.mi"
```

in the final output.

The same happens for the *link* text.

### Custom Scene

#### Custom Global Text

Custom global text control is especially useful for adding custom link, \$include and code statements. It can also be used to add texture and shader declarations.

Within a scene many types of text nodes can be created, but just the selected one gets exported. The contained text is written once at the beginning of the .mi stream right before the first option block gets written. Certain modes are available which determine how the custom text should be applied to the generated output.

Note that incorrect .mi text could be introduced that cannot be recognized nor corrected by mental ray for Maya processing.

#### Custom Options Text

Similar to Custom Global Text, Custom Options Text is provided to allow customized mental ray option settings. It offers the ability to extend or replace the generated option settings. For example, custom framebuffer statements should be added here.

## 7 | Window, menu, and node descriptions

Reference > Render Layer/Pass Control

### Custom Lights, Cameras, and Scene Text

These enable custom text on certain sequentially exported sections like lights section, camera section, and scene section, in this order. Those sections can be extended or completely replaced, similar to the Custom Globals. For example, custom lights can be appended to the generated output. This would require that the scene section be extended with the incremental change of the new root instance group including the new light.

### Render Layer/Pass Control

Lets you enable render layers and render passes.

### Maya Hardware tab

For information on the render global settings, see "Render Global Settings window" on page 159.

### Quality

For more information about render speed and image quality, see "Image quality and render speed" on page 131.

#### Presets

When you select a Preset here, settings in the applicable sections in the rest of the tab are automatically set.

Use these settings as a starting point for rendering your image at a given quality and with a certain effect.

At higher quality settings, objects appear smooth, but may take more time to render. At lower quality settings, objects may appear a little more jagged, but render quickly.

**Custom** Lets you specify the hardware quality settings independently.

**Preview Quality** The Enable edge anti-aliasing is set to off.  
The number of samples is set to 1.  
Color texture resolution is set to 128.  
Bump texture resolution is set to 256.

**Intermediate Quality** The Enable edge anti-aliasing is set to on.  
The number of samples is set to 3.  
Color texture resolution is set to 256.  
Bump texture resolution is set to 512.

## 7 | Window, menu, and node descriptions

Reference > Quality

Production

Quality      The Enable edge anti-aliasing is set to on.  
The number of samples is set to 9.  
Color texture resolution is set to 512.  
Bump texture resolution is set to 1024.

### Number of Samples

Lets you select the exact number of samples per pixel used to control the anti-aliasing of objects during rendering.

For software rendering, each pixel is sampled first in the center, then slightly off center for subsequent samples. For hardware, each pixel is sampled in the center. For subsequent samples, the image is then rerendered slightly offset, and each pixel is sampled in the center again. The images are then aligned to produce the final image.

### Transparent Shadow maps

#### Transparency sorting

The method by which sorting is performed prior to rendering to improve transparency.

Per object      Transparent objects are sorted and drawn from furthest to closest in distance. This option provides faster results but may not render complex transparent objects correctly.

Per polygon      Each object's polygons are sorted and drawn from furthest to closest in distance from the viewer. This option provides more accurate transparency representation but may take longer to process.

### Color Texture Resolution

If hardware rendering cannot directly evaluate a shading network, the shading network is baked to a 2D image that the hardware renderer can use. This option specifies the dimension of the baked image for supported mapped color channels on a material. Supported channels include color, incandescence, ambient, reflected color, and transparency. The default value is 128, which means that any baked color images have dimensions 128 by 128 pixels.

### Bump Texture Resolution

If hardware rendering cannot directly evaluate a shading network, the shading network is baked to a 2D image that the hardware renderer can use. This option specifies the dimension of the baked image for supported bump maps, which typically must be of a higher resolution



than that used for mapped color channels. The default value for this option is 256, which means that any baked bump images have dimensions 256 by 256 pixels.

### Render Options

For more information about render layers and passes, see "Layers and passes" on page 83.

#### Culling

Lets you control the type of culling used for rendering.

**Per object** The culling option is based on the per object settings found in the Render Stats section of the selected object's Attribute Editor. The current options are:

*Double Sided* renders double sided lighting with the current normals on the object.

*Single Sided* renders with single sided lighting with the current normals on the object.

*Opposite* renders with single sided lighting with the reversed normals on the object.

**All Double sided**

Forces all objects to render using the Double Sided option, whether or not you set that option on the object. Single Sided offers better rendering performance than Double Sided.

**All Single sided**

Forces all objects to render using the Singled Sided options whether or not you set that option on the object. If the Opposite suboption is enabled then that suboption is used. Single Sided offers better rendering performance than Double Sided.

#### Small Object Culling

When this performance-improving option is enabled (default), opaque objects that are smaller than the specified threshold are not drawn.

This option provides the same functionality as the Occlusion Culling option found in High Quality Rendering mode in viewports.

## 7 | Window, menu, and node descriptions

Reference > Render Options

Culling  
Threshold (% of  
image size)

This is the threshold suboption for the Small Object Culling option. The threshold you provide is the percentage of the image size that an object occupies in the output image.

If an object is less than that percentage in size then it is not drawn. Size is measure in pixels in screen space (relative to the camera used for rendering). The default percentage is 0 percent.

This option ignores View->Camera Settings options (such as Gate and Fill options), which are used for image output only.

E.g. % = 10.0. Image size 100 by 100 (pixels). The threshold in pixels would be  $100 \times 100 \times .10 = 1000$  pixels. If an object was less than 1000 pixels in size then it would not be drawn.

E.g. % = 0.0 Image size 100 by 100 (pixels). The threshold in pixels would be  $100 \times 100 \times 0 = 0$  pixels. If an object was less than 0 pixels in size then it would not be drawn. This can occur when one opaque object completely obscures another object with respect to the current camera used for rendering.

### Motion Blur

If this option is on, you can change Motion Blur by Frame option and the Number of Exposures option.

### Motion Blur by Frame

In the hardware renderer, motion blur is achieved by rendering the scene at specific points in time and blending the resulting sample renders into a single image.

Blur by frame represents the absolute time range, starting from the current frame, that is blurred. This determines the approximate start and end times of the blur. This time range is then adjusted in accordance with the camera's Camera Shutter Angle attribute in the Attribute Editor.

### Number of Exposures

The number of exposures divides the above time range determined by the Motion Blur by Frame option into discrete moments in time, where the entire scene is re-rendered. The final image is the

accumulated average of all the exposures. So to obtain a smooth blur, a larger number of exposures is desired. Similarly, for a motion trail, a smaller number of exposures is preferable.

### Enable Geometry Mask

For hardware rendering. When this option is turned on, opaque geometry objects mask out particle objects, and transparent geometry is not drawn. This is especially useful when compositing particles over software-rendered geometry.

## Render layers

### Enable Render Layers

Tells the renderer to render only the layers for which renderable is turned on. In interactive mode, all layers with renderable turned on are rendered into a single image. In batch mode, each layer is output to a file named:

*camera\_filename\_layername\_passname.ext*

## Maya Vector tab

To select a renderer to see the Maya Vector tab, see "Select a renderer" on page 25. Render global settings that apply to all renderers are in the Common tab.

For information on the render global settings, see "Maya Vector renderer" on page 22.

## Image Format Options

### Frame Rate (SWF and SVG only)

The frame rate of the Flash Player file or SVG file (measured in frames per second).

---

**Note** This option is only available when Image Format is SWF or SVG.

---

### Flash Version (SWF only)

The version of the rendered Flash Player file: Flash 3, Flash 4, or Flash 5. The rendered Flash Player file plays back in any version of the Flash Player (and import into any version of the Flash authoring application) that is equal to or greater than the Flash Version.

## 7 | Window, menu, and node descriptions

### Reference > Image Format Options

**Note** This option is only available when Image Format is SWF.

**Note** When Flash Version is Flash 4, and Fill Style is Area Gradient or Mesh Gradient, the rendered animation contains a dummy frame at its beginning. (This is to compensate for a limitation in the Flash 4 authoring application.) After importing your animation into the Flash 4 authoring application, delete this extra frame.

#### Open in Browser (SWF only)

Displays the vector image or animation in your default browser after it is rendered (using Render > Current Frame, Render > Batch Render, or *mayaVectorRender*).

**Note** You must have the Flash browser plug-in installed on your system in order to display the rendered image or animation.

**Note** This option is only available when Image Format is SWF.

#### Combine Fills and Edges (SWF only)

When Combine Fills and Edges is on, outlines and fills for a surface are a single object. If you import the file into the Flash authoring application, you cannot separate the outlines and fills unless you break apart the object. However, the size of the rendered file is smaller than when Combine Fills and Edges is off.

When Combine Fills and Edges is off, outlines and fills for a surface are separate objects. If you import the file into the Flash authoring application, you can separate the outlines and fills without breaking apart the object. However, the size of the rendered file is larger than when Combine Fills and Edges is on.

**Note** This option is only available when Image Format is SWF.

### Svg Animation (SVG only)

If Svg Animation is Native, Maya creates one SVG file containing the frames of your animation and the scripting that drives it.

If Svg Animation is Script, Maya creates an SVG file containing the frames of your animation and an HTML file containing the JavaScript that drives it.

If your animation is long (approximately 40 frames or more), file size increases when Svg Animation is Native.

---

**Note** This option is only available when Image Format is SVG.

---

### Compress (SVG only)

Compresses the rendered SVG file, significantly reducing its file size.

If you plan to publish the SVG file directly to the web, you may want to turn on Compress. If you plan to import the SVG file into another application and edit it, turn off Compress. You cannot edit a compressed SVG file.

---

**Note** This option is only available when Image Format is SVG.

---

## Appearance Options

### Curve Tolerance

A value from 0 to 10 that determines how object outlines are represented with either curved lines or a series of straight line segments.

When Curve Tolerance is 0, object outlines are represented by a series of straight line segments (one segment for each polygon edge). This produces an outline that exactly matches the outline of polygons, but also produces larger file sizes.

When Curve Tolerance is 10, object outlines are represented by curved lines. This produces an outline that may appear slightly distorted compared to the original object's outline, but also produces smaller file sizes.

You may need to adjust the Curve Tolerance setting on a scene by scene basis to produce the best compromise between outline accuracy and file size. Begin by setting Curve Tolerance to 7.5 (the default). If

## 7 | Window, menu, and node descriptions

### Reference > Fill Options

the rendered file size is too large, try increasing Curve Tolerance. If object outlines appear distorted, or the animation appears jumpy where there are curved outlines, try decreasing Curve Tolerance.

**Note** Adjusting the Curve Tolerance value may have no apparent effect on file size when another setting (for example, Fill Style) is the dominant factor affecting file size.

#### Detail Level Preset, Detail Level

Determines the level of detail in the rendered image. A High Detail Level (30) produces a more detailed image and a more accurate render than a Low Detail Level (10), but takes longer to render and increases file size. (When the Detail Level is low, small polygons are combined with adjacent polygons.)

You may need to adjust the Detail Level on a scene by scene basis to produce the best compromise between image quality and file size. Begin by setting Detail Level to Low, and increase it as necessary to produce acceptable image quality.

Set Detail Level to Automatic to allow Maya to choose the appropriate level of detail for your scene.

Set Detail Level to Custom and use the numeric field or slider to set the Detail Level to any value between 1 and 50. (Setting Detail Level to 0 is the same as choosing the Automatic preset.)

**Note** Doubling the Detail Level value produces twice as much detail in the rendered image.

**Note** Setting Detail Level less than 4 is not recommended.

## Fill Options

### Fill Objects

Surfaces are shaded based on the Fill Style. To render surfaces as unfilled outlines, turn off Fill Objects and turn on Include Edges.

### Fill Style

The style of shading used to fill surfaces in the rendered image.

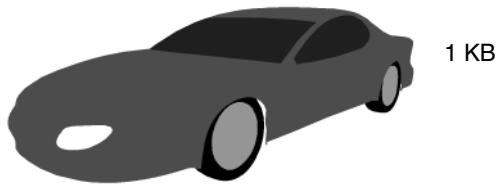
## 7 | Window, menu, and node descriptions

Reference > Fill Options

For all fill styles (except Single Color) the fill color is based on surface material color and lighting from point lights only; all other types of lights are ignored. If your scene does not contain point lights, a default point light (located at the camera) is automatically created during rendering (and removed after rendering).

**Note** Surface fills are re-calculated for each frame and may appear to change, shift or jump during an animation.

### Single Color



Fills each surface with one solid color based on the surface material color.

Single Color can produce nice cartoon-like results, especially when your model is composed of separate surfaces that each have a different colored material.

**Note** The Single Color fill color is actually based on the surface material color and an ambient light (located at the camera) that is automatically created during rendering (and removed after rendering). Therefore, the fill color may not exactly match the surface material color. The fill color should not change during an animation.

**Tip** For better definition of surface edges, turn on Edges.

### Two Color



## 7 | Window, menu, and node descriptions

### Reference > Fill Options

Fills each surface with two solid colors based on the surface material color and on scene lighting.

Two Color produces results that look slightly more 3D than Single Color, but also produces larger file sizes.

**Tip** For geometric objects that consist of many flat planes (for example, a cube), Two Color may produce unnatural looking results (that is, each flat surface is filled with two solid colors). For such objects Average Color is usually more appropriate.

#### Four Color



Fills each surface with four solid colors based on the surface material color and on scene lighting.

Four Color produces results that look even more 3D than Two Color or Single Color, but also produces much larger file sizes.

**Tip** For geometric objects that consist of many flat planes (for example, a cube), Four Color may produce unnatural looking results (that is, each flat surface is filled with four solid colors). For such objects Average Color is usually more appropriate.

#### Full Color



Fills each polygon on a surface with one solid color based on the surface material color and on scene lighting.

Full Color produces realistic 3D results, but also produces very large file sizes. (The greater the number of polygons in your model, the greater the file size.)



## 7 | Window, menu, and node descriptions

Reference > Fill Options

**Tip** If you want to produce a high level of detail, and file size is not an issue, Mesh Gradient usually produces better results than Full Color.

**Note** Full Color is the highest quality fill style available when rendering to AI and EPS formats.

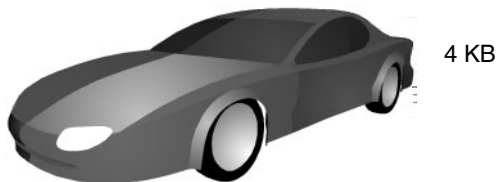
### Average Color



Fills each surface with one solid color based on the surface material color and on scene lighting.

**Tip** For objects that are divided into surfaces with hard edges, Average Color often produces the best combination of 3D effect and modest file size, especially when the object is animated. For smooth, organic objects that have few surfaces defined by hard edges, Average Color does not usually produce results that are any better than Single Color.

### Area Gradient (SWF and SVG only)



Fills each surface with one radial gradient based on the surface material color and on scene lighting.

Area Gradient can produce nice 3D effects with a small increase in file size.

## 7 | Window, menu, and node descriptions

Reference > Fill Options

**Tip** For scenes that contain faceted objects (objects composed of many distinctly defined surfaces), Area Gradient produces very good results.

For scenes that contain a combination of flat and smooth surfaces, Area Gradient produces a nice balance of fills. The smooth surfaces are filled with gradients, and the flat surfaces are filled with a more even color.

For scenes that contain only smooth surfaces, Area Gradient may produce an overwhelming number of gradient fills.

**Note** This option is only available when File Format is SWF or SVG.

### Mesh Gradient (SWF and SVG only)



Fills each polygon on a surface with a linear gradient based on the surface material color and on scene lighting.

Mesh Gradient produces very realistic 3D results, but also produces very large file sizes. (The greater the number of polygons in your model, the greater the file size.)

Mesh Gradient is the highest quality fill style available when rendering to SWF and SVG formats.

**Note** This option is only available when File Format is SWF or SVG.

**Note** In certain rare situations shading may be incorrect when Fill Style is Mesh Gradient. For example, a plane having a ramp texture applied to it may render with an area of solid color. Try adjusting the texture very slightly and re-rendering.

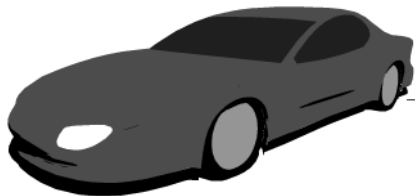
### Show Back Faces

Surfaces with normals facing away from the camera are rendered as if they were facing the camera. When Show Back Faces is off, surfaces with normals facing away from the camera are not rendered.

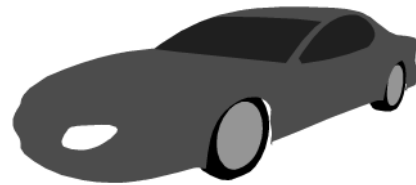
**Note** Surfaces with normals facing away from the camera may not be visible, even if Show Back Faces is on, if another surface is between it and the camera.

**Tip** Turning off Show Back Faces may decrease rendering times and file size.

### Shadows (SWF and bitmap formats only)



Shadows ON



Shadows OFF

Object shadows are rendered (based only on shadow-casting point lights in your scene). Shadows can greatly enhance the 3D effect. However, shadows also increase file size and significantly increase render time.

**Note** When Shadows is turned on, shadows are rendered for all objects. You cannot render shadows only on certain objects (for example, by turning off Casts Shadows or Receive Shadows for an object).

**Note** Shadows are only rendered if there is a shadow-casting point light in your scene (that is, a point light that has Use Depth Map Shadows or Use Ray Trace Shadows turned on).

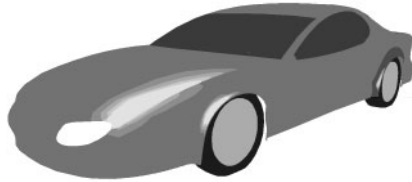
**Note** You cannot set the shadow color.

## 7 | Window, menu, and node descriptions

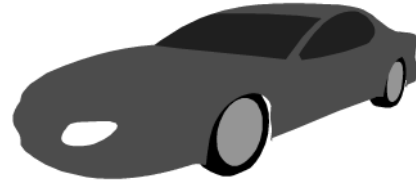
Reference > Fill Options

Note Shadows are not cast onto surfaces with transparent materials.

Highlights (SWF and bitmap formats only)



Highlights ON



Highlights OFF

Specular highlights are rendered (based only on point lights in your scene and on surface material shininess). (When Fill Style is Single Color, specular highlights are based on the *position* of point lights in your scene. Changing the intensity or color of point lights does not change the appearance of highlights.)

Regions of surfaces that are close to being perpendicular to a point light are filled with a number of concentric solid color regions (based on surface material Specular Color and on the Highlight Level value) that are lighter than the rest of the surface.

<b>For this material...</b>	<b>Surface shininess is based only on...</b>
Anisotropic	Roughness
Blinn	Eccentricity
Phong	Cosine Power
Phong E	Roughness

Note This option is only available when Fill Style is Single Color, Average Color and Area Gradient.

Note Highlights are only rendered if there is a point light in your scene that has Emit Specular turned on.

## 7 | Window, menu, and node descriptions

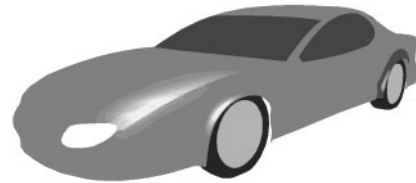
Reference > Fill Options

**Note** If a surface material's Specular Color is mapped with a texture, the color of the highlight is based on the texture's Default Color. If a surface material's Specular Color is mapped with a utility node, the color of the highlight is white.

Highlight Level (SWF and bitmap formats only)



Highlight Level = 1

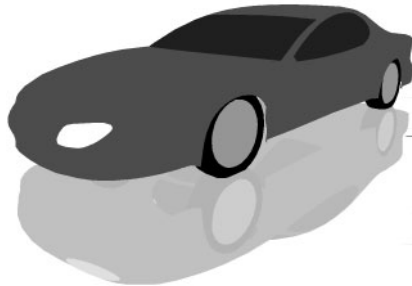


Highlight Level = 8

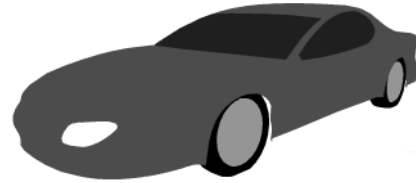
The number of concentric solid color regions used to represent specular highlights. The valid range is 1 to 8. The default value is 4.

**Note** This option is only available when Highlights is on.

Reflections (SWF and bitmap formats only)



Reflections ON



Reflections OFF

Surface reflections are rendered (based on the surface material Reflectivity).

Reflection Depth (SWF and bitmap formats only)

The maximum number of times a surface can inter-reflect with other surfaces. The valid range is 1 to 4. The default value is 2.

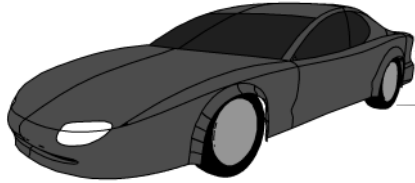
**Note** This option is only available when Reflections is on.

## 7 | Window, menu, and node descriptions

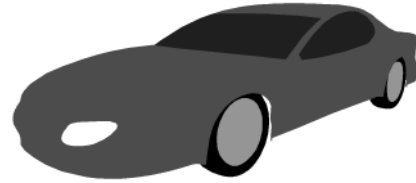
Reference > Edge Options

### Edge Options

Include Edges



Include Edges ON



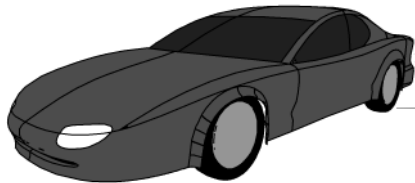
Include Edges OFF

Surface edges and silhouettes are rendered as outlines.

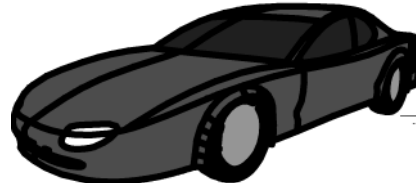
**Tip** To render surfaces as unfilled outlines, turn off Fill Objects and turn on Include Edges.

**Note** Edges are not rendered on surfaces with transparent materials.

Edge Weight Preset, Edge Weight



Edge Weight = 2 pt



Edge Weight = 8 pt

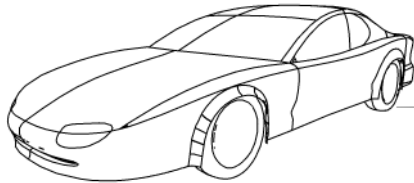
The thickness of surface outlines (measured in points).

**Note** When File Format is SWF, changes in Edge Weight less than 1 Point are not noticeable unless you zoom into the outline.

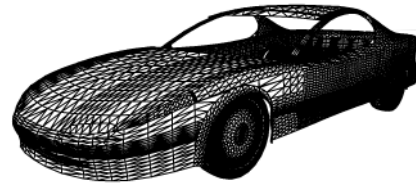
## 7 | Window, menu, and node descriptions

Reference > Edge Options

### Edge Style



Edge Style = Outline



Edge Style = Entire Mesh

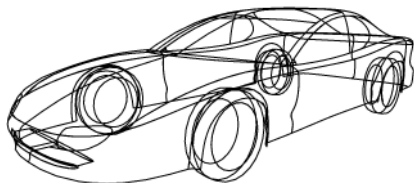
When Edge Style is Outline, surface edges and silhouettes are rendered as outlines. (Use Detail Edges to also render sharp polygon edges as outlines.)

When Edge Style is Entire Mesh, all polygon edges are rendered as outlines. Entire Mesh produces very large file sizes. (The greater the number of polygons in your model, the greater the file size.)

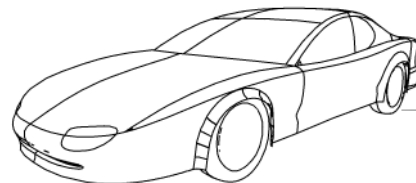
### Edge Color

The color of surface outlines.

### Hidden Edges



Hidden Edges ON



Hidden Edges OFF

Surface edges that are behind another surface are visible in the rendered image. (This may make certain objects look transparent or make models appear as wireframes.)

Hidden Edges increases rendered file size because of the extra vector information.

**Tip** If you are rendering a model with many polygons, avoid turning on Hidden Edges and setting Edge Style to Entire Mesh; too many lines will likely appear in the rendered image.

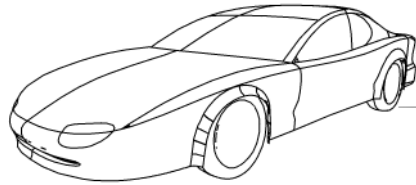
### Edge Detail

Sharp edges between polygons are rendered as outlines. The Min Edge Angle controls which polygon edges are rendered as outlines.

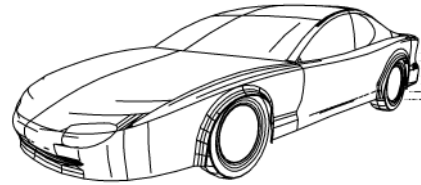
## 7 | Window, menu, and node descriptions

### Reference > Render Layer Control

Edge Detail can help define the shape of a 3D object, especially when the object is composed of few surfaces, but also produces larger file sizes.



Edge Detail OFF



Edge Detail ON, Min Edge Angle = 10

**Note** This option is only available when Edge Style is Outlines.

### Min Edge Angle

Determines which polygon edges are rendered as outlines when Edge Detail is on. Min Edge Angle is the minimum angle (measured in degrees) that two adjacent polygons' normals must have in order for their common edge to be rendered as an outline.

Decreasing the Min Edge Angle produces larger file sizes because of the extra vector information in the rendered file.

**Note** This option is only available when Edge Style is Outlines.

## Render Layer Control

### Enable Render Layers

Renders and saves each renderable render layer as a separate file (named filename\_layername) when batch rendering.

**Note** If Enable Render Layers is on, shadows and reflections are not cast between objects in different render layers.

## Render View

### Render View menu bar

You can access these items from pop-up menus by right-clicking in the panel.



Some menu items are renderer-specific. For example, IPR menu items do not appear for Maya hardware rendering.

For more information on Render View, see “Render View rendering” on page 71.

### File menu

#### Open Image

Loads images from disk into Render View. Images usually end with suffixes indicating their image format.

#### Save Image

Saves the image to disk in the `/images` directory (as specified by your current project management settings).

#### Open IPR File

Opens the file browser to the `iprImages` directory from where you can open a saved IPR file into Render View.

<b>Note</b>	Make sure the IPR file you load corresponds to the current scene file. If the name of a surface in the IPR file does not match a corresponding surface in the current scene, you are unable to adjust the shading characteristics of that surface.
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#### Save IPR File

Saves the current IPR file to the `iprImages` directory.

#### Close IPR File

Closes the IPR file on which you are working and ends the current IPR session.

#### Render Diagnostics

The Render Diagnostics window appears providing you with valuable information about how to improve performance or avoid certain limitations. You can run the diagnostics while experimenting with different settings, or before you start final rendering.

#### Keep Image in Render View

Keeps the current image so you can view it later. When you keep more than one image, a slider displays at the bottom of the window letting you bring a specific image into view without loading the image. The images are lost when you end your Maya session.

## 7 | Window, menu, and node descriptions

Reference > View menu

### Remove Image from Render View

Releases the current image (and the memory needed by it) from Render View. Select the image that you want to remove using the slider.

### View menu

#### Frame Image

Frames the image you are rendering to fit Render View.

#### Frame Region

Frames the region you marquee to fit Render View.

#### Real Size

Automatically adjusts the view so the zoom factor is 1.0, and each pixel of the image occupies one pixel on the display.

#### Show Region Marquee

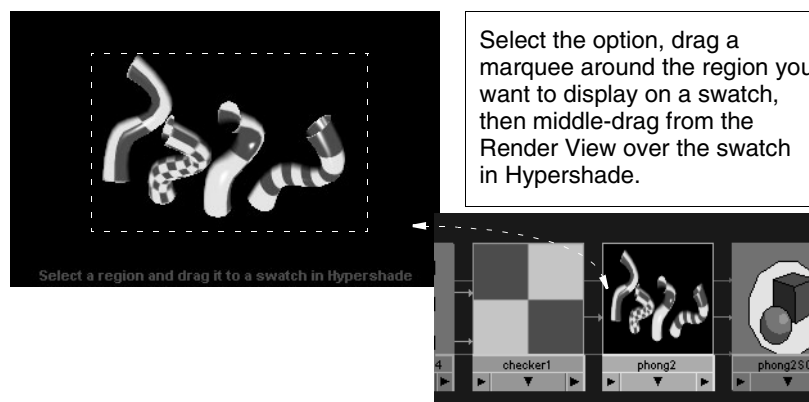
Displays the red render region marquee.

#### Reset Region Marquee

Resets the render region marquee to surround the entire image.

#### Grab Swatch to Hypershade/ Visor

Use to customize Hypershade swatches. A customized swatch lets you quickly access a scene and all its associated attributes.



### Render menu

#### Redo Previous Render

Renders the same view you last rendered. If you rendered a region the last time, Redo Previous Render renders the entire image.

### Render Region

When you draw a marquee around an area in Render View, select this option to render only that area. This is useful if you've made a change to part of the surface on which you want to perform a quick test render.

### Render

Opens a menu from which you can choose the view to render.

### Snapshot

*Does not work when IPR rendering.* Opens a menu from which you can choose the view. A wireframe snapshot is taken of the view you select and loaded as a background into Render View. You can then marquee a region to render in front of the snapshot's background and select the Render Region icon.

**Tip** Zoom into the view you select if you want to see the results up close.

## IPR menu

For Maya software rendering only.

For details on IPR, see "Interactive Photorealistic Rendering (IPR)" on page 67.

### Redo Previous IPR Render

IPR renders the same view last IPR rendered.

### IPR Render

Opens a menu, from which you can choose the view to IPR render.

### Update Shadow Maps

Regenerates shadow maps and updates the IPR image. *You cannot interactively adjust shadow maps.*

### Update Image Planes/Background

Updates the marquee IPR region with any changes you make to the image plane. If you don't select this option after you make changes to an image plane, the effects of the changes are not visible in IPR until you either perform a new IPR render or marquee a new tuning region.

## 7 | Window, menu, and node descriptions

Reference > Options menu

### Refresh IPR Image

Completely updates (re-shades) the entire image based on all changes you have made. The refresh occurs a bit at a time because loading all samples for the entire image often uses too much memory.

### IPR Tuning Options

Specifies what characteristics of the scene update interactively as you adjust. These options are related to the IPR Options in the Render Global Settings window. For example, if you turn off Render Shading, Lighting, and Glow in Render Global Settings window, you cannot adjust them.

#### Update Shading and Lighting

If on, the IPR image updates whenever you adjust an attribute for shading networks, lights, or when you make shading group assignments or move lights.

#### Update Shader Glow

If on, the IPR image updates whenever you adjust a shader glow (post-process) attribute.

#### Update Light Glow

If on, the IPR image updates whenever you adjust lighting or light glow attributes, or move a light.

#### Update Motion Blur

If on, the IPR image updates whenever you adjust 2D motion blur attributes. Modifying the scene's animation (for example, to make an object move faster and increase the blur) does not affect the IPR image's motion blur because modifying the animation changes the information that was generated during the initial IPR render (motion vectors are changed), which is a change to the visibility calculation. You have to perform a new IPR render to see the results.

### Pause IPR Tuning

Pauses the updating of the selected IPR region in the Render View.

## Options menu

Some menu items are renderer specific. For example, the Ignore Shadows menu item does not appear for Maya hardware rendering.

### Render Globals

Opens the Render Global Settings window when test-rendering (not IPR).

### Test Resolution

Select the resolution at which you want to render the image. Use a reduced resolution to test render the scene if possible. See also "Test render a low-res still or frame" on page 111 or "Test render a low-res animation" on page 111

### Auto Resize

Allows Render View to resize the image each time you render. When on, always displays the rendered image in the center of Render View, and at real size if the image fits (one to one pixel matching). When off, the image always displays in the same place according to the last view.

### Auto Render Region

When on, renders the image as soon as you finish dragging a marquee in Render View. This can make rendering a region a one-step process: drag a render region, and when you release the mouse button the region is immediately rendered.

### Ignore Shadows/Ignore Glows

Tells Maya not to test-render any shadows or glows in the scene. This can speed up test-rendering.

## Display menu

### Red Channel, Green Channel, Blue Channel

Displays the red, green, or blue channels only.

### All Channels

Displays RGB channels.

### Luminance

Displays a weighted average of R, G, and B planes that define the luminance level of the image.

### Mask Channel

Displays the mask channel only.

### Dithered

Turn off Dithered to display the *best* version of a image. Turn on Dithered to display a dithered image (does not flicker when displayed). Dithered is on by default.

### Toolbar

Shows/hides the Render View toolbar. Toolbar is on by default.

## 7 | Window, menu, and node descriptions

Reference > Render View toolbar


### Render View toolbar

You can use the rendering buttons in the Status Line in Maya's main window, or use the buttons in the Render View toolbar to perform various operations.


Some tools are renderer specific. For example, the IPR tools appear only for Maya software rendering.

For more information on Render View, see "Render View rendering" on page 71.


#### Redo Previous Render

 Renders the same view you rendered last. If you rendered a region the last time, Redo Previous Render renders the entire image.


#### Render Region

 Renders only the region with a marquee. This is useful if you've made a change to part of the surface on which you want to perform a quick test render. See "Render a region of your scene" on page 113 for details.

#### Redo Previous IPR Render

 IPR renders the same view last IPR rendered.


#### Refresh the IPR Image

 Completely updates the entire image based on all changes you have made. The refresh occurs a bit at a time—loading all the samples for the entire image may use too much memory.

#### Open Render Globals Window

 Opens the Render Global Settings window.


#### Display RGB Channel

 Displays the image with RGB channels. This is the default display mode.

#### Display Alpha Channel

Displays the image's alpha channel only. See Use Background and Matte Opacity for a few examples of how this option is used.


#### Display Real Size

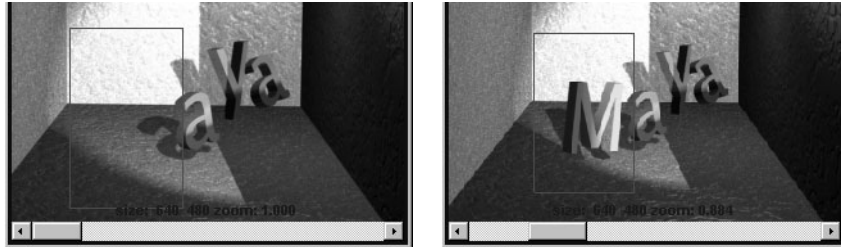
 Displays the image at its real resolution. See also "Test render a low-res still or frame" on page 111.

## 7 | Window, menu, and node descriptions

Reference > Rendering Flags window


### Keep Image

 Keeps the current image so you can view it later. When you keep more than one image, a slider displays at the bottom of the window. Drag this slider to bring a specific image into view without loading the image.




**Note** The extra images are lost when you end your Maya session.

### Remove Image

 Releases the current image (and the memory it needs) from Render View. Select the image you want to remove using the slider at the bottom of the window.

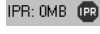
### Show Render Diagnostics in the Script Editor

 Click the icon after you adjust objects, and before you re-render. The Script Editor that displays provides valuable information about how you can improve performance. You can run the diagnostics while experimenting with rendering settings, or before you start the final render.

### Pause IPR Tuning

 Pauses the updating of the selected IPR region in the Render View.

### Close IPR File and Stop Tuning

 Closes the current IPR file and ends the current IPR session.

## Rendering Flags window

### Rendering Flags window

The Rendering Flags window (Window > Rendering Editors > Rendering Flags) lets you list the elements in your scene and provides you with a way to set the attributes for the nodes you select.

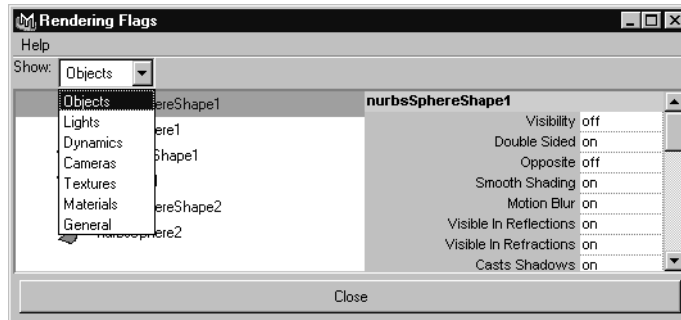
## 7 | Window, menu, and node descriptions

Reference > Rendering Flags Show list

### Rendering Flags Show list

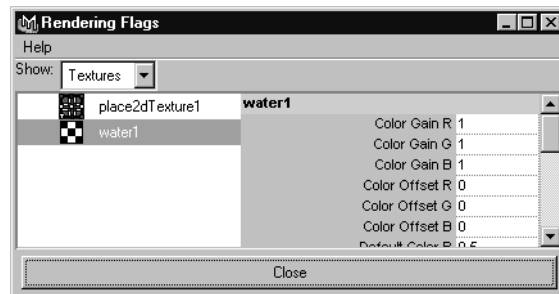
Click the down arrow to display the Show menu, then select an item or items for which you want a list of attributes.

The attributes for these items are listed in the right panel where you can change and set them, much like in the Channel Box.



### Rendering Flags window panels

The Rendering Flags window contains two panels. The left panel lists the items you select from the Show menu, and the right panel lists the attributes for the selected items. In the left panel, click the list item for which you want to change or set the attributes and the details display in the right panel.



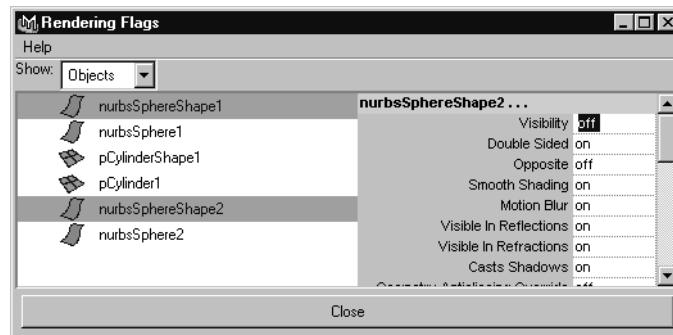
### To set attributes for multiple nodes in the Rendering Flags window

You can change or set attributes for several related objects by selecting them in the left panel, and setting the attribute value in the right panel. For example, if you want to turn the visibility off for two NURBS spheres in the scene, select both spheres from the left panel and type **off** beside Visibility in the right panel.



## 7 | Window, menu, and node descriptions

Reference > Use the hardware render buffer



Once you change an attribute for a selected item, the heading changes color in the list reminding you of the change.

### Hardware Render Buffer

#### Use the hardware render buffer

**Note** The Hardware renderer, with its greater capabilities, is now recommended to perform hardware rendering. See “Maya Hardware renderer” on page 16.

The Hardware Render Buffer (Window > Rendering Editors > Hardware Render Buffer) lets you render an animation using your computer’s display graphics card. Hardware rendering is much faster than software rendering, although the result may be of lower quality. You can use the Hardware Render Buffer to preview animations, or to render specific types of particle effects.

**Note** Render Sequence will not render particles successfully if the Render Passes and “Motion Blur” options (found in the Multi-Pass Render Options section of the Hardware Render Buffer Attribute section) are equivalent integers. For example, if Render Passes is set to 3 and Motion Blur is set to 3, hardware particle rendering will not work.

Set them to non-equivalent values or to use the Disk Cache option (Solvers > Create Particle Disk Cache).

## 7 | Window, menu, and node descriptions

Reference > Use the hardware render buffer

**Note** When the overscan attribute of the camera is anything other than 1.0, image planes are positioned incorrectly in the hardware render buffer (as can be seen compared to the correct placement in software rendering).

To work around this limitation, temporarily set the overscan to 1.0 when hardware buffer rendering.

### To open the Hardware Render Buffer

- Select Window > Rendering Editors > Hardware Render Buffer.

### To set options for the Hardware Render Buffer

- In the Hardware Render Buffer, click Render > Attributes. For a description of the options, see "Hardware Render Buffer" on page 233

### Important

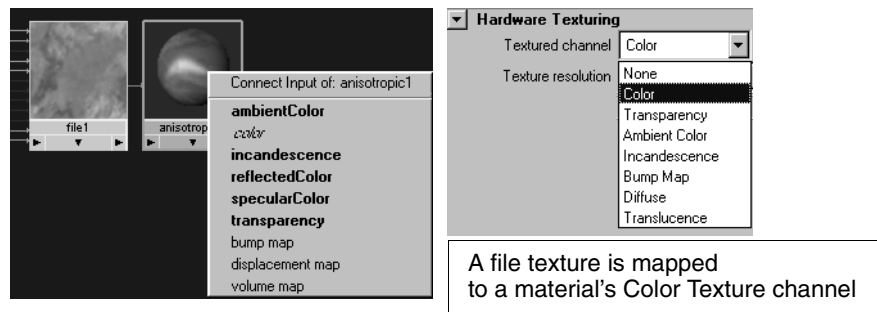
The Hardware Render Buffer renders images based on your monitor's display (using screen captures). Before rendering from the Hardware Render Buffer, make sure the Hardware Render Buffer fits on your monitor, make sure no other window overlaps the Hardware Render Buffer, and disable your computer's screen saver.

### To determine hardware rendering quality

- 1** In the Shading menu in the view panel, make sure Smooth Shade All and Hardware Texturing are selected.
- 2** In Hypershade, double-click the material swatch you want to preview to open its Attribute Editor.
- 3** In the Hardware Texturing section of the material's Attribute Editor, the Textured channel menu contains the attributes you can hardware render. Select the Textured channel you want to view from the menu.

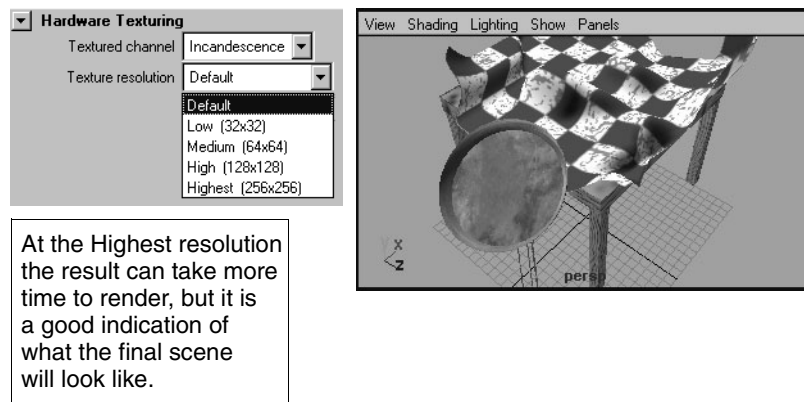
## 7 | Window, menu, and node descriptions

Reference > Use the flipbook



- Notes
- You can only view one channel at a time.
  - To view an attribute, it must be mapped to a texture. Attributes that are not mapped are dimmed.
  - Some channels, such as Bump Map, do not provide hardware textured results. You must use Render View to see the results.

### 4 Select the resolution you want from the Texture resolution menu.



## Use the flipbook

(IRIX, Linux, and Windows only)

The Flipbook lets you play back a rendered sequence of images. The sequence is displayed using the fcheck utility. To use the Flipbook, see "Use the flipbook" on page 235.

### To play back a rendered sequence of images

- Select the sequence from the Flipbooks menu. The sequence is displayed using the fcheck utility.

## 7 | Window, menu, and node descriptions

Reference > Hardware Render Buffer global settings

# Hardware Render Buffer global settings

## Image Output Files

### File name

The base name for all hardware rendered image files. The default file name is *im*.

### Extension

The format of the extension(s) added to the base name for all rendered image files. Options with `ext` include the Image Format in the extension. The default setting is *name.001*.

### Start Frame, End Frame

The first and last frame to render. The default value for Start Frame is 1. The default value for End Frame is 10.

### By Frame

The increment between frames you want to render. For instance, if By Frame is set to 1, the Hardware Render Buffer renders frames 1, 2, 3, etc. If set to 2, it renders 1, 3, 5, etc. The default value is 1.

### Image Format

The format for saving hardware rendered image files. The default setting is Maya IFF.

### Resolution

The resolution of hardware rendered image files. Click the Select button to select a preset image resolution.

### Alpha Source

The type of alpha information saved with the hardware rendered images. Alpha information represents the opacity of each pixel, and is used for compositing images using compositor software. (Alpha information is also referred to as alpha channel, mask, matte, or alpha buffer.) If you do not plan to composite hardware rendered images, set Alpha Source Off. The default setting is Off.

### Write ZDepth

If Write ZDepth is on, the hardware rendered contains depth information (the distance of objects from the camera). Write ZDepth is off by default.

## 7 | Window, menu, and node descriptions

Reference > Image Output Files

**Tip** Depth information is sometimes necessary when compositing images (for example, compositing hardware rendered particles that pass behind a software rendered transparent object). If you do not plan to composite hardware rendered images, or do not require depth information for compositing, turn off Write ZDepth.

### Alpha Source table

Off	Alpha information is <i>not</i> included in hardware rendered images.
Hardware Alpha	Assigns each pixel an alpha value based on its opacity, regardless of its brightness or color. The more opaque a pixel is, the more opaque it appears in the image's alpha channel.  Setting Alpha Source to Hardware Alpha only has an effect if your computer has a hardware alpha buffer. If it does not have a hardware alpha buffer and you set Alpha Source to Hardware Alpha, the alpha channel of hardware rendered images is fully opaque.
Luminance	Assigns each pixel an alpha value based on its brightness. The brighter a pixel is, the more opaque it appears in the image's alpha channel.
Red Channel	Assigns each pixel an alpha value equal to the value of its RGB red component. The higher a pixel's red value is, the more opaque it appears in the image's alpha channel.
Green Channel	Assigns each pixel an alpha value equal to the value of its RGB green component. The higher a pixel's green value is, the more opaque it appears in the image's alpha channel.
Blue Channel	Assigns each pixel an alpha value equal to the value of its RGB blue component. The higher a pixel's blue value is, the more opaque it appears in the image's alpha channel.

## 7 | Window, menu, and node descriptions

Reference > Render Modes

Clamp	Assigns each <i>rendered</i> pixel an alpha value of 1 (fully opaque), and each <i>unrendered</i> pixel an alpha value of 0 (fully transparent).
Inverse Clamp	Assigns each <i>rendered</i> pixel an alpha value of 0 (fully transparent), and each <i>unrendered</i> pixel an alpha value of 1 (fully opaque).

### Render Modes

#### Lighting Mode

Controls how objects are lit during hardware rendering. The default setting is Default Light.

##### Default Light

A default directional light illuminates the scene in the direction that the camera faces.

##### All Lights

The lights in the scene (up to a maximum of eight lights) illuminate the scene.

##### Selected Lights

The lights in the scene that you've selected (for example, in the Outliner) illuminate the scene.

#### Draw Style

Controls how objects are hardware rendered. (If Geometry Mask is on, Draw Style has no effect.) The default setting is Smooth Shaded.

##### Points

NURBS surfaces are rendered as points evenly spaced along surface, polygonal surfaces are rendered as points (corresponding to vertices), and particles are rendered as points.

##### Wireframe

Surfaces are rendered in wireframe.

##### Flat Shaded

Surfaces are rendered as flat shaded polygons.

##### Smooth Shaded

Surfaces are rendered as smooth shaded polygons using a Phong material.

### Texturing

If on, textures are hardware rendered. Texturing is on by default.

### Line Smoothing

If on, sharp, jagged edges on surfaces and streaks on Streak or MultiStreak particles are softened. Line Smoothing is off by default.

### Full Image Resolution

If on and Resolution is greater than the monitor's resolution (the hardware rendered images cannot fit on the screen), the Hardware Render Buffer divides the image into tiles, renders each tile separately, then assembles the tiles together when it saves the image to disk. If you are rendering an animation, the Hardware Render Buffer displays each tile as it renders it.

If off and Resolution is greater than the monitor's resolution, the Hardware Render Buffer only renders the part of the image displayed on the monitor.

### Geometry Mask

When off, surfaces are hardware rendered. When on, Maya masks out all geometry by setting the mask values to 0. Pixels of the rendered image belonging to any geometry have a zero opacity in the image's alpha channel. Geometry Mask is off by default.

### Display Shadows

Turn this on to display shadows from directional and spot lights for geometry (NURBS, polygons, subdivision surfaces) and particles (points, multipoints, and spheres only). This is available only when All Lights or Selected Lights are specified in the Lighting Mode drop-down list.

**Note** These hardware shadows can be calculated and displayed on graphics cards with drivers that support the ARB\_multitexture and EXT\_texture\_env\_combine OpenGL extensions (such as graphic cards with NVidia GeForce or Quadro GPU, or ATI Radeon 8800).

## 7 | Window, menu, and node descriptions

Reference > Multi-Pass Render Options

### Multi-Pass Render Options

#### Multi Pass Rendering

If off, the Hardware Render Buffer renders each frame using one pass. If on, the Hardware Render Buffer renders each frame using more than one pass (based on the Render Passes setting, next). This softens or blurs particles with a MultiStreak or MultiPoint Render Type. Multi Pass Rendering is off by default.

#### Render Passes

The number of passes the Hardware Render Buffer uses to render each frame. The more passes per frame, the greater the softening or blurring of particles with a MultiStreak or MultiPoint Render Type (and a longer rendering time). Render Passes is only available if Multi Pass Rendering is on. The default setting is 3.

**Tip** If the Motion Blur value is greater than 0, set the Render Passes value to at least the Motion Blur value minus 1. For example, if the Motion Blur value is 4, set the Render Passes value to at least 3.

#### Anti-Alias Polygons

If on, sharp, jagged surface edges are softened (anti-aliased) during hardware rendering. This option only works if Multi Pass Rendering is on and the computer hardware supports anti-aliasing. Anti-Alias Polygons is off by default.

#### Edge Smoothing

Controls how much sharp, jagged surface edges are softened (anti-aliased) during hardware rendering when Anti-Alias Polygons is on. The higher the value, the softer the edges.

Set Edge Smoothing to 1 for clear, smooth edges. If Edge Smoothing is too large (for example, 5), surface edges are excessively blurred. An Edge Smoothing value of 0 has the same effect as turning off Anti-Alias Polygons. The default value is 1.

#### Motion Blur

Controls how much objects are motion blurred. The higher the Motion Blur value, the greater the motion blur effect. A Motion Blur value of 0 means no motion blur. A value of 0.5 means the shutter is open for half the frame duration. The default value is 0.



**Tip** If the Motion Blur value is greater than 0, set the Render Passes value to at least the Motion Blur value minus 1. (For example, if the Motion Blur value is 4, set the Render Passes value to at least 3.)

### Display Options

Controls which icons are hardware rendered, and the background color for hardware rendered images.

#### Grid

If on, the grid is hardware rendered. Grid is off by default.

#### Camera Icons

If on, any camera icons visible in the Hardware Render Buffer are rendered. Camera Icons is off by default.

#### Light Icons

If on, any light icons visible in the Hardware Render Buffer are rendered. Light Icons is off by default.

#### Emitter Icons

If on, any emitter icons visible in the Hardware Render Buffer are rendered. Emitter Icons is off by default.

#### Field Icons

If on, any field icons visible in the Hardware Render Buffer are rendered. Field Icons is off by default.

#### Collision Icons

If on, any collision icons visible in the Hardware Render Buffer are rendered. Collision Icons is off by default.

#### Transform Icons

If on, any transform icons (from the translate, rotate, or scale tools) visible in the Hardware Render Buffer are rendered. Transform Icons is off by default.

#### Background Color

The background color for hardware rendered images. The default color is black.

## 7 | Window, menu, and node descriptions

Reference > Hardware Render Buffer menus

**Tip** If you plan to composite hardware rendered images, set the Background Color to black.

### Hardware Render Buffer menus

#### File menu

Contains the Close option. Either click the box at the top right of the window or select this option to close the Hardware Render Buffer window.

#### Render menu

Contains options for setting rendering attributes, rendering a frame or sequence of frames, and controlling the display of the Hardware Render Buffer.

**Attributes** Opens the Attribute Editor and displays Hardware Render Buffer Render Globals. For details, see "Hardware Render Buffer" on page 233.

**Test Render** Test-renders the current frame in the Hardware Render Buffer.



Click on the rendered image to return to the view.

**Render Sequence** Select to render the current animation.

**Scale Buffer** Scales the size of the Hardware Render Buffer so the rendered image is 100%, 70%, 50%, 30%, or 10% of the Resolution.

## 7 | Window, menu, and node descriptions

Reference > Camera menu

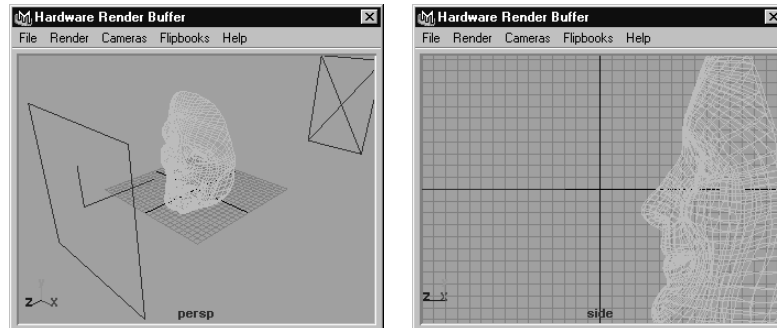
- Tips
- Set Scale Buffer to 100% for the final render.
  - Scaling down the size of the rendered image decreases the amount of rendering time required and increases the speed of playback.
  - A dimmed Scale Buffer option (percentage) means that the rendered image would either be too large to display on the screen, or too small to see adequately.

**Time Slider** Displays the time slider and transport controls at the bottom of the Hardware Render Buffer. Click to turn the Time Slider at the bottom of the window on or off.

### Camera menu

The view in the Hardware Render Buffer is actually a copy of the corresponding camera view. For example, if the camera view displays the resolution gate, the Hardware Render Buffer view also displays the resolution gate.

The Cameras menu contains a list of all cameras in the scene. Select a camera view by selecting it from the Cameras menu. For example, if you select camera 1, the Hardware Render Buffer displays the view as seen from the camera. If side, it displays the side view.



- You can select and move objects in the Hardware Render Buffer view just as you would in a regular view. You can also adjust the camera in the Hardware Render Buffer using the Alt (IRIX, Linux, and Windows) or Option (Mac OS X) key and the left, middle or right mouse buttons.

## 7 | Window, menu, and node descriptions

Reference > Flipbooks menu

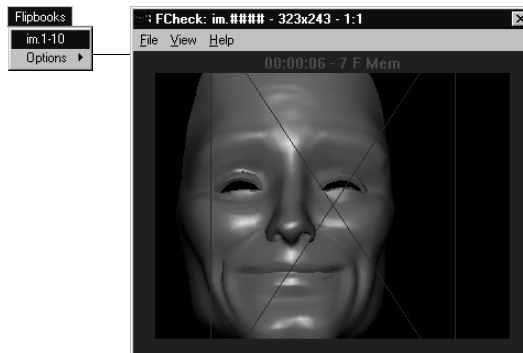
- When you playback an animation in the Hardware Render Buffer, it also plays back in the corresponding view. To make an animation play back only in the Hardware Render Buffer, click anywhere in the Hardware Render Buffer view while the animation is playing.

### Important

Make sure nothing on the screen covers any part of the Hardware Render Buffer during rendering. (Hardware rendering uses screen captures to create rendered frames.)

## Flipbooks menu

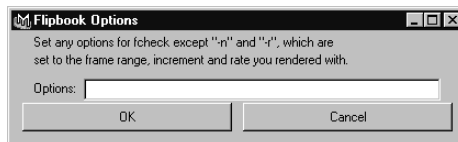
The Flipbooks menu contains the list of sequences you rendered in the Hardware Render Buffer (if you selected Render Sequence from the Render menu) as well as the Clear Flipbook Menu option and Flipbook Flags.



The Flipbooks Options control how sequences of images rendered from the Hardware Render Buffer display and displays the Flipbook Options window.

## Flipbook Options

These options control how sequences of images rendered from the Hardware Render Buffer are displayed.



### Options

Enter fcheck options to be used when playing back a hardware rendered sequence of images (by selecting the sequence from the Flipbooks menu of the Hardware Render Buffer).

### Clear Flipbook Menu

Removes any rendered sequences of images from the Flipbooks menu.

### Flipbook Flags

Displays the Flipbook Options window. This option is available for only IRIX, Linux and Windows.

See also “fcheck” in the Rendering Utilities online documentation for information on fcheck options.

### Time slider and transport controls

The time slider and transport controls in the Hardware Render Buffer are similar to the time slider and transport controls in the main Maya window. See the “Animate > Create Animated Sweep” on page 56 in the Animation guide for details about the Time Slider.

## Menus

### File

#### File > Export All, Export Selection (mental ray)

#### File > Export Selection, Export All >

#### File Type

When you select `mentalRay` from the File Type drop-down list, the many options appear.

#### File Type Specific Options

##### File Format

In ASCII mode, all data in the exported .mi file will be human-readable ASCII text. In binary mode, certain floating-point data (points, normals, texture coordinates, etc.) will be output in binary format to reduce the size of the exported file. The ASCII mode tabulator size determines the amount of indentation in the .mi file.

## 7 | Window, menu, and node descriptions

Reference > File > Export Selection, Export All >

### Output File Per Frame

When animation is enabled, Maya exports all data required to render all the frames specified by the Render Globals animation range settings. With Output File Per Frame off, data for all the frames is output to a single .mi file. With this option on, a separate file is output for each frame.

### Frame Extension

When Output File Per Frame is enabled, this option determines the convention for naming each frame's output file.

### Frame Padding

When Output File Per Frame is enabled, determines the amount of padding applied to the frame numbers. Setting the padding to 2 means each frame number is at least 2 characters long (01, 02, 03, ...), setting it to 3 means each frame number will be at least 3 characters long (001, 002, ...), etc.

### Export Selection Output

If objects do not change, reprocessing before exporting to .mi is not required, and the export process is significantly shortened as a result.

Renderable  
Scene

This is the default.

Maya exports all scene entities (lights, cameras, shaders, globals, etc.) that are necessary to render the selected geometry. The resulting scene will be renderable using the mental ray standalone.

Scene  
Fragment

Maya exports only the nodes that are selected. This mode can be used to export particular lights, cameras, shaders, or geometry. The resulting .mi file will most likely not be directly renderable, so it is called a Scene Fragment.

### Export Materials

In addition to the selected nodes, this setting also exports any materials that they are connected to. This applies to selected geometry and shading nodes.

### Export All Incoming Shaders

In addition to selected shading nodes, also exports all inputs to those nodes. For example, if a surface shader is selected, this mode causes any texture networks feeding into the shader to be exported along with the shader.

## 7 | Window, menu, and node descriptions

Reference > Create > Cameras > Camera >

### Export Entire Child DAG

This option specifies that in addition to selected geometry, any children of that geometry should also be exported.

The standard export filters (enabled by turning on Export Selected Items Only) are also applied to the nodes identified for export. This allows you to prevent the export of unwanted node types.

### Export Includes Startup File

With this option enabled, the exported .mi file contains an `$include` directive for the `maya.rayrc` startup file that is used by the interactive mental ray renderer in Maya. Use this option to ensure that a consistent configuration is used for rendering both with the mental ray standalone and interactively in Maya.

### Export Selected Items Only

This option allows detailed control over precisely which mental ray entities are exported into the .mi file. See the *mental ray User Manual*, available from the Maya Help, for descriptions of the various entity types that can be exported.

### Predefined Export Filters

Provides several useful preset combinations of entity types for export.

## Modify

### Modify > Convert Displacement to Polygons

Lets you convert a displacement mapped subdivision surface to polygons to see the tessellation triangles.

## Create

### Create > Cameras > Camera

Creates a a one-node camera, which is a basic camera.

For more information on the types of cameras, see "Maya camera types" on page 27.

### Create > Cameras > Camera >

#### Camera Properties

The camera viewing tools (tumble, track, and dolly) use this value to determine the "look at" point when the camera is a Basic camera.

## 7 | Window, menu, and node descriptions

Reference > Create > Cameras > Camera > □

### Center of Interest

The distance from the camera to the center of interest, measured in the scene's linear working unit.

### Lens Properties

#### Focal Length

Also available in the camera's Attribute Editor. The focal length of the camera, measured in millimeters.

Increasing the Focal Length zooms the camera in and increases the size of objects in the camera's view. Decreasing the Focal Length zooms the camera out and decreases the size of objects in the camera's view. The valid range is 2.5 to 3500. The default value is 35.

For more information about focal length in general, see "Focus and blur" on page 28.

#### Lens Squeeze Ratio

The amount the camera's lens compresses the image horizontally. Most cameras do not compress the image they record, and their Lens Squeeze Ratio is 1. Some cameras (for example, anamorphic cameras), however, compress the image horizontally to record a large aspect ratio (wide) image onto a square area on film. The default value is 1.

#### Camera Scale

Scales the size of the camera relative to the scene. For example, if Camera Scale is 0.5, the camera's view covers an area half as large, but objects in the camera's view are twice as large. If the Focal Length is 35, the effective focal length for the camera would be 70.

### Film Back Properties

Don't edit these attributes unless you are bringing in live action footage.

#### Horizontal Film Aperture, Vertical Film Aperture

The height and width of the camera's aperture or film back, measured in inches. The Camera Aperture attribute determines the relationship between the Focal Length attribute and the Angle of View attribute. The default values are 1.417 and 0.945.

#### Horizontal Film Offset, Vertical Film Offset

Vertically and horizontally offsets the resolution gate and the film gate relative to the scene. Changing the Film Offset attribute produces a two-dimensional track. Film Offset is measured in inches. The default setting is 0.



## 7 | Window, menu, and node descriptions

Reference > Create > Cameras > Camera >

### Film Fit

Controls the size of the resolution gate relative to the film gate. If the resolution gate and the film gate have the same aspect ratio, then the Film Fit setting has no effect. The default setting is Fill.

Fill	Fits the resolution gate within the film gate.
Horizontal	Fits the resolution gate horizontally within the film gate.
Vertical	Fits the resolution gate vertically within the film gate.
Overscan	Fits the film gate within the resolution gate.

You can also set Film Fit in the camera view's View > Camera Settings submenu.

### Film Fit Offset

Offsets the resolution gate relative to the film gate either vertically (if Film Fit is Horizontal) or horizontally (if Film Fit is Vertical). Film Fit Offset has no effect if Film Fit is Fill or Overscan. Film Fit Offset is measured in inches. The default setting is 0.

### Overscan

Scales the size of the scene in the camera's view only, *not* in the rendered image. Adjust the Overscan value to see more or less of the scene than will actually render. If you have view guides displayed, changing the Overscan value changes the amount of space surrounding the view guides, making them easier to see. The default value is 1.

1	The view guide fills the view. The edges of the view guide may be exactly aligned with the edges of the view, in which case the view guide is not visible.
> 1	The higher the value, the more space is outside the view guide.

### Clipping Planes

For information on clipping planes, see "Clipping planes" on page 34.

## 7 | Window, menu, and node descriptions

Reference > Create > Cameras > Camera >

### Near Clip Plane, Far Clip Plane

For Hardware rendering, Vector rendering, and mental ray for Maya rendering, this represents the distance of the near and far clipping planes of perspective or orthographic cameras. The default setting for Near Clip Plane is 0.1 and for Far Clip Plane is 1000.

For Maya software rendering, by default Auto Render Clip Plane is on (see "Auto Render Clip Plane" on page 269), and the Near Clip Plane and Far Clip Plane values *do not* determine the position of the clipping planes. See "Auto Render Clip Plane" on page 269.

If the distance between the near and far clipping planes is much larger than is required to contain all the objects in the scene, the image quality of some objects may be poor. Set the Near Clip Plane and Far Clip Plane attributes to the lowest and highest respective values that produces the desired result

**Tip** The objects you want to render are usually within a certain range from the camera. Setting the near and far clipping planes just slightly beyond the limits of the objects in the scene can help improve image quality.

**Note** The ratio of far:near clipping planes determines the depth precision. Try to keep that ratio as small as possible for better results.

Since most of the depth precision is concentrated around the near clip plane, try to avoid a lot of detail on distant objects.

This concept is crucial for hardware rendering because it has only 24 bits of depth precision, as opposed to software rendering which has 32 bits.

### Motion Blur

#### Shutter Angle

The Shutter Angle influences the blurriness of objects of motion blurred objects. The larger the Shutter angle setting, the more blurry objects. Shutter Angle is measured in degrees. The valid range is 1 to 360. The default value is 144.

## 7 | Window, menu, and node descriptions

Reference > Create > Cameras > Camera >

The Camera Shutter Angle option is a multiplier for the time range of the blur. Similar to traditional film and video cameras, the camera shutter angle determines the length of the exposure. However, for the purposes of motion blur, it only alters the absolute time range of the exposure based on the following equation:

$$\text{Blur range} = (\text{Camera Shutter Angle} / 360 \text{ degrees}) \times \text{Blur by Frame}$$

(In real-world film cameras, this is calculated at 180 degrees; during the other 180 degrees of rotation, the film is advanced to the next frame for exposure. Computer graphics cameras have no film.)

For information on a real-world camera's shutter angle and exposure in general, see "Focus and blur" on page 28.

**Note** For the shutter angle setting to take effect (that is, for motion blur to appear), Motion Blur must be set for the following:

- for the scene in the Render Global Settings window (for the particular renderer you are using).
- for at least one object in the object's Render Stats section of the Attribute Editor.

### Orthographic Views

By default, when you create a camera from the Create menu, the view is perspective. If you want an orthographic camera view, click the Orthographic check box and change the Orthographic Width if necessary.

The Orthographic Views attributes control whether a camera is perspective or orthographic (top, front, or side), and also lets you control the field of view for orthographic cameras. See also "Viewing cameras vs. rendering cameras" on page 27.

#### Orthographic

If on, the camera is an orthographic camera. If off, the camera is a perspective camera. Orthographic is off by default.

**Tip** The default cameras are aligned to the major axis. You can create an off-axis orthographic camera by rotating the orthographic camera or changing the default tumble options and using the tumble tool.

To rotate an orthographic view, in the Tumble tool's option window, make sure the Locked setting turned off. See "View > Camera Tools > Tumble Tool >

 on page 275.

## 7 | Window, menu, and node descriptions

Reference > Create > Cameras > Camera and Aim > □

### Orthographic Width

The width (in inches) of the orthographic camera. The width of an orthographic camera controls how much of a scene the camera can see. Changing the width of an orthographic camera has the same effect as zooming a perspective camera.

**Tip** If you want to create a new perspective camera and get out of orthographic view mode, select Edit > Reset Settings, then click the Apply button.

### Create > Cameras > Camera and Aim

Creates a two-node camera, which is a basic camera plus an aim-vector control for aiming the camera at a specified “look at” point.

For more information on the types of cameras, see “Maya camera types” on page 27.

### Create > Cameras > Camera and Aim > □

See “Create > Cameras > Camera > □” on page 247.

### Create > Cameras > Camera, Aim, and Up

Creates a three-node camera, which is a basic camera with the aim-vector control plus an up-vector control for rotating the camera.

For more information on the types of cameras, see “Maya camera types” on page 27.

### Create > Cameras > or Camera, Aim, and Up > □

See “Create > Cameras > Camera > □” on page 247.

## Window

### Window > Rendering Editors > Render View

Opens the Render View.

For information about Render View, see “Render View rendering” on page 71.

### Window > Rendering Editors > Hardware Render Buffer

Opens the Hardware Render Buffer.

For information about Hardware Render Buffer, see "Hardware Render Buffer" on page 233.

### Window > Rendering Editors > Render Globals

Opens the Render Globals Settings window.

For information about Render Globals, see "Render Global Settings window" on page 159.

### Window > Rendering Editors > Hypershade

Opens the Hypershade.

For information about Hypershade, see "*Hypershade*" on page 99 in the *Shading* guide.

### Window > Rendering Editors > Rendering Flags

Opens the Rendering Flags window.

For information about the Rendering Flags window, see "Rendering Flags window" on page 231.

### Window > Rendering Editors > Shading group attributes

Opens the Attribute Editor for the selected object.

For information about the Attribute Editor, see "*Attribute Editor*" on page 189 in the *Basics* guide.

### Window > Rendering Editors > Multilister

Opens the Multilister.

## 7 | Window, menu, and node descriptions

Reference > Create > Cameras > or Camera, Aim, and Up > □

### Window > Rendering Editors > mental ray > Approximation Editor

Opens the mental ray for Maya Approximation Editor where you can set tessellation settings for mental ray for Maya.

### Window > Rendering Editors > mental ray > Custom Text Editor

Opens the mental ray Custom Text Editor.

For information about the Custom Text Editor, see “*Custom mental ray text*” on page 45 in the *Shading* guide.

## Rendering menu set

### Render

Some menu items are renderer-specific. For example, IPR menu items appear only for Maya software rendering.

### Render > Render Current Frame

Opens Render View and renders the current scene.

### Render > Redo Previous Render

Opens Render View and re-renders the scene from the previous view.

### Render > IPR Render Current Frame

Opens Render View and IPR renders the current scene. See “*Interactive Photorealistic Rendering (IPR)*” on page 67 for more details.

### Render > Redo Previous IPR Render

Opens Render View and re-IPR renders the scene from the previous view. See “*Interactive Photorealistic Rendering (IPR)*” on page 67 for more details.

### Render > Test Resolution

The resolution at which the image renders in Render View. Use a reduced resolution to test render the scene to increase rendering time.

## 7 | Window, menu, and node descriptions

Reference > Render > Batch Render >

Camera Panel	Renders at the resolution of the current view.
Render Globals	Renders at the Resolution set in the Render Global Settings window. The default setting is 320x240.
50% Globals	Renders at 50% of the Resolution set in the Render Global Settings window. The default setting is 160x120.
25% Globals	Renders at 25% of the Resolution set in the Render Global Settings window. The default setting is 80x60.
10% Globals	Renders at 10% of the Resolution set in the Render Global Settings window. The default setting is 32x24.

### Render > Render Diagnostics

Runs the Render Diagnostics tool. See "Diagnose scene problems" on page 141 for more information.

### Render > Batch Render

Runs a batch render. For more information, see "Batch renders from within Maya (UI)" on page 72.

opens the Batch Render option dialog box to let you set options to render an animation on a local or remote computer, or on a computer with several processors. For descriptions of these options, see "Render > Batch Render > " on page 255.

For more information on batch rendering, see "*Batch renders from within Maya (UI)*" on page 72 in Rendering guide.

### Render > Batch Render >

#### For Windows

##### Use all available processors

If on, rendering uses all processors available on the local computer.

If off, rendering only uses the number of processors indicated by Number of Processors to Use. Use all available processors is off by default.

## 7 | Window, menu, and node descriptions

Reference > Render > Batch Render >

### Number of Processors to Use

The number of processors used for rendering when Use all available processors is off. The default value is 1.

### For IRIX and Linux

#### Rendering CPU

Determines whether rendering takes place on the local computer (Local) or on another computer across a network (Remote). If you select Remote, set Remote Machine name to the name of the computer you want to render on. The default setting is Local.

#### Remote Machine Name

When set to Remote, type the name of the computer on which the rendering takes place and press Enter. If you do not, the render occurs on the local machine.

## Render > Cancel Batch Render

Cancels the batch render that was launched in the current Maya session.

For more information on batch rendering, see *"Batch renders from within Maya (UI)"* on page 72 in Rendering guide.

## Render > Show Batch Render

Opens an fcheck display window and displays the last rendered image.

For more information on batch rendering, see *"Batch renders from within Maya (UI)"* on page 72 in Rendering guide.

## Render > Save Distributed Render

(IRIX only)

Saves the current scene to a file and opens Dispatcher, which allows you to render across a network of computers (IRIX only).

For more information on Dispatcher, see *"Overview of Dispatcher"* on page 15 in the Rendering Utilities guide.

## Render > Render Using > Maya Hardware

Changes the rendering mode to use the Maya Hardware renderer.



## 7 | Window, menu, and node descriptions

Reference > Render > Set NURBS Tessellation >

For more information about Maya's Hardware renderer, see "Maya Hardware renderer" on page 16.

### Render > Render Using > Maya Software

Changes the rendering mode to use the Maya Software renderer.

For more information about Maya's Software renderer, see "Maya Software renderer" on page 15.

### Render > Render Using > Maya Vector

Changes the rendering mode to use the Maya Vector renderer.

For more information about Maya's Vector renderer, see "Maya Vector renderer" on page 22.

### Render > Set NURBS Tessellation

#### Render > Set NURBS Tessellation >

With this window:

- Maya can automatically optimize NURBS surface tessellation throughout an animation range (select Automatic (default)).  
This method is exceptionally powerful for scenes in which the distance between the camera and the object changes (animation), and lets you save memory (and time) and enhance performance by preventing overtessellation.
- You can manually adjust tessellation for objects that require non-default settings (select Manual).

#### Apply Tessellation

Selected

Surfaces,

All Surfaces

Lets you change the tessellation attributes for Selected Surfaces or All Surfaces at one time. Selected Surfaces is on by default.

#### Tessellation Mode

Maya automatically sets the optimal tessellation settings based on an object's distance from the renderable camera(s), or lets you set them.

To adjust tessellation settings, you need to switch to Manual Mode.

## 7 | Window, menu, and node descriptions

Reference > Render > Set NURBS Tessellation >

**Note** Set the desired Resolution in Render Global Settings window before using the Automatic Tessellation mode. Maya uses the Resolution settings to determine what tessellation level is needed to avoid nickeling.

### Automatic (default)

Tessellation is based on the coverage and distance of the surface from the camera and the "Automatic Mode settings" on page 258.

Objects that are either close to the camera or occupy a significant amount of screen space are automatically tessellated with more triangles.

Objects that are further from the camera or are smaller have fewer triangles.

Maya takes into consideration that distance changes over time if the surface or camera is animated, and tessellation is computed for a the range of frames set in Use Frame Range. Tessellation is evaluated and optimized at each frame, and the worst-case tessellation scenario requirements are determined and applied.

In automatic mode, the tessellation can be computed for the current frame or the frame range from the render globals or time slider.

### Manual

Tessellation is based whether you select Basic or Advanced in Manual Mode. This is the same as if you opened the Attribute Editor for each surface, and set the tessellation settings.

## Automatic Mode settings

Some of these settings appear and work for the Basic settings of Manual Mode too.

### Use Frame Range

Available only in Automatic (default) Mode.

The tessellation computed by Automatic Tessellation depends on the distance of the surface from the camera. When the surface or camera is animated, this relationship changes over time.

Generally, when the surface is closest to the camera you need the best tessellation (the most triangles). If you know which frame this is, use "Current Frame". Otherwise, Maya computes this for you by running

## 7 | Window, menu, and node descriptions

Reference > Render > Set NURBS Tessellation >

up the animation for a specified frame range, evaluates the tessellation at each frame, and sets the tessellation attributes to provide optimal tessellation.

A progress bar at the bottom left of Maya's window indicates the runup progress. You can also interrupt the runup for the tessellation evaluation by pressing the Esc key. During the interruption, the tessellation values are set and are valid up until the frame at which it was interrupted.

Render Globals	Maya uses the frame range set in Render Global Settings window.
Time Slider	Use the time slider to adjust the frame range as necessary.
Current Frame	Evaluates the best tessellation for the current frame.

### Compute From

Available only in Automatic (default) Mode.

All Renderable Cameras	The default. Computes the automatic tessellation from the point of view of all renderable cameras.
Current View	Computes the automatic tessellation from the current view only.

### Curvature Tolerance

You can determine how smooth the nickeling of the tessellation needs to be. When you adjust this setting, Maya automatically sets the Chord Height Ratio (an Advanced setting that is hidden, but automatically set in both Automatic (default) Mode and Manual Basic Mode).

In more complex scenes with many small objects, set the smaller objects to Low Quality. (This table applies only for manual mode; automatic mode sets the chord height, depending on the distance from the camera.)

Low Quality	Chord Height ratio = 0.987
Medium Quality (default)	Some nickeling may occur, but a significantly lower polygon count is produced. Chord Height ratio = 0.990
High Quality	Chord Height ratio = 0.994.
Highest Quality	The result is very smooth edges with no nickeling. Chord Height ratio = 0.995.

## 7 | Window, menu, and node descriptions

Reference > Render > Set NURBS Tessellation >

No Curvature  
Check

No attempt to smooth out nickeling is made and only the initial sampling for the tessellation is done.

### U Division Factor, V Division Factor

Before adjusting these settings, adjust Curvature Tolerance to get the results you want.

When you adjust this setting, Maya automatically multiplies the values by the Per Surf # of Isoparms in 3D setting (an Advanced setting that is hidden, but automatically set in both Automatic (default) Mode and Manual Basic Mode).

The higher the values, the more polygons produced. The U Divisions Factor and V Divisions Factor attributes should contain approximately the same value.

### Use Smooth Edge

Use this to increase the number of triangles only along the boundary of an object. This lets you smooth the edges or prevent cracks between shared curves of adjacent surfaces without tessellating across the entire object, which incurs a high rendering time.

The higher the ratio, the smoother the edges and the higher the polygon count.

If you get artifacts in highlights along curved parts of the surface close to an edge, don't use this attribute.

### Smooth Edge Ratio

Adds more triangles where required in areas of curvature along the edges of the surface. The edge is the boundary of the NURBS surface, where one of the U or V parameters takes on its most extreme value. (This does not address the silhouette edges based on how the object is viewed from the camera.)

While extra triangles are primarily added along the edge, some are also added to the interior of the surface as needed to prevent cracking at T-junctions within the surface.

The ratio is the length of the tessellated triangle and the curve of the boundary.

### Edge Swap

Helps to divide quadrilateral surface spans into optimal triangles by swapping the two vertices on a quadrilateral used to create triangles. This is a secondary criteria, but it uses minimal resources.

## 7 | Window, menu, and node descriptions

Reference > Render > Set NURBS Tessellation >

### Manual Mode

- Basic** Basic settings appear when you select this option. For descriptions of these settings, see Automatic Mode settings.
- When you adjust Basic settings, Maya automatically sets the Advanced settings (which are hidden for simplicity) as follows (see "Advanced Tessellation settings" on page 261 for details):
- Advanced** Advanced settings appear when you select this option. For descriptions of these settings, see "Advanced Tessellation settings" on page 261.

### Advanced Tessellation settings

Available only in Manual Mode with the Advanced option selected. If you have set the Curvature Tolerance (in either Automatic (default) mode or Manual Basic mode) to the highest setting and the object is still not smooth enough, use these settings to have more control over tessellation.

### Mode U, Mode V

These are Primary Tessellation attributes (see "Primary vs. secondary tessellation passes" on page 44). These settings tell Maya how to tessellate the surface. The U and V values represent the U and V parametric dimensions of the NURBS surface. You can set these values differently to produce tessellation for each direction of your surface.

- Per Surf # of Isoparms** Ignores the number of surface spans and lets you specify the number of subdivisions you want to create. The result is a sparser number of isoparms on the surface than number of spans. Essentially, this setting pretends that everything is equally spaced.
- Per Surf # of Isoparms in 3D** Same as Per Surf # of Isoparms, but attempts to space the isoparms equally in 3D space (instead of parametric space). Good for converting NURBS to polygons. This mode produces more evenly distributed triangles than other modes.

## 7 | Window, menu, and node descriptions

Reference > Render > Set NURBS Tessellation >

Per Span # of  
Isoparms

This is the most common mode. Divides each span, no matter how large or small, into the same number of subdivisions. Very small spans are divided into the same number of subdivisions as very large spans. The default setting is 3. Per span settings help to prevent cracks between joined surfaces where the spans match, which is particularly important for character building with multiple surfaces.

Best Guess  
Based on  
Screen Size

Creates a bounding box around the NURBS surface, projects it into screen space, and calculates the number of pixels in the space. Maya uses this number to guess at the per surface # of isoparms. The maximum value is 40. With this mode, the more screen space the object uses, the higher the value.

This is not good for animation if the camera or the object is moving because the bounding box would change constantly. If the bounding box changes so does the tessellation and texture jitter as a result. (Problems with highlights may occur as well.)

**Note** If you have a complicated NURBS surface and have Display Render Tessellation turned on, this setting could delay the update of the display, so be patient.

### Number U, Number V

The actual values associated with Mode U, Mode V.

### Use Chord Height

**Note** Use the Chord Height *or* Chord Height Ratio *or* Min Screen option, but not a combination of them.

Turn on to enable the Chord Height slider value.

### Chord Height

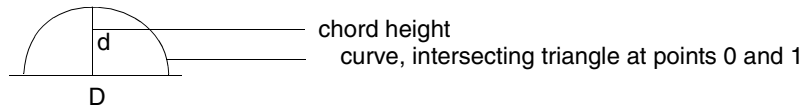
Chord height is a physical measurement based on object space units; it's perpendicular distance at the centre of a triangle edge to the curve that defines the surface. If the actual distance measured is greater than the Chord Height value, the triangle is subdivided. Once it is

## 7 | Window, menu, and node descriptions

Reference > Render > Set NURBS Tessellation >

subdivided, it will be checked again against the same criteria and the process will continue until the criteria is met. Chord height is measured in Object Space. The default is 0.1.

Chord Height is based on a default unit and doesn't always work well for very small models as the chord height values on a small model will be smaller still.



When chord heights are calculated, if any are larger than 0.1, Maya subdivides the triangles and recomputes. This subdivision process continues until all triangles meet this criteria. The smaller the chord height, the better the approximation of the triangle to the surface curve. (This may be useful for industrial designers concerned with the accuracy of a model in relation to a prototype model.)

**Note** Do not build models too small. Chord height is measured in Object Space. If you build models on a very small scale and then scale them up, the chord length is always relative to the object, not to World Space, which means tessellation criteria can be very expensive on small objects. For small or scaled objects, select "Use Chord Height Ratio".

Specifies the maximum distance the center of a tessellated span can be from the actual NURBS surface.

### Use Chord Height Ratio

Turn on to enable the Chord Height Ratio slider value.

### Chord Height Ratio

Specifies the maximum ratio between the length of a span and the distance the center of that span is from the actual NURBS surface.

Takes the ratio between the chord height (d) and the Distance (D) between the two points where the triangle intersects the surface, and subtracts it from 1, as shown in the equation:

$$\text{Chord Height Ratio} = 1 - d/D$$

A Chord Height Ratio value of 0.997 and above produces very smooth tessellated surfaces. The default is 0.9830, which means d is very small compared to D (i.e.,  $0.9830 = 1 - d/D$ ). The closer to 1, the tighter the fit of the triangle to the surface. (This is best used in animations.)

## 7 | Window, menu, and node descriptions

Reference > Render > Set NURBS Tessellation >

### Use Min Screen

Turn on to enable the Min Screen box.

**Note** Use the Chord Height *or* Chord Height Ratio *or* Min Screen option, but not a combination of them.

**Note** Don't turn on Use Min Screen for surfaces that are moving toward or away from the camera during an animation. Min Screen causes the tessellation to change over time and can cause unwanted displacement or texture 'popping'.

### Min Screen

Bases tessellation on a minimum screen size (default, 14 pixels). All triangles created during tessellation must fit within this screen size. If they don't, they are further subdivided until they do. This option is good for still images with a setting off 11.0. This option is not recommended for animations because the tessellation will constantly change when an object is moving, causing textures to jitter or jump because the shading for a particular pixel will have different tessellations to deal with on each frame.

**Note** If you have a complicated NURBS surface and have Display Render Tessellation turned on, this setting could delay the update of the display, so be patient.

Tessellates a surface based on how far it is from the camera and uses the screen space to determine how much tessellation is required (instead of object or world space).

All triangles must fit within the specified area. The default is 14 pixels, which means all triangles must fit within a 14X14 pixel area on the screen. Triangles that do not meet this criteria are subdivided iteratively until they fall within the specified area. The smaller you set this value, the smaller the triangles must be to satisfy the criteria. Lowering this value can dramatically increase memory, so use caution.



### Render > Render Using > mental ray

Changes the rendering mode to use the mental ray for Maya renderer.

For more information about the mental ray for Maya renderer, see "mental ray for Maya renderer" on page 17.

## Panel menus

### View

#### View > Select Camera

Selects the view's corresponding camera. The attributes for this camera appear in the Channel Box and the Attribute Editor.

---

**Tip** Selecting the camera is useful if you want to edit the look-at and camera up nodes associated with the camera.

---

#### View > Camera settings

##### Perspective

If on, the camera is a perspective camera. For more information on perspective cameras, see "Maya camera types" on page 27.

##### Journal

If on, all camera movements, such as tumble, track, and zoom, are written to the Script Editor (MEL journal) which lets you undo or redo camera movements or copy camera movements to use them for other cameras or scenes.

Journal is off by default, but you can still use [ and ] to undo and redo camera moves.

##### No Gate

Turns off the Film Gate and Resolution Gate display.

Displays no frustum (viewable volume) when not you are not looking through the camera. This is the default.

The frustum is the area or space the camera can see. Any object within the camera's frustum shows up in images rendered from that camera's view. See "Clipping planes" on page 34 for an diagram of the frustum.

## 7 | Window, menu, and node descriptions

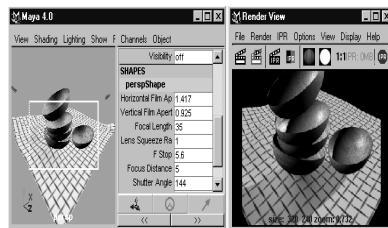
Reference > Render > Set NURBS Tessellation > □

### Film Gate

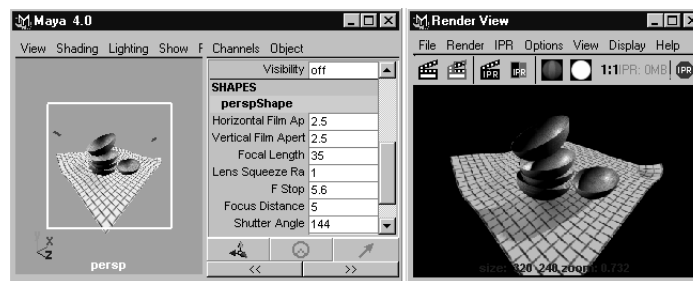
Displays a border indicating the area of the camera's view a real-world camera records on film. The dimensions of the film gate represent the dimensions of the camera aperture.

The film gate does not represent the render region. The Camera Aperture, Film Fit, rendering Resolution, Lock Device Aspect Ratio, and Device Aspect Ratio attributes, all affect what Maya renders.

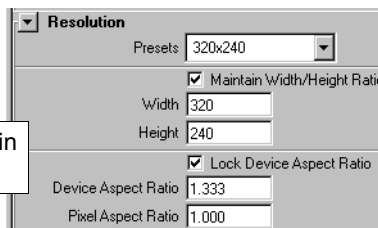
The film gate view guide indicates the area of the camera's view that renders only if the aspect ratios of the camera aperture and rendering resolution are the same.



Horizontal and Vertical Film Aspect Ratio adjusted in Channel Box to view almost the entire scene in Render View.



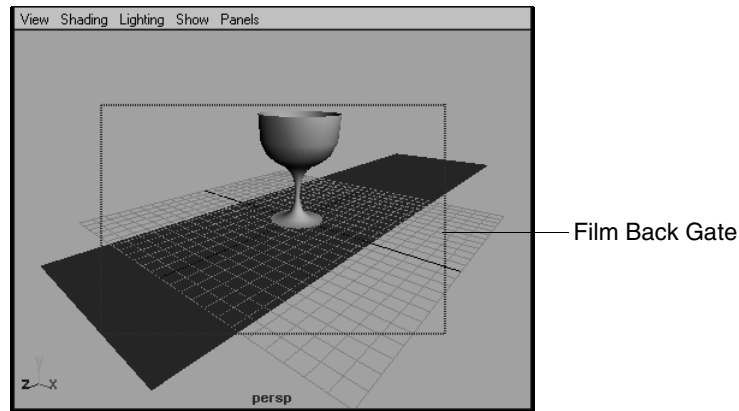
Resolution settings in Render Globals.



Displays the viewable frustum according to the film back size. The aspect ratio of the window (or rendering resolution) determines what you actually see. Also sets the camera Overscan attribute to 1.5. The following illustration shows the film gate representing the maximum viewable (or renderable) area.

## 7 | Window, menu, and node descriptions

Reference > Render > Set NURBS Tessellation >

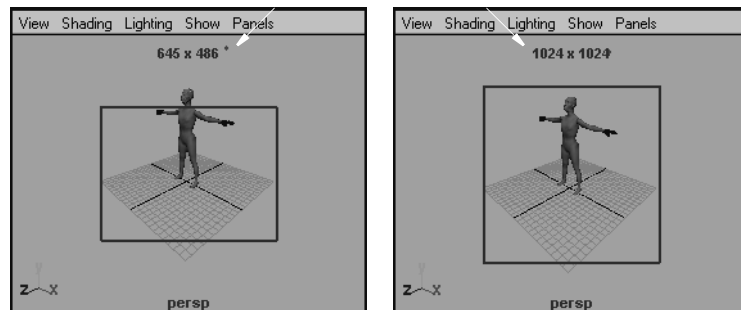


### Resolution Gate

The dimensions of the Resolution Gate represent the rendering resolution (the region to be rendered). The rendering resolution values are displayed above the Resolution Gate in the view. You can change these dimensions in the Resolution section of the Render Global Settings window.

Resolution values.

Change these values in the Render Global Settings



Enabling this option displays the renderable area for the current resolution specified in Render Global Settings window. This often specifies a more exact rendered image than the Film Gate option. Also sets the camera Overscan attribute to 2.0, so that more area outside the specified resolution can be viewed.

**Note** If the aspect ratio between the film back and the resolution is the same, then the two resulting rendered images match.

## 7 | Window, menu, and node descriptions

Reference > Render > Set NURBS Tessellation >

### Field Chart

Turn Field Chart on to display a grid that represents the twelve standard cell animation field sizes. The largest field size (number 12) is identical to the rendering resolution (the resolution gate). Render Resolution must be set to NTSC dimensions for this option to be meaningful.

### Safe Action

Turn this option on to display a box defining the region that you should keep all of your scene's action within if you plan to display the rendered images on a television screen.

For more information on Safe Action, see "Safe display regions for TV production" on page 33.

### Safe Title

Turn this option on to display a box defining the region that you should keep all of your scene's text (titles) within if you plan to display the rendered images on a television screen.

Render Resolution must be set to NTSC or PAL dimensions for this option to be meaningful.

For more information on Safe Title, see "Safe display regions for TV production" on page 33.

### Fill, Horizontal, Vertical, Overscan (for advanced users)

The following options control the size of the Resolution Gate relative to the Film Gate. If the resolution gate and the film gate have the same aspect ratio, these settings have no effect. The default setting is Fill.

Fill	Fits the resolution gate within the film gate. Automatically selects a horizontal or vertical fit so that the selected image fills the render frame.
Horizontal	Fits the resolution gate horizontally within the film gate. Selects a horizontal fit for the selected image in the render frame.
Vertical	Fits the resolution gate vertically within the film gate. Selects a vertical fit for the selected image in the render frame.
Overscan	Fits the film gate within the resolution gate.

Selects a slightly larger fit for the selected image in the render frame.

### View > Camera Attribute Editor

Opens the camera's Attribute Editor.

### Camera attributes

**Tip** If you click the boxes at the right of some of the attributes in this editor, the Create Render Node window appears, which means you can map certain render nodes to the camera attributes. For more information on the Create Render Node window, see "Create > Create Render Node" on page 107 in the *Shading* guide.

#### Controls

See "Maya camera types" on page 27 for information about the type of cameras: Camera; Camera and Aim; and Camera, Aim, and Up.

#### Angle of view

For more information on angle of view and how it's affected by the focal length of the camera, see "Angle of view (focal length)" on page 32.

**Tip** Try to avoid using a perspective camera with a very small angle (less than 5 degrees). Doing so may result in a much decreased depth precision, resulting in depth-fighting artifacts. Instead, try using an orthographic camera for a similar look.

#### Focal length

See "Focal Length" on page 248.

#### Camera scale

See "Camera Scale" on page 248.

#### Auto Render Clip Plane

For Maya software only. If this is on, the near and far clipping planes are automatically set so they enclose all objects within the camera's view. (For the hardware renderer and mental ray for Maya renderers, you must set the near clip plane and far clip plane manually. You can set the planes manually for Maya software rendering too.)

## 7 | Window, menu, and node descriptions

Reference > Film Back

All objects render and depth precision problems are eliminated. Clipping planes are not visible in the views.

If off, the near and far clipping planes are set to the Near Clip Plane and Far Clip Plane attribute values.

Auto Render Clip Plane is on by default.

Turn off Auto Render Clip Plane (and set the Near Clip Plane and Far Clip Plane) in the following cases:

- to limit which objects render based on their distance from the camera if you are compositing based on depth

Near Clipping Plane, Far Clipping Plane

See "Near Clip Plane, Far Clip Plane" on page 250.

### Film Back

The Film Back attributes control the basic properties of a camera (for example, the camera's film format: 16mm, 35mm, 70mm).

#### Film Gate

Lets you select a preset camera type. Maya automatically sets the Camera Aperture, Film Aspect Ratio, and Lens Squeeze Ratio. To set these attributes individually, set Film Gate to User. The default setting is User.

#### Camera Aperture

The height and width of the camera's Film Gate setting, measured in inches. The default values are 1.417 and 0.945. This setting has a direct effect on the camera's angle of view (see Angle of view).

**Note** The Camera Aperture setting has no effect on the fStop. For more information on fStop, see "Focus and blur" on page 28.

#### Film Aspect Ratio

The ratio of the camera aperture's width to its height. Maya automatically updates the Film Aspect Ratio (and vice versa). The valid range is 0.01 to 10. The default value is 1.5.

#### Lens Squeeze Ratio

See "Lens Squeeze Ratio" on page 248.

#### Film Fit

"Film Fit" on page 249.

### Film Fit Offset

"Film Fit Offset" on page 249.

### Film Offset

Vertically and horizontally offsets the resolution gate and the film gate relative to the scene. Changing the Film Offset produces a two-dimensional track. Film Offset is measured in inches. The default setting is 0.

1	The view guide fills the view. The edges of the view guide may be exactly aligned with the edges of the view, in which case the view guide is not visible.
> 1	The higher the value, the more space is outside the view guide.

### Overscan

"Overscan" on page 249.

## Depth of Field

These attributes provide control over the camera's focus.

For more information on depth of field, see "Aperture determines Depth of Field (DOF)" on page 29.

Tip	The more out of focus an image is, the longer it takes to generate the final rendered image (that is, the post-render blur takes longer.)
-----	---

### Depth Of Field

If on, some objects in the scene are sharply focused and others are blurred or out of focus, based on their distance from the camera. If off, all objects in the scene are sharply focused. Depth Of Field is off by default.

### Focus Distance

The distance from the camera at which objects appear in sharp focus, measured in the scene's linear working unit. Decreasing the Focus Distance also decreases the depth of field. The valid range is 0 to  $\infty$ . The default value is 5.

## 7 | Window, menu, and node descriptions

Reference > Output Settings

### F Stop

The range of Camera Aperture settings which affect the Depth of Field. The lower the fStop (for example, f4) the lower amount of Depth of Field. The higher the fStop value (for example, f32) the greater amount of Depth of Field.

For more information about fStop, see "fStop (aperture) and shutter speed/angle" on page 28.

### Focus Region Scale

Scales the Focus Distance value. The valid range is 0 to  $\infty$ . The default value is 1.

## Output Settings

Controls whether the camera generates an image during rendering, and what types of images the camera renders.

### Renderable

If on, the camera can create an image file, mask file, and/or depth file during rendering; that is, it is able to render. By default, Renderable is on for the default perspective camera, and off for all other cameras.

This option is affected by the Camera option in the Image File Output section of the Render Global Settings window. For more information on the Render Global Settings window, see "Render Global Settings window" on page 159.

### Image

If on (and Renderable is on), the camera creates an image file during rendering. The default setting is on.

### Mask

If on (and Renderable is on), the camera creates a mask during rendering. A mask is an 8-bit channel (the alpha channel) in the image file that represents objects in shades of gray. Black areas represent areas where there are no objects (or fully transparent objects), and white areas represent areas where there are (solid) objects. Masks are used primarily for compositing.

For image formats that do not support mask channels, the mask is stored as a separate image.

For more information on mask channels, see "Mask and depth channels" on page 84.



### Depth

If on (and Renderable is on), the camera creates a depth file during rendering. A depth file is a type of data file that represents the distance of objects from the camera.

Depth files are used primarily for compositing. When on, the Depth Type attributes (next) are enabled.

For image formats that do not support depth channels, the depth is stored as a separate image.

For more information on mask channels, see “Mask and depth channels” on page 84.

### Depth Type

Determines how to compute the depth of each pixel.

#### Closest Visible

**Depth** Uses the closest object to the camera. When transparent objects are located in front of other objects, turn on “Transparency Based Depth” to ignore the transparent object.

#### Furthest Visible

**Depth** Most often used when a particle effect is occluded by an opaque object. Maya uses the Furthest Visible Depth to create a Depth file.

### Transparency Based Depth

Turns on Threshold, which determines which object is closest to the camera, based on transparency. Transparency Based Depth is only enabled when you select Closest Visible Depth.

### Threshold

Used when compositing multiple layers of transparency (which varies from 0 to 1).

## Environment

Control the appearance of the scene’s background as seen from the camera. Different cameras can use different backgrounds.

### Background Color

The color of the scene’s background. The default color is black.

## 7 | Window, menu, and node descriptions

Reference > Special Effects

**Note** The background color of a camera cannot be texture mapped. If a procedural background is required, use an image plane instead.

### Image Plane

*For Maya software and mental ray for Maya rendering.*

Creates an image plane and attaches it to the camera. Clicking the Create button automatically changes the focus of the Attribute Editor to include attributes for an image plane.

For more information on image planes, see *"Create, edit, or position an image plane"* on page 265 in the Shading guide.

## Special Effects

### Shutter Angle

See *"Shutter Angle"* on page 250.

**Note** Motion Blur must be on in the Render Global Settings window. For Maya software rendering, motion blur must also be set in at least one object's Attribute Editor for the Shutter Angle to have any effect.

## Display Options

Controls the display of view guides in the camera's view, and provides options for moving the camera. You can also access most of these attributes in any panel's View > Camera Settings menu.

### Display Film Gate

*"Film Gate"* on page 266.

### Display Resolution

*"Resolution Gate"* on page 267.

### Display Field Chart

*"Field Chart"* on page 268.

### Display Safe Action

*"Safe Action"* on page 268.

## 7 | Window, menu, and node descriptions

Reference > View > Camera Tools > Tumble Tool >

### Display Safe Title

"Safe Title" on page 268.

### Journal Command

"Journal" on page 265.

### Center of Interest

The distance from the camera to the center of interest, measured in the scene's linear working unit.

### Tumble Pivot

The point the Tumble tool pivots the camera about when Tumble Camera About is set to Tumble Pivot in the Tumble Tool settings window.

## View > Camera Tools

Selects one of the camera tools. For information on the camera tools, see "Camera tools" on page 30.

## View > Camera Tools > Tumble Tool >

For a description of the Tumble tool, see "Tumble" on page 30.

### Tumble scale

Scales the speed of the camera movement. The slider range is 0.01 to 10. The default value is 1.

### Tumble camera about

Center of Interest	The camera tumbles about its center of interest. Tumble camera about is set to Center of interest by default.
Tumble Pivot	The camera tumbles about its pivot point. This tumble pivot can also be set in the camera's Attribute Editor (see "Tumble Pivot" for details). These values are stored in world space coordinates.  View operations such as Frame Selection, Frame All, Look at Selection, Default Home, and Bookmarks all set the tumble pivot.

### Orthographic views

Locked	If on, you cannot tumble an orthographic camera. If off, you can tumble an orthographic camera. Locked is on by default.
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## 7 | Window, menu, and node descriptions

Reference > View > Camera Tools > Track Tool >

Stepped	If on, you can tumble an orthographic camera in discrete steps. The Stepped operation lets you easily return to the Default Home positions. If off, you can tumble an orthographic camera smoothly. Stepped is only available if Locked is off. Stepped is on by default.
Ortho step	The angle of steps (in degrees) that you can tumble an orthographic camera when Locked is off and Stepped is on. The valid range is 0.01 to 180. The default value is 5.

### View > Camera Tools > Track Tool >

For a description of the Track tool, see "Track" on page 30.

---

**Tip** You can also press Alt+middle-drag to use the Track tool. Press the Shift key to constrain movement in horizontal or vertical directions.

---

#### Track Geometry

If off, as the camera moves an object moves at a speed that may be different than the speed of the cursor. This problem occurs with objects far from the camera. Track Geometry is off by default.

If on, as the camera moves, an object moves at the same speed as the cursor. The object selected at the beginning of the Track operation remains under the cursor. Tracking is slower (especially if there are many objects in the scene) if Track Geometry is on.

#### Track Scale

Scales the speed of the camera movement. The slider range is 0 to 100. The default value is 1.

### View > Camera Tools > Dolly Tool >

For a description of the Dolly tool and tips on how to use it, see "Dolly" on page 31.

#### Scale

Scales the speed of the camera movement. The slider range is 0.01 to 10. The default value is 1.

## 7 | Window, menu, and node descriptions

Reference > View > Camera Tools > Zoom Tool >

### Dolly

Local	If on, drag in the camera's view to move the camera toward or away from its center of interest. If off, drag in the camera's view to move both the camera and its center of interest along the camera's sight line. Local is on by default.
Center of Interest	<p>If Center of Interest is on, middle-drag in the camera's view to move the camera's center of interest toward or away from the camera. If off, drag in the camera's view to move the camera toward or away from its center of interest. drag a region and snap the center of interest to the center of those objects. Center of Interest is off by default.</p> <p>If Center of Interest (and/or Local) and Bounding box are on, when you drag in the views, a red line with a small x at the end points to indicate the Center of Interest.</p>

### Snap box dolly to

A box dolly moves the center of interest to the marquee region when you use the Ctrl+Alt+drag method to dolly the camera.

### Surface

If on, when you perform a box dolly (Ctrl+drag) on an object, the center of interest moves onto the surface of the object. Calculating the surface point is slower if Smooth Shade mode is off (and especially if there are many visible objects in the scene).

### Bounding box

If on, when you perform a box dolly (Ctrl+drag) on an object, the center of interest moves to the center of the object's bounding box. Bounding Box is on by default.

## View > Camera Tools > Zoom Tool >

For a description of the Zoom tool, see "Zoom" on page 31.

### Zoom Scale

Scales the speed of the camera movement. The slider range is 0.01 to 3. The default value is 1.

## View > Camera Tools > Roll Tool >

For a description of the Roll tool, see "Roll" on page 31.

## 7 | Window, menu, and node descriptions

Reference > View > Camera Tools > Azimuth Elevation Tool

### Roll Scale

Scales the speed of the camera movement. The slider range is 0.01 to 10. The default value is 1.

## View > Camera Tools > Azimuth Elevation Tool

For a description of the Azimuth tool, see "Azimuth Elevation" on page 31.

### Scale

Scales the speed of the camera movement. The slider range is 0.01 to 10. The default value is 1.

### Rotation type

Controls whether the camera movement is an Azimuth Elevation movement or a Yaw Pitch movement.

---

Tip Press Shift to constrain the camera's movement.

---

## View > Camera Tools > Yaw Pitch Tool >

For a description of the YawPitch tool, see "Yaw-Pitch" on page 31.

### Scale

Scales the speed of the camera movement. The slider range is 0.01 to 10. The default value is 1.

### Rotation type

Controls whether the camera movement is a Yaw Pitch movement or an Azimuth Elevation movement.

---

Tip Press Shift to constrain the camera's movement.

---

## View > Image plane

Provides you with options to import a file to use an image plane and access the Image Plane's attributes.

For more information on image planes, see "Create, edit, or position an image plane" on page 265 in the Shading guide.

Import Image Import a file to use as an image plane.

Image plane attributes Access the image plane's attributes.

## Nodes

### Object-specific render attributes (Attribute Editor)

#### Render Stats

Find this section in some selected objects' Attribute Editor, from the Attribute Spreadsheet (Window > General Editors > Attribute Spreadsheet) or the Rendering Flags window (Window > Rendering Editors > Rendering Flags).

The Render Stats section lets you turn on or off various rendering options for selected objects.

#### Casts Shadows

Turns on the shadow casting ability of the surface. To make shadows render faster, for surfaces that do not need to cast shadows, turn off Casts Shadows.

- If you want the object's shadow to render—the shadow the object casts onto other objects—make sure Casts Shadows is on.
- If you *do not* want the object's shadow to render—the shadow the object casts onto other objects—turn Casts Shadows off.

- Notes
- If you render shadows separately, use the mask channel of the rendered shadow image in your compositing software to reduce the brightness of another image.
  - When you render from the Render View window, you can render active objects *only* by setting Renderable Objects to Render Active in the Render Global Settings window.

#### Receive Shadows

Turns on the shadow-catching ability of the surface.

#### Motion Blur

Turns on motion blur for the surface. You must also turn on Motion Blur in the Render Global Settings window.

#### Primary Visibility

When on, the surface is visible in the view and renders.

## 7 | Window, menu, and node descriptions

Reference > Render Stats

**Tip** A surface's shadow renders, however, if its Primary Visibility is off and Cast Shadows is on. This also applies to reflections and refractions.

### Smooth shading

If this is on, each vertex uses its own normal vector - meaning smoother transition between two faces. If this is off, one normal vector is used for a face ; 3 vertices in a triangle uses a same normal vector, resulting flat looking shading.

### Visible in Reflections

When on, the surface reflects in reflective surfaces.

### Visible in Refractions

When on, the surface refracts in transparent surfaces.

### Double Sided

Determines if the surface is double-sided. If single-sided, you can decrease memory use and use the Opposite option.

### Opposite

Opposite flips the surface normals. *Double-Sided must be off to set Opposite.*

### Geometry Antialiasing Override

When on, the surface overrides the geometry anti-aliasing settings.

**Tip** Motion-blurred objects ignore any changes to the Geometry Antialiasing Override settings. The blur generally hides any aliasing artifacts.

### Antialiasing Level

Level 1	The default. It takes 32 visibility samples.
Level 2	Takes 96 visibility samples.
Level 3	Takes 288 visibility samples.
Level 4	Takes 512 visibility samples.
Level 5	Takes 800 visibility samples. Level 5 gives the best edge anti aliasing quality, but it is also the most expensive (in both memory and speed).



### Shading Samples Override

When on, the surface overrides the global shading sample settings in the Render Global Settings window.

### Shading Samples

Sets the minimum number of times Maya samples each pixel. For example, if set to 1, Maya samples each pixel once; if set to 8, Maya samples each pixel 8 times. The number of shading samples taken per pixel is limited by the number of visibility samples performed by the Edge Anti-Aliasing computation. So, if you use Medium Quality (which performs 8 visibility samples per pixel), you cannot get more than 8 shading samples regardless of the Shading Samples attribute setting.

Since Shading Samples computation is very expensive, you should try adjusting the Max Shading Samples first. See Max Shading Samples.

### Max Shading Samples

Sets the maximum number of times a pixel is sampled during the second pass of a Highest Quality render (adaptive shading pass). The higher the number, the longer the rendering takes, but the more accurate the resulting image is.

Max Shading Samples has an effect only when used in conjunction with Highest Quality edge anti-aliasing. Also, depending on the requirements to compute an accurate solution, the number of Shading Samples taken can be less than the number of Max Shading Samples.

**Tip** Occasionally, when an object is moving, the object's textured edges look distorted. To resolve this, try increasing the number of Max Shading Samples.

**Tip** Sometimes, skinny highlights can exhibit roping or flickering artifacts. Try increasing the Max Shading Samples setting. You may also need to increase the Shading Samples setting, but you can set it on a per-object basis.

### Volume Samples Override

When on, the object overrides the global volume shading settings and you can turn on the Depth Jitter option in Render Global Settings window.

## 7 | Window, menu, and node descriptions

Reference > NURBS objects tessellation

### Volume samples

Adjusts the number of samples placed inside the fog volume.

### Depth Jitter

If you set Volume Sample Override on, you can turn on Depth Jitter option. Randomizes the samples of the volume with depth which replaces banding artifacts in volume renders with noise. The noise can be dramatically reduced by increasing the volume samples and anti-aliasing levels.

## Tessellation

### NURBS objects tessellation

#### Display render tessellation

Shows or hides (default) the tessellation triangles so that you can have more control while adjusting settings.

**Note** This option does not display displacement mapping  
In the main Maya window, select Shading > Displacement to Polygon to preview the effect of your tessellation and displacement together, then discard the generated polygon object when you are finished previewing.

#### Refresh tessellation

When advanced tessellation with min screen is on, the tessellation only updates when refresh is pressed.

#### Triangle count

This is the number of render triangles in the surface when a tessellation is displayed.

#### Curvature tolerance

See "Curvature Tolerance" on page 259.

#### U Division Factor, V Division Factor

See "U Division Factor, V Division Factor" on page 260.

# Index

## Symbols

- .mi files
  - exporting . . . . . 72, 118
- .mi format
  - exporting to . . . . . 72

## Numerics

- 2D Blur memory Limit attribute . . . . . 175
- 2D motion blur
  - artifacts . . . . . 126
  - rendering problems . . . . . 124
- 3D Blur Visib attribute . . . . . 167
- 3D Motion Blur . . . . . 30
- 3D Motion Blur Production attribute . . . . . 166

## A

- Acceleration Method attribute . . . . . 200
- Advanced Tessellation
  - for surfaces . . . . . 261
- Alias Pix format . . . . . 75
- aliasing . . . . . 126
- All Channels
  - Render View . . . . . 229
- All Double sided attribute . . . . . 209
- All Renderable Cameras
  - for tessellation . . . . . 259
- All Single sided attribute . . . . . 209
- All Surfaces
  - for tessellation . . . . . 257
- Alpha Channel (Mask) . . . . . 161
- alpha channels
  - enabling . . . . . 96
  - premultiplication . . . . . 84
- Alpha mode attribute . . . . . 199
- Alpha Source attribute . . . . . 236
- Angle of view . . . . . 33
- angle of view, cameras . . . . . 32
- Animation
  - mental ray for Maya . . . . . 20

- animation
  - batch render . . . . . 115
  - batch rendering . . . . . 72
  - command line rendering . . . . . 72, 117
  - low-res rendering . . . . . 111
  - rendering single frame . . . . . 71
  - swimming . . . . . 121
  - troubleshooting . . . . . 121
- animations
  - test render . . . . . 111
- Anti-alias
  - Anti-aliasing Quality, Render Globals . . . . . 165
  - Hardware Render Globals . . . . . 240
- anti-aliasing
  - about . . . . . 131
  - adjusting . . . . . 99, 134
  - blobby surfaces . . . . . 121
- Antialiasing Level
  - Render Stats . . . . . 280
- aperture (fstop) . . . . . 28
- Apply Fog in Post
  - Render Options . . . . . 175
- Apply tessellation, NURBS . . . . . 257
- approximation
  - about . . . . . 43, 45
  - controlling fine . . . . . 55
  - default settings . . . . . 45
  - fine . . . . . 47
  - vs. tessellation . . . . . 43
- Approximation Editor
  - attributes . . . . . 62
- approximation node
  - assigning . . . . . 61
  - assigning to geometry . . . . . 53
  - creating . . . . . 52, 61
  - editing . . . . . 54, 61
- approximation nodes . . . . . 45
- Approximation settings . . . . . 56
- approximation settings . . . . . 45
  - overriding . . . . . 54
- approximation styles . . . . . 47
- Area Gradient (SWF and SVG only) . . . . . 217

## Index

- Area Lights
  - mental ray . . . . . 19
- artifacts
  - 2D motion blur . . . . . 126
  - about . . . . . 132
  - clipping plane . . . . . 132
  - fixing . . . . . 134
  - troubleshooting . . . . . 124
- aspect ratio
  - image . . . . . 164
  - pixel . . . . . 80, 95, 96
- At Top/At Bottom attribute . . . . . 171
- atmosphere . . . . . 175
- Attribute Editor
  - Rendering Flags . . . . . 20
  - surface settings . . . . . 62
- Attributes
  - option in Hardware Render Buffer . . . . . 242
- Auto Render Region
  - in Render View . . . . . 229
- Auto Resize
  - in Render View . . . . . 229
- Automatic
  - tessellation mode . . . . . 258
- Average Color . . . . . 217
- AVI image format . . . . . 75
- azimuth
  - description . . . . . 31
  
- B**
- Back attribute . . . . . 188
- background
  - rendering problems . . . . . 124
- Background Color
  - Display Options . . . . . 241
- Background Color attribute
  - Environment attributes . . . . . 273
- Basic camera . . . . . 27
  
- Batch Render . . . . . 255
  - about . . . . . 72
  - advantages . . . . . 72
  - and IPR . . . . . 109
  - animation . . . . . 115
  - cancel . . . . . 256
  - error handling . . . . . 22, 142
  - show . . . . . 256
  - still image . . . . . 115
- Batch Render Frame window . . . . . 115
- Best Guess Based on Screen Size
  - primary tessellation . . . . . 262
- Bias
  - Raytracing Quality . . . . . 172
- bitmap
  - image file format . . . . . 78
- blobby surface
  - anti-aliasing problem . . . . . 121
- block ordered textures . . . . . 139
- Blue Channel
  - Render View . . . . . 229
- Blur
  - By Frame, Motion Blur . . . . . 173
  - Length, 2D Motion Blur . . . . . 173
  - Sharpness, 2D Motion Blur . . . . . 174
- blur . . . . . 28
- Blur by Frame attribute . . . . . 210
- BOT . . . . . 139
- BOT files . . . . . 139
- Both attribute . . . . . 188
- Both Fields
  - Interlaced . . . . . 170
  - Separate . . . . . 170
- Bounding Box
  - Dolly camera setting . . . . . 277
- Box attribute . . . . . 192
- Box Filter attribute . . . . . 186
- BSP (default) attribute . . . . . 200
- BSP Depth attribute . . . . . 201
- BSP settings . . . . . 136
- BSP Size attribute . . . . . 201
- Bump mapping . . . . . 122
- Bump Texture Resolution . . . . . 208
- Bump Texture Resolution attribute . . . . . 208

- By Frame
  - Hardware Render Globals . . . . . 236
  - Image File Output . . . . . 95, 160
  - Renumber Frames, Render Globals . . . . . 162
  
- C**
- cache size limit, for approximation . . . . . 55
- Calculation attribute . . . . . 190
- Camera
  - attributes in Render Globals . . . . . 161
  - optimizing, render faster . . . . . 138
  - Select Camera option . . . . . 265
- camera
  - Center of Interest option. . . . . 248, 275
- Camera and Aim . . . . . 27
- Camera Aperture . . . . . 270
- Camera Icons attribute . . . . . 241
- Camera Properties attributes . . . . . 247
- Camera Settings option, View menu . . . . . 265
- camera tools . . . . . 30
- Camera Tools option, View menu. . . . . 39
- Camera, Aim, and Up . . . . . 27
- cameras
  - adjusting attributes . . . . . 35
  - aiming . . . . . 30, 39
  - azimuth . . . . . 31
  - changing settings. . . . . 265
  - creating . . . . . 35
  - dollyng . . . . . 31
  - elevation . . . . . 31
  - field chart . . . . . 268
  - fill . . . . . 268
  - film gate . . . . . 266
  - fly . . . . . 32
  - frustrum . . . . . 265, 266
  - gate. . . . . 265
  - horizontal . . . . . 268
  - journal . . . . . 265
  - looking through. . . . . 38, 40
  - making renderable. . . . . 36
  - oversan . . . . . 268
  - perspective . . . . . 265
  - resolution gate . . . . . 267
  - rolling . . . . . 31
  - safe action. . . . . 268
  - safe title . . . . . 34, 268
  - save movements . . . . . 41
  - selecting current. . . . . 38
  - tilt . . . . . 31
  - tracking . . . . . 30
  - tumbling . . . . . 30
  - types of . . . . . 27
  - viewing vs. rendering. . . . . 27
  - yaw . . . . . 31
  - zoom . . . . . 31
- Cancel Batch Render . . . . . 256
- cancelling
  - IPR . . . . . 108
- Casts Shadows
  - Render Stats . . . . . 279
- Casts Shadows attribute
  - Render Stats attributes . . . . . 279
- Caustic
  - Rendering Flag. . . . . 20
- Caustic Accuracy attribute . . . . . 192
- Caustic Filter Kernel attribute . . . . . 192
- Caustic Filter Type attribute. . . . . 192
- Caustic Radius attribute . . . . . 192
- caustics
  - troubleshooting . . . . . 138
- Caustics attribute . . . . . 192
- Caustics/Global Illumination attribute . . . . . 198
- Center of interest . . . . . 248, 275
- channels
  - about . . . . . 82, 84
  - premultiplication. . . . . 84
- Channels attribute . . . . . 161
- Chord Height . . . . . 262
- Chord Height Ratio attribute . . . . . 263
- Chord Height Ratio, Use. . . . . 263
- Cineon format. . . . . 75, 142
- client. . . . . 146
- client setup . . . . . 149
- Clip Final Shaded Color attribute . . . . . 176
- clipping plane
  - artifacts . . . . . 132
- clipping planes
  - about . . . . . 34

## Index

- Close IPR File
    - Render View window . . . . . 225
  - Close option
    - Hardware Render Buffer . . . . . 242
  - Closest Visible Depth
    - Depth Type . . . . . 273
  - Collision Icons attribute . . . . . 241
  - color channels
    - about . . . . . 82
    - enabling . . . . . 96
  - Color Texture Resolution . . . . . 208
  - Color Texture Resolution attribute . . . . . 208
  - Colorclip attribute . . . . . 199
  - Combine Fills and Edges (SWF only) . . . . . 212
  - command line rendering . . . . . 72, 117, 154
  - common tab
    - Render Globals . . . . . 159
  - Composite
    - Threshold . . . . . 177
  - compositing
    - arranging objects . . . . . 85
    - rendering tips . . . . . 83
  - Compress (SVG only) . . . . . 213
  - Compute From
    - for tessellation . . . . . 259
  - Cone Angle . . . . . 137
  - Cone attribute . . . . . 192
  - Console . . . . . 22, 142
  - contours
    - custom shaders . . . . . 198
  - Contrast Sensitive Production attribute . . . . . 166
  - Coverage attribute
    - Anti-aliasing Quality attributes . . . . . 169
  - CPUs
    - multi-thread rendering . . . . . 180
    - use all available for multi-thread rendering . 180
  - Culling attribute . . . . . 209
  - Culling Threshold attribute . . . . . 210
  - Current Frame
    - for tessellation . . . . . 259
  - Current View
    - for tessellation . . . . . 259
  - Curvature Tolerance
    - Set NURBS Tessellation . . . . . 259
  - Curve Tolerance . . . . . 213
  - Custom . . . . . 207
  - Custom attribute . . . . . 165, 207
  - Custom Cameras Text . . . . . 207
  - Custom Extension attribute . . . . . 171
  - Custom Global Text . . . . . 206
  - Custom Global Text attribute . . . . . 206
  - Custom Globals . . . . . 21
  - Custom Globals attribute . . . . . 206
  - Custom Lights attribute . . . . . 207
  - Custom Lights Text . . . . . 207
  - Custom Options Text . . . . . 206
  - Custom Options Text attribute . . . . . 206
  - Custom Scene . . . . . 21, 206
  - Custom Scene attribute . . . . . 206
  - Custom Scene Text . . . . . 207
  - Custom shaders, contours . . . . . 198
  - Custom Textures . . . . . 21
  - Custom Vertex Data . . . . . 21
  - Customization attribute . . . . . 204
  - customizations
    - mental ray for Maya . . . . . 21
- ## D
- Data Type attribute . . . . . 199
  - Default Field Extension (o and e) attribute . . . . 171
  - Depth attribute
    - Output Settings attributes . . . . . 273
  - depth channel
    - description . . . . . 85
  - Depth Channel (Z Depth) . . . . . 161
  - depth channels
    - about . . . . . 82, 84
    - enabling . . . . . 96
  - depth file
    - description, for cameras . . . . . 273
  - depth files
    - creating . . . . . 96
  - depth information
    - IFF files . . . . . 18

Depth Jitter		Display menu	
Render Stats . . . . .	282	Render View window . . . . .	229
depth map shadows		Display Options attributes	
optimizing . . . . .	137	cameras . . . . .	274
Depth Of Field . . . . .	271	Hardware Render Globals . . . . .	241
Depth of Field		Display Real Size button	
rendering . . . . .	37	Render View window . . . . .	230
Depth Of Field attribute . . . . .	271	Display Resolution attribute . . . . .	274
Depth Type		Display RGB Channels button	
Closest Visible Depth . . . . .	273	Render View window . . . . .	230
Furthest Visible Depth . . . . .	273	Display Safe Action attribute . . . . .	274
Output Settings attributes . . . . .	273	Display Safe Title attribute . . . . .	275
Depth-of-field . . . . .	123	Display Shadows attribute . . . . .	239
derive from Maya . . . . .	18, 45, 121	Distributed Render (Save) . . . . .	256
Desaturate attribute . . . . .	199	distributed rendering . . . . .	145
Detail Level . . . . .	214	Dither attribute . . . . .	200
Detail Level Preset . . . . .	214	Dithered option	
Device Aspect Ratio attribute . . . . .	164	Render View window . . . . .	229
Diagnose BSP attribute . . . . .	198	Dmap Filter Size . . . . .	137
Diagnose Grid . . . . .	142	Dmap Focus attribute . . . . .	137
Diagnose Grid attribute . . . . .	197	Dmap Resolution . . . . .	137
Diagnose Photon . . . . .	142	Dolly	
Diagnose Photon attribute . . . . .	198	Bounding Box camera setting . . . . .	277
Diagnose Photon Density . . . . .	142	camera settings . . . . .	277
Diagnose Samples . . . . .	142	Local camera setting . . . . .	277
Diagnose Samples attribute . . . . .	197	Snap box dolly to camera settings . . . . .	277
diagnosing		Surface camera setting . . . . .	277
scenes . . . . .	133	dollying, cameras . . . . .	31
Diagnostics . . . . .	142	Double Sided	
differences		Render Stats . . . . .	280
mental ray for Maya . . . . .	18	Draft attribute . . . . .	184
Diffuse		Draft motion blur attribute . . . . .	184
Render Layer Pass . . . . .	88	Draw Style attribute . . . . .	238
Direct Illumination Shadow Effects attribute . . . . .	194		
Disk Based Dmaps . . . . .	138	<b>E</b>	
displacement . . . . .	122	Edge Anti-aliasing attribute . . . . .	166
displacement mapping		Edge Color . . . . .	223
performance . . . . .	136	Edge Detail . . . . .	223
troubleshooting . . . . .	127	Edge Smoothing attribute . . . . .	240
Display Alpha Channel button		Edge Style . . . . .	223
Render View window . . . . .	230	Edge Swap	
Display Field Chart attribute . . . . .	274	Set NURBS Tessellation . . . . .	260
Display Film Gate attribute . . . . .	274		

## Index

- Edge Weight . . . . . 222
  - Edge Weight Preset . . . . . 222
  - edges
    - rendering problems. . . . . 124
    - troubleshooting . . . . . 126
  - elevation
    - description, for azimuth elevation tool . . . . . 31
  - Emitter Icons attribute. . . . . 241
  - Enable Default Light . . . . . 164
  - Enable Default Light attribute . . . . . 164
  - Enable Depth Maps attribute . . . . . 176
  - Enable Global Passes attribute. . . . . 182
  - Enable Render Layer Passes attribute. . . . . 182
  - Enable Render Layers . . . . . 211, 224
  - Enable Render Layers attribute . . . . . 181
  - Enable Stroke Rendering attribute . . . . . 182
  - End Frame attribute
    - Image File Output attributes . . . . . 95, 160
    - Image Output Files attributes . . . . . 236
  - Environment attributes . . . . . 273
  - Environment Fog attribute . . . . . 175
  - error handling
    - mental ray for Maya . . . . . 22, 142
  - errors, rendering . . . . . 141
  - Even Field . . . . . 170, 171
  - Exact. . . . . 20, 29
  - export
    - to mi. . . . . 118
  - Export All Incoming Shaders . . . . . 246
  - Export Custom Colors attribute. . . . . 204
  - Export Custom Data attribute . . . . . 205
  - Export Custom Motion attribute . . . . . 205
  - Export Custom Text attribute. . . . . 204
  - Export Custom Vectors attribute. . . . . 205
  - Export Entire Child DAG . . . . . 247
  - Export Exact Hierarchy attribute. . . . . 202
  - Export Full Dagpath attribute . . . . . 202
  - Export Light Linker attribute . . . . . 204
  - Export Maya Options attribute . . . . . 204
  - Export Nurbs Derivatives attribute. . . . . 203
  - Export Polygon Derivatives attribute. . . . . 203
  - Export Shape Deformation attribute. . . . . 203
  - Export State Shader attribute . . . . . 204
  - Export Textures First attribute. . . . . 202
  - Export Verbosity attribute . . . . . 202
  - exporting
    - .mi files . . . . . 72, 118
    - optimizing .mi format. . . . . 72
  - Extension attribute. . . . . 236
  - extension, image. . . . . 93
- ## F
- F Stop attribute . . . . . 272
  - Faces attribute . . . . . 188
  - Falloff Start attribute . . . . . 196
  - Falloff Stop attribute . . . . . 196
  - Far Clip Plane attribute. . . . . 250
  - far clipping plane. . . . . 34
  - Field
    - options. . . . . 170
  - Field Chart option . . . . . 268
  - Field Dominance
    - Even Fields . . . . . 170
    - Odd Fields . . . . . 170
    - render options . . . . . 170
  - Field Dominance attribute . . . . . 124
  - Field Icons attribute. . . . . 241
  - Field Options attributes . . . . . 169
  - field rendering . . . . . 80
  - fields. . . . . 81
    - description . . . . . 81
    - Even. . . . . 171
    - interlacing. . . . . 99
    - rendering . . . . . 98
    - rendering problems. . . . . 124
    - vs. frames . . . . . 80
  - File Export. . . . . 18
  - file format, image. . . . . 93
  - file formats
    - bitmap vs. vector . . . . . 74
    - rendering . . . . . 73
  - File menu
    - Render View window . . . . . 225
  - File Name Prefix attribute . . . . . 160



file name, image . . . . .	93
Filename attribute . . . . .	236
files	
rendering output location . . . . .	79
Fill Objects. . . . .	214
Fill option . . . . .	268
Fill Style . . . . .	214
Film Aspect Ratio attribute. . . . .	270
Film Back attributes . . . . .	270
Film Back Properties attributes . . . . .	248
Film Gate attribute. . . . .	270
Film Gate option. . . . .	266
Film Offset attribute . . . . .	271
Filter attribute. . . . .	195
Filter Height attribute . . . . .	186
Filter Width attribute. . . . .	186
final gather	
troubleshooting . . . . .	139
Final Gather attribute . . . . .	194
Final Gather File attribute. . . . .	196
Final Gather Rays attribute. . . . .	195
Final Gather Rebuild attribute. . . . .	196
Fine Approximation . . . . .	56
fine approximation . . . . .	47
controlling triangles . . . . .	55
setting cache limit . . . . .	55
Fine Displacement . . . . .	56
Fix Texture Warp	
description . . . . .	69
Flash	
rendering. . . . .	22
Flash Version (SWF only) . . . . .	211
flicker	
about . . . . .	131
fixing . . . . .	134
flickering animations	
troubleshooting . . . . .	127
Flipbook Options . . . . .	244
Flipbooks menu	
Hardware Render Buffer . . . . .	244
Fly Tool . . . . .	32
fly, cameras . . . . .	32
focal length . . . . .	32
Focus Distance attribute . . . . .	271
Focus Region Scale attribute . . . . .	272
focus, vs. motion blur . . . . .	28
fog	
motion blur artifacts . . . . .	126
Fog Shadow Samples . . . . .	138
format, image file	
setting . . . . .	93
Four Color . . . . .	216
frame	
rendering . . . . .	71
Frame All option	
Maya View menu . . . . .	40
Frame Image option	
Render View window . . . . .	226
Frame Padding attribute. . . . .	95, 161
Frame Range, Use	
for tessellation . . . . .	258
Frame Rate (SWF and SVG only) . . . . .	211
Frame Region option	
Render View window . . . . .	226
Frame Selection . . . . .	40
Frame/ Animation Ext attribute. . . . .	94, 160
Frames	
render . . . . .	170
frames . . . . .	81
batch rendering . . . . .	72
command line rendering . . . . .	72, 117
low-res rendering . . . . .	111
rendering . . . . .	98
rendering single. . . . .	114
test render. . . . .	111
vs. fields . . . . .	80
Front attribute . . . . .	188
frustum . . . . .	265, 266
renderable. . . . .	267
fstop . . . . .	28
Full Color . . . . .	216
Full Image Resolution attribute. . . . .	239
Furthest Visible Depth	
Depth Type. . . . .	273

## Index

### G

Gamma attribute ..... 199  
Gamma Correction attribute ..... 176  
gate ..... 265  
Gaussian Filter attribute ..... 186  
geometry  
    assigning approximation to ..... 53  
    mental ray approximation ..... 48  
    NURBS ..... 44  
Geometry Antialiasing Override  
    Render Stats ..... 280  
Geometry Mask attribute ..... 239  
geometry types  
    mental ray for Maya ..... 48  
gGlobal illumination  
    troubleshooting ..... 138  
GIF format ..... 75  
Global Illum Accuracy attribute ..... 193  
Global Illum Radius attribute ..... 193  
Global Illumination attribute ..... 192  
Globillum  
    Rendering Flag ..... 20  
Grab Swatch to Hypershade & Visor button  
    Render View window ..... 226  
Green attribute ..... 169  
Green Channel option  
    Render View ..... 229  
Grid attribute ..... 201, 241  
Grid Depth attribute ..... 201  
Grid Max Size attribute ..... 201  
Grid Resolution attribute ..... 201  
Grid Size ..... 142  
Grid Size attribute ..... 197  
guidelines, in scene views ..... 36

### H

hardware rendering ..... 15  
    Render Globals ..... 207  
HDR images ..... 19  
HDRI ..... 19  
HDTV ..... 142

Rendering  
290

Height attribute  
    Resolution attributes ..... 96, 164  
Hidden Edges ..... 223  
High Quality attribute ..... 166  
Highest Quality attribute ..... 166  
Highlight Level (SWF and bitmap formats only) 221  
highlights  
    troubleshooting ..... 128  
Highlights (SWF and bitmap formats only) .... 220  
Horizontal Film Aperture attribute  
    see Camera Aperture attribute  
Horizontal Film Offset attribute  
    see Film Offset attribute  
Horizontal option ..... 268

### I

IBL attribute ..... 198  
IFF image  
    depth information ..... 18  
Ignore Film Gate attribute ..... 175  
Ignore Glows  
    Render View ..... 229  
Ignore Shadows  
    Render View ..... 229  
image  
    filtering ..... 101  
image aspect ratio ..... 164  
Image attribute  
    Output Settings ..... 272  
Image Based Lighting attributes ..... 198  
image file formats  
    setting ..... 93  
Image File Output attributes ..... 160  
Image Format attribute  
    Image File Output attributes ..... 93, 160  
    Image Output Files attributes ..... 236  
Image Output Files attributes ..... 236  
Image Plane attribute  
    Environment attributes ..... 274

- images
  - aspect ratio . . . . . 164
  - directory . . . . . 95
  - extension . . . . . 93
  - fields . . . . . 81
  - file format . . . . . 93
  - file name . . . . . 93
  - frames . . . . . 81
  - name . . . . . 93
  - pixel aspect ratio . . . . . 95
  - premultiplied . . . . . 84
  - rendering quality . . . . . 131
  - rendering speed . . . . . 131
  - resolution . . . . . 95
- images, keeping rendered
  - Render View . . . . . 231
- Include Edges . . . . . 222
- Interactive Photorealistic Rendering. See IPR . . . . 67
- interactive rendering, multi-threaded . . . . . 180
- interlacing
  - description . . . . . 81
- Intermediate . . . . . 207
- Intermediate Quality attribute . . . . . 165
- Interpolate Samples attribute . . . . . 199
- IPR
  - about . . . . . 67
  - batch rendering . . . . . 109
  - canceling . . . . . 107
  - cancelling . . . . . 108
  - how it works . . . . . 67
  - limitations . . . . . 69
  - options . . . . . 105
  - pausing . . . . . 107
  - rendering with . . . . . 107
  - saving . . . . . 107
  - troubleshooting . . . . . 128
- IPR default light . . . . . 69
- IPR menu
  - Render View window . . . . . 227
- IPR Render Current Frame . . . . . 254
- IPR Render option
  - Render View window . . . . . 227
- IPR Tuning Options
  - Render View window . . . . . 228
- IRIX setup . . . . . 149
- IRP
  - troubleshooting . . . . . 125
- J**
  - Jitter attribute . . . . . 187
  - Jitter Final Color attribute . . . . . 176
  - Journal . . . . . 41
  - Journal Command attribute . . . . . 275
  - Journal option . . . . . 265
  - JPEG format . . . . . 76
- K**
  - Keep Image
    - Render View . . . . . 231
  - Keep Image in Render View option
    - Render View window . . . . . 225
  - Keep Motion Vectors
    - 2D Motion Blur . . . . . 174
- L**
  - Lanczos attribute . . . . . 186
  - Layer Editor . . . . . 106
  - Layered Shader
    - performance . . . . . 137
  - layers
    - about . . . . . 85
    - advantages of . . . . . 83
    - creating . . . . . 105
    - Display vs. Render . . . . . 86
  - Leaf Primitives attribute . . . . . 179
  - lens . . . . . 32
  - Lens Properties attributes . . . . . 248
  - Light Icons attribute . . . . . 241
  - Lighting Mode attribute . . . . . 238
  - Line Smoothing attribute . . . . . 239
  - Linear . . . . . 20, 29
  - Linux setup . . . . . 149
  - Local
    - Dolly camera setting . . . . . 277
  - Lock Device Aspect Ratio attribute . . . . . 164

## Index

- Locked
  - Tumble camera setting . . . . . 275
- Logfile . . . . . 22, 142
- Look At Selection . . . . . 40
- Look Through Selected option, Panels menu . . . . 38
- Low Quality attribute . . . . . 166
- Luminance option
  - Render View window . . . . . 229
  
- M**
- Maintain Width/Height Ratio attribute. . . . . 164
- Manual
  - tessellation mode. . . . . 258
- mask
  - description, for cameras . . . . . 272
- Mask attribute
  - Output Settings attributes . . . . . 272
- Mask Channel
  - or alpha channel. . . . . 85
  - Render View. . . . . 229
- mask channels
  - about . . . . . 84
  - about, alpha channels
    - about82
    - enabling. . . . . 96
    - modifying . . . . . 97
- matte opacity . . . . . 123
- Matte Opacity attribute. . . . . 97
- Matte Opacity Mode attribute . . . . . 97, 98
- matte transparency, see Matte Opacity . . . . . 97
- Max 3D Blur Visib attribute . . . . . 168
- Max Photon Depth attribute. . . . . 193
- Max Radius attribute. . . . . 195
- Max Reflection Photons attribute . . . . . 193
- Max Refraction Photons attribute . . . . . 193
- Max Sample Level attribute . . . . . 185
- Max Shading attribute. . . . . 167
- Max Shading Samples
  - Render Stats . . . . . 281
- Max Shading Samples attribute. . . . . 167
- Max Trace Depth attribute . . . . . 187
- Max Visib Samples attribute . . . . . 167
  
- Maya Hardware
  - Render Globals. . . . . 207
- Maya IFF format. . . . . 76
- Maya Vector
  - Render Globals. . . . . 211
- maya.rayhosts. . . . . 147
- maya.rayrc . . . . . 147
- Maya16 IFF format. . . . . 76
- Medium Quality attribute . . . . . 166
- MEL commands
  - run at render time . . . . . 82
  - running after rendering . . . . . 99
  - running before rendering . . . . . 99
- Memory and Performance Options. . . . . 180
- Memory and Performance Options attributes. . . 177
- memory exceptions . . . . . 121
- mental ray . . . . . 147
  - approximation . . . . . 43
  - Area Lights . . . . . 19
  - BSP settings . . . . . 136
  - configuration files . . . . . 147
  - exporting .mi files . . . . . 118
  - exporting files . . . . . 72
  - motion blur . . . . . 29
  - network rendering. . . . . 146
  - output window messages . . . . . 26
  - Render Globals. . . . . 184
  - rendering problems. . . . . 121, 122
  - rendering with. . . . . 118
- mental ray for Maya
  - Animation. . . . . 20
  - customizations. . . . . 21
  - differences . . . . . 18
  - error handling . . . . . 22, 142
  - geometry types . . . . . 48
  - NURBS surfaces. . . . . 48
  - polygonal meshes . . . . . 48
  - shading networks . . . . . 19
  - subdivision surfaces . . . . . 49
- mentay ray
  - approximation . . . . . 45
- Mesh Gradient (SWF and SVG only) . . . . . 218
- miDeformation . . . . . 73
- Min Edge Angle . . . . . 224

Min Radius attribute . . . . . 195

Min Sample Level attribute . . . . . 185

Min Screen attribute  
     Secondary Tessellation Attributes . . . . . 264

miTangents . . . . . 73

Mitchell attribute . . . . . 186

Mode U attribute  
     Tessellation . . . . . 261

Mode V attribute  
     Tessellation . . . . . 261

Modify Extensions attributes . . . . . 162

moire patterns. . . . . 187

Motion Back Offset attribute . . . . . 205

Motion Blur. . . . . 20, 29  
     2D troubleshooting . . . . . 124  
     creating . . . . . 103  
     diagnostics . . . . . 142  
     Render Stats . . . . . 279  
     Tips . . . . . 174

motion blur  
     about . . . . . 30  
     artifacts . . . . . 126  
     troubleshooting . . . . . 128

Motion Blur attribute. . . . . 173, 190, 210  
     Multi-Pass Render Options . . . . . 240

Motion Blur attributes  
     Create Camera Options . . . . . 250  
     Render Globals window . . . . . 173

Motion Blur By attribute. . . . . 190

Motion Blur Shadow Maps attribute . . . . . 190

Motion Blur Type attribute. . . . . 173

motion blur, vs. focus . . . . . 28

Motion Object Output attribute. . . . . 205

motion picture  
     rendering fields . . . . . 80

Motion Steps attribute. . . . . 191

Multi Pass Rendering attribute . . . . . 240

Multi Processing. . . . . 180

Multi-Pass Render Options attributes. . . . . 240

multi-pixel filter . . . . . 101

multiple processors . . . . . 105

multi-processor rendering . . . . . 116

multi-thread interactive rendering . . . . . 180

**N**

name  
     images, setting . . . . . 93

Near Clip Plane attribute . . . . . 250

near clipping plane . . . . . 34

network rendering. . . . . 145, 146, 154  
     troubleshooting . . . . . 155

No Field Extension attribute . . . . . 171

No Gate option. . . . . 265

nodes  
     approximation . . . . . 45  
     creating approximation . . . . . 52

NTSC . . . . . 124

NTSC video. . . . . 81, 142

Number of CPUs to use . . . . . 180

Number of Exposures attribute . . . . . 210

Number of Processors to Use attribute. . . . . 116, 256

Number of Samples. . . . . 208

Number of Samples attribute. . . . . 208

Number U attribute  
     Tessellation . . . . . 262

Number V attribute  
     Tessellation . . . . . 262

NURBS  
     approximation . . . . . 48  
     display tessellation . . . . . 51  
     surfaces . . . . . 44

NURBs  
     multi-uv rendering problems . . . . . 119  
     tessellation settings. . . . . 50

NURBS surfaces  
     mental ray for Maya . . . . . 48

**O**

objects  
     framing with camera. . . . . 40  
     mental ray approximation . . . . . 48  
     rendering . . . . . 93  
     tessellation settings. . . . . 49  
     vibrating . . . . . 124  
     when to tessellate . . . . . 51

Odd Field attribute . . . . . 171

## Index

- Odd Fields . . . . . 170
- Only Render Strokes attribute . . . . . 183
- Open Image option
  - Render View window . . . . . 225
- Open in Browser (SWF only) . . . . . 212
- Open IPR File
  - Render View window . . . . . 225
- Open Render Globals Window . . . . . 230
- OpenGL attribute . . . . . 188
- opengl mode attribute . . . . . 189
- Opposite
  - Render Stats . . . . . 280
- Optimize Instances . . . . . 136
- Optimize Instances attribute . . . . . 178
- Optimize Raytrace Shadows attribute . . . . . 204
- optimizing
  - cameras . . . . . 138
  - scenes . . . . . 135
  - shadows . . . . . 137
- Options attribute . . . . . 245
- Options menu
  - Render View window . . . . . 228
- Ortho step
  - Tumble camera setting . . . . . 276
- Orthographic Camera . . . . . 251
- orthographic camera
  - width of . . . . . 252
- Orthographic views
  - camera settings . . . . . 275
- Orthographic Width . . . . . 252
- Output Settings attributes . . . . . 272
- Output to Subdirectories attribute . . . . . 182
- Output Window . . . . . 22, 142
- Overscan camera attribute . . . . . 267
- Overscan option . . . . . 268
  
- P**
- PAL . . . . . 124
- PAL video . . . . . 81, 142
- parallel rendering . . . . . 146
- particle rendering
  - mental ray . . . . . 123
- Particles attribute . . . . . 168
- passes
  - about . . . . . 87
  - advantages of . . . . . 83
  - creating . . . . . 106
- Pause IPR Tuning
  - Render View window . . . . . 228
- Per object attribute . . . . . 208, 209
- Per polygon attribute . . . . . 208
- Per Span # of Isoparms
  - primary tessellation . . . . . 262
- Per Surf # of Isoparms
  - primary tessellation . . . . . 261
- Per Surf # of Isoparms in 3D
  - primary tessellation . . . . . 261
- Performance attribute . . . . . 203
- Perspective option . . . . . 38, 265
- Photon Density attribute . . . . . 198
- Photon Map File attribute . . . . . 194
- Photon Map Rebuild attribute . . . . . 194
- Photon Volume Accuracy attribute . . . . . 193
- Photon Volume Radius attribute . . . . . 193
- Photons Obey Light Linking attribute . . . . . 204
- Photoshop format . . . . . 76
- Physical Memory attribute . . . . . 202
- Pix format . . . . . 75
- pixel aspect ratio . . . . . 95
  - about . . . . . 80
- Pixel Aspect Ratio attribute . . . . . 96, 164
- Pixel Filter Type attribute . . . . . 168
- Pixel Filter Width X attribute . . . . . 169
- Pixel Filter Width Y attribute . . . . . 169
- pixels . . . . . 68, 80, 82
- Plugin Format attribute . . . . . 164
- plug-ins
  - multi-pixel . . . . . 101
- PNG format . . . . . 76
- polygonal meshes
  - mental ray for Maya . . . . . 48
- polygonal surfaces . . . . . 69
- polygons
  - approximation . . . . . 48

port number	
troubleshooting	155
Post Fog Blur	
Render Options	175
Post Frame MEL attribute	165
Post Render MEL attribute	99
Pre Frame MEL attribute	165
Pre Render MEL attribute	99
Precompute Photon Lookup attribute	194
premultiplied images, defined	84
Premultiply attribute	200
Presets	
Render Resolution	163
Presets attribute	184
Preview	207
Preview Animation attribute	205
Preview attribute	184
Preview Custom attribute	205
Preview Final Gather Tiles attribute	197
Preview Motion Blur attribute	205
Preview Quality attribute	165
Preview Render Tiles attribute	205
preview, renders	13
PreviewCaustics attribute	184
PreviewFur attribute	185
PreviewGlobalIllum attribute	185
previewing	
Resolution Gate	37
PreviewMotionBlur attribute	185
Primary Tessellation	
Best Guess Based on Screen Size	262
Per Span # of Isoparms	262
Per Surf # of Isoparms	261
Per Surf # of Isoparms in 3D	261
primary tessellation	44
Primary Visibility	
Render Stats	279
problems	
messages	142
rendering	141
processor, multiple	105
Production	208
Production attribute	185
Production Quality attribute	166
ProductionMotionBlur attribute	185
projection textures	
troubleshooting	121
Prune Invisible Parts attribute	203
<b>Q</b>	
quality	
raytracing	102
Quantel format	76
QuickDraw format	76
Quicktime image format (UNIX only)	77
<b>R</b>	
Ramp Shader	
Motion Blur tips	174
Rapid attribute	188
Raw attribute	199
Ray Depth Limit	138
Ray Tracing attribute	187
rayserver	
troubleshooting	155
raytraced shadows	
optimizing	138
Raytracing	
description	102
raytracing	
setting quality	102
Raytracing attribute	172
Raytracing Quality attributes	171
Real Size option	
Render View window	226
Rebuild Shadow Maps attribute	189
Receive Shadows	
Render Stats	279
Recursion Depth attribute	179
Red attribute	169
Red Channel option	
Render View	229

## Index

- Redo Previous IPR Render option
  - Maya Render menu . . . . . 254
  - Render View window . . . . . 227
- Redo Previous Render . . . . . 115
- Redo Previous Render option
  - Maya Render menu . . . . . 254
  - Render View window . . . . . 226
- Reflection Depth . . . . . 221
- Reflection Limit . . . . . 137
- Reflections attribute . . . . . 172, 187
- Refraction Limit . . . . . 137
- Refractions attribute
  - Raytracing Quality attributes . . . . . 172, 187
- Refresh IPR Image
  - Render View window . . . . . 228
- Remote Machine Name attribute . . . . . 256
- Remove Image from Render View option
  - Render View window . . . . . 226
- Render 2D Motion Blur attribute . . . . . 181
- Render Current Frame . . . . . 254
  - Maya Render menu . . . . . 115
- Render Diagnostics . . . . . 141, 255
- Render Diagnostics attribute . . . . . 225
- Render Globals
  - common tab . . . . . 159
  - for tessellation . . . . . 259
  - settings window . . . . . 92, 159
- Render Globals option
  - Render View window . . . . . 228
- Render Globillum Global Pass attribute . . . . . 204
- Render Layer Options
  - Renderable . . . . . 106
- Render menu
  - Render View window . . . . . 226
- Render Modes attributes . . . . . 238
- Render option
  - Render View window . . . . . 227
- Render Options attributes . . . . . 164, 175
- Render Passes attribute . . . . . 240
- Render Region option
  - Render View window . . . . . 227, 230
- Render Resolution . . . . . 96
- Render Shading, Lighting and Glow attribute . . 181
- Render Shadow Maps attribute . . . . . 181
- Render Stats . . . . . 279
- Render utility . . . . . 112, 116, 117, 118
- Render View
  - about . . . . . 71
- Render View window
  - menus . . . . . 224
- Renderable
  - Render Layer options . . . . . 106
- Renderable attribute . . . . . 36, 272
- renderable cameras . . . . . 143
- Renderable Objects attribute . . . . . 161, 279
- Renderable Scene . . . . . 246
- renderer
  - choosing . . . . . 25
  - setting default . . . . . 26
- renderers
  - Maya hardware . . . . . 16
  - Maya software . . . . . 15
  - mental ray for Maya . . . . . 17
  - selecting . . . . . 25
  - vector . . . . . 22
- rendering
  - active objects . . . . . 93
  - at low-res . . . . . 111
  - background problems . . . . . 124
  - BOT files . . . . . 139
  - cameras . . . . . 27
  - command line . . . . . 154
  - depth of field . . . . . 37
  - errors . . . . . 141
  - exporting .mi files . . . . . 72, 118
  - fields . . . . . 98
  - file formats . . . . . 73
  - file output location . . . . . 79
  - final rendering . . . . . 91
  - final renders . . . . . 13
  - Flash . . . . . 22
  - frames . . . . . 98, 114
  - global settings window . . . . . 92
  - hardware . . . . . 15

## Rendering



hardware render globals . . . . .	207	Reset Region Marquee option	
image output location . . . . .	95	Render View window . . . . .	226
image resolution . . . . .	80	resolution	
layers and passes . . . . .	83, 85, 87	image . . . . .	95
looping forever . . . . .	129	low-res rendering, Render View	
MEL scripts . . . . .	82	low-res rendering 111	
mental ray BSP settings . . . . .	136	of rendered images . . . . .	80
mental ray problems . . . . .	121, 122	Resolution attribute . . . . .	236
mental ray render globals . . . . .	184	Resolution attributes . . . . .	162
multiple scenes . . . . .	119	Resolution Gate attribute . . . . .	37
multi-processor . . . . .	116	Resolution Gate option . . . . .	267
network . . . . .	145	Reuse Existing Dmap(s) . . . . .	138
network (mental ray) . . . . .	146	Reuse Tessellations attribute . . . . .	178
object vibration in . . . . .	124	RGB . . . . .	84
over a network . . . . .	154	RGB (default) attribute . . . . .	199
previewing . . . . .	13, 67	RGB Channel (Color) attribute . . . . .	161
problems . . . . .	141	RGBA . . . . .	84
regions of scene, Render View		RGBAZ . . . . .	84
render region 13		RLA format . . . . .	77
resolution . . . . .	95	Roll Scale setting . . . . .	278
running MEL commands before/after . . . . .	99	rolling, cameras . . . . .	31
safe region for TV . . . . .	33	Rotation type setting . . . . .	278
single frames . . . . .	114		
software . . . . .	14	<b>S</b>	
specific surfaces . . . . .	112	Safe Action option . . . . .	268
speed . . . . .	132	Safe Title option . . . . .	34, 268
speed vs. quality . . . . .	131	Sample Lock attribute . . . . .	187
test animation . . . . .	111	Save Distributed Render . . . . .	256
test frames . . . . .	111	Save Image option	
testing . . . . .	13, 67	Render View window . . . . .	225
tips . . . . .	14	Save IPR File	
typical workflow . . . . .	89	Render View window . . . . .	225
vector . . . . .	15, 22	Save IPR File option . . . . .	109
vector render globals . . . . .	211	Scale setting . . . . .	276, 278
with command line . . . . .	117	Scanline attribute . . . . .	188
with IPR . . . . .	67	Scanline Only Rendering . . . . .	122
with Maya . . . . .	154	Scene Fragment . . . . .	246
with mental ray . . . . .	118, 154	scene views	
with Render View . . . . .	71	guidelines . . . . .	36
with the command line . . . . .	72	selecting camera . . . . .	38
Rendering CPU attribute . . . . .	256	view lighting . . . . .	110
Rendering Flags		view shading . . . . .	110
Attribute Editor . . . . .	20		
Rendering Flags window . . . . .	231		
Re-number Frames attributes . . . . .	162		
Re-number Frames Using attribute . . . . .	162		

## Index

- scenes
  - diagnosing ..... 133
  - diagnosing (mental ray) ..... 133
  - finding problems
    - Render Diagnostics 133
  - framing with camera ..... 40
  - optimizing ..... 135
  - rendering multiple ..... 119
  - rendering region ..... 113
- secondary tessellation ..... 44
- Segments attribute ..... 189
- Select Camera ..... 265
- Selected Surfaces
  - tessellation ..... 257
- server ..... 146
- server setup ..... 149
- service file
  - troubleshooting ..... 155
- Set NURBS Tessellation ..... 50
- setting ..... 96
- setup
  - client ..... 149
  - server ..... 149
- SGI format ..... 77
- SGI Movie format (UNIX only) ..... 77
- SGI16 format ..... 77
- shaders ..... 21
- Shading attribute ..... 167
- shading networks
  - mental ray for Maya ..... 19
- Shading Samples
  - Render Stats ..... 281
- Shading Samples attribute ..... 167, 168
- Shading Samples Override
  - Render Stats ..... 281
- Shading Samples Override attribute ..... 128
- Shadow ..... 20
- shadow mapping ..... 122
- Shadow Rays attribute ..... 138
- Shadow Trace Depth attribute ..... 188
- shadows
  - optimizing ..... 137
- Shadows (SWF and bitmap formats only) ..... 219
- Shadows attribute ..... 172
- Shadows Obey Light Linking attribute ..... 176
- Show Back Faces ..... 219
- Show Batch Render ..... 256
- Show menu
  - Rendering Flags window ..... 232
- Show Region Marquee option
  - Render View window ..... 226
- Shutter Angle
  - description, for cameras ..... 250
- shutter angle ..... 28
- Shutter Angle attribute ..... 274
- Shutter attribute ..... 191
- Shutter Delay attribute ..... 191
- shutter setting
  - mental ray vs. Maya ..... 191
- shutter speed ..... 28
- Simple attribute ..... 188
- Single Color ..... 215
- Small Object Culling attribute ..... 209
- Smooth
  - 2D Motion Blur ..... 174
- Smooth Alpha
  - 2D Motion Blur ..... 174
- Smooth Color
  - 2D Motion Blur ..... 174
- Smooth Edge Ratio
  - Set NURBS Tessellation ..... 260
- Smooth Value
  - 2D Motion Blur ..... 174
  - tip, Motion Blur ..... 174
- Snap box dolly to
  - camera settings ..... 277
- Snapshot
  - in Render View ..... 113, 114
- Snapshot option
  - Render View window, Render menu ..... 227
- SoftImage format ..... 77
- software rendering ..... 14
  - memory and performance ..... 104
- Sort attribute ..... 188
- Special Effects attributes
  - cameras ..... 274

- specific surfaces
    - rendering . . . . . 112
  - Specular
    - Render Layer Pass . . . . . 88
  - Start Frame attribute
    - Image File Output attributes . . . . . 95, 160
    - Image Output Files attributes . . . . . 236
  - Start Number attribute . . . . . 162
  - Stepped
    - Tumble camera setting . . . . . 276
  - Subdivision Power attribute . . . . . 180
  - subdivision surfaces
    - mental ray for Maya . . . . . 49
  - subDs
    - approximation . . . . . 48
    - display tessellation . . . . . 52
    - obtaining quads for approximation . . . . . 61
  - Surface
    - Dolly camera setting . . . . . 277
  - surfaces
    - background showing through . . . . . 124
    - identical . . . . . 136
    - mental ray approximation . . . . . 48
    - performance . . . . . 136
    - polygonal . . . . . 69
    - single-sided . . . . . 136
    - tessellation settings . . . . . 49
    - troubleshooting . . . . . 126, 128
  - Svg Animation (SVG only) . . . . . 213
  - syntax, file name . . . . . 78
- T**
- Targa format . . . . . 77
  - Task Size attribute . . . . . 202
  - television
    - safe region rendering . . . . . 33
  - tessellate
    - strategies . . . . . 51
  - tessellation . . . . . 126
    - about . . . . . 43
    - adjust for polygons . . . . . 52
    - adjusting settings . . . . . 50
    - display for NURBs . . . . . 51
    - display for subDs . . . . . 52
    - memory and performance . . . . . 104
    - primary . . . . . 44
    - problems with . . . . . 124
    - secondary . . . . . 44
    - span-based . . . . . 51
    - strategies for . . . . . 43
    - surface types . . . . . 44
    - viewing settings . . . . . 49
    - vs. approximation . . . . . 43
    - when to adjust . . . . . 43
  - Tessellation attribute . . . . . 198
  - Tessellation Mode . . . . . 257
  - tessellation passes
    - about . . . . . 44
  - test render . . . . . 13
  - Test Resolution . . . . . 229
  - Test Resolution option . . . . . 254
    - Render View window . . . . . 111
  - Texture resolution menu . . . . . 235
  - Textured channel menu . . . . . 234
  - textures
    - popping . . . . . 264
    - troubleshooting . . . . . 121
  - Texturing attribute . . . . . 239
  - Threshold
    - Output Settings attribute . . . . . 273
  - Tiff format . . . . . 78
  - Tiff16 format . . . . . 78
  - tilt, cameras . . . . . 31
  - Time Contrast
    - Motion Blur . . . . . 20, 29
  - Time Contrast R attribute . . . . . 191
  - Time Slider
    - for tessellation . . . . . 259
  - Time slider
    - Hardware Render Buffer . . . . . 245
  - Toolbar option
    - Render View window . . . . . 229

## Index

- Trace..... 20
  - Trace Depth attribute ..... 196
  - Trace Reflection attribute ..... 196
  - Trace Refraction attribute..... 196
  - Track Geometry setting..... 276
  - Track Scale setting ..... 276
  - tracking, cameras ..... 30
  - Transform Icons attribute..... 241
  - transparency
    - channels ..... 82
    - matte, see Matte Opacity ..... 97
    - premultiplication..... 84
  - Transparency Based depth
    - Output Settings attributes, for cameras ..... 273
  - Transparency sorting attribute ..... 208
  - transparent objects
    - motion blur problems..... 126
  - Transparent Shadow maps attribute..... 208
  - Triangle (default) attribute ..... 186
  - troubleshooting ..... 155
    - caustics ..... 138
    - displacement maps ..... 127
    - edges ..... 126
    - final gather ..... 139
    - flickering ..... 127
    - global illumination ..... 138
    - highlights ..... 128
    - image quality and render speed ..... 131
    - motion blur..... 128
    - surfaces ..... 128
  - Tumble
    - Locked camera setting ..... 275
    - Ortho step camera setting ..... 276
    - Orthographic views camera settings ..... 275
    - Stepped camera setting..... 276
    - Tumble camera about camera settings..... 275
    - Tumble pivot camera setting..... 275
    - Tumble scale camera setting ..... 275
  - Tumble camera about
    - camera settings..... 275
  - Tumble pivot
    - Tumble camera setting ..... 275
  - Tumble Pivot attribute ..... 275
  - tumble, cameras ..... 30
  - tuning
    - region ..... 107
  - TV production
    - safe region rendering ..... 33
  - Two Color ..... 215
- ## U
- U Divisions Factor
    - Set NURBS Tessellation ..... 260
  - U Divisions Factor attribute..... 126
  - Update Image Planes/Background option
    - IPR menu ..... 70
    - Render View window..... 227
  - Update Light Glow
    - on or off for IPR ..... 228
  - Update Motion Blur
    - on or off for IPR ..... 228
  - Update Shader Glow
    - on or off for IPR ..... 228
  - Update Shading and Lighting
    - on or off for IPR ..... 228
  - Update Shadow Maps option
    - IPR menu ..... 70
    - Render View window..... 227
  - Use 2d Blur memory Limit
    - 2D Motion Blur ..... 174
  - Use all available CPUs ..... 180
  - Use all available processors attribute ..... 116, 255
  - Use Chord Height attribute ..... 262
  - Use Chord Height Ratio ..... 263
  - Use Custom Extension attribute ..... 95, 162
  - Use Displacement Bounding Box attribute ..... 179
  - Use Dmap Auto Focus ..... 137
  - Use File Cache attribute ..... 177
  - Use Frame Range
    - for tessellation ..... 258
  - Use Min Screen attribute
    - Secondary Tessellation Attributes ..... 264
  - Use Multi Pixel Filter attribute ..... 168
  - Use Smooth Edge
    - Set NURBS Tessellation ..... 260
  - Use X- Dmap attribute ..... 138

Use X+ Dmap attribute ..... 138  
 Use Y- Dmap attribute ..... 138  
 Use Y+ Dmap attribute ..... 138  
 Use Z- Dmap attribute ..... 138  
 Use Z+ Dmap attribute ..... 138  
 UVs ..... 69

**V**

V Divisions Factor  
     Set NURBS Tessellation ..... 260  
 V Divisions Factor attribute ..... 126  
 vector file formats, bitmap file formats ..... 74  
 vector renderer ..... 22  
 vector rendering ..... 15  
     Render Globals ..... 211  
 verbosity ..... 22, 142  
 Vertical Film Aperture attribute  
     see Camera Aperture attribute  
 Vertical Film Offset attribute  
     see Film Offset attribute  
 Vertical option ..... 268  
 video ..... 80  
     frame rendering ..... 80  
 video fields ..... 81  
 View menu  
     Render View window ..... 226  
 Visible ..... 20  
 Visible in Reflections  
     Render Stats ..... 280

Visible in Refractions  
     Render Stats ..... 280  
 visualization  
     IPR rendering ..... 107  
     rendering ..... 90  
 visualization, renders ..... 13  
 Volume Samples  
     Render Stats ..... 282  
 Volume Samples Override ..... 281  
 voxels, example of ..... 201

**W**

walk throughs ..... 32  
 Width attribute  
     Resolution attributes ..... 96, 164  
 Windows Bitmap  
     image file format ..... 78  
 Windows setup ..... 149  
 Write ZDepth attribute ..... 236

**Y**

yaw, cameras ..... 31

**Z**

Z buffer channel ..... 85  
 Z depth channel ..... 85  
 Zeroth Scanline attribute ..... 124, 170  
 Zoom Scale setting ..... 277  
 zooming, cameras ..... 31

## **Index**

Rendering  
302