



---

## WHAT'S NEW IN MAYA 3.0

## WHAT'S NEW IN MAYA 3.0

Copyright ©2000, Alias|Wavefront, a division of Silicon Graphics Limited.  
Printed in U S A. All rights reserved.

**The Maya 3 Documentation was created by:** Steven Brooks, John Dila, Lisa Ford, Conan Hunter, Claude Macri, Susan Park, Diane Ramey, Linda Rose, and Michael Stivers.

**Stuart Little image: Image courtesy of Sony Pictures Imageworks. Columbia/TriStar. All rights reserved.**

The following are trademarks of Alias|Wavefront, a division of Silicon Graphics Limited:

Alias®	Maya Complete™	Maya Paint Effects™
Conductors™	Maya Composer™	Maya Real Time SDK™
Dynamation™	Maya ComposerLite™	Maya Unlimited™
Explore™	Maya Fur™	SuperConductors™
Kinematic™	Maya Fusion™	TraX™
IPR™	Maya Fusion Lite Edition™	Visualizer™
Maya®	Maya F/X™	VizPaint2D™
Maya Artisan™	Maya Invigorator™	Wavefront™
Maya Builder™	Maya Invigorator Lite Edition™	ZaP!iT™
Maya Cloth™	Maya Live™	

Alias|Wavefront and the Alias|Wavefront logo are trademarks of Silicon Graphics, Inc. exclusively used by Alias|Wavefront, a division of Silicon Graphics Limited. Maya is a registered trademark of Silicon Graphics, Inc. exclusively used by Alias|Wavefront, a division of Silicon Graphics Limited.

Graph Layout Toolkit Copyright © 1992-1996 Tom Sawyer Software, Berkeley, California, All Rights Reserved.

Fusion is a trademark of eyeon Software.

Invigorator is a trademark of Zaxwerks.

Linux is a trademark of Linus Torvalds. Red Hat is a registered trademark of Red Hat, Inc.

Microsoft and Windows NT are registered trademarks of Microsoft Corporation.

SGL is a trademark, and IRIX and Silicon Graphics are registered trademarks of Silicon Graphics, Inc.

UNIX is a registered trademark, licensed exclusively through X/Open Company, Ltd.

All other product names mentioned are trademarks or registered trademarks of their respective holders.

This document contains proprietary and confidential information of Alias|Wavefront, Inc. and is protected by Federal copyright law. The contents of this document may not be disclosed to third parties, translated, copied, or duplicated in any form, in whole or in part, without the express written permission of Alias|Wavefront, Inc. The information contained in this document is subject to change without notice. Neither Alias|Wavefront, Inc. nor its employees shall be responsible for incidental or consequential damages resulting from the use of this material or liable for technical or editorial omissions made herein.

---

# Alias | *wavefront*

ALIAS|WAVEFRONT ■ 210 KING STREET EAST ■ TORONTO, CANADA M5A 1J7

# CONTENTS

## WHAT'S NEW IN MAYA 3.0

<b>1 THE BIG PICTURE</b>	<b>1</b>
<b>2 BASIC FEATURES</b>	<b>5</b>
<b>Layout improvements</b>	<b>6</b>
Status Line changes	7
Shelf changes	8
Layer Bar changes	8
<b>Menu changes</b>	<b>9</b>
New Find Menu feature	9
Edit menu	9
Modify menu	10
Display menu	10
Window menu	12
Options menu	13
Lights and Shading menus	14
Polygon menus	14
Dynamics menus	14
Subdivision surfaces menus	14
<b>Command option box improvements</b>	<b>14</b>
<b>New Isolate Select view</b>	<b>15</b>
<b>New Import for Adobe Illustrator® and EPS files</b>	<b>17</b>
<b>New Artisan Paint Textures tool</b>	<b>18</b>
<b>New Preferences</b>	<b>18</b>

## CONTENTS

Preferences window	18
New preference settings	19
<b>New Color Chooser features</b>	<b>21</b>
Using the alpha slider	21
Using the Blend box	22
Using the Palette	22
<b>Hotkey improvements</b>	<b>23</b>
Hotkey Editor reorganized	24
Hotkeys on menu labels	27
Custom hotkeys preserved	28
<b>Outliner and other editor improvements</b>	<b>28</b>
Outliner	28
Script Editor	29
Component Editor	29
Various editors	30
<b>Project management improvements</b>	<b>30</b>
<b>Basic modeling improvements</b>	<b>31</b>
Reset and Freeze Transformations	31
Enlarging manipulators with + hotkey	31
Object templates	32
Display surface origin	32
Selection types	32
Three Point Snap	33
Proportional Modification Tool	33
Repeat Last	34
Move Normal Tool	34
Normals Display Scale	34
<b>File referencing improvements</b>	<b>34</b>
Using spaces in filenames	34

WHAT'S NEW IN MAYA 3

## CONTENTS

Missing references fixed	34
<b>Add, Delete, and Rename custom attributes</b>	<b>35</b>
<b>3 NURBS MODELING</b>	<b>37</b>
<b>Surface Editing Tool</b>	<b>37</b>
<b>Breaking or smoothing tangents</b>	<b>39</b>
<b>Rebuilding surfaces</b>	<b>40</b>
<b>Creating output geometry as Bezier</b>	<b>41</b>
<b>Lofting surfaces</b>	<b>41</b>
<b>Attaching and aligning surfaces</b>	<b>41</b>
<b>Extruding surfaces</b>	<b>41</b>
<b>Rebuilding curves</b>	<b>42</b>
<b>Creating text</b>	<b>42</b>
<b>Selecting patches</b>	<b>43</b>
<b>4 POLYGONAL MODELING</b>	<b>45</b>
<b>Menu reorganization</b>	<b>46</b>
Polygons menu reorganization	46
Edit Polygons menu reorganization	47
<b>Interface improvements and changes</b>	<b>48</b>
<b>New UV functionality</b>	<b>48</b>
Automatic mapping	49
Layout UVs	54
Move and Sew UVs	58
Average Vertices	60
Transfer	61

## CONTENTS

Map UV border	63
Relax UVs	66
<b>New UV set options</b>	<b>68</b>
<b>New multitexturing functionality</b>	<b>70</b>
Applying layered textures to UV sets	70
Blend modes	79
<b>New Convert Display colors option</b>	<b>80</b>
<b>New Split vertex operation</b>	<b>81</b>
<b>New Extrude commands</b>	<b>81</b>
<b>New Texture View features</b>	<b>83</b>
Select Shell and Select Shell Border	83
Display Unfiltered	84
Pixel Snap	84
<b>New Normals options</b>	<b>85</b>
Modified Reverse option	85
Conform	87
<b>Support for nonmanifold geometry</b>	<b>87</b>
<b>Cleanup improvements</b>	<b>89</b>
<b>Extract changes</b>	<b>90</b>
<b>Merge Vertices improvements</b>	<b>91</b>
<b>Hypershade workflow improvements</b>	<b>91</b>
<b>5 SUBDIVISION SURFACES MODELING</b>	<b>93</b>
<b>Subdivision Surfaces menu reorganization</b>	<b>94</b>
<b>Hierarchy and Polygon proxy modes</b>	<b>95</b>
Hierarchy mode	95
Polygon proxy mode	96

## CONTENTS

<b>Navigating the hierarchy</b>	<b>97</b>
<b>Display filtering</b>	<b>98</b>
<b>New functionality</b>	<b>98</b>
Extract Vertices	98
Full and Partial Crease Edge/Vertex	99
Collapse hierarchy	99
Display normals	99
New Hull display	100
Create Subdiv option window changes	101
Mirror	101
Attach	102
<b>Performance tips</b>	<b>103</b>
<b>Rendering tips</b>	<b>103</b>
<b>6 ANIMATION</b>	<b>105</b>
<b>Basic interface enhancements</b>	<b>107</b>
Range Slider display	107
Quick access to playback looping options	107
Frame rate display	107
<b>Graph Editor improvements</b>	<b>107</b>
Euler angle filtering	107
Scaling keys within a region	108
Outliner split control	108
<b>Motion path flipping improvement</b>	<b>108</b>
<b>Motion path camera direction control</b>	<b>109</b>
<b>Nonlinear character animation—the Trax Editor</b>	<b>110</b>
About clips	110
Using the Trax Editor window	111

## CONTENTS

Enhancing the Trax Editor display	111
Understanding clips and poses in the Visor	112
Working with clips	113
MEL commands and dependency graph nodes	131
<b>Adding and removing tracks</b>	<b>132</b>
<b>Motion warping</b>	<b>133</b>
<b>Using poses</b>	<b>134</b>
<b>Exporting and editing character maps</b>	<b>135</b>
<b>Working with subcharacters in the Trax Editor</b>	<b>136</b>
Using clips on a character with subcharacters	137
Using clips on a subcharacter	137
Creating subcharacters on a character with clips	137
<b>7 CHARACTER SETUP</b>	<b>139</b>
<b>Blend shape slider orientation control</b>	<b>140</b>
<b>New advanced deformer creation options</b>	<b>140</b>
<b>Mirroring smooth skin weights</b>	<b>141</b>
<b>Copying smooth skin weights</b>	<b>142</b>
<b>Holding smooth skin weights</b>	<b>143</b>
Specifying weight holding when adding influence objects	144
Editing weight holding of joints	144
Editing weight locking of smooth skin influence objects	144
Holding smooth skin influence weights from Component Editor	144
<b>Improved smooth skin influence object behavior</b>	<b>145</b>
<b>Control of smooth skin weight normalization</b>	<b>145</b>
<b>New create character options</b>	<b>146</b>
<b>New subcharacters feature</b>	<b>146</b>

<b>New character channel editing capabilities</b>	<b>146</b>
<b>8 DYNAMICS</b>	<b>147</b>
<b>Usability improvements</b>	<b>148</b>
<b>New Volume emitters</b>	<b>148</b>
Creating volume emitters	<b>149</b>
Setting volume emitter attributes	<b>150</b>
Emitter attributes and Power Animator equivalents	<b>153</b>
<b>New Volume Axis field</b>	<b>157</b>
Creating volume axis fields	<b>158</b>
Setting volume axis field attributes	<b>158</b>
<b>New Volume fields</b>	<b>161</b>
Creating volume fields	<b>162</b>
Setting volume field attributes	<b>162</b>
Keeping particles inside the volume	<b>164</b>
<b>New particle caching</b>	<b>164</b>
Particle disk caching	<b>165</b>
Particle start-up caching	<b>173</b>
<b>Improved particle rendering attribute control</b>	<b>175</b>
Using the Particle Sampler Info node	<b>175</b>
Creating a Particle Sampler Info node	<b>176</b>
Examples of using the Particle Sampler Info node	<b>177</b>
Setting Particle Sampler Info node attributes	<b>187</b>
Re-using a Particle Sampler Info node	<b>190</b>
Using user-defined attributes	<b>190</b>
<b>Improved particle cloud shader</b>	<b>193</b>
<b>Improvements to particle lifespan</b>	<b>197</b>
Understanding finalLifespanPP	<b>198</b>

## CONTENTS

Using lifespan in expressions	198
Using Random Range mode	199
File compatibility	199
Script compatibility	199
Deleting Lifespan and LifespanPP	200
<b>Increased control over randomness</b>	<b>200</b>
<b>Instancing strokes from Paint Effects</b>	<b>202</b>
Centering strokes on particles	202
<b>Dynamics menu improvements</b>	<b>203</b>
<b>Improvements to particle attribute editor</b>	<b>205</b>
<b>Directional emission from curves</b>	<b>205</b>
<b>New attributes for position of emitted particles</b>	<b>205</b>
<b>Improvements to Turbulence field</b>	<b>205</b>
New attributes	206
<b>Changes to Air field defaults</b>	<b>207</b>
<b>Fixes to particle scaling</b>	<b>207</b>
<b>Changes to file loading</b>	<b>207</b>
<b>New command line functionality</b>	<b>208</b>
<b>9 RENDERING</b>	<b>209</b>
<b>General improvements</b>	<b>211</b>
<b>Image quality improvements</b>	<b>211</b>
New Area lights	211
Displacement mapping improvements	214
Crackless tessellation	216
Raytrace Shadow transparency improvement	217
<b>Performance improvements</b>	<b>217</b>

## CONTENTS

Multi-threaded shadow maps	217
Multi-threaded interactive rendering	217
Ray tracing	219
Speed	219
<b>Hypershade/Visor improvements</b>	<b>219</b>
New Hypershade File menu	219
Hypershade Edit menu changes	220
Hypershade menu bar changes	220
Easier directory access from the Visor panel	222
Texture assignment improvement	223
<b>Polygonal texture mapping improvements</b>	<b>223</b>
Multitexturing	223
Baking shadows	224
<b>New Layered Texture Node</b>	<b>224</b>
<b>New Movie Texture</b>	<b>230</b>
<b>New Paint Textures Tool</b>	<b>231</b>
Paint Textures Tool and texture naming	232
About switch nodes and painted textures	233
Using the Paint Textures Tool	234
Masking polygonal faces while painting	235
Painting and IPR rendering	236
Determining stamp spacing and brush depth	239
Selecting and painting attributes	240
Placing painted 2d textures	245
Assigning, saving, and reloading textures	246
<b>2D/3D Integration enhancements</b>	<b>248</b>
Render Layer management	249
Render Layer/Pass Control	250
Render Pass management spreadsheet	251

## CONTENTS

New Render Globals Field Options	252
<b>10 PAINT EFFECTS</b>	<b>255</b>
Instancing Paint Effects strokes	255
New Primary Visibility option	255
Rendering Paint Effects strokes at test resolutions	256
Rendering strokes without depth output	256
Rendering multiple images and stitching	256
Disappearing file textured leaves and flower petals	256
Dragging and dropping textures onto the canvas	256
<b>11 CLOTH</b>	<b>257</b>
New attribute for painting wrinkles	258
Changing the Cloth Paint Tool Settings	261
<b>12 FUR</b>	<b>263</b>
New Global Scale fur attribute	264
New Roll fur attribute	264
New shadow map setting	265
Fur Globals improvements	265
Fur Render Options	266
New advanced options	267
Batch rendering is now per frame	269
Baking improvements	269
Fog now renders with fur	269

## CONTENTS

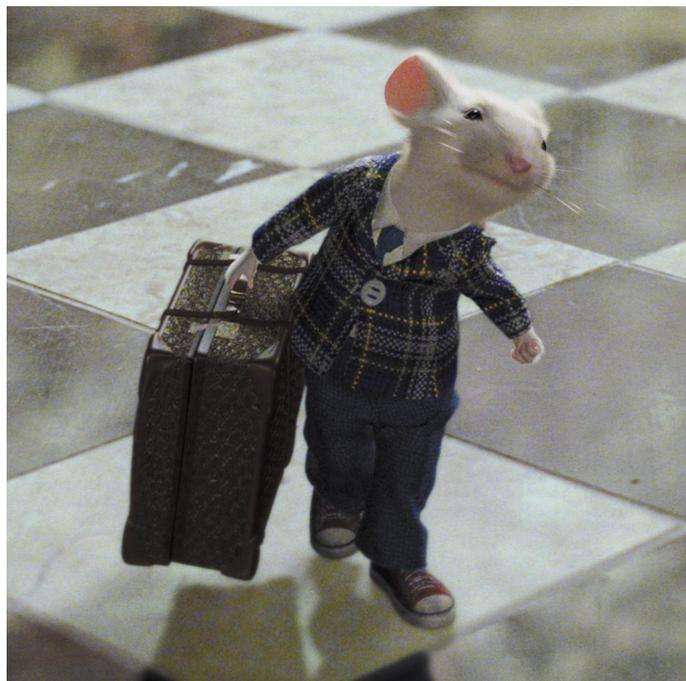
<b>13 LIVE</b>	<b>271</b>
Tracker improvements	271
New Locator Summary panel	273
New infinite and locked points	274
New Filter for Solve task	276
Camera rotation order improvement	277
<b>14 MAYA DOCUMENTATION</b>	<b>279</b>
<b>Online improvements</b>	<b>279</b>
New Search tools	279
Maya Glossary	279
<b>Printed or online?</b>	<b>280</b>
<b>What's New in Maya 3</b>	<b>280</b>
<b>15 EXPRESSIONS AND MEL</b>	<b>281</b>
Script and Expression Editor improvements	281
Simplified expressions for particle lifespan	282
New capabilities for making attributes paintable	282
<b>16 API AND DEVELOPER'S TOOL KIT</b>	<b>285</b>
<b>General improvements</b>	<b>285</b>
Upgrading existing plug-ins for Maya 3.0	285
Plug-in compatibility changes made in Maya 2.0	287
<b>New features</b>	<b>292</b>
New API for subdivision surfaces (for Maya Unlimited)	292
Support for Multi UV's on Polygons	293

## CONTENTS

New API classes	<b>294</b>
Enhanced API classes	<b>295</b>
Corrections to existing functionality	<b>297</b>
Documentation corrections	<b>299</b>
Miscellaneous corrections	<b>299</b>

# 1

## THE BIG PICTURE



Stuart Little image courtesy of Sony Pictures Imageworks. Columbia/TriStar. All rights reserved.

In its 3.0 release, Maya achieves best-of-class status as the premiere tool for next-generation game development and the most powerful solution for digital content creation.

Maya 3 provides numerous user interface and workflow improvements throughout, making it even easier to learn and use.

*What's New in Maya 3* provides complete information on all the features we've added in this release.

To help you decide what to look at first, we've summarized a few of the highlights:

### What's New in all Maya packages

Features common to Maya Builder, Complete, and Unlimited include:

- **Cleaner interface**—better use of space and quick access to items often used
- **Trax nonlinear animation editor**—a new way to mix animation sequences with total control over motion blending
- **Dense data editing and resampling**—now you can use and manipulate motion capture data more easily
- **Improved animation**—path animation and deformer refinements
- **Improved polygonal architecture**—new nonmanifold polygonal architecture

### What's New in Maya Builder

Maya Builder is our basic modeling, texturing, and animation package, created especially for level designers and tool builders. Some of the enhancements we've added to Maya Builder 3 include:

- **Multiple UV per vertex support**— you can apply multiple textures for a variety of uses in games engines
- **UV auto projection and relaxation**—improves workflow for creative texturing, especially larger models with more than 100 polygons
- **Bezier improvements**—The new Bezier surface editor and output as Bezier has been added to a large number of surfacing operations. It provides full access to curved surface representation for use in next-generation games.

Games-related features will also be supported in the new Maya Real Time SDK, making it part of an integrated toolset that supports the “Art to Engine” workflow for game developers. This integrated approach allows games artists and programmers to work cooperatively in one unified architecture to create and deliver cinematic quality for next-generation games.

### What's New in Maya Complete

Maya Complete is Alias | Wavefront's award-winning 3D modeling, rendering, animation, and paint software. Maya Complete provides a full range of dynamics, character setup, rendering, and effects software—everything professional digital content creators need to produce world-class animation and digital effects.

Our new *Universal Rendering* policy provides all customers with unlimited rendering. One floating license lets you render on up to 10,000 supported platforms.

Maya Complete 3 includes all the enhancements listed for Maya Builder 3, as well as:

- **Global stitch**—for Maya 3, we’ve moved this feature from Maya Unlimited to help Maya Complete users address skinning problems
- **Artisan Paint Textures**—you can now use the Artisan brush to paint color, bump, transparency and other renderable channels directly onto NURBS, and polygonal models
- **Instanced Paint Effects brushes on particles**—you can instance Paint Effects brushes on individual particles to generate a vast range of software-rendered dynamics effects
- **Displacement mapping**—a totally new technique that delivers new levels of speed of quality fully comparable with the best available anywhere
- **Area lighting**—greatly increases the subtlety, realism, and sophistication of Maya lighting effects
- **Multi-threaded interactive software rendering and shadow map generation**—just two of the many performance improvements for the Maya renderer
- **Faster raytracing**—substantial performance increases
- **New Layered Texture node**—provides fast layering of multiple images making realistic rendered textures easier and more efficient to design
- **Render layer management**—separates user-specified elements in a sequence into different image layers to integrate Maya more tightly into the compositing process
- **Render pass management**—greater flexibility for compositors to manipulate the fine details of any sequence after final rendering is completed
- **Improvements to cloud volume shader**—provides substantial improvements to the look and quality of particle rendering
- **New Gas/Cloud turbulence**—now it’s easier to generate realistic cloud and gas motion effects with new turbulence, time random, and noise controls
- **Volume particle controls and emitters**—intuitive control of particles makes dynamics easier to set up by the non-specialist

- **Particle disk caching and scrubbing**—for accurate multi-processor rendering of particle effects

### What's New in Maya Unlimited

Maya Unlimited is the most powerful software available for creating computer-generated animation and special effects. It provides precision matchmoving, digital cloth simulation, advanced modeling capabilities, and realistic styling and rendering of hair and fur.

The major focus of Maya Unlimited completes the full subdivision surface pipeline from modeling right through animation to final rendering.

In Maya Unlimited 3, we've added the features listed for other Maya software, as well as:

- **Integration of subdivision surfaces with hierarchical deformers/animation tools**—Subdivision surfaces are now fully equal citizens to NURBS and polygons inside of Maya
- **Subdivision hierarchy navigation and editing**—lets you work at different levels of detail
- **Full and partial creasing**—makes it easier to construct both rounded organic forms and hard-edged objects
- **Subdivision surface texturing and rendering**—eliminates requirement to convert subdivision surfaces to polygons before texturing and rendering in many cases
- **Artisan cloth property painting**—naturalistic assignment of cloth properties such as stretch or stiffness
- **Maya Live tracker enhancements**—blur before tracking eliminates film grain and noise, allowing the tracker to more easily lock onto the target
- **Enhancements in Fur offer increased efficiency and quality**—Global Scale per Fur Description, Area Value per Fur Description, Roll parameter, separate shadow passes, new shadow map controls. Fur is both more stable and easier to manipulate.

# 2

## BASIC FEATURES

We've made the following enhancements to the user interface and basic tools in Maya 3.0.

### Interface improvements

- "Layout improvements" on page 6
- "Menu changes" on page 9
- "Command option box improvements" on page 14

### New features

- "New Isolate Select view" on page 15
- "New Import for Adobe Illustrator® and EPS files" on page 17
- "New Artisan Paint Textures tool" on page 18
- "New Preferences" on page 18
- "New Color Chooser features" on page 21

### Improvements to existing functionality

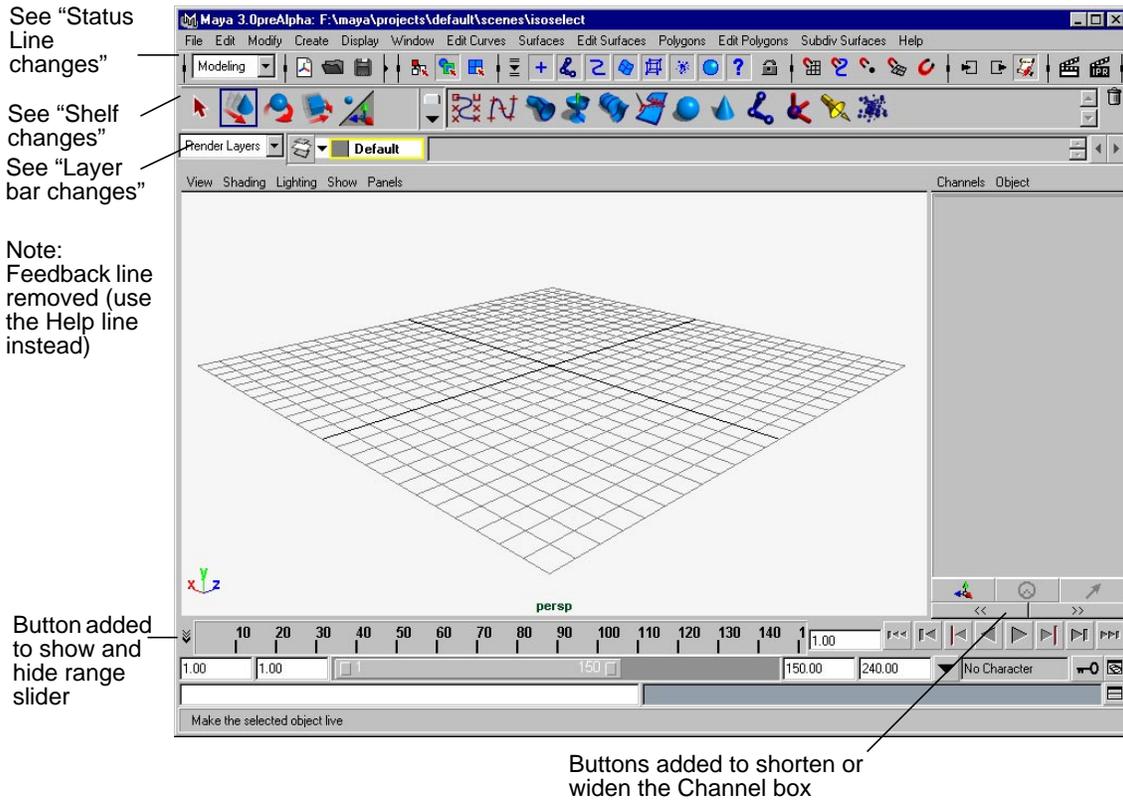
- "Hotkey improvements" on page 23
- "Outliner and other editor improvements" on page 28
- "Project management improvements" on page 30
- "Basic modeling improvements" on page 31
- "File referencing improvements" on page 34
- "Add, Delete, and Rename custom attributes" on page 35

## BASIC FEATURES | 2

Layout improvements

# LAYOUT IMPROVEMENTS

The following illustration summarizes the various improvements we've made to the Maya layout. In general, the improvements make better use of space and give you quick access to items often used.



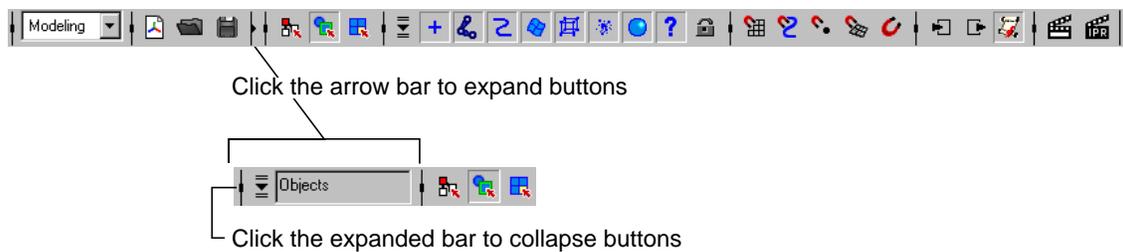
WHAT'S NEW IN MAYA 3

## Status Line changes

To save space, the Status Line is now smaller in height. It also contains more buttons that are commonly used. The following illustration summarizes these improvements.

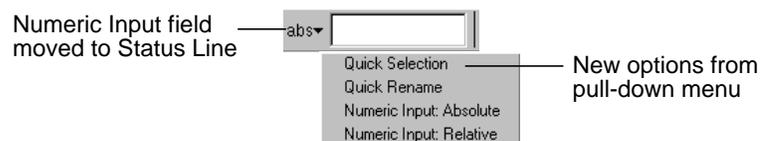


For better organization, the buttons are divided into groups that you can expand and collapse, as shown in the following illustration.



## Numeric Input field

The Numeric Input field has been moved to the right side of the Status Line. Previously, it was on the Feedback line, which was removed.



There are also new capabilities in this field.

**Quick Selection** In this mode, you can type the name of objects or nodes in order to quickly select them. Using wildcard characters (\* and ?), you can select several items with the same string in their names.

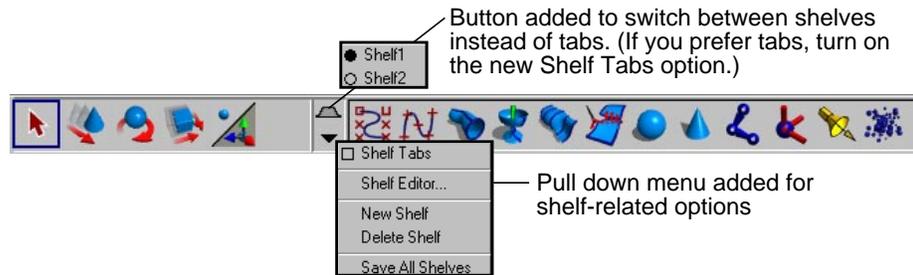
**Quick Rename** In this mode, you can type a new name for the selected object.

## BASIC FEATURES | 2

Layout improvements

### Shelf changes

The Shelf tabs are no longer displayed; they are replaced by a button (but you can display the tabs if you prefer them). The following illustration summarizes these improvements.



### Layer Bar changes

The Layer Bar now indicates whether a display layer is set to invisible, template, or reference. The layer swatch is marked X if Visible is off, T if Template is on, or R if Reference is on.



We also added pop-up commands when you right-click on the Create Layer button.

#### Make New Layers Current

This is a new setting. When it is on, you can add a new layer and Maya makes it the current layer. When this setting is off, the default layer or last layer selected remains current.

#### Use Current Layer

This setting was moved from the preferences. When it is on, objects you create will be automatically assigned to the current layer. When it is off, you must assign new objects to a layer.

#### Render layers

Maya 3.0 introduces a workflow enhancement called render layers. While display layers are used to quickly select and hide groups of objects, render layers are used to render objects in separate passes.

You set up render layers from the Layer Bar. A new pull-down lets you switch between Display Layers and Render Layers. The Layer Bar works the same for render layers as display layers; see *Using Maya: Essentials* for details.

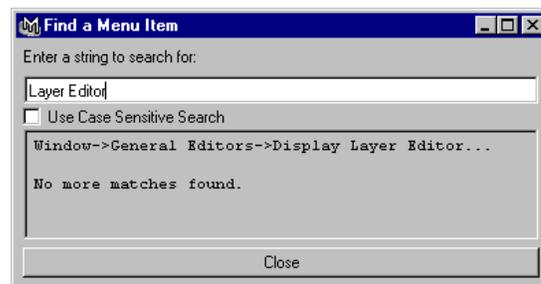
Once you have render layers set up, you can take advantage of the Render Layer/Pass Control settings in the Render Globals. For more information on these settings, see “Render Layer management” in Chapter 9.

## MENU CHANGES

We reorganized and simplified several menus. This section lists the organizational changes and also lists some new menu selections that were added as part of new features.

### New Find Menu feature

To find the location of any menu item, choose Help > Find Menu and type the menu name you want to find. The search is not case-sensitive. It accepts wildcard characters (\*), but if the menu was renamed or removed, type the name in full.



### Edit menu

We removed the Create New Display Layer menu item. You can still create layers from the Layer Editor or the Layer Relationship Editor, or by clicking  on the Layer Bar.

## BASIC FEATURES | 2

Menu changes

### Modify menu

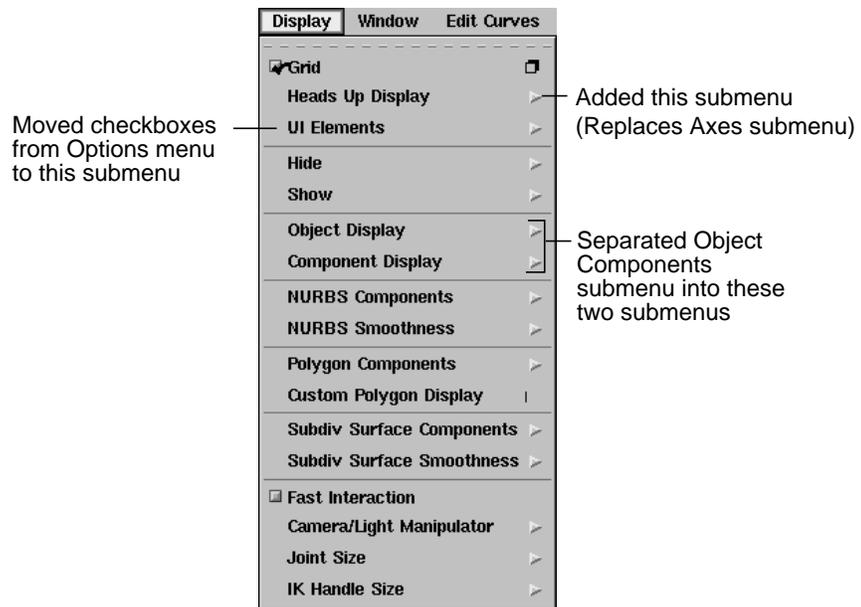
We moved Paint Selection Tool to Edit > Paint Selection Tool.

We moved the Measure submenu to Create > Measure Tools. The measure tools are Distance, Parameter, and Arc Length.

There are also new selections: Delete Attributes and Rename Attributes. Along with Add Attributes, these selections make it easier to create and modify custom (or *dynamic*) attributes. (They are also available from the Attribute Editor > Attributes menu.)

### Display menu

The Display menu has a number of new submenus. The following illustration summarizes these changes.



#### Heads Up Display submenu

This submenu includes the View Axis and Origin Axis options (previously under the Display > Axis submenu), as well as other display options:

- Poly Count is moved here from its previous location, Polygons > Display Poly Count. It shows polygon statistics for the visible objects displayed in the view panel. This feature is useful for games development.
- Frame Rate is a new command. It displays the frame rate in Hertz for the current port.

**UI Elements submenu**

The UI Elements submenu contains the checkboxes from the Options menu, which is now removed. See “Options menu” on page 13 for details. The last two items on this submenu were also on the Options menu, but are renamed.

- Hide UI Elements: Temporarily hides all UI elements except the workspace panels. For example, you can maximize the scene view while working on detailed models. Was Options > Show Only Viewing Panes.
- Restore UI Elements: Displays the UI elements that were hidden. Was Options > Show All Panes.

**Object Display and Component Display submenus**

We separated the Display > Object Components submenu into two submenus:

- Display > Object Display: contains controls for displaying object templates, geometry, and bounding boxes.
- Display > Component Display: contains controls for all other component display.

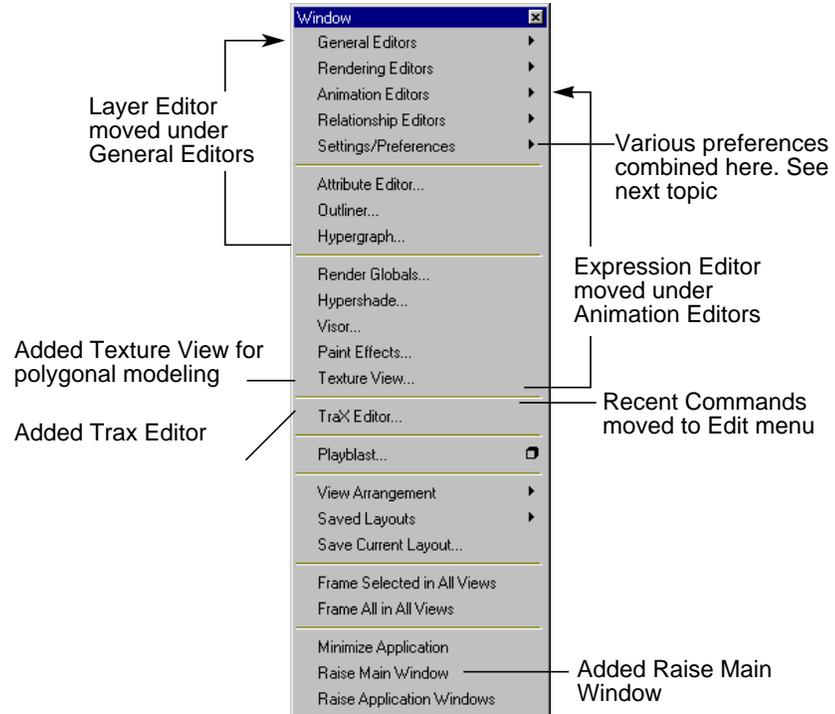
The Object Display submenu also contains a new option, Untemplate. For more information, see “Object templates” on page 32.

## BASIC FEATURES | 2

Menu changes

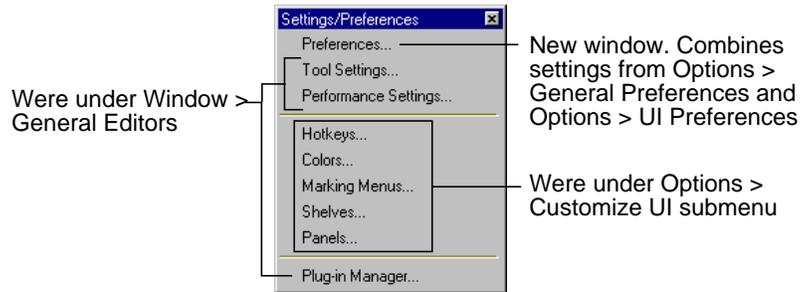
### Window menu

The following illustration lists the Window menu changes.



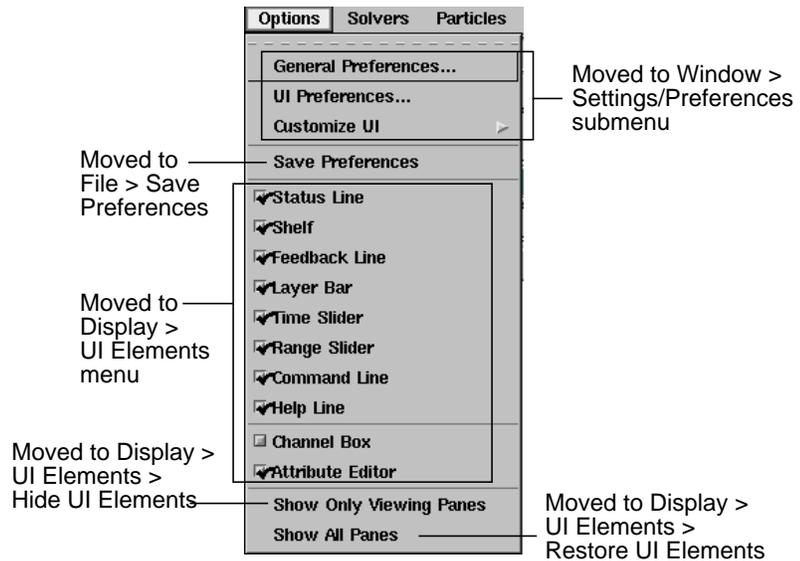
### Settings/Preferences submenu

We combined selections relating to preferences under one submenu. See the following illustration for a summary. For more information on the new Preferences window, see "Preferences window" on page 18.



## Options menu

We removed the Options menu. Most of the items on this menu are now under the Window and Display menus. The following illustration lists the new locations.



## BASIC FEATURES | 2

Command option box improvements

### Lights and Shading menus

The Lights and Shading menus under the Render menu set are now combined and labeled Lights/Shading.

Also, based on customer requests, we moved the light creation options from the Lights menu to the Create > Lights submenu.

### Polygon menus

The Polygon and Edit Polygons menus have been reorganized for ease of use. See Chapter 4, “Polygonal Modeling” for details.

### Dynamics menus

The Fields menu is simplified, the Connect/Add menu items are relocated to more appropriate places, and various other menu items have been renamed. See Chapter 8, “Dynamics” for details.

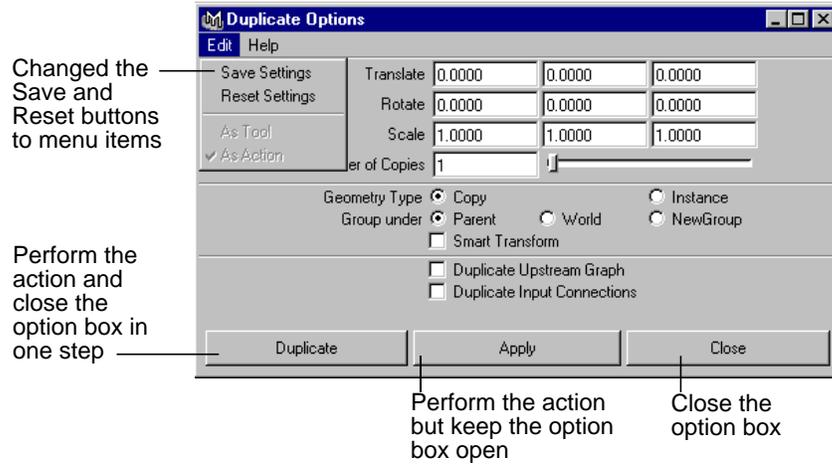
### Subdivision surfaces menus

Both the Subdiv Surfaces menu and marking menu for selected subdivision surfaces have been reorganized. See Chapter 5, “Subdivision Surfaces Modeling” for details.

## COMMAND OPTION BOX IMPROVEMENTS

We redesigned the buttons on the bottom of command option boxes, such as Edit > Duplicate . (Tool option boxes are not changed.)

Now you can either apply your settings and close the option box in one step, or apply your settings first, check that they’re correct, and then close the option box. The following illustration summarizes these changes.



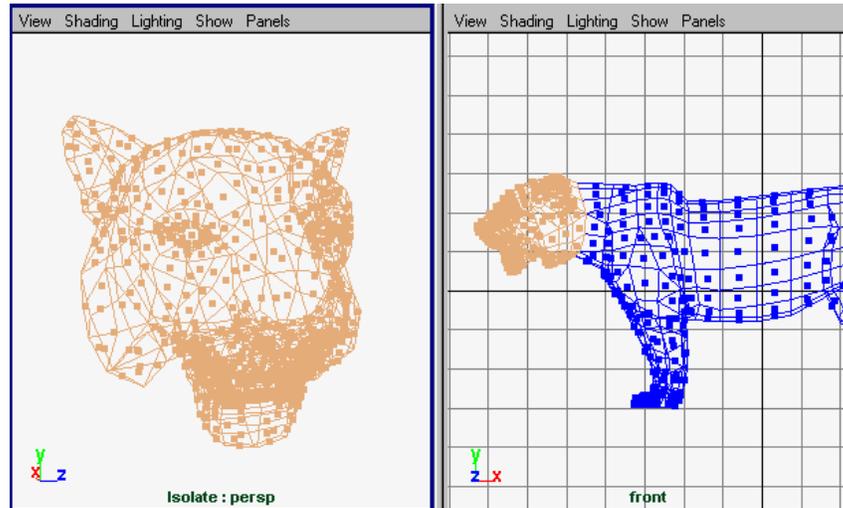
## NEW ISOLATE SELECT VIEW

Use the Isolate Select feature (Show > Isolate Select > View Selected) to quickly isolate objects or components in a view panel. You simply select the items, choose Show > Isolate Select > View Selected, and all other objects and components in your scene become hidden.

Unlike the Display > Hide commands, which hide mostly objects, the Isolate Select feature can also isolate components. For example, by selecting polygonal faces, you could isolate the head of a model. Another difference is Isolate Select affects screen display only, while Display > Hide commands also affect rendering.

## BASIC FEATURES | 2

### New Isolate Select view



Isolate Select works on a per-panel basis for any view panel (perspective or orthographic). The components you can select for isolation are:

- CVs of NURBS surfaces
- faces of a polygon mesh
- faces of a subdivision surface mesh

Other components cannot be selected for isolation, such as NURBS patches, curve segments, particles, or lattice points. However, you can still see and manipulate other component types within the items you have isolated.

Use the new Show > Isolate Select menu to control the isolate select feature. The menu options are described below.

#### Tip

Keep open at least one other workspace panel with isolate select turned off so you can select other items. Also, tearing off the Isolate Select submenu gives you quick access to these commands.

#### View Selected

Activates or deactivates the isolate select feature. When activated, the word “Isolate” appears at the bottom of the panel and the current selection becomes isolated.

**Auto Load Selected Objects**

Turn on to automatically update the isolate select panel when you change your selection. If turned off, you must use the Load, Add, or Remove Selected Objects options to update the panel.

**Load Selected Objects****Add Selected Objects****Remove Selected Objects**

If you don't have auto load on, you can use these options to control the isolate select display. Select items from the isolate panel or another panel and then load, add, or remove them as needed. Note that Load Selected Objects replaces the display with the current selection, while Add Selected Objects adds the current selection to the selections already displaying.

**Bookmarks**

Enables you to bookmark an isolated selection. To create a bookmark, choose Show > Bookmarks > Bookmark Current Objects. Choose the option box if you want to name the bookmark; otherwise, a default name is used.

To view bookmarked items, choose Show > Bookmarks > *BookmarkName*. Choose it again to turn it off and return to the previous view. You can view multiple bookmarks at the same time.

Bookmarks are saved with the scene as a set. You can manage them using the Relationship Editor.

## NEW IMPORT FOR ADOBE ILLUSTRATOR® AND EPS FILES

You can now import Illustrator and Encapsulated PostScript (EPS) files into Maya. With this feature, you can create 3D models based on 2D graphics, such as text or logos. Maya imports them as NURBS curves, which you can then group into surfaces, convert to polygons, and so forth.

Support for Illustrator files extends from version 4 up to version 8. Any versions before 4 or after 8 are not necessarily supported.

**How curves are converted**

The curves from Illustrator and EPS files are actually Bezier curve segments. During import, Maya attaches the segments into a single curve. The Curve Degree is set to 3 (cubic) and the Knot Spacing is set to Multiple End Knots.

## BASIC FEATURES | 2

### New Artisan Paint Textures tool

#### To import an Illustrator or EPS file:

- 1 Choose File > Import.
- 2 In the file browser, navigate to the Illustrator or EPS file.
- 3 If needed, click the Options button (NT) or choose Options > Options (IRIX) to set the following controls.

<b>Scale Factor</b>	Allows you to control the scale of the curves produced from the import. It is the same operation as using the Scale tool.
<b>Group</b>	Turn on this option to group the imported curves. It is the same operation as using the Edit > Group option.
- 4 Click Import.

## NEW ARTISAN PAINT TEXTURES TOOL

We added a new Artisan paint tool, Paint Textures, that paints the following texture attributes: color, transparency, incandescence, bump, specular color, and reflectivity. It is located in the Rendering menu set, Lighting/Shading > Paint Textures Tool.

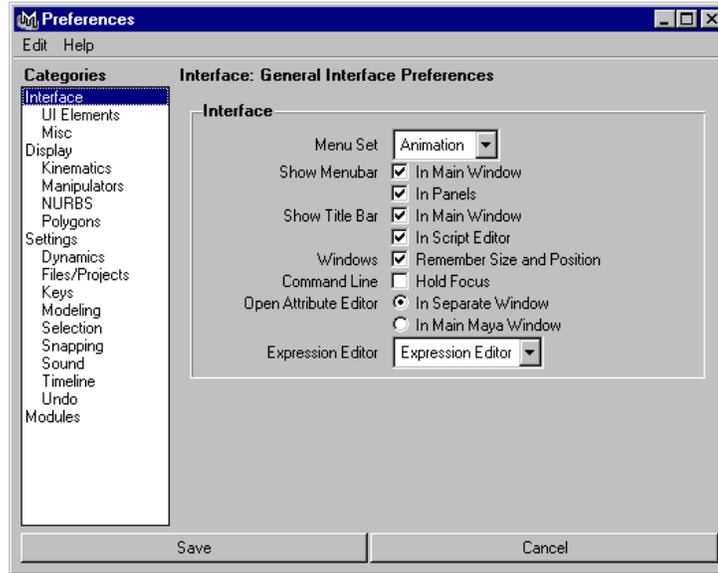
This tool operates similar to other Artisan paint tools; however, some tool settings are unique, such as Blend Mode. For information specific to this tool, see Chapter 9, “Rendering.”

## NEW PREFERENCES

We combined the General Preferences and UI Preferences windows into a single, streamlined Preferences window. Plus, there are various new preferences.

### Preferences window

Preference settings now have a new window and a new menu location: Window > Settings/Preferences > Preferences. Previously, preferences were separated into the General Preferences and UI Preferences windows under the Options menu.



The categories listed on the left correspond to the tabs from the previous preference windows, with a few exceptions. In some cases, such as Display, the category is further subdivided to make it easier to find settings.

### Saving and reverting changes

Your changes to the preferences are now saved automatically when you quit Maya or when you click the Save button in the Preferences window. If you need to revert to previous settings, you can use the options under the Edit menu: Revert to Saved and Restore Factory Settings.

## New preference settings

The following preferences are new.

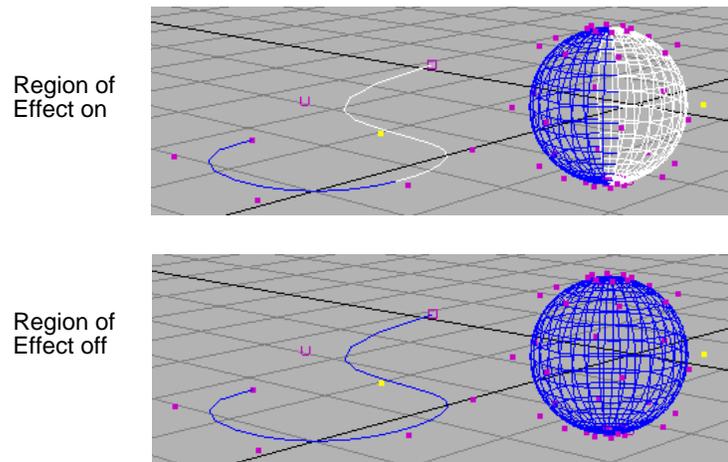
### Display category

#### Region of Effect

This new option lets you turn on or off the region of effect display. Region of effect is the part of an object that will potentially change as a result of moving a selected CV. Note that curves now show the region of effect as well as surfaces. Previously, only surfaces showed the region of effect.

## BASIC FEATURES | 2

### New Preferences



### Selection category

#### Click Box Size

This option controls the size of the selection area around the mouse pointer, or *click box*. If you are having problems with selecting objects or components, try adjusting this option. For example, a higher click box size might make it easier to select curves. Increasing the click box size is also useful if you have a high resolution screen display.

### Snapping category

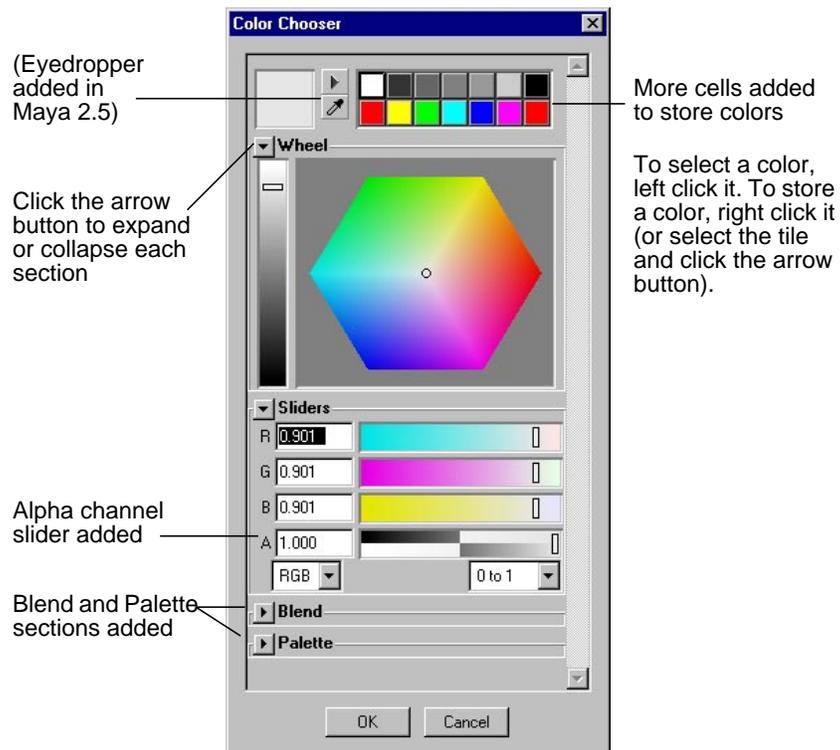
With these options, you can control the size region around the mouse pointer that is used for the snap operation.

**Use Snap Tolerance** When on, the snap region is restricted to a square area around the cursor, defined by the Snap Tolerance option. When off, the snap region is unlimited; you can snap to anything viewable.

**Snap Tolerance** Controls the size of the snapping area around the cursor when Use Snap Tolerance is on. For example, if you have two curves close together and you try snapping to one of the curves, the object may snap to the wrong curve. To avoid this, try using a small Snap Tolerance value.

## NEW COLOR CHOOSER FEATURES

The following illustration summarizes the changes made to the Color Chooser window, which you open from the Colors window or Attribute Editor.



### Using the alpha slider

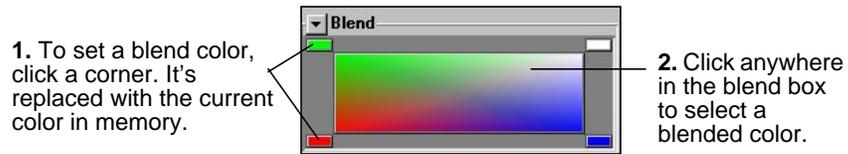
With the new A (alpha) slider, you can control the opacity or transparency of the color you choose. Many Maya options already have an alpha or transparency control, but if it does not or you are calling the Color Chooser from the command line, you can use this slider to control the alpha channel.

## BASIC FEATURES | 2

New Color Chooser features

### Using the Blend box

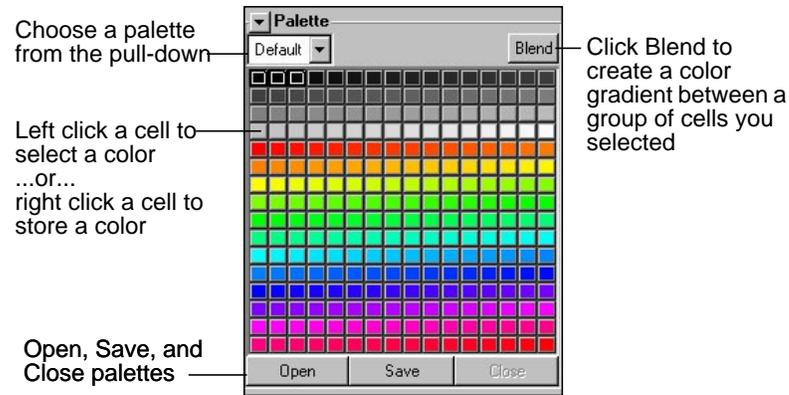
The Blend box creates a blend between colors so that you can select a new color from the blended gradient. The following illustration explains how to use it.



### Using the Palette

In the Palette section, you can create and save custom color palettes. You can also open Adobe color palettes (file extension .aco), if it is in one of the following formats: RGB, HSV, CMYK, Lab, or Inverted Lab. (Other formats, such as Pantone, are not supported.)

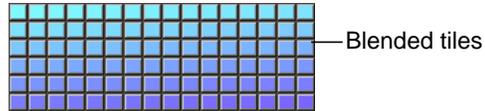
The following illustration highlights the palette components.



#### To create a custom palette

- 1 Select a color using any of the Color Chooser tools, such as the Wheel.
- 2 Right click on any tile to store the current color there.
- 3 To create a blended gradient, select several tiles by dragging the mouse, then click Blend.

A color gradient is created between the first and last tiles in your selection. For example, as shown below, you may want more color gradations than in the default palette.



- 4 When finished assigning colors, click Save and specify the filename. You can save the file in any directory. It is saved in ascii format.

## HOTKEY IMPROVEMENTS

We improved the usability of the Hotkey Editor, made hotkeys visible on menu labels, and changed the hotkey file structure to better preserve your custom hotkey settings.

---

### *Warning*

Do *not* copy hotkey preference files from a prior Maya version to the Maya 3 directory. If you do, your custom changes become lost, because Maya stores custom hotkeys in a new file and a different format. Simply start Maya 3 and it will find and convert saved hotkey preferences to the new Maya 3.0 structure.

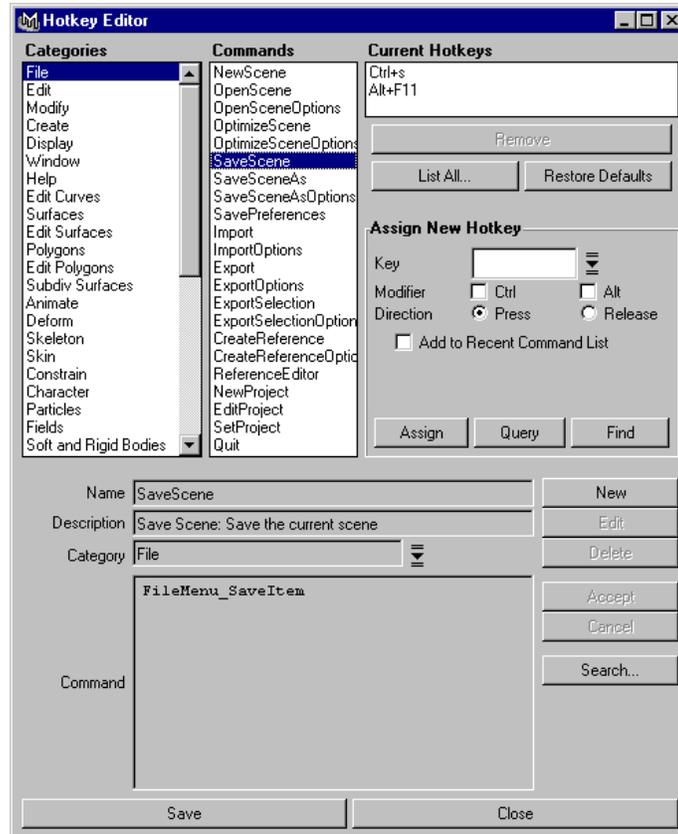
---

## BASIC FEATURES | 2

### Hotkey improvements

## Hotkey Editor reorganized

The Hotkey Editor is now reorganized to make it easier to use. Also keep in mind that its new location is Window > Settings/Preferences > Hotkeys.



### To assign a hotkey:

- 1 Choose Window > Settings/Preferences > Hotkeys.
- 2 Select the category and command.
- 3 In the Assign New Hotkey area, specify the key combination and other settings. You can see a list of which keys are unmapped by clicking List All.

<b>Key</b>	<p>Enter the key you want to assign to the selected command. Enter a letter from A to Z (upper and lower case are different keys) or a number from 0 to 9. You cannot use more than one letter or number.</p> <p>Or, choose a special key from the pull-down list. For example, if you want the right arrow key to act as the trigger, assign it here.</p>
<b>Modifier</b>	Select either Alt or Ctrl for the hotkey modifier.
<b>Direction</b>	<p>Use Press or Release to associate a command with the press or a release of a key. For example, you can create a hotkey to instruct Maya to snap to a curve when you press a key, then turn off the snapping when you release it.</p> <p>If you added a key to an operation ending with (Press) or (Release), add the same key to the corresponding (Release) or (Press) operation.</p>
<b>Repeatable</b>	Turn on so that this hotkey is repeatable using the Edit > Repeat command. Turn off to prevent repeating the hotkey using Edit > Repeat.
<b>Query</b>	Click Query to determine whether the specified key settings have already been assigned to a command.
<b>Find</b>	Clicking Find highlights the category and command for the key you enter in the Key field.

**4** Click Assign.

The new hotkey should appear in the Current Hotkeys list.

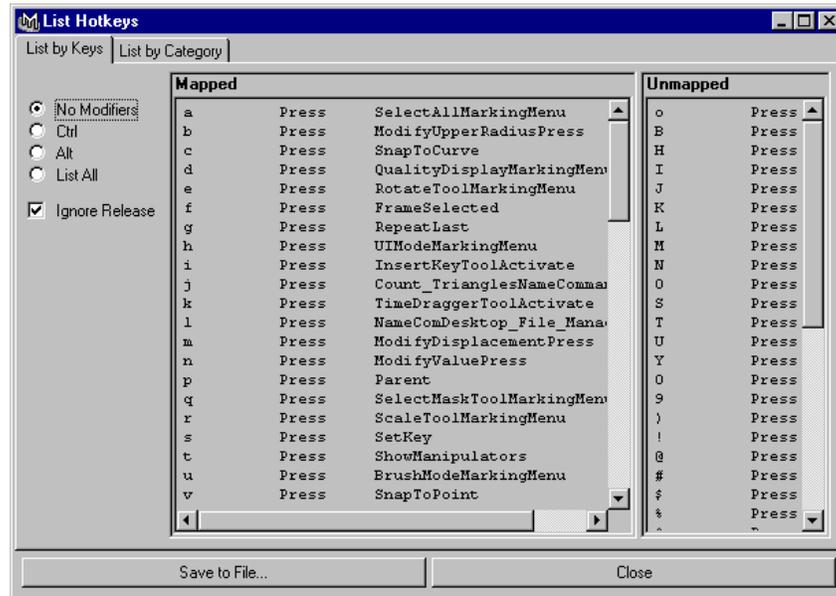
## BASIC FEATURES | 2

### Hotkey improvements

#### To list keys:

Click List All to view a list of mapped and unmapped keys. This opens a window that allows you to sort the keys in various ways.

To print the hotkeys list to a file, click Save to File button and specify a destination directory.



#### No Modifiers

Lists only single hotkeys, without Ctrl or Alt.

#### Ctrl

Lists only hotkeys with a Ctrl + key combination.

#### Alt

Lists only hotkeys with an Alt + key combination.

#### List All

Lists all hotkeys.

#### Ignore Release

Turn on to ignore the hotkeys that activate when you release the key, versus when you press the key. Turn off to see all hotkeys, including the ones activated when you release the key.

**To create a new command for hotkey assignment:**

- 1 Click Create.
- 2 Complete the Name and Description boxes.  
These fields are for future reference. They only appear in the Hotkey Editor.
- 3 Enter or select a category in the Category box.
- 4 Enter the MEL command into the Command box.
- 5 Click Accept.

The command should appear under the chosen category. You can now assign a hotkey to this command.

**To search commands:**

Click the Search button at the bottom of the Hotkey Editor to perform a search through all existing commands. For example, you may want to perform a search if you know part of a command name, but not the category. Or, if you are creating a new command, you can first search for commands that are related.

In the Search for Command window, you type a case-sensitive string. The program searches for that string in the command names and command syntax. You can use \* to represent any character or characters. You can also use brackets to enclose both capital and lower-case letters.

## Hotkeys on menu labels

Hotkeys now display next to main menu labels. (This feature does not apply to menu labels in the hotbox.)



When you assign a new hotkey to a menu item, the change also appears on the main menu label.

## BASIC FEATURES | 2

Outliner and other editor improvements

### Custom hotkeys preserved

Maya now saves your custom hotkey preferences so that they do not interfere with the default Maya hotkey settings. Your preferences will not be overwritten when you upgrade to the next Maya version.

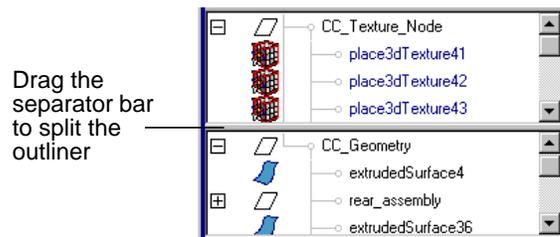
The new file names containing hotkey preferences are *userHotkeys.mel* and *userNamedCommands.mel* under the prefs directory. If you have hotkey preferences saved from a previous version of Maya, it will be detected at startup and converted to the new Maya 3.0 structure.

## OUTLINER AND OTHER EDITOR IMPROVEMENTS

### Outliner

The following changes affect the Outliner window, as well as the outliner panes in the Graph Editor, Relationship Editor, and Dope Sheet.

- Hierarchies become highlighted if they are collapsed but contain an item that is selected.
- As a quick way of expanding several collapsed hierarchies, you can select them, expand one of them, and they all expand.
- You can now split the Outliner window in order to see either end of a long list. To split the window, click the separator at the bottom of the window and drag it up. Restore full display by dragging the separator back to the bottom. As visual cue, moving your cursor over the separator bar changes it to: ↓ (IRIX) or ⇄ (Windows NT). (This capability is not available in the Dope Sheet.)

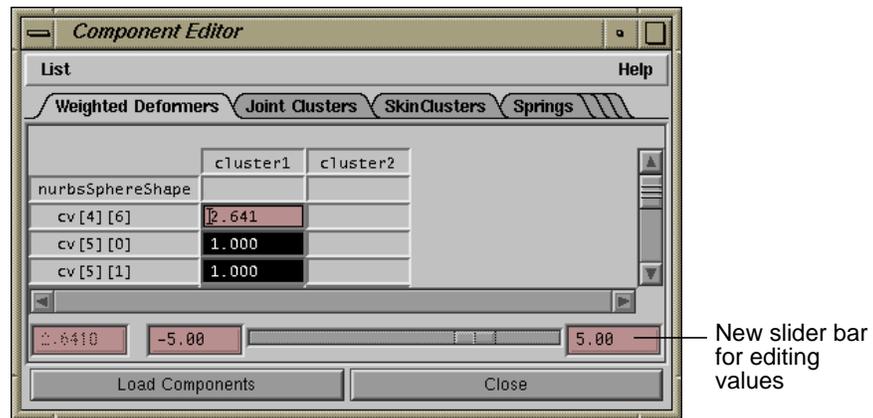


## Script Editor

- We added the Edit > Clear All command to help remove clutter.
- Pressing Ctrl+Enter now executes commands. Previously, only Enter on the keypad or Edit > Execute would execute commands.

## Component Editor

To make this editor more usable, we markedly improved the performance and added a slider bar for changing values.



### Note

If you undo, redo, or modify components in the workspace, you must click the Load Components button to refresh to Component Editor display. As part of the performance improvements, the display no longer updates automatically for these types of changes. However, it still refreshes when you change your selection (provided List > Auto Update is on).

## BASIC FEATURES | 2

### Project management improvements

## Various editors

The following improvements affect various editors, as noted.

### Clearing filter display

When you filter the display in the Outliner, Hypergraph, Graph Editor, or Relationship Editor, you can now return to a display of all objects by clicking the filtered display icon ()

### Edit keys (IRIX only)

Because using the Expression Editor, Script Editor, and other input boxes can involve text editing, we added support for the following edit keys:

- Ctrl+c: Copy
- Ctrl+x: Cut
- Ctrl+v: Paste
- Ctrl+k: Delete to end of line
- Ctrl+d: Delete next character
- Ctrl+a: Move cursor to beginning of line
- Ctrl+e: Move cursor to end of line

Previously, these edit keys were not supported on IRIX. However, the Ctrl+c, Ctrl+x, and Ctrl+v keys have always operated on NT. Also, Ctrl+a on NT selects all the text in the edit box.

## PROJECT MANAGEMENT IMPROVEMENTS

- On Windows NT only, the Open and Save windows now display the path of the current project in the window header.
- In the Set Project window (File > Projects > Set), the default path is now set to the current project. Previously, the default path was set to a standard location, which could be completely different from the location you typically use.
- In the New Project window (File > Project > New), the Location field now supports browsing. Click the browse button next to the Location field to open a browse window and select a project directory.

- The Maya file browser now remembers from session to session the last path that was accessed.
- You can now set the project from the Open and Save windows.
- When you save or open files on IRIX, you can now use the tilde (~) character to specify a user home directory, such as ~cbrown.

## BASIC MODELING IMPROVEMENTS

This section explains basic modeling features that appear within the standard menu set (File, Edit, Modify, Display). For more modeling changes, see Chapter 3, “NURBS Modeling” and Chapter 4, “Polygonal Modeling.”

### Reset and Freeze Transformations

The Reset and Freeze Transformations options under the Modify menu now provide an option box to apply the operation separately for translation, rotation, or scale. Previously, these operations applied to all three transformations.

Freezing sets the existing translation, rotation, or scale for selected objects to be the initial state. The result is that transform values change to zero (or one for scale), but the object itself remains in place. Resetting, on the other hand, transforms the object back to the translation, rotation, and scale it was when created or last frozen.

#### To freeze an object:

- 1 Select one or more objects that you have moved, rotated, or resized.
- 2 Choose Modify > Freeze Transformations .
- 3 In the option window, turn on or off Translate, Rotate, or Scale, as needed.
- 4 Click OK.

### Enlarging manipulators with + hotkey

Pressing the + key (on the numeric keypad or on the top of the keyboard) now enlarges the move, rotate, and scale manipulators. Previously, only the = key would enlarge manipulators.

## BASIC FEATURES | 2

Basic modeling improvements

### Object templates

We changed the menu selection for creating object templates.

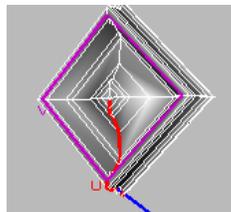
- Display > Object Display > Template: Makes an object into a template.
- Display > Object Display > Untemplate: Returns a template object back to standard display. You must first select the template object through the Outliner.

Previously, you used one menu selection, Display > Object Components > Templates, to toggle between these operations.

### Display surface origin

We added a new option to display surface origins. The option is: Display > NURBS Components > Custom > Surface Origins.

Surface Origins is helpful for alignment and placement of the surface. The command highlights the first U and V isoparms and labels them U and V. It also draws a line indicating the surface normal direction. The colors used for Surface Origins are defined in Window > Settings/Preferences > Colors > Components.



### Selection types

For greater selection control, we divided the Edit > Select All by Type > NURBS Geometry menu item into the following selections:

- Select All by Type > NURBS Curves
- Select All by Type > NURBS Surfaces

## Three Point Snap

In Maya 3.0 you can snap three points (representing a plane) to another three points. Instead of using the Move and Rotate tools, you can easily move an object to a specific point by snap aligning the object.

In previous versions, you could only snap a single point to another single point, or two points to two other points (defining an axis snap).

### To snap three points to three points:

- 1 Select three points on an object.
- 2 Select three points on the destination object.

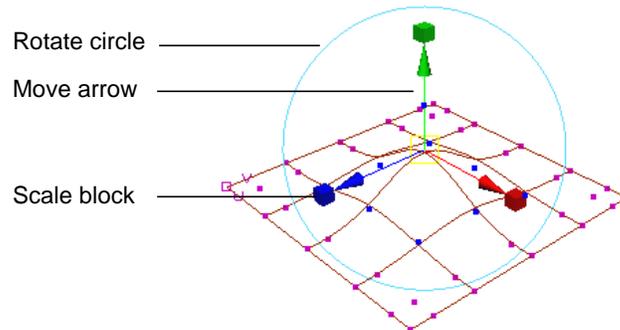
Select the points on the destination object in the order you want the snap to occur. The first point should correspond to the first point selected on other object, and so on.

- 3 Select Modify > Snap Align Objects > 3 Points to 3 Points.

## Proportional Modification Tool

The Proportional Modification Tool (Modify > Transformation Tools > Proportional Modification Tool) now rotates, scales, and translates (in previous versions it only translated).

The manipulator for Proportional Modification is a combination of the move, rotate, and scale manipulators. Click on the appropriate part of the manipulator, depending on what type of transformation you want to perform.



## BASIC FEATURES | 2

File referencing improvements

### Repeat Last

The Repeat Last and Recent Commands menu selections now let you repeat commands invoked from Shelf icons, hotkeys, and option boxes. Note that both Repeat Last and Recent Commands are relocated under the Edit menu.

### Move Normal Tool

The Move Normal tool is now a separate menu item in the Modify > Transformations Tools menu. In previous versions, Move Normal was only available as an option in the Move Tool's option box.

The Move Normal tool orients the manipulator axes along U, V and normal. The standard move tool's axes are oriented to the world coordinate axis by default.

### Normals Display Scale

We added an attribute called the Normals Display Scale to change the display size of NURBS surface normals. The attribute is located in the NURBS Surface Display section of the surface Attribute Editor.

## FILE REFERENCING IMPROVEMENTS

To avoid errors, we improved the way Maya locates files that you specify with imported objects, textures, MEL scripts, and other file referencing.

### Using spaces in filenames

On both Windows and IRIX, Maya now accepts references to files with spaces in the name.

### Missing references fixed

We corrected problems involving missing references. The problem resulted from the fact Maya stored references to textures and other project data using a path relative to the project directory. If you referenced another scene file outside of your project, textures and certain project data in the referenced file would appear missing.

Now, Maya saves all file references as full, absolute paths—including files located below the current project directory. See the next topic for more information on the way Maya searches for file references.

### Search order for referenced files

You can still move your project without risk of references breaking, even though Maya stores references as full paths. Rather than using a relative path for file references below the current project directory, Maya adds an extra slash in front of the project directory. The extra slash helps Maya search for files if you move the project.

When you open a scene, Maya searches for referenced files in the following order of locations:

- absolute, full path stored in the scene
- path below the project directory (as indicated by the extra slash)
- path relative to the current scene file location

If Maya cannot find the referenced file, use the *dirmap* command to remap the file location. The *dirmap* command maps one or more directories to replacement directories. Maya stores this mapping when you save the file. See the online *MEL Command Reference* for details.

## ADD, DELETE, AND RENAME CUSTOM ATTRIBUTES

We added menu selections to make adding, deleting, and renaming custom (or *dynamic*) attributes easier and more intuitive. The following table lists these new menu selections.

Task	From Attribute Editor menu	From main menu
Add attribute	Attributes > Add	Modify > Add Attributes
Delete attribute	Attributes > Delete	Modify > Delete Attributes
Rename attribute	Attributes > Rename	Modify > Rename Attributes

## **BASIC FEATURES | 2**

Add, Delete, and Rename custom attributes

# 3

## NURBS MODELING

In Maya 3.0, we've added the following features and enhancements to NURBS modeling:

- "Surface Editing Tool" on page 37
- "Breaking or smoothing tangents" on page 39
- "Rebuilding surfaces" on page 40
- "Creating output geometry as Bezier" on page 41
- "Lofting surfaces" on page 41
- "Attaching and aligning surfaces" on page 41
- "Extruding surfaces" on page 41
- "Rebuilding curves" on page 42
- "Creating text" on page 42
- "Selecting patches" on page 43

### SURFACE EDITING TOOL

A new Surface Editing Tool lets you click a position on the surface, then deform the region around the position with a manipulator. This provides a handy alternative to working directly with CVs.

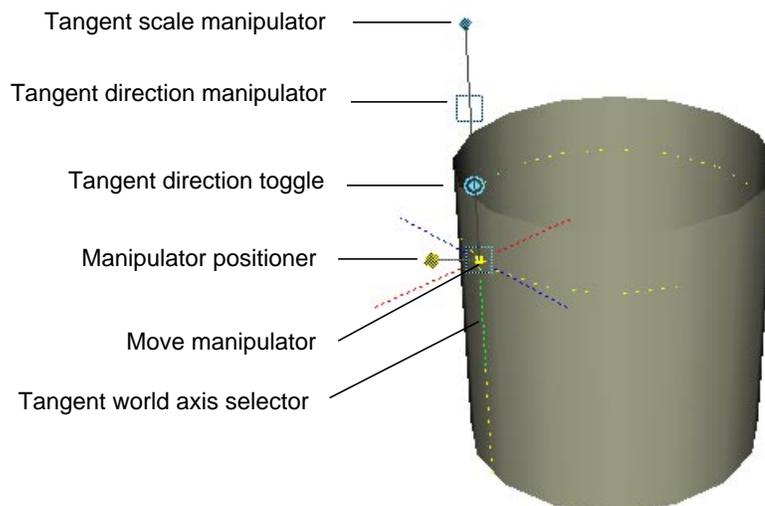
#### To use the Surface Editing Tool:

- 1 Select the surface.
- 2 Select Edit Surfaces > Surface Editing > Surface Editing Tool.

The tool manipulator appears on the surface.

## NURBS MODELING | 3

### Surface Editing Tool



#### Move manipulator

Drag this manipulator in any direction to deform the surface in that direction.

#### Manipulator positioner

Drag the manipulator positioner to reposition the move manipulator. Alternatively, you can click anywhere on the surface to reposition the manipulator.

You can use Snap to curve to snap the manipulator to an isoparm, or Snap to grid to snap to a patch corner. The manipulator snaps to the isoparms or patch corners that appear when you display the object with Display > NURBS Smoothness > Rough—not the isoparms or patch corners that appear only with finer Smoothness settings.

#### Tangent scale manipulator

Drag this manipulator forward or backward to scale the length of isoparms that lie parallel to the tangent direction manipulator.

#### Tangent direction toggle

Aligns the tangent direction to one of three fixed surface directions: U, V, or normal. Thereafter you can use the tangent scale manipulator in the direction selected.

**Tangent direction manipulator**

Click this icon to display a move manipulator that lets you drag the surface tangent in any direction. This tangent works like an large metal plate welded to the surface at the manipulator positioner. Moving this manipulator generally bulges one part of the surface while indenting the surface on the opposite side of the manipulator.

**Tangent world axis selector**

If you click one of the red, green, and blue dotted lines that make up the 3D axes, the surface tangency deforms in the direction of the axis. This axis is stationary and has the same spatial orientation as the world axis.

---

**Note**

This Surface Editing Tool deforms a region within two spans of the manipulator. Deformation decreases as distance from the tool position increases.

---

## BREAKING OR SMOOTHING TANGENTS

You can now break isoparm tangents or make broken isoparm tangents smooth.

**To break a tangent:**

- 1 Select the isoparm.
- 2 Select Edit Surfaces > Surface Editing > Break Tangent.

This inserts enough knots along the isoparm to allow the surface tangent to be broken. The shape of the surface doesn't immediately change. You can do that with your subsequent surface deformations.

Note that if you break the tangent for a surface point rather than an isoparm, Maya breaks the tangent in both directions. If you are using the Surface Editing Tool, only the tangent being edited is broken.

**To make a tangent smooth:**

- 1 Select the isoparm that has the broken tangent.

## NURBS MODELING | 3

### Rebuilding surfaces

#### 2 Edit Surfaces > Surface Editing > Smooth Tangent.

This moves the control vertices as necessary, but doesn't change the number of control vertices or spans. The surface position along that isoparm may change.

Note that if you smooth the tangent for a surface point rather than an isoparm, Maya smooths the tangent in both directions. If you are using the Surface Editing Tool, only the tangent being edited is smoothed.

## REBUILDING SURFACES

You can now set the following options in the Rebuild Surfaces options window:

### Rebuild Type End Conditions

Rebuilds the positioning of the surface's end CVs and knots. If you select End Conditions, two extra options appear for the End Conditions: No Multiple knots and Multiple knots.

With No Multiple Knots turned on, the rebuilt surface doesn't pass through the end CVs. This makes the surface harder to control in some cases, but makes other operations easier. For example, it's easier to create smooth joins between adjacent surfaces. (If you rebuild both surfaces with No Multiple knots, you can snap CVs together to get exact tangency across the boundary.)

If you turn on Multiple Knots, the surface touches the end CVs, making it easier to control the surface boundaries and related tangency.

A surface rebuilt with End Conditions has the same degree as the original.

### Trim Convert

Rebuilds a single-region trimmed surface (with four boundary curves) into a non-trim surface. This option is displayed only for Maya Unlimited users.

### Bezier

Rebuilds the surface as a Bezier surface. If you prefer working with Bezier surfaces rather than NURBS surfaces, consider using this option to convert the surface.

### Keep NumSpans

Gives the rebuilt surface the same number of spans as the original.

**Degree U/V Original**

Makes the U/V degree of the rebuilt surface the same as the original surface.

You can turn on Degree U/V Original and Keep NumSpans to create a uniform rebuild for several surfaces that have a different number of spans.

## CREATING OUTPUT GEOMETRY AS BEZIER

All surface actions that let you create output geometry as Subdiv or Polygons now let you create Bezier geometry. The actions and tools affected are Revolve, Loft, Extrude Tool, Boundary, Square, and Bevel, Freeform Fillet, and Fillet Blend.

## LOFTING SURFACES

We've added the following option to the options window:

**Section Spans**

This option sets the number of spans between the lofted curves. Higher numbers give finer control of surface deformations at the expense of extra processing time.

## ATTACHING AND ALIGNING SURFACES

Edit Surfaces > Attach Surfaces and Align Surfaces now compute the twist values for edges, so you do not need to attach or align the surfaces then toggle the twist attribute to get a clean join.

## EXTRUDING SURFACES

We've added the following option to the options window:

**Surface Degree**

Select Linear to give the extruded surface sharp edges between isoparms. Select Cubic for smooth edges. Be aware that Maya processes your interactions with a complex surface much faster with the Linear setting.

## REBUILDING CURVES

We've added the following option to the options window:

**Keep NumSpans** Gives the rebuilt curve the same number of spans as the original.

## CREATING TEXT

You can now use an extended character set to create text curves in Maya. For example, you can use an e with an umlaut. This feature is available on Windows NT only.

### To specify a character from an extended character set:

- 1 Select Create > Text  to open the options window.
- 2 Type a new word in the Text box.
- 3 To type the special character, select Programs > Accessories > Character Map from the Windows NT Start menu.

This displays the Unicode Character Map window.

- 4 Choose the same font you selected in Maya's Text Curves Options window, select the font subset, then click the desired character in the window. Click the Select and Copy buttons.
- 5 In Maya's Text Curves Options window, use Ctrl-v to paste the text into the Text field.

---

### *Important*

To avoid pasting an incorrect character into the text field, make sure the font you select in the Unicode Character Map window is the same as the font you select in Maya's Text Curve Options window.

---

- 6 In the Text Curves Options window, click Create.

## SELECTING PATCHES

You can now select NURBS patches the same way you select polygon faces. This affects the operation of Edit Surfaces > Duplicate NURBS Patches, which takes a connected group of patches and makes a new surface out of it. Unlike polygonal facets, you cannot move, rotate, or scale a NURBS patch that is a component of an object. You *can* move, rotate, or scale a NURBS patch that is a new object created with Duplicate NURBS Patches.

## **NURBS MODELING | 3**

Selecting patches

# 4

## POLYGONAL MODELING

In addition to rewriting the underlying polygonal modeling engine to provide improved performance and stability with large datasets, with this release of Maya, we've added the following new features and improvements to the polygonal modeling environment.

### Interface improvements

- Menu reorganization
- Interface improvements and changes

### New functionality

- New UV functionality
- New UV set options
- New multitexturing functionality
- New Convert Display colors option
- New Split vertex operation
- New Extrude commands
- New Texture View features
- New Normals options

### Improvements to existing functionality

- Support for nonmanifold geometry
- Cleanup improvements
- Extract changes
- Merge Vertices improvements
- Hypershade workflow improvements

## POLYGONAL MODELING | 4

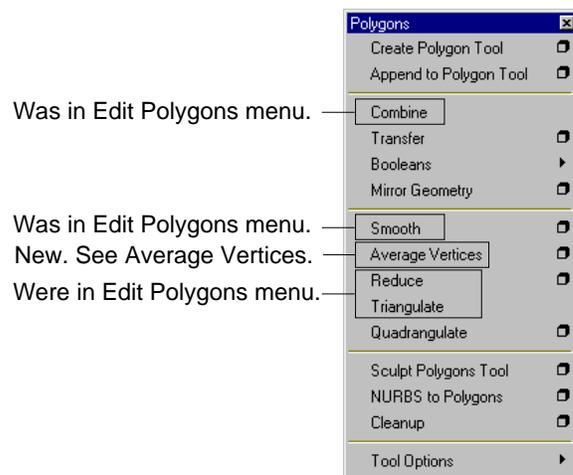
Menu reorganization

### MENU REORGANIZATION

The Polygon and Edit Polygons menus and submenus have been reorganized in this version of Maya.

The Polygons menu now primarily contains commands that act on an entire object, while the Edit Polygons menu contains commands that act on components of an object.

#### Polygons menu reorganization



## Edit Polygons menu reorganization

Moved to Edit Polygons menu.

New. Used to be Extrude in Polygons menu. See New Extrude commands.

New. See New split vertex operation.

Was in Polygons menu.

Were in Polygons menu.

Was Set Normal.

New. See Conform.

New. See: Create Empty UV Set  
Copy Current UV Set

New. See: Set Current UV Set  
Rename Current UV Set  
Delete Current UV Set

Renamed.

New. See: Map UV Border  
Relax UVs

Renamed.

New. See New Convert Display colors option.

Reverse and Propagate now a Reverse option. See New Reverse options.

## INTERFACE IMPROVEMENTS AND CHANGES

As well as reorganized menu items, new options to existing tools have been relocated and added throughout the polygonal modeling toolset.

- The Blind Data editor is now available from Window > General Editors > Blind Data Editor
- The Texture View window is now available from the Window menu.
- Display Poly Count is now available from Display > Heads Up Display > Poly Count.

## NEW UV FUNCTIONALITY

This release of Maya introduces new functionality for creating and manipulating UVs. Good UVs (non-overlapping and fitting in the 0 to 1 texture space) are an essential requirement for texturing, painting, and adding Fur to polygonal objects. These new features are particularly useful for larger polygonal models.

The new functionality includes:

- Automatic mapping
- Layout UVs
- Move and Sew UVs
- Creating good UVs on complex models
- Transfer
- Map UV border
- Relax UVs

---

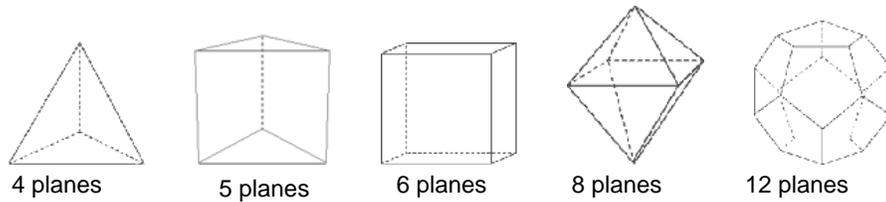
### Notes

This functionality is part of the **polyUVsPlus.so** plug-in (except for Map UV Border and Relax UVs) which loads by default. If you do not see the commands in the Polygons and Edit Polygons menus, select Window > Plug-in Manager and load the plug-in. For information on loading plug-ins, see *Using Maya: Essentials*.

---

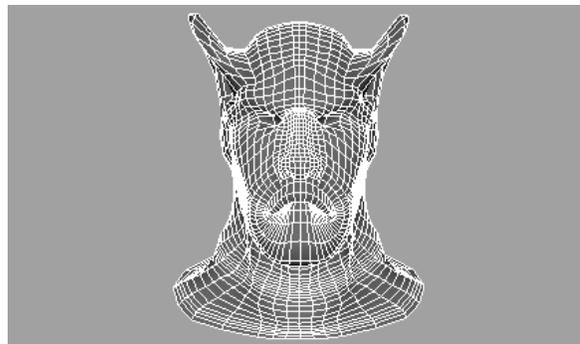
## Automatic mapping

Use Automatic Mapping to create a texture map by simultaneously projecting UVs onto multiple planes. You can choose a projection based on shapes with 4, 5, 6, or 12 planes.



This technique is very useful in cases where the simple planar, cylindrical, or spherical projections would result in severe distortion of UVs in some areas (as is often the case in more complex models). Automatic Mapping maps the model to multiple disjoint pieces in texture space. Automatic Mapping is most useful for applying Fur or for texture painting using projection because both Fur and texture painting can easily make use of UV meshes that are cut into pieces.

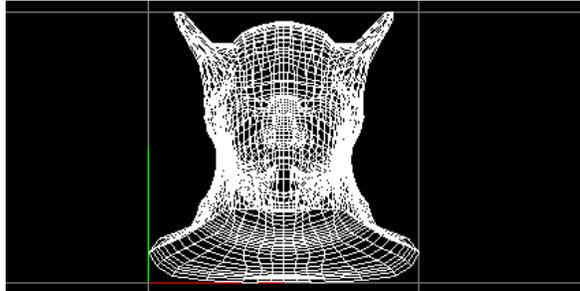
In the following example, the planar, cylindrical, and spherical projections all have overlapping UVs, and the cylindrical and spherical projections are distorted. The automatic mapping projection automatically cut the overlapping areas of the UV mesh and laid them out within the 0 to 1 texture space.



Polygonal model.

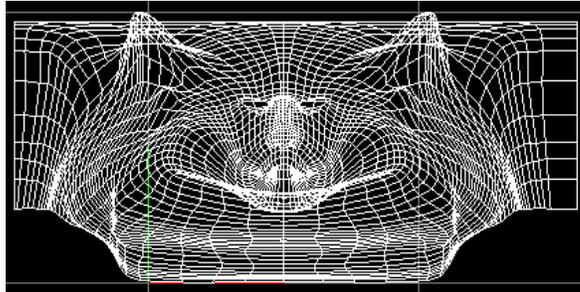
## POLYGONAL MODELING | 4

New UV functionality



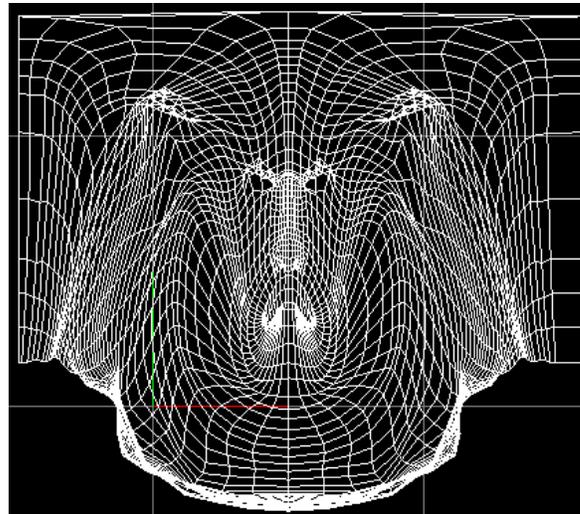
Planar Projection.

(Overlapping and distorted UVs.)



Cylindrical Projection.

(Overlapping and distorted UVs.)

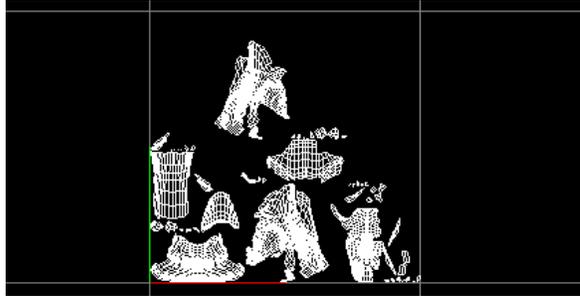


Spherical Projection.

(Overlapping and distorted UVs.)

## POLYGONAL MODELING | 4

### New UV functionality



Automatic Mapping.

(UVs cut and laid out in the 0 to 1 texture space.)

Although the mesh is typically broken into many small pieces, and some of the texture space is wasted, you can use the Move and Sew UVs command to join the pieces together (see “Move and Sew UVs” on page 58). You can also use the transformation tools in the Texture View to make better use of the texture space.

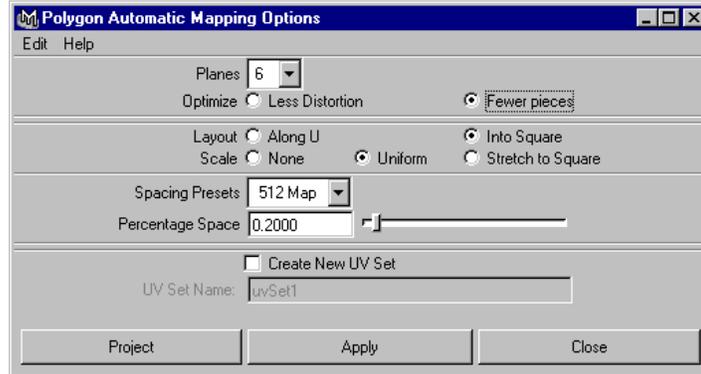
#### To project UVs from multiple planes automatically:

- 1 Open the Texture View window (Window > Texture View) so you can view the projection.
- 2 To clearly see the 0 to 1 texture space, change the texture Grid to 1, if it is not already (View > Grid ). This is particularly important for Fur and Texture Paint, which both require the mapping to be positioned entirely within this space.
- 3 In the modeling view, select the faces you want to map (usually the entire model).
- 4 Select Edit Polygons > Texture > Automatic Mapping .
- 5 Select the required settings, then click Project or Apply.

## POLYGONAL MODELING | 4

New UV functionality

### Automatic Mapping options



#### Planes

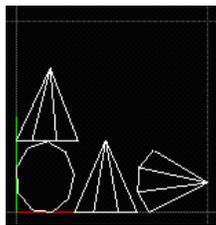
Select the number of planes you are projecting from. The more planes used, the less distortion occurs and the more pieces created. The default is 6.

#### Optimize

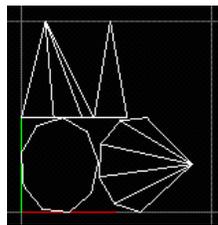
Select how you want the projection optimized.

**Less Distortion** Projects all planes equally. While this method provides the best projection for any face, you may end up with more pieces. It is particularly useful if you have a symmetrical model and you want the pieces of the projection to be symmetrical.

**Fewer pieces** Projects each plane until the projection encounters a projection angle that is not ideal. This can result in larger pieces, and fewer of them. This is the default.



Less distortion



Fewer pieces

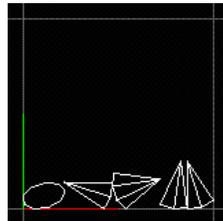
#### Layout

Select where you want the pieces of the UV mesh to lie in the texture space.

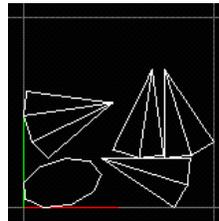
#### Along U

Positions the pieces along the U axis.

**Into Square** Positions the pieces within the 0 to 1 texture space. This is the default.



Along U



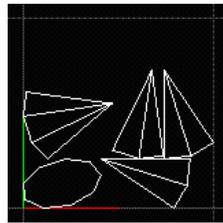
Into Square

**Scale** Select how you want the pieces of the UV mesh scaled within the texture space.

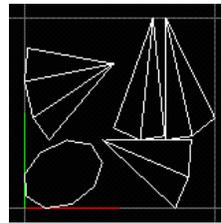
**None** Performs no scaling.

**Uniform** Scales the pieces to fit the 0 to 1 texture space without changing the aspect ratio. This is the default.

**Stretch to Square** Stretches the pieces to fit the 0 to 1 texture space. The pieces may become distorted.



Uniform

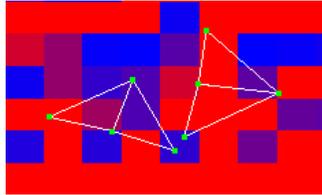


Stretch to Square

**Spacing Presets** Maya puts a bounding box around each piece and lays out the pieces so that the bounding boxes are very close together. If the pieces end up positioned exactly next to each other, two UVs on different pieces can share the same pixel and when texture painting, overscanning can also cause the paint to spill onto the adjacent piece).

## POLYGONAL MODELING | 4

### New UV functionality



To avoid this situation, ensure that there is at least a pixel between the bounding boxes by selecting a spacing preset from this menu. Select a preset that corresponds to your texture map size. If you don't know the size, select a smaller map, which will result in a larger spacing between adjacent pieces in UV space. (The smaller your map in pixels, the bigger the UV spacing must be between bounding boxes.)

Select Custom to set the size of the space as a percentage of the map size (in the Percentage Space box).

**Percentage Space** If you select Custom beside Spacing Presets, enter the size of the space between bounding boxes as a percentage of the map size.

**Create New UV Set** Turn this option on to create a new UV set and place the newly created UVs in that set. Type the name of the set in the UV Set Name box.

---

### Note

After performing an Automatic Mapping projection, you can modify the Planes, Optimize, Layout, and Scale settings for the projection in the Channel Box. However, do not modify these settings after painting a texture or applying Fur—the UVs may change drastically.

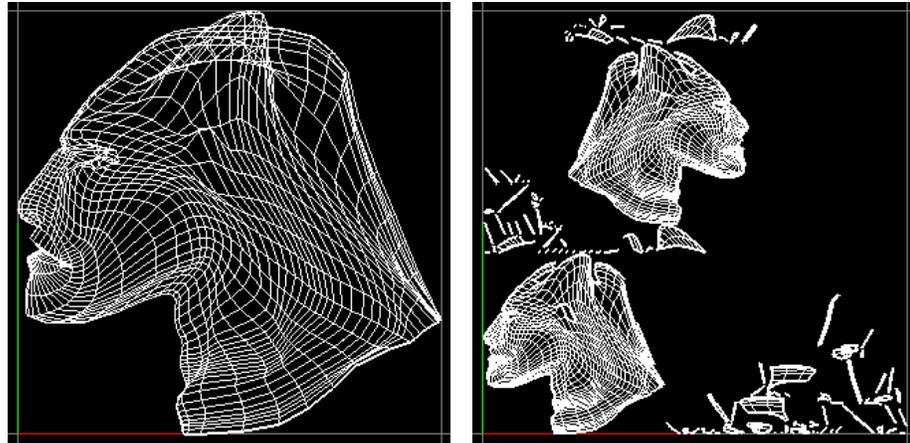
---

## Layout UVs

Use Layout UVs to lay out overlapping pieces of an existing UV mesh (optionally, cutting them if necessary) so that they no longer overlap, either along U or into a square. (Automatic Mapping does this automatically for new mappings.)

For example, you could perform regular planar mapping on a character, and then use the Layout UVs command to separate any overlapping pieces—this typically separates the front and back pieces intact. Although in most cases, other smaller pieces will also be produced, you can sew them back together

using the Move and Sew UVs command (see “Move and Sew UVs” on page 58). You can also scale or stretch the UVs to fit within the 0 to 1 texture space, and flip and reverse pieces.



Planar mapping.

After Layout UVs.

#### To lay out existing UVs on an overlapping UV mesh:

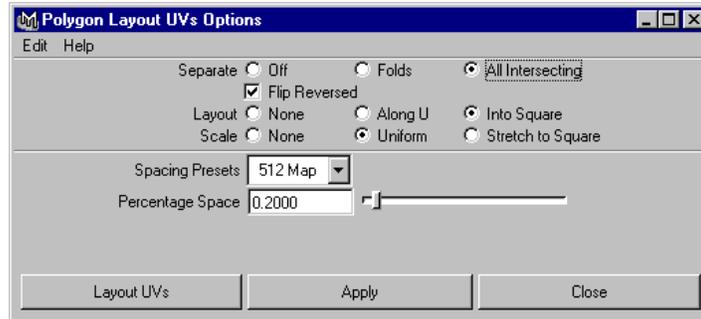
- 1 Open the Texture View window (Window > Texture View) so you can view the projection.
- 2 To clearly see the 0 to 1 texture space, change the texture Grid to 1 if it is not already (View > Grid ). This is particularly important for Fur and 3D-paint, which both require the mapping to be positioned entirely within this space.
- 3 In the modeling view, select the faces with UVs you want to lay out.
- 4 Select Edit Polygons > Texture > Layout UVs .
- 5 Select the required options, then click Layout UVs.

## POLYGONAL MODELING | 4

New UV functionality

### Layout UVs options

The default settings give the best results in most situations.



#### Separate

Select how you want to cut, or separate overlapping pieces of the UV mesh.

##### Off

Does not separate overlapping pieces of the mesh. Only the Scale option has an effect.

##### Folds

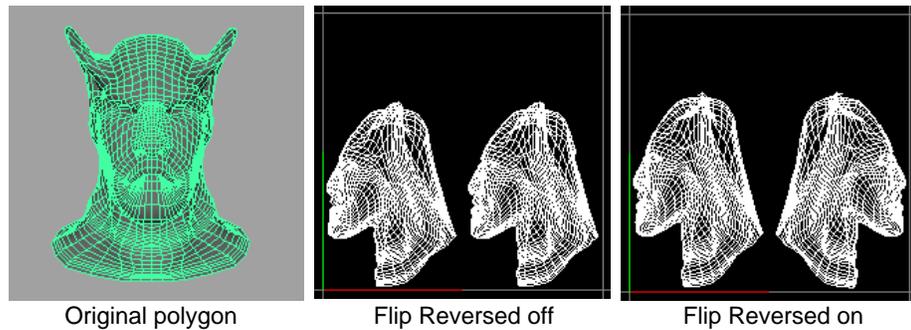
Separates only pieces where the surface normals of overlapping pieces point opposite directions. This method is faster, especially for larger models, however, you may be left with overlapping UVs.

##### All Intersecting

Separates all pieces where the UVs overlap. This is the default.

#### Flip Reversed

Turn this option on to flip pieces of the UV mesh that have normals pointing in opposite directions.



*Tip*

If your model is symmetrical (for example, a character's face), you can save texture space by turning this option off and superimposing the pieces of UV mesh so they occupy the same texture space.

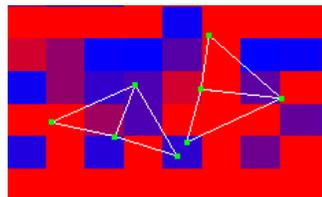
**Layout** Select where you want the pieces of the UV mesh to lie in the texture space.

- None** Does not lay out pieces after they have been cut. Some pieces may lie on top of others.
- Along U** Positions the pieces along the U axis. This is the default.
- Into Square** Positions the pieces within the 0 to 1 texture space.

**Scale** Select how you want the pieces of the UV mesh scaled within the texture space.

- None** Performs no scaling.
- Uniform** Scales the pieces to fit the 0 to 1 texture space without changing the aspect ratio. This is the default.
- Stretch to Square** Stretches the pieces to fit the 0 to 1 texture space. The pieces may become distorted.

**Spacing Presets** Maya puts a bounding box around each piece and lays out the pieces so that the bounding boxes are very close together. If the pieces end up positioned exactly next to each other, two UVs on different pieces can share the same pixel and when texture painting, overscanning can also cause the paint to spill onto the adjacent piece).



To avoid this situation, ensure that there is at least a pixel between the bounding boxes by selecting a spacing preset from this menu. Select a preset that corresponds to your texture map size. If you don't know the size, select

## POLYGONAL MODELING | 4

### New UV functionality

a smaller map, which will result in a larger spacing between adjacent pieces in UV space. (The smaller your map in pixels, the bigger the UV spacing must be between bounding boxes.)

Select Custom to set the size of the space as a percentage of the map size (in the Percentage Space box).

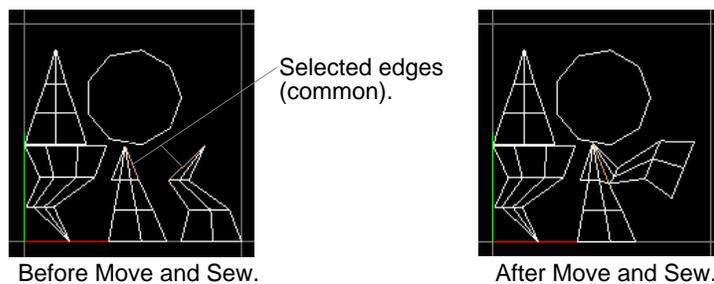
**Percentage Space** If you select Custom beside Spacing Presets, enter the size of the space between bounding boxes as a percentage of the map size.

## Move and Sew UVs

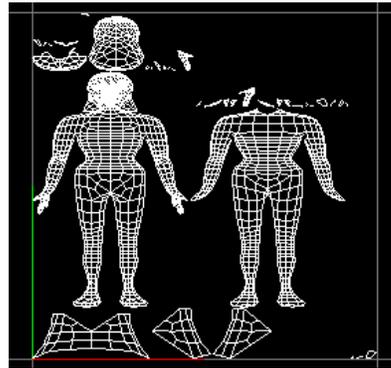
Use Move and Sew UVs to sew together separate pieces of the UV mesh by merging selected edges *and* moving one piece (the smaller one) of the mesh to the other (the larger one). You can quickly join separate pieces of the UV mesh produced by Automatic Mapping or Layout UVs back to their neighboring UVs.

There are two methods of moving and sewing UVs: manual and automatic. With the manual method, you must select the edges you want to join. With the automatic method, smaller pieces are moved and sewn automatically. You define how small the pieces should be.

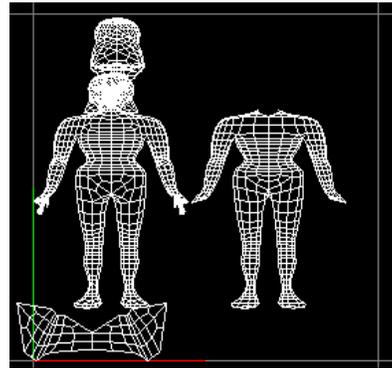
### Manual Move and Sew.



Automatic Move and Sew.



Before Move and Sew UVs.



After Move and Sew UVs  
(moved and sewed only those  
meshes with fewer than 50 pieces.)

#### To move and sew pieces of UV mesh manually:

- 1 Select the edges you want to join. The common edges are highlighted in the texture view and in the modeling view.
- 2 Select Edit Polygons > Texture > Move and Sew UVs .
- 3 Turn off Limit Piece Size.
- 4 Click Apply.

#### To move and sew pieces of UV mesh automatically:

- 1 Select all the pieces.
- 2 Select Edit Polygons > Texture > Move and Sew UVs .
- 3 Turn on Limit Piece Size and select the maximum number of faces a piece of the UV mesh can have to be moved and sewn.
- 4 Click Apply.

---

#### Tip

After performing a Move and Sew operation, you can select the history node (polyMapSewMove) in the Channel Box and adjust the Number of Faces until you achieve the results you want.

---

### Average Vertices

Use Polygons > Average Vertices to smooth geometry by averaging the values of vertices without changing the topology of the object. This method of smoothing can be used with the Transfer command to easily produce good UVs for texturing. For information on using Average Vertices and Transfer to produce good UVs, see “Creating good UVs on complex models” in *Using Maya: Polygonal Modeling*.

---

#### Note

Using the Smooth operation of the Sculpt Polygons tool you can paint vertices to produce the same result. For information on the Sculpt Polygons tool, see the “Smoothing, Beveling, and Sculpting Polygons” chapter in *Using Maya: Polygonal Modeling*.

---

#### To average vertices (smooth them) without changing the topology:

- 1 Select the vertices you want to smooth.
- 2 Select Polygons > Average Vertices .
- 3 Enter the required number of iterations then click Average or Apply.  
Smaller iteration values produce more subtle results. Because iterations are accumulative, the more iterations you enter, the more smoothing will take place each time you average.
- 4 Click Average or Apply repeatedly until the desired smoothness is achieved.

#### Creating good UVs on complex models

Use Average Vertices to smooth geometry so that good UVs are simpler to produce. (For example, the wrinkles on a model of a finger would likely result in overlapping UVs because the angle necessary for a good projection changes continuously.) You can then transfer the good UVs back to the original model using the Transfer command.

---

**Note**

You can also do this using the Smooth operation of the Sculpt Polygons tool. For information on the Sculpt Polygons tool, refer to *Using Maya: Polygonal Modeling*.

---

**To average vertices for mapping without changing the model's topology:**

- 1 Duplicate the original model.
- 2 On the duplicate model, select the vertices you want to smooth.
- 3 Select Polygons > Average Vertices .
- 4 Enter the required number of iterations then click Apply.
- 5 Click Apply repeatedly until the desired smoothness is achieved.
- 6 Project the UVs onto the smoothed duplicate model using any of the projection methods under Edit Polygons > Texture.
- 7 Use the new Transfer command (see next) to apply the UVs to the original model.

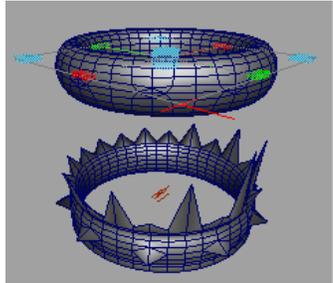
## Transfer

Use Transfer to transfer vertex positions, UV sets, and/or vertex color between two models with identical topology. To create good UVs, you can incorporate the Transfer tool into your workflow by first duplicating the original model, manipulating the vertices so that it is more suitable for projection using a method that does not change the topology (for example, using Average Vertices, or the Sculpt Polygons tool), projecting the UVs on the modified model, then using Transfer to copy them back to the original model.

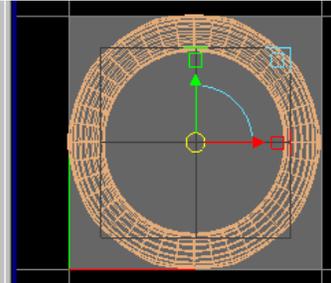
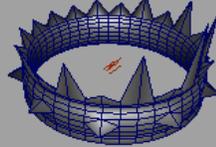
## POLYGONAL MODELING | 4

New UV functionality

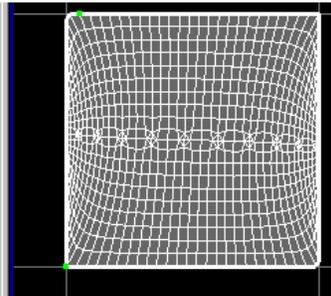
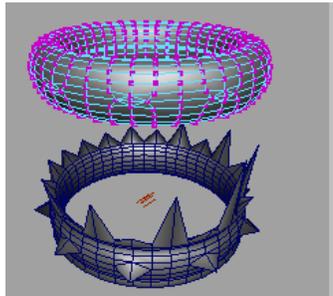
Smoothed Duplicate  
of complex model.



Complex model.

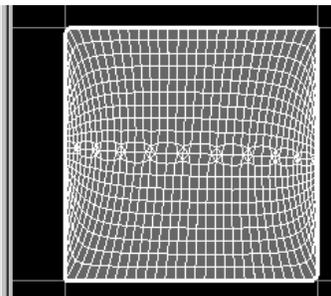
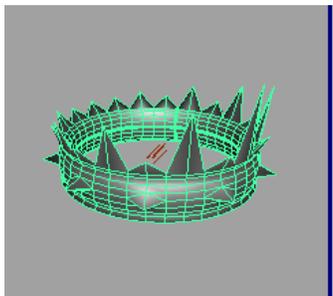


Planar projection of  
smoothed duplicate.



Good UVs created using Map  
UV Border and Relax UVs.

Good UVs  
transferred back to  
original model and  
smoothed duplicate  
deleted.



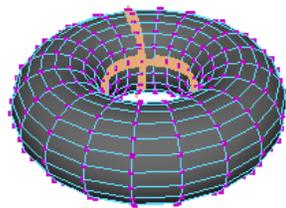
**To transfer UVs:**

- 1 Select both the source object and the destination object, in that order.
- 2 Select Polygons > Transfer .
- 3 Select the type of information you want to transfer (Vertices, UV Sets, Vertex Color), then click Transfer.

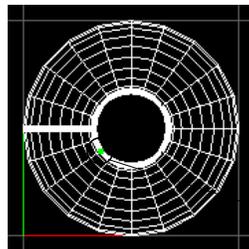
**Map UV border**

With Map UV Border, you can automatically force the border of a UV mesh to a square or circle shape fitting within the 0 to 1 texture space, optionally maintaining a proportion of the original world space relationships between the edges (Shape Detail). This is very useful for untangling borders, prior to using a tool such as Relax UVs to untangle the interior UVs.

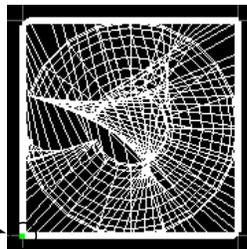
In the following example, UVs were cut along the inside and back of a torus, creating a UV border. The UV border was mapped to a square, then relaxed to eliminate overlapping UVs.



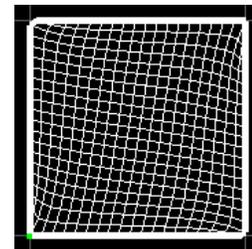
UVs on torus cut to create UV border.



Planar mapping of torus with cut UVs. Selected UV will map to origin.



UVs mapped to square.



Relaxed UVs.

## POLYGONAL MODELING | 4

### New UV functionality

#### To map a UV border:

- 1 Select a UV on the border.

---

#### Note

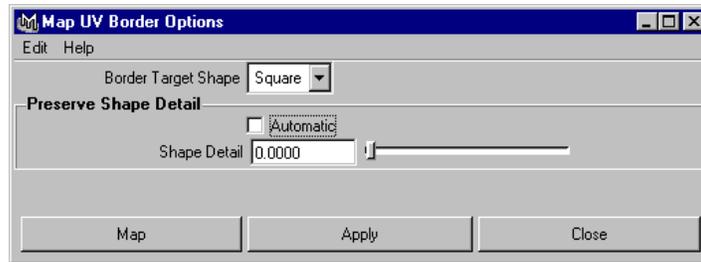
The UV you select maps to a point on the diagonal of the 0 to 1 texture space. It maps as closely as it can to the origin while containing the UV mesh in the 0 to 1 space.

---

- 2 Select Edit Polygons > Texture > Map UV Border , or in the Texture View, select Edit > Map UV Border .
- 3 Select the required options, then click Map.

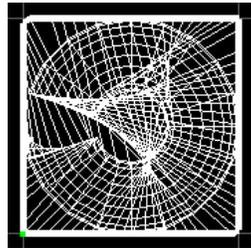
Remember that you are only dealing with the border—don't worry about how tangled the interior UVs appear. You can untangle the interior UVs using the Relax UVs tool (see "Relax UVs" on page 66).

#### Map UV Border options

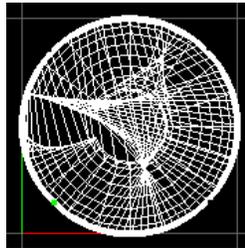


#### Border Target Shape

Select the shape you want to map the UV border to (Circle or Square). The Square option makes best use of texture space, but can result in faces having zero or very little texture space around the edges of the mesh. The Circle option is less likely to produce this type of problem, but uses texture space less efficiently.



UV border mapped to square.



UV border mapped to circle.

These UV border mappings produce overlapping UVs, which can be fixed using the Relax UVs tool.

### Preserve Shape Detail

#### Automatic

Turn on Automatic to map the UV border automatically using a Shape Detail value (see next) that approximates the best use the texture space while maintaining the world-space relationships between edges.

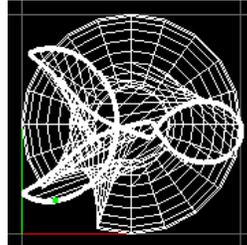
#### Shape Detail

Turn off Automatic and use the slider or enter a value between 0 and 1 to control the blend of the border with the specified shape. A value of 0 produces a border closest to the specified shape. A value of 1 produces a border that closely represents the world-space relationships between edges, but can result in concave areas along the border—these will produce overlapping interior UVs once relaxed.

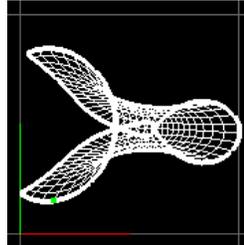
## POLYGONAL MODELING | 4

### New UV functionality

Border Target Shape = Circle.

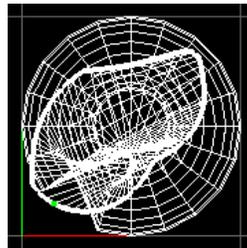


Shape Detail 1.0.

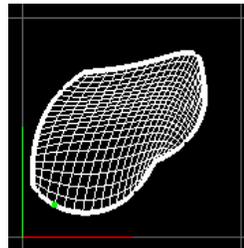


Relaxed.

Concave areas produce overlapping borders. In this situation, reduce the Shape Detail value.

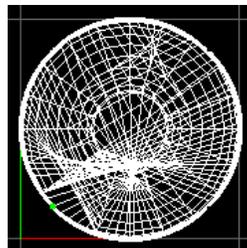


Shape Detail 0.3.

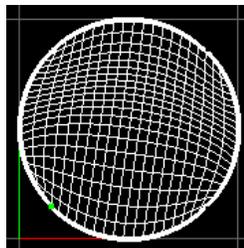


Relaxed.

Reducing the Shape Detail value eliminates the overlapping borders while attempting to minimize distortion.



Shape Detail 0.



Relaxed.

A Shape Detail value of 0 eliminates the overlapping borders, forcing them into the set shape.

## Relax UVs

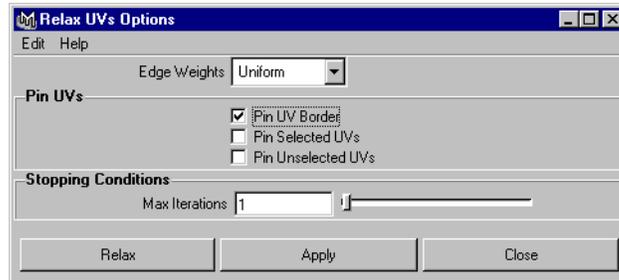
Use Relax UVs to automatically untangle and even out UVs, while retaining a fixed border or fixed UVs. This is extremely useful for untangling UV meshes when used in combination with Map UV Border.

### To relax UVs:

- 1 Select a UV within the UV mesh.
- 2 Select Edit Polygons > Texture > Relax UVs .

- 3 Select the required options, then click Relax or Apply. You may need to click Relax again until you achieve the desired results.

### Relax UVs options



#### Edge Weights

Select how the UV relax affects edges.

##### Uniform

Attempts to make all of the edges the same length. This is the default.

##### World Space

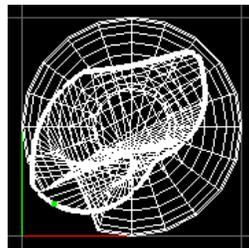
Attempts to retain the original world-space angles (subject to the restrictions of the pinned border).

#### Pin UVs

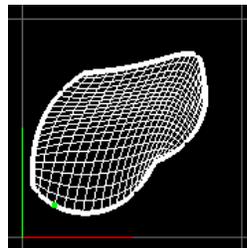
Use the following options to relax only selected parts of the UV mesh.

#### Pin UV Border

Turn this option on to maintain the position of the border UVs. This is the default.



Pin UV Border, before Relax UVs.



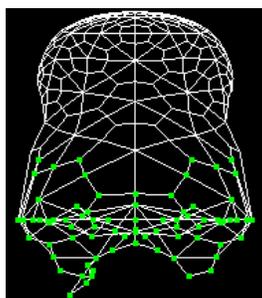
Pin UV Border, after applying Relax UVs several times.

## POLYGONAL MODELING | 4

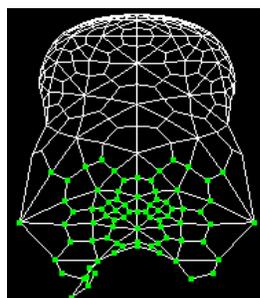
### New UV set options

**Pin Selected UVs** Turn this option on to maintain the position of selected UVs. For example, if you want more texture space for an area on a face with very dense UVs, you could select these UVs, scale them up, pin them, then relax the rest of the UVs to eliminate any overlapping you may have introduced during the scale.

**Pin Unselected UVs** Turn this option on to maintain the position of the unselected UVs. This option is useful for relaxing only the selected UVs.



Pin Unselected UVs,  
before Relax UVs.



Pin Unselected UVs,  
after applying Relax  
UVs several times.

### Stopping Conditions

**Max Iterations** Enter the number of relaxation iterations that will be performed on the UVs—ideal UV relaxation is subjective and iterative.

## NEW UV SET OPTIONS

The following options have been added to the Texture menu providing you with a mechanism to create, name, and delete UV sets. Press **Q** for each of these options to open the options window.

- Create Empty UV Set
- Copy Current UV Set
- Set Current UV Set
- Rename Current UV Set
- Delete Current UV Set

You can create and edit multiple UV sets for working with multitextured objects which can be viewed in hardware shaded display mode as well as software rendered.

You can create a new UV set when you do the UV mapping or you can create an empty UV set independently of a projection.

#### To create a new UV set when you project a map:

In the projection option box, turn on Create New UV Set and type a name for the set in the UV Set Name box.

#### To create a new empty UV set:

- 1 Select the object, then select Edit Polygons > Texture > Create Empty UV Set .
- 2 In the Create UV Set Name box, type the name of the empty set and click Create.

#### To set a UV set to be current (select the set):

- Right-click on the object and drag down and select UV Sets > *UVsetName*, where *UVsetName* is the name of the UV set you are selecting.  
*or*
  - In the Texture View, select Image > UV Sets > *UVsetName*, where *UVsetName* is the name of the UV set you are selecting.  
*or*
  - Select the object, then select Window > Relationship Editor > UV Linking > UV-Centric and click on the UV set name.  
*or*
- 1 Select the object, then select Edit Polygons > Texture > Set Current UV Set .
  - 2 In the UV Set Name box, type the name of the UV set you are making current.

#### To rename a UV set:

- 1 Select the set you want to rename.
- 2 Select Edit Polygons > Texture > Rename Current UV Set .

## POLYGONAL MODELING | 4

### New multitexturing functionality

- 3 In the New UV Set Name box, type the new name for the set and click Rename Current or Apply.

#### To copy values from one set to another existing set:

- 1 Select the set you want to copy from.
- 2 Select Edit Polygons > Texture > Copy Current UV Set .
- 3 In the UV Set Name to Copy to box, type the name of the UV set you want to copy the UVs of the selected set to.

#### To delete a UV set:

- 1 Select the set you want to delete.
- 2 Select Edit Polygons > Texture > Delete Current UV Set.

## NEW MULTITEXTURING FUNCTIONALITY

Multitexturing is the layering and blending of multiple textures on an object, potentially using a distinct UV set for each layer. Although it is not necessary that each texture contains its own set of UVs, it is often an important part of multitexturing.

In Maya 3, you can create and edit multiple UV sets for working with multitextured objects which can be viewed in hardware shaded display mode as well as software rendered.

New UV sets can be created and named when using polygonal UV projection tools.

### Applying layered textures to UV sets

Use the Layered Texture node to manage multiple textures. You can drag and drop file textures onto this node using the middle mouse button, and RGB and alpha connections are automatically made. You can alternatively drag textures from Hypershade into the Layered Texture's Attribute Editor.

The following workflow shows you how to create UV sets, layer textures, and how to manage the correspondence between texture layers and UV sets.

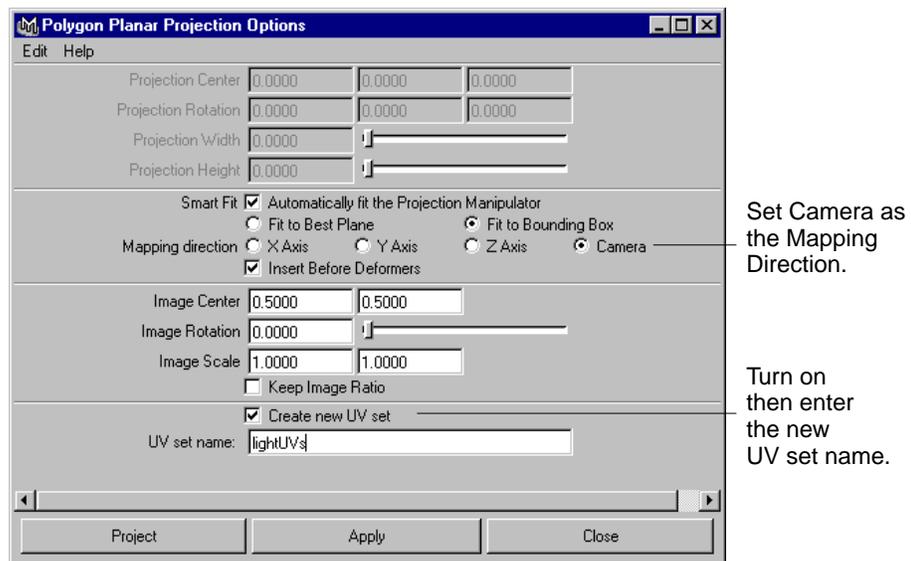
**To create UV sets:**

- 1 In the top view, create a polygonal plane, scale it larger than the default, and select it.

**Tip**

From the top view panel's menu, select Shading > Smooth Shade All and Hardware Texturing to see the results when you have completed the texture assignment.

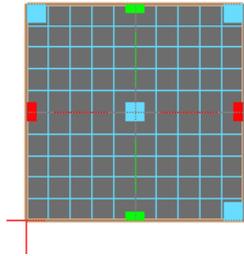
- 2 Select Edit Polygons > Texture > Planar Mapping  to open the Planar Projections Options window.
- 3 Set the Mapping Direction to Camera, turn on Create New UV Set, and enter *lightUVs* as the set name, then click the Project button.



The plane should now display the projection map manipulators.

## POLYGONAL MODELING | 4

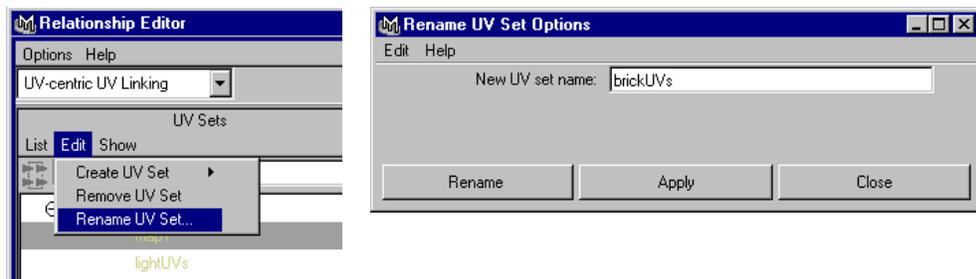
New multitexturing functionality



- 4 Select Window > Relationship Editors > UV Linking > UV-Centric.
- 5 Click map1 to make it current.



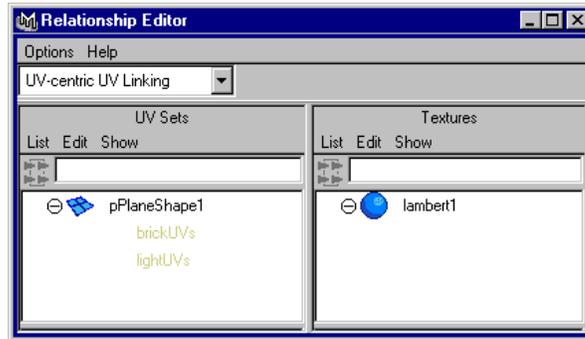
- 6 Select Edit > Rename UV Set and enter *brickUVs* in the Rename UV Set options window.



The Relationship Editor displays both UV sets.

## POLYGONAL MODELING | 4

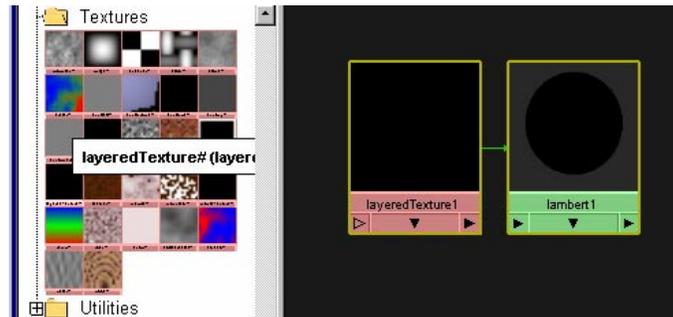
New multitexturing functionality



- 7 Make sure *brickUVs* is selected in the Relationship Editor.
- 8 Select half the faces on the plane and then select Edit Polygons > Texture > Unitize UVs to tile the UVs for the *brickUVs* UV set.

### To create texture layers:

- 1 In Hypershade, use the middle-mouse button to click-drag the Layered Texture swatch from the Visor panel onto the material swatch in Hypershade and connect it to one of the material's attributes (such as Color). Select Color from the material swatch's pop-up menu).



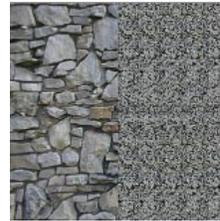
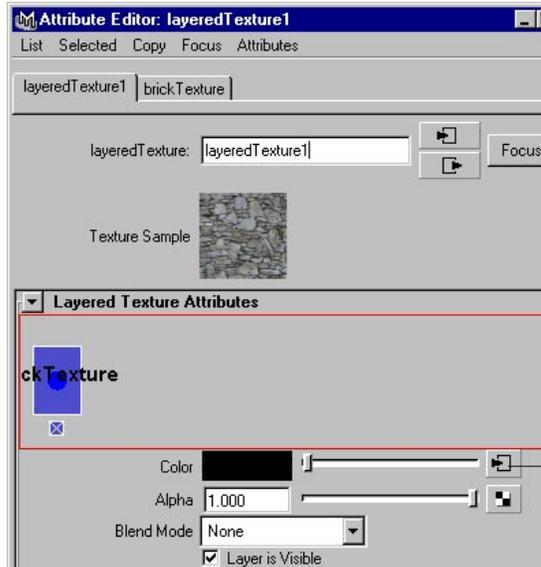
or

Select Create > Textures > Other > Layered Texture, click in Hypershade and middle-mouse-button drag the texture swatch over the material swatch to connect it to an attribute.

## POLYGONAL MODELING | 4

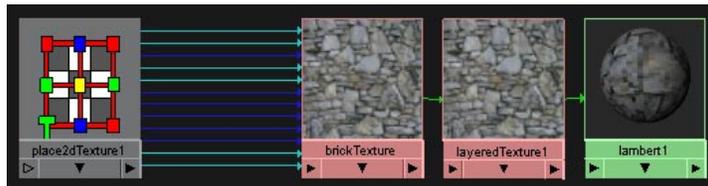
### New multitexturing functionality

- 2 Double-click the Layered Texture swatch in Hypershade to open its Attribute Editor. In the Layered Texture's Attribute Editor, map the Color to a file texture (for example, some kind of brick or stone texture you may have). Rename this texture brickTexture.



Result in the view panel.

Click to map a 2D file texture to the Color attribute.



Hypershade view.

- 3 Click in the top-most area of the Layered Texture Attributes section of the Attribute Editor to create a second layer and click the box next to Color to map it to another file texture. Rename this texture lightTexture.

---

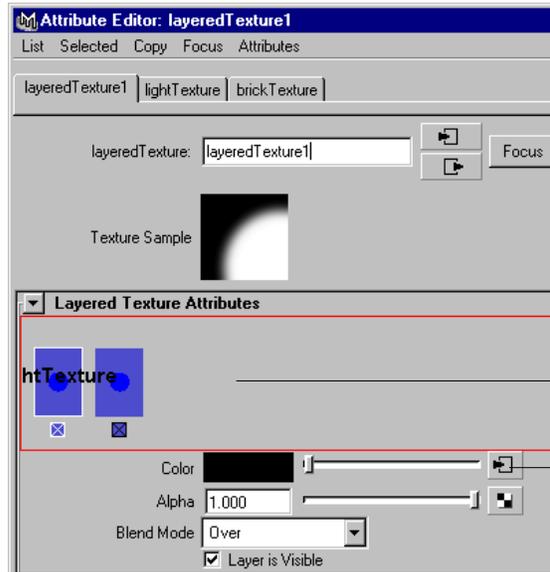
### Note

You can use any file texture and not necessarily a light map. See "Example 2" on page 78.

---

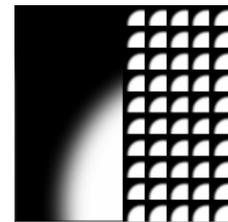
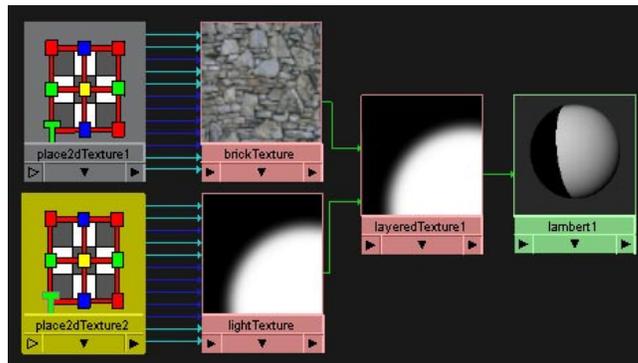
## POLYGONAL MODELING | 4

New multitexturing functionality



Click in this section to add another layer.

Click to map a 2D file texture to the Color attribute.



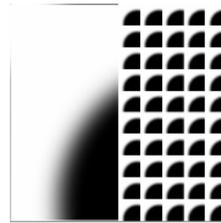
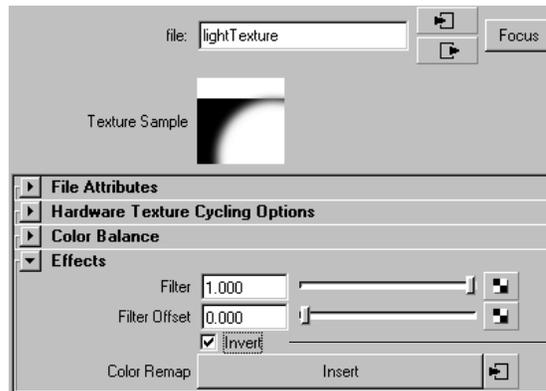
Result in the view panel.

Hypershade view.

- 4 In the lightTexture's Attribute Editor, open the Effects section and turn on Invert to invert the lightTexture.

## POLYGONAL MODELING | 4

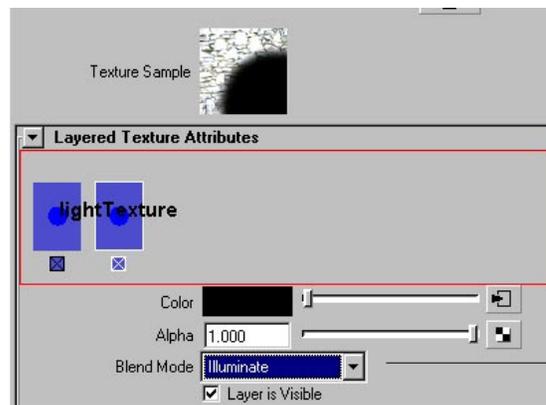
### New multitexturing functionality



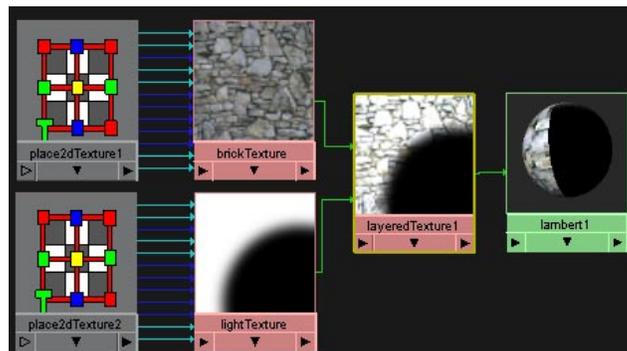
Result in the view panel.

Turn Invert on.

- 5 In the Layered Texture's Attribute Editor, click the lightTexture swatch and set the Blend Mode to Illuminate (or Subtract).



Select the Illuminate or Subtract Blend Mode.



Hypershade view.

## POLYGONAL MODELING | 4

### New multitexturing functionality

- 6 Click the brickTexture swatch and make sure the Blend Mode is None (the default).

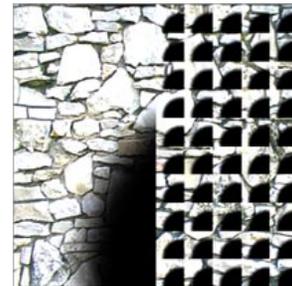
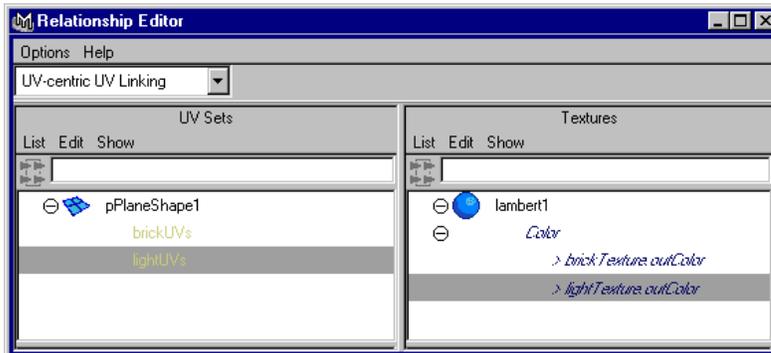
The order of layers within the Layered Texture Attribute Editor is important since you want the light file texture to blend on top of the brick texture. Make sure the brickTexture is first (the right-most texture).

#### To connect the UVs to the textures:

- 1 Open the Relationship Editor in UV-Centric mode (Window > Relationship Editors > UV Linking > UV - Centric).
- 2 Select the plane to update the Relationship Editor.
- 3 Click the lightUVs UV Set in the left column, and click the texture items in the right column to compare results. See the following examples.

#### Example 1

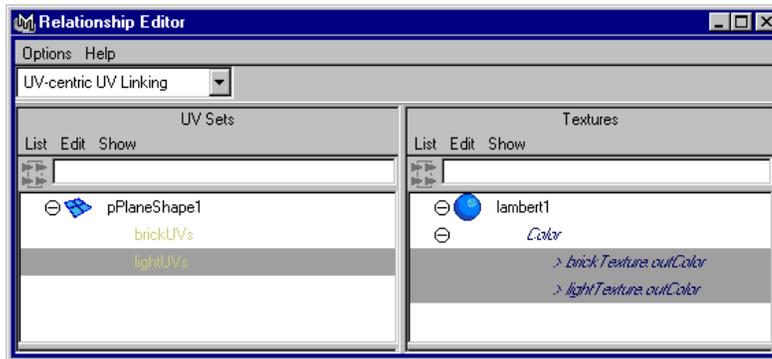
Shows brick UVs used to map brick texture and light map UVs used to light map texture.



## POLYGONAL MODELING | 4

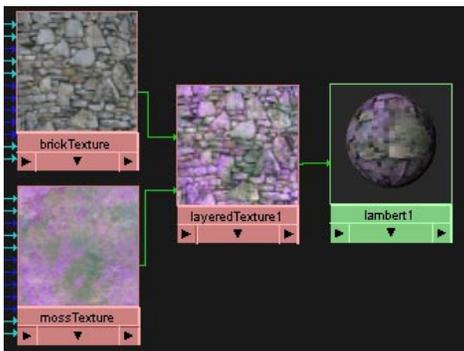
### New multitexturing functionality

Shows light map UVs used to map both textures.



### Example 2

These next few images show what happens when you change the overlaying texture by mapping another file and selecting the lightUVs set in the Relationship Editor.

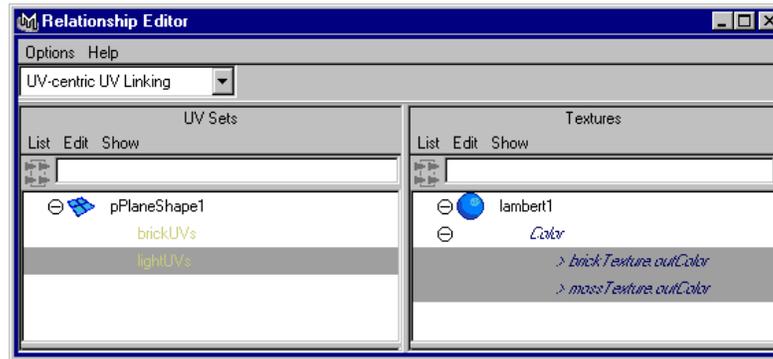
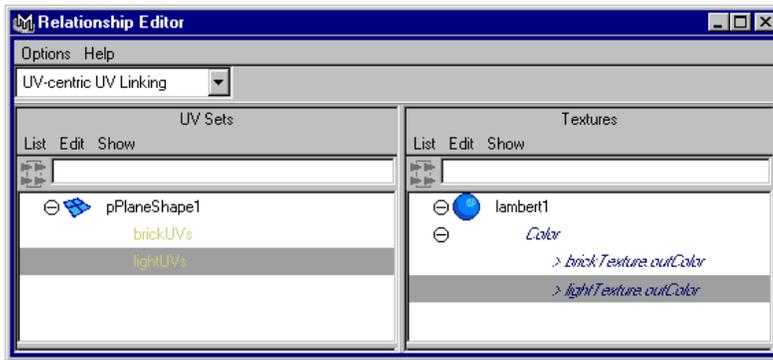


Double-click the texture switch to open its Attribute Editor and select another file texture.

Rename the new file texture.

## POLYGONAL MODELING | 4

New multitexturing functionality



## Blend modes

Textures can be blended with the texture below them using the Texture Blend attribute in the Layered Texture's Attribute Editor.

The Blend Mode specifies how the currently selected layer blends with the layers behind it. The following blend modes are available.

- None** The foreground texture covers up the background texture entirely.
- Over** The foreground texture is applied like a decal to the background. The blending of the decal is determined by the foreground alpha.
- In** The result is the background texture cut in the shape of the foreground alpha.

## POLYGONAL MODELING | 4

### New Convert Display colors option

<b>Out</b>	The result is the opposite of In. It is as if the shape of the foreground alpha has been cut out of the background.
<b>Add</b>	The foreground color is added to the background color as if being projected on the background through a slide projector.
<b>Subtract</b>	The foreground color is subtracted from the background color.
<b>Multiply</b>	The result color is the foreground color multiplied by the background color.
<b>Difference</b>	The result color is the difference between the foreground color and the background color.
<b>Lighten</b>	The result color of each pixel is the background color or foreground color, whichever is lighter.
<b>Darken</b>	The result color of each pixel is the background color or foreground color, whichever is darker.
<b>Saturate</b>	The result color is the background color with saturation increased in proportion to the foreground alpha.
<b>Desaturate</b>	The result color is the background color with saturation decreased in proportion to the foreground alpha.
<b>Illuminate</b>	The result color is the background color mixed with the foreground color, brighter where the foreground color is bright and darker where the foreground color is dark. It is as if the foreground texture represents the light falling on the background.

## NEW CONVERT DISPLAY COLORS OPTION

Turn this new Colors option on or off to show colors in hardware texture shaded mode (in the view) when appropriate.

## NEW SPLIT VERTEX OPERATION

You can now split a shared vertex into multiple vertices—one for each polygon that shares it. This removes connectivity at the vertex, so you can perform independent operations on the split edges.

### To split a vertex:

- 1 Select the vertices you want to split.

---

#### *Note*

Any selected vertices that are not shared are ignored.

---

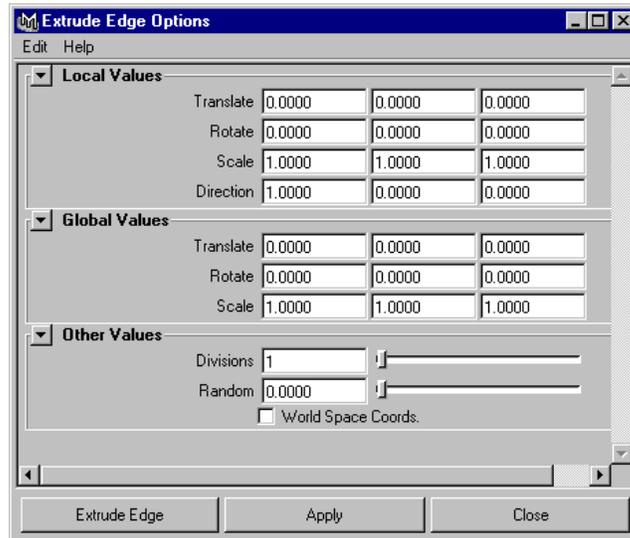
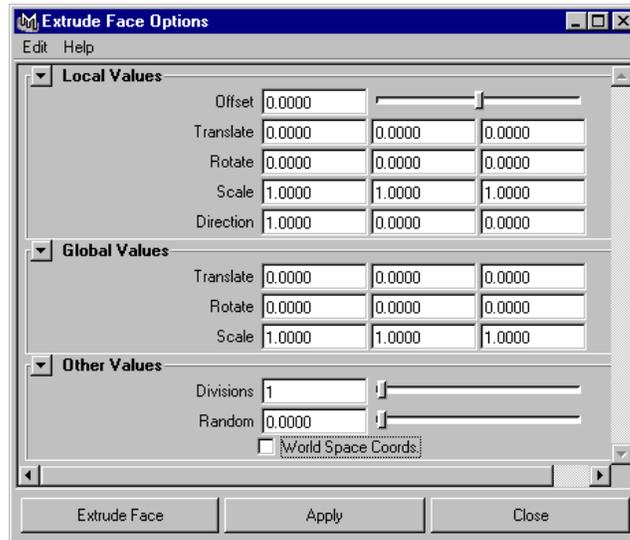
- 2 Select Edit Polygons > Split Vertex.

## NEW EXTRUDE COMMANDS

Previously, you could only extrude faces using Extrude. You can now choose to extrude either faces or edges by selecting Extrude Face or Extrude Edge from the Edit Polygons menu. Click  next to the menu item to open its associated option window.

## POLYGONAL MODELING | 4

### New Extrude commands



## NEW TEXTURE VIEW FEATURES

The following new features have been added to the Texture View:

- Select Shell and Select Shell Border
- Display Unfiltered
- Pixel Snap

### Select Shell and Select Shell Border

You can easily select entire shells and shell borders using the Select Shell and Select Shell Border commands, respectively.

#### To select a shell:

- 1 Do one of the following:
  - Select a UV to select all UVs on the UV shell.
  - Select a vertex to select all vertices in the polygon shell.
  - Select an edge to select all edges in the polygonal shell.
  - Select a face to select all faces in the polygonal shell.
- 2 In the Texture View, choose Select > Select Shell.

#### To select a shell border:

- 1 Do one of the following:
  - Select a UV to select all UVs on the border of the UV shell.
  - Select a vertex to select all vertices on the border of the polygon shell.
  - Select an edge to select all edges on the border of the polygonal shell.
  - Select a face to select all faces with edges on the border of the polygonal shell.
- 2 In the Texture View, choose Select > Select Shell Border.

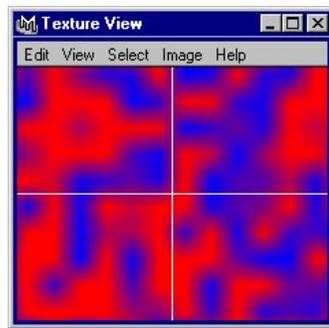
## POLYGONAL MODELING | 4

### New Texture View features

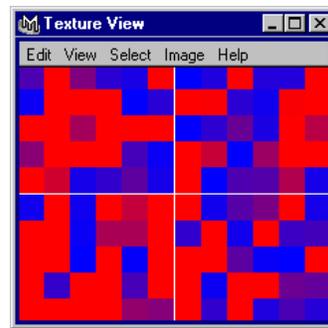
## Display Unfiltered

By default, images display filtered so that pixels blend into each other for a smoother quality. You can display images unfiltered so that when you zoom in you can see each pixel clearly. With pixels clearly displayed, you can use the Pixel Snap option (see next) to snap UV points to precise points on the texture.

To display images unfiltered, turn on Display Unfiltered in the Image menu of the Texture View.



Filtered image display.



Unfiltered image display.

## Pixel Snap

For greater control over UVs when you translate them, you can snap them to pixels (like snapping to a grid).

### To snap UVs to pixels:

- 1 Turn on Display Unfiltered in the Image menu.
- 2 Zoom in on the texture so you can see the pixels.
- 3 Select the UV you want to snap to a specific pixel and select the transformation tool.
- 4 Drag the UV. It will snap to the closest pixel corner.

## NEW NORMALS OPTIONS

The Reverse and Propagate option has been removed from the Normals submenu and incorporated with the Reverse option.

Also, a new Conform option has been added to the Normals menu.

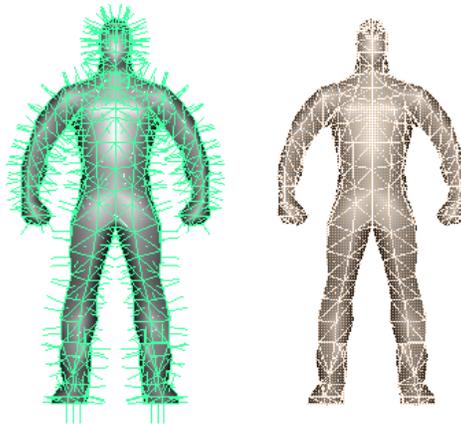
### Modified Reverse option

Reversing face normals affects the orientation of the face and causes the face normals to be computed in the opposite direction. Vertex normals are computed from the face normals, so they are affected as well.

There are three ways to reverse normals. You can:

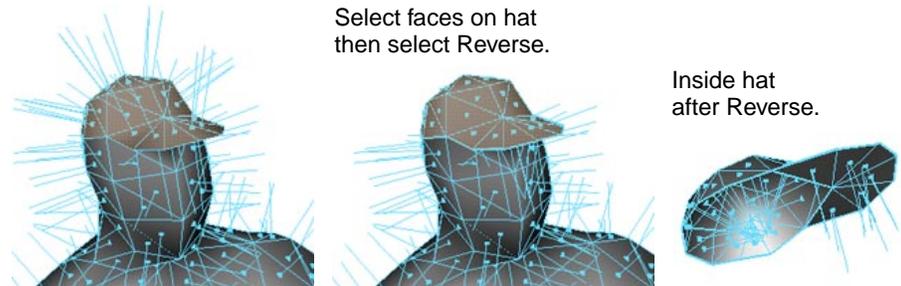
- Only reverse face normals.
- Reverse face normals and vertex normals and then extract the vertices.
- Reverse face normals and propagate the change to the rest of the normals in the shell.

You can reverse face normals one at a time or reverse multiple face normals.



## POLYGONAL MODELING | 4

### New Normals options



#### To reverse polygonal face normals:

- 1 To display normals on an active object, select Display > Polygon > Components > Normals.
- 2 Select the faces you want to reverse normals on:
  - To reverse the normals on an entire object, marquee-select the object.
  - To reverse normals on individual faces, press F11 or press the right mouse button and select Face from the marking menu, then click to select the faces whose normals you want to reverse and select Edit Polygons > Normals > Reverse.
- 3 Select Edit Polygons > Normals > Reverse .
- 4 Beside Mode, select how you want to reverse normals and click Reverse Normals or Apply.

#### Reverse

Maya reverses the normals on the selected faces.

---

#### Note

Reversing normals using this option can make your geometry nonmanifold. To correct nonmanifold geometry, perform a cleanup. For details, see “Cleanup improvements” on page 89.

---

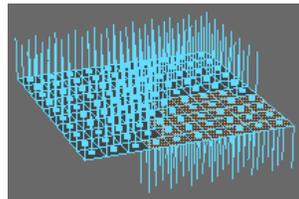
**Reverse and Extract** Maya reverses the normals on the selected faces and then extracts, or splits the vertices.

**Reverse and Propagate**

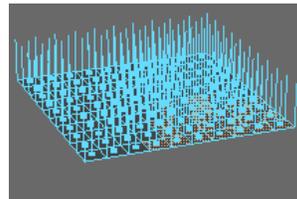
Maya reverses the normals on the selected faces and forces all the normals in the shells to which the faces belong to go in the direction of the reversed selection. This can come in handy if you create models where some of the normals are pointing in the opposite direction of the others.

**Conform**

Using the Conform normals option you can make all the normals of selected faces point in a consistent direction (no normals point in opposite directions).



Before Conform.



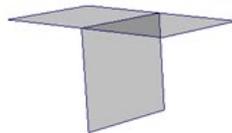
After Conform.

**To conform normals:**

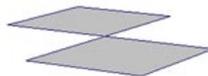
- 1 Select the faces whose normals you want to conform.
- 2 Select Edit Polygons > Normals > Conform. Normals conform to the direction shared by most of the faces.

**SUPPORT FOR NONMANIFOLD GEOMETRY**

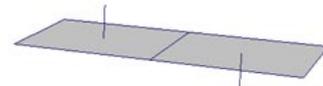
Maya 3.0 supports geometry with nonmanifold topology. Nonmanifold topology is illustrated by the following three examples:



Three or more faces share an edge.



Two or more faces share a single vertex but no edge.



Adjacent faces have opposite normals.

## POLYGONAL MODELING | 4

### Support for nonmanifold geometry

In the first example (the “T” shape), more than two faces share an edge.

In the second example (the “bowtie” shape), two faces share a single vertex without also sharing an edge. This shape is also possible where two three-dimensional shapes share a vertex (such as two cubes meeting at a single point).

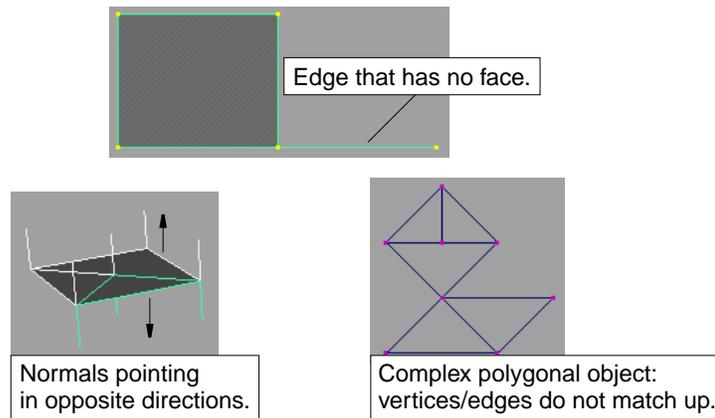
In the third example, a single shape has non-contiguous normals (without border edges). This is a less obvious example of nonmanifold geometry.

The following operations can produce nonmanifold geometry:

- Extrude Edge
- Normals > Reverse (reverse normals without extracting geometry)
- Merge Vertices
- Delete Face (select the face and press the backspace key)
- Collapse (Face or Edge)

To keep the polygon count down and make tasks such as mapping textures to your objects much easier and quicker, make the pieces of polygonal geometry making up a model fit properly. Avoid creating a polygonal edge that has no face. Also, try to create your polygons so that their normals point in the same direction. Although it is technically valid for the normals to point in opposite directions, textures may not behave as expected.

You can automatically make nonmanifold geometry 2-manifold (including the less obvious case of adjacent faces with opposite normals) using Polygons > Cleanup. For more information, see “Cleanup improvements” on page 89.



---

**Notes**

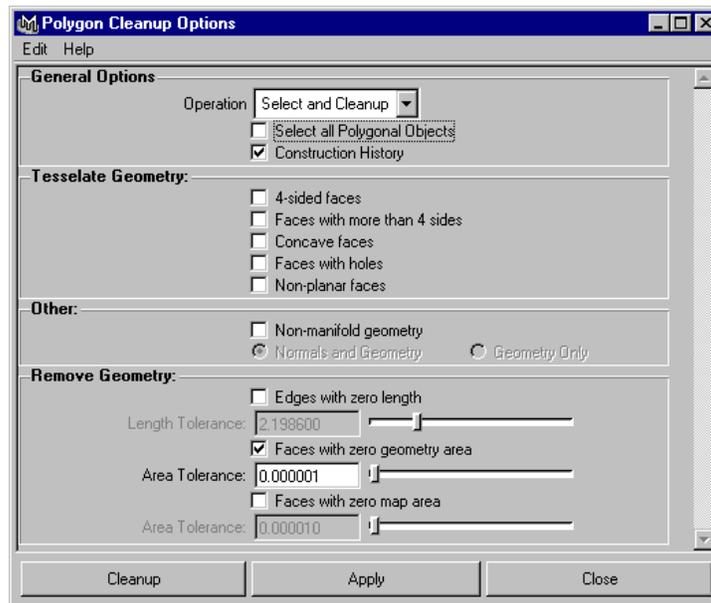
- Boolean and Reduce operations have no effect on polygonal objects with nonmanifold geometry.
  - Merge Edge operations have no effect on nonmanifold edges, although they work on 2-manifold edges that are part of nonmanifold geometry.
- 

## CLEANUP IMPROVEMENTS

A new section has been added to the Polygon Cleanup Options window (Polygons > Cleanup ) so you can clean up newly supported nonmanifold geometry.

## POLYGONAL MODELING | 4

Extract changes



### Other section

#### Nonmanifold geometry

Turn this option on to clean up nonmanifold geometry. Select one of the following options to control what happens to the resulting normals. For information on nonmanifold geometry, see “Support for nonmanifold geometry” on page 87.

#### Normals and Geometry

Turn on this option to conform normals when cleaning up nonmanifold vertices or edges.

#### Geometry Only

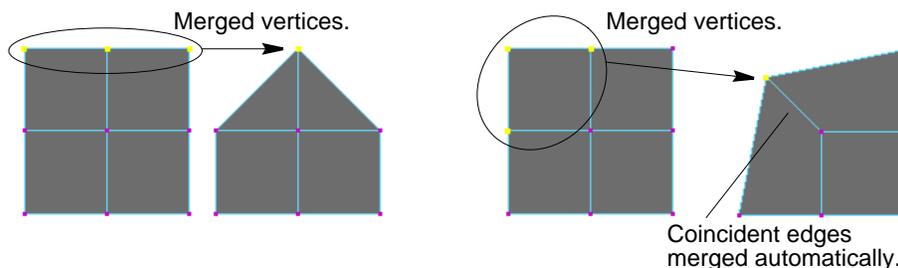
Cleans up nonmanifold geometry without changing the resulting normals.

## EXTRACT CHANGES

When you extract faces, Maya now separates the extracted faces by default. To extract faces without separating them, select **Edit Polygons > Extract**  and turn off **Separate Extracted Faces**.

## MERGE VERTICES IMPROVEMENTS

Merge Vertices now provides the additional functionality of Merge Multiple Edges as part of the same operation (providing the edges are coincident within the specified tolerance). In addition, Merge Vertices also merges the associated UVs, creating shared UVs.



---

### Note

Merging vertices can make your geometry nonmanifold. It is important to be aware of the orientation of face normals and the existence of coincident edges when performing this operation, and to consider this possibility when cleaning up a model, or preparing for export.

To correct nonmanifold geometry, perform a cleanup. For details, see “Cleanup improvements” on page 89.

---

## HYPERSHADE WORKFLOW IMPROVEMENTS

It is now possible to assign textures directly to selected objects and components in the view through Hypershade.

Right-click on a texture swatch and select Assign Texture's Material to Selected Objects from the pop-up menu. The texture is assigned to the selected objects and components in the view.

If the texture does not have an associated material, it automatically creates a Lambert material, assigns the texture to the Color channel, and continues with the assignment.

## POLYGONAL MODELING | 4

Hypershade workflow improvements

---

### *Note*

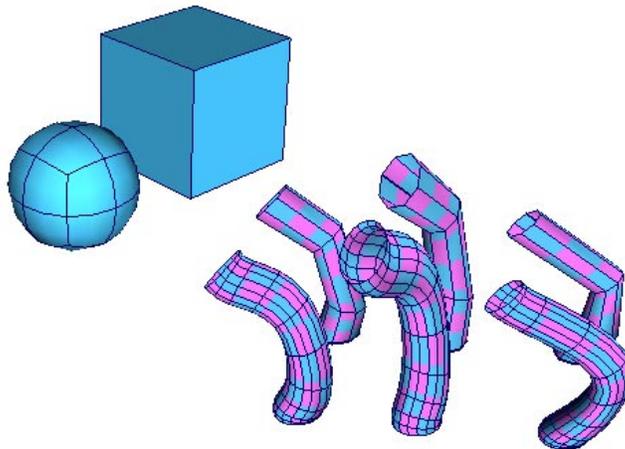
If a texture is associated with multiple materials, or any other ambiguous shading network, the operation will fail.

---

For information on other Hypershade improvements, see Chapter 9, “Rendering.”

# 5

## SUBDIVISION SURFACES MODELING



With this release of Maya Unlimited, we've added new features and improvements to the subdivision surfaces modeling environment.

Subdivision surfaces are now better integrated into Maya Unlimited's animation and rendering environments, and features improved performance, stability, flexibility, and hierarchy navigation.

### Subdivision Surfaces menu reorganization

#### Hierarchy and Polygon proxy modes

- Hierarchy mode
- Polygon proxy mode

## SUBDIVISION SURFACES MODELING | 5

Subdivision Surfaces menu reorganization

### Navigating the hierarchy

### Display filtering

### New functionality

- Extract Vertices
- Full and Partial Crease Edge/Vertex
- Collapse hierarchy
- Display normals
- New Hull display
- Create Subdiv option window changes
- Mirror
- Attach

### Performance tips

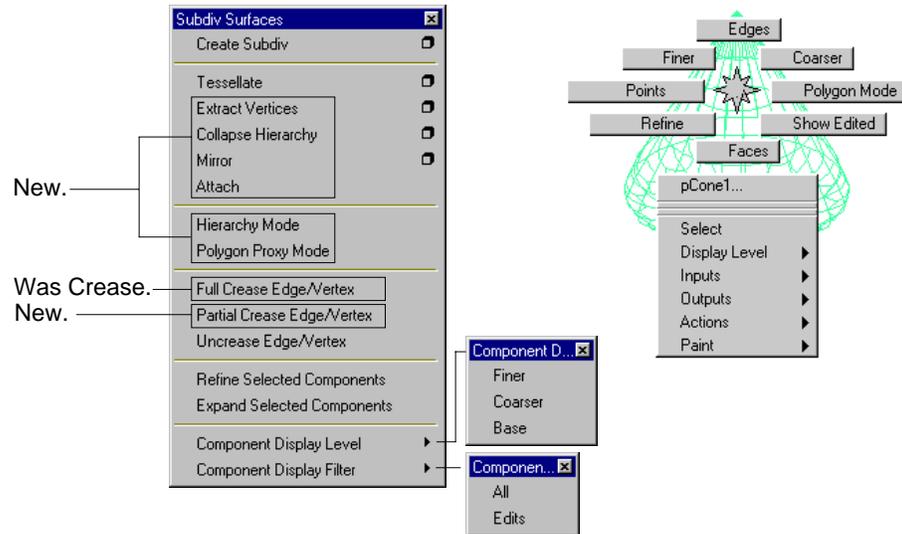
### Rendering tips

## SUBDIVISION SURFACES MENU REORGANIZATION

Both the Subdiv Surfaces menu and the marking menu for a subdivided surface have been reorganized for Maya Unlimited 3.0.

## SUBDIVISION SURFACES MODELING | 5

### Hierarchy and Polygon proxy modes



## HIERARCHY AND POLYGON PROXY MODES

You can now use one of two modes when working with subdivision surfaces:

- Hierarchy mode
- Polygon proxy mode

You can choose the mode when creating the subdivided object from the polygon, switch between the modes using the **Subdiv Surfaces > Hierarchy Mode** or **Polygon Proxy Mode** menu items, or use the right mouse button to select a mode from the marking menu.

### Hierarchy mode

In Hierarchy mode, the control points, edges, or faces at any level of the hierarchy can be viewed, manipulated (rotated, scaled, or translated), keyframed, etc. The subdivision surface will have no construction history (no deformers, etc.).

## SUBDIVISION SURFACES MODELING | 5

### Hierarchy and Polygon proxy modes

You can also crease edges and vertices, and you can now manipulate edges and faces (rotate, scale, translate) including the move normal and proportional modification functionality.

You can switch to this mode from the polygon mode at any stage of modeling. If you have deformations or any other construction history, it is deleted when you switch into this mode. If the surface is bound to joints, you cannot switch to polygon mode.

### Polygon proxy mode

Switching into this mode creates a polygon that matches the level 0 (base) control mesh of the subdivision surface.

In Polygon proxy mode, you can use the usual polygon tools and functions to indirectly modify the level 0 (base) control mesh of the subdivision surface since everything is connected through construction history. For example, you can extrude a face or delete one. The hierarchical edits are usually maintained.

You can switch to this mode from the hierarchy mode at any stage of modeling. The subdivision surface should have no construction history before you switch into this mode.

This mode also allows you to edit the UVs on the subdivision surface, indirectly, by editing the UVs on the polygon proxy object.

---

#### Notes

- When in polygon proxy mode, the polygon is not connected to any shaders, so it will draw as wireframe even while in shaded mode. This lets you see the resulting subdivision surface while manipulating the polygon using the usual polygonal tools and functions.
- Some polygonal operations will not maintain the hierarchical edits, namely Boolean operations and Bevel.

---

#### Example

You create a model in Hierarchy mode and then decide you need to extrude a face.

Switch to the Polygon proxy mode, extrude the face and return to hierarchy mode.

---

**Tip**

Try to perform a limited number of topological changes (for example, creating or deleting edges, faces or vertices) before returning to Hierarchy mode. In a way, you “bake” the changes with that action. You can then return into the polygon proxy mode to make new modifications.

---

## NAVIGATING THE HIERARCHY

Subdivision surface components (faces, vertices, and edges) now have a Display Level attribute, accessible through the Channel Box, that you can use to navigate to different levels of the component hierarchy (see Display filtering next).

These levels apply to components only. The object remains the same.

The levels are available from the pop-up menu or in the surface’s Attribute Editor, although only refined levels are shown. (Levels 1 and 2 are refined automatically and are always available from the pop-up menu).

You can select vertices from different levels using this navigation tool since selections are not lost as levels are changed.

Shift-click and Ctrl-Shift-click to add vertices to the selection. This opens up new opportunities deforming the surface at different levels.

---

**Note**

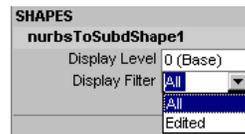
You cannot deform at different levels of the hierarchy using the same deformer.

---

## DISPLAY FILTERING

A Display Filter attribute for subdivision surfaces is now available in the Channel Box. You can use this attribute to hide and show specific types of vertices.

Use the Display Filter pop-up menu to select the vertices you want to see.



- All displays all the vertices of the current level.
- Edited displays only edited vertices (vertices that have been transformed) at the current level.

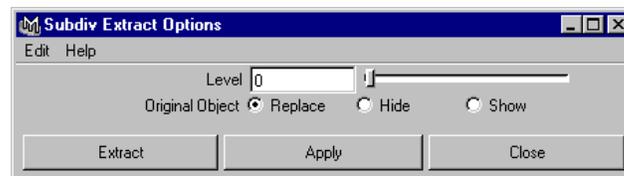
## NEW FUNCTIONALITY

The following have been added or changed for subdivision surfaces in Maya Unlimited 3.0.

### Extract Vertices

Use the new menu item, **Subdiv Surfaces > Extract Vertices**, to create a polygon that matches the control points of the subdivision surface (at a given level) instead of one that matches the shape of the surface.

This option is equivalent to the Control Points option in the **Polygons > NURBS to Polygon** function. The following shows the option window for this new function:



## Full and Partial Crease Edge/Vertex

Subdiv Surfaces > Crease has been renamed Full Crease Edge/Vertex and the Partial Crease Edge/Vertex function has been added.

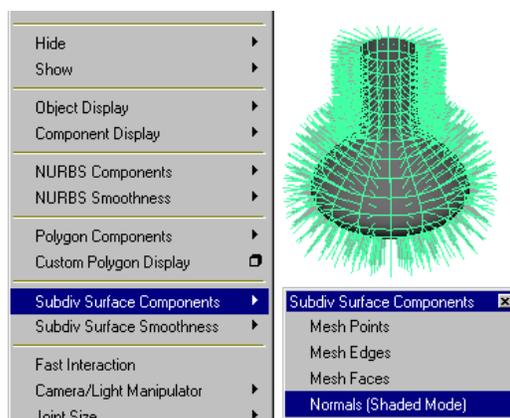
Partial Crease Edge/Vertex lets you change the shape of the surface in the vicinity of the selected vertex or edge without making a tangent break in the surface.

## Collapse hierarchy

Use this option to remove a number of levels of the hierarchy from the coarsest level. This keeps the shape of the surface, but increases detail at the base mesh. For example, if you collapse at level 2, previous level 2 vertices now become level 0 vertices, level 3 vertices become level 1 vertices, level 4 vertices become level 2 vertices, and so on.

## Display normals

You can now display the normals on a subdivided surface using Display > Subdiv Components > Normals (shaded mode) while in shaded mode.



To return to the original display mode, select Display > Subdiv Components > Normals (shaded mode) again.

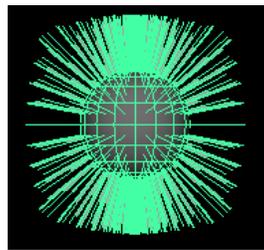
## SUBDIVISION SURFACES MODELING | 5

New functionality

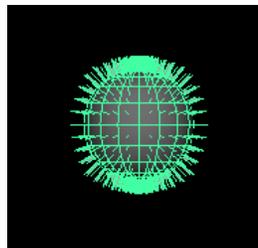
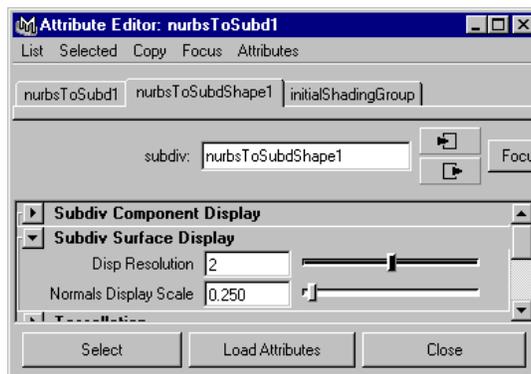
### Changing the normal size and resolution

You can also control the size and resolution of the displayed normals.

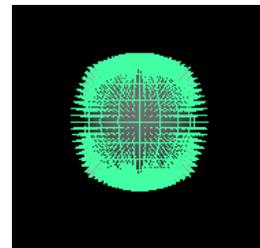
- Open the surface's Attribute Editor.
- Click to open the Subdiv Surface Display section and use the Disp Resolution and Normals Display Scale sliders to adjust the resolution and size of the normals.



Default size and resolution: 1 and 1.0.



Size set to 0.25.



Size set to 0.25 and resolution set to 2.

### New Hull display

Hull display is simply a fast approximate display tool for subdivision surfaces. Select Display > Subdiv Surface Smoothness > Hull for faster interaction with your subdivided surfaces. This new feature can be useful when working with deformations.

Similar to Display > NURBS Smoothness > Hull display, CVs are joined instead of drawing the entire surface. The CVs of the finest level faces that have been edited are drawn. Using this display mode can be useful because this mode shows any cracks if vertices have been edited at different levels.



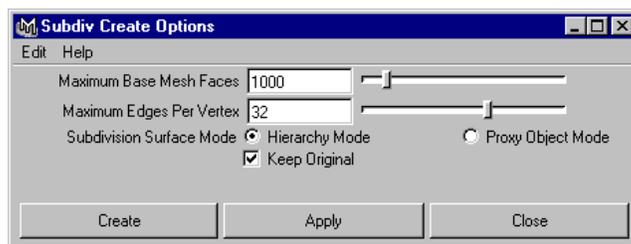
Hull display off.



Hull display on.

## Create Subdiv option window changes

The Create Subdiv option window has been changed for this release of Maya. Instead of Replace, Hide, and Show options, the combination of Keep Originals on or off and Hierarchy Mode and Object Proxy Mode options has been added.



## Mirror

Using Mirror, you can duplicate and flip a selected subdivision surface relative to the x, y, and z axis.

## SUBDIVISION SURFACES MODELING | 5

New functionality

---

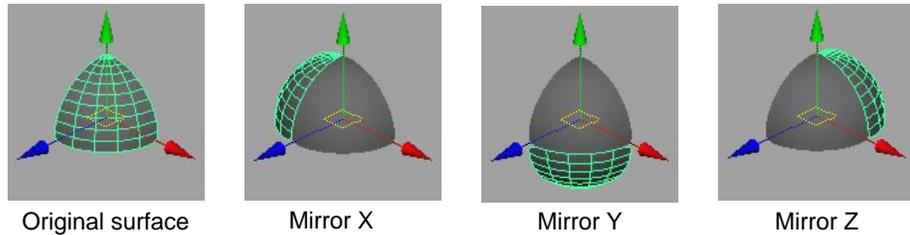
### Note

Do not mirror subdivision surfaces using a negative scale on a duplicate of the surface. Hierarchical edits and normals behave differently on the duplicate so you will be unable to successfully attach the mirrored duplicate to its original.

---

#### To mirror a subdivision surface:

- 1 Select the subdivision surface.
- 2 Select Subdiv Surfaces > Mirror .
- 3 Turn on the axes you want to mirror the surface along and click Mirror or Apply. By default, Maya duplicates and flips the surface along the X axis.



## Attach

Using Attach, you can merge two selected subdivision surfaces to create a new single subdivision surface. For example, you can use Attach to merge mirrored surfaces, or to attach an arm to a torso.

The edges of the surfaces will “stitch” together only if each surface has the same number of polygonal edges at the base mesh level (level 0). If the surface does not have the same number of edges, the surfaces combine, but do not merge. Only edges within the threshold defined by Edit Polygons > Merge Multiple Edges are merged. For information on Merge Multiple Edges, see *Using Maya: Polygonal Modeling*.

---

**Note**

If you mirror subdivision surfaces using a negative scale on a duplicate instance of the surface, Attach will not successfully merge the duplicate to the original.

---

**To attach subdivision surfaces:**

- 1 Make sure the two surfaces you want to attach each have the same number of polygonal edges at the base mesh (level 0). If they do not have the same number of edges, the surfaces will combine, but not merge.
- 2 Switch to hierarchy mode, if you are not already in it (Subdiv Surfaces > Hierarchy Mode).
- 3 If you are merging mirrored surfaces, delete the history on the mirror copy.
- 4 Select the surfaces you want to attach.
- 5 Select Subdiv Surfaces > Attach.

## PERFORMANCE TIPS

- Use Display > Subdiv Surface Smoothness > Hull display for faster interaction with subdivided surfaces.
- From the View panel, select Show > Isolate Select and choose a menu item to view only parts of the subdivided surface. See the chapter, Basic Features, for more information on the new *Isolate Select* feature.
- Converting a high resolution polygonal model to a subdivision surface creates a dense subdivision surface, defeating the purpose of the subdivision surface and decreasing performance.

## RENDERING TIPS

- There are no multiple UVs on subdivision surfaces, so when converting from polygonal surfaces to subdivision surfaces, only a single set of UVs is inherited.

## SUBDIVISION SURFACES MODELING | 5

### Rendering tips

- Component level shader assignment is allowed on subdivided surfaces, but should be assigned to level 0 (base mesh) or level 1 faces. When converting from a polygon with component level shader assignment, the shaders are assigned correctly to the newly created subdivided surface.
- Motion blur, displacement mapping, texturing, etc. all work on subdivision surfaces. The tessellation controls for rendering are now available in the Attribute Editor for a subdivided surface.
- Subdivided surfaces with component level shaders render (or IPR) correctly.
- Converting a subdivided surface to a polygon (tessellate or extract vertex) assigns a default shader to the resulting surface and will not carry through component level shader assignments.

# 6

## ANIMATION



Character set up, animated, and rendered in Maya by Cristoph Berndt.

In Maya 3, we've added many animation features, including the new Trax Editor for creating nonlinear character animation. This chapter describes the new animation features in Maya 3.0.

Maya provides these animation enhancements:

#### **Basic interface enhancements**

- “Range Slider display” on page 107
- “Quick access to playback looping options” on page 107
- “Frame rate display” on page 107

#### **Graph Editor improvements**

- “Euler angle filtering” on page 107
- “Scaling keys within a region” on page 108
- “Outliner split control” on page 108

#### **Motion path flipping improvement**

#### **Motion path camera direction control**

#### **Nonlinear character animation—the Trax Editor**

- “About clips” on page 110
- “Using the Trax Editor window” on page 111
- “Understanding clips and poses in the Visor” on page 112
- “Working with clips” on page 113
- “MEL commands and dependency graph nodes” on page 131

#### **Adding and removing tracks**

#### **Motion warping**

#### **Using poses**

#### **Exporting and editing character maps**

#### **Working with subcharacters in the Trax Editor**

## BASIC INTERFACE ENHANCEMENTS

### Range Slider display



Range Slider display toggle

A new button next to the Timeline lets you quickly display or hide the Range Slider.

### Quick access to playback looping options

You can now quickly select playback looping options from the Timeline.

Press the right mouse button in the Timeline to display a pop-up menu and select Playback Looping from that menu. Now, select Once, Oscillate, or Continuous playback looping.

These are the same the playback looping options that appear in the Preferences window (now under Animation Timeline and Playback).

### Frame rate display

You can now display the actual frame rate of an animation in the workspace. Select Display > Heads Up Display > Frame Rate. The actual frame rate is displayed in the lower right hand side of your current view.

This helps you remember which frame rate you are using, and can be useful when providing demos of your work.

## GRAPH EDITOR IMPROVEMENTS

### Euler angle filtering

When you import motion capture data into Maya as animation curves, the curves sometimes become mangled when the rotation values are restricted to a specific range.

## ANIMATION | 6

### Motion path flipping improvement

#### To filter curves to correct mangling:

- 1 In the Graph Editor, select the mangled animation curves (for example, Rotate X, Y, and Z).
- 2 Select Curves > Euler Filter.

Note that the filtering is always applied to entire curves, not just to selected curve segments within some time range.

### Scaling keys within a region

With the Graph Editor's new Only Scale Specified Keys option, you can now scale the keys in a selected region of the Graph Editor. The keys outside the region are not affected by the scaling.

#### To scale the keys in a region:

Select Edit > Scale .

### Outliner split control

You can now split the Graph Editor's outliner to view two different listings at once. This helps you switch back and forth when working on different sets of animation curves.

#### To split the outliner:

- 1 Move the cursor towards the bottom of the outliner.  
The cursor icon changes into an up-down icon.
- 2 You can now drag the cursor to move the outliner separator, creating a second outliner space.

Note you can also split the Relationship Editor's outliner this same way.

## MOTION PATH FLIPPING IMPROVEMENT

In Maya 3.0, you can prevent objects from flipping using the Attach to Path Options menu. Previously, objects could suddenly flip during motion path animation when World Up was specified as the Up Direction in the Attach to Path Options menu (Animate > Paths > Attach to Path .

The Attach to Path Options menu now includes selections for World Up Type, World Up Vector, and World Up Object. These options work in the same manner as the options you set to prevent rolling effects with constraints.

For example, you can now create a locator and designate it as the World Up Object, then rotate it, as needed, to prevent flipping.

## MOTION PATH CAMERA DIRECTION CONTROL

One common use for motion path animation is to animate a camera to move forward along a curve. With the new Inverse Front attribute (and Animate > Attach to Path  options), it is now easier to turn a camera around along the curve and point it forward. In previous releases, it was sometimes difficult to get a camera to point forward because of the way the camera aligned along the curve by default.

### To animate a camera along a curve:

- 1 Attach the camera to the curve as before (Animate > Attach to Path).
- 2 Adjust the camera's orientation by editing the motionPath node attributes as usual (the Inverse Up, Front Axis, and Up Axis attributes).
- 3 Use the new Inverse Front attribute (next to Inverse Up in the Attribute Editor) to quickly reverse the direction the camera is pointing along the curve.

Typically, the camera will be pointing backwards along the curve. By clicking Inverse Front on, you can point the camera point forward along the curve.

Note that although this workflow is typically used for animating cameras, it also applies to any object you want to animate along a curve.

## NONLINEAR CHARACTER ANIMATION—THE TRAX EDITOR

The Trax Editor lets you layer and blend character animation sequences nonlinearly—independently of time. You can work with any type of keyed animation, including motion capture and path animation. The Trax Editor lets you synchronize animation created with a variety of Maya techniques.

### About clips

At the heart of Trax Editor usage is the *clip*—a span of animation you obtain from an existing animated character. The most commonly used clips are independent, reusable animation sequences that are easy to merge or blend with other clips. For example, a walk cycle, run cycle, jump, and tumble are ideal candidates for clips because you can blend and sequence them in various ways.

Common ways to work with clips follow:

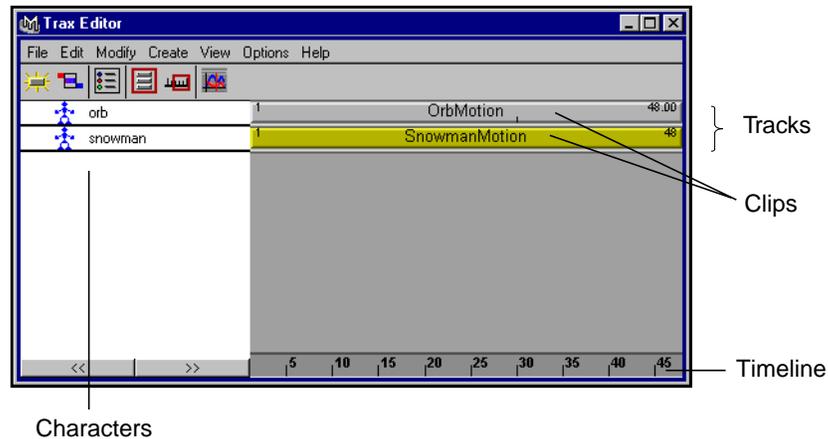
- Move a clip to a different playback time.
- Cycle a clip to make animation repeat.
- Synchronize clips of a single character or of several characters. (See *Using Maya: Character Setup* for details on characters.)
- Instance or copy a clip to new characters. You can even export, import, and reference clips from other scenes.

The Trax Editor also helps you explore variations in animation without losing your work. For instance, suppose you create a soldier walking, but decide you want to lift the legs higher to make the character march rather than walk. If you make the walk cycle a clip, you can set additional keys that adjust the leg motion without affecting the rest of the character.

If you create a clip from the new leg motion, you can blend it with the old leg motion or disable it if decide you don't like it. By creating several clips with different leg motion, you can experiment with various clips until you get the desired results. No prior animation is destroyed in the process.

## Using the Trax Editor window

To understand the elements of the Trax Editor, display it by selecting Window > Trax Editor.



The left side of the Trax Editor window lists the characters and subcharacters in your scene. The right side of the window displays a Timeline and tracks that contain the animation clips you create. You see tracks (and characters) in the Trax Editor only if you've created characters in your scene.

You can animate a character with one or more clips on one or more tracks. A track can have multiple clips in sequence. Clips play from left to right as the scene plays. If a character has multiple tracks, Maya uses the clips on all of them. Overlapping clips have an additive effect. You can blend overlapping clips to avoid doubling the motion.

Note you can create a character with the Trax Editor by selecting Create > Character. This option is identical to Character > Create from Maya's main menus. See *Using Maya: Character Setup* for details.

## Enhancing the Trax Editor display

Once you've learned to use the Trax Editor, there are several ways you can enhance the display to provide information:

## ANIMATION | 6

Nonlinear character animation—the Trax Editor

### To view only the current character's clips:

- 1 In Maya's main menus, select Character > Set Current Character > *character*.
- 2 In the Trax Editor, turn on View > List Current Characters Only.

### To view the Trax Editor only where clips exist:

In the Trax Editor, select View > Frame All.

### To view the entire Timeline range:

In the Trax Editor, select View > Frame Timeline Range.

### To increase the view size of tracks:

- 1 In the Trax Editor, select Options > Preferences.
- 2 Select Large for the Track Height.

### To display all of a character's clips on a single track:

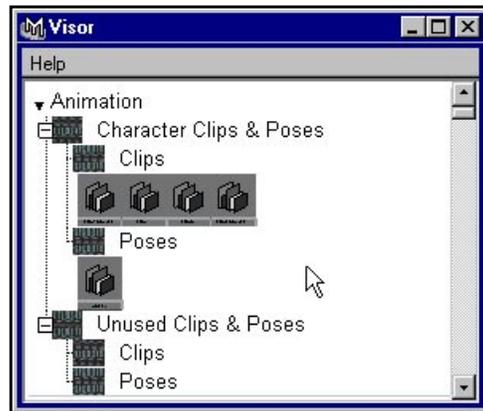
In the Trax Editor, click the triangle to the left of a character name.

The multiple tracks are displayed as a single blue track. If you move this track to a different location, you move all tracks within it.

## Understanding clips and poses in the Visor

The Animation section of the Visor shows the source clips that exist in a scene. When you are considering whether to import, export, or copy and paste clips from one character to another, you'll likely want to display the clips in the Visor.

To open the Visor from the Trax Editor, select File > Visor.



Two folders are related to clips: Character(s) Clips & Poses and Unused Clips & Poses. If there is a current character, the Clips folder under Character(s) Clips & Poses contains source clips for that character only. If there is no current character, it contains source clips for all characters in the scene.

The Clips folder under Unused Clips & Poses contains source clips that aren't used by any characters in your scene. For example, if you've imported a clip from another scene, it is stored here. If you paste it to a character, it still appears in Unused Clips & Poses, but Maya adds an extra copy of the clip to the character. After you're done pasting the clip to a character, you can delete it to avoid wasting memory.

A pose is a snapshot you create of a character's current positioning for any moment in the Timeline. (See "Using poses" on page 134 for details.)

If you select a character as the current character, the Poses folder under Character(s) Clips & Poses contains poses for that character only. If there is no current character, it contains poses for all characters in the scene. The Poses folder under Unused Clips & Poses contains the poses that weren't derived from any character in your scene.

## Working with clips

After you've animated a character, you can create a clip for all or part of its animation. The following paragraphs describe how you can edit clips.

- "Creating clips" on page 114

## ANIMATION | 6

Nonlinear character animation—the Trax Editor

- “Editing clip attributes” on page 116
- “Editing source clip attributes” on page 119
- “Cutting, copying, and pasting clips” on page 120
- “Duplicating clips” on page 122
- “Instancing clips” on page 123
- “Splitting clips” on page 124
- “Merging clips” on page 125
- “Blending clips” on page 126
- “Viewing and editing a clip’s animation curves” on page 128
- “Editing a clip’s original keys” on page 129
- “Disabling and enabling clips” on page 129
- “Importing and exporting source clips” on page 130
- “Importing clips by reference” on page 131

### Creating clips

#### To create a clip:

- 1 Select a character.
- 2 In the Trax Editor, select Create > Clip  to display the options window.  
You can alternatively select Animate > Create Clip  from Maya’s main menus to display the options window.
- 3 Set the following options and click the Create Clip button.

#### Name

Specifies a name for the clip. Default is clip*n*.

#### Keys

Leave Keys in Timeline leaves the character’s keys in the Time Slider’s Timeline and puts the clip in the Visor (see “Understanding clips and poses in the Visor” on page 112). This is useful if you won’t use the clip currently but want to store it for future use. By leaving the keys in the Timeline, you can create another clip with the keys.

With Leave Keys in Timeline off, you can choose whether to put the clip in in the Visor only or in the Trax Editor and Visor. Put a clip in the Trax Editor if you want to be able to play the clip immediately after you create it.

With Leave Keys in Timeline off, you can no longer create a clip for that character from the keys that were previously in the Timeline. Maya removes the keys and leaves the Timeline empty so you can start to create a new clip.

If you want to create several clips for different time ranges of a character’s animation, turn off Leave Keys in Timeline and turn on Put Clip in Trax Editor and Visor. Create a clip with the entire range of desired keys, then split the clip into the desired animation segments. See “Splitting clips” on page 124.

Note that if you turn on Leave Keys in Timeline, the Put Clip in Trax Editor and Visor option is dim to prevent keys in the Timeline adding to the clip animation in the Trax Editor. This would have a doubling effect on the animation. If you create a clip for a character and later key the character in the Time Slider’s Timeline, the key animation is added to the clip animation. This is called *motion warping* or nondestructive animation.

**Clip**

Specifies where to put the clip you’re creating:

Put Clip in Visor Only is useful if you won’t use the clip currently but want to store it for future use.

Put Clip in Trax Editor and Visor lets you work on the clip in the Trax Editor now. This is the default setting.

**Time Range**

Specifies the clip’s time range in the Trax Editor:

Use Selected uses a time range you’ve selected in the Timeline for the clip. To select a time range, Shift-drag through the desired times in the Time Slider’s Timeline.

Use Time Slider Range uses a time range defined by the Playback Start and End times of the Timeline.

Use Animation Curve Range uses a time range that spans the range of the character’s animation curves. That is, the start time is the time of the first key on the character, and the end time is the time of the last key.

Specify Start and End uses a time range you enter directly in Start and End boxes.

**Start and End**

Specifies the start and end times of the clip. Available if Specify Start and End is on.

## ANIMATION | 6

Nonlinear character animation—the Trax Editor

**Subcharacters** Include Subcharacters in Clip includes the animation for any subcharacters in addition to the character’s animation. See “Working with subcharacters in the Trax Editor” on page 136.

### Editing clip attributes

#### To edit clip attributes:

- 1 In the Trax Editor, click a clip to select it.
- 2 In the Trax Editor, select Modify > Attribute Editor.

The following attributes are displayed:

#### Anim Clip Attributes

**Weight** Scales up or down the value of each attribute in the clip by the specified percentage. The scaling occurs for the entire animation of the clip, and pivots around the clip’s start value. For example, suppose an object’s translateX attribute increases in value from 10 to 20 in 30 frames. If you set Weight to 0.5, the translateX attribute rises from 10 to 15 in 30 frames.

All attribute data types are effected by Weight except Boolean (on/off) attributes.

**Offset** Specifies how Maya interprets attribute values for the clip if the attributes were controlled by a prior clip or keys in the Timeline:

Absolute uses an attribute’s clip value regardless of the prior value.

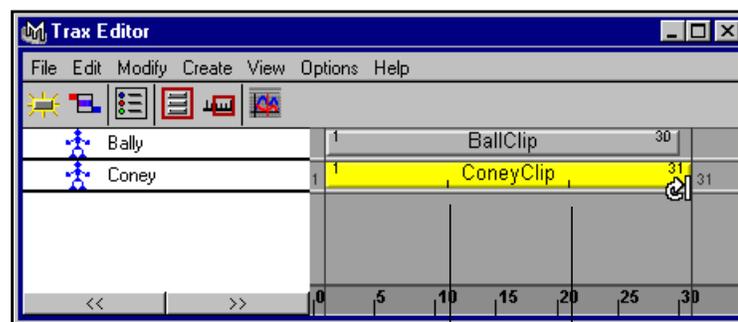
Relative adds the attribute’s clip value to its prior value.

For example, suppose you’ve created two clips that play sequentially in the Timeline. The first clip is a character walking away from the origin along the X-axis, the second clip is the character running away from the origin along the X-axis.

If you turn on Relative, the character walks away from the origin then starts running from the position where the walking clip ends and the running clip begins. If you turn on Absolute, the character walks away from the origin. When the walking clip ends and the running clip begins, the character moves instantly to the origin and starts running from that position.

Note that if two clips overlap in a pair of tracks for the same character, Maya adds the values of any redundant attributes, regardless of whether you use Absolute or Relative. This compounding effect is typically undesirable unless you blend the clips (see “Blending clips” on page 126).

- Enable** Disabling a clip turns off the animation controlled by the clip. Enabling turns on normal animation. It’s often useful to disable clips you’re not working on to lessen visual distraction.
- Start Frame** Specifies the starting time of the clip’s playback. You can alternatively drag a clip left or right in the Trax Editor to change the Start Frame.
- Cycle** Specifies how many times the clip repeats. For example, suppose your clip originally plays for 10 frames. A value of 2 causes the clip to play twice in 20 frames. A value of 0.5 causes the clip to play half its animation in 5 frames. If you use a Cycle value over 1, the clip displays a small ruler-type marker to indicate where each additional cycle begins.

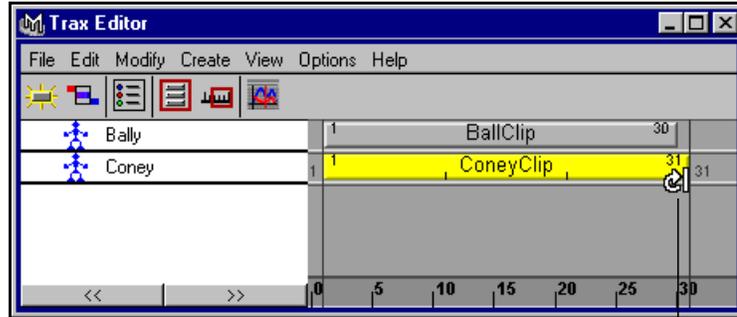


Cycle markers

As an alternative to typing a Cycle value, you can drag the lower right edge of a clip to increase or decrease the value. As you drag, the following icon appears on the clip:

## ANIMATION | 6

Nonlinear character animation—the Trax Editor

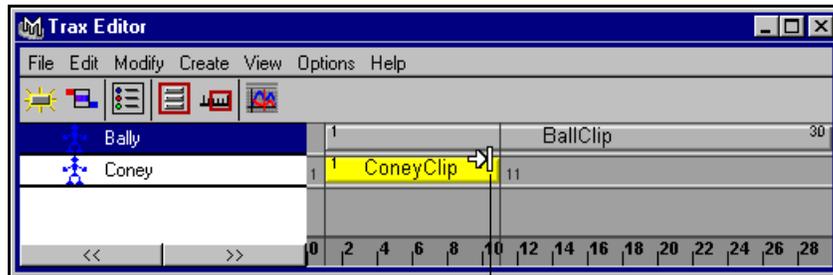


Cycle drag icon

### Scale

Expands or contracts the time range for which the clip plays. If you increase the scale, the attributes animate slower. Decreasing the scale has the opposite effect.

You can alternatively drag the upper right edge of a clip to change the Scale value. As you drag, the following icon appears on the clip:



Scale drag icon

### Source Clip Attributes

For more information, see “Editing source clip attributes” on page 119.

### Node Behavior

Contains rarely used, general attributes. See *Using Maya: Essentials* for details.

**Extra Attributes**

None, by default.

**Tip**

As an alternative to using menu items at the top of the Trax Editor, you can right-click a clip to display menus applicable to that clip only.

**Editing source clip attributes**

When you create a clip, Maya stores the entire range of the selected character's animation curves in a node named `clipSource` in the Visor (see "Understanding clips and poses in the Visor" on page 112). A clip in the Trax Editor is a playback instance of the source clip. The playback range of the clip in the Trax Editor can be part or all of the range stored in the source clip.

You can edit a few attributes of the source clip, for example, the start time that you originally selected when you created the clip. For instance, suppose, in frames 1 to 100, you key a basketball player bouncing a ball repeatedly then shooting. You then create a clip from frames 30 to 50 for a single bounce. If you decide to extend the clip to be a single bounce followed by the shot, you cannot extend the bounce by modifying the clip in the Trax Editor. You must instead modify the Start attribute in the source clip.

Note that when you change an attribute of the source clip, each use of that clip in the Trax Editor is modified.

**To edit source clip attributes:**

- 1 In the Trax Editor, right-click a clip and select Select Clip Source from the pop-up menu.
- 2 In the Trax Editor, select Modify > Attribute Editor.

The following attributes are displayed:

**Anim Clip Attributes**

This area is dim because the attributes do not apply to the clip source. For more information, see "Editing clip attributes" on page 116.

## ANIMATION | 6

Nonlinear character animation—the Trax Editor

### Source Clip Attributes

<b>Pose</b>	If you created a pose for the character rather than a clip, the Attribute Editor displays the Pose option as being turned on. See “Using poses” on page 134 for details on creating poses. This option simply lets you know that this clip is a pose rather than an animation clip. Note that Maya puts poses in the Visor.
<b>Start</b>	Specifies the start time of the source clip.
<b>Duration</b>	Specifies the amount of time the source clip range extends from the Start.

### Node Behavior

This section includes rarely used, general purpose attributes not specific to clips. See *Using Maya: Essentials* for details.

### Extra Attributes

None, by default.

## Cutting, copying, and pasting clips

You can cut or copy a clip from the Trax Editor, and you can copy a clip from the Visor. After you cut or copy a clip, you can paste it to the same character, or more typically, to a different character that has similar attributes.

If you copy and paste a clip to the same character, you create a playback instance of the clip (see “Instancing clips” on page 123). If you copy a clip and paste it to a new character, you create a duplicate (see “Duplicating clips” on page 122).

Note that you cannot paste over a selected clip to replace it. You must delete the undesired clip, copy and paste the desired clip to the character, then move the clip to the correct position.

It’s best to paste a clip only to a character that has similar attributes and objects as the original. If the two characters differ, you’ll typically need to do many extra steps described in “Exporting and editing character maps” on page 135.

### To cut a clip:

- 1 Select the clip.

- 2 In the Trax Editor, select Edit > Cut.

#### To copy a clip from the Trax Editor:

- 1 Select the clip.
- 2 In the Trax Editor, select Edit > Copy.

#### To paste a clip to the same character:

- 1 Select the character.
- 2 In the Trax Editor, select Edit > Paste.

#### To paste a clip to a different character:

- 1 Select the character.
- 2 In the Trax Editor, select Edit > Paste .
- 3 Set the following options and click the Paste Clip button:

#### Paste Method

By Attribute Name pastes attribute values to the matching attribute names of the receiving character. Object names are ignored.

By Attribute Order pastes attribute values to the receiving character based on the descending order of attributes in the Channel Box.

By Node Name pastes attribute values to the matching object and attribute names of the receiving character.

By Current Map is relevant only if you are doing the steps in “Exporting and editing character maps” on page 135.

#### Example

Suppose you copy and paste a clip from a character named Mars to a character named Earth. If you’ve animated the translate X, Y, and Z attributes of Mars and you specify By Attribute Name, the animation will be applied to the translate X, Y, and Z attributes of Earth.

If you instead specify By Attribute Order, the animation might or might not be applied to the translate X, Y, and Z attributes of Earth, depending on whether these attributes are listed in the Channel Box in the same descending order for both characters.

## ANIMATION | 6

### Nonlinear character animation—the Trax Editor

If you instead specify By Node Name, the animation will be applied to the translate X, Y, and Z attributes of Earth only if the objects in Earth’s hierarchy have identical names as those in Mars.

Note that Maya allows two characters to have identical object and attribute names only if each character has its objects grouped under a group node.

#### Start Frame

Specifies where in the Timeline the clip will be pasted:

Current Time specifies the current time of the Timeline.

Timeline Start specifies the Start Time of the scene.

Clipboard Start specifies the Start Time of the clip.

If the location in the Timeline is already occupied by a clip, Maya puts the clip on the first available track below, adding a track if necessary.

#### To copy a clip from the Visor and paste it in the Trax Editor:

- 1 From the Trax Editor, select File > Visor.
- 2 From the Visor, middle-mouse drag the clip to the desired track and position. Maya puts the clip where you click in the track unless a clip occupies that spot. If occupied, Maya puts the clip on the first available track below, adding a track if necessary.

If you middle-mouse drag to a character from a source clip from the same character, Maya creates an instance of the clip (see “Instancing clips” on page 123).

If you middle-mouse drag to a different character and you previously created a character map between the characters, Maya pastes the clip using the character map (see “Exporting and editing character maps” on page 135). Otherwise, Maya pastes using the By Node Name paste method. If you want to paste using a different method such as By Attribute Name, right-click the clip in the Visor and select Copy, then use Edit > Paste  and select the desired method.

#### Duplicating clips

You can duplicate a clip to create a copy of the original source clip and all of its animation curves. If you create a duplicate, you can modify the animation of the original source clip without affecting the duplicate.

For example, suppose you've created a jump clip you want to keep, but you also want to create a slightly different jump clip. Simply duplicate the clip, activate the duplicate's keys, then modify them for the new jump. You won't affect the original jump clip or any of its instances. For details on activating a clip, see "Editing a clip's original keys" on page 129.

A source clip can be used by only one character, so you can't duplicate a source clip and use it with multiple characters. If you want to use a copy of a source clip on a different character, you must copy and paste a clip from one character to another.

#### To set duplicate clips options:

- 1 In the Trax Editor, select Edit > Duplicate .
- 2 Set the following options and click the Duplicate Clip button:

#### Clip

Specifies where to put the copy of the clip.

Put Clip in Visor Only is useful if you won't use the clip currently but want to store it for future use.

Put Clip in Trax Editor and Visor lets you work on the clip in the Trax Editor now. Maya puts the playback instance of the clip in the Trax Editor at the current time. This is the default setting.

### Instancing clips

If you select a clip in the Trax Editor and instance it, the resulting clip uses the animation curves of the selected clip's source clip. If you modify the animation for a source clip, you modify both clips. Instancing a clip uses less computing resources than creating several different source clips for identical animation.

An example illustrates the benefits of instancing. Suppose you create a clip of a character jumping. If you want the character to jump several times, you'll use less computing resources by instancing several jumps rather than making copies.

You can also use the Cycle attribute to play a clip repeatedly with the same savings in computing resources. However, cycling plays a clip repeatedly without allowing breaks between each playback of the clip. For details on cycling, see "Editing clip attributes" on page 116.

## ANIMATION | 6

### Nonlinear character animation—the Trax Editor

A source clip can be used by only one character, so you can't create instances from the same source clip to multiple characters. To animate several character identically, you must copy and paste a clip from one character to another.

#### To instance clips:

- 1 In the Trax Editor, select the clip you want to instance.
- 2 In the Trax Editor, select Edit > Instance.

You can alternatively instance a clip by middle-mouse dragging a source clip in the Visor to the same character in the Trax Editor.

#### Splitting clips

You can split a clip to divide a character's animation into multiple, reusable clips. For example, suppose you've animated a character to do three moves: a karate punch, a swinging leg kick, and a tumble. You can split the clip into the three moves then rearrange their order.

#### To set split clip options:

- 1 In the Trax Editor, select Edit > Split .
- 2 Set the following options and click the Split Clip button:

#### Source Clip

Specifies what to do with the source clip for the clip being split:

Delete Original Source deletes the source clip before creating two new source clips. Use this option if you know you won't use the whole clip again.

Keep Original Source leaves the source clip in place before creating two new source clips. If you think you might use the whole clip again in the future, use this option.

The two new source clips are named clip $n$ SourceStartSource and clip $n$ SourceEndSource, by default.

#### Split Time

Specifies where to split the clip:

Current Time uses the current time in the Timeline.

Specify Time lets you enter the time where the split occurs in an entry box labeled Split Time.

---

**Tip**

You cannot split a cycled clip directly. Instead, merge the clip (with no other clips) to create a clip that doesn't cycle, then split the new clip.

---

**Merging clips**

You can merge two or more clips into a single clip. The clips to be merged can be positioned sequentially in a track or above one another on different tracks.

The benefits of merging clips follow:

- You can move, scale, and cycle a merged clip conveniently.
- You'll have a clip that won't be damaged if you edit the original clips.
- If you merge a pair of blended clips, the resulting source clip has keys for the blended animation. You can activate the merged clip and edit its animation in the Graph Editor.
- You can merge a single clip into a new clip. This is useful for creating an absolute clip from a relative clip, or for splitting a cycled clip (see the prior Tip).
- Because Maya lets you blend only pairs of clips, you can merge three or more clips into a pair of clips, then blend the pair.

**To merge clips:**

- 1 Select the clips you want to merge.
- 2 In the Trax Editor, select Edit > Merge .
- 3 Set the following options and click the Merge Clip button:

**Name**

Specifies the name of the merged clip.

**Keep originals  
in Trax editor**

Leaves the original clips in the Trax Editor after creating the merged clip. If you think you might use the original clips again in the future, turn on this option. To use less memory, turn this option off.

## ANIMATION | 6

Nonlinear character animation—the Trax Editor

### Blending clips

You can blend the common attributes of two clips of a character. This creates a smooth transition between the motion of each clip. You'll have best results blending clips that have similar motion. For example, you can create a smooth transition from a character walking then running.

Blending dissimilar motion might not work well. For instance, blending a character running and tumbling might create an awkward transition.

After blending clips, you can edit the resulting blend or you can reposition the clips in the Timeline to alter the range of the blend.

The clips to be blended can be overlapping one another in different tracks or positioned sequentially in a track. You'll typically blend partially overlapping clips. If you blend two partially overlapping clips, Maya blends only the overlapping region.

#### To blend clips:

- 1 Select the clips you want to blend.

The clips must have one or more common attributes or the Blend operation will fail.

- 2 In the Trax Editor, select Create > Blend .

- 3 Set the following option and click the Create Blend button:

**Initial Weight Curve** Specifies how the blend is interpolated at the beginning, middle, and end of the clip:

Linear changes attribute values at a constant rate from beginning to end of the clip.

Ease In changes attribute values slowly at the beginning and quickly at the end.

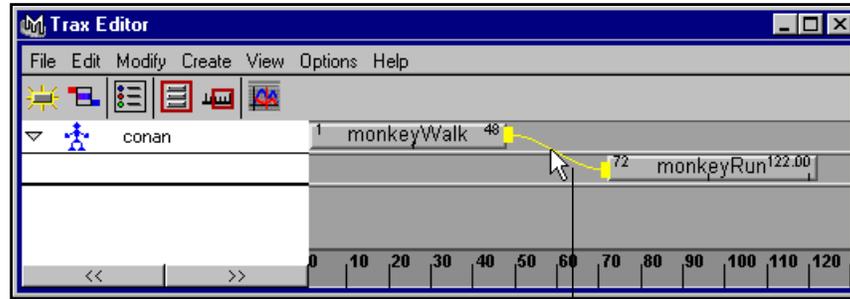
Ease Out changes attribute values quickly at the beginning and slowly at the end.

Ease In Out changes attribute values slowly at the beginning and end, and quickly in the middle.

- 4 For overlapping clips, make adjustments to the clip positions in the Trax Editor so the animation transitions smoothly from one clip to the other.

**To edit the blended animation:**

- 1 Click the curved line that connects the two blended clips.

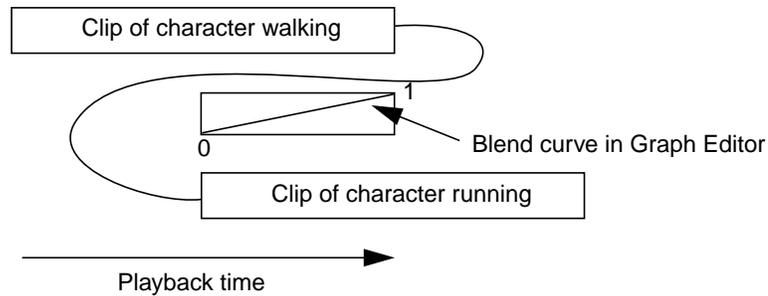


Click this curve to edit blended animation

- 2 In the Trax Editor, select View > Graph Anim Curves.

The Graph Editor displays the blend curve in a time range of 0 to 1, which represents the start and end of the blend. Maya ignores parts of the curve that are outside the range 0 to 1. The first clip to play in the animation is blended into the clip that plays second.

In the following figure, a linear blend curve connects the two clips.

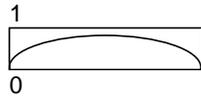


At the first frame where the clips overlap, the top clip controls the motion 100% and the bottom clip controls the motion 0%. At the last frame where the clips overlap, the bottom clip controls the motion 100% while the top clip controls the motion 0%.

## ANIMATION | 6

### Nonlinear character animation—the Trax Editor

During playback, the top clip’s control decreases as the bottom clip’s control increases. You can adjust the shape of the curve to alter the percentage of control each clip has. For example, you could reshape the blend curve as follows:



The top clip would start with 100% control at the start of the blend, decrease to 0% at the middle, then increase to 100% control at the end. The bottom clip would change correspondingly from 0% to 100% to 0% control during the blend.

If you plan to add a key to the blend curve to alter its shape, make sure Timeline Snapping is turned off in the Timeline settings of the Preferences window. Otherwise Maya won’t allow keys at floating point values.

If you selected one type of blend, for instance, linear, and want to switch it to another, delete the blend and add a new blend of the desired type. To delete a blend, select it in the Trax Editor and press Delete on your keyboard.

If you blend two overlapping clips that start at the same time in the Timeline, Maya uses the first clip selected before the Blend operation as the initial 100% controlling clip.

If you move the first-playing clip to a position where it plays later than the second-playing clip, you’ll likely get unexpected blend motion. The blend operation is intended for blending a clip that plays first into the clip that plays second.

If blending clips doesn’t provide the exact transition you want, try adding motion warping to tune the transition. If this doesn’t work, you’ll need to key the transition.

### Viewing and editing a clip’s animation curves

You can edit a clip’s animation curves by opening the Graph Editor for a selected clip.

#### To view and edit the animation curves of a clip:

- 1 Select the clip.

- 2 In the Trax Editor, select View > Graph Anim Curves.

### Editing a clip's original keys

To edit the original keys of a clip while displaying them on the Timeline, you must activate the clip. To return the clip to a state where you can't edit the keys inadvertently, you must deactivate the clip.

When you activate a clip, Maya displays the keys in the Timeline at their original positions. (If you've moved the clip to a different Timeline location in the Track Editor, the keys won't be shown at those positions.)

While a clip is activated, Maya ignores clip settings such as Weight, Offset Relative, and so on. Maya disables all other clips on the character so that their effects do not add to the activated clip.

If you set new keys on the clip that extend past the end of the original source clip's duration, the keys play while the clip is activated, but won't be included in the deactivated clip unless you modify the source clip's duration in the Attribute Editor. See "Editing source clip attributes" on page 119.

#### To edit the original keys of a clip:

- 1 Select the clip.
- 2 In the Trax Editor, select Modify > Activate/Deactivate Clip.  
The keys appear in the Timeline and are available for editing.

#### To disable the ability to edit the keys of the clip:

- 1 Select the clip.
- 2 In the Trax Editor, select Modify > Activate/Deactivate Clip.  
The keys are removed from the Timeline and are unavailable for editing.

### Disabling and enabling clips

You can disable a clip to stop its playback. If you later decide you want the clip to play again, enable the clip.

A useful animation technique is to create many clips for a combination of motions, then control which clips apply in a situation by disabling and enabling clips.

## ANIMATION | 6

Nonlinear character animation—the Trax Editor

### To disable clips:

- 1 Select the clip you want to enable.
- 2 In the Trax Editor, select Modify > Enable/Disable.

### To enable clips:

- 1 Select the clip you want to enable.
- 2 In the Trax Editor, select Modify > Enable/Disable.

## Importing and exporting source clips

When you create a project, Maya creates a clips directory. If you export a source clip from a scene, Maya stores it in a scene file in the clips directory of your project. If you import a clip to your scene, Maya puts it in the scene's Visor.

Many animators use an otherwise empty scene file to store a collection of generalized animation clips, for example, walking and running clips.

Maya applies imported clips to a character by node and attribute name. So if you create a generalized library, use a naming scheme that allows you to apply the clips to all the characters you plan to use.

### To export clips from your current scene:

- 1 Select the clip(s).
- 2 In the Trax Editor, select File > Export Clip.  
In the file browser window, select a filename to which you want to export the clip(s), then click Export.

### To import clips:

- 1 In the Trax Editor, select File > Import Clip.
- 2 In the file browser window, select the file that contains the clip(s), then click Import.

The clip is listed in the Visor under Unused Clips & Poses.

- 3 To use the clip, middle-mouse drag it to the Trax Editor or copy and paste it to a character with Trax Editor menu items.

## Importing clips by reference

When you export a clip, it is saved in a scene file, but without links to any character. It's essentially a collection of animation curves independent of the attributes they controlled. If you import a previously exported clip, you cannot paste it with the By Current Map option. You can work around this limitation by referencing a scene that has the character with the clips you want to import.

### To import a clip by referencing:

- 1 Open the file that contains the destination character—the character to which you want to apply the clip.
- 2 Reference the file that contains the source character—the character with the clip you want to use.
- 3 Open the Trax Editor and copy and paste from the source character to the destination character.
- 4 Select File > Reference Editor.
- 5 Select the reference in the Reference Editor then Edit > Remove Reference.

This procedure is preferable to importing a scene containing a character, because removing the reference removes all source character scene elements. You won't have useless extra nodes in your scene.

Note that you can create a MEL script for this procedure to import various motion capture data into clips.

## MEL commands and dependency graph nodes

### MEL commands

MEL commands related to the Trax Editor are:

- character
- clip
- clipEditor
- clipEditorCurrentTime
- clipScheduler
- pose

## ANIMATION | 6

### Adding and removing tracks

For more information about these commands, refer to the online *MEL Command Reference* documentation.

#### Dependency graph nodes

The dependency graph nodes related to the Trax Editor are:

- animation clip source node, or clip node (animClip node, default name: clip*n*)
- blend node (animBlendInOut node, default name: blend*n*)
- clip library node (default name: clipLibrary*n*)
- clip scheduler node (default name: clipScheduler*n*)
- character node (default name: character*n*)

For more information, refer to the online *DG Node Reference* documentation.

## ADDING AND REMOVING TRACKS

For a selected character, you can add or remove an empty track. If you add multiple tracks to a character, you can put several similar clips in identical time ranges and conveniently compare the animation of each. Disable all but one of the clips and play the animation. Repeat this for each clip.

#### To add a track:

- 1 Select the character for which you want to add a track.
- 2 In the Trax Editor, select Modify > Add Track.

Maya adds the track below the lowest track that contains a clip for the selected character.

#### To remove an empty track:

- 1 Select the character for which you want to remove the track.
- 2 In the Trax Editor, select Modify > Remove Track.

Maya removes the selected character's lowest empty track.

## MOTION WARPING

You can set keys on a character that already has an animation clip. The keys have effect on the character relative to existing clip animation. The technique of applying animation on top of existing animation is known as nondestructive animation or *motion warping*. Motion warping is useful in these situations:

- You're satisfied with an existing clip but want to make subtle changes without destroying your work.
- You've created animation clip instances for various characters, for instance, a street gang walking down an alley, but want to impart a unique walking motion to each character.
- You've created dense key data for a character, for instance, with motion capture, and you want to adjust the motion without altering the keys.

As you set keys on your character, the range of the motion warp appears in the Trax Editor as a blue region on the Timeline.

Before you add the motion-warping keys, first set keys (without changing attribute values) at the start and end of the clip region you want to modify. These bounding keys delimit the start and end of the motion warp. Then set the additional keys within the delimited region. Play the animation repeatedly to make sure the warp works as you expect. When you're satisfied with the additional keys, create a clip for them so you can modify the Weight to tune the motion.

For example, suppose you have a clip of a soldier marching. You like the general motion, but you want to raise the soldier's foot higher during the march. First, set bounding keys at both frames where the foot is on the ground, without changing any attribute values. Then, where the foot is raised, move it a little higher and set a key in this position. Create a clip for the keys and try different Weight values to tune the animation.

Motion warping might have undesirable results if you do it over relative clips, including cycled clips. If you want to create a motion warp on a relative or cycled clip, make the clip absolute by using Edit > Merge on it.

## USING POSES

After you've animated a character, you can store a snapshot of its current positioning, known as its *pose*, for any moment in the Timeline. You can instance, copy, and paste poses to the Trax Editor the same as for clips. The following examples illustrate how poses can be useful:

- You can use a pose for positional comparison as you animate the character. For example, if you animate a character walking in a circle, you can display the pose of the character at its first step so you know where it must return in its circular route.
- You can create poses for Maya's Blend Shape feature to create combinations of blendShape sliders. For example, if you define blendShape sliders for all facial muscles, you can create poses from the weight settings that produce all phonetic positions of English speaker.
- As a lead animator, you can create various key poses for a lengthy character animation sequence and give your coworkers the creative freedom to animate the character's motion between the key poses.

### To create a pose:

- 1 Select the character.
- 2 Click the frame in the Timeline.
- 3 In the Trax Editor, select Create > Pose  to display the options window.  
You can alternatively use Maya's main menus to select Animate > Create Pose .
- 4 Enter a name for the pose in the Name box, then click the Create Pose button.

When you create a pose, Maya stores the pose in the Visor. To put the character in the pose position thereafter, right-click the desired pose in the Visor and select Apply Pose from the pop-up menu.

To return the character to the actual animation position, rewind and play the animation or click a frame in the Timeline.

In the Visor, you can also right-click a *clip* and select Apply Pose. This moves the character to the clip's starting position without you having to change the current scene time.

## EXPORTING AND EDITING CHARACTER MAPS

When you copy a clip from one character and paste it to another, the receiving character's attributes might not animate as expected. For example, the foot might rotate instead of the neck.

If this problem occurs, it's likely the attribute animation was applied, or *mapped*, to a character with attributes or objects that differ from the original character. To fix the mapping so the character acts like the original, you must export a character map and edit its incorrect attribute mapping.

### To export a character map and fix the mapping:

- 1 Delete or undo the pasted clip.
- 2 Select the two characters.
- 3 In the Trax Editor, select File > Export Character Map .
- 4 Set the following option:

#### Map Method

Specifies how to format the map:

By Attribute Name creates a map where the copied character's attribute values are mapped to the counterpart attribute names of the receiving character.

By Attribute Order creates a map where the copied character's attribute values are mapped to the receiving character based on the descending order of attributes in the Channel Box.

By Node Name creates a map where the copied character's attribute values are mapped to the counterpart object and attribute names of the receiving character.

By Current Map works only if you've already exported a character map and executed the resulting mel script as described in the following steps. This option creates a map with the current mapping for the selected characters. This is useful if you've already exported a map to fix character mapping, then later add new attributes to the character. If you use By Current Map, you'll be able to edit fewer attribute mappings—only those you've added since the last time you corrected the mapping.

## ANIMATION | 6

### Working with subcharacters in the Trax Editor

The best Map Method option you choose depends on which map you expect will be easiest to edit. You'll need to know the attributes (and possibly their ordering) of both characters.

- 5 Click the Export button.  
A file browser window appears.
- 6 In the file browser, specify a filename and your *loginname/maya/scripts* directory as the location to export the character map, then click Write. The character map is a .mel file. (See *Using Maya: MEL* for details on scripts.)
- 7 Open the script with a text editor and correct the attribute mapping. Instructions for editing the file are in the file.
- 8 In the Script Editor, select File > Source Script to source the script into the scene. Then type the script name (without the filename extension) in the Script Editor and press the Enter key on the numeric keypad.
- 9 Copy and paste the clip as you originally did, except select Edit > Paste  and turn on By Current Map as the Paste Method.
- 10 Play the animation and check the results.

## WORKING WITH SUBCHARACTERS IN THE TRAX EDITOR

A subcharacter bundles related attributes of a character so you can key them in unison. If you set keys for a character, Maya also sets keys for all its subcharacters. With the Trax Editor, you can use subcharacters when you need to create one clip with a Relative offset and another for the same character with an Absolute offset. (See "Editing clip attributes" on page 116.)

For example, suppose you animate a character walking. The character root moves forward and the arms and legs rotate. Suppose further you create the root as the main character and the arms and legs as a subcharacter. You can create a clip for the entire character in which the main character clip uses relative attributes and the subcharacter clip uses absolute attributes.

## Using clips on a character with subcharacters

If you turn on Include Subcharacters in Clip when you create a clip, Maya creates a single source clip that includes all animation curves for the character and all its subcharacters. In the Visor, you can instance the source clip to a single subcharacter or to the entire character by middle-mouse dragging to the desired tracks.

To copy a source clip with subcharacter data to a new character, first export a character map that establishes a relationship between the two characters and their subcharacters. (See “Exporting and editing character maps” on page 135.) Then paste the source clip to the character and its subcharacters using the By Current Map option.

## Using clips on a subcharacter

To create a source clip that contains only the animation curves for a single subcharacter, set the current character to be the subcharacter and create the clip.

A source clip can be used by only one subcharacter, so you can't create instances from the same source clip to multiple subcharacters. To animate several subcharacters identically, you must copy and paste a clip from one subcharacter to another.

## Creating subcharacters on a character with clips

If you create a subcharacter on a character that has existing clips, the subcharacter inherits the existing clips so that no animation is lost.

## **ANIMATION | 6**

Working with subcharacters in the Trax Editor

# 7

## CHARACTER SETUP



Character set up, animated, and rendered in Maya by Olivier Junquet, University of Paris, Department of Arts and Images Technology. Visit <http://www.splotsh.com>.

Maya 3.0 includes several important new features for character setup. This chapter summarizes the new character setup features in Maya 3.0:

- “Blend shape slider orientation control” on page 140

## CHARACTER SETUP | 7

### Blend shape slider orientation control

- “New advanced deformer creation options” on page 140
- “Mirroring smooth skin weights” on page 141
- “Copying smooth skin weights” on page 142
- “Holding smooth skin weights” on page 143
- “Improved smooth skin influence object behavior” on page 145
- “Control of smooth skin weight normalization” on page 145
- “New create character options” on page 146

## BLEND SHAPE SLIDER ORIENTATION CONTROL

You can now control the orientation of the sliders in the Blend Shape window (Window > Animation Editors > Blend Shape). You can arrange the sliders vertically or horizontally, whichever is most intuitive for you.

To orient the sliders vertically, select Options > Orientation > Vertical (the default).

To orient the sliders horizontally, select Options > Orientation > Horizontal.

## NEW ADVANCED DEFORMER CREATION OPTIONS

Maya 3.0's new advanced deformer creation options provide a more robust workflow for creating a deformer that can affect more than one surface.

Previously, when you created a deformer for more than one surface, and specified a new (not currently existing) exclusive partition, you could get as many partitions as surfaces instead of just one partition as needed.

For example, in Maya 2.5, if you were to select CVs of several surfaces, create a lattice deformer with Exclusive advanced creation option checked on, and specify a new name for the partition (select Deform > Create Lattice , click Advanced tab, check on Exclusive, and specify a new partition name), you would get as many partitions as surfaces.

To correct this problem, Maya 3.0 now includes new advanced deformer options. These new options are Partition to Use and New Partition Name. Partition to Use lists all the existing partitions and a default selection Create

New Partition. If you select Create New Partition, you can edit the New Partition Name field to specify the name of a new partition. This workflow eliminates the problem that can happen with multiple surfaces.

Note that these two new options (Partition to Use and New Partition Name) replace the Exclusive Partition and Existing Partitions options.

## MIRRORING SMOOTH SKIN WEIGHTS

You can now mirror smooth skin weights, either from one smooth skin object to another, or within the same smooth skin object. Mirroring smooth skin weights greatly speeds up the process of editing and fine-tuning skin deformation effects. For example, you can perfect the smooth skin weighting for a character's right shoulder area and then simply mirror the weighting to the character's left shoulder. Mirroring smooth skin weights can save you a lot of time, and greatly improves the overall skinning workflow.

### To mirror smooth skin weights:

- 1 Select the smooth skin object(s), then select Skin > Edit Smooth Skin > Mirror Skin Weights .
- 2 In the Mirror Skin Weights Options window, specify the plane about which you want to mirror (the Mirror Axis) as XY, YZ, or XZ.

Note that the planes are the planes of Maya's global workspace axis, so for the mirroring to work properly the skin objects (or character) should be centered on the global axis, or at least aligned along the axes you want to mirror about.

- 3 Specify the Direction of the mirroring as Positive to Negative (on) or Negative to Positive (off).
- 4 Click the Mirror button.

The new MEL command for this feature is `copySkinWeights`, which carries out both mirroring and copying.

## COPYING SMOOTH SKIN WEIGHTS

You can now copy smooth skin weights from one smooth skin object to another, or from one group of smooth skin objects to another. As with the new mirroring smooth skin weights feature, copying smooth skin weights dramatically improves the overall skinning workflow. You no longer have to tackle the tedious, uncreative task of painting several characters each in the same way.

For example, suppose you have created a team of very similar characters for a football game, and you're at that point in the character setup process where you have just skinned them all and are about to paint the smooth skin weights to perfect the deformation effects. You first paint the weights of the quarterback. Next you have to paint the weights of all the other players. Instead of having to paint the players individually, you can copy what you did for the quarterback to each of the other players. You might then want to fine-tune the weights of the various other players, but by copying the weights you have still saved yourself a lot of time. You can focus on the creative challenges unique to the case of a particular character rather than on doing the same type of painting over and over again.

- For best results, the skeleton of the character you are copying from and the skeleton you are copying to should have the same structure. If the skeletons are similar, Maya will still try to copy the weights. However, if the skeletons are radically different, Maya may not be able to copy the weights.
- Also, for best results, the skeletons of each character should be in the same pose during copying. If the orientation of the joints are not similar, the copying can lack some precision, which means you may have to do some touch up painting to the results.
- If the skin objects have different numbers of CVs, or if the ordering of the CVs is different, the copying will intelligently take into account the differences and provide the same type of weighting. This is very useful if you want to apply the smooth skin weighting from a high-res character to a low-res version of the character.

You can copy smooth skin weights between skin objects of different types: for example, you can copy from a subdivision surface to a NURBS surface or a polygonal surface.

**To copy smooth skin weights:**

- 1 Select the two smooth skin objects (or two groups of objects)
- 2 Select Skin > Edit Smooth Skin > Copy Skin Weights.

The new MEL command for this feature is `copySkinWeights`.

## HOLDING SMOOTH SKIN WEIGHTS

Typically, when you change (edit or paint) the weights of smooth skin objects, the weights of one object can affect the weights of other objects. This is because Maya considers the weights of all skin objects that are influenced by a particular influence object to be relative to each other. Maya does this by requiring that all the weights add up to one. When you change certain weights, Maya can automatically change various other weights so that the total of all the weights continues to be one. This allows Maya to know the relative influences of the weights.

The process of scaling some numbers so they add up to one is called “normalization.” By constantly normalizing weight values, Maya keeps track of their relative influences.

Sometimes when you change the weights of smooth skin objects, you may not want the weights of other objects don’t change. If you’ve perfected the weighting of a particular object, you might want to make sure that its weights are not going to undergo any normalization changes. Maya now lets you “hold” the weights of particular smooth skin objects so that their values don’t change when you are editing other smooth skin objects. You can hold weights by:

- “Specifying weight holding when adding influence objects” on page 144
- “Editing weight holding of joints” on page 144
- “Editing weight locking of smooth skin influence objects” on page 144
- “Holding smooth skin influence weights from Component Editor” on page 144

Note that if you hold the weights of many objects at the same time, Maya might not be able to normalize the rest of the weights properly, and you could get an error message. In general, you should not hold the weights of many objects at the same time. Typically, you would want to hold the

## CHARACTER SETUP | 7

### Holding smooth skin weights

weights of only one or two objects. However, if you don't want to stop holding the weights of any of the objects, you can turn off weight normalization directly from Maya's interface (see "Control of smooth skin weight normalization" on page 145).

### Specifying weight holding when adding influence objects

We've added two new options for locking weights. You set these options when you set add influence options (Skin > Edit Smooth Skin > Add Influence ). The displayed Add Influence Options window now includes Weight Holding and Default Weight options. With Weight Holding's Hold Weights on, you specify that Maya hold the weights of the specified influence object to their current value (or to a value specified in Default Weight).

### Editing weight holding of joints

You now specify whether a particular joint's weights are locked using the new Hold Weights option in the Smooth Skin Parameters section of the Attribute Editor for the joint. Turn Hold Weights on to set the skinCluster's corresponding Hold Weights attribute on; turn it off to set the corresponding Hold Weights attribute off.

### Editing weight locking of smooth skin influence objects

You can specify whether a particular smooth skin influence object's weights are locked by setting the new Hold Weights option in the Smooth Skin Parameters section of the Attribute Editor for the object. Turning on Hold Weights sets the skinCluster's corresponding Hold Weights attribute on; turning it off sets the corresponding Hold Weights attribute off.

Finally, you can also change whether the Hold Weights settings for joints or smooth skin influence objects are on or off by telling the Component Editor to "hold" the weights.

### Holding smooth skin influence weights from Component Editor

When you are directly editing joint smooth skin influence object weights with the Component Editor, you can now quickly specify whether the weights of particular joints or smooth skin influence objects can change. Under the skinClusters tab, note the new Hold row.

## Improved smooth skin influence object behavior

For each joint or smooth skin influence object, the value for Hold corresponds to the skinCluster Lock Weights[*n*] attribute (and to the Lock Weights settings for the Attribute Editor's Smooth Skin Parameters). If Hold is on, Maya holds weights at their current values when you modify the weights of other influence objects. However, you can still modify the weights by entering new values in the Component Editor.

In summary, you can use Hold to hold weights at their current values while you modify the weights of other influence objects. However, you still can change these values directly with the Component Editor.

## IMPROVED SMOOTH SKIN INFLUENCE OBJECT BEHAVIOR

Beginning with Maya 2.5.2, smooth skinning's skinCluster node includes a new useComponentsMatrix attribute. This attribute enables you to improve the component-based influence object behavior when the influence object is on a skin that changes its scale. In Maya 2.5.2, this new attribute is off by default so that the behavior of scenes created prior to Maya 2.5.2 are not changed by default. However, in Maya 3.0, the attribute is now on by default for all newly created smooth skinning (skinCluster) nodes. When the attribute is on, the influence object uses a new deformation algorithm that allows you to create a component-based influence object on a character that changes scale.

To set the attribute, select the skinCluster node acting on the object and set the useComponentsMatrix attribute to true in the Channel Box or Attribute Editor.

## CONTROL OF SMOOTH SKIN WEIGHT NORMALIZATION

You can now control whether Maya will normalize smooth skin weights directly from Maya's interface. Normalizing weights means scaling the weights so their values all add up to one. Previously, you would have to use the skinPercent command's normalize option to control weight normalization. Now you can do this without having to use MEL.

Select Skin > Edit Smooth Skin, and note the new Disable Weight Normalization, Enable Weight Normalization, and Normalize Weights options. These options allow you to turn normalization off or on, and to

## CHARACTER SETUP | 7

### New create character options

normalize weights. After skinning, you can specify normalization with the skinCluster node's new Normalize Weights attribute, which is included in the Attribute Editor and the Channel Box.

## NEW CREATE CHARACTER OPTIONS

Maya now includes new create character options (Character > Create ) that you can use to exclude certain attributes from being keyable. In the Create Character window, under All Keyable except, you can set the Translate, Rotate, Scale, and Visibility attributes as all keyable or non-keyable. By default, Scale and Visibility are on, so that by default only those attributes are non-keyable. With these options, you can quickly control the number of attributes included in a character as you create the character. This can save you time, reduce the number of attributes listed in the Channel Box, and help make your animation work more efficient.

## NEW SUBCHARACTERS FEATURE

You can now define subcharacters within previously defined characters. This is useful because you can now apply the power of Maya's character animation features to parts of a character's hierarchy.

Creating subcharacters is similar to creating characters: you select a character's objects that you want to define as a subcharacter (for example, the objects that make up the character's face) and then select Character > Create Sub-Character. The creation options for subcharacters are the same as the options for creating characters.

## NEW CHARACTER CHANNEL EDITING CAPABILITIES

When you create a character, the character set can include quite a few channels (keyable attributes) that might not be pertinent to what you want to animate. During creation you can have some control over what channels are included with the new create character options (see "New create character options" on page 146). You can now also add and remove channels after you have created a character. To do so, use the new Character > Add To Character and Character > Remove From Character selections.

# 8

## DYNAMICS

We've added the following new features and improvements to Dynamics in Maya 3.0.

### Summary of usability improvements

- "Usability improvements" on page 148

### New features

- "New Volume emitters" on page 148
- "New Volume Axis field" on page 157
- "New Volume fields" on page 161
- "New particle caching" on page 164

### Improvements to existing features

- "Improved particle rendering attribute control" on page 175
- "Improved particle cloud shader" on page 193
- "Improvements to particle lifespan" on page 197
- "Increased control over randomness" on page 200
- "Instancing strokes from Paint Effects" on page 202
- "Dynamics menu improvements" on page 203
- "Improvements to particle attribute editor" on page 205
- "Directional emission from curves" on page 205
- "New attributes for position of emitted particles" on page 205
- "Improvements to Turbulence field" on page 205
- "Changes to Air field defaults" on page 207
- "Fixes to particle scaling" on page 207
- "Changes to file loading" on page 207

## DYNAMICS | 8

### Usability improvements

- “New command line functionality” on page 208

## USABILITY IMPROVEMENTS

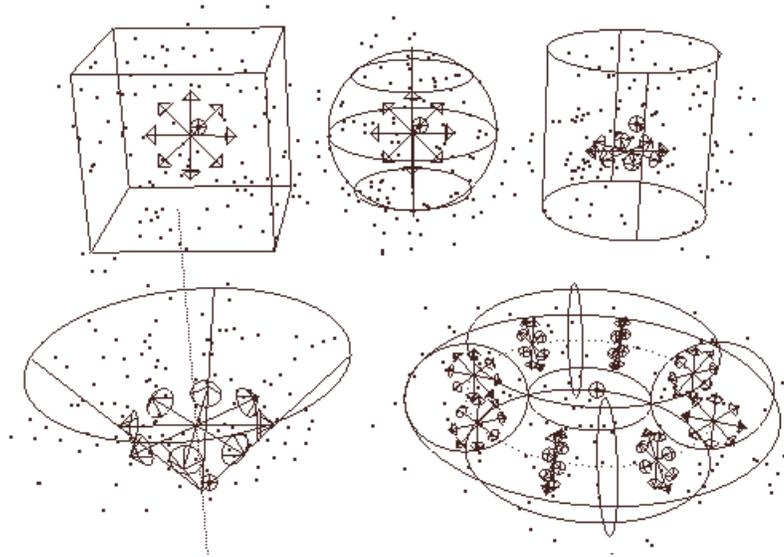
For Maya 3.0, we’ve made it easier and faster to create effects with Dynamics. Improvements include:

- Particle cache on save. This avoids run-up when loading files. See “New particle caching” on page 164 for details.
- Reorganization of dynamics menus for greater ease of use and learning. See “Dynamics menu improvements” on page 203 for details.
- Improvements to the particle attribute editor to make it easy to find all relevant nodes (shaders, springs, etc.) affecting a particle object. See “Improvements to particle attribute editor” on page 205.
- Pop-up help in all the field and emitter option boxes.
- Improved layout of field and emitter option windows so they match the Attribute Editor.
- New attributes that make it easy to create random particle speeds without using expressions. See “Increased control over randomness” on page 200 for details.
- New control to restart emitter streams without using expressions (similar to Power Animator’s time random feature). See “Increased control over randomness” on page 200 for details.
- Simplification of particle lifespan controls. Easy workflow to generate random lifespans without expressions. See “Improvements to particle lifespan” on page 197).

## NEW VOLUME EMITTERS

For Maya 3.0, we’ve added volume-controlled emission based on the “volume lights” of Power Animator. In Maya, you don’t emit from a light, like Power Animator but we’ve added attribute controls on the emitter to give you similar functionality.

The volume emitters draw arrows to illustrate the speed values you have set. These are not manipulators. You can turn them off, if you wish.



## Creating volume emitters

Volume emitters emit particles from a closed volume. We've provided five volume shapes to choose from: cube, sphere, cylinder, cone, and torus.

### To create a volume emitter:

- 1 Select **Particles > Create Emitter** .
- 2 Under **Basic Emitter Attributes**, set the **Emitter Type** to **Volume**.
- 3 Under **Volume Emitter Attributes**, click **Volume Shape** and select a shape from the menu.
- 4 Set the **Volume Emitter** attributes as desired. See "Setting volume emitter attributes" on page 150 for information on the volume emitter attributes.
- 5 Click **Create**.

The implicit shape of the volume emitter is displayed on the screen. You can move, rotate, scale, or shear the emitter.

## DYNAMICS | 8

### New Volume emitters

---

#### Note

You can't deform the volume or use an arbitrary volume.

---

#### To hide the shape of the volume emitter:

- Select the emitter and select Display > Hide > Hide Selection.

## Setting volume emitter attributes

In the Attribute Editor and the Create Emitter option window, attributes not applicable to a volume shape are dimmed. However, the Channel Box does not support dimming. We recommend you use the Attribute Editor to edit emitter attributes until you become familiar with the attributes that apply to each volume shape.

#### To set volume emitters' attributes:

- 1 Select the emitter and display the Attribute Editor.

---

#### Tip

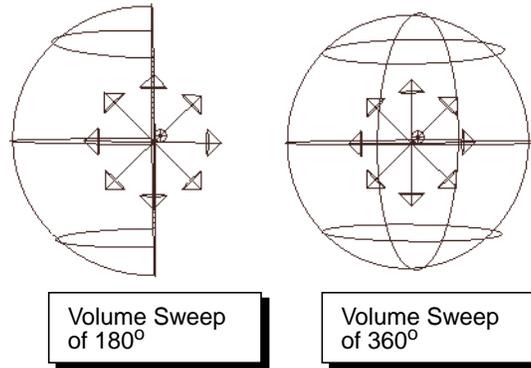
Now you can select the particle object and the Attribute Editor displays a tab for the emitter.

---

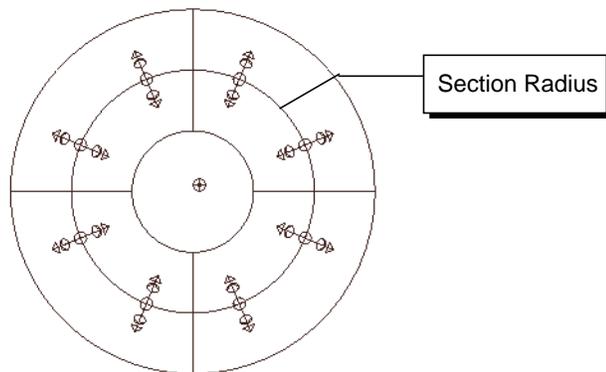
- 2 You can set the following volume and speed emitter attributes:

#### Volume Emitter Attributes

<b>Volume Shape</b>	Specifies the shape of the volume.
<b>Volume Offset</b> <b>X, Y, Z</b>	Offsets the emitting volume from the location of the emitter. If you rotate the emitter, you also rotate the offset direction because it operates in local space.
<b>Volume Sweep</b>	Defines the sweep of rotation for all volumes except cubes.



**Section Radius** (*Torus only*) Defines the thickness of the solid portion of the torus, relative to the radius of the torus's central ring. The radius of the central ring is determined by the emitter's scale. If you scale the emitter, the Section Radius will maintain its proportion relative to the central ring.



**Die on Emission**  
**Volume Exit** If you turn this attribute on, the emitted particles die when they exit the volume. Although this is a particle shape attribute, you can initially set it using the Emitter options window.

If you want to edit this attribute after you create the emitter, display the particle shape attributes in the Attribute Editor Volume Exit (under Emission Attributes).

## DYNAMICS | 8

### New Volume emitters

#### Volume Speed Attributes

The Volume Speed Attributes apply only to the initial velocity of the particles. To affect particles as they move through the volume, use the Volume Axis field (see “New Volume Axis field” on page 157).

<b>Away From Center</b>	Specifies the speed at which particles move away from the center point of cube or sphere volumes.
<b>Away From Axis</b>	Specifies the speed at which particles move away from the central axis of cylinder, cone, or torus volumes.
<b>Along Axis</b>	Specifies the speed at which particles move along the central axis of all volumes. The central axis is defined as positive-Y for cube and sphere volumes.
<b>Around Axis</b>	Specifies the speed at which particles move around the central axis of all volumes.
<b>Random Direction</b>	Adds irregularity to the direction and initial speed of the particles Volume Speed attributes, somewhat like Spread does for other emitter types.
<b>Directional Speed</b>	Adds speed in the direction specified by the Direction XYZ attributes of all volume emitters.
<b>Scale Speed by Size</b>	If you turn this attribute on, when you increase the size of the volume, the speed of the particles increases.
<b>Display Speed</b>	Turns on the display of arrows indicating speed.

## Emitter attributes and Power Animator equivalents

If you are a Power Animator user, the following table summarizes the emitter attributes and their equivalent settings in Power Animator.

Attribute Name	Function	Types of emitters it applies to	PA Equivalent
<b>Basic Emitter Attributes</b>			
Emitter Type	Determines the type of emitter. There is a new choice, Volume.	All emitters	None
Use Rate PP	No change	Omni, Directional	None
Need ParentUV	When turned on in surface emitters, adds parentU and parentV attributes to the particle shape.	Surface	None
Spread	No change	Directional, Curve	None
Rate	No change	All	Particles/Sec
Scale Rate By Object Size	If turned on (the default), object size affects number of particles emitted per frame. If turned off, it does not.	All except volume. (Always turned off in Volume emitters.)	Turn off to make Rate work as it did in PA.

## DYNAMICS | 8

### New Volume emitters

Attribute Name	Function	Types of emitters it applies to	PA Equivalent
Cycle Emission=None (timeRandom off); Cycle Emission=Frame (timeRandom on)"	Restarts the random number sequence of the emission. If set to Frame, the sequence is restarted after the number of frames specified by the cycleInterval attribute.	All	timeRandom. We put the name timeRandom directly into the value so former PA users recognize it. PA timeRandom on is equivalent to cycleEmission=Frame; cycleInterval = 1.
Cycle Interval	Defines the interval between reseeds (in frames) for cycleEmission.	All	See comments on cycleEmission. This attribute takes the timeRandom functionality beyond where it was in PA.
<b>Basic Speed Attributes</b>			
Speed	Same as now for all except volume emitters. Does not apply to volumes	All except volume	Speed

Attribute Name	Function	Types of emitters it applies to	PA Equivalent
Speed Random	If set to a positive value, the emitter generates random speeds for each particle, with Speed as the mean, and speedRandom defines the width of the distribution. Each particle's speed will be a random value between speed - speedRandom/2 and speed+speedRandom/2.	All	Speed Range
Tangent Speed	No change	All except volume	-
Normal Speed	No change	All except volume	-

**Volume Emission Attributes**

Volume Shape: Cube, Sphere, Cylinder, Cone, Torus	Determines extent of volume where particles are emitted. For the solids of rotation (cylinder, cone, and torus), the major axis of the solid defines the action of the volume speed attributes. Note that the major axis of the torus is defined as the circle that runs through the center of the solid portion of the torus, in the local XZ plane, not the vertical axis.	All volumes	Shape
---	--	-------------	-------

## DYNAMICS | 8

### New Volume emitters

Attribute Name	Function	Types of emitters it applies to	PA Equivalent
Volume Offset	Offsets the emitting volume from the location of the emitter. Operates in local space; if you rotate the emitter, you will also rotate the offset direction.	All volumes	None
Section Radius	Defines thickness of solid portion of torus. Same as for polygonal torus primitive. (Note: There is no radius attribute; scale the object up, using the scale manipulator.)	Torus only	torusRadius
Volume Sweep	Defines sweep of rotation for the solids of rotation, same as in NURBS modelling.	All volumes except cube	Arc

#### Volume Speed Attributes

Away From Center	Speed away from center point of volume.	Cube, sphere	concentric
Away From Axis	Speed away from central axis of volume. For cylinder, for example, gives component of velocity in XZ plane.	Cylinder, cone, torus	concentric
Along Axis	Speed along central axis of volume.	All volumes	directional
Around Axis	Speed rotating around central axis of volume	All volumes	radial

Attribute Name	Function	Types of emitters it applies to	PA Equivalent
Random Direction	Adds a random component to the speed. This components adds to the others, so in effect it gives some irregularity to the direction and speed of the particles, much like spread does for other emitter types.	All volumes	-
Directional Speed	Adds a component of speed in the direction specified by the directionX/Y/Z attributes.	All volumes	-
Scale Speed By Size	If true, scaling the volume up increases the speed of the particles.	All volumes	-
Display Speed	Turns on or off the display of arrows showing speeds	All volumes	-

## NEW VOLUME AXIS FIELD

The new Volume Axis field lets you move particles in various directions in a volume. The motion imparted on the object is relative to the axis of the volume.

You can use the Volume Axis field to create effects such as particles flowing around obstacles, solar flares, mushroom clouds, explosions, tornadoes, and rocket exhaust.

For example, you can specify the speed at which particles move around the central axis of a volume. If you use a a cylinder volume shape, this can create swirling gaseous effects.

## DYNAMICS | 8

### New Volume Axis field

The Volume Axis field provides most of the volume speed controls of the volume emitter in the form of a field, and its attributes work just like the corresponding volume emitter attributes. You can also invert the attenuation (see the Invert Attenuation attribute on page 160).

Like the emitter, the volume field draws arrows to illustrate the speed values you have set. These are not manipulators. As with the emitter, you can turn them off, if you wish.

## Creating volume axis fields

Volume axis fields affect particles and rigid bodies in an area defined by a closed volume. We've provided five volume shapes to choose from: cube, sphere, cylinder, cone, and torus.

### To create a volume axis field:

- 1 Select Fields > Volume Axis .
- 2 In the Volume Axis Options window, select a shape from the Volume Shape pulldown menu.

If you set the Volume Shape to None, it disables the field.

- 3 Set the volume axis field attributes as desired. See "Setting volume axis field attributes" on page 158.
- 4 Click Create.

The implicit shape of the volume axis field is displayed on the screen. You can move, rotate, scale, or shear the field.

---

### Note

You can't deform the volume or use an arbitrary volume.

---

## Setting volume axis field attributes

In the Attribute Editor and the Create Emitter option window, attributes not applicable to a volume shape are dimmed. However, the Channel Box does not support dimming. We recommend you use the Attribute Editor to edit volume attributes until you become familiar with the attributes that apply to each volume shape.

**To set volume axis field attributes:**

- 1 Select the field and display the Attribute Editor.

**Tip**

Now you can select the particle object connected to the field and the Attribute Editor displays a tab for the field.

- 2 You can set the following attributes:

<b>Magnitude</b>	Specifies the strength of the volume axis field.
<b>Attenuation</b>	Sets how much the strength of the field diminishes from the central axis of the volume axis field.  A value greater than 0 makes the strength of the field diminish to 0 at the edge of the volume. The greater the value, the more rapidly the strength decreases.  A value of 0 makes the strength remain constant from the central axis of the volume axis field to its edge (see also the Invert Attenuation attribute on page 160).
<b>Max Distance</b>	Sets the maximum distance at which the field has an effect. You must also turn on Use Max Distance for Max Distance to take effect.

**Note**

The Max Distance and Attenuation attributes operate in a special way for the Volume Axis field. For all volume axis shapes except sphere, distance (for both the Max Distance and Attenuation attributes) is defined as the distance from the volume's central axis to the point.

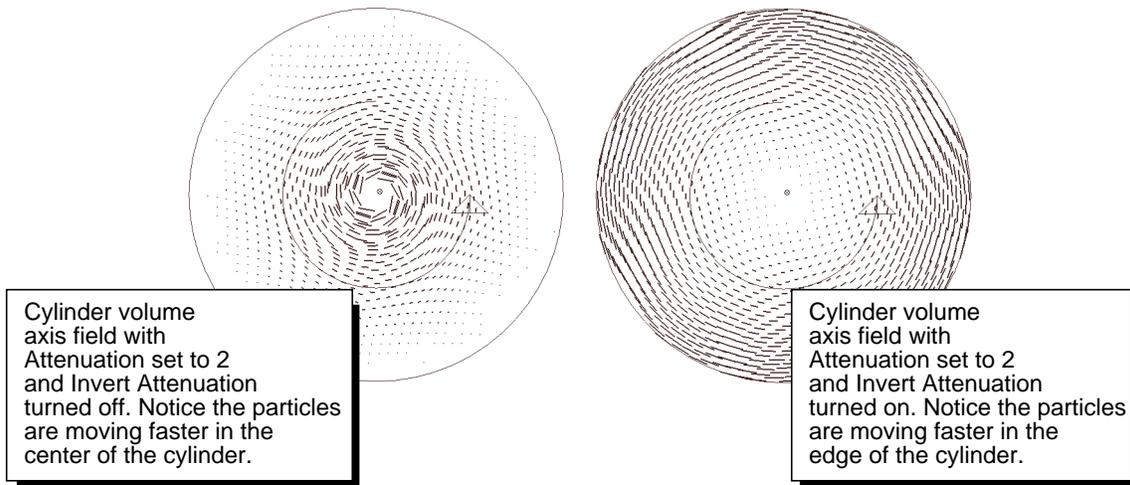
For cylinder, cone, and cube, the central axis is the positive Y axis. For torus, the central axis is the ring in the center of the solid part of the torus. The sphere volume is an exception— it uses the center point, not the center axis (it works like the other fields).

This special definition of distance applies only to the Volume Axis field. It does not apply to other fields even when they are using volumes.

## DYNAMICS | 8

### New Volume Axis field

<b>Volume Offset</b> X, Y, Z	Offsets the volume axis field from the actual location of the field.
<b>Volume Sweep</b>	Defines the sweep of rotation for all volume shapes except cube.
<b>Section Radius</b>	Defines the thickness of the solid portion of a torus volume shape.
<b>Invert Attenuation</b>	When you turn on Invert Attenuation and you have Attenuation set to a value greater than 0, the strength of the volume axis field is strongest at the edge of the volume and diminishes to 0 at the central axis of the volume axis field (see also the Attenuation attribute on page 159).



#### **Away From Center**

Specifies the speed at which particles move away from the center point of cube or sphere volumes. You can use this attribute to create explosive effects.

<b>Away From Axis</b>	Specifies the speed at which particles move away from the central axis of cylinder, cone, or torus volumes. For torus, the central axis is the ring in the center of the solid part of the torus.
<b>Along Axis</b>	Specifies the speed at which particles move along the central axis of all volumes.
<b>Around Axis</b>	Specifies the speed at which particles move around the central axis of all volumes. When used in conjunction with a cylinder volume shape, this attribute can create swirling gaseous effects.
<b>Directional Speed</b>	Adds speed in the direction specified by the Direction XYZ attributes of all volumes.
<b>Direction X, Y, Z</b>	Moves particles in the directions specified by the X, Y, and Z axes.

---

*Tip*

When working with volumes, it's sometimes useful to set the Conserve attribute to 0 in the particle shape. This keeps the particles within the volume. Particles will not exit the volume unless other forces act on them to make them do so. Also, see "Keeping particles inside the volume" on page 164.

---

## NEW VOLUME FIELDS

For Maya 3.0, we have added volume control of fields. You can select a volume to define the region in space in which particles or rigid bodies are affected by any field in Maya. The volume shapes we've added include cube, sphere, cylinder, cone, and torus.

For example, if you create a Turbulence field and set its volume shape to cube, only particles or rigid bodies within the region of the cube are affected by the turbulence.

We've also added a new ninth field that uses the volume to define its motion (see "New Volume Axis field" on page 157).

## Creating volume fields

Volume fields affect particles and rigid bodies in an area defined by a closed volume. We've provided five volume shapes to choose from: cube, sphere, cylinder, cone, and torus.

### To create a volume field:

- 1 Select Fields *fieldname* .
- 2 In the field's options window, from the Volume Shape pulldown, select a shape (other than None).

None means that the field acts as in previous versions of Maya, with no volume.

- 3 Set the volume field attributes as desired. See "Setting volume field attributes" on page 162.
- 4 Click Create.

The implicit shape of the volume field is displayed on the screen. You can move, rotate, scale, or shear the field.

---

### Note

You can't deform the volume or use an arbitrary volume.

---

## Setting volume field attributes

In the Attribute Editor and the Create Emitter option window, attributes not applicable to a volume shape are dimmed. However, the Channel Box does not support dimming. We recommend you use the Attribute Editor to edit volume field attributes until you become familiar with the attributes that apply to each volume shape.

### To set volume field attributes:

- 1 Select the field and display the Attribute Editor.

---

**Tip**

Now you can select the particle object connected to the field and the Attribute Editor displays a tab for the field.

---

- 2 You can enter values for the following volume shape attributes:

<b>Volume Exclusion</b>	When Volume Exclusion is turned on, the volume defines the region in space where the field has no effect on particles or rigid bodies.
<b>Volume Offset X, Y, Z</b>	Offsets the volume from the location of the field. If you rotate the field, you also rotate the offset direction because it operates in local space.

---

**Note**

Offsetting the volume changes only the volume's location (and therefore, which particles the field affects). It does not change the actual field location for purposes of computing field force, attenuation, etc.

---

<b>Volume Sweep</b>	Defines the sweep of rotation for all volumes except cubes.
<b>Section Radius</b>	Defines the thickness of the solid portion of the torus, relative to the radius of the torus's central ring. The radius of the central ring is determined by the field's scale. If you scale the field, the Section Radius will maintain its proportion relative to the central ring.

**Tips on using volume fields**

- The action of a vortex field is still controlled by its Axis attribute, even for a Torus field. If you want a circular motion around the section axis of the torus, use the new Volume Axis field (see "New Volume Axis field" on page 157).
- You cannot deform or tweak the field volume. You are restricted to the volume types we provide—you can't use general volumes.
- The field Max Distance attribute still applies with volumes.

## DYNAMICS | 8

### New particle caching

- There is no API support for volume fields in 3.0 but there is some support for the Volume Axis field.
- There are no manipulators for any of the new field attributes in 3.0.

## Keeping particles inside the volume

You can keep particles inside a volume by using a radial field that affects only particles outside the volume you are interested in, and pushes the particles back in. You can also use this procedure to keep particles inside an emission volume.

- 1 Create the particles (or emitter) and the field whose volume you want the particles to stay inside.
- 2 Select the particles and select Fields > Radial .
- 3 Set the volume shape of the radial field to be the same as for the field you created in step 1.
- 4 Turn on Volume Exclusion.
- 5 Set the radial field magnitude to a negative value.  
Try a value which is about one-half the magnitude value of your first field, but is negative. For example, if the first field has magnitude 10 or -10, use a radial field magnitude of -5.
- 6 Parent the radial field to the first field, and reset the radial field's transform to be the identity.

This makes the radial field have the same volume as the original field.

Whenever particles move outside the original field volume, the radial field pushes them back in. You may want to tune the radial field magnitude and/or transform values to get the exact look you want.

## NEW PARTICLE CACHING

We've added two new types of particle caching for Maya 3.0—particle disk caching and particle start-up caching.

*Particle disk caching* lets you cache complete sequences to disk. You can use the cache for batch rendering and playback. Disk caching has the following advantages:

- It lets you render more efficiently, especially when using multi-processor batch rendering. Maya loads the particles from the disk cache instead of re-computing them. This avoids the particle “run-up” at the start of the render.
- It lets you play the scene faster and scrub in the time slider.
- You can also use particle disk caching to create different caches for the same scene. This lets you create and quickly play back variations on a scene.

*Particle start-up caching* avoids run-up. It’s used when you save your scene at some frame greater than the start frame (it’s on by default). In the past, Maya needed to “run up” your animation in such a situation. The start-up cache lets you save your particle data for that one frame to disk so no run-up is needed.

## Particle disk caching

### Specifying where the cache files are stored

In Maya 3.0, we’ve added an additional workspace directory for particles. By default, this is given the name *particles*. You can specify your workspace particles directory using the Project Editor, the same as for all the other workspace directories.

If you are using an old workspace from a previous version of Maya, Maya creates the particles directory for you the first time you create a particle disk cache.

The disk cache files are stored in subdirectories of the particles directory. You can specify what subdirectory name you want to use by entering the name in the Cache Directory box of the Particle Disk Cache Options window (see “Setting particle disk cache options” on page 167). Before each new caching operation, Maya automatically deletes any cache files existing in the specified subdirectory.

### Determining the frame range

If Maya can’t find a cache file for the given frame, but finds cache files both for frames greater and lesser than the current frame it is evaluating, it interpolates between them. If the frame difference is large, you see the results of interpolation rather than the results of solving frame by frame.

## DYNAMICS | 8

### New particle caching

In simple cases, to evaluate a given frame, Maya usually needs the particle cache files only for that frame. However, Maya may need to access the state of particles at some other frame in order to resolve expressions, rigid body motion, motion blur, etc. If you are in doubt, we recommend caching out all frames. For example, if you want to render starting at frame 100, cache all frames up to 100 as well.

### Creating a particle disk cache

After you have created a particle disk cache, Maya uses the cached particle data, no matter what changes you make to your scene, until you *explicitly* tell it not to.

For example, if you cache the scene, then apply a gravity field to a particle object, you will not see any effect from that field because Maya is using the cached particle motion. To see the effect, you must turn off Use Particle Disk Cache (see “Editing particle disk cache settings” on page 168).

However, if you make a change that does not alter per-particle attributes, such as changing the render type from blobby to streak, you will see the change without turning off Use Particle Disk Cache.

#### To create a particle disk cache:

---

#### *Tip*

We suggest you name your scene before creating a particle disk cache; otherwise, Maya saves the particles in a directory named *untitled*.

---

- 1 Select Solvers > Create Particle Disk Cache.

Maya plays through the scene once using the current time slider playback range and writes out cache files. Maya does not re-draw the screen during this playback. If you want to cache a different range, you can either change the current range of your time slider or use the range in Render Globals (see “Use Render Globals Range” on page 168).

Maya must play the scene through once to create the cache. If you don’t want to wait through the playback, you can interrupt it by pressing the ESC key, but the cache won’t be created.

- 2 After creating the cache, save your scene so any settings you made to the Particle Render Cache Option window get saved with the scene. Otherwise Maya might not know to look for your cache or might not be able to find it.

When you create the cache in the above manner, Maya creates a cache for *all* particles in the scene. If you want to cache some particles objects and not others, see “Caching a single particle object” on page 172.

---

### *Important!*

Be sure to save your scene after creating the cache. Otherwise, Maya won't know about the cache when batch rendering.

---

## Setting particle disk cache options

You can set the following particle disk cache options before creating the cache. These options affect all subsequent caching operations.

### To set the particle disk cache options:

- 1 Select Solvers > Create Particle Disk Cache .
- 2 Set the following options:

- Cache Directory** Specifies where to store the disk cache. See “Specifying where the cache files are stored” on page 165.
- If you don't specify a name, Maya uses a directory that matches your current scene name. If that directory doesn't exist, Maya creates it.
  - If you specify a name that is different from the current scene name, Maya prompts you to be sure you want to use it. It is generally preferable to use the name of the scene because if two scenes are cached in the same directory, a new caching operation overwrites the old cache.

This same prompt appears if you cache a scene, save the scene under a different name, and re-cache the scene. When you try to re-cache, Maya detects that the cache name now differs from the scene name and asks you to confirm.

- Don't specify an absolute directory name. Maya considers the cache directory always to be relative to the Particles directory of your workspace. However, you can set the Particles directory of your workspace to an absolute directory name using File > Project > Edit Current.

## DYNAMICS | 8

### New particle caching

- The name of the directory used is stored with your scene, so if you change the name of the scene, Maya is still able to find your disk cache. The name is stored in the dynGlobals node (see “Editing particle disk cache settings” on page 168).

#### Use Render Globals Range

If you turn on this option, Maya caches particles for the frame range specified in the defaultRenderGlobals instead of for the current playback range. Turn on this option if you plan to use the render globals range in your render.

### Editing particle disk cache settings

#### To edit particle disk cache settings:

- 1 Select Solvers > Edit Oversampling or Cache Settings.  
The Attribute Editor for the dynGlobals node is displayed.
- 2 Expand the Particle Disk Cache settings.

---

#### *Important!*

Be sure to save your scene after editing any of these values. Otherwise, Maya won't know about them when batch rendering.

---

- 3 Enter values for the following:

#### Use Particle Disk Cache

This determines whether Maya uses the cache. When you create a cache, this attribute is turned on automatically. Turn off Use Particle Disk Cache if you don't want Maya to use the cache. For example, if you have made changes to certain emitter attributes that affect playback, such as speed or emitter type, turn off this attribute to see the effect of your changes. You can also recreate the cache.

#### Cache Directory

This attribute lets you specify the directory where Maya looks for the cache. You can use this to choose which of several saved caches you want to use (see “Playing back different caches” on page 169).

For example, you could cache one simulation to a directory named *cache1* and another to a different directory called *cache2*. Enter the name of the Cache Directory you want Maya to use.

This directory is always relative to the Particles directory of your workspace. Don't type an absolute path name.

Entering a name here does not re-create the cache—you do that using Particle Disk Cache > Create. Entering a name here also does not change the name of your existing cache directory. If you want to rename your directory, use your operating system.

---

### Tip

Solver > Create Particle Disk Cache  also has a Cache Directory attribute. If you enter a value in the dynGlobals Attribute Editor, that value becomes the default for the option box. Any different value that you enter in the option box is displayed in the dynGlobals node.

---

#### Min Frame Cached, Max Frame Cached

These attributes record the minimum and maximum frames that were stored at the most recent caching operation. You can't enter values here—these attributes are for your information only. Because they describe the most recent caching operation, if you choose a different cache directory using Cache Directory, the values in Min Frame Cached and Max Frame Cached won't necessarily correspond to what is stored in that directory.

### Playing back different caches

You can use particle disk caching to create different caches for the same scene. This lets you create and quickly play back variations on a scene.

#### To create and play back different caches:

- 1 Create your scene and name it.
- 2 Select Solvers > Create Particle Disk Cache .
- 3 Enter a name for the Cache Directory or leave the default name, which is the scene name.
- 4 Click Create to create the cache.
- 5 Make any changes to your particles.
- 6 Select Solvers > Create Particle Disk Cache .
- 7 Enter a new name for the Cache Directory and click Create.

## DYNAMICS | 8

### New particle caching

- 8 Continue this process to create as many caches as you want.
- 9 To choose a cache for playback, select Solvers > Edit Oversampling or Cache Settings, and enter the cache name in the Cache Directory box.
- 10 Press the play button to see the scene play back from the specified cache.

### Re-creating the cache

Once you have created the cache, Maya uses that cache until you tell it not to. It ignores any changes in emission, forces, etc. on that particle object.

If you change something in the scene that alters per-particle attributes, you must re-create your cache in order to get correct renders. Maya writes out the disk cache only when you select Create Particle Disk Cache. That menu item does not turn on a “caching state.” This is an important difference between memory caching and disk caching. Maya does not automatically update or re-create your disk cache.

#### To re-create your cache:

- Select Solvers > Create Particle Disk Cache.

You don’t need to re-create the cache if you make a change that does not alter per-particle attributes. For example, you could change a particle shape’s render type from blobby to cloud, save the file, and re-render. Or you could change keyframed colorRed/colorBlue/colorGreen attributes. In both these examples, you would not need to re-create the cache because the attributes involved are not per-particle.

Be careful, however, because attributes such as colorRed can indirectly affect per-particle attributes. In the previous examples, if you had a per-particle expression on some particle object that made use of the render type or colorRed as an input, the results of that expression would be affected, so you would need to re-create the cache.

### Particle disk cache files

Maya saves one cache file for each particle for each frame. These binary files have the extension .pdc, which stands for particle data cache. This is a new file format for Maya 3.0. Maya uses the *dynExport* command to write these files.

You can't read .pdc files. If you want to output particle data files you can read, see the online documentation in the *dynExport* command for information on outputting .pda and .pdb files, and also the *gifts/readpdb* directory. See Appendix A, "PDC File Format" for information on writing your own reader.

### Deleting cache files

There is no way to delete cache files or directories from within Maya. Delete them using your operating system.

### Caching tips

#### Ramps

If you are animating per-particle rendering attributes by ramps, and you change those ramps, you'll see the change in playback even if the cache is enabled. This also applies to changes in hardware display/rendering attributes such as *pointSize*. To avoid any confusion, turn off the Use Particle Disk Cache attribute before you make changes to your scene, and re-create your cache just before you render.

If you are animating any attribute with expressions, or animating *rampPosition*, *rampVelocity*, or *rampAcceleration* with ramps, any changes you make to those expressions or ramps will not be visible in playback as long as the cache is enabled. Turn off Use Particle Disk Cache.

#### Particle collisions with rigid bodies

If you have a rigid body being driven by particle collisions, and you disk-cache the particles, the rigid bodies will no longer evaluate correctly. In effect, the caching takes away the dynamic properties that allow the rigid bodies to evaluate and they can't detect the collisions any more. To cache such a scene, first bake out the rigid bodies (see "Baking rigid bodies," below), then disk-cache the particles. The same limitation and same workaround apply to in-memory caching as well.

## DYNAMICS | 8

### New particle caching

#### Baking rigid bodies

The particle disk cache always applies to particles only. It does not apply to rigid bodies. In most cases, rigid bodies can compute their positions without needing to do a run-up. If you encounter any problems in this area, you can resolve them by baking out your rigid bodies, using the *bakeResults* command.

For example, to bake out *rigidBody1* for frames 1 to 100, do this:

```
bakeResults -t "1:100" -simulation true rigidBody1;
```

You can't use the *bakeResults* command to bake out particle motion. It bakes out animation channels, such as translateX/Y/Z, not particle positions.

Even if unbaked rigid bodies do cause a run-up, the run-up will go faster if your particles are cached, because the particles are loaded from the disk cache instead of being recomputed.

#### Caching a sequence in two parts

You may find it necessary to cache two parts of a sequence separately. For example, if you cache frames 1 to 45 in one place, and frames 46 to 90 in another place, you must be sure that the two caches "line up" so there is no discontinuity from 45 to 46.

Make sure that the animation and dynamics the first time you cache are consistent with the second. Make sure you didn't add or change anything, or have something changed for you.

In particular, if you have expressions that use the MEL `rand()` function, you must make sure your expressions are properly reseeded (see "Reproducing Randomness" in Chapter 5 of *Using Maya: Expressions*).

#### Caching a single particle object

Using Solvers > Create Particle Disk Cache caches all particle objects in the scene. You can cache a specified object from the command line using the *dynExport* command (see the online Command documentation for information on the *dynExport* command).

You can also get this same result by using your operating system to delete the cache files for all objects you don't want read from the cache.

### Caching only certain attributes

By default, all attributes are cached. However, you can cache only certain attributes using the *dynExport* command (see the online Command documentation for information on the *dynExport* command).

## Particle start-up caching

The particle start-up cache lets you save files at frames greater than the start frame without doing a run-up. It saves a copy of the particle shape's attribute values in a different file than the particle disk cache files.

### Using the start-up cache

Using the start-up cache lets you save and quickly re-load scenes at frames greater than the start frames of your particle objects. If you always save your files at the particles' start frames, you can turn off Save Start-up Cache to save disk space.

The disk space used for the particle cache is determined by how many particles are in your scene at the frame saved, and how many attributes they have. Likewise, the time savings at file load is determined by how heavy your scene is and how long it takes to play back. There is no simple formula—you must assess the trade-off between file size and time savings. Because of this, we made this a preference you can turn on or off. It is turned on by default.

### To use the start-up cache:

- 1 Select Window > Settings/Preferences > Dynamics.
- 2 Turn on Save Start-up Cache for Particles.

When this option is turned on (the default), Maya automatically saves the start-up cache for all your particles every time you save the file. Unlike particle disk caches, you don't have to create the start-up cache explicitly every time.

When the file is loaded (in either interactive or batch mode), the particle shape's current state is read from the start-up cache and no run-up occurs. If Maya cannot find or read the cache file, it gives you a warning and then runs the scene up. This would happen, for example, if you copied the file into a different workspace and did not also copy the start-up cache. If you re-save the scene at that point, Maya re-creates the start-up cache.

### **Location and names of start-up cache files**

Start-up cache files are kept in a subdirectory of your workspace particles directory. Each scene has a separate start-up cache directory.

Normally, Maya names this directory by appending *\_startup* to your scene name. For example, if your scene is called *myScene*, Maya puts the start-up cache in a directory called *myScene\_startup*.

However, if you have created a particle disk cache for that scene, Maya uses the name of that particle disk cache directory in place of your scene name. For example, if you store your particle disk cache in a directory *safePlace*, Maya calls the start-up cache *safePlace\_startup*. (By default, the disk cache directory name is the same as the scene name.)

If you first disk cache the scene under one name, then rename the scene, any start-up file written uses the first name (because that's the name your disk cache was created under). We recommend that you name your scene when you start and don't change it.

### **Using start-up caches with batch rendering**

Maya uses the start-up cache in batch rendering only when you are rendering the exact frame for which the start-up cache was saved. It does not use the start-up cache when you are rendering other frames. When rendering sequences, or rendering in distributed or multiprocessor fashion, we recommend that you use the particle disk cache and not rely on the start-up cache.

### **Using disk caches and start-up caches**

If you have both a particle disk cache (a complete sequence) and a start-up cache, the particle disk cache takes precedence. Maya searches for caches in the following order:

- Maya first looks for a particle disk cache.
- If it can't find a particle disk cache, it looks for a start-up cache.
- If it can't find either, it runs the scene up (*only when rendering*).

If you have a particle disk cache, but you want to save a state that is different from what's stored in the particle disk cache, be sure to turn off Use Particle Disk Cache before saving the file. Otherwise, Maya saves what was in the disk cache, using that cache until you specify not to use it.

---

**Tip**

If you believe you have rendering problems that are due to the start-up cache, create a particle disk cache for the complete sequence.

---

## IMPROVED PARTICLE RENDERING ATTRIBUTE CONTROL

In Maya 3.0, we've improved control over particle rendering attributes. A new particle rendering utility node, called the Particle Sampler Info node, replaces the four utilities previously available in the Hypershade window under Create > Utilities > Particle. These were particle color mapper, transparency mapper, incandescence mapper, and age mapper.

The Particle Sampler Info node lets you:

- Use particle object attributes (including ramps and particle expressions) to drive particle shader attributes on a per-particle basis.
- Use rgbPP and opacityPP attributes in software rendering. Previously, you could use these attributes only in hardware rendering.
- Have more control over texture placement nodes for particles, including the use of per-particle attributes for texture coordinates.

### Using the Particle Sampler Info node

The Particle Sampler Info node provides particle shape attributes to either a particle shader, texture, or texture placement node for use in software rendering.

When you use a Particle Sampler Info node, you connect one or more of its outputs to attributes of a particle shader or texture placement node. This tells the shader to get the per-particle information from the Particle Sampler Info node. It also tells the Particle Sampler Info node which attributes to get from the particle shape.

#### Types of outputs

The Particle Sampler Info node has the following types of outputs:

## DYNAMICS | 8

### Improved particle rendering attribute control

- A uv coordinate output designed to drive the uv coordinate input for texture placement nodes. This is somewhat like the output from the old particle utilities, but more powerful.
- Outputs that correspond to predefined attributes of the particle shape, such as Rgb PP. These are used to drive attributes of shaders or textures on a per-particle basis.
- Ten predefined outputs for user-defined attributes that you can add to the particle shape. Five are scalar attributes and five are vector (see “Using user-defined attributes” on page 190).
- Two outputs, birthPosition and worldBirthPosition, that correspond to two optional attributes (with the same name), which you can add to your particles.

---

#### Note

You still have to add attributes to the particle shape, where applicable. The Particle Sampler Info node just gets attribute values, if they are present. For example, making a connection from the Particle Sampler Info node parentU to the shader tells the sampler info node to get parentU if it's there, and use it in the shading. You still have to add parentU to the particle shape.

---

The Particle Sampler Info node has no association with any particular camera, unlike the samplerInfo node. The two nodes are similar in that both provide data to shaders to use in shading samples. They are different in that much of the data the samplerInfo node provides is camera-dependent.

## Creating a Particle Sampler Info node

This is the general procedure for creating a Particle Sampler Info node. These are general steps—we've included examples of specific tasks in “Examples of using the Particle Sampler Info node” on page 177.

#### To create a Particle Sampler Info node:

- 1 Create your particles and set the Render Type Cloud, Blobby, or Tube.
- 2 Determine which particle attribute you want to use to drive a shader attribute.

- 3 Add that attribute to the particle shape, if necessary.
- 4 Select the particles and display the Attribute Editor. Click the Attribute Editor tab for the shader, and find the shader attribute you want to drive with the particle attribute.
- 5 Click the  (map) button next to that attribute to display the Create Render Node window.
- 6 In the Create Render Node window, select the Utilities tab. Under Particle Utilities, click the Particle Sampler Info button.

This displays the Connection Editor with the Particle Sampler Info node on the From side and the shader on the To side.

In the case of color, transparency, and incandescence, the Connection Editor is not displayed when you click the Particle Sampler Info button. Instead, Maya creates the new Particle Sampler Info node for you, and automatically makes the following default connections:

- outColor -> color
  - outTransparency -> transparency
  - outIncandescence -> incandescence
- 7 Using the Connection editor, connect Particle Sampler Info node attributes to shader node attributes however you wish.

The connection between the particle shape and the Particle Sampler Info node is implicit— you don't actually make it. The only connection you make is between the Particle Sampler Info node and the shader.

## Examples of using the Particle Sampler Info node

To help you use the Particle Sampler Info node: we've included the following examples to help you learn how to use the Particle Sampler Info Node to achieve some commonly used effects. Refer to "Setting Particle Sampler Info node attributes" on page 187 provides complete information on Particle Sampler Info node attributes

- "Example: Using the particles' age to color particles:" on page 178
- "Example: Using the Particle Sampler Info node with rgbPP:" on page 181
- "Example: Creating fading particles:" on page 184
- "Example: Creating smoke:" on page 185

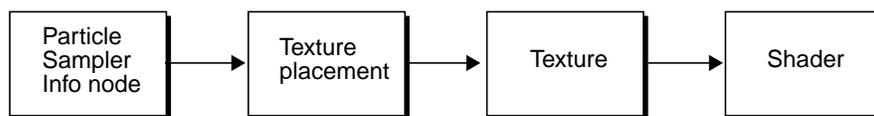
## DYNAMICS | 8

Improved particle rendering attribute control

### Strategies for using the Particle Sampler Info node

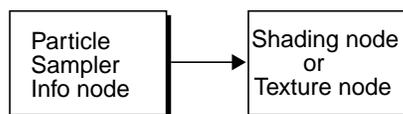
There are two basic strategies for using the Particle Sampler Info node to control your particles:

- The first strategy uses the Particle Sampler Info node to drive a texture placement node. The setup is:



The advantage of this strategy is two-fold: you can use any type of texture, and you can use the controls on the texture placement node.

- The second strategy uses the Particle Sampler Info node to feed per-particle attributes, such as `rgbPP`, directly to the shading or texture node. The setup is:



The main advantage of this strategy is that it lets you control the per-particle attribute using expressions, ramps, or the Component Editor and see the result in the shading or texture node.

### Using the Particle Sampler Info node to drive a texture placement node

Here is an example of the first strategy—using the Particle Sampler Info node to drive a texture placement node, which textures the shader color. In this example, we'll use the particles' age to color the particles.

#### Example: Using the particles' age to color particles:

- 1 Make a cone emitter emitting upwards with a speed of 8, set the particles' Lifespan Mode to Constant with a Lifespan of 2, and set their Render Type to cloud.

To do this, you can copy the following Mel commands from the online help and paste them into the Script Editor:

## Improved particle rendering attribute control

```
emitter -pos 0 0 0 -type volume -r 100 -vsh cone -alx 8;
particle;
connectDynamic -em emitter1 particle1;
setAttr particleShape1.lifespanMode 1;
setAttr particleShape1.lifespan 2.0;
setAttr particleShape1.particleRenderType 8;
```

- 2 Select the particle shape and display the Attribute Editor.
- 3 Select the particleCloud tab, and press the  button next to Life Incandescence to display the Create Render Node window.

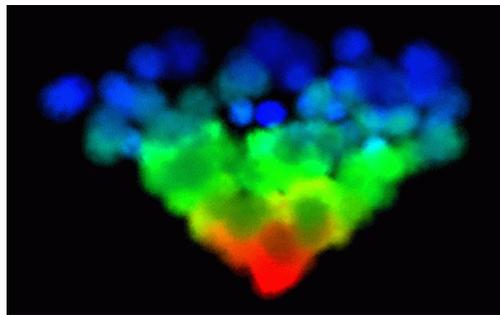
---

**Tip**

Incandescence is the same as color but is self illuminating so you don't need to add a light.

---

- 4 Click the Ramp button.  
This creates a new ramp, a texture placement node, and a Particle Sampler Info node. Life Color isn't actually an attribute at all—it's just a control in the Attribute Editor that tells Maya to set up these connections to color for you.
- 5 Play the scene back and render.  
You'll see the particle color textured by the ramp as the particles age.



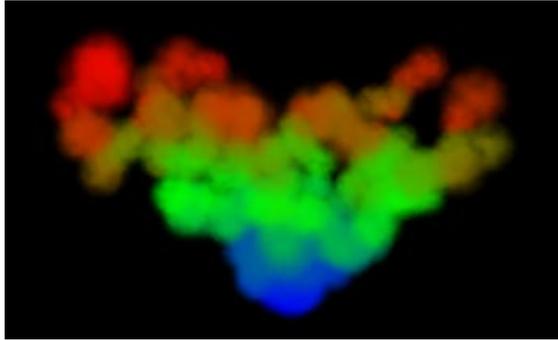
Now we'll change some of the controls in the Particle Sampler Info node.

- 6 Select the particle shape and display the Attribute Editor. Click the particleSamplerInfo1 tab.

## DYNAMICS | 8

Improved particle rendering attribute control

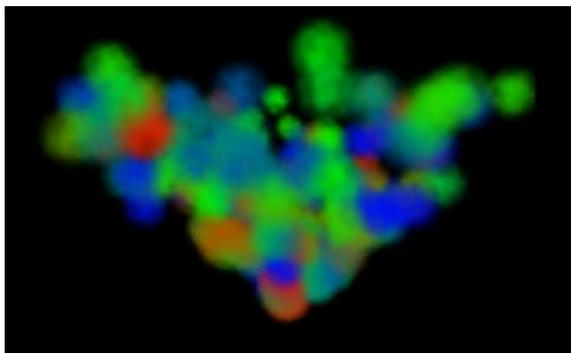
- 7 Turn on Inverse Out Uv and re-render.



The colors are reversed—instead of the particles changing from red to green to blue, they change from blue to green to red.

Now we'll change a control on the texture node.

- 8 In the particle shape Attribute Editor, click the particleCloud tab.
- 9 Click the Input Connection  button next to Life Incandescence.
- 10 Click place2DTexture1.
- 11 Set Noise UV to 1.0 and 1.0 and re-render.

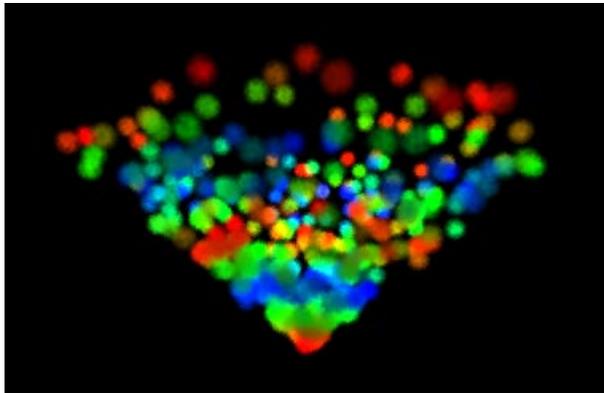


Noise is applied to the placement of the ramp creating randomness in the red, green, and blue particles.

- 12 Change Noise UV back to 0.0 and 0.0.

- 13 Click Load Attributes and display the particle shape Attribute Editor.
- 14 Change Lifespan Mode to Live forever.
- 15 Select the tab for the Particle Sampler Info node.
- 16 Change the Out Uv Type to Absolute Age and set a normalization value of 1.
- 17 Rewind, play about 100 frames, and render.

Notice that the particles cycle through the ramp more than once as they age.



### Using the Particle Sampler Info node with per-particle attributes

Here is an example of the second general strategy—driving shader color directly with rgbPP. Use this strategy when you want to use expressions or ramps driven by something other than age.

#### Example: Using the Particle Sampler Info node with rgbPP:

- 1 Make a cone emitter emitting upwards with a speed of 8, set the particles' Lifespan Mode to Constant with a Lifespan of 2, and set their Render Type to cloud.

To do this, you can copy the following Mel commands from the online help and paste them into the Script Editor:

```
emitter -pos 0 0 0 -type volume -r 100 -vsh cone -alx 8;
particle;
connectDynamic -em emitter1 particle1;
setAttr particleShape1.lifespanMode 1;
```

## DYNAMICS | 8

### Improved particle rendering attribute control

```
setAttr particleShapel.lifespan 2.0;  
setAttr particleShapel.particleRenderType 8;
```

- 2 Select the particle shape and select Fields > Create Gravity.
- 3 With the particle shape selected, display the Attribute Editor.
- 4 Under Add Dynamic Attributes, click Color.  
The Particle Color window is displayed.
- 5 Click Add Per Particle Attribute and click Add Attribute.
- 6 In the Attribute Editor, click the particleCloud1 tab.
- 7 Next to the Incandescence attribute (not Life Incandescence), press the  map button to display the Create Render Node window.
- 8 Click the Utilities tab, and under Particle Utilities, click the Particle Sampler Info button.

This automatically creates a new Particle Sampler Info node and connects its color output to the incandescence. (If you had already created a Particle Sampler Info node, you could use that and connect it directly, in the connection editor.)

- 9 Select the particle shape tab in the Attribute Editor. Under Per Particle (Array) Attributes, right click on rgbPP and select Runtime Expression.
- 10 In the Expression Editor, enter the following expression:

```
particleShapel.rgbPP = << mag(particleShapel.velocity) /  
10, 0.0, 1 -mag(particleShapel.velocity)/10 >>;
```

This tells Maya to change the particle color from blue to red as the velocity increases.

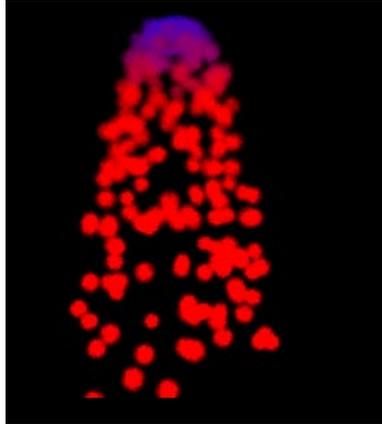
---

#### *Tip*

We used an expression in this example to achieve a specific effect. However, you don't have to use expressions with the Particle Sampler Info node. You can also use a ramp, which will give you a different effect.

---

- 11 Play about 75 frames and render.



Notice that the Particle Sampler Info node `outIncandescence` output automatically uses `rgbPP` if that attribute is present. If there is no `rgbPP`, it uses `colorRed`/`colorGreen`/`colorBlue`, if they are present.

The advantage of using `rgbPP` is that you can set or animate its value in any of the ways available for per-particle attributes, and see the results in software. You will also then be using the same color attribute in both hardware and software rendering.

However, `rgbPP` can be animated only with expressions and ramps (or the component editor). The advantage of using Life Color is that you get a texture placement node and can make use of its additional controls. In particular, you can use any texture, not just a ramp, since you get both `u` and `v` control. You can connect any compatible Particle Sampler Info node attribute you want.

### Setting transparency with the particle info node sampler

As with color, Life Transparency is still available. It uses the `outUvCoord` attribute of a Particle Sampler Info node in conjunction with a texture placement node, instead of a particle transparency mapper and age mapper.

And as with color, you can use per-particle attributes such as `opacityPP` directly. You use the `outTransparency` attribute of the Particle Sampler Info node.

## DYNAMICS | 8

### Improved particle rendering attribute control

#### Example: Creating fading particles:

- 1 Make a volume emitter with the shape of a flat cylindrical disk, with Speed Away From Axis equal to 1 and other speeds zero.

To do this, you can copy the following Mel commands from the online help and paste them into the Script Editor:

```
emitter -pos 0 0 0 -type volume -r 100 -sro 0 -spd 1 -vsh cylinder -afx 1;  
scale -r 5 0.5 5 ;  
particle;  
connectDynamic -em emitter1 particle1;
```

- 2 Reduce emission rate to 50 and set the particle radius to 1.5.
- 3 Set the particle's render type to cloud. Click Add Attributes for Current Render Type and set the Radius to 1.5.
- 4 In the Attribute Editor, under Add Dynamic Attributes, click Opacity. Turn on Add Per Particle Attribute and click Add Attribute.
- 5 Under Per Particle Attributes, right click on opacityPP and select Runtime Expression.
- 6 In the Expression Editor, enter the following expression and click Create:

```
opacityPP = 1 / (0.01 + mag( position ));
```

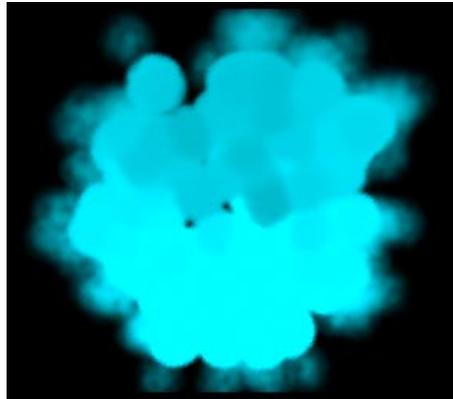
(We added 0.01 in the denominator to avoid dividing by zero when particle is at the origin.)

- 7 Select the particleCloud shader tab and click the map  button for Transparency (not Life Transparency).
- 8 In the Create Render Node window, click the Utilities tab and click the Particle Sampler Info button (under Particle Utilities).

This create a new Particle Sampler Info node and connects its outTransparency to the shader transparency. As with color and incandescence, the outTransparency output automatically uses opacityPP, if that attribute is present, otherwise it uses opacity.

Opacity and transparency have an inverse relationship: the more opaque something is, the less transparent it is. If you connect the outTransparency output of the Particle Sampler Info node, then the node automatically converts opacity to transparency so that you get the right result.

- 9 Add a light, play the scene about 50 frames, and render. A camera view from the top, looking down the y-axis, is best. The particles will appear more transparent the further they are from the origin.



### Controlling noise on a per-particle basis

You can connect any per-particle attribute to the attribute in the shader that you want to control. You can then put an expression on the per-particle attribute to control it exactly the way you want.

#### Example: Creating smoke:

- 1 Make a simple curve emitter emitting particles vertically upward.

To do this, you can copy the following Mel commands from the online help and paste them into the Script Editor:

```
curve -d 3 -p -6.861087 0 7.36723 -p -2.43128 0 2.685247 -p 2.685247 0 -2.43128
-p 6.968851 0 -6.714884 -k 0 -k 0 -k 0 -k 1 -k 1 -k 1 ;
emitter -type curve -r 100 -sro 0 -nuv 0 -cye none -cyi 5 -spd 6 -srn 0 -nsp 0
-tsp 0 -mxd 0 -mnd 0 -dx 0 -dy 1 -dz 0 -sp 0 ;
particle;
connectDynamic -em emitter1 particle1;
```

- 2 Set the particles' lifespan mode to random range. Set lifespan to 2 and lifespanRandom to 2.
- 3 Set the particle rendering type to cloud. Click Add Attributes for Current Render Type, and set Radius to 1.5.

## DYNAMICS | 8

### Improved particle rendering attribute control

- 4 Select the particleCloud tab, and set the color to a light gray color, or any other color you like.

Now we'll use any per-particle attribute you aren't using. For example, we have no need of parentU and parentV here, so we'll use that.

---

#### Note

For simplicity, we used parentU and parentV in this example because they are easily added and weren't being used. However, you can use any dynamic attribute—even those you define yourself.

- 5 Select Attributes > Add Attributes. Click the Particle tab in the Add attribute window.
- 6 Select parentU and click Add. Select parentV and click Add. Click OK.
- 7 Right-click on either parentU or parentV, select Runtime Expression, and add the following expression:

```
parentU = 0.7 + 2*(age/finalLifespanPP)
parentV = age / (1.5*finalLifespanPP);
```

We want the particles to get less dense and more noisy as they age, the way smoke would.

---

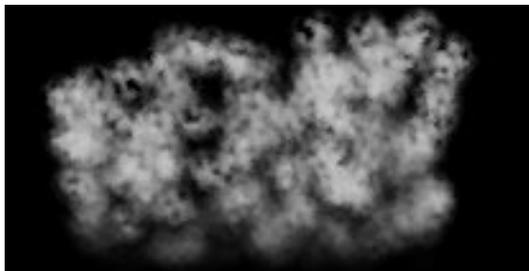
#### Tip

We used an expression in this example to achieve a specific effect. However, you don't have to use expressions with the Particle Sampler Info node. You can also use a ramp, which will give you a different effect.

- 8 In the particleCloud Attribute Editor, click the map  button next to noise.
- 9 The Create Render Node window, click the Utilities tab and click the Particle Sampler Info button (under Particle Utilities).

The Connection Editor is displayed.

- 10 Connect the Particle SamplerInfo node's parentU to Noise, and connect parentV to Density.
- 11 Add a light. Play the scene to about frame 60 and render.



## Setting Particle Sampler Info node attributes

The Particle Sampler Info node attributes provide all the functionality of the old particle color mapper, transparency mapper, incandescence mapper, and age mapper.

### To set the Particle Sampler Info node attributes:

- 1 Select the particle shape and display the Attribute Editor. Click the particleSamplerInfo tab.

The particle shape Attribute Editor includes a tab for each Particle Sampler Info node associated with that shape. The two sections in the Attribute Editor: Common Read-Only attributes and More read-Only attributes list the attributes that the node knows about by default. You can also use your own user-defined attributes.

- 2 You can set the following attributes:

<b>Out Uv Coord</b>	By default, Out U Coord and Out V Coord give you the normalized age of the particles. The outUv Coord attribute is comprised of Out U Coord and Out V Coord. They are provided in this form so that you can use this attribute to control texture placement nodes.
<b>Out Uv Type</b>	Specifies how Out Uv Coord is computed. You have four choices:

## DYNAMICS | 8

### Improved particle rendering attribute control

#### **Normalized age**

The particle's age divided by its finalLifespanPP. The finalLifespanPP attribute is used for the particle's age. This works in all Lifespan Modes of the particle shape. But if Lifespan Mode is set to Live forever, all lifespans are effectively infinite, so normalized age is always zero.

Out UV Type set to Normalized age is the default; you don't need to set a use relative age attribute as you did in previous releases.

You can use this output of the Particle Sampler Info node regardless of whether the particle shape has an ageNormalized attribute.

#### **Absolute age**

Uses the Normalization Value attribute of the Particle Sampler Info node, in place of finalLifespanPP. This is useful if you want to have the particles live forever, or if you want to cycle through a texture a number of times during the lifespan.

#### **Parent UV and Collision UV**

Use these attributes of the particle shape as the u and v values. This gives you more power than you had before, because in addition to age, you can use these attributes to define your own texture coordinates for the particles.

#### **Normalization Method**

*(Applies only if the Out UV Type is set to Absolute age.)* Specifies how to apply Absolute Age and particle age to compute the Out UV Coord. The age ranges from 0 to the value specified by the Normalization Value.

#### **Oscillate**

As the particle's actual age increases, Maya cycles through the normalization range repeatedly. For example, if the normalization value is 2, as the particle age, Maya uses the following values:

<b>Actual particle age</b>	<b>Value Maya uses</b>
0	0
0.1	0.1

## Improved particle rendering attribute control

Actual particle age	Value Maya uses
1	1
2	2
2.1	0.1
3	1
4	2

**Clamp**

If the actual age exceeds the normalization value, Maya uses the normalization value. For example, if the normalization value is 2, as the particle age, Maya uses the following values:

actual age	value to use
0	0
0.1	0.1
1	1
2	2
2.1	2
3	2
4	2

**Normalization value** (*Applies only if the Out UV Type is set to Absolute age.*) Specifies upper value of the age range. For example, if you use a value of 2, the particles' ages range from 0 to 2.

**Inverse Out Uv** Uses 1 - Out Uv Coord in the final computation (instead of Out Uv Coord). For example, if you have out Uv Type set so that the value is 1 when the particle is born and 0 when it dies. This applies to all Out UV types.

### Re-using a Particle Sampler Info node

In most cases, you need to make a new Particle Sampler Info node only the first time you want to map attributes for a particular shading node. If you decide later that you want to map another attribute, you can re-use the existing Particle Sampler Info node.

By reusing the Particle Sampler Info node, you can reduce clutter. However, if you want different attribute settings for different purposes, you can use more than one Particle Sampler Info node.

#### To re-use a Particle Sampler Info node:

- 1 Select Window > Hypershade.
- 2 Locate the Particle Sampler Info node on the left side of the Hypershade window.
- 3 Middle-mouse-drag it on top of the shading node.

The Connection Editor is displayed.

---

#### *Tip*

If you are not sure which Particle Sampler Info node goes with which shader, put the shader in the workspace and use Graph | Up and Downstream Connections to display the associated utility nodes.

---

### Using user-defined attributes

In addition to its many outputs for predefined attributes of the particle shape (such as position, radiusPP, and so on), the Particle Sampler Info node includes ten predefined outputs for user-defined attributes, which you can add to the particle shape.

Five of these are scalar and five are type; they are called userScalar1PP, userVector1PP, and so on.

If you connect one of these to a shading attribute, the Particle Sampler Info node looks for an attribute of the identical name on the particle shape, and fetches those values. For example, if you connect userScalar1PP to shader noise, then the Particle Sampler Info node looks for a userScalar1PP attribute on the particle shape.

## Adding user-defined attributes

To use any of these attributes, you must add an attribute of the identical name and type to the particle shape.

You cannot add attributes of arbitrary names and use them with the Particle Sampler Info node. However, you can assign the value of any of your attributes to the one that the particle sampler info node recognizes, using an expression.

### To add a user-defined attribute:

- 1 Create an emitter.
- 2 Display the Attribute Editor and select Attributes > Add Attributes.
- 3 Click the Particle tab in Add Attribute window.
- 4 Scroll down the list and select a userScalar#PP or userVector#PP attribute. Click Add.

### Example 1

Suppose you want to make the particles more noisy the further they are from the origin. To do this you would animate the noise parameter of the shader as a function of the magnitude of the particle's position vector.

- 1 Create an emitter.
- 2 Select the particle shape and set the Render Type to Cloud.
- 3 Display the Attribute Editor and select Attributes > Add Attributes.
- 4 Click the Particle tab in Add Attribute window.
- 5 Add the userScalar1PP attribute to the particle shape.
- 6 Assign it a value with this runtime expression:

```
userScalar1PP = mag(position);
```

---

### Tip

Although this example uses an expression to achieve its effect, you can use a ramp to animate userScalar1PP.

---

## DYNAMICS | 8

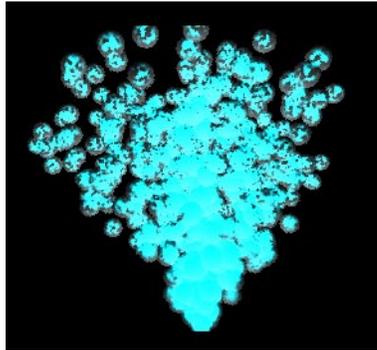
Improved particle rendering attribute control

- 7 Select the particleCloud1 tab in the particle Attribute Editor.
- 8 Click the  (map) button next to the Noise attribute.
- 9 In the Create Render Node window, select the Utilities tab. Under Particle Utilities, click the Particle Sampler Info button.
- 10 In the left column of the Connection Editor, select UserScalar1 PP and in the right column, select Noise. Click Close.

This connects the Particle Sampler Info node's User Scalar1 PP output to the shader's Noise input.

The Particle Sampler Info node will fetch the value of userScalar1PP and pass it to noise. In this example, we assigned userScalar1PP a value using an expression, but we could have used a ramp to assign it a value.

- 11 Add a light, play the scene. Select Window > Rendering Editors > Render View and test render.



### Example 2

Suppose you already had an attribute called *myNoise*, which you had already written an expression on or connected to a ramp, and you wanted to pass this value to the Particle Sampler Info node. Then you would do this:

- 1 Add the userScalar1PP attribute to your particle shape.
- 2 Add this as the last line of your expression:  

```
userScalar1PP = myNoise;
```
- 3 Select the particleCloud1 tab in the particle Attribute Editor.

- 4 Click the  (map) button next to the Noise attribute.
- 5 In the Create Render Node window, select the Utilities tab. Under Particle Utilities, click the Particle Sampler Info button.
- 6 In the left column of the Connection Editor, select UserScalar1 PP and in the right column, select Noise. Click Close.

Now the Particle Sampler Info node fetches userScalar1 PP, which gets the value of *myNoise*, as desired. Do this with expressions and do not try to simply connect *myNoise* to userDefined1PP.

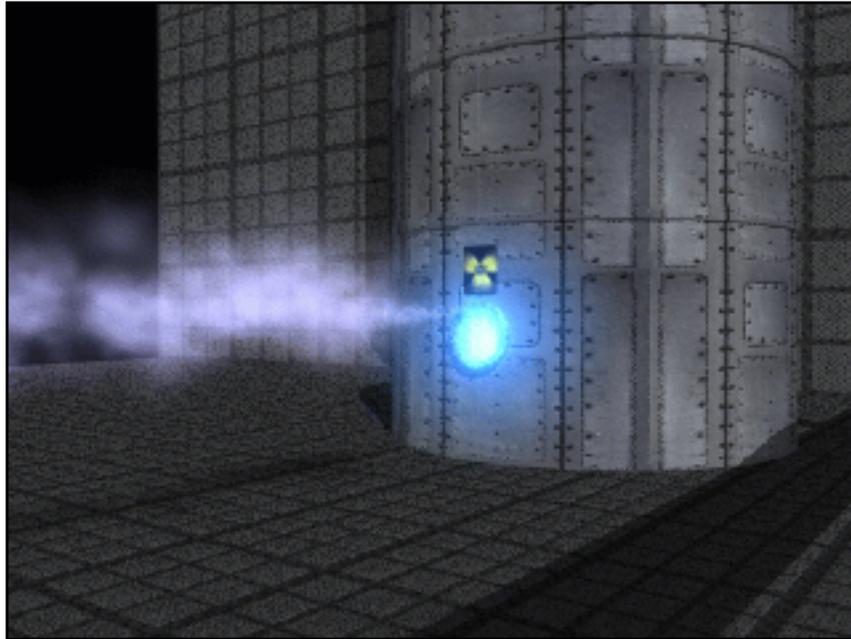
## IMPROVED PARTICLE CLOUD SHADER

We've greatly enhanced the look and control of the particle cloud shader for Maya 3.0 in several ways. The new particle cloud shader has Noise turned on by default and the default value has been increased from 0 to 0.75, which is good for volumetric clouds.

The clouds also look brighter with raytracing turned on because more light is allowed by default to penetrate. We've added a new Translucence attribute (with a default of 0.5) that gives you additional control over how much light can generate a particle.

## DYNAMICS | 8

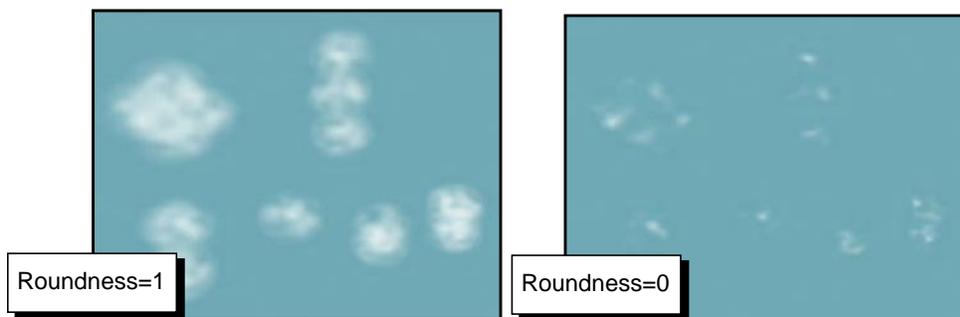
Improved particle cloud shader



To give you more control over the particle cloud shader, we've added the following attributes:

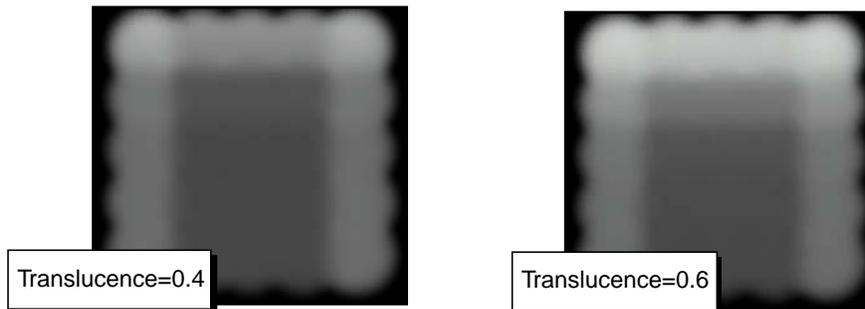
### Roundness

Controls the noise's irregularity. The smaller the value, the less rounded the shape.



### Translucence

Specifies a scaling factor for density that is used only to compute shadows. The larger the translucence value, the more light penetrates. The formula is:

$$\text{density} * (1 - \text{translucence})$$


- Noise Anim Rate** Specifies a scaling factor that controls the rate of built-in noise changes during an animation.
- Solid Core Size** Determines the size of the core, which is the area where the particle is opaque.
- Diffuse Coeff** Controls how much of the light in the scene is reflected from the particles. Most materials absorb some of the light falling on them, and scatter the rest. The default value is 0.0. If you set this to 1.0, all the light falling on the material is reflected. Use a high value when you are creating dense clouds. If you set this to 0.0 (the minimum), no light is reflected and no surface shading occurs. The surface color is modulated by the transparency. This value can be greater than 1.0, so the surface property can still appear even when the material is transparent.
- Surface Color** Specifies the basic color of the particle cloud surface (as opposed to the inside of the cloud). Diffuse Coeff must be set to a value greater than 0 to enable this option.
- Bump Mapping** Makes the surface appear rough or bumpy by altering surface normals (during rendering) according to the intensity of the pixels in the bump map texture. Diffuse Coeff must be set to a value greater than 0 to enable this option. A bump map does not actually alter the surface. A silhouette of the surface will appear smooth.

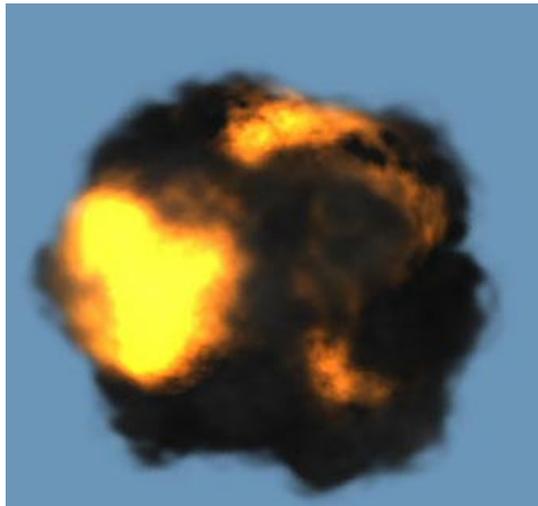
## DYNAMICS | 8

Improved particle cloud shader

**Translucence Coeff** Simulates the way light diffusely penetrates through translucent objects. This means that when light shines on one side of the object, the other side is partially illuminated. You can use this to create effects such as clouds, fur, hair, marble, jade, wax, paper, leaves, etc. If you set Translucence Coeff to 0 (the default), no light shows through the object. If you set Translucence Coeff to 1, all the light shows through. Diffuse Coeff must be set to a value greater than 0 to enable this option.

### Surface Shading Shadow

Determines if the surface shading is combined with the pre-illumination, which contains shadows, if enabled (see the Filter Radius attribute). Diffuse Coeff must be set to a value greater than 0 to enable this option.



This cloud shader uses Surface color and Surface Shading Shadow to create an explosion.

### Filter Radius

Volumetric particles use pre-illumination, which evaluates the lighting at each particle's center by default. This can sometimes cause popping if the illumination changes too fast in an animation, and is especially noticeable if Surface Shading Shadow is on.

Filter radius lets you filter the pre-illumination results so the value at each particle's center will be the average of all the pre-illumination results within the filter radius. Higher values increase render time but produce smoother images.

## IMPROVEMENTS TO PARTICLE LIFESPAN

Maya 3.0 contains a significant improvement to make it easier for you to work with lifespans and to generate random particle lifespans without using expressions.

In past versions of Maya, the only way to generate random lifespans for particles was to add `lifespanPP` and then write a creation expression for it. You also had to reseed the Mel random number stream for your expressions.

Now you never need to add lifespan attributes. The lifespan attributes are already in the particle and displayed on a new section in the particle attribute editor. Also, you can now generate simple random lifespans without expressions.

In Maya 3.0, all particle shapes have the following attributes:

- `lifespanMode`
- `lifespan`
- `lifespanPP`
- `finalLifespanPP`

The first two attributes are per-object and the other two are per-particle. These attributes are used together to control lifespan, as follows:

- If you set mode to Live Forever, all particles live forever, regardless of the values of the other lifespan attributes.
- If you set mode to Constant, all particles get a lifespan equal to `lifespan`, and the other lifespan attributes are ignored.
- If you set mode to Random Range, the particle object generates a random lifespan for each new particle. This lifespan is uniformly distributed with `Lifespan` as the mean and `Lifespan Random` as the width of the distribution.

For example, if `Lifespan` is 3 and `Lifespan Random` is 2, then each particle is will have a lifespan between 2 and 4. The resulting value is stored in an attribute called `finalLifespanPP` (see “Understanding `finalLifespanPP`” on page 198).

- If you set mode to `lifespanPP` only, then the `lifespanPP` attribute (with any associated expressions) is used to control all particles’ lifespan.

## DYNAMICS | 8

Improvements to particle lifespan

### Understanding finalLifespanPP

A new read-only per-particle attribute called finalLifespanPP stores the final result of lifespan computations no matter what mode you are using. The particle shape uses finalLifespanPP to kill particles and to drive ramps.

- In Constant or Random Range mode, the value computed from lifespan/lifespanRandom is stored for each particle.
- In lifespanPP only mode, the value of lifespanPP is stored.
- In Live Forever mode, a maximum-value float is stored.

You cannot set the value of finalLifespanPP yourself in any way (for example, with an expression, ramp, or component editor). Like age, it is an attribute the particle shape computes for you. But you can read its value (but not assign its value) in an expression (see “Using lifespan in expressions” on page 198).

In Random Range mode, lifespans are determined for each particle when it is born, and are stored in finalLifespanPP at that time. If you change lifespan or lifespanRandom, it affects new particles but does not affect particles that are already born. If you rewind and re-play, all particles are affected.

### Using lifespan in expressions

If you are using any lifespan mode other than lifespanPP only, then you should use finalLifespanPP on the right-hand side of all expressions. For example, in past versions of Maya you might have written:

```
opacityPP = 1 - age/lifespanPP;
```

This works in Maya 3.0, but only if you have lifespan mode set to lifespanPP only. The better way to write this expression now is:

```
opacityPP = 1 - age/finalLifespanPP;
```

This works for all lifespan modes because finalLifespanPP always stores the actual lifespan being used for the particles in all modes.

Existing expressions that refer to lifespanPP work as long as you set the lifespan mode to lifespanPP only. You need to have finalLifespanPP on the right-hand side only if you wish to use Constant or Random Range mode.

If you always used `lifespanPP` anyway and will not use any other mode, you can read (but not set its value) in your expressions. You need to use `finalLifespanPP` only if you intend to make use of one of the other lifespan modes.

## Using Random Range mode

The random number stream for Random Range lifespan mode is maintained inside the particle object and is automatically reseeded when you rewind. You do not have to reseed it yourself.

If you want to specify the seed, it is stored in the attribute `generalSeed`. Normally this is not something you have any need to control.

---

### Note

While `lifespan = 4`, `lifespanRandom = 2` is mathematically equivalent to the expression `lifespanPP = 3 + rand(2)`, these two methods of setting lifespan will not give identical results because the random number streams are different.

---

## File compatibility

Files written out by previous versions of Maya will load and play correctly. Maya detects the presence of `lifespan`, `lifespanPP`, and `useLifespanPP` attributes and sets `lifespanMode` accordingly. If your particle shape is missing either `lifespan` or `lifespanPP`, Maya adds it for you.

## Script compatibility

Scripts written for previous versions of Maya will work with two changes:

- You need to add a line to your script setting the lifespan mode.
- You need to remove all `addAttr` statements for `lifespan` and `lifespanPP`. These `addAttr` statements will produce errors with Maya 3.0 because those attributes are already present in all particle objects.

For example, if you have a script which writes an expression on `lifespanPP`, you need to remove any `addAttr` statements for `lifespanPP`, and you need to add this line:

```
setAttr <shape name>.lifespanMode 3
```

## DYNAMICS | 8

Increased control over randomness

to set the lifespan mode to lifespanPP only. The lifespanPP attribute will govern particles' lifespan and your expressions will work.

---

### *Warning*

Do not use pre-Maya 3.0 versions of clip effect scripts with Maya 3.0. Maya 3.0 has new versions of clip effects.

---

## Deleting Lifespan and LifespanPP

We strongly recommend that you never delete the lifespan and lifespanPP attributes.

## INCREASED CONTROL OVER RANDOMNESS

We've added a number of attributes to give you more control over randomness in the emission without using expressions. Some of these are based on Power Animator attribute such as Time Random.

The new particle lifespan attributes also give increased control over randomness (see "Improvements to particle lifespan" on page 197).

### **New Basic Emitter Attributes**

#### **Scale Rate by Object Size**

If you turn on this attribute, the size of the object emitting the particles affects the rate of particles emitted per frame. The larger the object, the greater the rate of emission.

If you turn off this attribute, the emission rate is absolute, as it was in Power Animator, instead of relative to object size.

#### **Need Parent UV (NURBS)**

*(Surface emitters only.)* If you turn this on in the Emitter Options window (before you create the emitter), Maya adds parentU and parentV attributes to the particle shape (NURBS only) and sets the needparentUV attribute to on. You can use parent UVs to drive the value of some other parameter such as color or opacity.

If you turn this on in the Attribute Editor or Channel Box (after you create the emitter). Maya sets the needParentUV attribute to on, it does not add the attributes.

**Cycle Emission** Cycle Emission is familiar to Power Animator users as Time Random. We've extended it in Maya so you can also create simple cycles for games work.

Cycle Emission lets you restart the random number sequence of the emission. If you set it to Frame, the sequence is restarted after the number of frames you specify in Cycle Interval (same as Time Random on).

If you set it to None, the random number generator is not restarted (same as Time Random off).

**Cycle Interval** Defines the interval in frames for restarting the random number sequence when using Cycle Emission.

### New Basic Emission Speed Attribute

**Speed Random** The Speed Random attribute lets you add randomness to your emission speeds without using expressions. If you set Speed Random to a positive value, the emitter generates random speeds for each particle. The Speed value is the mean speed; Speed Random defines the range of the speed variation.

Each particle's speed is a random value between:

$\text{Speed} - \text{Speed Random}/2$

$\text{Speed} + \text{Speed Random}/2$

## DYNAMICS | 8

Instancing strokes from Paint Effects

# INSTANCING STROKES FROM PAINT EFFECTS

You can now use strokes from Paint Effects as instanced objects for particles. The image below was created using Paint Effects strokes instanced to particles.

See *Using Maya: Paint Effects* for information on painting in your scene, and see “Instancing animated geometry to particles” in *Using Maya: Dynamics* for information on instancing.



## Centering strokes on particles

When you instance an object to a particle, the local origin of the object is instanced to the particle. With spheres and cubes, the local origin is the center of the object.

With the NURBS curves that comprise the strokes in Paint Effects, however, the local origin is not directly related to the geometry of the curve. No matter where you actually draw the curve, its origin is the world origin. For example, if you draw a short stroke in the workspace at position 5,0,5 to get a single flower and instance it to a particle object, the flowers will be offset from the particles by 5,0,5.

To center the Paint Effects geometry on your particles, there's a few things you can do. The obvious one is to start your curve at the origin. Unfortunately, this is hard to do in regular Paint Effects mode because you draw the curve, instead of placing down the CVs with grid snapping. We suggest the following procedures:

#### To center instanced strokes on particles-method 1:

- 1 Draw your curve near the origin.
- 2 Unhide the curve.
- 3 In component mode, select all of the CVs in the curve and use the Translate tool to move the CVs so the base of Paint Effects geometry (like the base of the flower) is at the origin.

You move the CVs instead of the transform because the top-most translation and rotation of the instanced hierarchy is ignored.

#### To center instanced strokes on particles-method 2:

- 1 Group the stroke.
- 2 Move the transform of the stroke so that the base of the Paint Effects geometry is at the origin of the new group node.
- 3 Instance the group instead of the stroke.

This has the same effect as moving the CVs.

---

#### *Tip*

Turn on Tube Completion. This lets you make a very short stroke while the tube continues to grow until it reaches the end of its number of segments.

---

## DYNAMICS MENU IMPROVEMENTS

We have made some improvements to the Dynamics menus for version 3.0. To summarize the changes, we:

- consolidated entries in the Field menu

## DYNAMICS | 8

### Dynamics menu improvements

- eliminated the Connect menu and moved its relevant entries to more appropriate places
- changed some of the menu labels to make it easier to understand for first-time users

For those of you already familiar with Dynamics menus from previous versions, the following is a guide to the changes.

Old menu item	New name or new workflow
Fields > Create...	Fields > <i>fieldname</i> . The Add menu entries are gone. The new entries are the equivalent of the old Create. These entries no longer fail if you have certain inapplicable entries set in the option box.
Fields > Add ...	Create the field, then use Fields > Attach to Selected Object as Source
Particles > Add Emitter	Particles > Emit from Object
Connect/Add > Connect to Field	Fields > Affect Selected Object
Connect/Add > Connect to Emitter	Particles > Use Selected Emitter
Connect/Add > Connect to Collision	Particles > Make Collide
Connect/Add > Connect to Time	Particles > Connect to Time
Connect/Add > Add to Owner	Fields > Attach to Selected Object as Source

#### Tip

To find the location of any menu item, choose Help > Find Menu and type the menu name you want to find. The search is not case-sensitive. It accepts wildcard characters (\*), but if the menu was renamed or removed, type the name in full.

## IMPROVEMENTS TO PARTICLE ATTRIBUTE EDITOR

We've made it easy to find all relevant nodes such as springs, fields, and shaders affecting a particle object. When you select a particle object and display the Attribute Editor, you'll see tabs for the relevant nodes associated with that particle object.

For example, if your particle render type is set to Cloud and you select the particle object and display the Attribute Editor, you'll see a tab for the particleCloud shader. If you change the render type, the Attribute Editor does not refresh. You must reselect the particle object.

## DIRECTIONAL EMISSION FROM CURVES

You can now set the Direction X, Y, and Z attributes for curve emitters.

## NEW ATTRIBUTES FOR POSITION OF EMITTED PARTICLES

We've added two new optional attributes that you can add to emitted particles—birthPosition and worldBirthPosition.

The birthPosition attribute stores the position at which each particle was born in the particle's local space. The worldBirthPosition attribute stores the position at which each particle was born in world space.

## IMPROVEMENTS TO TURBULENCE FIELD

We've improved the Turbulence field to make more realistic clouds and gases.

In previous versions of Maya, the Turbulence field had a single (scalar) attribute called Phase that caused a disruption in the Z direction. In Maya 3.0, the Turbulence field has three attributes Phase X, Phase Y, and Phase Z, which cause disruption in the corresponding directions.

The Phase manipulator for the Turbulence field now manipulates Phase Z, so it has the same effect as in previous releases. There are currently no manipulators for Phase X and Phase Y.

## DYNAMICS | 8

### Improvements to Turbulence field

#### Backward compatibility

Old scenes with the Turbulence field will load correctly in Maya 3.0. The old Phase attribute get copied to the new Phase Z. The *-phase* option on the turbulence command still works (for backward compatibility) and is equivalent to the new *-phaseZ*.

The API function set for Turbulence accesses Phase Z, so code written using that function set will have the same effect as in previous releases.

### New attributes

In addition to the phase attributes, we've added two noise attributes and an interpolation type to make more realistic turbulence.

#### Noise Level

To get a more natural, irregular look, you now have the option of telling the Turbulence field to do more than one lookup into the noise table. The Noise Level is the number of additional lookups you want done. A value of 0 does only one lookup and is equivalent to previous versions of Maya. The total turbulence value is a weighted average of the lookups.

#### Noise Ratio

Noise Ratio is the weighting of successive lookups. The weights are cumulative. For example, if you set Noise Ratio to 0.5, then successive lookups are weighted 0.5, 0.25, and so on. Noise ratio has no effect if the Noise Level is set to 0.

#### Interpolation Type

In previous versions of Maya, the Turbulence field did a linear interpolation between values in the noise table. This could create noticeable breaks along lines of force. You now have the option of using quadratic interpolation for a smoother look. Quadratic interpolation does require noticeably more execution time. You set interpolation type in the Attribute Editor or Channel Box.

## CHANGES TO AIR FIELD DEFAULTS

We've changed the defaults of two option boxes in the Air field in Maya 3.0 to make it to work better with volumes:

- Inherit Rotation is not turned on
- Direction is now 0,1,0

This will not affect any existing files or scripts.

## FIXES TO PARTICLE SCALING

Particle rendering in Maya 3.0 now correctly handles the situation of transforms on the particle object:

- In previous versions, scaling of particle or camera transforms did not correctly affect the radius of cloud particles. This has been fixed.
- In previous versions, scaling of the particle shape was not handled correctly if the particle shape's isDynamic attribute was set to false. This has been fixed.

## CHANGES TO FILE LOADING

In past versions of Maya, if you saved a file at a time greater than the start time, particles would automatically run up when the file was loaded (requiring that the scene be played forward to the current time). In Maya 3.0, this is no longer true. Particles will run up in this way only if you have turned on Run Up To Current Time under Dynamics Preferences (Window > Settings/Preferences > Preferences > Dynamics).

If you haven't turned on this preference, your scene will load at the desired frame, but the particles will not run up (and will not, in general, be in the correct positions). To see your particles, you need to rewind and play forward.

A warning message appears to remind you to do this. You'll most likely get this message when loading pre-3.0 scenes into Maya 3.0. If you play the scene forward to the desired frame and save the scene using Maya 3.0 (with

## DYNAMICS | 8

New command line functionality

Save Startup Cache for Particles turned on, which happens by default), the message won't appear anymore and your particles will load at the correct positions.

## NEW COMMAND LINE FUNCTIONALITY

### Reading particle PP array attributes into an array variable

We have added a new option, *-array*, to the *getParticleAttr* command. The *-array* option lets you query a block of data from particles all at once. For example, you can return an array containing the positions of all particles in a given particle object or component. This can be useful for writing expressions and scripts. See the online command documentation for *getParticleAttr*.

# 9

## RENDERING

In Maya 3, both Maya Complete and Maya Unlimited customers have unrestricted use of the Maya Batch Renderer. Up to 9,999 supported licenses are provided at no extra charge. Universal rendering is available for both IRIX and Windows NT users.

With this release of Maya, we've added new features and improvements to the rendering environment. The following describe Maya 3.0's new rendering features and improvements:

### General improvements

#### Image quality improvements

- "New Area lights" on page 211
- "Displacement mapping improvements" on page 214
- "Crackless tessellation" on page 216
- "Raytrace Shadow transparency improvement" on page 217

#### Performance improvements

- "Multi-threaded shadow maps" on page 217
- "Multi-threaded interactive rendering" on page 217
- "Ray tracing" on page 219
- "Speed" on page 219

#### Hypershade/Visor improvements

- "New Hypershade File menu" on page 219
- "Hypershade Edit menu changes" on page 220
- "Hypershade menu bar changes" on page 220
- "Easier directory access from the Visor panel" on page 222

- “Texture assignment improvement” on page 223

#### **Polygonal texture mapping improvements**

- “Multitexturing” on page 223
- “Baking shadows” on page 224

#### **New Layered Texture Node**

#### **New Movie Texture**

#### **New Paint Textures Tool**

- “Paint Textures Tool and texture naming” on page 232
- “About switch nodes and painted textures” on page 233
- “Using the Paint Textures Tool” on page 234
- “Masking polygonal faces while painting” on page 235
- “Painting and IPR rendering” on page 236
- “Determining stamp spacing and brush depth” on page 239
- “Selecting and painting attributes” on page 240
- “Placing painted 2d textures” on page 245
- “Assigning, saving, and reloading textures” on page 246

#### **2D/3D Integration enhancements**

- “Render Layer management” on page 249
- “Render Layer/Pass Control” on page 250
- “Render Pass management spreadsheet” on page 251

#### **New Render Globals Field Options**

## GENERAL IMPROVEMENTS

- You can now software render subdivision surfaces (*for Maya Unlimited only*).
- In Maya 3.0, a “-rep” command line option in batch rendering has been added to avoid rendering onto a filename that already exists.
- Modifications have been made to improve the camera dolly and track when zoomed in.
- Image view can now save to non-IFF image formats.

## IMAGE QUALITY IMPROVEMENTS

The following lists the rendering improvements to image quality for this release of Maya.

### New Area lights

Area lights are two-dimensional rectangular light sources. You can use area lights to simulate the rectangular reflections of windows on surfaces. An area light is initially two units long and one unit wide. You re-size and place area lights in your scene using Maya’s transformation tools.

#### Specular highlight size and orientation

- 1 Position and scale the Area light using Maya transformation tools (such as standard or light-specific manipulators, through the Channel Box, Attribute Editor, etc.).
- 2 Use the IPR window to view the specular highlight interactively.

---

#### *Tip*

Make sure you use a specular material (any material other than Lambert).

---



Model by Dua Xiong  
Lit and shaded by Sanjay Bakshi

A car lit by area lights.

Notice the long thin highlights.

### Soft lighting distribution

The size and orientation of the area light icon controls the light distribution. A large area light emits more light. The light can be non-proportionally scaled to modulate the distribution. The farther away the object is from the light, the less light is cast onto the object.



Image by Josh Cameron

Ball lit by area lights.

The color of the lights are set to imitate color bleeding. Notice the soft blues and reds produced by the area light on the sides of the ball.

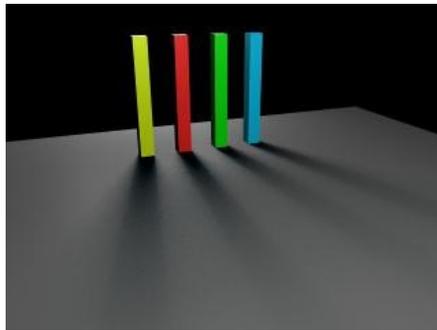
### Realistic shadows

You can achieve realistic shadows using raytracing. Select Raytracing in the Render Globals window, then select Use Ray Trace Shadows in the area light's Attribute Editor. Again, the size and orientation of the light control the shadow color distribution.

**Note**

You may have to increase the number of sample rays to ensure high quality shadows. This can be expensive.

Depthmap shadows also work, but you cannot create shadows that vary from hard to soft. Adjust the filter size to control the uniform softness of the shadow.



Pillars illuminated by an area light.

Notice how the shadow dissipates as the receiving surface sees more of the Area light.

**Optical effects**

Any light that is visible to the camera lens can produce an optical effect (or light glow) on the film. This is also true for area lights. In Maya 3, we've improved Maya's postprocessing so that optical effects for an Area light reflect the shape of the Area light. This is particularly evident in a halo effect.



The camera is oriented to look directly into the Area light.

The Post Process OpticalFX utility is linked to the Area light.

A Linear Halo Type is selected in the OpticalFX Attribute Editor

## Displacement mapping improvements

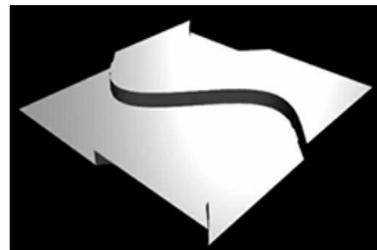
Displacement mapping can now capture all the details of the displacement map and result in good tessellation quality. Additionally, this improvement means that you do not have to implicitly add a bump node. The following are examples of the new and improved feature-based displacement mapping functionality.

### Example 1

The image on the left is rendered using Maya2.0. The image on the right is rendered by the new feature-based displacement map. The object in this simple test is a NURBS plane with a wavy ramp texture used as displacement-map.



Maya 2.0 displacement mapping.

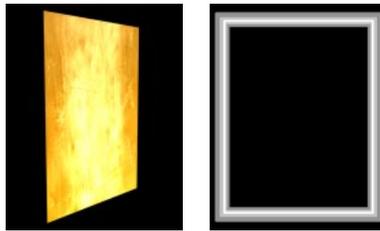


Maya 3.0 displacement mapping.

Maya 2.0 produced 9522 triangles to generate the left image. The feature-based displacement map needed 1326 triangles for the right image. With this new improvement, Maya only tessellates the surface where needed.

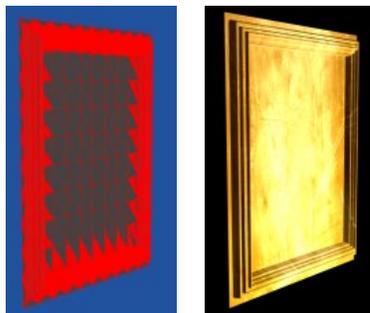
### Example 2

The following illustration shows a rendered surface without the displacement map (on the left) and the texture used to displacement map the surface (on the right).



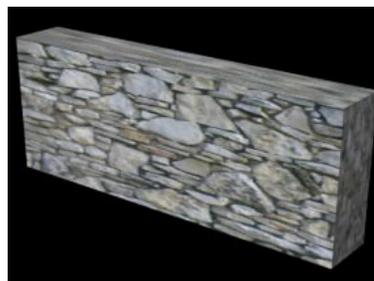
The image on the left shows the final tessellation mesh illustrating where the triangles are concentrated. Use Lighting/Shading > Displacement to Polygon to see the triangles in the view. Once you are done viewing the result, you can select the mesh and backspace to delete it. The image on the right displays the final rendered image.

Notice how tightly the mesh becomes *only* where the texture is finer in detail.

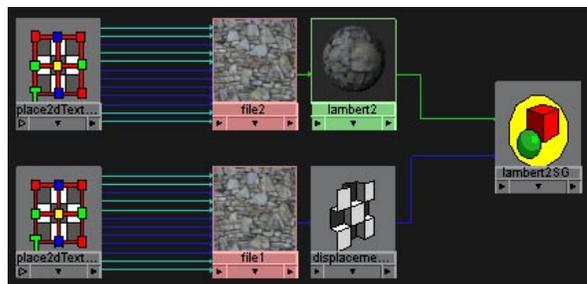


### Example 3

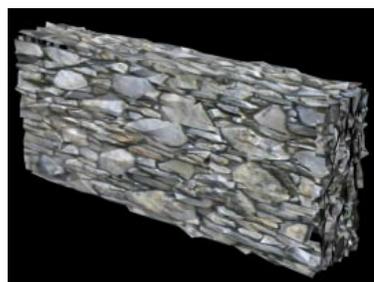
In this example, a NURBS cube was mapped with a simple 2D file stone texture then displacement mapped to provide a realistic looking 3D stone wall.



Before displacement mapping.



Hypershade view.



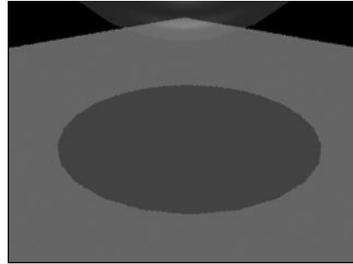
After displacement mapping.

## Crackless tessellation

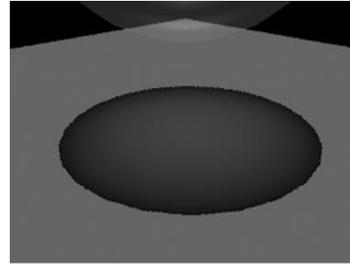
The tessellation of shared curves between adjoining surfaces results in no cracks between the adjoining surfaces if the shared curves are the same. Turn on Smooth Edge in the object's Attribute Editor to view the result.

## Raytrace Shadow transparency improvement

Maya can now alternate refractions improving the quality of Raytrace Shadow transparency. See the following illustrations:



Result pre-Maya 3.0



Result in Maya 3.0

## PERFORMANCE IMPROVEMENTS

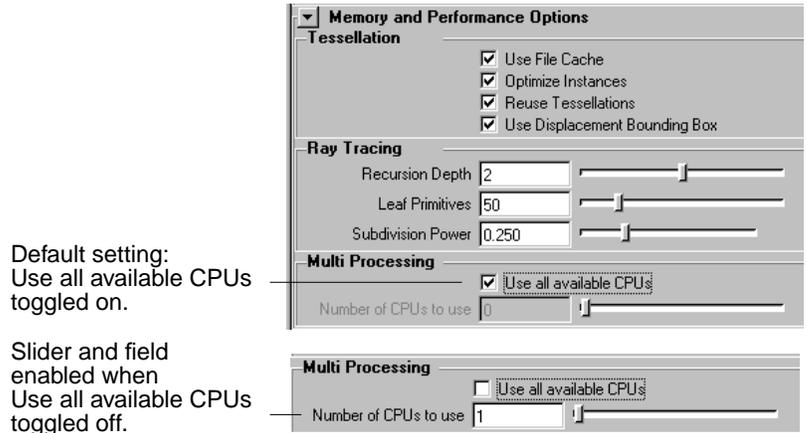
### Multi-threaded shadow maps

Shadow map generation at the beginning of rendering is now fully multi-threaded. With multiple processors, this provides significant speed improvements. The improvement depends on the complexity of the scene and number of shadows casting lights.

### Multi-threaded interactive rendering

Maya 3.0 provides multi-threaded interactive rendering in the Render View. The same type of performance gain is true for the batch renderer.

You can now specify the number of CPUs used for interactive rendering in the Memory and Performance Options section of the Render Globals window. This value is saved with the scene which can be very helpful should you have MP problems.



By default, all available CPUs are used. If toggled off, the slider below the option is enabled.

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 off enables all CPUs for interactive rendering.

### Batch Render window and Multi-thread interactive rendering

There are no changes to the batch renderer. However, if you want to use an MP batch render, specify the number of processors to use in the Batch Render window or use the `-n` flag.

---

#### Notes

- If IPR is in use, the number of CPUs cannot be changed until the current IPR session is closed. The following warning displays:

```
// Warning: IPR will need to be closed
before this change in CPUs will take
effect. //
```

- There is no environment variable to set the number of threads of CPUs. Setting `MAYA_IPR_THREADS` no longer has an effect.
-

## Ray tracing

Ray tracing performance has been improved up to 40%.

## Speed

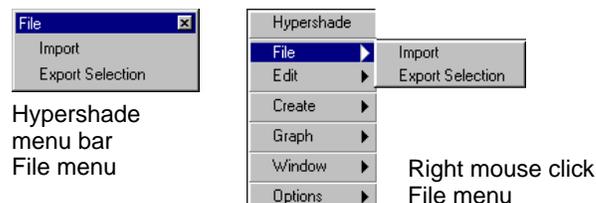
- Across-the-board 5 to 10% speed improvements.
- Additional across-the-board 5 to 10% speed improvements on IRIX.
- File I/O is faster the first time an image is written or read.
- Reduction in memory usage for poly structures.

## HYPERSHADE/VISOR IMPROVEMENTS

- The Hypershade panel background is now black by default.
- Import and Export Selection menu items have been added to the Hypershade.
- Set Default Shading Group and Parent Texture to Selected items are now available in the Hypershade.
- A Rearrange Graph button is now included in the Hypershade menu bar.
- The feature is now the default operation.
- You can now access your directories from the Visor panel. You can create a folder in the Visor that displays the files for any directory on your disk.
- Maya now provides predefined swatch sizes for the Visor panel.

## New Hypershade File menu

These menu items let you import or export textures, lights, or rendered scenes to your directory. The file browser opens to a specific directory within the current project. You can point the file browser to any directory.



<b>Import</b>	Reads elements from another file and loads them into the current file.
<b>Export Selection</b>	Exports the selected item into a new file. The file browser opens to its best guess directory, but can browse to any directory, or cancel, before exporting.

## Hypershade Edit menu changes

The Set Default Shading Group and Parent Texture to Selected items are now available in the Hypershade Edit menu.

**Set Default Shading Group** This setting sets the highlighted shading group as the default shading group. All new geometry is shaded with the default shading group. Changing the default shading group does not change the color of existing geometry, only geometry created after the change. The default shading group is not a Hypershade preference, and is not saved when you end the Maya session.

**Parent Texture to Selected items** Requires that you highlight a 3D Texture Placement and select geometry in the view. Creates a connection between the placement and the geometry so that translating the object does not result in the object *swimming* through the texture.

---

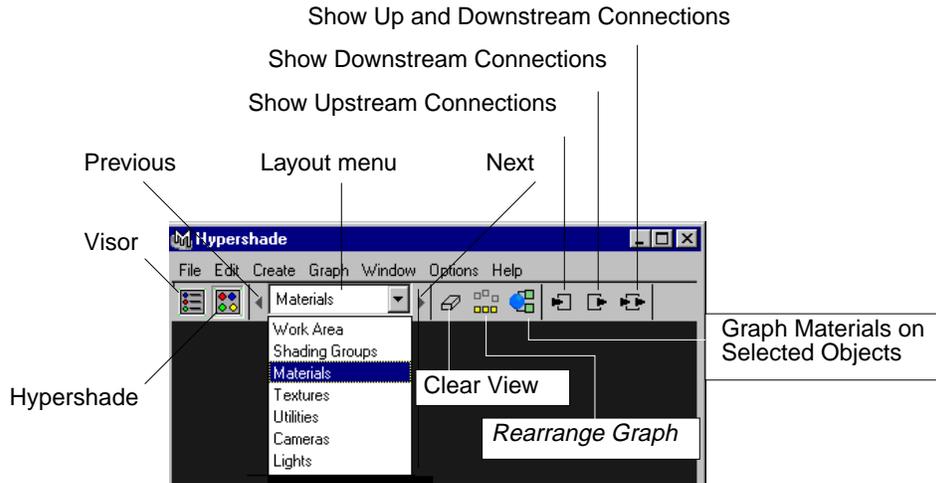
### Note

If you deform an object, this option will not prevent the *swimming*. To solve this situation, either use reference objects or Convert to File Texture.

---

## Hypershade menu bar changes

The Hypershade menu bar has been updated and a new button, Rearrange Graph, has been added.



**Rearrange Graph**

Also found in the Hypergraph’s Graph menu, this handy button is now readily accessible from the menu bar. It rearranges the nodes in the current layout so you can see all the nodes and networks without overlaps.

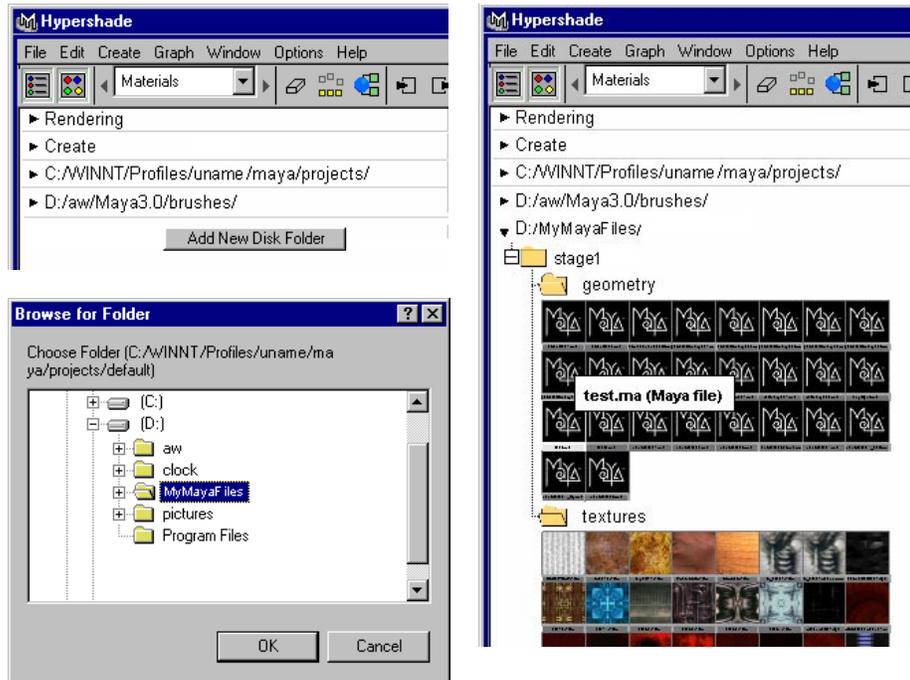


**Clear Before Graphing**

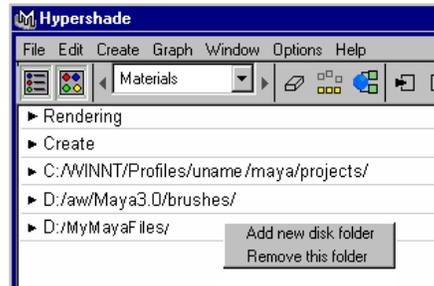
This Options menu item clears the Hypershade layout every time you drag a new node into the Hypershade. Previously you had to toggle this option on. It is now the default operation.

## Easier directory access from the Visor panel

It is now easier to access your Maya files from any directory. Just click the right mouse button in the Visor panel and select Add New Disk Folder to link to your directories. Select a folder (directory) from the browser and drag your icons to the Hypershade panel to either open a file or import a texture.



To remove a folder, place the cursor in the directory area or highlight the directory name, right mouse click and select Remove this folder.



## Texture assignment improvement

You can now assign textures directly to selected objects and components in the view through the Hypershade.

Select the objects or components in the view, right-click on a texture swatch in the Hypershade, and select Assign Texture's Material to Selected Objects from the pop-up menu. The texture is assigned to the selected objects and components in the view.

If the texture does not have an associated material, it automatically creates a Lambert material, assigns the texture to the Color channel, and continues with the assignment.

---

### Note

If a texture is associated with multiple materials or any other ambiguous shading network, the operation will fail.

---

## POLYGONAL TEXTURE MAPPING IMPROVEMENTS

### Multitexturing

Multitexturing is the layering and blending of multiple textures using a distinct UV set for each layer. You can now create and edit multiple UV sets for working with multitextured objects, which can be viewed in hardware shading display mode and software rendered.

New UV sets can be created and named when using polygonal UV projection tools.

Use the New Layered Texture Node node to manage multiple textures. You can drag and drop file textures onto this node using the middle mouse button, and RGB and alpha connections are made. Alternatively, you can drag textures into the texture field of the Layered Texture node's Attribute Editor.

UV set editing is managed through the Relationship Editor using UV-centric or texture-centric management of UV sets. In the Relationship Editor, you can duplicate UV sets, as well as remove and rename them, and UV sets can be hidden and shown individually.

See Chapter 4, “Polygonal Modeling” for more information.

## Baking shadows

You can now use Convert to File Texture to bake shadows. A new option, Bake Shading Group Lighting, bakes the lights that illuminate the selected surface into the new image file when you convert a texture or material into an image file.

The new image file looks like it is lit by the same lights that are linked to the surface in the scene. This option is ideal for color matching. You must select a surface and a shading group (not a material) when you use Bake Shading Group Lighting.

## NEW LAYERED TEXTURE NODE

Maya 3.0 now provides a quicker way to layer single attributes, such as color attributes, using the new Layered Texture node.

You can use Layered Texture to create a texture that consists of two or more of the textures already in the scene composited together in a certain way. You use textureA and textureB to produce a textureC in which textureA is applied as a decal over textureB.

Previously, you used the Layered Shader node with the Compositing Flag set to Layered Texture. The problem with this approach is that textures typically consist of Color and Alpha. The Layered Shader node, even when used in layered texture mode, consists of Color, Transparency (not Alpha), and Glow. Also, the Layered Shader node provides only one way to blend/composite layers together. The new Layered Texture node provides numerous choices (see “Layer is Visible” on page 228).

**To create a layered texture node:**

- 1 In the Hypershade, use the middle mouse button to drag the Layered Texture swatch from the Visor panel onto the material swatch in the Hypershade and connect it to one of the material's attributes (such as Color).

*or*

Select Create > Textures > Other > Layered Texture, using the middle mouse button, click in the Hypershade and drag the texture swatch over the material swatch to connect it to an attribute.

---

**Tip**

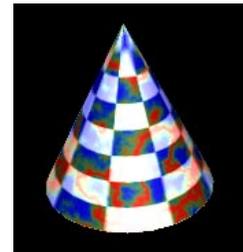
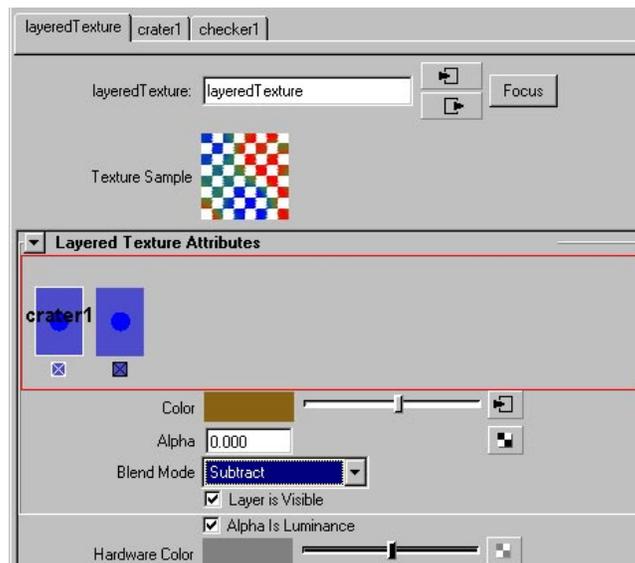
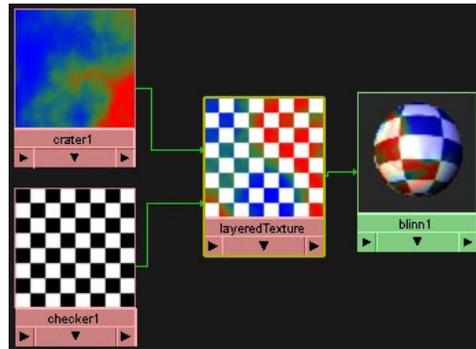
You can add layers into the original Layered Texture's Attribute Editor by dragging and dropping them from the Visor panel or Hypershade panel, or by clicking in the Layered Texture Attributes section of the editor.

---

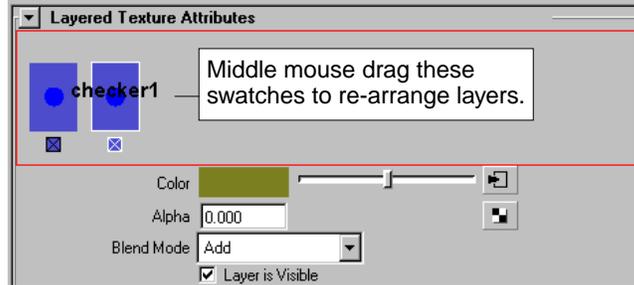
- 2 In the Layered Texture's Attribute Editor, select the layer you want to edit. When you select a layer, Maya updates the Color, Alpha, Blend Mode, and Layer is Visible attributes to reflect the properties of the selected layer.

## RENDERING | 9

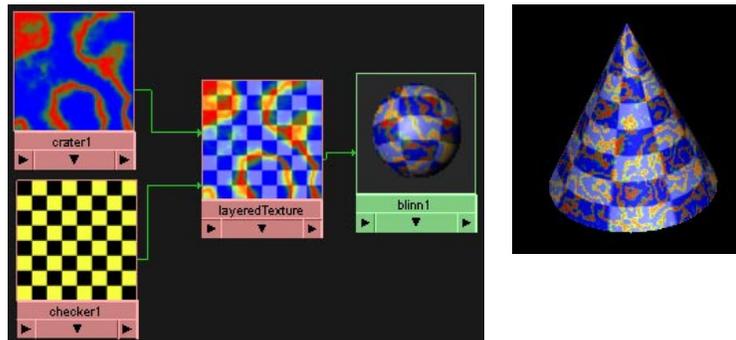
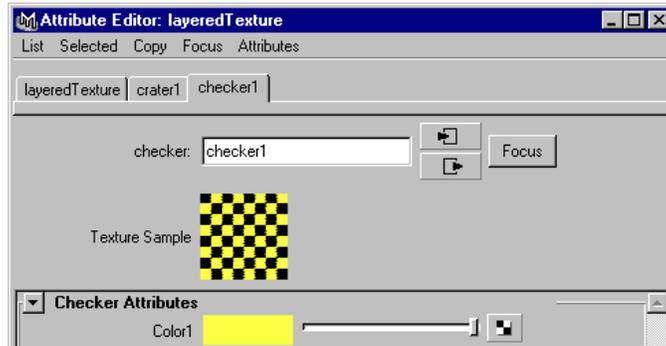
### New Layered Texture Node



You can also re-order the layers in the Layered Texture's Attribute Editor. Using the middle mouse button, drag the texture swatch to the place where you need it.



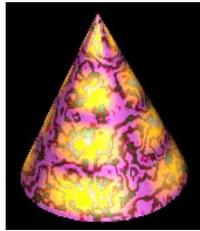
To change a specific layer's texture attributes, click the tab at the top of the Attribute Editor to access that texture's attributes. See the following example.



## New Layered Texture Node

**Layer is Visible**

The Layer is Visible attribute specifies whether the layer should be taken into consideration during computation of the result color and alpha of the layered texture. If toggled off, it is as if the layer does not exist. Use this when you want to verify how a particular layer looks by itself. See the following examples.



Layer is Visible on (default).



Layer is Visible off.

**Alpha is Luminance**

This check box lets you specify that the Alpha should be the luminance of the Out Color, as with other 2D textures, such as a File texture. The slider value determines the extent of the blend. For instance:

Alpha = 0 results in the background texture

Alpha = 1 results in a full blend

Alpha = anything between 0 and 1 results in some background texture, and some blend. This slider essentially controls an Over of the full blend on the background texture.

**Hardware Color**

This lets you specify the color you want to objects using this texture to display in the view while in hardware shading mode (not hardware texturing mode).

**Blend Modes**

The new Blend Modes are supported by the layered texture and layered shader nodes. Using one of these blend modes, you can define how each layer in the layered texture and layered shader blends with the underlying layer.

The Blend Mode specifies how the currently selected layer blends with the layers behind it. The following lists the blend modes:

<b>Normal</b>	Edits or paints each pixel to make it the result color. This is the default. (Normal mode is called Threshold when you're working with a bitmapped or indexed-colored images).
<b>Over</b>	The foreground texture is applied like a decal to the background. The shape of the decal is determined by the foreground alpha.
<b>In</b>	The background texture is cut in the shape of the foreground alpha.
<b>Out</b>	The result is the opposite of In. It is as if the shape of the foreground alpha has been cut out of the background.
<b>Add</b>	The result color is the foreground color added to the background color as if being projected on the background through a slide projector. The result color is then applied over the background color using the foreground alpha to define the opacity of the result.
<b>Subtract</b>	The result color is the foreground color subtracted from the background color. The result color is then applied over the background color using the foreground alpha to define the opacity of the result.
<b>Multiply</b>	Looks at the color information in each channel and multiplies the base color by the blend color. The result color is always a darker color. Multiplying any color with black produces black. Multiplying any color with white leaves the color unchanged. When you're painting with a color other than black or white, successive strokes with a painting tool produce progressively darker colors. The effect is similar to drawing on the surface with multiple magic markers.
<b>Difference</b>	Looks at the color information in each channel and subtracts either the blend color from the base color or the base color from the blend color, depending on which has the greatest brightness value. Blending with white inverts the base color values; blending with black produces no change.

<b>Lighten</b>	Looks at the color information in each channel and selects the base or blend color, whichever is lighter, as the result color. Pixels darker than the blend color are replaced, and pixels lighter than the blend color do not change.
<b>Darken</b>	Looks at the color information in each channel and selects the base or blend color, whichever is darker, as the result color. Pixels lighter than the blend color are replaced, and pixels darker than the blend color do not change.
<b>Saturate</b>	Creates a result color with the luminance and hue of the base color and the saturation of the blend color. Painting with this mode in an area with no (0) saturation (gray) causes no change.
<b>De-saturate</b>	The result color is the background color with saturation decreased in proportion to the foreground color scaled by foreground alpha. If the foreground color is red, for example, the result color will be the background color with desaturated reds.
<b>Illuminate</b>	Creates a result color with the hue and saturation of the base color and the luminance of the blend color. This mode creates an inverse effect from that of the Color mode.

## NEW MOVIE TEXTURE

The movie node is a file node with two important differences:

- It assumes that a multiple frame sequence is all stored in a single multiple frame file (a movie file) instead of a sequence of individual image files.
- It is optimized for reading and displaying those frames interactively as quickly as possible.

### Movie Texture attributes

The file node attributes let you animate the texture. These attributes are:

- File Texture Name
- Use Frame Extension
- Frame Extension.

If Use Frame Extension is on, the file node constructs the name of the actual image file to use from the File Texture Name and the Frame Extension.

The movie node has the exact same attributes and uses them the exact same way. The only difference is that the movie texture node assumes that all the frames are stored in the single file named by File Texture Name instead of separate files.

If Use Frame Extension is on, Frame Extension will be the number of the frame to load from the movie file.

If Frame Extension specifies a frame before the beginning or after the end of the movie, the first or last frame will be displayed.

For performance reasons, if any image filter type is specified, it is treated as if it were a box filter.

This node is intended to allow you to put higher performance but perhaps lower quality animated images into your scenes. For example, you could take a movie file and use it as the texture on the face of a television. The image on the TV should update relatively quickly as frames change.

On the other hand, if you need good quality filtered textures for a final render, you may want to use a file texture node and a lot of images on disk.

---

### Note

The first time you access a frame from an MPEG file, it may take a while to load. The movie library has to scan to the end of an MPEG file to see how many frames are in it as this information is not available in the movie header.

---

## NEW PAINT TEXTURES TOOL

Maya now provides you with the Paint Textures Tool which you can use to paint renderable attributes such as color, bump, transparency, and specular color, on either polygons or NURBS. You can also paint on file textures assigned to your objects.

---

**Note**

For polygonal objects, you must have non-overlapping UVs which fit within the 0 to 1 texture space to achieve expected results. See *Using Maya: Polygonal Modeling* for details about polygons.

---

See *Using Maya: Essentials* for information on how to set Paint Texture Tool options common to Artisan tools, such as pressure sensitivity in the Stroke tab, and the hotkeys such as b to resize the brush, or alt F to flood the surface.

## Paint Textures Tool and texture naming

When you enter the Paint Textures Tool, Maya checks to see if there are any file textures already assigned to the selected surfaces for the current attribute (such as color or bump maps). If any of the surfaces do not have file textures assigned, Maya prompts you to assign textures to the surfaces. Maya names the new textures based on the current scene, shape and attribute names and places them in the current project's textures directory.

If there are existing file textures, Maya checks to see if their names match the current shape, scene and attribute names. If they do not, Maya copies the textures to the correct names. This prevents you from overwriting existing file textures, and makes it easier for the tool to keep track of the textures.

**Example:**

**Scene name:** myPaintScene

**Shape names:** ballShape, planeShape

**Attributes:** color, transparency

**Resulting texture names:**

myPaintScene\_ballShape\_color.iff,  
myPaintScene\_ballShape\_transparency.iff,  
myPaintScene\_planeShape\_color.iff,  
myPaintScene\_planeShape\_transparency.iff

.iff is the default file format. When you Assign Textures you can choose to save the file as Maya IFF (the default), SGI, SoftImage, TIFF, Alias PIX, GIF, RLA, JPEG, EPS, and Quantel.

---

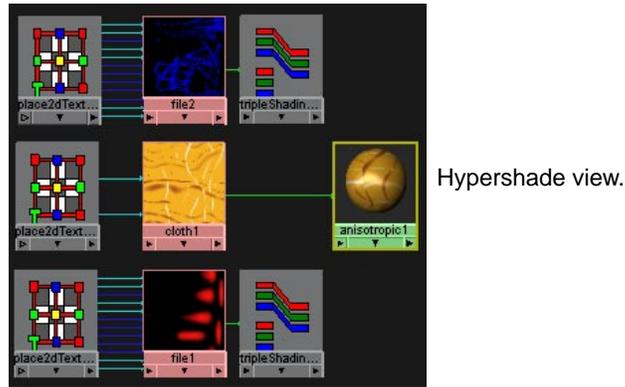
### Notes

- A bump map attribute displays as *normalCamera* in the scene name.
  - If the original textures were not a power of 2 in each dimension (such as 512 x 512, 256 x 128), Maya resizes the copies to the nearest power of 2. This makes the Paint Textures tool more efficient.
  - If you change the shape or scene name, for example by renaming a surface, or by saving the scene as a new name, the next time you enter the Paint Textures tool, the textures are copied to the new name.
  - To ensure your textures are in sync with your scene name, you should enter the Paint Textures tool and display each painted attribute (such as color, bump) AFTER changing your scene name using File > Save Scene As. This prevents you from overwriting the newer scene's textures if you return and edit an earlier version of the scene.
- 

## About switch nodes and painted textures

Maya creates switch nodes for each material attribute for multiple painted surfaces. This lets you use a single material for multiple painted surfaces by assigning the correct file texture to each surface. For a single surface, no switch node is created.

When assigning a texture to multiple surfaces attached to the same material, *tripleShadingSwitch* or *singleShadingSwitch* swatches, file texture swatches, and the *place2dTexture* swatches display in Hypershade.



Full color (RGB) attributes, such as Color, Transparency, and Incandescence, create a tripleShadingSwitch.

A single channel attribute, such as BumpMap, Diffuse, and Translucence, create a singleShadingSwitch node. If you paint color on one of these attributes, it automatically displays as grey.

See also the table under the heading “Texture attribute availability” on page 240.

## Using the Paint Textures Tool

### To use the Paint Textures Tool:

- 1 Select the surface or surfaces you want to paint.
- 2 Open the Paint Textures Tool options window from the Lighting/Shading menu (click the ).
- 3 Select the attribute you want to paint from the Texture Attribute to Paint pop-up menu.

If you have not previously painted or assigned file textures to one or more of the surfaces, a warning prompt displays in the Command Feedback line:

Some surfaces have no file textures assigned.

- 4 Press the Assign Textures button and select the required size and file format for the textures from the Assign File Textures window that displays.

---

**Note**

The texture size is currently limited to 2048 x 2048 and must be a power of 2 in each dimension. The default is 256 x 256. Smaller textures provide faster performance.

---

- 5 By default, the Texture Attribute to Paint is Color. Select a color from the Color Chooser and paint on the surface. You can use either UV texture mode or Projective paint mode. Select the mode from the Misc tab.

Once you finish painting one attribute, you can paint another attribute.

- 6 Select Save Textures at any time to checkpoint your work—you can retrieve the saved textures by pressing the Reload Textures button.

If AutoSave on Exit is not turned on (under the Misc tab), you are prompted to save the textures when exiting the tool, or when selecting a new attribute to paint. Maya saves the textures to the textures directory of the current project with a name derived from the scene, the surface, and the attribute being painted. You should not change the name of these textures.

---

**Tip**

For increased performance, hide the surfaces you are not painting.

---

## Masking polygonal faces while painting

When painting polygonal objects, you can choose to paint on only selected faces to mask out the rest of the faces and protect them from the paint.

### To mask polygonal faces while painting:

- 1 Select the faces on which you want to paint.
- 2 Enter the Paint Textures tool and proceed as normal. An outline displays around the selected faces.

See the procedure, “Painting polygonal faces” on page 237 to get an idea of how this works.

---

### Notes

- Flood ignores the selection and paints the entire polygonal mesh.
  - If you want to change your selection, you must exit the Paint Textures tool, make your new selection, and then re-enter the tool. There is no need to re-assign the textures.
- 

## Painting and IPR rendering

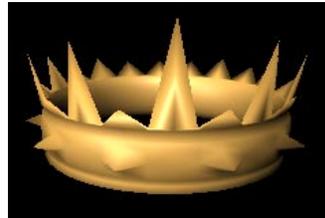
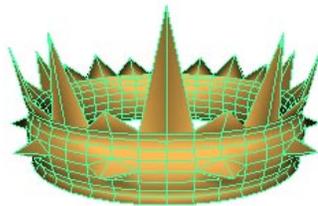
The following procedure shows you how to paint more than one attribute and IPR render the scene.

The model used is a tiara, which is a polygonal object. The procedure is broken into a series of steps:

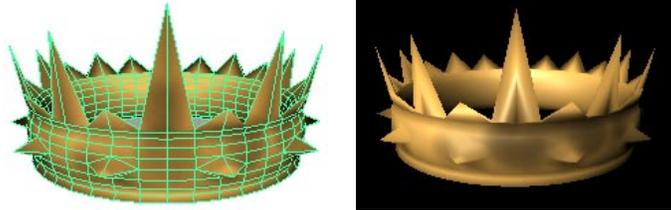
- “Painting a model” on page 236
- “Painting polygonal faces” on page 237
- “Painting transparency” on page 237
- “Painting bump maps” on page 238

### Painting a model

- 1 Select the tiara and enter the Paint Textures tool.
- 2 Select Color as the Texture Attribute to Paint, click the Assign Textures button, and make sure 512 x 512 is the size in the Assign File Textures window.
- 3 Select a color from the Color Chooser, such as gold (click the Color Value bar to open the Color Chooser) and paint the crown. Select Flood to complete.

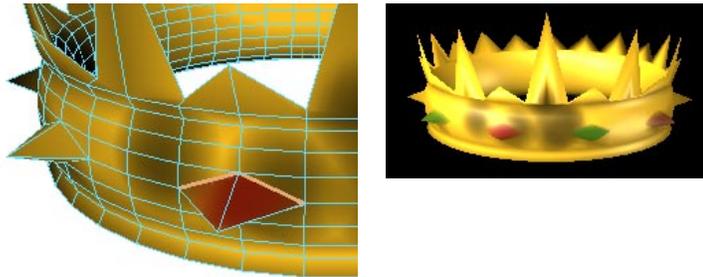


- 4 Change the color (drag the slider to make it darker), lower the opacity value and paint some dirt.



### Painting polygonal faces

- 1 Select the tiara (if not already selected), press the right mouse button while over the tiara and select Face from the marking menu to enter polygon component selection mode.
- 2 Select the four front gemstones, which are two rubies and two emeralds, and paint them red and green (Shift-select all the faces of two gemstones, paint them red, then Shift-select the faces on the other two and paint them green). Once you select all the faces of the gemstones, a heavy line displays.



### Painting transparency

The gemstones are semi-transparent. Use this method to paint them.

- 1 Shift-select the faces of the gemstones.
- 2 Select Transparency and Assign Textures, 512 x 512.
- 3 Flood the tiara with black, select Color and paint the four stones light grey.



### Painting bump maps

To add depth and a few ornamental decals to the tiara, you can paint bump maps.

- 1 Select the tiara (right mouse click and choose Select All from the marking menu).
- 2 Select BumpMap and Assign Textures, 512 x 512.
- 3 Select UV Texture Paint mode (under the Misc tab), and turn on Reflection (under the Stroke tab).

---

#### Note

Reflection is only available in UV Texture Mode and provides good results only when the UVs are symmetrical in texture space.

---

This next step is optional. You can also open the Render View outside of the panels and when you click Maya's select icon to get out of the tool, the IPR view updates.

- 4 Select the panel layout Persp/RenderView. Select Panels > Layouts > 2 Side by Side, Panels > Perspective > persp in one view and Panels > Render View in another view.
- 5 Marquee-select some pixels at the front of the tiara in the Render View, then click the IPR icon to IPR render.
- 6 In the perspective view, click the tiara and Flood with a mid grey color.
- 7 Select a slightly darker grey and paint ornamental swirls on the front of the tiara. Repeat this using a lighter grey color. Change the Shape of the brush if you want.
- 8 Press Save Textures to see the update in the IPR.

To save the texture automatically at the end of the stroke, turn on AutoSave on Stroke (under the Misc tab). Use with caution, though, because this removes the ability to undo.

- 9 Repeat painting and updating the textures if you want. The following shows the finished tiara.



## Determining stamp spacing and brush depth

Maya also provides you with options to adjust the stamp spacing, and control the brush depth.

### Changing the Stamp Spacing

If you find your stroke is broken or dotted, try decreasing the Stamp Spacing (Misc tab) slightly. Conversely, if you find that your stroke is too slow, your Stamp Spacing may be set too low. The default setting is 1.0. The ideal value will vary depending on your model and your texture size.

Default Stamp Spacing=1.0



Stamp Spacing set to 10.0

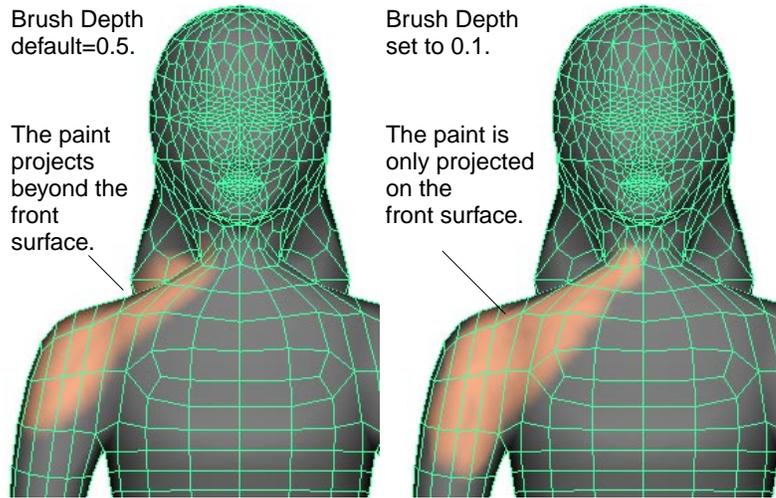


Stamp Spacing set to 0.5.  
Slower feedback.



### Changing the Brush Depth

The brush depth is indicated by the vertical line through the center of the brush. The Brush Depth value determines how far the paint is projected. For example, when you are painting where there are folds in the surface, decrease the Brush Depth value so the paint does not run into other areas of the object. The default setting is 0.5.



### Selecting and painting attributes

In the File Texture section of the Tool Settings window, Maya provides you with a number of attributes you can paint onto your objects.

#### Texture attribute availability

Select an attribute from the pull-down menu, then click the Assign Textures button to paint the attribute onto the object. The following table shows available attributes and whether they are RGB or single channel.

RGB	Single Channel
Color	BumpMap
Transparency	Reflectivity

RGB	Single Channel
Incandescence	Diffuse
Specular Color	Translucence
Ambient Color	
Reflected Color	

Available attributes vary depending on the material type. For example, Specular Color is not available for a Lambert material. If you want to paint other attributes, drag and drop another material from Hypershade onto your model.

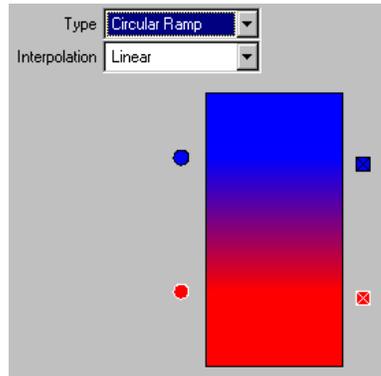
### Painting attributes not shown in the Texture list

You can drag and drop textures directly onto attributes in a material's Attribute Editor. This means that even though the attributes are not shown on the Texture list, you can connect the texture to the attribute of your choice. Try the following example.

#### To paint attributes not shown in the Texture list:

- 1 Create a polygonal Plane primitive.
- 2 Create a material, such as Blinn, and assign it to the plane.
  - In the Blinn's Attribute Editor, assign a Ramp texture to the Color attribute.
  - In the Ramp texture's Attribute Editor, click one of the color boxes with an X through it to delete the color, and change the Type to Circular.

New Paint Textures Tool



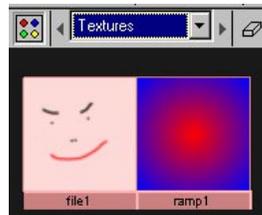
- 3 Select the plane and enter the Paint Textures Tool.
- 4 Select Transparency as the Texture Attribute to Paint and assign a texture.

Flood the plane with a flesh tone. Click the Color Value bar and use the Color Chooser to create a flesh-toned color, click the brush on the plane, then click the Flood button.

Click the Color Value bar and select another color from the Color Chooser to paint a mouth, then select another color to paint a pair of eyes.



Result in view.

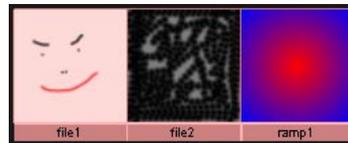


Tip: Select Textures from the Hypershade menu to quickly see the texture swatches.

- 5 Select Incandescence and assign a texture to the plane. Choose a color and paint hair all over the plane.



Result in view.



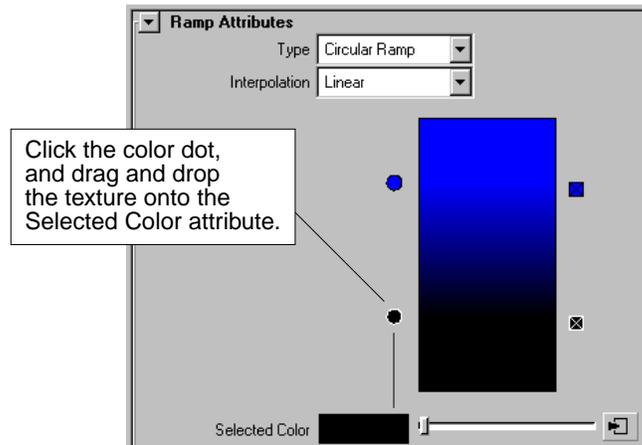
Hypershade view of textures.

- 6 Exit the Paint Textures Tool.
- 7 Double-click the Blinn swatch in Hypershade to open its Attribute Editor and change Hardware Texturing back to Color.

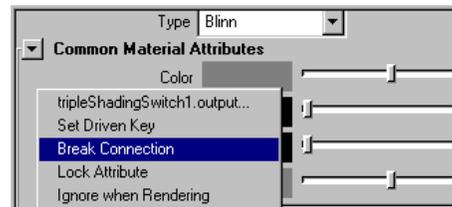
- 8 Open the Ramp texture's Attribute Editor and click the bottom color dot. From Hypershade, use the middle mouse button to drag and drop the first file texture (the face) onto the Selected Color attribute. Click the bottom color dot and drag and drop the second file texture (the hair) onto the Selected Color attribute.

**Note**

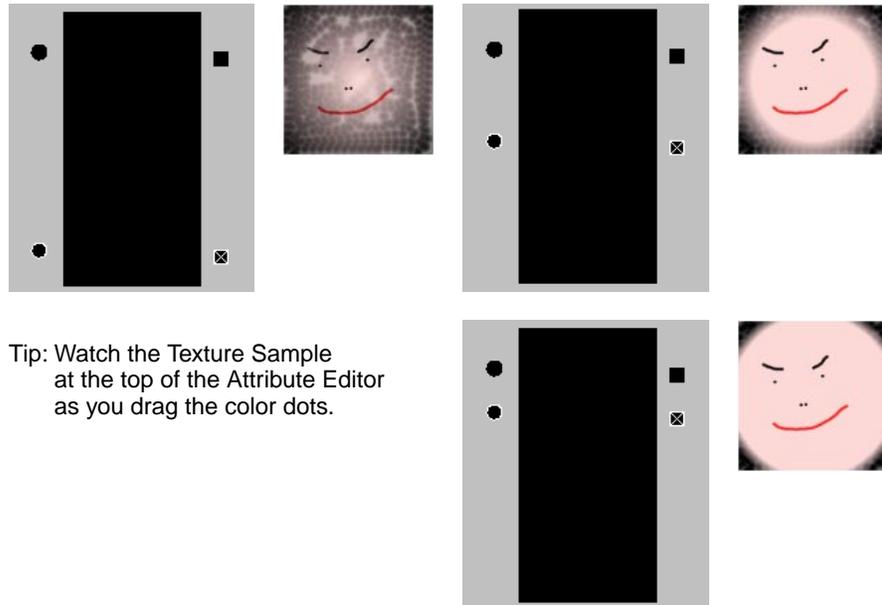
If you have painted multiple surfaces, drag the switch node instead.



- 9 In the material's Attribute Editor, break the connections for both Transparency and Incandescence (right mouse click while the cursor is over the name of the attribute and select Break Connection).



To test the results, open the Ramp texture's Attribute Editor and drag the color dots up and down. Notice how the face and hair fade in and out as you drag.



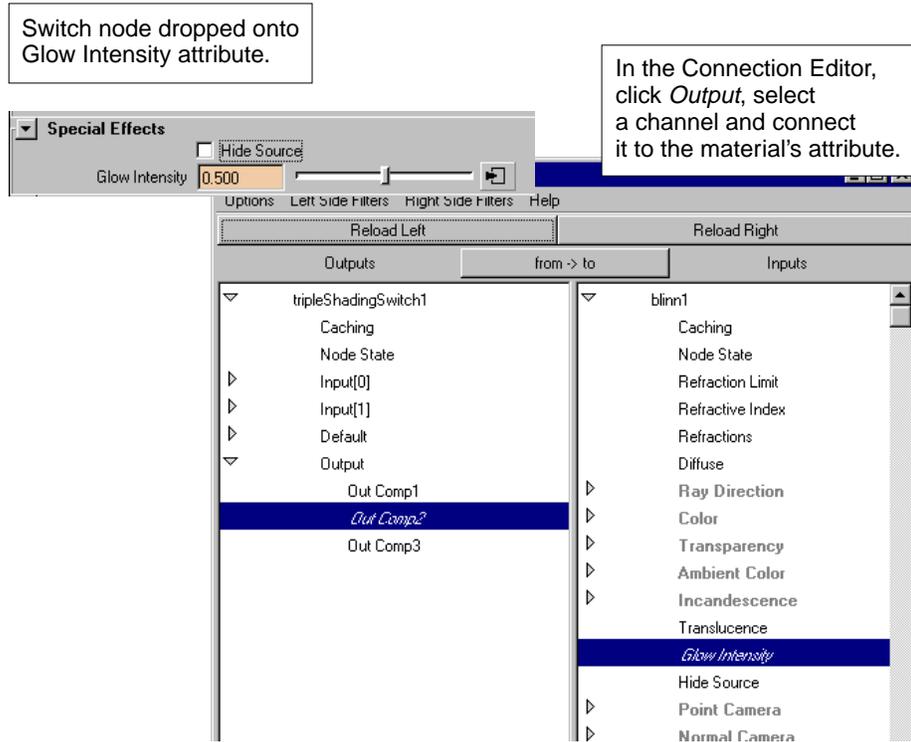
Tip: Watch the Texture Sample at the top of the Attribute Editor as you drag the color dots.

---

**Note**

If you want to use the texture on a full-color (RGB) attribute, make sure you choose to paint an attribute, such as Incandescence, which has three channels. See the table under the heading “Texture attribute availability” on page 240 for details.

If you connect a triple channel attribute to a single channel attribute, such as Color to Glow Intensity in the following example the Connection Editor displays. Select an Output channel for the switch utility and click to connect it to the attribute you want.

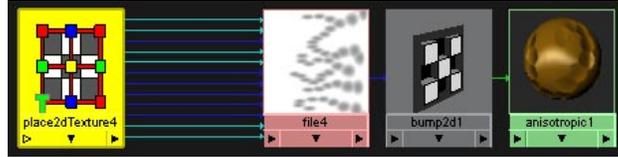


## Placing painted 2d textures

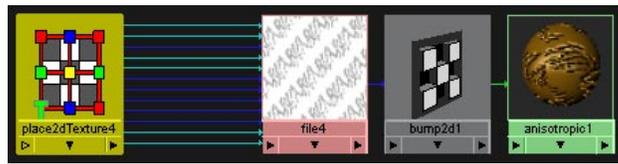
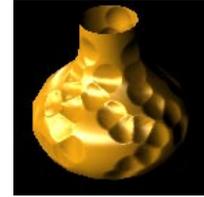
Maya also creates a place2dTexture node when you paint a surface using the Paint Textures Tool. That means you can place the texture using manipulators or by changing the attributes under the place2dTexture tab in the material's Attribute Editor.

To quickly access the place2dTexture attributes, click the place2dTexture swatch in Hypershade. See Chapter 36, "Place 2d & Place 3d Utilities" in the online *Maya Rendering: Reference* book for details about the attributes.

In the following, a bump map is painted onto the object, and the texture is placed by changing various place2dTexture attributes.



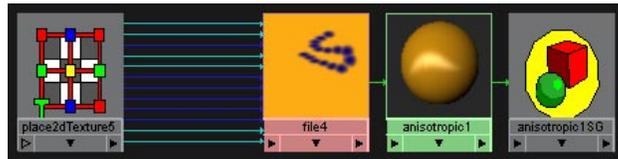
Original painted bump map texture.



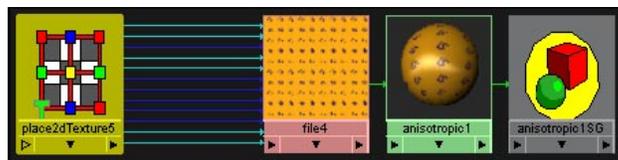
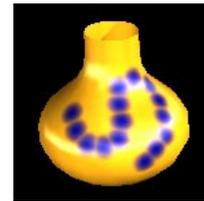
Bump map texture altered by changing various place2dTexture attributes.



In this next example, the Color texture is placed.



Original painted color texture.



Color texture altered by changing place2dTexture attributes (set both Repeat U and V values to 10.).



## Assigning, saving, and reloading textures

Use the three buttons at the bottom of the Paint tab to assign, save, or reload your paint textures.

## Assigning textures

You must click this button once you have selected an object or objects (or faces) and an attribute to paint. If you have not previously painted or assigned file textures to one or more of the surfaces, a warning prompt displays in the Command Feedback line:

```
Some surfaces have no file textures assigned.
```

## Saving textures

Click the Save Textures button at any time to checkpoint your work. You can also determine when you want to save the texture, meaning when you exit the tool or when you've finished a stroke. Under the Misc tab in the Tool Settings window, the AutoSave section contains two options: AutoSave on Exit (on by default), and AutoSave on Stroke.

**AutoSave on Exit**—Saves the textures when you exit the Paint Textures Tool, or when you select a new attribute to paint.

If off, Maya prompts you to save the textures when you exit the tool or select another attribute.

**AutoSave on Stroke**—This option is off by default. Turn this option on if you want to save each stroke you paint on the object. Use this option when IPR rendering. As you release the stylus (or mouse) at the end of each stroke, the texture is updated and the IPR render refreshes to reflect your changes.

---

### Note

Turn this option on only in circumstances when you know you will not be making too many errors because you cannot undo your strokes when this option is on.

---

## Reloading textures

Click the Reload Textures button to retrieve any textures you saved (if you clicked the Save Textures button).

**Tips on texture and paint modes (under the Misc tab)**

- UV Texture Paint may be faster when you have good, non-overlapping, contiguous UVs, and also allow the reflection mode to be used if the UVs are symmetrical in texture space—for NURBS, this is always the case. For polygons, it may not be.
- Projective Paint works best when the UV mesh is cut into multiple pieces, and also virtually eliminates brush distortion at seams and at areas where there is uneven parameterization.

---

**Notes**

- You will have to assign textures for each attribute you choose to paint the first time you choose to paint that attribute.
  - When painting grayscale attributes such as bump, the color you paint with automatically converts to grayscale.
- 

## 2D/3D INTEGRATION ENHANCEMENTS

The addition of render layers and render passes provides a mechanism to easily break down a scene so that its parts can be quickly re-rendered.

By rendering each individual layer and pass and compositing them, you can dramatically improve iteration times versus repeated re-rendering of the entire scene.

You can control the creation and options on each render layer from the Layer Bar. This bar contains both Display Layers and Render Layers. Select Render Layers from the pull-down menu to access this functionality. See the chapter, *Basic Features* in this document for more information on the Render Layer bar.

In addition, a new section, Render Layer/Pass Control, has been added to the Render Globals window.

## Render Layer management

### User-defined output of specified layers

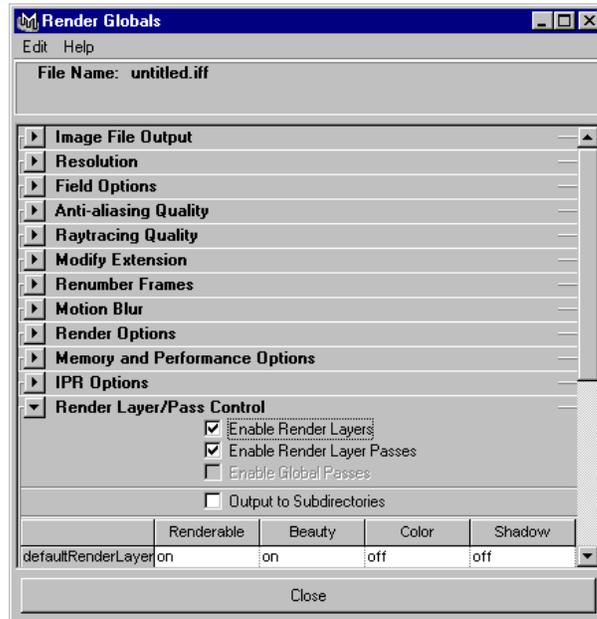
The new render layer and pass functionality provides you with the following options:

- Each object can only be in one layer and all objects are in a layer.
- Objects only cast shadows on other objects in the same layer.
- Objects not in the current layer are oblivious to the renderer—it treats each layer as if it came from a separate scene.
- In interactive mode, when you request a test render, all layers with renderable attributes set on are rendered into the window.
- In batch mode, each layer is rendered to a separate file for off-line compositing.

You can control which passes are rendered from the pull-down menu associated with each layer in the render layer bar. These options can only be used if Enable Render Layers is toggled on in the Render Layer/Pass Control section of the Render Globals window (see next).

You can also use the Render Pass management spreadsheet to quickly control the rendering state of the layers. Options include Beauty, Color, and Shadow. The layer portion of this spread sheet is available when either Enable Render Layers or Enable Global Passes are toggled on in the Render Globals window.

## Render Layer/Pass Control



### Enable Render Layers

Tells the renderer to render only the layers for which renderable is turned on.

In interactive mode, all layers with renderable toggled on are rendered into a single image. In batch mode, each layer is output to a file named:

```
camera_filename_layername_passname.ext
```

### Enable Render Layer Passes

This option is available when Enable Render Layers is toggled on and allows for individual passes to be rendered for each layer.

### Enable Global Passes

This option is available when Enable Render Layers is toggled off and allows for passes to be rendered for the entire scene.

**Output to Subdirectories**

This option 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
```

**Render Pass management spreadsheet**

Depending on the settings for layers and passes, this spreadsheet provides control over all current rendering options. This is a quick way to control all the render layers and/or passes. You can choose rendering passes for each layer (layer passes), or rendering a specific pass for all objects in a scene (global passes).

Turn on either Enable Render Layer Passes or Enable Global Passes to display the spreadsheet.

This spreadsheet provides access to the passes, Beauty, Color, and Shadow, for the appropriate layers.

**Enable Global Passes**

When Enable Global Passes is selected, only one layer, the Global Layer, is available.

**Enable Layer Passes**

When Enable Layer Passes is on, all layers are available.

<b>Beauty</b>	The Beauty pass is used by default and produces a complete rendering of all the components.
<b>Color</b>	The Color pass produces only the color component of the image. No shadow information is produced.
<b>Shadow</b>	The Shadow pass produces only the shadow component of the image. No color information is produced.

When combined, the Color and Shadow components produce the same image as the Beauty pass. The benefit is that you can now tweak the shadows independently in a compositing/paint package.

**Troubleshooting**

**Q:** I've turned off some layers but they are still being rendered.

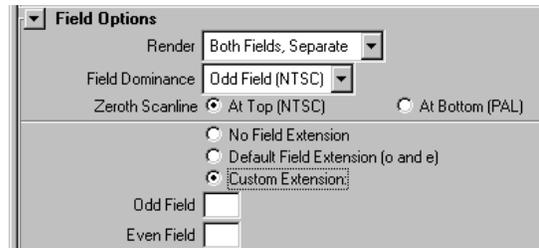
**A:** Remember to turn on Render Layers in the Render Globals window.

**Q:** I've turned on the shadow pass but some shadows are not being rendered.

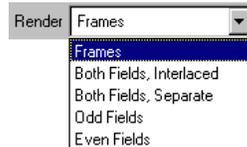
**A:** Objects can only catch shadows from objects in that layer. Make sure the object casting the shadow and the object on which the shadow should fall are in the same layer.

## NEW RENDER GLOBALS FIELD OPTIONS

The Field Options control how Maya renders images as fields. With this release, new options are provided.



### Fields



Controls whether Maya renders images as frames or fields. Select an option from the pull-down menu. Options include:

- Frames**                      Render regular frames.
- Both Fields, Interlaced**      Render both odd and even fields (for video) and automatically interlace 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 Field**                      Render odd fields only.

<b>Field Dominance</b>	<b>Even Field</b> Render even fields only.
	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”.
	<hr/> <i>Note</i>
	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).
	To render fields for NTSC systems, set Field Dominance to Odd Field first.
	To render fields for PAL systems, set Field Dominance to Even Field first.
<b>ZerOTH Scanline</b>	Controls whether the first line of the first field Maya renders is at the top of the image or at the bottom of the image.
	<hr/> <i>Note</i>
	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.
<b>At Top/At Bottom</b>	Set the At Top option (unless you encounter problems with a test rendered animation). At Top is set by default.
	If you encounter problems in an animation where 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, and render the animation until the problem is solved.
<b>No Field Extension</b>	No extension is added to odd and even field file names.

**Default Field  
Extension  
(o and e)**

Maya saves the two field image files by adding an “e” (for even fields) and an “o” (for odd fields) onto your frame number extension or file name. For example, `name.001e.iff` and `name.001o.iff`. This is the default setting.

**Custom Extension**

Set this option 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.

# 10 PAINT EFFECTS

With this release of Maya, we've added improvements and bug fixes to the Paint Effects environment.

## Improvements

- Instancing Paint Effects strokes
- New Primary Visibility option
- Rendering Paint Effects strokes at test resolutions
- Rendering strokes without depth output
- Rendering multiple images and stitching
- Disappearing file textured leaves and flower petals
- Dragging and dropping textures onto the canvas

## INSTANCING PAINT EFFECTS STROKES

You can now instance a Paint Effects stroke to Dynamics particles. For details, see the "Dynamics" chapter in *What's New in Maya 3.0*.

## NEW PRIMARY VISIBILITY OPTION

There is a new Primary Visibility option on the stroke node (select the stroke and click the strokeShape node in the Attribute Editor).

When Primary Visibility is turned on, the stroke is visible in the view and renders. When its turned off, the stroke is visible in the view but it does not render. Note that if Primary Visibility is turned off and Cast Shadows is turned on, the stroke's shadow renders.

## **PAINT EFFECTS | 10**

Rendering Paint Effects strokes at test resolutions

### **RENDERING PAINT EFFECTS STROKES AT TEST RESOLUTIONS**

When you render Paint Effects strokes at test resolutions, the Paint Effects strokes are now modified appropriately.

### **RENDERING STROKES WITHOUT DEPTH OUTPUT**

When you render a scene with Paint Effects strokes, depth output is no longer forced. In previous versions, final images always incorporated depth.

### **RENDERING MULTIPLE IMAGES AND STITCHING**

When you render multiple images and stitch them together, Paint Effects renders will now match seamlessly. However, glow and light glow will still not match across the seams.

### **DISAPPEARING FILE TEXTURED LEAVES AND FLOWER PETALS**

In previous versions of Maya, if you turned on Time Clip and turned off Leaf Use Branch Tex, file textured leaves and flower petals disappeared, which affected growth animation for any presets with textured leaves. This limitation has been fixed for Maya 3.0.

### **DRAGGING AND DROPPING TEXTURES ONTO THE CANVAS**

in previous versions of Maya, dragging and dropping a new file texture onto the Paint Effects canvas and turning on Auto Save was not always successful. This limitation has been fixed for Maya 3.0.

# 11 CLOTH



Stuart Little image courtesy of Sony Pictures Imageworks. Columbia/TriStar. All rights reserved.

In Maya 3.0, you can use Artisan paint tools to paint properties and wrinkling effects across the entire surface of a garment. This lets you apply properties to portions of the cloth panel instead of the entire panel.

Using the new Cloth Property Paint tool, you can apply properties such as stiffness to isolated parts of the garment rather than to whole panels, much like spraying starch on a collar.

When you select a property attribute to paint, a paint attribute is dynamically added to the cloth. The paint attribute is used as a multiplier or “weight.” The property attribute value is multiplied by the paint attribute value.

---

*Remember...*

Cloth is available only in Maya Unlimited.

---

## NEW ATTRIBUTE FOR PAINTING WRINKLES

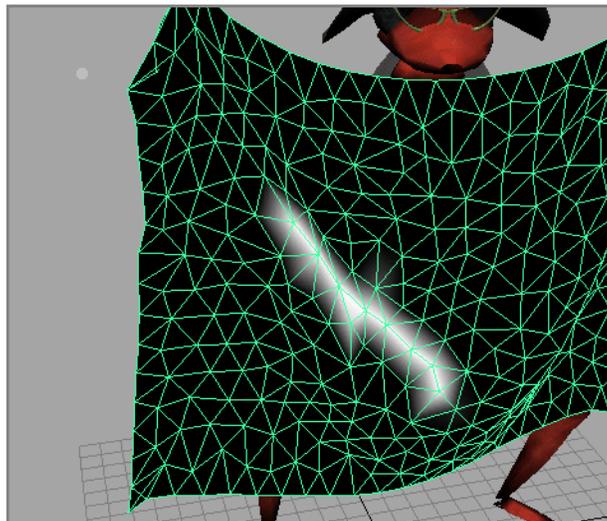
Cloth has a new attribute—`bendAngle`—to make it easy to paint wrinkles on your cloth. The `bendAngle` attribute is dynamically added to the cloth when you choose `bendAngle` from the Cloth Property Paint tool.

The `bendAngle` attribute specifies the resting angle of the cloth. Initially, the resting angle value for each edge of each triangle of the cloth mesh is zero. The cloth solver uses the `bendAngle` to bend the cloth mesh about the each triangle edge. When painting, you can see the final values for each vertex in the Script Editor.

For example, in the image below notice the wrinkles on the cloth sheet.



If you want to see a larger wrinkle propagated along the diagonal, you can use the Property Paint tool to paint a `bendAngle` value on this area.



After the area is touched up, you simulate the cloth. The `bendAngle` attribute causes the cloth to bend or wrinkle in this region during the simulation.



#### To paint properties on cloth:

- 1 Select Shading > Smooth Shade Selected Items.
- 2 Select the cloth you want to paint property attribute values on.
- 3 From the Cloth menu set, select Simulation > Properties > Paint Property .

The Cloth Property Paint Tool is displayed.

- 4 From the Paint Attribute pulldown menu, select the property attribute you want to paint values for. If you want to paint wrinkles, select the `bendAngle` attribute.

For information on the property attributes see “Applying properties to panels” on page 104 of *Using Maya: Cloth*.

- 5 Define the Cloth Paint settings, if required.

For each property attribute, the initial value is set to 1.0. For information on defining settings, see “Setting Script Paint Tool options” on page 442 of *Using Maya: Essentials*. The Cloth Paint settings are the same as Script Paint settings.

- 6 Move the pointer over the cloth.

The pointer becomes a paintbrush.

- 7 Paint along the triangle edges.

The value of the property attribute in the painted area is modified according to the settings of the Cloth Property Paint tool. Look in the Script Editor to see the values.

### Painting U/V attributes

For attributes with U and V settings, such as U Scale, V Scale, U BendRate and V BendRate, the U and V share one paint attribute.

For example, if you select the Scale property from the Paint Attribute pulldown, U Scale and V Scale are both affected by the Scale weight. The formula is:

```
the final uscale = uscale * scaleWeight
```

```
the final vscale = vscale * scaleWeight
```

## CHANGING THE CLOTH PAINT TOOL SETTINGS

You can change the Cloth Paint Tool settings to create different effects. Again, these are the same as the Artisan Paint Tool settings.

### Stroke

The stroke defines how the brush moves across the selected surface.

- For information on changing the stroke, see “Changing brush stroke settings” on page 397 of *Using Maya: Essentials*.

### Display

Display defines how the brush and screen are displayed.

- For information on changing the display, see “Changing display settings” on page 404 of *Using Maya: Essentials*.

### Miscellaneous

Less frequently used tool settings are stored under the Misc tab.

## CLOTH | 11

### Changing the Cloth Paint Tool Settings

- For information on changing miscellaneous settings, see “Changing miscellaneous tool settings” on page 406 of *Using Maya: Essentials*.

# 12 FUR

---

With this release of Maya, we've added the following new features and improvements to Fur.

- New Global Scale fur attribute
- New Roll fur attribute
- New shadow map setting
- Fur Globals improvements
- Batch rendering is now per frame
- Baking improvements
- Fog now renders with fur

---

*Remember...*

Fur is available only in Maya Unlimited.

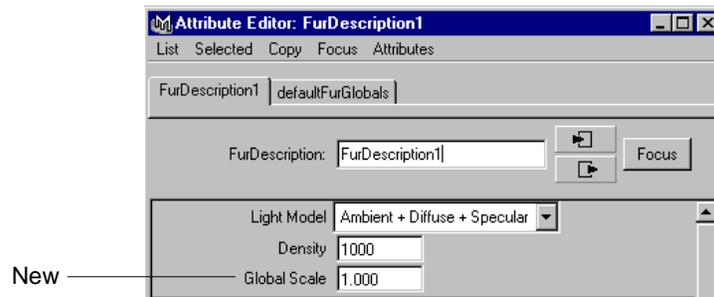
---

## FUR | 12

New Global Scale fur attribute

### NEW GLOBAL SCALE FUR ATTRIBUTE

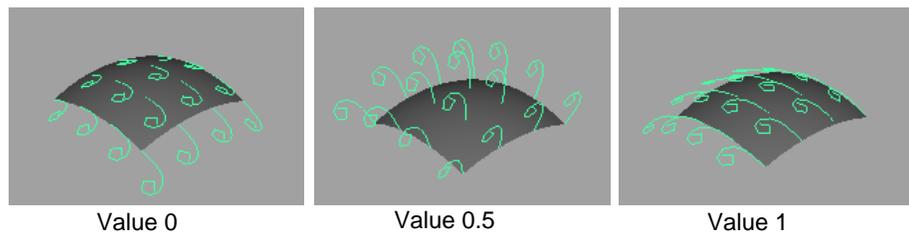
You can now scale the Base Width, Tip Width, and Length values all at once for a fur description (including mapped values) using the new Global Scale fur attribute.



### NEW ROLL FUR ATTRIBUTE

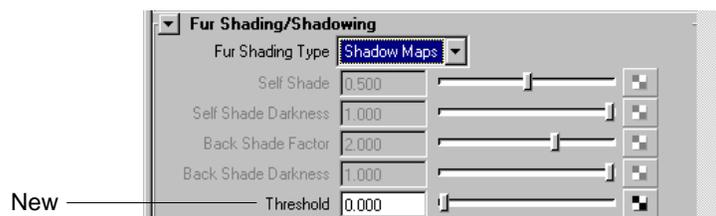
The Roll fur attribute rotates hair about the surface V axis. You can achieve almost any fur angle using Polar and Inclination, so use this option only when the fur has curl and you want the curls to lie flat. Use the following settings as guidelines.

- 0.0**                    -90 degree rotation.
- 0.5**                    No rotation. This is the default.
- 1.0**                    90 degrees rotation.



## NEW SHADOW MAP SETTING

The Threshold value determines how much of the pixel must be covered by hair before hair depth information is stored in the shadow map. Use this option to prevent very fine hairs from showing up in the shadow map—this can cause fine hairs to cast thick shadows, although it is rare).



Use the following settings as guidelines.

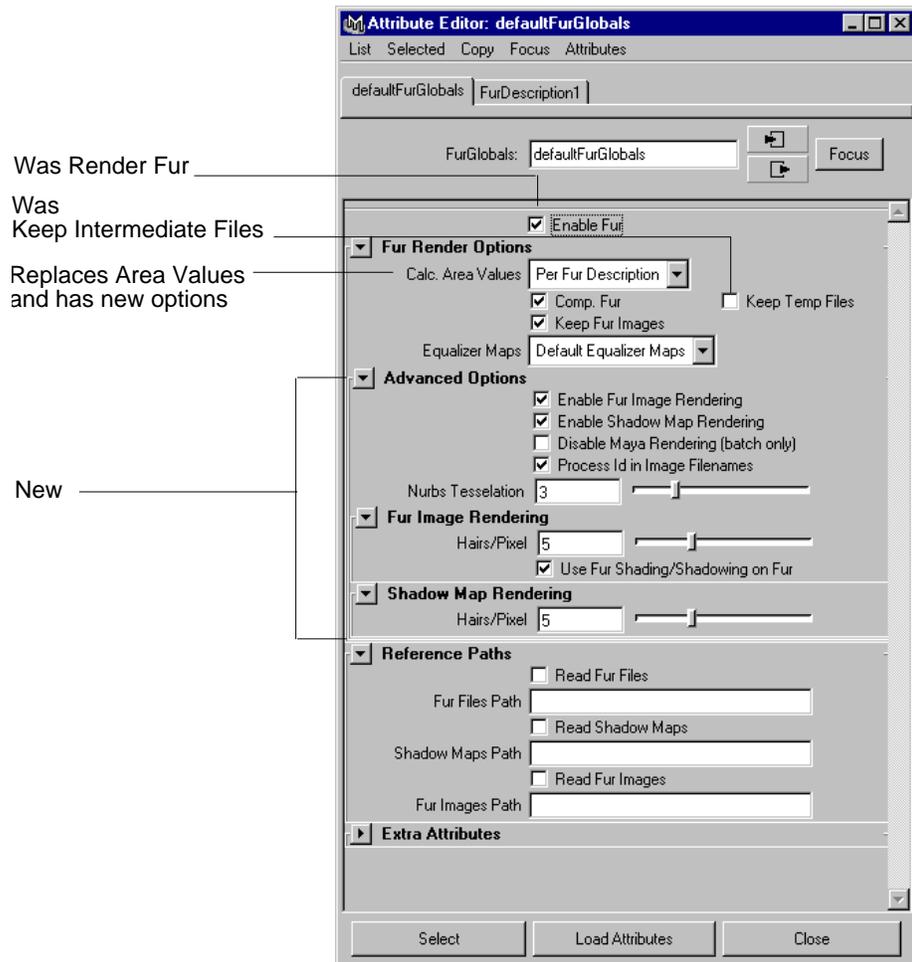
- 0** Stores a depth value for each pixel if hair exists in that pixel, no matter how fine the hair.
- 0.5** Only stores hair depth information for pixels that are covered 50 percent or more by hair.

## FUR GLOBALS IMPROVEMENTS

Some additions and changes have been made to the Fur Globals (Fur > Fur Globals).

## FUR | 12

Fur Globals improvements



## Fur Render Options

Calc. Area Values replaces Area Values, with options described next Keep Intermediate Files is now Keep Temp Files and is off by default.

### Calc. Area Values

Calc. Area Values replaces Calc. Area Values. Use this setting to specify how you want hair to be distributed across surfaces.

If you select Globally or Per Fur Description, hairs are distributed evenly across furry surfaces by taking the largest piece of furry geometry in the scene, assigning it a value of 1, then calculating values proportional to that surface for all the other furry surfaces in the scene. Then each surface receives a proportion of the density value set in the fur description assigned to the surface, based on the calculated area value.

For example, if the Density is set to 10,000, the largest furry surface will receive 10,000 hairs, whereas a surface in the scene that is half that size will receive 5,000 hairs.

**Off** Each surface receives the same number of hairs specified by the Density value for the fur description. This works if your character is made up of a single surface, or distinctly different surfaces. In these cases, you can use Baldness to roughly control relative densities within a single fur description.

**Globally** This option is the equivalent of toggling Area Value on in previous versions of Fur. For models made up of multiple patches, this gives an even distribution on hairs across different sized surfaces.

The density of each fur description is distributed evenly over all surfaces with fur descriptions attached, regardless of which fur description is attached.

**Per Fur Description** Distributes hairs evenly across multiple different sized surfaces. The distribution of hair for one fur description does not affect the distribution for another fur description, unlike the Globally option. This is the default.

## New advanced options

The following new advanced options have been added:

### Enable Fur Image Rendering

Turn this option off to render only the geometry and fur shadows on geometry (no fur images).

## FUR | 12

### Fur Globals improvements

#### Enable Shadow Map Rendering

Turn this option off to render the fur and geometry as if the lights in the scene had no fur shadowing attributes.

#### Disable Maya Rendering (batch only)

Turn this option on if you are using a distributed or batch renderer and want to render only the fur images.

#### NURBS Tessellation

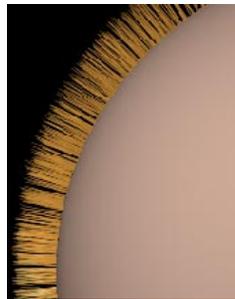
In previous versions, the tessellation factor Fur used for NURBS surfaces was hard coded and was often higher than the default tessellation factor used by Maya for the NURBS surface. The sometimes resulted in mismatched composites.

This option allows you to set the tessellation factor of the NURBS surface used by the Fur render.

The tessellation factor Fur uses for NURBS surfaces is sometimes higher than the default tessellation factor used by Maya for the NURBS surface. This sometimes results in mismatched composites.



Mismatched composite



Matched composite

Use this option to set the tessellation factor of the NURBS surface used by the Fur renderer.

#### Fur Image Rendering

##### Hairs/Pixel

Specify the number of hairs per pixel that are tracked for fur images. Lower values use less memory while higher values produce better quality renders.

Batch rendering is now per frame

#### **Use Fur Shading/Shadowing on Fur**

Turn this option off to cast fur shadows on geometry but not on fur for shadow map lights.

#### **Shadow Map Rendering**

#### **Hairs/Pixel**

Specify the number of hairs per pixel that are tracked for shadow maps. Lower values use less memory while higher values produce better quality renders.

## **BATCH RENDERING IS NOW PER FRAME**

When you batch render a scene, Fur now completes rendering both the fur images and the geometry for each frame before starting the next. In previous versions of Fur, all the Fur images would be rendered for all the frames, then all the geometry would be rendered.

## **BAKING IMPROVEMENTS**

Rebaking maps now overwrites the old maps and puts them in the furAttrMap directory rather than the source images directory.

## **FOG NOW RENDERS WITH FUR**

You can now render fog with fur. In the Render Globals window (Window > Render Globals), expand Render Options and turn on Apply Fog in Post before rendering.

## **FUR | 12**

Fog now renders with fur

WHAT'S NEW IN MAYA 3

**270**

# 13 LIVE

In Maya 3.0, we've added the following features to Maya Live:

- "Tracker improvements" on page 271
- "New Locator Summary panel" on page 273
- "New infinite and locked points" on page 274
- "New Filter for Solve task" on page 276
- "Camera rotation order improvement" on page 277

As of Maya 3, the Comprehensive solver is discontinued and Live now uses the Root Frame solver exclusively. Any mention of the solver refers to the Root Frame solver.

---

### *Remember...*

Live is available only in Maya Unlimited.

---

## TRACKER IMPROVEMENTS

We've added features to help the tracker follow image changes better and stay locked on the target. The new features are:

- blurring
- adjusting for rotation and scale

### **Blurring**

By default, the tracker now blurs images to compensate for interference within the images, such as film grain. You don't actually see the blur (it is done in memory only), but it helps the tracker stay on target.

You can control the amount of blur by adjusting the Blur Radius parameter on the Track Options control panel. For example, if you are tracking a subtle feature, the default amount of blur may be too much. A value of zero disables the blur.

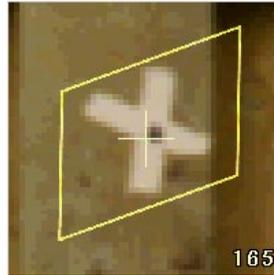
## LIVE | 13

### Tracker improvements

**Rotate and Scale** The target box now automatically adjusts in shape to compensate for rotation or scale changes in the target image. This feature helps with the most common reason for tracking failures: shape changes in the feature you are tracking.



Starting track box



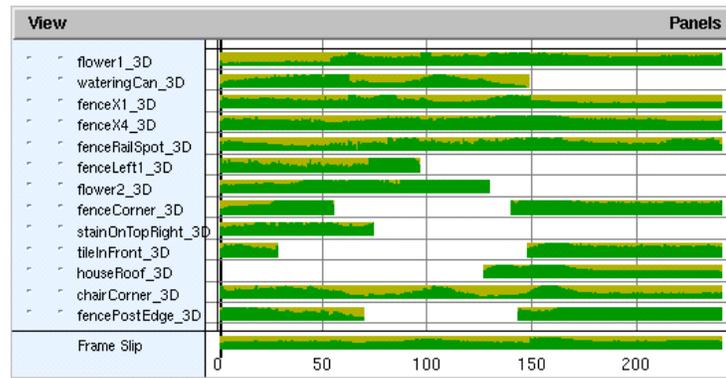
Track box rotation

You can control the amount of rotation or scale by adjusting the Use Rotate and Use Scale parameters on the Track Options control panel. If you find the tracker is falling off target, adjusting the value for these parameters may help.

## NEW LOCATOR SUMMARY PANEL

The Solve task now includes a Locator Summary panel. This panel graphs locator and frame slip quality, which were previously displayed in the Track Summary. The Track Summary now graphs only track information.

Use the Locator Summary panel to evaluate how closely the 3D locators created by the solver match with the 2D track points. Also use it to make points infinite or locked. This is a new feature; see “New infinite and locked points” on page 274 for more information.



### Locator quality

Graphically indicates the amount of pixel slip between each locator and its corresponding track point. Pixel slip is the distance in pixels between the track point and its locator. Like the Track Summary, green is good quality, yellow is a warning, and red is a strong warning.

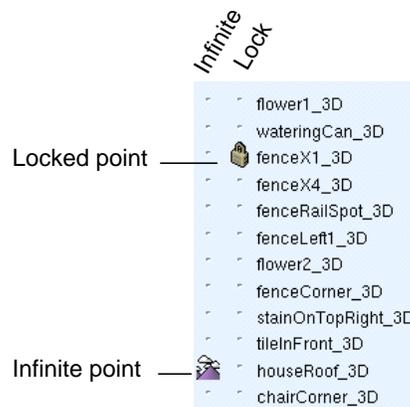
### Frame Slip

Graphs the average pixel slip for all locators.

## NEW INFINITE AND LOCKED POINTS

You can now make points infinite or locked in the Locator Summary panel. These new designators are another way to help the solver, like survey constraints.

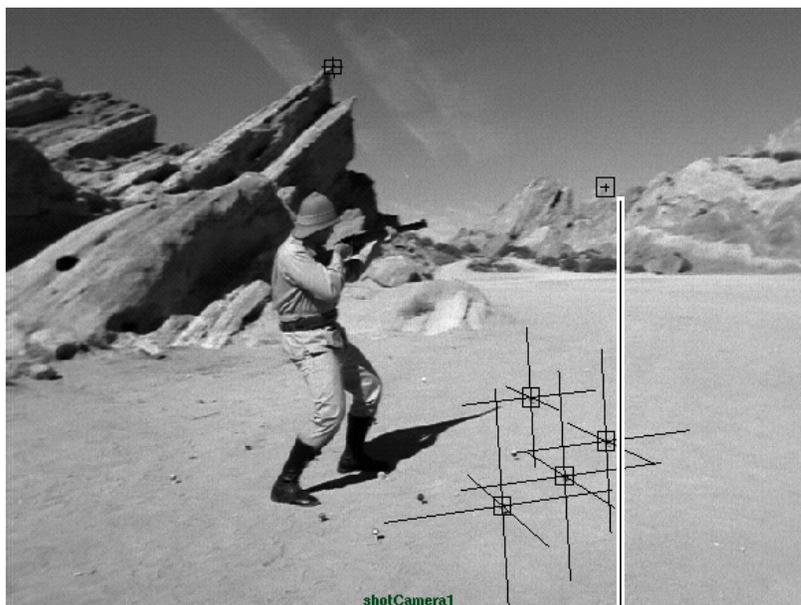
To make a point infinite or locked, simply click next to the locator in the Locator Summary panel. To return a point to normal, click the icon again. See the following illustration.



### Infinite

Tells the solver to treat the point as infinitely far from the camera, such as a cloud, mountain, or any feature in the distant background. Knowing a point is infinite, the solver can use it exclusively for calculating camera movement. It does not need to determine the point's position in space, so the locator becomes hidden.

By making two or more points infinite, you can significantly help the solver calculate zoom shots, provided those points are visible long enough.



Infinite points help define camera movement  
(notice it has no 3D locator)

### Lock

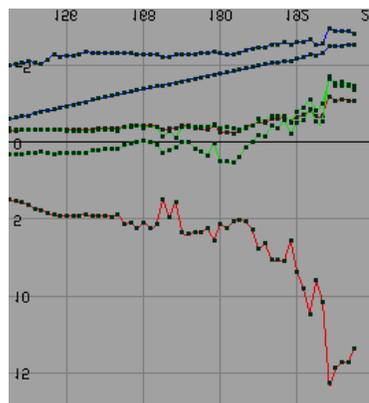
Locks the locator point to a specific 3D location. A locked point is exactly like assigning it to a survey Point constraint, but the workflow is easier. Simply click the lock icon and move or snap the locator to a given position. However, Point constraints are still required if you want it to be used for registration only.

There are several uses for locked points:

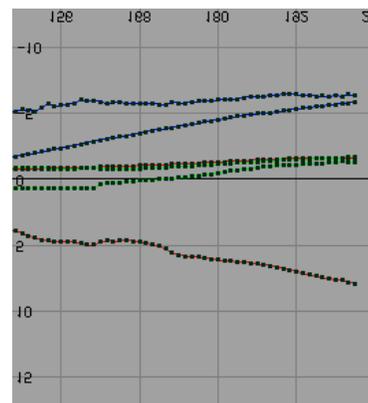
- to lock points onto a model you created or imported
- to help resolve ambiguities for the solver by specifying exact locations for two or more points, taken from survey data
- to register the whole scene around a certain point, such as the origin

## NEW FILTER FOR SOLVE TASK

To correct for unwanted jitter in your camera move solution, we've added a filtering process and Filter Level control on the Solve control panel. Filtering specifically corrects the jitter that can occur around frames where the solution is mathematically ambiguous or uncertain. The root frame solve process tends to amplify these ambiguities, creating jitter in the camera's motion. Filtering finds the frames with ambiguities and applies a strong filter to those areas in the camera curves. The filtering occurs during the Finish step.



Solution without filter



Solution with filter

Adjust the Filter Level if you want more filtering or if the precision of the solution suffers as a result of too much filtering. A value around ten is the upper limit, while zero disables the filter.

### Filter Level vs. Smoothing Interval

Filter Level is different from Smoothing Interval, which is also on the Solve control panel. Smoothing Interval corrects for isolated jumps in camera motion curves around frames where track points appear or disappear. Filter Level, on the other hand, corrects for overall camera jitter wherever it occurs.

## CAMERA ROTATION ORDER IMPROVEMENT

You can now change the Rotate Order attribute of the shot camera for your solutions. You can find the Rotate Order attribute in the Attribute Editor, under the shotCamera node, Transform attributes. For example, if you wanted to modify the camera solution as if it was on a tripod, you could change the Rotate Order to ZXY.

**LIVE | 13**

Camera rotation order improvement

# 14 MAYA DOCUMENTATION

For Maya 3, we've updated the documentation to include information on the features that have been added since Maya 2. This chapter describes the improvements we've made to documentation for this release, including:

- "Online improvements" on page 279
- "Printed or online?" on page 280
- "What's New in Maya 3" on page 280

## ONLINE IMPROVEMENTS

For Maya 3, we've completely updated our online look. We hope that you'll find the new online books more pleasant to view and easier to find information in. We now provide documentation for the full Unlimited product, no matter which version of the software you're using

### New Search tools

We've provided an enhanced Library search tool in Maya 3.0. You can use the Library Search tool without installing the documentation files on a server. To access the Library Search tool, return to the main Maya Library page and select Library Search.

A Book Search tool is also provided in the left frame of most books. Use this tool when to look for an item in the book you are viewing currently.

### Maya Glossary

For 3.0, we've provided an online glossary so you can look up meanings of words you encounter which are new or confusing.

## PRINTED OR ONLINE?

Most Maya documentation is available in both html (viewable) form and pdf (printable) form. To access pdf files, insert your Maya CD and open /pdf/library.pdf. Additional printed document sets are available from Alias|Wavefront.

---

### *Note*

Online help requires version 4 or higher of either Netscape Communicator or Internet Explorer.

To print the pdf files, you must have Adobe Acrobat Reader.

---

## WHAT'S NEW IN MAYA 3

For Maya 3, this What's New includes information on the new features that appear throughout the Maya software. This information is much more complete than in previous releases, so that you can learn about the new features without referring to other books.

# 15 EXPRESSIONS AND MEL

This chapter describes Maya 3.0 improvements to expressions and MEL scripts.

- “Script and Expression Editor improvements” on page 281
- “Simplified expressions for particle lifespan” on page 282
- “New capabilities for making attributes paintable” on page 282

## SCRIPT AND EXPRESSION EDITOR IMPROVEMENTS

- We’ve added the Edit > Clear All command to help remove clutter.
- Pressing Ctrl+Enter now executes commands. Previously, only Enter on the keypad or Edit > Execute would execute commands.

### Edit keys (IRIX only)

Because using the Expression Editor, Script Editor, and other input boxes can involve text editing, we’ve added support for the following edit keys:

- Ctrl+c: Copy
- Ctrl+x: Cut
- Ctrl+v: Paste
- Ctrl+k: Delete to end of line
- Ctrl+d: Delete next character
- Ctrl+a: Move cursor to beginning of line
- Ctrl+e: Move cursor to end of line

Previously, these edit keys were not supported on IRIX. However, the Ctrl+c, Ctrl+x, and Ctrl+v keys have always operated on NT. Also, Ctrl+a on NT selects all the text in the edit box.

## SIMPLIFIED EXPRESSIONS FOR PARTICLE LIFESPAN

Maya 3.0 simplifies the way you work with particle lifespan. No longer do you need to use an expression to set random or constant lifespans on a per particle basis. See *Using Maya: Dynamics* for details.

If you are using any lifespan mode other than *lifespanPP only*, you may read but not assign to `finalLifespanPP` in expression statements. For example, in past versions of Maya you might have written:

```
opacityPP = 1 - age/lifespanPP;
```

This works in Maya 3.0, but only if you have lifespan mode set to `lifespanPP` only. Now the way to write this expression is:

```
opacityPP = 1 - age/finalLifespanPP;
```

This works for all lifespan modes because `finalLifespanPP` always stores the actual lifespan used for the particles in all modes.

Pre-Maya 3.0 expressions that refer to `lifespanPP` will work correctly now as long as you select *lifespanPP only* as the lifespan mode. If you select Constant or Random Range mode, you can read the value `finalLifespanPP`, not `lifespanPP`. You need to use `finalLifespanPP` only if you intend to make use of one of the other lifespan modes.

## NEW CAPABILITIES FOR MAKING ATTRIBUTES PAINTABLE

To make an attribute paintable by the Attribute Paint Tool, it must be registered in the MEL script `ArtisanRegistPaintAttrCmd.mel`. This attribute registration process now has added capabilities.

For a full explanation of how to register a paintable attribute, see *Using Maya: MEL*, Chapter 13 “Setting Up Artisan MEL Scripts.” In brief, the registration command format is:

```
attrPaintCtx -e -rpa <nodeName> <displayName> <type> <attribute1> <attribute2>  
<getGridCmd> `currentCtx`;
```

### New capabilities:

- There are additional attribute data types you can register as paintable:

multiDouble  
 multiFloat  
 multiInt (mutli integer)  
 multiVector

Specify the attribute data type in the third variable position; for example:

```
attrPaintCtx -e -rpa "polyReduce" "thresholds" "multiFloat"
`currentCtx` ;
```

- You can now specify which component mask you want to be painted: faces, edges, or vertices. If left undefined, the paint tool applies to all vertices.

To specify a component mask, first register the attribute, then enter this additional command:

```
attrPaintCtx -e -acm <nodeName> <attribute> <componentMask>
`currentCtx` ;
```

For example, the following command limits the paint tool to faces:

```
attrPaintCtx -e -acm "polyExtrudeFaceW" "weights" "faces"
`currentCtx` ;
```

- We've added a command for situations where the paintable attribute affects the surface topology. For example, you might create a paintable attribute to reduce the number of polygons. To keep the surface shape frozen, you need to reference a geometry node that remains unaffected by the paintable attribute.

The command is:

```
attrPaintCtx -e -ish <nodeName> <geometryAttribute>
`currentCtx` ;
```

For the <geometryAttribute> variable, specify the name of an attribute in the paintable node that is connected to a geometry node you can use as a static reference. In the following example, "ip" is the node used as a static reference:

```
attrPaintCtx -e -ish "polyReduce" "ip" `currentCtx` ;
```

## **EXPRESSIONS AND MEL | 15**

New capabilities for making attributes paintable

# 16 API AND DEVELOPER'S TOOL KIT

With this release of Maya, we've added new features and improvements to Maya's API and Developer's Tool Kit:

## General improvements

- Upgrading existing plug-ins for Maya 3.0
- Plug-in compatibility changes made in Maya 2.0

## New features

- New API for subdivision surfaces (for Maya Unlimited)
- Support for Multi UV's on Polygons
- New API classes
- Enhanced API classes
- Corrections to existing functionality
- Documentation corrections
- Miscellaneous corrections

## GENERAL IMPROVEMENTS

### Upgrading existing plug-ins for Maya 3.0

All plug-ins that were written with a previous version of Maya must be re-compiled under the Maya 3.0 API to load and run without problems.

Source code compatibility between versions has always been a goal of the Maya API, however there are a few changes that will have to be made to the source code of plug-ins in order to rebuild them on Maya 3.0.

Before starting this procedure, you should be aware that the header file, `MTypes.h`, defines a preprocessor macro, `MAYA_API_VERSION`, that is set to the current API version. This variable defines the current version of the Maya API and lets you write plug-ins that compile differently on different Maya releases.

The variable is numeric and corresponds to the Maya version number with the "." (dot) characters removed. For example, Maya 1.0.1 would be 101, Maya 1.5 would be 150 and Maya 3.0 would be 200. Since the variable was not defined for Maya 1.0, its value defaults to 0 in that release.

### Compiler requirements

**IRIX:** For Maya 3.0 plug-in we recommend the SGI MIPSpro 7.3.1.1m compiler. As of the time that Maya 3.0 shipped, no patches to this compiler were required to successfully build Maya plug-ins.

**NT:** For Maya3.0 plug-ins the Microsoft Visual C++ v6.0 is required. The most current service pack for this compiler should also be installed.

### Plug-ins that use the class `MFnLightDataAttribute` require a small code change

A new feature has been added to the Maya 3.0 rendering software that will require a source code change to plug-in shaders that use this the `MFnLightDataAttribute` class. The scope of the change is that a new attribute has been added to the compound light data structure and needs to be declared and created within the `MFnLightDataAttribute` constructor so your plug-in will compile in Maya 3.0. The two affected methods in this class are: `create` and `setDefault` both of which now require an additional argument.

There are 6 example plug-in shaders in the Developers Tool Kit that used this class and these have all been modified to take this change into account. The modified example files are:

- `backfillShader.cpp`
- `lambertShader.cpp`
- `lightShader.cpp`
- `phongShader.cpp`
- `shadowMatteShader.cpp`
- `anisotropicShader.cpp`

Please refer to the example source code files, and the additional declaration and handling of the attribute named `aBlindData`.

## Plug-in compatibility changes made in Maya 2.0

If you are upgrading from a Maya 1.0 or Maya 1.5 directly to Maya 3.0, you will also need to know what source code compatibility changes were made to the API between Maya 1.x and Maya 2.0. The information in this section has been reproduced verbatim from the Maya 2.0 "What's New" document.

### Multiple OpenMaya libraries for modularization

The Maya Developers Kit now offers multiple libraries to effectively modularize the code into various components of Maya.

As a result of this change, you have to modify your Makefiles or project files to add the appropriate link directives for the OpenMaya library in addition to libraries your plug-in requires. We have added an indicator to each class definition to indicate which library will be required when using that class.

The developers libraries now exist in several shared libraries as follows:

OpenMaya:	All base API functionality that is shared between the other libraries. Also includes all NURBS and polygon support.
OpenMayaUI:	User-Interface related classes.
OpenMayaAnim:	Animation related classes.
OpenMayaFX:	Dynamics related classes.
OpenMayaRender:	Software rendering related classes.

### Plug-in autoloader

Previously, when a plug-in was marked for autoloader it was recorded in the `userPrefs.mel` prefs file as an absolute pathname to the plug-in. Now just the plug-in name is stored in `userPrefs.mel` and the standard `MAYA_PLUG_IN_PATH` environment variable is used to locate the plug-in.

#### UI methods moved from MGlobal class to M3dView class

As part of the modularization effort described above, the following static methods were moved from the class MGlobal to the class M3dView:

- active3dView
- numberOf3dViews
- get3dView
- display
- deviceContext
- applicationShell

If you used any of these methods in your plug-in, you will have to change the class name appropriately and add OpenMayaUI to the link directives for the plug-in.

#### New MPxIkSolverNode class

##### Replaces MPxIkSolver class for registering and creating user defined IK solvers

IK solvers are now being registered as Maya nodes. In prior versions of Maya, IK solvers were registered using a special registration mechanism, MFnPlugin::registerIkSolver. This registerIkSolver method is problematic as the plugin needs to be unloaded and reloaded after a File > New. The class MPxIkSolverNode has been added from which IK solvers should be derived. The previous class, MPxIkSolver, and the method MFnPlugin::registerIkSolver will be removed in a post 2.0 release of Maya.

---

#### Note

The registration of an IK solver as a regular Maya node makes it possible to use plug-in IK solvers in the same way that non-default IK solvers (for example, ikMCSolver) are used.

---

If your solver was written using the old MPxIkSolver class, you can convert it to derive from the new MPxIkSolverNode class.

**To use the new MPxIkSolverNode class:**

- 1 Add an empty initialize method and node id to the class derived from MPxIkSolverNode. For example:

```
static MStatus initialize();
static MTypeId id;
MTypeId simpleSolverNode::id(0x81234);
MStatus simpleSolverNode::initialize()
{ return MS::kSuccess; }
```

- 2 Change registerIkSolver to registerNode, and pass the node id and initialize method as additional arguments. For example:

```
plugin.registerNode("simpleSolverNode", simpleSolverNode::id,
    &simpleSolverNode::creator,
    &simpleSolverNode::initialize,
    MPxNode::kIkSolver);
plugin.deregisterNode(simpleSolverNode::id);
```

- 3 Create a solver, using the createNode. For example:

```
createNode simpleSolver;
```

**MPxNode::addAttribute****Now fails on duplicate attributes**

In previous versions of Maya, if an attempt was made to create an attribute whose long or short names conflicted with those inherited from parent nodes, the attempt would fail, but addAttribute would not return an error indicating the failure.

In Maya 2.0, the method MPxNode::addAttribute now fails if:

- you attempt to add an attribute more than once
- the long and short name of an attribute are identical
- the long name of the attribute is used as the long name of any previously added attribute
- the short name of the attribute is used as the short name of any previously added attribute

The API is now reporting a latent bug that went unreported in previous versions. If you are checking the return status of `addAttribute` you will start getting failures from your node's `initialize` routine and will have to correct the names used for the node's attributes.

#### **MStatus::error**

##### **No longer returns incorrect boolean value**

In previous versions of Maya, this method was wrong. The method returned `true` when there was no error and `false` if there was—exactly the opposite of how it was documented to behave. This has been corrected for Maya 2.0. If you wrote code to accommodate this bug in previous versions of Maya, you will have to change your code to accept the new (correct) return value.

#### **MPxContext::setImage method**

##### **Replaces addToolIcon and removeToolIcon functionality**

The `addToolIcon` and `removeToolIcon` MEL subroutines were added in Maya 1.5 to allow you to associate an icon with your tool context. This allowed Maya to display the icon for your context in the 6th position of the Maya mini-bar.

In Maya 2.0, the new way to accomplish this is to use the new `setImage` method in the `MPxContext` class. The `addToolIcon` and `removeToolIcon` interfaces have been modified so they will continue to work but support for them will be removed in a post 2.0 release.

#### **Signature of MDagPath::getPathTo method changed**

The method, `getPathTo`, in the `MDagPath` class has been changed so that it returns an `MStatus` and provides its result in a reference parameter. A compatibility method using the old signature exists, but will be removed in a post 2.0 release of Maya.

## **getRotation, setRotation in MFnlkJoint, MTransformationMatrix signatures**

### **Classes have changed**

The methods `getRotation` and `setRotation` in `MFnlkJoint` and `MTransformationMatrix` have been changed to no longer accept a space parameter as these rotations are only valid in transformation space. Compatibility methods that contain the old signatures exist, but will be removed in a post 2.0 release of Maya.

## **Layers no longer accessed with the MFnSet class**

In previous versions of Maya, layers were implemented using sets so that when you created a layer a special kind of set was created. In Maya 2.0, layers are implemented using their own dependency node and are no longer related to sets in any way. This change resulted in the removal of the `isLayer` parameter from the `create` method in the `MFnSet` class. To create a layer node, create a dependency node of type `MFn::kDisplayLayer`.

To make the old signatures compatible with the changes, you must set the `isLayer` to false. Otherwise an `invalidParameter` error is displayed.

The method `isLayer` is now obsolete. A compatibility method with this name still exists, but it will unconditionally return false. The replacement for this method is to use the `hasFn` method of `MObject`, and see if the node supports the type `MFn::kDisplayLayer`.

## **MFnNurbsSurface tessellate method**

### **New argument and new return value**

A new argument, `parentOrOwner`, has been added to the `MFnNurbsSurface::tessellate` method to specify the owner of the new surface. The return value has also changed depending on the usage of the new argument. Source code that uses the previous versions function signature will result in a new transform created for the mesh and added to the DAG.

#### M3dView::refresh method

##### New force argument

A new argument, *force*, has been added to the refresh method of the API class *M3dView*. The default setting is *false*, which maintains the previous behavior of the method. However, if it is set to *true*, the views are refreshed even if they do not require it.

---

##### *Caution!*

The *force* option should be used with extreme caution. Extra refreshes will greatly hinder application performance. The only time it will likely be necessary to use this option is from a command that intends to use something like *glReadPixels* to snap an image of the screen.

---

## NEW FEATURES

### New API for subdivision surfaces (for Maya Unlimited)

Maya implements fully hierarchical Catmull-Clark quad based subdivision surfaces. You can use them without any hierarchical edits, but their full power is only realized when you do use the hierarchy. Using the hierarchy lets you access additional vertices on the existing faces. For example, a single 4 vertex plane can give you access, through hierarchy, to over 16,000,000 points at the finest level of the hierarchy (please don't try it). Additionally, the points at the finer levels are created only as you need them and only in the areas where you need them, giving you an implied level of detail workflow.

The "base" mesh is sometimes used to describe the coarsest level of the hierarchy. Once we go one level finer (to level "1") all faces are four sided (though not all vertices are of valence 4). At that point, each face can be considered to have 4 "children" faces. Starting with a 4 vertex single face plane, there will be 4 faces (and 9 vertices) at level 1, 16 faces (and 25 vertices) at level 2, etc. You can go as deep as level 12.

Please consult Maya documentation on subdivision surfaces for more details.

The subdivision surface API consists of 3 classes:

### **MFnSubd**

This function set provides access to subdivision surfaces. Objects of type MFn::kSubdiv, MFn::kSubdivData, and MFn::kSubdivGeom are supported. MFn::kSubdiv objects are shapes in the DAG, MFn::kSubdivGeom objects are the raw geometry that the shapes use, and MFn::kSubdivData objects are the data that is passed through dependency graph connections.

### **MFnSubdNames**

This function set provides some simple utilities for the interpretation and manipulation of the subdivision surface vertex, edge and face ids.

### **MFnSubdData**

MFnSubdData allows the creation and manipulation of Subdivision Surface data objects for use in the dependency graph.

If a user written dependency node either accepts or produces Subdivision Surfaces, then this class is used to extract or create the data that comes from or goes to other dependency graph nodes. The MDataHandle::type method will return kSubdiv when data of this type is present.

If a node is receiving a Subdivision Surface via an input attribute, the asSubdSurface method of MDataHandle can be used to access that input Subdivision Surface.

If a node is to create a Subdivision Surface and send it via an output attribute, a new MFnSubdData must be instantiated and then the create method called to build the actual data block as an MObject. This MObject should be passed to the MFnSubd::create method as the parentOrOwner parameter so that the Subdivision Surface will be constructed inside the data block. The MDataHandle::set routine is then used to pass the data block down the connection.

## **Support for Multi UV's on Polygons**

### **Multi Texturing in MFnMesh, MIItMeshFace and MIItMeshVertex**

Modifications to support Multi Texturing have been added to the MFnMesh, MIItMeshFace and MIItMeshVertex classes. These modifications provide access to the multi texture data via the API.

---

#### *Note*

These classes are software compatible with Maya 2.5 plug-ins.

---

## New API classes

### **MAnimUtil**

A class that contains static animation helper methods such as “isAnimated” that allows you to determine if a particular object or plug is animated. Other methods allow you to find the animCurve node or nodes that drive the animation.

### **MConditionMessage**

A new class derived from the MMessage class that is used to register callbacks for changes to specific conditions. The complete list of conditions available in Maya can be found in the documentation for the scriptJob command under the “listConditions” flag. Some example conditions are “DynamicsExists” and “isPlayingBack”, and “readingFile”.

### **MEventMessage**

A new class derived from the MMessage class that is used to register callbacks for changes to specific events. The complete list of events available in Maya can be found in the documentation for the scriptJob command under the “listEvents” flag. Some example events are “NewSceneOpened” and “playbackRangeChanged”, and “SelectionChanged”.

### **MUiMessage**

A new class derived from the MMessage class that is used to register callbacks to track the deletion of UI objects.

### **MFnAreaLight**

Provides methods to that allow you to create and manage “area lights”, which are a new Rendering feature in Maya 3.0.

**MFnSubd, MFnSubdData and MFnSubdNames**

These classes are part of the new subdivision surface API and are described previously in the “New Features” section of this document.

**MUInt64Array and MFnUInt64ArrayData**

New classes that manage arrays of unsigned 64-bit values. These are currently used as part of the subdivision surface API.

**MFnVolumeAxisField**

Provides methods to that allow you to create and manage “volume access fields”, which are a new Dynamics feature in Maya 3.0.

**MPxGIBuffer**

A new proxy class that allows you to create an user-defined off screen rendering buffer. Maya can now be directed to render to this buffer instead of to the screen.

**MRenderCallback**

A new class that is used to register callbacks to gain access to Maya's rendering information during software rendering. You can modify Maya's shadow maps, RGB pixmap, and depth map to composite your own rendering effects into Maya's rendering.

**Enhanced API classes**

- Two new methods, numNonZeroSpansInU and numNonZeroSpansInV, have been added to the class MFnNurbsSurface. These are needed to compute the number of patches on Bezier surfaces.
- Four new methods have been added to the MString class. Two overloaded “set” methods now allow you to initialize the string with a double. As well, operator= and operator+ methods that take double arguments were added. These methods allow you to add numeric values to strings without first converting them to strings.
- Two new overloaded “setResult” methods have been added to the MPxCommand class that take MIntArray and MDoubleArray arguments respectively.

### New features

- Two new methods, “getAffectedAttributes” and “getAffectedByAttributes” have been added to the MFnDependencyNode class. These methods allow you to determine which attributes of a node are affected by a particular attribute or which attributes affect a particular one. See the new example plug-in, getAttrAffectsCmd for an example that shows how to use these new methods.
- A new method, parentNamespace, has been added to the MFnDependencyNode class, which returns name of the namespace in which a node resides.
- A new overloaded “intersect” method has been added to the MFnNurbsSurface class. This method returns an MPointArray that contains all intersection points of the given ray with the surface.
- Two new methods: rotateOrientation and setRotateOrientation were added to the class MFnTransform to allow manipulation of the rotation orientation.
- Four new methods: setExistWithoutInConnections, existWithoutInConnections, setExistWithoutOutConnections and existWithoutOutConnections have been added to the MPxNode class. These allow you to define whether or not your new node should be deleted when the last node to which it has an input or output connection is deleted.
- A new method, uvPoint, as been added to the MDynSweptTriangle class.
- New overloaded create methods were added to the MFnDependencyNode and MFnDagNode classes that allow you to specify an initial name for newly created nodes.
- New “copy” methods have been added to the classes: MDoubleArray, MFloatArray, MFloatPointArray, MFloatVectorArray, MIntArray, MPointArray and MvectorArray.
- The new enum element, kIprRender, was added to the MRenderState enum in the MRenderUtil class to allow a plug-in to determine if an IPR render is in progress.
- The cleanup method of the MLibrary class has been enhanced so that it now accepts an exit code as a parameter. If provided, when the cleanup code causes your application to exit, it will exit with the given value.

## Corrections to existing functionality

### Improvements in API classes

- In previous releases it was impossible to add shapes to a set that had been created by the create method of the MFnSet class when the kRenderableOnly flag was provided to the create call.
- The operator\*= method in the MMatrix class has been fixed.
- The missing documentation for the registerShape method in the MFnPlugin class has been added.
- Maya will no longer crash if a call to the isPlaying method of the MAnimControl class is made from a multi-threaded plug-in on a multi-processor machine.
- A new virtual method, isAbstractClass, has been added to the class MPxNode class. If it is defined to return true, Maya will consider the new plug-in node type to be “abstract”. That is, it will not be possible to create an instance of that node type. The node type can however still serve as a base class for other derived plug-in nodes.
- Maya will no longer crash if the tessellate method of the MFnNurbsSurface class is called with a “parentOrOwner” set to NURBS Data and the MObject for the new surface is defined prior to that of the data.
- In the MFnCamera header file, the example parameter names “near” and “far” were changed. When using certain compiler flags, these names are reserved keywords in Visual C++ and could cause compile problems.
- In previous releases, if you were in a plug-in tool, and used the delete key to delete an object, that delete action would not get registered on the undo queue. This would cause serious problems if you tried to undo the operation.
- The projectionMatrix method of the MFnCamera class has been fixed.
- The setDrawColor method of the M3dView class now correctly sets the alpha value of the color.
- If you tumble the view while in a plug-in tool, the cursor now gets changed back to the tool’s cursor when the tumble is complete.
- Maya no longer crashes if you load and unload a tool plug-in numerous times.

## API AND DEVELOPER'S TOOL KIT | 16

### New features

- The `MItDependencyNodes` class now checks the first node seen against the filter. Because of the way that Maya scenes are initialized, the iterator would fail in previous releases when using a `MFn::kTime` filter.
- The `MAYA_FILE_ICON_PATH` environment variable is no longer used by Maya, and thus is no longer used to specify the location of bitmap files used by plug-in file translators. As of Maya 3.0, the `XBMLANGPATH` variable is used to specify the location of all types of bitmap files on all platforms.
- Maya stand-alone applications no longer crash if a call is made to the `getConnectedShaders` method of the `MFnMesh` class.
- Maya stand-alone applications could crash in previous releases with some `MTessellationParams` settings were used when making a call to the `tessellate` method of the `MFnNurbsSurface` class. This has been corrected.
- The copy constructor of the `MSelectionList` class has been fixed.
- The `isZAxisUp` method of the `MGlobal` class no longer returns false unconditionally.
- The `upAxis` method of the `MGlobal` class no longer returns `[0, 0, 0]` unconditionally.
- The C++ preprocessor defines “`STRICT`” and “`EXPORT`” have been removed from the `MTypes.h` header file. They were unused in previous release and could cause compile problems in certain circumstances.
- The `setUIUnit` method of the `MAngle` class has been fixed.
- The `MSelectionList` parameter to the `MItSelection` list constructor was erroneously not declared “`const`” in previous releases. This has been corrected.
- Maya no longer crashes if a plug-in node that has had dynamic attributes added to it is duplicated.
- The `isFlipNorm` method of the `MFnNurbsSurface` class could cause Maya to crash under some circumstances. This has been corrected.
- In Maya 2.0 and Maya 2.5, Maya would sometimes crash in the `setWeight` method of the `TdnWeightGeometryFilter` class if this method was called while iterating over the components of a NURBS surface via the `MItGeometry` class. This has been corrected.

## Documentation corrections

- Documentation has been updated to `getConnectedSetsAndMembers` and `getConnectedShaders` methods of `MFnMesh` to indicate that they only work when the function set is initialized with a `kMesh` (a shape) node. These methods will not work with `kMeshData` objects.
- Fixed a formatting problem in the `MAnimUtil` class that made it very hard to read.
- Corrected the documentation for the `getBlindDataTypes` method of `MFnMesh`. Previously, the list of documented parameters was not the same as the list of actual parameters.
- Fixed the description of the components of the transformation matrix in the `MTransformationMatrix` class.
- Added detailed documentation for the `MSpace` class to the API class documentation.
- Updated the documentation of the `MItDag` class to indicate that the root of the traversal is included.
- A section was added to the API Developer's manual in the Chapter on writing commands that describes how to return values from commands.
- In the `MFnLight` class, added a new overloaded `lightDirection` method that returns the direction the light is pointing. Fixed the documentation for the existing `lightDirection` method to indicate that it is only operational during rendering.

## Miscellaneous corrections

- A new plug-in, "swissArmyManip." was added to the devkit example plug-ins. This contrived example shows how to create every available kind of plug-in manipulator.
- In the plug-in manager, if you mark the plug-in for autoload without first loading it, the plug-in will now be autoloaded the next time you start Maya.

## **API AND DEVELOPER'S TOOL KIT | 16**

New features

WHAT'S NEW IN MAYA 3

**300**

## Symbols

+ hotkey 31

## Numerics

2D/3D integration 248  
2-manifold geometry 88

## A

A slider 21  
Absolute offset  
  clip attribute 116  
Activate/Deactivate Clip 129  
active3dView 288  
actual frame rate display 107  
Add Selected Objects 17  
Add Track  
  clips 132  
Adobe Illustrator files  
  importing 17, 18  
Air field defaults 207  
All Keyable 146  
Along Axis attribute 152, 161  
Along U 52  
alpha channel 21  
alpha slider 21  
animation  
  changes 105  
API  
  changes 285  
applicationShell 288  
Apply Fog in Post 269  
Apply Pose  
  from Visor 134  
area lights 211

Around Axis attribute 152, 161  
article start-up caching 173  
Artisan paint tools 18  
Assign Textures  
  Paint Textures Tool  
  button 247  
attenuation  
  inverting 160  
Attribute Paint Tool 282  
attribute registration process 282  
attributes  
  paintable 282  
  painting 240  
attrPaintCtx command 283  
Auto Load Selected Objects 17  
autoload 287  
Automatic mapping 48, 49, 52  
  options 52  
AutoSave on Exit  
  Paint Textures Tool 247  
AutoSave on Stroke  
  Paint Textures Tool 247  
Average Vertices 60  
Away From Axis attribute 152,  
  161  
Away From Center attribute 152,  
  160

## B

baking  
  Fur changes 269  
  particles 164  
Base Width 264  
basic tools  
  changes 5  
batch rendering  
  changes 269  
  -rep command line  
  option 211  
bendAngle attribute in cloth 258  
Bezier  
  Rebuild Surfaces option 40  
birthPosition attribute 205  
Blend  
  box 22  
  clips 126  
  modes 79, 228  
Blend shape slider orientation  
  control 140  
Blind Data editor 48  
Blur Radius 271  
blurring 271  
bookmarks 17  
Border Target Shape map UV  
  border option 64  
Both Fields  
  Interlaced 252  
  Separate 252  
Brush Depth  
  Paint Textures Tool 240  
bump mapping  
  attribute 195  
  painting 238  
By Attribute Name  
  Export Character Map 135  
  Paste 121  
By Attribute Order  
  Export Character Map 135  
  Paste 121  
By Current Map  
  Export Character Map 135  
  Paste 121  
By Node Name  
  Export Character Map 135  
  Paste 121

## INDEX

### C

- cache
  - creating for particles 166
- cache files
  - deleting 171
- cache settings for particles
  - editing 168
  - options 167
- caching
  - particle start-up 173
  - recreating the cache 170
  - single particle object 172
  - tips 171
  - using start-up with batch rendering 174
- caching particles
  - playing back 169
- Calc. Area Values 266
- cameras
  - moving forward along a curve 109
- character maps
  - exporting and editing 135
- character setup
  - changes 139
- Character(s) Clips & Poses Visor 113
- characters
  - attributes as all keyable or non-keyable 146
  - new creation options 146
- Clear All command 281
- Click Box Size 20
- Clip
  - Create Clip 115
- Clipboard Start
  - Paste 122
- clips
  - blending 126
  - copying 120
  - creating 114
  - cutting 120
  - disabling 129
  - duplicating 122
  - editing animation curves 128
  - editing attributes 116
  - editing blended 127
  - editing original keys 129
  - editing source attributes 119
  - in Visor 112
  - instancing 123
  - merging 125
  - pasting 120
  - splitting 124
  - Trax Editor 110, 111
- Cloth
  - changes 257
- cloud shader 193
- Color Chooser
  - changes 21
- Command option box
  - changes 14
- commands
  - executing 29
- compiler requirements 286
- Component Display submenu 11
- Component Editor 29
  - Hold 144
- component-based influence
  - object behavior 145
- Comprehensive solver 271
- Conform normals 87
- Continuous selection 107
- Convert Display colors 80
- Copy
  - clips 121
- Copy Current UV Set 68

- copySkinWeights 141, 143
- crackless tessellation 216
- Create Character window 146
- Create Clip 114
- Create Empty UV Set 68
- Create New Display Layer menu item 9
- Create New UV Set
  - automatic mapping option 54
- Create Pose 134
- Current Time
  - Paste 122
  - Split 124
- custom attributes 35
- Custom Extension attribute 254
- Cut
  - clips 121
- Cycle
  - clip attribute 117
  - Emissions attribute 201
  - Interval attribute 201

### D

- Default Field Extension (o and e) attribute 254
- deformers
  - new advanced creation options 140
- Delete Attributes option 10
- Delete Current UV Set 68
- Delete Original Source
  - Split 124
- Developer's Tool Kit
  - changes 285
- deviceContext 288
- Die on Emission Volume Exit attribute 151
- Diffuse Coeff attribute 195

- Direction 25
  - Direction X, Y, Z attribute 161
  - Directional Speed attribute 152, 161
  - Disable Maya Rendering 268
  - Disable Weight Normalization 145
  - disabling
    - clips 129
  - disappearing file textured leaves 256
  - displacement mapping 214
  - Display category 19
  - Display menu 13
    - changes 10
  - Display Poly Count 48
  - Display Speed attribute 152
  - Display Unfiltered 84
  - documentation
    - changes 279
  - dolly 211
  - dragging and dropping textures 256
  - Duplicate
    - clips 123
  - Duration
    - source clip attribute 120
  - Dynamics
    - changes 147
  - Dynamics menu
    - improvements 203
- E**
- Ease In/Out
    - Blend 126
  - Edge Weights relax UVs option 67
  - edit keys 30, 281
  - Edit Polygons menu 14, 46, 47
  - editing weight locking
    - of joints 144
    - of smooth skin influence objects 144
  - empty UV set 69
  - Enable
    - clip attribute 117
  - Enable Fur Image
    - Rendering 267
  - Enable Shadow Map
    - Rendering 268
  - Enable Weight Normalization 145
  - Enable/Disable
    - clips 130
  - Encapsulated PostScript files
    - importing 17, 18
  - End Conditions
    - Rebuild Surfaces option 40
  - enlarging manipulators 31
  - EPS files
    - importing 17, 18
  - Euler angle filtering 107
  - Euler Filter 108
  - Even Field attribute 254
  - Even Fields 253
  - Exclusive Partition creation option 141
  - executing commands 281
  - Existing Partitions creation option 141
  - Export Character Map 135
  - Export Selection option
    - Hypershade 220
  - exporting
    - clips 130
  - Expression Editor
    - changes 281
  - Expressions
    - changes 281
  - extracted faces 90
  - Extrude commands 81
- F**
- Feedback line 6
  - Fewer pieces 52
  - Field Dominance
    - Even Fields 253
    - render options 253
  - Field Dominance
    - Odd Fields 253
  - Field Options attributes 252
  - Fields attribute 252
  - Fields menu 14
  - File menu
    - Hypershade 219
  - File Texture
    - Paint Textures Tool 240
  - file textured leaves 256
  - filter display
    - clearing 30
  - Filter Level 276
  - Filter Radius attribute 196
  - finalLifespanPP 198
  - Find 25
  - Find Menu 9
  - Flip Reversed layout UVs option 56
  - flipping during path animation 108
  - flower petals 256
  - Frame All
    - Trax Editor 112
  - Frame Rate 11, 107
  - Frame Slip 273

## INDEX

Frame Timeline Range  
  Trax Editor 112  
Frames  
  render 252  
Freeze Transformations 31  
freezing an object 31  
Fur  
  changes 263  
Fur Globals  
  changes 265  
Fur Image Rendering 268  
Fur Render Options 266  
furAttrMap directory 269

## G

General Preferences 18  
get3dView 288  
Global Scale fur attribute 264  
glossary 279  
Graph Anim Curves  
  clips 127  
Graph Editor  
  outliner split control 108  
Group option  
  for file import 18

## H

hair  
  rotating about surface V  
  axis 264  
Hairs/Pixel 268, 269  
header file 286  
Heads Up Display 10, 107  
Hide UI Elements 11  
Hold 144  
Horizontal slider option 140

Hotkey Editor  
  changes 24  
hotkeys 28  
  + 31  
  on menu labels 27  
Hypershade 219  
  changes 91

## I

IK solvers 288  
Illustrator  
  Adobe 17, 18  
images  
  displaying unfiltered 84  
importing  
  clips 130  
  clips by referencing 131  
  EPS and Adobe Illustrator  
  files 17, 18  
Inclination 264  
Include Subcharacters in Clip  
  Create Clip 116, 137  
Infinite 274  
infinite points 274  
Initial Weight Curve  
  Blend 126  
Instance  
  clips 124  
instancer  
  centering strokes on  
  particles 202  
  using Paint Effects  
  strokes 202  
instancing Paint Effects  
  strokes 255  
interactive rendering, multi-  
  threaded 217  
Interpolation Type 206

Into Square 53  
Inverse Front attribute 109  
Invert Attenuation 160  
IRIX edit keys 281  
Isolate Select 15, 16

## K

Keep Original Source  
  Split 124  
Keep originals in Trax editor  
  Merge 125  
Keys  
  Create Clip 114  
keys 25  
  listing 26

## L

Layer bar  
  changes 6, 8, 9  
Layer Editor 12  
Layer is Visible 228  
layer swatch 8  
Layered Texture node 224  
  creating 225  
layered textures 70  
layers  
  creating 9  
  render 8  
  texture 73  
Layout  
  automatic mapping option 52  
  layout UVs option 57  
Layout UVs 48, 54, 55, 56  
  options 56  
Leave Keys in Timeline  
  Create Clip 114

- Length 264
- Less Distortion 52
- Library search tool 279
- lifespan
  - in expressions 198
  - particle 282
- Lights
  - area 211
  - menu 14
- Linear
  - Blend 126
- List Current Characters Only
  - Trax Editor 112
- Live
  - changes 271
- Load Components button 29
- Load Selected Objects 17
- Locator quality 273
- Locator Summary panel 273
- Lock 275
- locked points 274

## M

- Magnitude attribute 159
- Make New Layers Current 8
- management
  - project 30
- mangled animation curves 107
- manipulator(s)
  - Surface Editing Tool 37
- manipulators
  - enlarging 31
- Map Method
  - Export Character Map 135
- Map UV border 48
  - options 64
- Max Distance attribute 159
- Max Iterations relax UVs
  - option 68
- MAYA\_PLUG\_IN\_PATH 287
- measure submenu 10
- measure tools 10
- MEL
  - changes 281
- menu labels
  - hotkeys on 27
- menu name
  - finding 9
- Merge
  - clips 125
- Merge Vertices
  - changes 91
- MFnLightDataAttribute 286
- Mirror button 141
- mirroring smooth skin
  - weights 141
- modeling
  - changes 31
- Modified Reverse option 85
- Modifier 25
- Modify menu
  - changes 10
- motion capture 107
- motion path animation 109
  - flipping improvements 108
- motion warping 115, 133
- Move and Sew UVs 48, 58
- Move Normal Tool 34
- MPxIkSolverNode class 288
- MTypes.h 286
- multiple images
  - rendering and stitching 256
- multitexturing 70
- multi-thread interactive
  - rendering 217
- multi-thread shadow maps 217

## N

- Name
  - Create Clip 114
  - Merge 125
- Need Parent UV attribute 200
- New Partition Name creation
  - option 140
- No Field Extension attribute 253
- No Multiple Knots
  - Rebuild Surfaces option 40
- Noise Anim Rate attribute 195
- Noise Level attribute 206
- Noise Ratio attribute 206
- nondestructive animation 115, 133
- non-IFF image formats 211
- nonlinear character
  - animation 105
- nonmanifold geometry 87, 88, 91
  - cleanup option 90
  - making 2-manifold 88
- Normalize Weights 145, 146
- normals
  - conforming 87
  - option changes 85
  - reversing 85
  - reversing and propagating 87
  - shells, when reversing 87
- Normals Display Scale 34
- Normals menu
  - Reverse 85
  - Reverse and Propagate 87
- NTSC video 253
- numberOf3dViews 288
- Numeric Input field 7
- NURBS modeling
  - changes 37

## INDEX

NURBS Tessellation 268

## O

Object Components submenu  
  changes 11  
object templates 32  
Odd Field 252  
  attribute 254  
Offset  
  clip attribute 116  
Once selection 107  
OpenMayaAnim  
  287  
OpenMayaFX  
  287  
OpenMayaRender  
  287  
Optimize automatic mapping  
  option 52  
Options menu 13  
  changes 11  
Origin Axis 10  
Oscillate selection 107  
Outliner  
  changes 28  
  splitting 28  
outliner separator 108  
outliner split control 108  
overlapping UVs, relaxing 66

## P

Paint Effects  
  changes 255

Paint Effects strokes  
  instancing 202, 255  
  rendering at test  
  resolutions 256  
  rendering without depth  
  output 256  
Paint Selection Tool 10  
Paint Textures Tool 18, 231  
  assigning textures 247  
  AutoSave on Exit 247  
  AutoSave on Stroke 247  
  Brush Depth 240  
  File Texture 240  
  masking polygonal faces 235  
  painting bump maps 238  
  polygonal faces 237  
  Reload Textures button 247  
  Save Textures button 247  
  Stamp Profiles 239  
  Stamp Spacing 239  
  texture attributes 240  
  texture naming 232  
  transparency 237  
  using 234, 236, 237  
paintable attributes 282  
painting  
  using the Paint Textures  
  Tool 234, 236  
  wrinkles 258  
PAL video 253  
palette 22  
  custom 22  
Parent Texture to Selected items  
  option  
  Hypershade 220  
particle attribute editor 205  
particle caching 164  
particle cloud shader 193

particle disk cache 165  
  creating 166  
  deleting 171  
  editing 168  
  playing back 169  
  recreating 170  
  setting options 167  
  tips 171  
particle lifespan 197  
  expressions for 282  
particle sampler info node 175  
  creating 176  
  examples 177  
  re-using 190  
  setting attribute 187  
Partition to Use creation  
  option 140  
Paste  
  clips 121  
Paste Method  
  Paste 121  
path  
  current project 30  
  default project 30  
Per Fur Description 267  
Percentage Space  
  automatic mapping option 54  
  layout UVs option 58  
Pin Selected UVs relax UVs  
  option 68  
Pin Unselected UVs relax UVs  
  option 68  
Pin UV Border relax UVs  
  option 67  
Pin UVs 67  
Pin UVs relax UVs options 67  
pixel slip 273  
pixel snap 84  
pixels  
  snapping to 84

WHAT'S NEW IN MAYA 3

306

- Planes option 52
  - playback looping options 107
  - Playback Looping selection 107
  - Plug-in autoloader 287
  - plug-ins
    - upgrading 285
  - Point constraint
    - vs locked point 275
  - Polar 264
  - Poly Count 11
  - Polygon Cleanup Options 89
  - Polygon menu 14, 46
    - changes 14
  - polygonal face normals
    - reversing 86
  - polygonal faces
    - painting 237
  - polygonal modeling
    - changes 45
  - polygonal texture mapping 223
  - Polygons menu 46
  - polyUVsPlus.so plug-in 48, 60, 61
  - Pose
    - source clip attribute 120
  - poses
    - creating 134
    - in Visor 112
  - Preferences
    - submenu 12
    - Trax Editor 112
    - window 18
  - Preferences window 18
  - Preserve Shape Detail map UV
    - border options 65
  - Primary Visibility option 255
  - project management
    - changes 30
  - Projective paint mode 235
  - Propagate option 85
  - propagating and reversing
    - normals 87
  - Proportional Modification Tool
    - changes 33
  - Put Clip in Trax Editor and Visor
    - Create Clip 115
    - Duplicate 123
  - Put Clip in Visor Only
    - Create Clip 115
    - Duplicate 123
- Q**
- Query 25
  - Quick Rename 7
  - Quick Selection 7
- R**
- Random Direction attribute 152
  - Random stream 199
  - Range Slider 107
  - Range Slider display toggle 107
  - ray tracing 219
  - Rearrange Graph button
    - hypershade 221
  - rebaking 269
  - recompiling plug-ins 285
  - referencing
    - clips 131
  - Region of Affect 19
  - registration process
    - attribute 282
  - Relative offset
    - clip attribute 116
  - Relax UVs 48
    - options 67
  - relaxing UVs 66
  - Reload Textures
    - Paint Textures Tool
      - button 247
  - Remove Selected Objects 17
  - Remove Track
    - clips 132
  - Rename Attributes option 10
  - Rename Current UV Set 68
  - render layer management 249
  - Render Layer/Pass Control 9
  - render layers 8
  - render pass management 251
  - rendering
    - changes 209
    - Paint Effects strokes 256
    - particles, in software 175
    - universal 209
  - rep
    - command line option, batch
      - rendering 211
  - Repeat Last 34
  - Repeatable 25
  - Replaces Axes submenu 10
  - requirements
    - compiler 286
  - Reset 31
  - Restore Factory Settings 19
  - Restore UI Elements 11
  - Reverse and Extract option 86
  - Reverse and Propagate
    - option 87
  - Reverse normals
    - description 85
  - Reverse option 85, 86
  - reversing and propagating
    - normals 87
  - Reversing face normals 85
  - Revert to Saved 19

## INDEX

Roll fur attribute 264  
Root Frame solver 271  
Rotate Order for Maya Live 277  
rotating hair about surface V  
axis 264  
Roundness attribute 194

## S

Save Textures  
Paint Textures Tool  
button 247  
Saving and reverting changes 19  
Scale  
automatic mapping option 53  
clip attribute 118  
layout UVs option 57  
scale changes to smooth  
skin 145  
Scale Factor 18  
Scale Rate by Object Size  
attribute 200  
Scale Speed by Size  
attribute 152  
Script  
changes 281  
Script Editor  
changes 29  
search tool 279  
Section Radius attribute 151,  
160  
Select Shell 83  
Selection category 20  
selection types 32  
Separate Extracted Faces 90  
Separate layout UVs option 56  
Set Current UV Set 68  
Set Default Shading Group  
option  
Hypershade 220  
Shading menu 14  
Shadow Map Rendering 269  
shadow map setting 265  
shadow maps, multi-  
threaded 217  
Shape Detail map UV border  
option 65  
Shelf  
changes 6, 8  
tabs 8  
shell border 83  
shells 83  
when reversing normals 87  
skinCluster node 145  
smooth skin influence object  
behavior  
improvement 145  
smooth skin weights  
copying 142  
locking influence objects 143  
mirroring 141  
normalizing 145  
smooth skinning  
changing scale  
improvements 145  
improved component-based  
influence object  
behavior 145  
smoothing  
Average Vertices 60  
Smoothing Interval  
vs Filter Level 276  
Snap Tolerance 20  
snapping  
category 20  
three points 33  
to pixels 84  
Solid Core Size attribute 195  
Solve task 273  
solver  
Comprehensive 271  
Root Frame 271  
Source Clip  
Split 124  
source clip  
editing attributes 119  
spaces in filenames 34  
Spacing Presets  
automatic mapping option 53  
layout UVs option 57  
Specify Start and End  
Create Clip 115  
Specify Time  
Split 124  
specifying weight locking when  
adding influence  
objects 144  
speed improvements 219  
Speed Random attribute 201  
Split  
clips 124  
Split Time  
Split 124  
Split vertex operation 81  
splitting a vertex 81  
Stamp Profiles  
Paint Textures Tool 239  
Stamp Spacing  
Paint Textures Tool 239  
Start  
source clip attribute 120  
Start and End  
Create Clip 115  
Start Frame  
clip attribute 117  
Paste 122

WHAT'S NEW IN MAYA 3

- start-up caches
    - using with batch rendering 174
  - Status bar changes 7
  - Status Line
    - changes 6, 7
  - stitching images 256
  - Stopping Conditions relax UVs
    - options 68
  - strokes
    - rendering 256
  - Subcharacters
    - Create Clip 116
  - subcharacters 146
    - using in clips 136
  - Subdiv Surfaces menu 14
  - subdivision surfaces
    - software render 211
  - subdivision surfaces modeling
    - changes 93
  - Surface Color attribute 195
  - Surface Editing Tool 37
  - surface origin
    - displaying 32
  - Surface Shading Shadow attribute 196
  - Switch utilities
    - and paint multiple surfaces 233
- T**
- templates 32
    - menu selection 32
  - tessellation, crackless 216
  - Texture Attribute to Paint
    - Paint Textures Tool 240
  - Texture Blend attribute 79
  - texture layers 73
  - texture mapping
    - automatic 49, 52
    - laying out UVs 54, 55, 56
    - moving and sewing UVs 58
    - polygonal 223
    - relaxing UVs 66
    - UV border 63
  - Texture View
    - changes 83
    - window 48
  - textures
    - assigning, Paint Textures Tool 247
    - attributes for Paint Textures Tool 240
    - dragging and dropping 256
    - layered 70
    - painting with Paint Textures Tool 231
    - reloading, Paint Textures Tool 247
    - saving, Paint Textures Tool 247
  - Three Point Snap 33
  - Threshold 265
  - Time Range
    - Create Clip 115
  - Timeline 107
    - Trax Editor 111
  - Timeline Start
    - Paste 122
  - Tip Width 264
  - topology
    - nonmanifold 87
  - track 211
  - tracker
    - changes 271
  - tracks
    - adding and removing clip 132
  - Transfer 48
  - Translucence attribute 194
  - Translucence Coeff attribute 196
  - transparency
    - painting 237
  - Trax 105
  - Trax Editor 110, 111
    - dependency graph nodes 132
    - enhancing display 111
    - MEL commands 131
  - Trax Gems 107
  - Trim Convert
    - Rebuild Surfaces option 40
  - Turbulence field
    - Improvements 205
- U**
- UI Preferences 18
  - unfiltered images
    - displaying 84
  - universal rendering 209
  - Untemplate 11, 32
  - Unused Clips & Poses
    - Visor 113
  - Use Animation Curve Range
    - Create Clip 115
  - Use Current Layer 8
  - Use Fur Shading/Shadowing on Fur 269
  - Use Rotate 272
  - Use Scale 272
  - Use Selected
    - Create Clip 115
  - Use Snap Tolerance 20
  - Use Time Slider Range
    - Create Clip 115
  - useComponentsMatrix attribute 145

## INDEX

- user interface
  - changes 5
- UV set
  - applying layered textures to 70
  - copying values to 70
  - creating 69, 71
  - deleting 70
  - empty 69
  - renaming 69
  - selecting 69
- UV texture mode 235
- UVs
  - automatic mapping 49, 52
  - changes 48
  - connecting to textures 77
  - laying out 54, 55, 56
  - mapping border 63
  - moving and sewing 58
  - on complex models 60
  - relaxing 66
  - untangling 66

## V

- vertex
  - splitting 81
- Vertical slider option 140
- vertices
  - smoothing 60
- View Axis 10
- View Selected 16
- Visor 219
  - clips and poses 112
- Volume Axis Field 157
- volume emitters 148
  - creating 149
  - setting attributes 150, 158, 162

- volume fields 161
  - keeping particles inside the volume 164
- Volume Offset attribute 150
- Volume Offset X, Y, Z attribute 160
- Volume Shape attribute 150
- Volume Sweep attribute 150, 160

## W

- Weight
  - clip attribute 116
- What's New in Maya 3 280
- Window menu 13
  - changes 12
- World Up Object option 109
- World Up Type option 109
- World Up Vector option 109
- worldBirthPosition attribute 205

## Z

- Zeroth Scanline attribute 253