What's New in Maya

Version 5

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What's New

Introduction

This book describes the new features we've added in Maya 5.

For the first time, we include information about Maya 5 on all four platforms in this book (Windows, Linux, IRIX, and Mac OS X). All features are common to all four platforms unless otherwise indicated. Some features, Fluid Effects, Cloth, Fur, and Live, are only found in Maya Unlimited (available on Windows, Linux, and IRIX platforms).

For your convenience, we've included complete procedures for using the new features in this book.

2 General

We've added some new features to Maya to enhance your Maya experience.

Online help changes

We are making changes to the Maya online help to increase ease of use and power. Behind the scenes, the help pages are being served to your browser by a small Java-based web server.

Improved search

Previous versions of Maya used various workarounds (Java applets, ActiveX controls) to allow something that is normally very difficult to achieve: local search from HTML pages. While these workarounds allowed a certain level of functionality, each had limitations.

In Maya 4.5 we introduced server-side search scripts, which gave faster and more reliable search functionality when you view the online help from a Web server.

By shipping a small, dedicated Web server with Maya, we can now make the server-side search the norm, allowing everyone to take advantage of faster and more reliable search.

The search available in the help server is significantly improved over previous search engines included with Maya:

- Many times faster than previous versions.
- Phrase searching (enclose words in quotation marks to search for the entire phrase).
- Boolean searches and wildcards.
- Additional search syntax for power users.
- Improved result ranking.

Identical help experience on all platforms

The help server allows us to deliver the same online help experience to all platforms, using standard Web-based technologies.

New capabilities for the next generation of online help

The help server is a base that allows us to explore new possibilities for help and user assistance tools in future releases of Maya.

Move along rotation axes

The Move tool now has a **Move: Along Rotation Axis** option to orient the move manipulator to the local rotation axes of the object.

New attribute to reverse rotation

When parent nodes have negative scaling factors they can make dragging the manipulator rotate the object in the opposite direction.

To correct for this effect, create a dynamic boolean attribute called flipRotateManip on the transform node and turn it on.

Dynamics performance improvements on Windows

We have switched to the Intel C++ compiler for compiling Dynamics. As a result, the performance of Dynamics in Maya for Windows has improved by 20-90%.

3 Modeling

This version of Maya includes significant improvements to polygon reduction, as well as new extrude and chamfer actions and a toolbar in the UV texture editor.

Extrude edges or faces along a path curve

1. Select the edges/faces you want to extrude and the curve you want to extrude along.
2. Select **Edit Polygons > Extrude Face** > ❒ or **Edit Polygons > Extrude Edge** > ❒.
3. Turn on the **Use selected curve for extrusion** option.
4. Click Extrude.
5. Use the controls in the attribute editor or channel box to edit the extrusion.

Options/Attributes

Twist

Rotates the extruded polygons as they travel along the curve.

Taper/Taper Curve

Scales the extruded polygons as they travel along the curve.

To control the taper exactly, open the Taper Curve section and use the graph control to set scaling along the length of the curve.

Poly Extrude Face History

Divisions

The number of subdivisions along the length of the extrusion.

Keep Faces Together

When this option is on, Maya extrudes each face separately. When this option is off, Maya extrudes the faces as a whole.

Extrude a vertex

Extrudes the selected vertex along its vertex normal, creating additional faces for each face that shares the vertex.

1. Select the vertex you want to extrude.
2. Select **Edit Polygons > Extrude Vertex** > ❒.

3 Set the length to extrude the vertex and click Extrude.

Options/Attributes

Length

The distance to move the extruded vertex along its normal.

Divisions

Controls number of sections along the extrusion.

Chamfer a vertex

Removes a vertex and creates a chamfered corner.

1 Select the vertex you want to chamfer.

2 Select **Edit Polygons > Chamfer Vertex**.

Notes

Due to the way Chamfer Vertex works internally, the node it creates has Length and Divisions attributes. These attributes are not meaningful to edit and are left locked.

Options/Attributes

Delete Faces

When this option is on, Maya does not fill the chamfered area with new faces.

Reduce the number of faces in a mesh

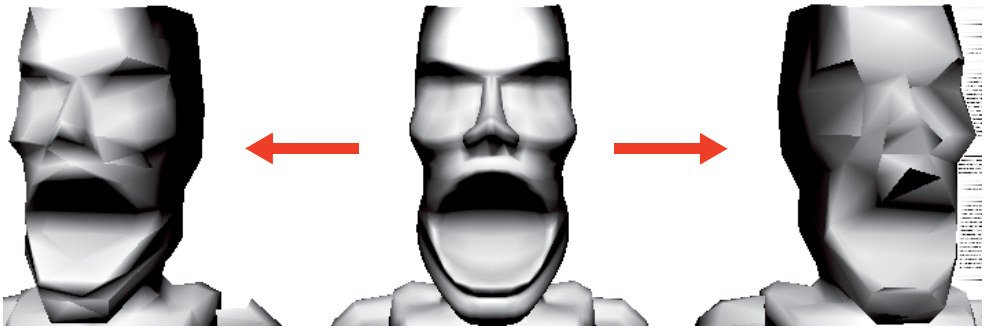
Polygons > Reduce is substantially improved over previous versions.

- Speed and quality are improved.
- The reduction can now respect UV borders and vertex colors as it reduces. This results in much better feature and texture placement retention.

  In the following illustration, the center model has been reduced by 90% to produce the models on the left and right.

  The model on the left was reduced with Influence Reduce: Color Per Vertex on. The reduction uses the color changes on the vertices to choose which areas to reduce, giving much better feature retention than the reduction on the right.

Two reductions of the center model, both at 90%.



Vertex colors influence reduce Original No influence.

- You can now use Maya paint technology to paint reduction amounts on the original model and watch the reduced model update automatically.

To...	Do this
Reduce the number of faces in the selection.	Select **Polygons > Reduce** > ❐, set the reduce options, then click Reduce.
Reduce the number of faces in a subset of a mesh.	Select the faces you want to reduce, then select **Polygons > Reduce** > ❐.
Keep the current polygon mesh so you can compare the original and reduced versions as you change options.	In the Polygon Reduce Options window, turn on the **Keep Original** option. The reduced mesh appears next to the original along the X axis.

To get finer control over what areas are reduced

1. Select the faces you want to reduce.
2. Select **Polygons > Reduce** > ❐.
3. Set the general reduction percentage and turn on **Keep Original**, then click Reduce.

   The reduced mesh appears next to the original along the X axis.
4. Select **Edit Polygons > Paint Reduce Weights Tool**.
5. Paint reduction values on the original.

Darker areas will be reduced more. Lighter areas will be kept as-is as much as possible.

As you paint on the original, the reduced version will update.

Notes

- You cannot paint reduce weights on the reduced version. You must use the **Keep Original** option and paint on the original object.

  If you try to paint reduce weights on the reduced version, Maya will automatically select the original instead.
- When you select faces to reduce (rather than reducing the entire polyset), faces bordering the selection may move or be reduced as well.

  You can avoid this effect by extracting the polygons from the mesh before reducing them. Turn on the Preserve: **Mesh Borders** option so the extracted mesh can be reattached later.
- When you are painting reduce weights, the Paint Attributes tool's default is to only update when you finish a stroke. This is because the reduce operation can take a noticeable amount of time on large polysets.

  If you want the reduced version to update as you paint, select **Modify > Attribute Paint** > ❐, open the Stroke section, and turn on **Update Continuously**.
- Reduce Weights are a bias, not an absolute control. In some extreme cases polygons that you painted white but are not needed will still be reduced to preserve shape elsewhere.
- Reduce can work with quads and n-sided polygons, however:
  - Unless you really need to preserve non-triangles, leave the Triangulate option on for better reduction.
  - Non-planar polygons can become deformed and do not reduce well.

Options/Attributes

Reduce by (%)

Maya tries to reduce the number of polygons in the selected mesh or meshes by the specified percentage. The actual reduction may not match this number exactly.

Triangle Compactness

Controls the degree to which Maya sacrifices mesh shape accuracy to produce better triangles, as a number from 0 to 1.

0 means try to reproduce the original mesh shape as accurately as possible while reducing, no matter what kind of triangles are produced. 1 means sacrifice accuracy as much as possible to produce regular equilateral triangles.

Numbers closer to 0 can produce long skinny triangles that can be hard to work with. Numbers closer to 1 can produce reduced meshes that do not match the shape of the original.

Triangulate

Converts the polygons to triangles before reducing them.

Unless you really need to preserve non-triangles, leave this option on for better results.

Influence Reduce

These options take extra information (in addition to shape) into account when reducing the mesh.

UVs

Reduces polygons to preserve UV mapping as much as possible. Turning this option on will preserve texture placement between the original and reduced polygons.

Color per Vertex

Reduces polygons so that color per vertex data (such as prelighting and painting) is preserved as much as possible. Turning this option on will devote more polygons in the reduced mesh to areas with color changes, and fewer polygons to areas with flat color to preserve the look of the original.

Preserve

Mesh Borders

Maya attempts to preserve the shape of polygon borders (edges that are not shared by other polygons).

UV Borders

Maya attempts to preserve the shape of UV borders as it reduces.

Hard Edges

Maya attempts to preserve the shape of edges marked “hard” as it reduces.

You can set edges on a mesh to be hard or soft using **Edit Polygons > Normals > Soften/Harden** > ❐.

Marking edges as “hard” can result in more shape retention than painting reduction weights.

Compatibility with previous versions

Maya now uses an improved reduce method which gives better results and allows you to preserve important details in your model.

Scene files created with previous versions of Maya may contain reduce nodes created by the old reduce method. The nodes in these scenes continue to use the old method. New reductions use the new method.

Show only a subset of all UVs

Maya lets you switch the texture editor between showing all UVs in the current set and only showing a selected subset in isolation. This can make it easier to work on part of the model without disturbing or accidentally selecting other UVs.

To show a subset of UVs

1. If you already have a subset isolated, click the Remove all button on the toolbar, or select **View > Isolate Select > Remove All**.
2. Select the UVs you want to isolate.
3. Click the Toggle isolate select button on the toolbar, or select **View > Isolate Select > View Set**.

   To switch back to showing all UVs, click Toggle isolation again, or turn off the **View > Isolate Select > View Set** menu item.

To add to the isolated subset

1. Click the Toggle isolate select button on the toolbar, or select **View > Isolate Select > View Set** to switch back to showing all UVs.
2. Select the UVs you want to add to the isolated subset.
3. Click the Add selected button on the toolbar, or select **View > Isolate Select > Add Selected**.

To remove UVs from the isolated subset

1. Select the UVs you want to remove from the isolated subset.
2. Click the Remove from isolation button on the toolbar, or select **View > Isolate Select > Remove Selected**.

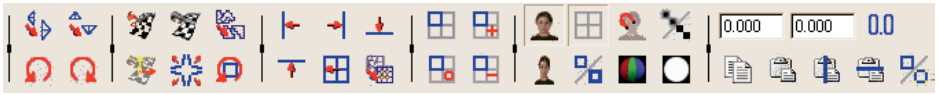
Copy UVs to another UV set

1. In the texture editor, select the UVs you want to copy.

2 In the texture editor panel, open the panel's Polygons menu, open the Copy UVs to UV Set sub-menu and choose a UV set.

UV texture editor toolbar

Most of the items on the texture editor toolbar are shortcuts for actions in the menus. Right-click a button to show its options.



UV position buttons

	Flip UVs U, Flip UVs V Flips the positions of the selected UVs. Shortcuts for **Edit Polygons >Texture > Flip UVs**.
	Rotate UVs clockwise, Rotate UVs counterclockwise Rotates the positions of the selected UVs. Shortcuts for **Edit Polygons >Texture > Rotate UVs**.
	Cut UVs along selection Separates UVs along the selected edges, creating borders. Shortcut for **Edit Polygons >Texture > Cut UVs**.
	Sew UVs Attaches UVs along the selected borders, but does not move them together in the texture editor view. Shortcut for **Edit Polygons >Texture > Sew UVs**.
	Move and Sew UVs Attaches UVs along the selected borders, and moves them together in the texture editor view. Shortcut for **Edit Polygons >Texture > Move and Sew UVs**.
	Split selected UV Separates UVs from each other along the edges connected to the selected UV points, creating borders. Shortcut for the texture editor's Polygons > Split UVs.

	Layout UVs Tries to move the UVs into a cleaner layout, based on the settings in the Layout UVs option box. Shortcut for **Edit Polygons > Texture > Layout UVs**.
	Cycle U and V Rotates the U and V values of the selected polygon.
	Align Min U, Align Max U, Align Min V, Align Max V Aligns the positions of the selected UVs. Shortcuts for the texture editor's Polygons > Align UVs.
	Move UVs to grid Moves every selected UV to its nearest grid intersection in texture space. Shortcut for **Edit Polygons > Texture > Grid UVs**. To change the grid, right-click the Toggle Grid button on the toolbar.
	Relax UVs Spreads out all UVs to make them easier to work with. Shortcut for **Edit Polygons > Texture > Relax UVs**.

Isolate Selection buttons

These buttons let you work on a subset of UV faces while hiding the rest.

❖ "Show only a subset of all UVs" on page 22

	Toggle isolation Switches between showing all UVs and only the isolated UVs. Shortcut for **View > Isolate Select > View Set**.
	Add selected to isolation Adds the selected UVs to the isolated subset. When you click the Toggle isolation button the selected UVs will be visible. Shortcut for **View > Isolate Select > Add Selected**.
	Removed selected from isolation Removes the selected UVs from the isolated subset. Shortcut for **View > Isolate Select > Remove Selected**.

Remove all

Clears the isolated subset. You can then select a new set of UVs and click Toggle isolation to isolate them. Shortcut for **View > Isolate Select > Remove All**.

View buttons

Toggle grid

Shows or hides the grid. Shortcut for **View > Grid**.

Toggle image

Shows or hides the texture image. Shortcut for **Image > Display Image**.

Toggle filtered pixels

Switches the background image between hardware texture filtering and sharply defined pixels. Shortcut for **Images > Unfiltered Image**.

Toggle image ratio

Switches between showing square texture space and texture space with the same ratio of width to height as the image. Shortcut for **Image > Use Image Ratio**.

Toggle snap to pixel

Chooses whether to automatically snap UVs to pixel boundaries. Shortcut for **Image > Pixel Snap**.

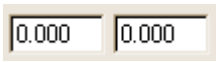
Toggle thick texture borders

Chooses whether Maya draws UV borders with a thick line.

Show image RGB/Show image Alpha

These two buttons switch between showing the RGB (color) channels of the image and the Alpha (transparency) channel. Shortcuts for **Image > Display RGB Channels** and **Image > Display Alpha Channels**.

UV edit buttons

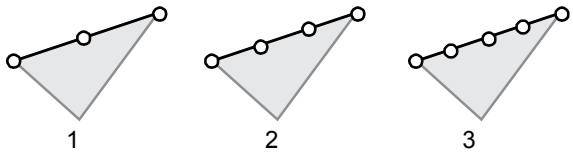
	U coordinate, V coordinate Show the coordinates of the selected UVs. Edit the text boxes and press Enter to move the points.
	The UV coordinates in the text boxes on the toolbar do not update automatically as you move the selected UV point. Click the refresh button to update the values in the text boxes.
	Copy/paste faces or UVs Switches the Copy and Paste buttons on the toolbar between working on UVs and UV faces.
	Copy Copies the selected UV points or faces (depending on the Copy/paste faces or UVs button) to the clipboard.
	Paste Pastes UV points or faces (depending on the Copy/paste faces or UVs button) from the clipboard.
	Paste U to selected UVs, Paste V to selected UVs Paste only the U or V values on the clipboard onto the selected UV points.

Exponential smoothing smoothes UVs

The Polygons > Smooth action with exponential smoothing now smoothes UVs as well, retaining texture placement after smoothing.

Improvements to Split Polygon tool options

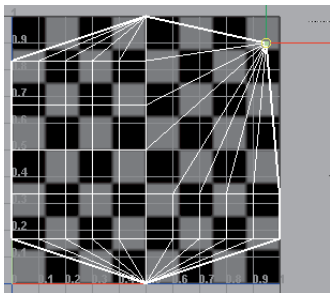
- Snap to Edge now constrains point placement to edges.
- Snap to Magnets snaps point placement to regular distances along an edge.
- Number of Magnets controls the number of magnet points inside edges.



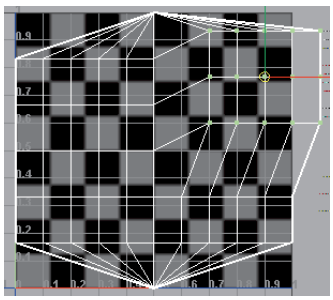
- Magnet Tolerance controls how close the point must be to a magnet before the point snaps to it. Set this to 100 to constrain points to always be at magnet points.

New option for Move tool in texture editor

In previous versions, snapping UVs with the Move tool would snap all the selected vertices to the same point.



You can now turn on the Retain Component Spacing option in the Move tool's options panel to snap the manipulator while maintaining UV layout.



Additional changes and improvements

The Maya texture editor view now always updates interactively. The MAYA_TEXTURE_VIEW_INTERACTIVE_REFRESH environment variable no longer has any effect.

Proportional Modification Tool works in parametric space

You can now use **Modify > Transformation Tools > Proportional Modification Tool** with falloff (the amount of influence the control point has on its surrounding points) set in parametric space (that is, measured across the surface, rather than in absolute world space).

This means that the influence on surrounding points is based on how close they are across the surface, rather than in absolute world space. In many cases this can lead to more intuitive results.

This feature only works on NURBS.

To use proportional modification with parametric falloff

1. Select a CV on a NURBS surface.
2. Select **Modify > Transformation Tools > Proportional Modification Tool** > ❐.
3. Set the **Modification Falloff** option to one of the parametric choices.

   When you transform the selected CV, other CVs move proportional to their distance from the selected CV across the surface.

Limitations

- Multiple CVs cannot be selected at this time.
- Performance may be slow for large falloff values on complex surfaces.

4 Animation

For Maya 5, we have added the following functionality to animation:

- The ability to mute animation channels
- New types of ghosting and enhanced ghosting display
- Improved clip snapping
- New colors for channel status in the Channel Box and Attribute Editor.

Muting Animation

You can now mute animation channels. Muting temporarily disables the animation on the selected channel without disconnecting its curve from the animated object.

Note Muted channels appear brown in the Channel Box.

Example

Muting lets you isolate and focus on a specific motion. When working with a model whose arms and legs are animated, you can use muting to turn off the animation of either the arms or legs.

Mute in the Channel Box

In the Channel Box, you can right-click selected channels and select the following options from the menu that appears.

Mute Selected

Mute the selected animation channels.

Unmute Selected

Removes muting from the selected animation channels.

Mute All

Mutes all channels for the current object(s).

Unmute All

Removes muting from all the channels of the current object(s).

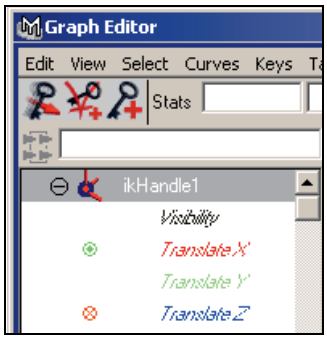
Mute node in the Channel Box

When you mute the animation channels of an object, a mute node is automatically created in the dependency graph for each muted channel.

The mute node in the Channel Box has the following format: mute_object*n*_channel. Example mute node names include: mute_pCube1_translateX, mute_joint1_rotateZ and so on.

When the mute is set to on, all animation nodes that connect to the mute node are muted. When the mute is set to off, all animation nodes that connect to the mute node are not muted. Setting the mute node to off in the Channel Box does not remove it from the dependency graph.

Graph Editor and Dope Sheet



A red icon appears beside a channel's name when it is muted.

A green icon appears beside a channel's name when it is not muted, but still connects to a mute node. When the mute node is set to off in the Channel Box, the green icon still appears beside the channel's name in the Graph Editor. See "Change the status of a mute node from the Channel Box" on page 30.

Change the status of a mute node from the Channel Box

To turn the mute node on or off

1. Select the mute node in Hypergraph.
2. In the Channel Box, click in the Mute field and enter the following:
   - Type on or 1 and press Enter to turn the mute node on.
   - Type off or 0 and press Enter to turn the mute node off.

Note: You can mute a time range by animating the status (on/off) of the mute node.

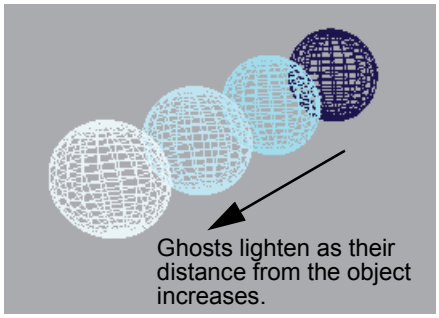
Ghosting Improvements

You can control ghosting locally on each object in your scene with the new Ghost Selected and Unghost Selected Options windows or with the Ghosting Information Attributes. In addition to ghosting individual objects, you can now ghost entire skeletons or object hierarchies.

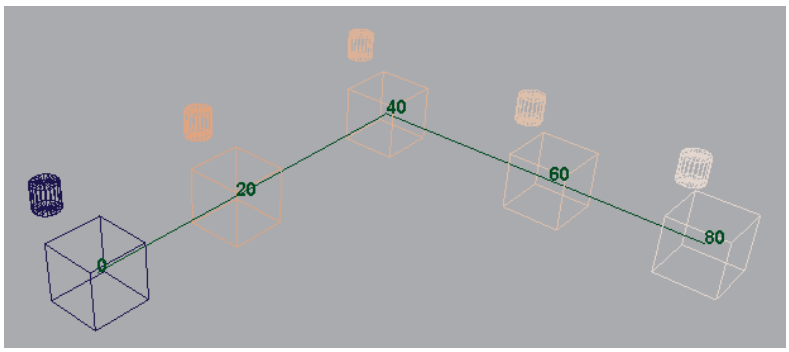
The appearance of ghosts in the scene view has also been improved for Maya 5. The color of ghosts before and after the current frame/keyframe lightens according to their distance from the current frame/keyframe. This is visible only when scene view Shading is set to Wireframe. See the following examples.

Examples

In the following example, the sphere's Type of Ghosting is Custom Frame Steps, and the sphere's ghost options are set to the following: Steps before Current Frame is set to 3, Steps after Current Frame is 0, and the Step Size is 3.



In the following example, the cube's Type of Ghosting is Custom Frames, and the cube's ghost options are set to the following: frame numbers 20, 40, 60, and 80 are present in the Frames to Display field and Hierarchy is on. The cylinder is the child of the cube. The cube also has a Motion Trail with frame numbers.



Set Local Ghosting

To set ghosting options for an object or skeleton

1. Select the object or the root of the hierarchy that you want to ghost.
2. Select Animate > Ghost Selected > ❐.

   The Ghost Options window appears.
3. Set the ghosting options. See "Animate > Ghost Selected" on page 32.
4. Do one of the following:
   - Click Ghost to apply the Ghost Options settings to the current object. The Ghost Options window closes.
   - Click Apply to apply the Ghost Options settings to the current object, overriding any other ghosting settings on the object. The Ghost Options window remains open.
   - Click Close to disregard any changes made to the ghosting options and close the Ghost Options window.

Animate > Ghost Selected

Animate > Ghost Selected > ❐

Note You can also set local ghosting options with the Ghosting Information attributes. To access these attributes, select Attribute Editor > *object*Shape > Object Display.

Type of Ghosting

Global Preferences	Uses the ghosting settings from Windows > Settings/Preferences > Preferences > Animation.
Custom Frames	Generates ghosts at the frames specified in the Frames To Display field. See "Frames to Display" on page 33.
Custom Frame Steps	Controls the number and spacing of ghosts for frames.
Custom Key Steps	Controls the number and spacing of ghosts for keyframes.

Keyframes — Generates ghosts at the range of keyframes defined by the Frame Range options. See "Frame Range" on page 34.

Frames to Display

Lets you define a list of frames at which ghosts are generated for the current object. When entering frame numbers, use the following syntax:

`#, #, #, #`

For example: 1, 5, 10, 15. This field is available only when the ghosting type is Custom Frames.

Steps Before Current Frame

Only available when the ghosting type is Custom Frame Steps or Custom Key Steps.

When the ghosting type is set to Custom Frame Steps, this field sets the number of ghosts that appear before the current frame. Spacing of these ghosts is defined by the Step Size field.

When the ghosting type is set to Custom Key Steps, this field sets the number of ghosts that appear before the current frame. Spacing of these ghosts is defined by the number of keyframes on an object and the Step Size.

Steps After Current Frame

Only available when the ghosting type is Custom Frame Steps or Custom Key Steps.

For Custom Frame Steps, this field sets the number of ghosts that appear after the current frame. Spacing of these ghosts is defined by the Step Size field.

For Custom Key Steps, this field sets the number of ghosts that appear after the current frame. Spacing of these ghosts is defined by the number of keyframes on an object and the Step Size.

Step Size

Only available when the ghosting type is Custom Frame Steps or Custom Key Steps.

For Custom Frame Steps, Step Size determines the number of frames between each ghost. For example, if the Step Size is 10, every tenth frame is ghosted.

For Custom Key Steps, Step Size and the number of keyframes control the spacing of ghosts. For example, if the Step Size is 2, then every other key is ghosted.

Frame Range

These options are available only when the ghosting type is Keyframes.

Timeslider	Generates a ghost of the current object at every keyframe on the timeline.
Start/End	Generates a ghost of the current object at the keyframes between the specified Start Frame and End Frame.

Start Frame

The frame at which the ghosting of keyframes begins. This field is available only when Start/End under Frame Range is selected.

End Frame

The frame at which the ghosting of keyframes ends. This field is available only when Start/End under Frame Range is selected.

Hierarchy

The specified ghost options are applied to the entire hierarchy below the selected joint or object. If Hierarchy is not selected, only the selected object is affected by the Ghost Options.

Note
- Hierarchy can seriously affect performance. We recommend that you use Hierarchy sparingly.
- For Custom Key Steps and Keyframes, ghosts only appear for objects in the hierarchy that possess keyframes, unless Ghost Driver is on.

Use Ghost Driver

Note Ghost Driver is relevant for only keyframe-based ghosting.

When on, the specified keys from the first selected object drive the ghosting for the rest of the selected objects. When off, all the selected objects use their own keys for ghosting. Use Ghost Driver is useful for comparing timing.

Animate > Unghost Selected

Animate > Unghost Selected > ❐

The Unghost Selected menu item turns ghosting off for selected objects.

Hierarchy

When on, the selected object and its child bones or objects are unghosted. When off, only the selected object is unghosted.

Animate > Unghost All

Turns off ghosting for all objects in the scene.

Changes to Ghosting in the Display menu

Ghosting and No Ghosting have been removed from Display > Object Display.

Clip Snapping Improvement

In previous versions of Maya, clips in the Trax Editor could only snap to the nearest frame. Now when you move or scale a clip on a track where multiple clips are present, the edges of the clip will snap to the edges of its neighboring clips. This is useful when working with clips that begin or end with a value that is not a whole number or if you are viewing many frames and require accuracy.

Changes to Channel colors

The colors that represent the state of channels in the Channel Box and Attribute Editor have changed for Maya 5. The following table illustrates these changes.

State	Color
Locked	• Gray (Windows, IRIX, and Linux) • Pink (Mac OS X)
Muted	Brown
Blended	Green
Keyed	Light Orange
Expression	Purple
Constrained	Blue
Connected	Yellow

4 | Animation

> Changes to Channel colors

5 Character Setup

For Maya 5, we have added the following functionality to character setup:

- The Parent constraint and many other constraint features
- The ability to blend IK and FK animation on the same skeleton
- The ability to apply keyframe animation and constraints to the same object
- The ability to use a NURBS object as the sculpt deformer's sculpting tool.

Parent Constraints

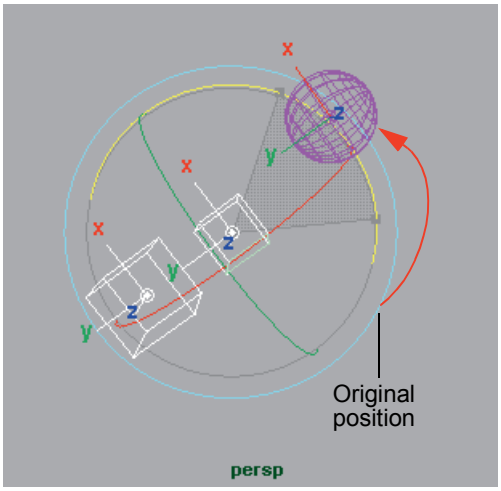
With a parent constraint, you can relate the position—translation and rotation—of one object to another, so that they behave as if part of a parent-child relationship that has multiple target parents. An object's movement can also be constrained by the average position of multiple objects.

Understanding Parent Constraints

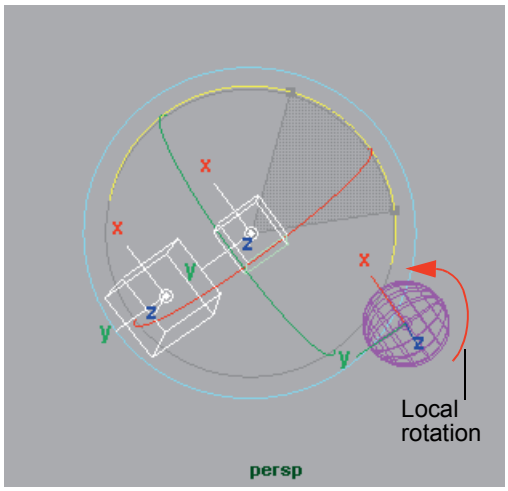
A parent constraint lets you constrain the X, Y, and Z translation and rotation of one object to another—mimicking a parent-child relationship. When a parent constraint is applied to an object, the *constrained* object does not become part of the *constraining* object's hierarchy or group, but remains independent and behaves as if it is the child of its targets. The constraining object is also known as the *target* object.

For more information, search the online help for Target objects.

An object with a parent constraint does not behave the same as an object with a point and orient constraint. When a Parent constraint is used, rotating the target objects affects the constrained object's rotation along the *world* axis. When a Point and Orient constraint are used, rotating the target objects affects the constrained object's rotation along its *local* axis. This is shown in the following figure.



Parent Constraint



Point and Orient Constraint

Workflow for Parent Constraints

Scenario

A character walks, looks around, stops, and then removes his hat from his head and places it on a table nearby.

1. Select the character's head, and then the hat.
2. Parent constrain the hat to the head, making sure that Maintain Offset is on and the weight is set to 1 in the constraint options.

   For the procedure on creating parent constraints see "To create a parent constraint" on page 40.

   Maintain Offset preserves the original, relative translation and rotation of the constrained object.

   The Weight attribute sets the amount of influence that the target's position and orientation has on the constrained object. For information on parent constraint weighting see "Weight" on page 42.

   A parent constraint is created. Now when the character moves, the hat respects the position and orientation of the character's head in the scene.
3. Select the hat, and then select the head's weight in the Channel Box.

Note	When the hat is selected, the parent constraint and all its target weights appear in the Channel Box.

4. Right-click the head's weight and select Key Selected from the menu that appears.

   This anchors the parent constraint's weighting, and the state of the hat, at the current time in the character's animation.

5. Animate the character so that it appears to walk, look around, and then stop.

   The parent constraint forces the hat to follow the head's movements as it nods up and down and rotates from side to side.

6. Animate the character's arm and hand so that it reaches up and takes hold of the hat's brim.

7. Select the hand, and then the hat.

8. Parent constrain the hat to the hand, making sure that Maintain Offset is on and the weight is set to 0 in the constraint options.

9. Key the weight of the head and the hand. See steps 3 and 4.

10. Advance one frame along the timeline.

11. Set the weight of the head to 0 and the weight of the hand to 1.

    The hand now fully controls the translation and rotation of the hat.

12. Key the head and hand weights. See steps 3 and 4.

    This anchors the weighting of the head and hand at the current time in the character's animation.

13. Transform the arm and hand to the position where it appears to be placing the hat on the table.

14. Set the hat's current position as its rest position.

    Setting the hat's rest position prevents it from popping back to its original position when the hand's weight is set back to 0. For more information on the rest position, see "Constrain > Set Rest Position" on page 45.

15. Set the weight of the hand to 0 and key the weight.

16. Animate the hands so that they return to their original positions hanging at the characters sides.

    Since the hands no longer have any influence over the hat's position or rotation, the hat remains on the table as the hands move back to the character's sides.

Note If you want to ensure that their is no interpolation between weights (weights switch between 1 and 0 with no blend), set the tangent types of the weights to Stepped.

Creating Parent Constraints

Before creating your first parent constraint in a Maya session, we recommend that you set the Parent constraint options. See the "Constrain > Parent" on page 42.

After you've created a parent constraint, you can add more target objects for additional control over the constrained object's position and rotation. Adding more target objects changes the target point, which in turn changes the constrained object's position.

For more information, search the online help for Target Point.

To create a parent constraint

1. Select one or more target objects, followed by the object you want to constrain.
2. Select Constrain > Parent > ❐.

   The Parent Constraint Options window appears.
3. Set the constraint options or select Edit > Reset Settings.

   For information on these options, see "Constrain > Parent" on page 42.
4. To finish setting the constraint, do one of the following:
   - Click Add to create a parent constraint. The Parent Constraint Options window closes. Select Edit > Save Settings to save the constraint options.
   - Click Apply to create a parent constraint. The Parent Constraint Options window remains open. By clicking apply, you can also apply the current constraint options settings to other objects. Select Edit > Save Settings to save the constraint options.
   - Click Close to close the Parent Constraint Options window without setting or creating the constraint.

   A parent constraint is created with the current constraint options.

   The constrained object's position attributes (Translate X, Y, and Z) and rotation attributes (Rotate X, Y, and Z) are now influenced by the target point.

For more information, search the online help for Target Point.

To add a target object

1. Select one or more objects to add as target objects, followed by the constrained object.
2. Select Constrain > Parent.

The constrained object's position and rotation change, indicating that it is now constrained by the objects you have added as target objects.

Note If you turn on Maintain Offset in the Parent Constraint Options, the constrained object's position and rotation will not change when you add a target to the constraint.

Editing a Parent Constraint

You can edit a parent constraint's attributes in the Channel Box and Attribute Editor. When you select a constrained object, its constrained axes appear blue in the Channel Box and Attribute Editor. This means that any changes you make to the Parent constraint affects only those axes.

Offset Parent Constraints

There are no offset values or fields present in the settings for Parent constraints. Unlike other constraints, you cannot offset Parent constrained objects from the Channel Box or options window. However, you can use the Maintain Offset option to set the offset of your constrained object or you can set a single key on the object to change its offset position.

To offset a Parent Constrained object using Maintain Offset

1. Select the constrained object.
2. Translate and rotate the object to where you want it positioned in your scene.
3. Select the target objects, followed by the constrained object.

For more information, search the online help for Targets.

4. Select Constrain > Parent Constraint > ❐.

   The Parent Constraint Options window appears. See "Constrain > Parent" on page 42.
5. Set the Parent constraint options to reflect the values of the constrained object's channels and settings in the Channel Box.
6. Verify that Maintain Offset is on.
7. Click Add or Apply.

   The constrained object is now offset from its targets by its current rotation and translation.

Constrain > Parent

Constrain > Parent > ❐

Maintain Offset

Preserves the original (state prior to constraining), relative translation and rotation of the constrained object. Use this option to maintain spatial and rotational relationships between constrained objects. See "Offset Parent Constraints" on page 41.

Constraint Axes

Determines whether the parent constraint is restricted to a specific axis (X, Y, Z) or to All axes. When All is checked, the X, Y, and Z boxes are dimmed.

Weight

This is useful only when there are multiple target objects.

Sets the amount of influence that a target object's position and rotation has on the constrained object. If the weight is 0.0000, the target object has no influence over the translation and rotation of the constrained object. If the weight is 1.0000, the target has full control over the constrained object's translation and rotation. Default weight is 1.0000.

Parent Constraint attributes

In the Attribute Editor, you can view or edit the characteristics of the parent constraint node. To edit this node, you must first select its name in the Outliner or its tab in the Attribute Editor. If you selected it in the Outliner, go to Windows > Attribute Editor or use the shortcut Ctrl+a to view its attributes.

For more information, search the online help for Constraint node attributes.

The following section describes the attributes specific to the Parent constraint node (parentConstraint*).*

Interp Type

Sets the rotation interpolation type for the constraint. Interp Type is relevant only when the constrained object has multiple targets.

Average	Averages rotation between the constrained object and its targets.

Shortest	Finds the shortest path between rotations from the constrained object to its targets using quaternion interpolation.
Longest	Finds the longest path between rotations from the constrained object to its targets using quaternion interpolation. This path is in the opposite direction from Shortest.
No Flip and Cache	No Flip caches the current rotation onto the constrained object. Once you select No Flip, you must click the Cache button to create the cache. Cache appears in the Interp Type menu field when there is cached interpolation on the constrained object.
Cache button	Caches the current rotation interpolation onto the constrained object and creates an animation curve for the current rotation interpolation on the constraint's node. Caching reduces the chance of flipping. Only available when you select No Flip.
Delete button	Deletes the current rotation interpolation cache from the constrained object. Only available when Cache appears in the Interp Type menu field.

Constraint Translate

Displays the constrained object's current position. This value can be useful when specifying the Offset Translate value. This field is read-only.

Constraint Rotate

Displays the constrained object's current rotation. This value can be useful when specifying the Offset Rotate value. This field is read-only.

Maintain Offset

With Maintain Offset, you can now preserve the original, relative translation, rotation, and scaling of a constrained object. Maintain Offset is present in all constraint option menus.

Constraint Axes

You can now select which individual axes (X, Y, Z, or All) of the constrained object are affected by the constraint. The Constraint Axes checkboxes are located in the constraint options windows.

Constrain > Modify Constrained Axis

Modify Constrained Axis lets you change which axes of a constrained object are influenced by the target object. Use this feature when you want to modify the axes of a constraint. Modify Constrained Axis can only be used in conjunction with the following constraint types: point, orient, scale, aim and parent.

To modify the axes of a constraint

1. Select the constrained object and its targets.
2. Select Constrain > Modify Constrained Axis.

   The Modify Constrained Axis options window appears.
3. Check the Constrain axes (X, Y, Z). You can also turn on Maintain Offset to preserve the relative position, rotation, or scaling of the constrained object.
4. To finish setting the node's new axes, do one of the following:
   - Click Modify to change which of the constrained object's axes are influenced by the target object. The Modify Constrained Axis options window closes.
   - Click Apply to change which of the constrained object's axes are influenced by the target object. The Modify Constrained Axis options window remains open.
   - Click Close to cancel the modify constrained axis operation. The Modify Constrained Axis options window closes.

Constrain > Remove Target

Constrain > Remove Target > ❐

With Remove Target, you can sever the connection between a target object and a constrained object without deleting the constraint node. When you remove a target from a constrained object, it no longer affects the constrained object.

To remove a target

1. Select the target object from which you want to remove the constraint connection, followed by the object it is constraining.
2. Select Constrain > Remove Target > ❐.

   The Remove Target Options window appears.
3. Check the constraint types whose connections you want to sever.
   - If you want to sever all constraint connections between the selected target and the constrained object, turn on All.

- If you want to preserve the relative transformation (translation, rotation, scale, and so on) of the constrained object, turn on Maintain Offset.

4 To finish this operation, do one of the following:

- Click Remove to remove the specified connection between the selected target object and the constrained object. The Remove Target options window closes.
- Click Apply to remove the specified connection between the selected target object and the constrained object. The Remove Target options window remains open.
- Click Close to cancel the remove target operation. The Remove Target options window closes.

Constrain > Set Rest Position

With Set Rest Position, you can set where in world space your constrained object is positioned when its target weight is 0. Rest position gives you control of the constrained object, rather than relying on the last position of the target objects. Setting the rest position prevents constrained objects from sticking to undesired positions in the scene when their target weights are set to 0.

For example, a book is point constrained to a character's hand. When the character places the book on the table, the book's position on the table is set as its rest position. This prevents the book from popping back to the model's hands when the weight of the hand changes to 0. The books target (the model's hand) weight is then set to 0. The hand now no longer influences the book's position. The character then proceeds to release the book, turn, and walk away from the table. The book does not snap back to the hand because its rest position was set.

To define a constrained object's default position

1 Select the constrained object for which you want to define the rest position.

2 Set the constrained object's target weights to 0.

3 Move the constrained object to a new position or leave it at its current position.

4 Select Constrain > Set Rest Position.

The current position of the constrained object is now its default location in world space when its target weights are 0.

Rest Position in the Attribute Editor

The rest position settings for each constraint are located in the constrained object's *constraint* attributes.

Enable Rest Position

If on, the rest position is active for the constrained object. If off, the rest position is inactive for the constrained object. Turning Enable Rest Position off does not remove it from the constrained object.

Rest Translate

Sets the X, Y, and Z translation for the constrained object's Translate rest position. These fields are present for only Point and Parent constraints.

Rest Rotate

Sets the X, Y, and Z rotation for the constrained object's Rotate rest position. These fields are present only for Orient, Aim, and Parent constraints.

Rest Scale

Sets the X, Y, and Z scaling for the constrained object's Scale rest position. These fields are present only for Orient and Parent constraints.

Constraint Improvements

You can now transform constrained objects regardless of their targets' weight settings. For example, if a cube is constrained by a sphere, you can manipulate the cube (constrained object) whether the sphere's (the target) weight is 0 or 1. This is useful when applying animation and constraints to the same object. See "Animation-Constraint Blending" on page 52.

Animate > IK/FK Keys > Move IK to FK

Move IK to FK moves an IK handle to the last joint of its IK joint chain.

In a typical FK/IK rig, the IK handle does not move with the skeleton during FK manipulation and thus appears out of sync. This can cause confusion when there are many IK handles. When animating with IK and FK, you can use Move IK to FK to synchronize the IK handle's position with the end effector's position.

If the IK handle is grouped or constrained in a control hierarchy, use Animate > IK/FK Keys > Connect IK to FK in conjunction with Move IK to FK to move the entire hierarchy.

Freezing Joint Orientation

You can now freeze the local joint rotation axes to match world space by turning on the new Orient option in Modify > Freeze Transformation > ❒. If Orient is off, the local joint rotation axes are not affected by Freeze Transformation.

IK/FK Blending

IK/FK blending lets you apply keyframe animation to joints and also control them with IK animation. Due to the addition of IK/FK blending, the IK Solver Enable attribute has now changed from an on/off value to a numeric 0.000–1.000 blend. Also, Ik Blend has replaced Enable Solver in the IK Handles Attributes. See ”Ik Blend” on page 52.

Now when you select a joint chain and its IK handle, the joint chain is drawn using three default or user defined colors. The blue joint chain represents the skeleton with pure FK animation, the brown joint chain represents the skeleton with pure IK animation, and the magenta joint chain represents the resulting animation blend. Also, you can customize the colors of the IK/FK joint chains and the size of the IK/FK joints. See ”Modify the display of IK/FK animated joint chains” on page 50.

Note In addition to blending IK and FK animation over multiple frames, a blend can occur over a single frame. Blending over a single frame switches IK to FK or FK to IK instantly.

Blend IK and FK Animation

Note For skeletons with IK animation created in previous versions of Maya, turn on Ik Fk Control if you want to rotate or key the joints in the skeleton’s joint chains. See ”New IK Solver Attributes” on page 52.

To create an animation blend from FK to IK

1. Select your joint chain and IK handle.
2. In the IK Solver Attributes, drag the *Ik Blend* slider to 0.000.

   The animation mode is now set to pure FK.
3. Set a key (default hotkey: s key).
4. Deselect the IK handle, select a joint in your joint chain, and set a key once more.

You will now be keying the joint (for FK)—not the handle (for IK).

5 Drag the current time indicator along the timeline and translate or rotate the joint.

6 Set a key.

7 Repeat steps 5 and 6 until you complete the FK portion of your animation.

8 Once you set the last FK key, deselect the joint and select the IK handle of your joint chain.

9 Verify that the Ik Blend slider is at 0.000, and set a key.

10 Drag the Ik Blend slider to 1.000 and set a key on the handle.

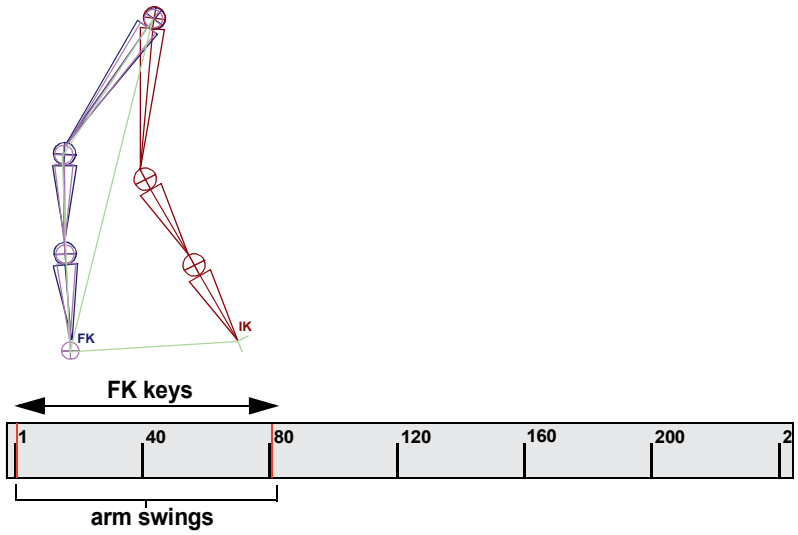
Since there is no period of animation between the last pure FK key and the first pure IK key, the FK animation switches to IK instantly (without a blend).

The animation mode is now set to pure IK.

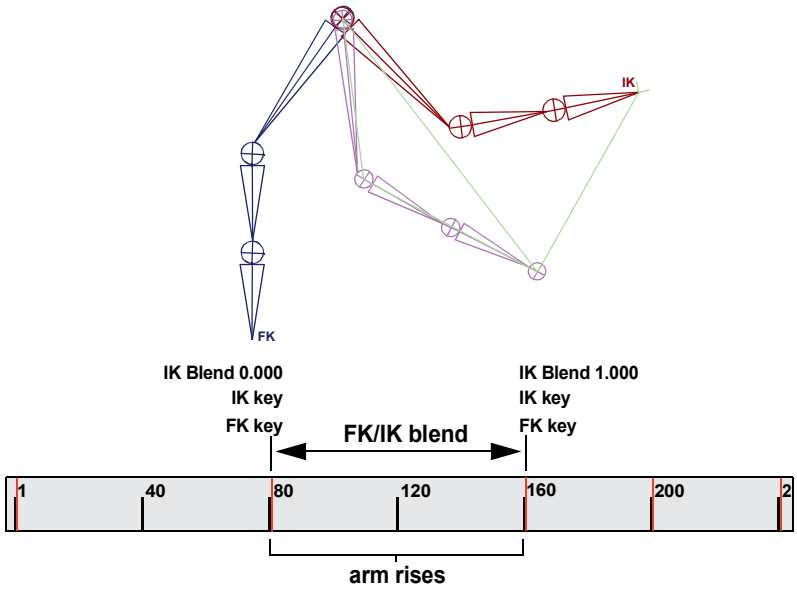
Note When there is a period of animation between a pure FK key and a pure IK key, it is interpolated by the IK Solver. The interpolated animation then appears as Ik Blend values between 0.000 and 1.000.

Example

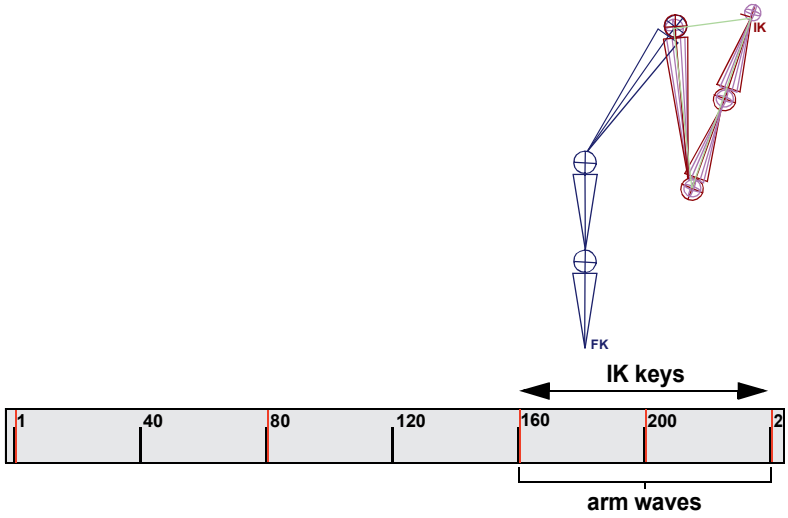
Blending the FK animation of a swinging arm with the IK animation of a waving arm.



A simple animation of a swinging arm during a walk cycle is created by selecting the root of an arm's joint chain (the shoulder joint), rotating it along the Z axis, and then setting keys for the joint. This produces a rudimentary FK animation.



This FK animation sequence is blended with the directed motion of the arm waving by setting keys on the IK handle and the shoulder joint at the end of the FK animation, moving the timeline indicator to create a *blend region*, changing the Ik Blend value to 1.000 (pure IK), and once again setting keys on the shoulder joint and IK handle. In the area between the pure FK and IK animation—the blend region, the IK Solver interpolates the animation from 0.000 to 1.000.



Pure IK animation is reached once the Ik Blend value is 1.000. The IK handle is then translated and rotated while setting keys, to produce the animation of the arm waving.

When the animation of the waving arm is complete, the animation is set back (using another blend region and changing the Ik Blend value to 0.000) to pure FK. The resulting animation resembles a swinging arm (FK) that rises into a wave (IK) and then descends back into a swinging motion (return to FK).

Modify the display of IK/FK animated joint chains

To set the display parameters for bones with FK or IK animation

1. Select Window > Settings/Preferences > Preferences from the Maya main menu bar.

   The Maya Preferences window appears.

2. Click Kinematics under Display to open the Kinematics Display Preferences.

   The Inverse Kinematics preferences appear.

3. Select a display option:
   - Choose None if you do not want to display any of the IK/FK blend skeletons.
   - Choose IK if you want to display only the IK and blend skeleton.
   - Choose FK if you want to display only the FK and blend skeleton.

- Choose Both if you want to display all the IK/FK blend skeletons. Both is the default setting.

4 Do one of the following:

- Click Save to save all changes to the IK/FK Blending Display. The Maya Preferences window remains open.
- Click Cancel to disregard any changes to the IK/FK Blending Display. The Maya Preferences window closes.

To set the color of IK/FK joint chains

1 Select Window > Settings/Preferences > Colors from the Maya main menu bar.

The Colors settings window appears.

2 Click the arrow beside IK/FK Blending to reveal the IK/FK joint color settings.

3 Click-drag the sliders beside FK Joints and IK/FK Blended Joints to set their display colors.

4 Do one of the following:

- Click Save to save all changes to the Blend and FK Joint display colors. The Color settings window remains open.
- Click Reset to Saved to cancel any changes made to the Blend and FK Joint display colors and revert to the color settings from your last file save. The Color settings window remains open.
- Click Close to cancel any changes to the Blend and FK Joint display color. The Color settings window closes.

To set the joint size for bones with FK or IK animation

1 Select Window > Settings/Preferences > Preferences from the Maya main menu bar.

The Maya Preferences window appears.

2 Click Kinematics under Display to open the Kinematics Display Preferences.

The Inverse Kinematics preferences appear.

3 Set the joint size using the Ik/Fk Joint Size field or slider.

4 Do one of the following:

- Click Save to save all changes to the Ik/Fk Joint Size. The Maya Preferences window remains open.
- Click Cancel to disregard any changes to the Ik/Fk Joint Size. The Maya Preferences window closes.

New IK Solver Attributes

Note
- Ik Blend has replaced *Solver Enable*.
- The new Ik Fk Control attribute turns off global and local *IK Handle Snap*.

Ik Blend

An Ik Blend value of 0.000 sets the animation mode to pure FK, and an Ik Blend value of 1.000 sets the animation mode to pure IK. When the Ik Blend value is a number between 0.000 and 1.000, then the animation on the current skeleton is blended IK and FK.

Ik Fk Control

Lets you manipulate and key the joints of a joint chain that has an animated Ik handle. In addition to being located in the local Ik Handle Attributes, Ik Fk Control is also present in the global skeleton settings (Skeleton > Enable Ik Fk Control).

Animation-Constraint Blending

You can now blend keyframe animation and constraints on the same object.

Examples

- A man runs to a parked convertible car, jumps over the door and into the driver's seat, and then drives away. In this example, both the character and car models are animated, and various parts of the man are point constrained to the car's door, seat, and steering wheel.
- A basketball player dribbles the ball, picks it up, and throws it to another player. The player that catches the ball pauses and then shoots for the hoop. In this example, the ball and all the players hands are animated, and the ball is parent constrained to the various player's hands.

Workflow for Animation-Constraint blending

Scenario

A basketball player character passes a ball to his teammate.

1. Select the first player's hands, and then the basketball.
2. Parent constrain the ball to the hands, making sure that Maintain Offset is on and the weight is set to 1 in the constraint options.

For the procedure on creating parent constraints, see "To create a parent constraint" on page 40.

Maintain Offset preserves the original, relative translation and rotation of the constrained object.

The Weight attribute sets the amount of influence that the target's position and orientation has on the constrained object. For information on parent constraint weighting see "Weight" on page 42.

3 In the Channel Box, set keys for the weights of the first player's hands.

Note	When the basketball is selected, the parent constraint and all its target weights appear in the Channel Box.

This anchors the parent constraint's weighting, and the position and orientation of the basketball, at the current time in the character's animation.

4 Animate the arms of the first player so that they appear to be throwing the ball.

5 At the point in the first character's animation where he is to let go of the ball, set a key on the ball and on the weights of the hands.

Since the basketball now has both a constraint and keyframe animation, a new *blend* weight attribute appears in the Channel Box.

6 Change the blend weight to 1, and key the blend weight.

7 Advance one frame along the timeline.

8 Set the weight of the first player's hands to 0, and set the blend weight to 0.

When the blend weight is 0, the keyframe animation has full control over the position and orientation of the ball.

9 Key the hands' weights and the blend weight.

This anchors the animation-keyframe blend weight and the first player's weight at the current time in the character's animation.

10 Keyframe the ball as it is *thrown* from the first player to the second player.

11 When the ball reaches the position where the second player catches it, parent constrain the ball to the hands of the second player, making sure that Maintain Offset is on and the weight is 0 in the constraint options.

12 Key the weights of the second player's hands and that of the blend weight.

13 Advance one frame along the timeline.

14 Set the blend weight to 1 and the second player's hands' weights to 1.

When the blend weight is 1, the parent constraint has full control over the position and orientation of the ball.

15 Key the blend weight and the weights of the second player's hands again.

This anchors the weighting of the ball's animation and that of the parent constraint at the current time in the characters' animation.

16 Animate the second player.

Note If you want to ensure that the transitions between the blend weights are clean (no interpolation), set the tangent types of the weights to Stepped.

Blend Weights in the Channel Box

Note When the driven object is selected, all its target and blend weight values can be viewed in the Channel Box under SHAPES > object*n*_typeConstraint*n* or INPUTS > pairBlend*n*.

Blend Constraint*n*

The keyframe animation-constraint blend value determines the amount of influence that the constraint and keyframe animation have on the constrained object. If the value is 0, the keyframe animation has total control over the constrained object's transformations. If the value is 1, the constraint has total control over the constrained object's transformations.

If there are more than one of the same type of constraint applied to the object, *n* stands for the constraint number. This value appears in the pairBlend node's attributes as *Weight*.

pairBlend node

The pairBlend node is automatically generated when both keyframe animation and a constraint are applied to an object. Once the animation and constraint are linked to the pairBlend node, you can modify the weight of the animation-constraint blend to generate various effects. See "Blend Weights in the Channel Box" on page 54.

In the dependency graph, the pairBlend node functions as a link between constraints, animation, and the object to which both are applied. The pairBlend node connections resemble the following: all target objects

connect to the constraint node, the constraint node and keyframe animation connect to the pairBlend node, and the pairBlend node connects to the object.

When multiple constraints are applied to the same object, a separate pairBlend node is created for each constraint and the animation channels of the constrained object connect to the same pairBlend node as their related constraints.

pairBlend attributes

Note Input 1 always represents the keyframe animation on the constrained object and Input 2 always represents the constraint node.

Caching

Unlike other cache data in Maya (for example, caches in Dynamics, Cloth, and Fluid Effects), the cache data for pairBlend is also an animation curve.

For more information, search the online help for node Caching.

Node State

For more information, search the online help for the Node State Attributes.

InTranslate*n*

The InTranslate fields display the X, Y, and Z translation values for Input 1 and Input 2. *n* represents the input number.

InRotate*n*

The InRotate fields display the X, Y, and Z rotation values for Input 1 and Input 2. *n* represents the input number.

Weight

Displays a blend value that determines the amount of influence that the constraint and keyframe animation have on the constrained object. This field is read-only. See "Blend Constraintn" on page 54.

TranslateXMode

Blend Inputs	The blended X translation of Input 1 and Input 2 controls the driven object's X translation.
Input 1 only	The X translation of Input 1 controls the X translation of the driven object.
Input 2 only	The X translation of Input 2 controls the X translation of the driven object.

TranslateYMode

Blend Inputs	The blended Y translation of Input 1 and Input 2 controls the driven object's Y translation.
Input 1 only	The Y translation of Input 1 controls the Y translation of the driven object.
Input 2 only	The Y translation of Input 2 controls the Y translation of the driven object.

TranslateZMode

Blend Inputs	The blended Z translation of Input 1 and Input 2 controls the driven object's Z translation.
Input 1 only	The Z translation of Input 1 controls the Z translation of the driven object.
Input 2 only	The Z translation of Input 2 controls the Z translation of the driven object.

RotateMode

Rotation is calculated by blending the rotation of the specified inputs along all axes.

Blend Inputs	The blended X, Y, and Z rotation of Input 1 and Input 2 controls the driven object's rotation along all axes.
Input 1 only	The X, Y, and Z rotation of Input 1 controls the driven object's rotation along all axes.
Input 2 only	The X, Y, and Z rotation of Input 2 controls the driven object's rotation along all axes.

Rotation Interpolation

Euler Angle	Use Euler Angles when the pairBlend weight value is between 0 (driven by keyframes) and 1 (driven by the constraint). Euler is the default rotation interpolation.

For more information, search the online help for Independent Euler Angles.

Note Euler angles may cause flipping when used to interpolate between keyframes and constraints. If this occurs, we recommend that you switch to quaternion rotation.

Quaternion	Quaternions smoothly interpolate the keyframe-constraint blend without producing anomalies (such as flipping). Use Quaternion when the pairBlend weight value is 1 or 0.

For more information, search the online help for Synchronized Quaternions.

Sculpt deformer can use any NURBS surface

The sculpt deformer can now use a NURBS object as the sculpting tool instead of the default implicit sphere.

Note	Deleting the sculpt node or the deformed object does not delete the custom sculpt tool.

To use a NURBS surface with the sculpt deformer

1. Select the object to deform, and then the NURBS surface to use as a sculpting tool.
2. Select **Deform > Create Sculpt Deformer** > ❐.
3. Turn on **Use Secondary Object as Sculpt Tool**.
4. Click Create.

MEL command

Two new flags have been added to the **sculpt** command to support this functionality.

- -st/-sculptTool *objectName*

  The -sculptTool flag takes the name of the NURBS object to use as the sculpt tool when creating the deformer. If you do not specify this flag, the command uses an implicit sphere.

- -e/-edit

  Use the -edit flag with the -sculptTool flag to replace the sculpt tool with a different object.

Limitations

- Geometry types other than implicit spheres and NURBS objects are not currently supported. To use another type of surface, convert it to a NURBS surface.
- Performance can degrade as the number of vertices in the sculpt tool and/or the object being deformed increase.

- For best results use closed, convex objects as sculpting tools.

Advanced

- As with previous versions of Maya, it is possible to have multiple sculpt deformers deforming the same object.
- You can use the connection editor or the MEL connectAttr command to manually connect a different object as the sculpt tool.

6 Rendering

Overview

We've added new rendering features and made the following enhancements in Maya 5:

- We've provided new options for QuickTime output for Mac OS X and made improvements to the way the IPR default light and the Convert to File Texture and depth map shadows algorithms work.

  For more information, see "Maya software rendering" on page 60.

- The mental ray for Maya plug-in has been integrated into the Maya application, and a significant number of improvements have been made, including:
  - the integration of bake-sets, which let you bake several objects with different baking options during the same baking process
  - improvements that optimize the export to `.mi` process
  - extended support for the IFF image format that permits both color and depth information to be written into a single file
  - support for Subdivision surface rendering
  - support for Particle types

  For more information, see "mental ray for Maya rendering" on page 62.

- Maya's new Hardware renderer provides an intuitive workflow to generate hardware rendered images for previews, specific passes, and hardware rendered particles. In some cases, image quality may be good enough for final delivery.

  For more information, see "Maya hardware rendering" on page 74.

- Maya's new Vector renderer lets you create stylized renderings (for example, cartoon, tonal art, line art, hidden line, wireframe) in various bitmap image formats and 2D vector formats.

  For more information, see "Maya Vector rendering (Windows and Mac OS X)" on page 76.

- Render globals for Maya's new hardware renderer, the newly integrated mental ray for Maya renderer, Maya's software renderer, and the Maya's new Vector renderer have been consolidated into one Render Globals Settings window.

  For more information, see "Unified Render Globals Settings window" on page 60.

Unified Render Globals Settings window

Render globals for the new Maya Hardware renderer, the integrated mental ray for Maya renderer, the Maya Software renderer, and the Maya Vector renderer have been consolidated into one Render Globals Settings window.

To choose the renderer

- Do one of the following:
  - Click Render > Render Using, then choose the renderer.
  - Select the renderer from the dropdown list in Render View or the Render Global Settings window.

To open the Render Global Settings window

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

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

  For descriptions of options in all tabs, see the online Rendering guide.

Maya software rendering

New options for QuickTime Output (Mac OS X)

For the Maya software renderer (and the new Maya Hardware renderer), QuickTime output now supports over 20 different compression codecs for batch rendering and Playblast.

This provides more flexible output options, and removes the necessity to edit uncompressed movies in another application.

Tip	Hold down the Ctrl key when adjusting the quality slider for finer control.

IPR default light improvements

The IPR default light that is created when doing an IPR render of a scene without a light operates like the Maya Software default light.

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

Convert to File Texture improvements

The algorithm Maya uses to Convert to File Texture has been improved to produce more reliable visual results more quickly and efficiently. Seams in UV space are now handled better. The algorithm is used for subdivision surfaces and polygons.

The new algorithm consists of two passes by default. The first pass samples the color of the inside of triangles; the second pass extends the sampled color slightly in each direction along the polygon border to fill texture seams. Games developers, or other users who have no room for overscanning, can disable the second pass by turning off the Fill Texture Seams option.

MEL command changes

The following flag for the mel command convertSolidTx is now obsolete:

```
-ubi/-uvBBoxIntersect boolean
```

The following flag has been added:

```
-fts/fillTextureSeams boolean
```

This specifies whether or not to overscan a polygon beyond its outer edges when creating the file texture. The default is true.

Depth map shadow improvements

The algorithm to compute mid dist depth shadows has been improved, making them more robust and removing some artifacts.

mental ray for Maya rendering

About the integration of mental ray for Maya

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

The mental ray for Maya plug-in is based on the new mental ray 3.2 core. All features of this version are accessible by mental ray for Maya.

For more information, see the online Rendering guide.

Note Because of the unified render global settings (see "Unified Render Globals Settings window" on page 60), the mental ray for Maya 'derive from Maya' settings no longer exist. You may need to modify some older files for which 'derive from Maya' was set by setting the mental ray for Maya render global settings.

Selecting the mental ray for Maya renderer

When you select the mental ray for Maya renderer, Maya's user interface is automatically configured to use mental ray for Maya. If you render the current frame, Maya uses mental ray for Maya. If you click the Display Render Globals Window button (in the main menu or in Render View), the unified Render Globals Settings window appears, showing the mental ray tab.

To select the mental ray for Maya renderer

- Do one of the following:
  - Click Render > Render Using > mental ray.
  - Select mental ray from the dropdown list in Render View or the Render Global Settings window.

  For more information on the mental ray for Maya render settings, see the online Rendering guide.

Baking and prelight improvements (mental ray for Maya)

The procedures for baking to textures and vertices with mental ray for Maya have been optimized to improve workflow for baking illumination, shadow, shading, and textures. These improvements benefit users such as game developers who require more flexibility to perform complex baking options.

Bake-sets, which let you bake several objects with different baking options during the same baking process, have been implemented. For information on bake-sets and instructions on how to bake textures and vertices with mental ray for Maya, see "Using bake-sets" on page 66.

Note Maya's Convert to File Texture command and Polygon Prelight command remain unchanged.

---

mental ray for Maya export improvements

Improvements let you optimize the export to `.mi` process. If objects do not change, reprocessing before exporting to `.mi` is not required, and the export process is significantly shortened as a result.

File > Export Selection > ❐

Additions have been made to the Export Selection Output options for File Type mental ray.

Export Selection Output

Renderable Scene	This is the default. Maya exports all scene entities (lights, cameras, shaders, globals, etc.) that are necessary to render the selected geometry. The resulting scene will be renderable using the mental ray standalone.
Scene Fragment	Maya exports only the nodes that are selected. This mode can be used to export particular lights, cameras, shaders, or geometry. The resulting `.mi` file will most likely not be directly renderable, so it is called a Scene Fragment.

Export Materials

In addition to the selected nodes, this setting also exports any materials that they are connected to. This applies to selected geometry and shading nodes.

Export All Incoming Shaders

In addition to selected shading nodes, also exports all inputs to those nodes. For example, if a surface shader is selected, this mode causes any texture networks feeding into the shader to be exported along with the shader.

Export Entire Child DAG

This option specifies that in addition to selected geometry, any children of that geometry should also be exported.

The standard export filters (enabled by turning on Export Selected Items Only) are also applied to the nodes identified for export. This allows you to prevent the export of unwanted node types.

Scene Export Optimization Controls

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

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

miDeformation

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

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

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

miTangents

Controls export of tangent vectors on objects.

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

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

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

Extended subdivision surface support

Subdivision surface rendering is now supported.

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

To prepare subdivision surfaces not directly supported (for example, where the base mesh does not contain only quads), you must bake the first level of subdivision surfaces to get quads everywhere.

To get quads everywhere in a rejected subdivision surface

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

Particle system translation and rendering

Particle types for software rendering are now supported on all platforms for rendering with mental ray. To render particles, a new mayabase shader library is required, which is also provided for all platforms. Particle data are also exported to `.mi` files. These files cannot be rendered yet on machines with different byte ordering (big end or little end) than the machine where Maya has been used (for example, mixing IRIX and Windows). Particle translation and rendering is limited and may not be able to handle large particle counts. Light linking is not supported with particles. However, software particles and particle instancing should work together seamlessly.

IFF color and depth format

The IFF image support in mental ray 3.2 has been extended to permit both color and depth information written into a single file. This requires the proper parameters to be set in the Render Global Settings (Depth Channel (Z Depth) in the Image File Output section must be turned on).

Improved support for batch rendering with mental ray for Maya

Any batch render with mental ray for Maya issued from the Maya user interface reports progress back to the Maya script editor. This has been improved to report frame numbers and file name extensions correctly.

Using bake-sets

About Bake-sets

Bake-sets

Bake-sets, which let you bake several objects with different baking options during the same baking process, have been implemented in Maya.

Bake-sets and their attributes define the properties with which sets of objects are baked.

Bake-sets let you:

- Easily apply different settings to different objects. For instance, you can texture-bake objects with different UV ranges or output resolution, or vertex-bake objects with different color blending or clamping.
- Save different baking parameter configurations, making it easier to re-bake periodically when needed.

Texture bake-sets and Vertex bake-sets

If you want to bake objects with different settings, you can create bake-sets and assign objects to them. When you bake textures (see "Bake textures" on page 67) or vertices (see "Bake vertices" on page 67), Maya automatically bakes the objects according to the attributes of the bake-set to which they are assigned.

(Bake-sets are derived from object sets. See the online documentation for more information about object sets.)

Bake textures and vertices

If you bake objects that you have not assigned to a bake-set, the objects are automatically assigned to the initial bake-set, and the baking proceeds.

In other words, if your baking requirements are simple (for example, you want to bake all objects in your scene with the same settings), you don't need to create bake-sets and assign objects to them. An initial bake-set is automatically created, and you can just bake textures or vertices.

Note Although no additional tasks are required for simple baking, the steps you must follow have changed for baking textures. Baking vertices using the Polygon Prelight command has not changed.

Note Usually you don't modify the attributes of an initial texture bake-set or an initial vertex bake-set. However, you can modify them if you want to change one or two of the default attributes with which new objects are baked. See "Adjust bake-set attributes" on page 70.

Bake vertices

To bake vertices with mental ray for Maya

1. Select the objects for which you want to bake vertices.
2. Do either of the following:
   - In the Rendering menu set, select Lighting/Shading > Batch Bake > ❐.
   - In the Modeling menu set, select Edit Polygons > Color > Polygon Prelight (mental ray) > ❐.
3. If desired, adjust any attributes, then click Convert and Close or Convert.

   For a description of the mental ray Baking Options window, see "mental ray Baking Options window" on page 68.

Bake textures

The process of baking textures *using mental ray for Maya* is no longer available from the Hypershade menu Convert File to Texture (it remains for Maya Software rendering). Instead, new menu items from the Rendering menu in the Rendering menu set let you do the following:

- Assign object to a new bake-set, which creates a new bake-set, letting you bake that object according to the attributes of that bake-set. See "Create a bake-set" on page 69.
- Assign object(s) to an existing bake-set, which lets you bake those objects according to the attributes of that bake-set. See "Assign objects to existing bake-sets" on page 73.
- Batch bake selected objects, which immediately bakes the selected objects according to:
  - the options set in the mental ray Baking Options window (see "mental ray Baking Options window" on page 68)
  - the attributes in their respective bake-set(s) (see "Bake-set attributes" on page 70)

To bake a texture

1. Select one or more objects you want to bake.
2. Select Lighting/Shading > Batch Bake (mental ray) > ❐.
3. Set the desired options, then click Convert or Convert and Close.

mental ray Baking Options window

> **Note** Most of options in the mental ray Baking Options window (formerly available from the Hypershade) have now moved to either the Texture bake-set Attribute Editor (see "Texture bake-set attributes" on page 70) or the Vertex bake-set Attribute Editor (see "Vertex bake-set attributes" on page 72).

Objects to Bake

Select from this list to bake all objects, or only selected objects.

Skip objects in initialBakeSets

If you select Select All from the Objects to Bake option, then all objects that are not assigned to the initial bake-sets are baked.

For information on initial bake-sets, see "Bake textures and vertices" on page 67.

Bake To

Bake either textures or vertices. The default is Texture when you access this window through the Lighting/Shading menu. If you select vertices, vertices are baked in the same manner as "Bake vertices" on page 67.

Color Mode

Allows mental ray for Maya to bake only illumination versus surface color with illumination. This is the converse of Maya's Bake Shading Group Lighting option, which allows you to bake only surface color vs. surface color with illumination. Select from one of the drop-down list options: Fully Lit and Shaded (default) or Incoming Global Illumination Only.

Bake Shadows

Turn this checkbox on to bake shadows.

Orthogonal Reflection

This option is off by default, which is useful if you are baking in order to accelerate software rendering and the reflections will only be viewed from the baked position. However, the textures or vertex colors it generates are not for use as textures in a game engine. When turned on, the Orthogonal Reflection option causes all reflection rays to be orthogonal to the surface being baked. They are no longer true reflection rays, pointing instead parallel to the surface normal vectors, but the resulting baked texture or vertex colors will be meaningful when viewed later from any direction.

Use Face Normals

mental ray for Maya lets the user specify the use of face normals for baking instead of interpolated vertex normals, as usually used for rendering.

Normal Direction

Determines in which direction the normals of the object to be baked should be pointing. The options in the drop-down list are: Face Camera, Front, and Back Camera.

Create a bake-set

You can create your own bake-sets to be able to bake objects in different ways. To create a bake-set, you must have an object in your scene that you want to assign to the bake-set.

To create a bake-set

1. Selected one or more objects for which you want to create a bake-set.
2. Use one of the following methods to assign the bake-set:
   - Click Light/Shading > Assign New Bake-Set > Texture Bake-set (to create a Texture bake-set) *or* Vertex Bake-Set (to create a Vertex bake-set).

- Right click the object, then select Baking > Assign New Bake-Set > Texture Bake-set *or* Vertex Bake-Set.
- Use the MEL command:

```
createNode [textureBakeSet|vertexBakeSet]
```

The new bake-set's attributes appear in the Attribute Editor (unless the Attribute Editor has been hidden).

3 Adjust the bake-set's attributes, see "Adjust bake-set attributes" on page 70.

Adjust bake-set attributes

Bake-set attributes

To adjust the attributes of a bake-set

1 Do one of the following:

- If the bake-set's attributes are shown in the Attribute Editor, proceed to the next step. (If you can't see the Attribute Editor, make sure it is not hidden.)
- If the bake-set's attributes are not shown in the Attribute Editor, right-click the object, then select Baking Attributes.
- To select a bake-set without selecting an object, you can select it from the tab that contains bake-sets in the Hypershade. If you do not see a tab that contains bake-sets, you must create one. See "Create a Bake-Set tab in Hypershade" on page 74.

2 Adjust the attributes.

Texture bake-set attributes

Prefix

Any bitmaps generated by this bake-set are prefixed with the value typed in this box.

x resolution, y resolution

The horizontal and vertical resolution of the image file, measured in pixels. The slider range is 1 to 512. The default value is 256.

File format

Lets you choose a format in which to save the file texture. The default is IFF.

Bits per channel

Specifies the number of bits per channel to use in the output bitmap.

Bake Alpha

Turn this on to bake the alpha channel (equivalent to Maya's Bake Transparency option) and then select an Alpha Mode.

Alpha mode

When Bake Alpha is turned on, the Alpha Mode specifies how it's computed. Select one of the options, which include Pass Through (alpha as output from shading network), Surface Transparency, Luminance of Surface Color, and Coverage.

Note The Pass Through option is mainly for custom shader usage within Maya. The returned baked color alpha component is retained and is not further affected by Maya's matte channel. Custom shaders usually set the fourth component of a mental ray color to provide the alpha channel.

UV range

Specifies the amount of the surface to sample in UV space. For example, if you select one or more faces on a polygonal object, instead of sampling the whole surface, only the selected faces are sampled.

U min, U max

Slider values specify how much to stretch the sampling range of U or V components. Maya stretches the sample region to fit the output image size within the [0,0] to [1,1] sampling range.

V min, V max

Minimum V and maximum V for baking.

Fill texture seams

If the selected UV space contains boundaries, these boundaries may appear as black stripes in renderings that use the baked textures. This occurs when the texture is sampled so close to a boundary that the filter picks up values (generally black) from outside the desired space.

This setting artificially extends the boundaries by a small amount to alleviate this problem. It is measured in texels (pixels of texture). Typically, the filter is only a few texels in diameter and can only reach as far as its radius into these boundary spaces, so a value of 1 or 2 is usually enough.

Fill scale

This option carries out a boundary detection in the UV space to be baked. If UVs are normalized to the unit square and the mesh is finely tessellated, accuracy problems (such as zero-size triangles) can occur. Temporary up-scaling the UVs helps in this case.

Override mesh UV set assignments

Activate this option to bake meshes as if they were in the specified UV set instead of the UV sets to which they are currently associated.

UV set name

The UV set to use for the meshes in this textureBakeSet.

Vertex bake-set attributes

Shared Vertices

A vertex often exists in a few different faces. Use this option to bake a single result for each vertex in the mesh rather than a single result for each vertex in each face in the mesh. Choosing shared vertices usually softens (sometimes dramatically) the shading of a mesh.

Bake Alpha

Turn this on to bake the alpha channel (equivalent to Maya's Bake Transparency option) and then select an Alpha Mode.

Alpha Mode

When Bake Alpha is turned on, the Alpha Mode specifies how it's computed. Select one of the options, which include Pass Through (alpha as output from shading network), Surface Transparency, Luminance of Surface Color, and Coverage.

Scale Rgba

Scale vertex colors by the specified value.

Clamp Min, Clamp Max

Turn on these options to clamp the minimum and maximum RGBA values so that the values are forced to be within the range you set.

Min Color

The lower limit to which to clamp vertex color.

Max Color

The upper limit to which to clamp vertex colors.

Color Blending

Merges existing vertex colors with the ones just baked, if any. The Don't Overwrite option means that no color data is written onto the mesh. If the mesh already has color data, those values remain untouched. If the mesh has no color, it remains colorless.

Alpha Blending

Merges existing vertex alphas with the ones just baked, if any. The Don't Overwrite option means that no color data is written onto the mesh. If the mesh has color data already, those values remain untouched. If the mesh has no color, it remains colorless.

Assign objects to existing bake-sets

After you create a bake-set, you can assign any additional objects you create to that bake-set.

To assign objects to existing bake-sets

- Assign each object, instance, or group to be baked to a bake-set, using one of the following methods:
  - The Maya Relationship Editor
  - Lighting/Shading menu > Assign Existing Bake-Set > then choose from the list of existing bake-sets.
  - Right-click the bake-set node in the Hypershade, then select Assign Selection to Bake Set.
  - Right-click the object, then select Baking > Assign Existing Bake-Set > then select the Bake-Set.
  - Use the MEL command. For example,

```
sets –add myBakeSet nurbsSphere2;
```

To change the attributes of the initial bake-set

1. Select any object in your scene.

   The object's attributes appear in the Attribute Editor.
2. Select the initial bake-set tab.
3. Set any of the attributes.

   To change the attributes of the initial texture bake-set, see "Texture bake-set attributes" on page 70.

   To change the attributes of the initial vertex bake-set, see "Vertex bake-set attributes" on page 72.

Create a Bake-Set tab in Hypershade

You can create a bake-set tab in the Hypershade to be able to view and select bake-sets.

To create a Bake-set tab

1. In the Hypershade, select Tab > Create New Tab.
2. In the Create New Tab window, type `Bake-sets` in the New Tab Name field.
3. In the Show Nodes Which Are field, select Bake Sets.
4. Click Create.

Maya hardware rendering

About Maya's new hardware renderer

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

Benefits include an intuitive workflow to generate hardware rendered images for previews, specific passes, and hardware rendered particles. The integration takes advantage of the new unified rendering workflow; you can render and display images using the Render View, which lets you compare images during the shading and lighting tasks.

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

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

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

Highlights of supported features

Supported features include:

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

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

Supported hardware and platforms

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

`www.aliaswavefront.com/qual_charts`

Selecting the hardware renderer

When you select the hardware renderer, Maya's user interface is automatically configured to use the hardware renderer. If you render the current frame, Maya uses the hardware renderer process the image and display it in the Render View. If you click the Display Render Globals Window button, the unified Render Globals Settings window appears, showing the Common tab and Maya Hardware tab.

To select the hardware renderer

- Do one of the following:
  - Select Maya Hardware from the dropdown list in Render View or Render Global Settings window.
  - Select Render > Render Using > Maya Hardware.

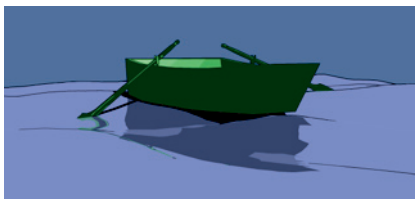
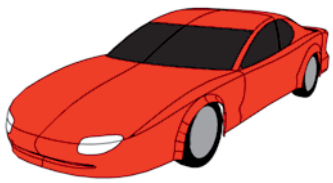
For more information about the Maya Hardware Global render settings, see the online Rendering guide.

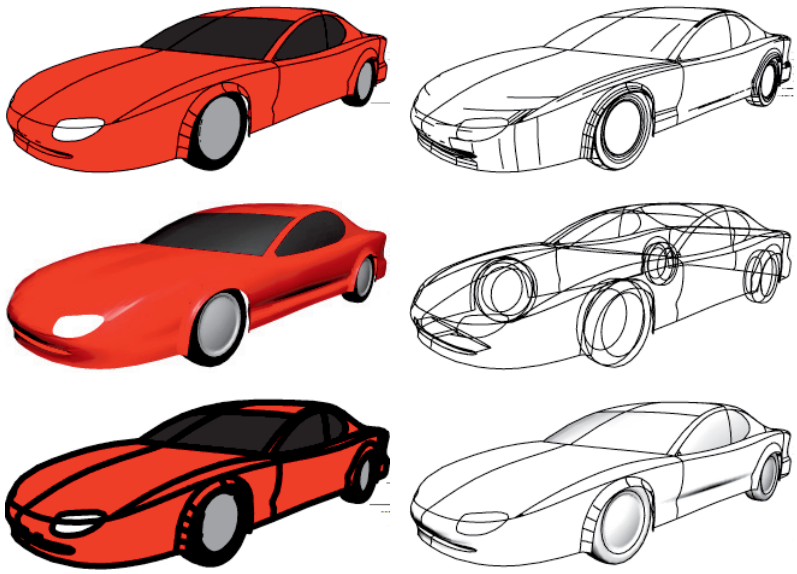
Maya Vector rendering (Windows and Mac OS X)

About the Maya Vector renderer

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

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

Example Animations	
	
helicopter.swf	flowers.swf
	
boat.swf	car.swf



Note The Maya Vector renderer cannot render certain Maya features (see "Maya features that will not vector render" in the Rendering online documentation.

For more information see "The Maya vector renderer" in the online Rendering guide.

> About the Maya Vector renderer

7 Paint Effects, Artisan, 3D Paint

We've added or enhanced the following painting features in Maya.

Paint Effects

Artisan

3D Paint Tool

Paint Effects

Paint Effects shelf and new brushes

We've added a Paint Effects shelf that contains a range of Paint Effects tools and brushes, including some new brushes.

If you are upgrading to Maya 5, the Paint Effects shelf will not be displayed. You can load the shelf manually using the instructions below in "To load the Paint Effects shelf."

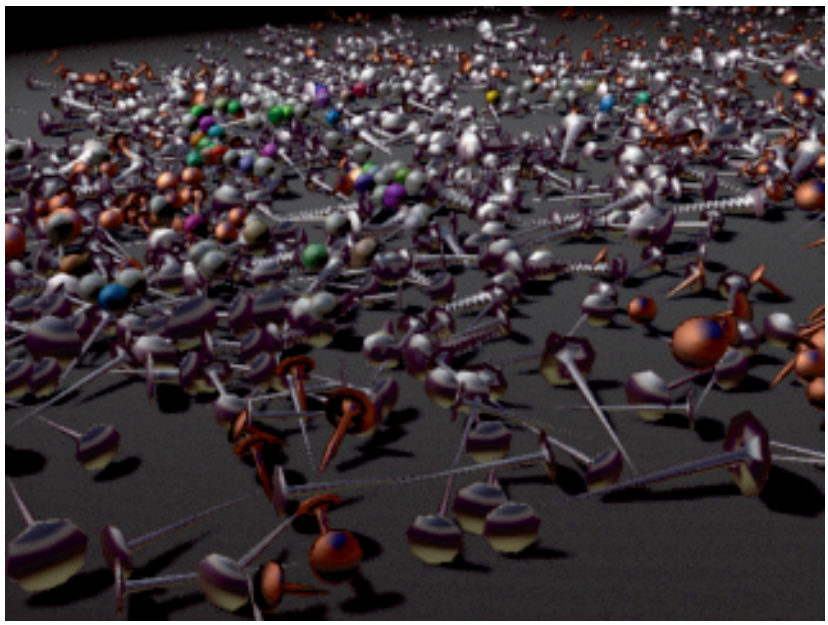
If you are new to Maya, the Paint Effects shelf, like the other Maya shelves, is loaded automatically on Windows and Mac OS X. The shelves are not loaded by default on IRIX and Linux because they can seriously impede the start up performance of Maya. To load these shelves on IRIX or Linux, follow the instructions in "Load the default shelves" in the Basics guide. To load only the Paint Effects shelf, follow the instructions below in "To load the Paint Effects shelf."

To load the Paint Effects shelf

1. Open the Script Editor (Window > General Editors > Script Editor).
2. Copy and paste the following in the Script Editor:

```
loadNewShelf "shelf_PaintEffects.mel";
saveAllShelves $gShelfTopLevel;
```

3. Select Script > Execute.



Example created using the new Mesh type brush
Image courtesy of Duncan Brinsmead

Select strokes by name

You can now select multiple strokes by name, for example, to have them share one brush. Use the Select Brush/Stroke Names Containing menu item in the Paint Effects menu.

To select strokes by name

1. Select a stroke.
2. Select Paint Effects > Select Brush/Stroke Names Containing.
3. In the Name Fragment text box, type the name of the stroke, for example, daisy.
4. Click Select Strokes. The strokes of that name are selected.

Flip Tube Direction

We've added a new menu item, Flip Tube Direction, to the Paint Effects menu, and a new Flip Tube Direction button on the toolbar in the Paint Effects panel.

Use this to switch the direction of the current brush between Along Path (best for canvas painting of plants) and Along Normal (best for scene painting of plants). This command is available as a hotkey.

In addition, we've added a *Force Tube to be Along Path* checkbox to the Canvas section of the Paint Effects Globals. *Force Tube Direction to be Along Path* causes brushes with tubes whose elevationMin is greater than 0.5 to be drawn along the path rather than along the normal in Canvas mode. This has the effect of making plant brushes draw in the expected direction when painting in the canvas.

Convert Paint Effects to polygons

You can convert Paint Effects strokes to polygonal meshes, including construction history, using Modify > Convert > Paint Effects To Polygons.

This allows you to:

- render in any renderer, including the Maya Software renderer, mental ray for Maya, the Hardware renderer, and the Vector renderer (For more information, see the online Rendering guide.)
- have Paint Effects show up in reflections, refractions and through transparent objects (For more information, see the online guides Lights and Cameras, and Shading.)
- use other polygon editing tools on them (For more information, see the online Modeling Polygons guide.)

You can edit brush attributes and see the effect on the output mesh. Shaders that closely match the look of the Paint Effects render are automatically generated and assigned to the resulting meshes. You can optionally choose to output color per vertex and also to bake lighting onto the mesh.

Note To optimize converting Paint Effects to polygons, see "Optimize Paint Effects Mesh quality" on page 82.

These are the options in the Paint Effects To Polygons Options window (Modify > Convert > Paint Effects To Polygons > ❐):

Vertex Color Mode

The default is None. Other options include Color and Illuminated.

Quad Output

Turn this on to output to quads. The default is off, defaulting output to triangles.

Hide Strokes

Turn this on to hide the Paint Effects strokes once they're converted to Polygons. Even if a stroke is hidden, its attributes can still be updated and will affect the polygon mesh. The default is on.

Poly Limit

This value indicates that when converting the Paint Effects stroke to polygons, it should stop after it has reached approximately this number of faces. This can be used to avoid creating excessively large meshes that could cause you to run out of memory. The default is 100 000. A value of 0 indicates no limit.

Optimize Paint Effects Mesh quality

Paint Effects Mesh Quality settings can be useful in simplifying both normal Paint Effects strokes as well as strokes that have been converted to polygons.

When converting Paint Effects to polygons, you can optimize the conversion by keeping some attribute values as low as possible, such as Segments, Leaf Segments, Petal Segments, Sub Segments, Split Max Depth, and Tube Sections. Also the Flatness value should be exactly 1 on leaves and petals as this can dramatically reduce the number of triangles if the Tube Sections value is large.

All the attributes mentioned above are located in different sections of the Paint Effects Brush Settings editor, so it can be time consuming to find and modify them for each brush you want to edit. To save time, use the Paint Effects Mesh Quality window (Paint Effects > Paint Effects Mesh Quality).

The Paint Effects Mesh Quality window is a collection of attributes from the selected brush and, where indicated, stroke. It refers to the first valid selection found and only represents one brush at a time. The brush may be selected indirectly through a stroke, a surface that was painted on, or a mesh that resulted from converting Paint Effects to polygons.

Changing the segments, Leaf Segments and Petal Segments may change the overall shape of the tubes. You can compensate for this somewhat on leaves and petals by adjusting the leaf and petal Stiffness, which also appear in this window. For segments you may need to modify Force attributes in the Paint Effects Brush Settings editor.

You can increase the number of sub segments without affecting the tube shape, although this will not remove nickling as the sub segments are linearly interpolated between the main segments. Sub segments are most useful if the brush has displacement turned on and you want to better resolve the displacement texture with more triangles, but don't want to affect the overall shape of the tubes. There may be other situations where more triangles are desired, but you don't want to affect the overall tube shape.

ThinLine Brush Type

We've added a ThinLine type of brush that allows you to render large numbers of fine tubes much more quickly than the Paint Brush Type. It uses a direct anti-aliased line draw rather than a series of brush stamps. A new Multi Streak method is also available when this Brush Type is used. In combination with the Multi Streak method, the ThinLine Brush Type can be up to 100 times faster for hair than the Paint Brush Type with better line detail. In addition, new looks are possible using the Multi Streaks, such as wet clumping hair.)

Note When using a large value for Tube Width with the ThinLine brush type, this may result in artifacts.

These are the attributes used to control the Multi Streaks:

Multi Streaks

The number of additional tubes or hairs to create around the original tube.

Multi Streak Spread1

The maximum offset at the tube base for the streaks.

Multi Streak Spread2

The maximum offset at the tube tip for the streaks.

Diffuse Random

Amount to randomize the brightness of each offset tube.

Specular Random

Amount to randomize the specular brightness of each offset tube.

Light All Streaks

Compute lighting for each added tube.

Example of long hair created using the ThinLine Brush Type
Image courtesy of Duncan Brinsmead

Mesh Brush Type

We've added a Mesh type of brush that renders Paint Effects using triangulated tubes instead of brush stamps. This results in accurate conical geometry with textures that correctly map on the surface. Flat surfaces are rendered more accurately than when the Paint Brush Type is used. While the Paint Brush Type is generally better when representing soft, fuzzy volumes, the Mesh Brush Type is better at hard surfaces.

With the Mesh Brush Type you can now create Paint Effects trees and plants that are convincing not just from a distance, but also close-up. You can also create previously impossible shapes, such as hard-edged geometry (buildings). You can do per-pixel lighting on the mesh (including specular highlights). There is also a new built-in environment map on the brush that is useful when simulating reflective surfaces (see "Mesh Environment Reflections" on page 89). We've added displacement and bump mapping to enhance the detail of the mesh surface (see "Mesh Displacement/Bump Mapping" on page 90). The triangles are not kept in memory, but rather generated at render time. As a result, you can use a lot of triangles without running out of memory.

Another feature made possible by representing the tubes as triangles is converting Paint Effects to Polygons. For details, see "Convert Paint Effects to polygons" on page 81.

These are the attributes to control the Mesh Brush Type:

Tube Sections

The number of points in the circle that is swept along the tube.

Sub Segments

The number of cross sections per segment of the tube.

Single Sided

Cull away facing triangles.

Per Pixel Lighting

Light each pixel, as opposed to each vertex.

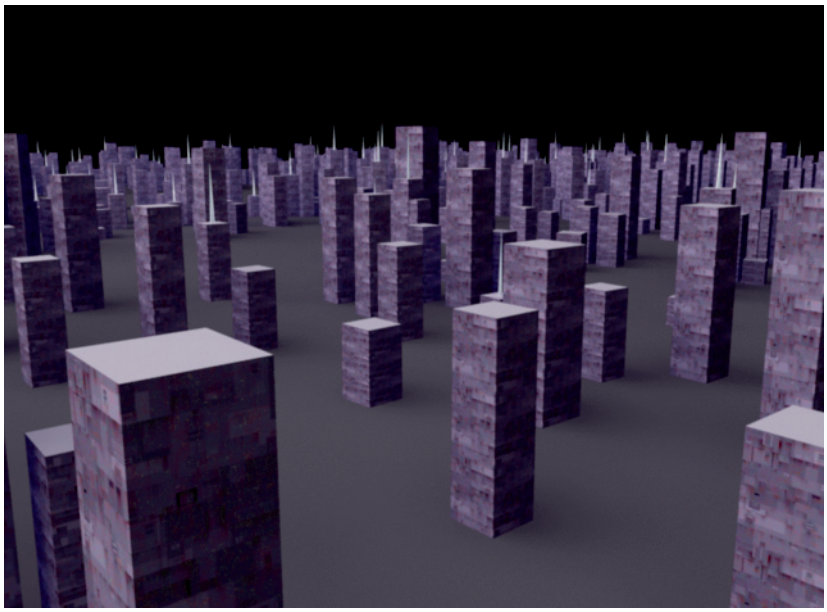
End Caps

This adds end cap geometry to tubes when using the Mesh Brush Type.

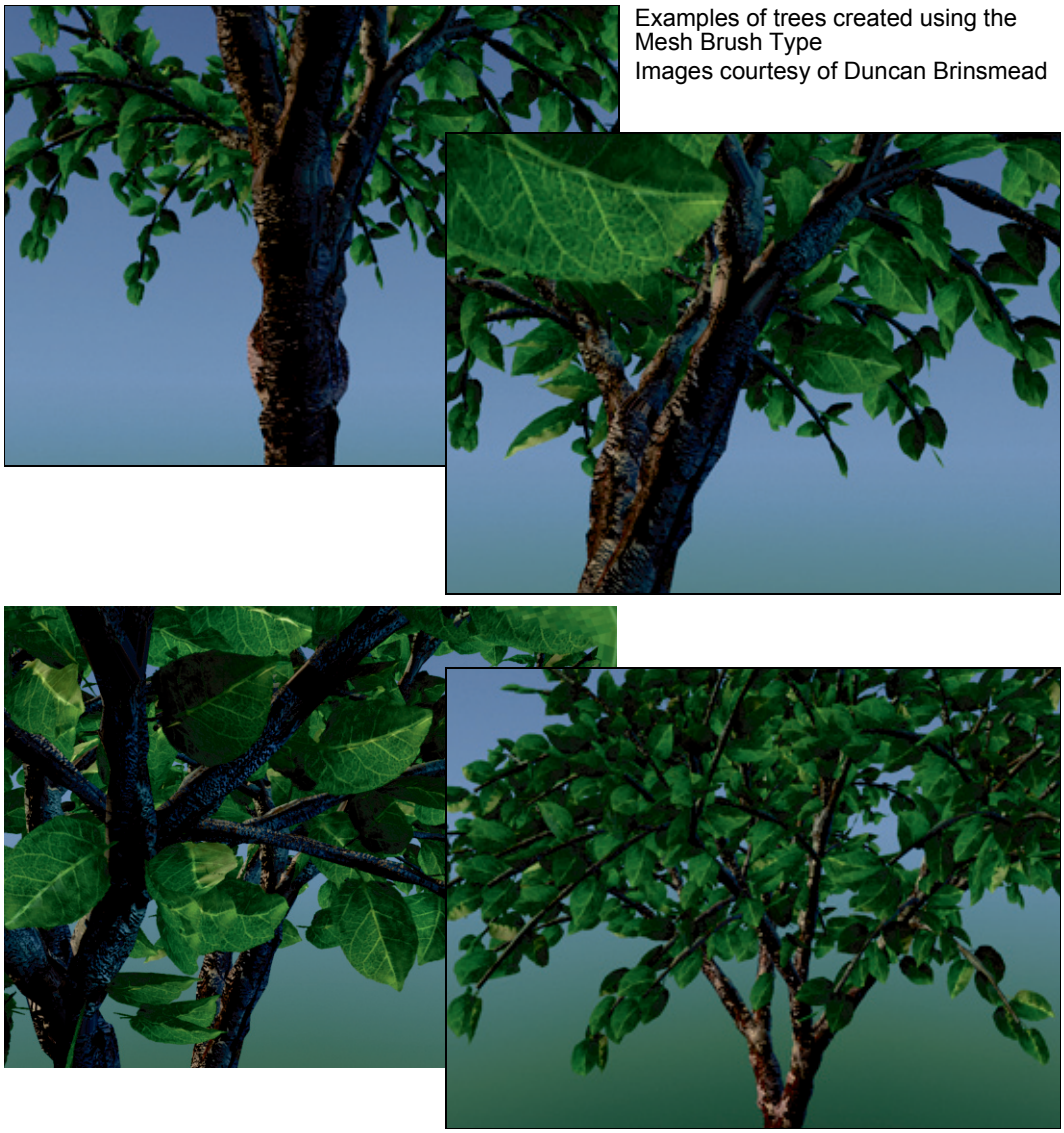
Hard Edges

This affects the lighting of the object and makes the edges around tubes hard when using the Mesh Brush Type. For example, if the tube sections are set to 4 and Hard Edges is turned on, it will make the tube shade as if the 4 sides are flat, rather than trying to simulate a rounded tube. For bends in the direction of the tube, for example, due to changes in the Width Scale, the bend angle across a given must be sufficiently large to make the angle hard. The number of segments used can affect whether a given region on the tube becomes hard edged or not. This attribute adjusts the normals used for shading and does not alter the shape of the tube. This is off by default.

> Mesh Brush Type



Example using the Mesh Brush Type with Hard Edges turned on

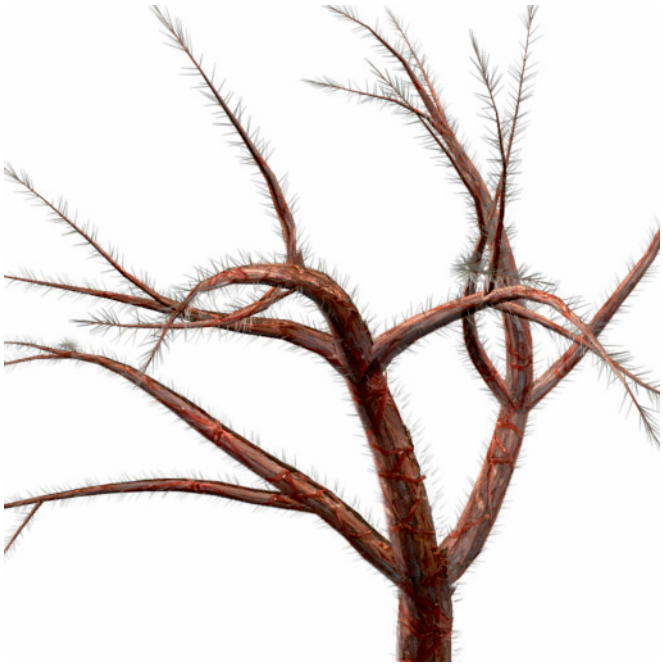


Examples of trees created using the Mesh Brush Type
Images courtesy of Duncan Brinsmead

Thorns on Mesh

Large numbers of thorns may be generated off the surfaces of the triangles created when using the Mesh Brush Type. These thorns are drawn using the rendering method associated with the ThinLine Brush Type and render quickly. They are single segment tubes, and do not appear in the wireframe representation of the strokes. You can use these to add thorns and prickles to plants or to create furry or fuzzy tubes.

Note	Thorns on Mesh are only created at render time.



Example of thorns on mesh

These are the attributes to control the look and size of the thorns:

Branch Thorns

Enable thorns on base tubes, including when tubes are off.

Twig Thorns

Enable thorns on twigs.

Leaf Thorns

Enable thorns on leaves.

Flower Thorns

Enable thorns on flowers.

Thorn Density

The number of thorns relative to the overall tube.

Thorn Elevation

The rotation of the thorns relative to the base tube's surface normal.

Thorn Length

Length of the thorn relative to the average tube width.

Thorn Base Width

The width of the thorn at the base (relative to average tube width).

Thorn Tip Width

The width of the thorn at the tip (relative to average tube width).

Thorn Specular

Specular highlight intensity (using an anisotropic model).

Thorn Base Color

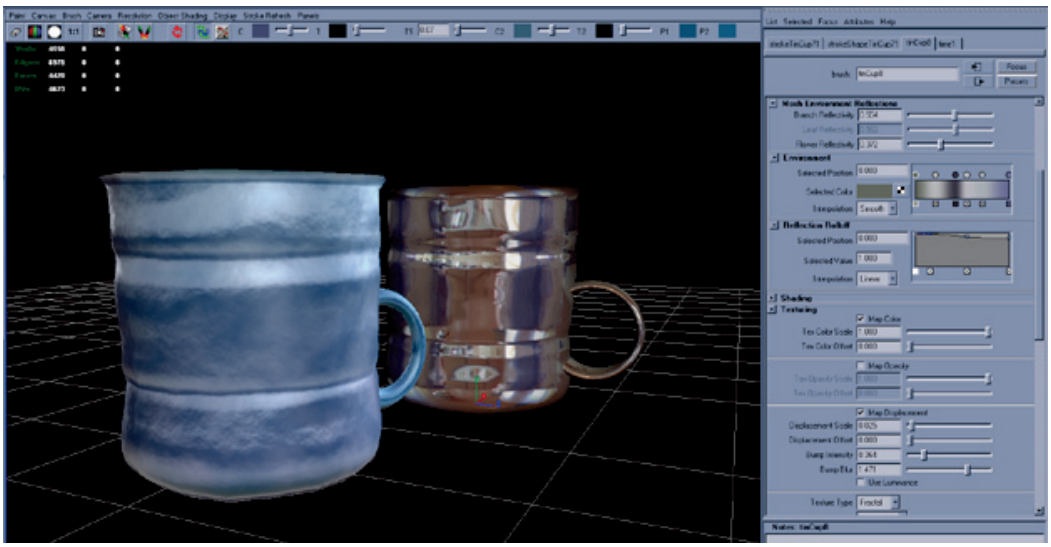
Color at thorn base.

Thorn Tip Color

Color at thorn tip.

Mesh Environment Reflections

A simple ramp-based environment may now be used in conjunction with the Mesh Brush Type. This can be used to create looks such as chrome, water, glass, shiny paint, etc.



Example of Mesh Environment Reflections

These are the attributes to control the Mesh Environment Reflections:

Branch Reflectivity

The amount the environment is reflected on base tubes, including the stroke when tubes are turned off.

Leaf Reflectivity

The amount of environment reflection on leaves.

Flower Reflectivity

The amount of environment reflection on flowers.

Environment

The ramp represents the reflected color of a spherical placement: the left side of the ramp is the color at the bottom of the spherical reflection and the right side of the ramp is the color at the top of it.

Reflection Rolloff

Represents the reflectivity with changing view angle (facing ratio).

Mesh Displacement/Bump Mapping

In the Texturing section of the Brush Settings window, you can apply displacements to the triangles created when using the Mesh Brush Type. If Per Pixel Shading is used, then a bump map is also applied along with the triangle displacement.

These are the attributes to control mesh displacement/bump maps:

Map Displacement

Turn on for displacement of triangles using texture.

Displacement Scale

Amount of displacement relative to tube width.

Displacement Offset

Amount of displacement independent of local tube width.

Bump Intensity

Strength of the added bump effect (if Per Pixel Shading is on).

Bump Blur

Controls separation of samples used in bump mapping.

Use Luminance

Use color brightness instead of the alpha for displacement.

New brush attributes

Forward Twist attribute

We've added Forward Twist (Brush Profile), Leaf Forward Twist (Tubes > Growth > Leaves) and Petal Forward Twist (Tubes > Growth > Flowers) attributes to the Brush Settings Attribute Editor.

When Forward Twist is turned on, then tube Flatness is always oriented towards the camera. This is particularly useful when the Flatness is 1, as you can use billboard textures to minimize geometry. For leaves, you could use a texture of a large clump of leaves with alpha on flat leaves. Turning on Leaf Forward Twist would ensure that the broad side of the textured leaf clump is rotated towards the view so it always looks full. Another example might be to use the image of an apple with alpha on a flat flower petal. Turning on Petal Forward Twist twists the petal to face the view so the apples do not look flat from some angles. The simplest way to represent a tree is an image of a tree with alpha textured to a billboard facing the camera. The following settings can be used to set up this type of billboard:

- Brush Type = Mesh
- Forward Twist = on
- Flatness1 = 1.0
- Flatness2 = 1.0
- Map Opacity = on
- Map Color = on
- Texture Type = File
- Image Name "yourTreeWithAlpha"
- Tube = on
- Segments = 1
- Tube Length1, 2 = 0.5
- Tube Width1, 2 = 0.5

These are the attributes to control Forward Twist:

Forward Twist

Forward twist applied to tubes so the broad or flat side is always oriented towards the camera. Textures are similarily affected so that they always face the camera.

Leaf Forward Twist

Forward twist applied to leaves so the broad or flat side is always oriented towards the camera. Textures are similarily affected so that they always face the camera.

Petal Forward Twist

Forward twist applied to petals so the broad or flat side is always oriented towards the camera. Textures are similarily affected so that they always face the camera.

Bend attribute

We've added a Bend attribute to the Tubes Behavior section of the Brush Settings Attribute Editor. Bend can be used to curl up leaves and flowers, as well as to make the overall branches bend in the U direction (along the length). You can create natural looking flower petals and plants, such as fiddlehead ferns. It is automatically animated in growth animations if non-zero. You can use the **Curl** attribute to bend leaves and petals in the V direction (along the width).

These are the attributes to control Bend:

Bend

Bend applied to base tubes.

Leaf Bend

Bend applied to leaves.

Flower Bend

Bend applied to flower petals.

Bend Bias

This controls how far down the stroke the bend starts. With a value of 0, the bend starts at the base. With a value of 1, there is no bend. High values cause a faster bending near the tip.

Curl attribute

We've added a Curl attribute to the Tubes Growth section of the Brush Settings Attribute Editor. Curl can be used to curl up leaves and petals. You can create realistic looking flower petals and leaves, such as lotus petals.

You can use the **Bend** attribute to bend leaves or petals in the U direction (along the length), and you can use the Curl attribute to bend leaves and petals in the V direction (along the width). Using these attributes allows

you to create a realistic and sophisticated looking flower with several petals. The Curl attribute is also useful at preventing collisions between petals.

The ramp controls the curl from root to tip of the leaf/petal. The left side of the ramp is the base of the leaf/petal and the right is the tip. Controlling the curl from base to tip can help define the natural shape of petals and leaves, as well as prevent interpenetration within a cluster. The mid line value on the ramp (0.5) represents zero curvature. Many petals and leaf shapes have curvature that is constantly changing. For example, iris petals or mistletoe leaves can be simulated by a wavy curl ramp.

These are the attributes to control Curl:

Leaf Curl

Curl applied to leaves.

Petal Curl

Curl applied to flower petals.

Petal Curl was used to create natural looking petals for this rose
Image courtesy of Yiqun Chen

Twirl attribute

Twirl controls the initial rotation of a leaf or petal relative to the branch. For example, by default a group of leaves at the top of a palm tree would twist sideways. With Twirl you can rotate them to a proper orientation with the flat side facing the ground. We've added Leaf Twirl (Tubes > Growth > Leaves) and Petal Twirl (Tubes > Growth > Flowers) to the Brush Settings Attribute Editor.

These are the attributes to control Twirl:

Leaf Twirl

Twirl applied to leaves.

Petal Twirl

Twirl applied to petals.

Stiffness attribute

Force attributes may affect leaves either too strongly or too weakly. The number of segments in a leaf or flower relative to the base segment count determines how much forces will affect the shape. The Stiffness attribute gives you an independent way of controlling how much the forces, such as Gravity, Random, and Turbulence, affect leaves and flowers. Stiffness affects the way forces act on the leaf. If the Stiffness is set to 1, forces have no effect. If Stiffness is set to 0.5, forces have the same effect per segment that they do on the main branches. If Stiffness is set to 0, forces totally affect the leaf or petal like a limp spaghetti noodle. If you have no forces, such as Spiral and Twist, Stiffness will have no effect.

We've added Twig Stiffness (Tubes > Growth > Twigs), Leaf Stiffness (Tubes > Growth > Leaves) and Petal Stiffness (Tubes > Growth > Flowers) to the Brush Settings Attribute Editor. The default for all of three attributes is 0.5.

These are the attributes to control Stiffness:

Twig Stiffness

Stiffness applied to twigs.

Leaf Stiffness

Stiffness applied to leaves.

Petal Stiffness

Stiffness applied to flowers.

Width Scale attribute

This allows you to use a graph to control the width from root to tip of tubes, rather than using a simple linear interpolation between two values. When combined with the Mesh Brush Type you can define shapes like spheres, as well as control the profile of a leaf. Width Scale is applied as a scale to the current width and defaults to 1.0 so that previous presets work with it.

These are the attributes to control Width Scale:

Width Scale

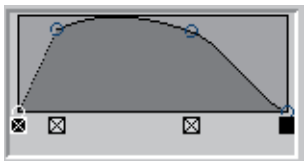
Affects tubes.

Leaf Width Scale

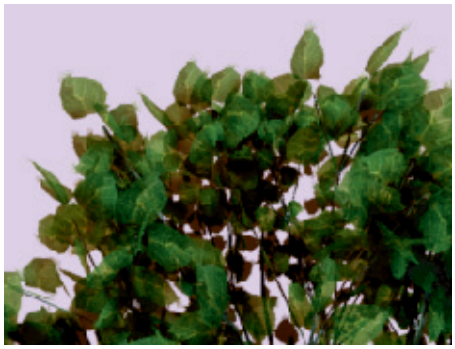
Affects leaves.

Petal Width Scale

Affects flowers.



Click a point along the graph and drag to position it in the graph. The shape of the graph corresponds to the width along the tube, leaf, or petal. In this example, the width would be narrow initially at the base, quickly widening at the middle and then narrow again at the tip.



The graph above was used to scale the Leaf Width for the leaves on the mature birch in the image on the left. As you can see the graph corresponds to a cross section of the shape of the leaf.

Mature birch Image courtesy of Yiqun Chen

Branch After Twigs attribute

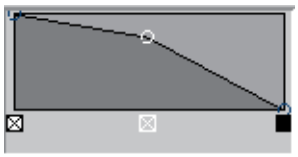
We've added a Branch After Twigs checkbox to the Twigs section of the Brush Settings Attribute Editor (Tubes > Growth > Twigs). Turn this on to put branches on twigs rather than twigs on branches. If Branch After Twigs is turned on, then twigs are evenly distributed along the main trunk and branches split after the twig. The splitting defined by the branch attributes will occur on the twigs. This is useful in helping define many common tree shapes, such as pines. You can have a central trunk with multiple branches splitting off of it. You can also use the Twig Length Scale attribute to adjust the overall profile of the tree; from the twigs' starting point, it controls the density of the twigs and branches along the main trunk. Shorter twigs are adjusted to have fewer branching events and segments.

Before turning on Branch After Twig

After turning on Branch After Twig

Twig Length Scale attribute

The base length of twigs is defined by the Twig Length attribute. However you might want twigs at the tip of a trunk to be shorter than ones at the base. The Twig Length Scale attribute allows you to scale the Twig Length: when it is set to 1.0 then the twigs will equal the Twig Length value, when it is set to 0.5 the twigs will be half the Twig Length value, etc. The horizontal dimension of the graph corresponds to the position from root to tip of the tube from which the twigs sprout.



Click a point along the graph and drag to position it in the graph. The shape of the graph corresponds to the length of the twigs. In this example, the length of the twigs at the base of the trunk would be as specified by the Twig Length, at the middle of the tree they'd be a bit shorter and at the top of the tree they'd be really short. This Twig Length Scale graph was applied to the pine tree as seen in the image to the left.

Specular control on components

You frequently may want leaves, flowers and branches to have a different specularity. The specular intensity is now controlled separately. We've added Leaf Specular (Tubes > Growth > Leaves) and Flower Specular (Tubes > Growth > Flowers) to the Brush Settings Attribute Editor.

These are the attributes to control specularity:

Leaf Specular

Specular control for leaves.

Flower Specular

Specular control for flowers.

Texture Flow attribute

We've added a Texture Flow check box to the Flow Animation section of the Brush Settings Attribute Editor. This moves the texture with flow as defined by Flow Speed (another attribute) in Flow Animation). In general this is best turned off for growth animations (growth with time clipping) because the textures will not move during the plant growth. But this is useful when you want a texture, particularily a displacement, to flow down the tubes. This is on by default.

General improvements

Object Shading menu

The name of the Shading menu in the Paint Effects panel was changed to the Object Shading menu to more accurately reflect what the menu is used for.

Preset Blending

We've modified the procedure for turning Preset Blending on and off. Previously Preset Blending was turned on or off by opening or closing its options window. Now when you select Preset Blending in the Paint Effects menu, a check mark appears beside it indicating it's on. To turn it off, select Preset Blending in the Paint Effects menu again and the check mark disappears. To open the Brush Preset Blend window and set the Shading and Shape values, select Paint Effects > Preset Blending > ❐.

Refresh improvements

The wireframe draw of Paint Effects strokes in the modeling view is now cached, dramatically speeding up refresh, in some cases by a factor of 100 or more. You can now work with the Stroke Settings Display Quality always at 100%. The new default for Display Quality is 100.

To speed up playback, there is a new Paint Effects Performance Settings option with three settings (Window > Settings/Preferences > Performance Settings).

On

Always updates strokes when they change.

Interactive

Updates strokes when changed, except during playback.

Off

Never updates strokes, even when the brushes or strokes are edited.

Animated strokes, for example, through turbulence on the brush, will automatically regenerate during playback, which can make playback slow. The Interactive Performance option is useful when you need fast playback, but you don't need to preview the turbulence animation.

Anti-aliasing quality

There are two new options in the Paint Effects section of Render Globals.

Oversample

Renders the Paint Effects at double resolution for better anti-aliasing.

Oversample Post Filter

Applies a weighted filter to the oversampled image for better smoothing.

These options are particularly useful when rendering Paint Effects fur or hair. Also the new Mesh Brush Type requires oversample be used to anti-alias the tube edges if you don't convert the Paint Effects to polygons.

Artisan

Paint Vertex Color Tool and Script Paint Tool ported to the new Artisan architecture

The Paint Vertex Color Tool and Script Paint Tool have been converted to the new Artisan architecture. For details on using brushes in the revised architecture, see "Brush Tool settings (revised architecture)" in the online Painting guide.

Paint vertex or vertex face

In the Color section of the Paint Vertex Color Tool settings window we've added two Paint options, Vertex and Vertex face. For more information about using this tool, see the online Modeling Polygons guide.

3D Paint Tool

Displacement attribute paintable

Displacement has been added to the Attribute to Paint drop-down list in the File Textures section of the 3D Paint Tool settings. Displacement is now a paintable attribute.

Edit existing textures

You can now edit both the size and file format of existing 3D Paint textures using the Assign/Edit Textures button in the File Textures section of the 3D Paint Tool settings. This button was previously named Assign Textures and was used only for assigning new textures; the button formerly had no effect on existing textures.

Set Erase Image

We've added a Set Erase Image button so you can set the current paint layer as what to erase back to.

Example of using Set Erase Image

1. Paint a base layer, such as a layer of dirt.
2. Click the Set Erase Image button.
3. Flood the layer with a color, such as grey.
4. Erase patches and the dirt layer shows through.

Color, Flood and Opacity

In the 3D Paint Tool settings we've modified the Color section and added a Flood section so you can set Flood Color and Opacity independent of Color and use it independent of the current brush Operation mode.

The Color section now only contains two attributes used for painting: Color and Opacity. The new Flood section also contains two attributes, Color and Opacity; and it has two buttons, Flood Paint and Flood Erase, with Flood options: All and Selected.

To flood paint

1. Specify a Color and Opacity value in the Flood section.
2. Select Flood All or Flood Selected.
3. Click the Flood Color button.

To flood erase

1. Specify an Opacity value in the Flood section.
2. Select Flood All or Flood Selected.
3. Click the Flood Erase button.

8 Fluid Effects

Note Fluid Effects is available only in Maya Unlimited.

For Maya 5, we have added the following functionality to Fluid Effects:

- The ability to define the contents of fluid initial states
- The ability to insert fluid contents with curves
- The ability for objects to push 2D and 3D fluids
- New Pond and Wake fluids.

Fluid Effects > Set Initial State

Fluid Effects > Set Initial State > ❐

With the Initial State Options window, you can set the contents of a fluid's initial state. The contents turned on in the Set Initial State Options window are set in the initial state. By default, all initial state content options are turned on.

The initial state of a fluid is created from the dynamic or static grid contents. When setting the initial state, if a content method has dynamic or static grid attributes but is not turned on in the Set Initial State Options window, a warning appears and you are prompted to either include the grid attributes or omit them from the cache.

Fluid Effects > Add/Edit Contents > Initial States

Fluid Effects > Add/Edit Contents > Initial States > ❐

This Initial State Options window lets you set the resolution of your fluid to that of an example fluid's initial state. By default, fluid examples have a very high resolution. Setting the fluid resolution is useful when you want to match the resolution of a fluid container to that of a fluid example. By default, From Initial State is on.

Fluid Resolution

As Is — Keeps the fluid container's current resolution.

From Initial State	Sets the current fluid container's resolution to that of the fluid example's initial state.

Set Contents with Curve

Set Contents with Curve lets you use a curve to define where contents are added to a fluid container. Like a painted fluid stroke, the curve does not *emit* the fluid but instead inserts *fluid* samples into the fluid container. When setting fluid contents from a curve, the container's fluid Content Methods must be set to dynamic or static. See "Create dynamic fluid effects" and "Create non-dynamic fluid effects" in the Fluid Effects guide.

To add fluid contents with a curve

1. Create a 2D or 3D Fluid container with or without an emitter.

   See "Create a fluid container with a fluid emitter" in the Fluid Effects guide.
2. Draw a curve within the Fluid container.

For more information, search the online help for Drawing Curves.

Note If the curve extends past the boundaries of the container, fluid contents are added to the container *only* where the curve is within its boundaries, and the number of fluid samples are calculated for the *entire* curve.

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3. Select the curve and the container, and then select Fluid Effects > Add/Edit Contents > With Curve > ❐.

   The Set Fluid Contents From Curve Options window appears.
4. Set the options for the fluid contents that are placed in the container by the curve. See "Fluid Effects > Add/Edit Contents > With Curve" on page 103.
5. Click one of the following:
   - Click Apply and Close to apply the defined fluid settings to the fluid contents that are inserted by the curve. The Set Fluid Contents From Curve Options window closes.
   - Click Apply to apply the defined fluid settings to the fluid contents that are inserted by the curve. The Set Fluid Contents From Curve Options window remains open.
   - Click Close to disregard any additions or changes to the fluid settings. The Set Fluid Contents From Curve Options window closes.

6 Set the initial state of your fluid. See "Set or delete the initial state of a fluid" in the Fluid Effects guide.

You must set the initial state of your fluid to retain the contents added to your fluid container by the curve.

Note You now have the option to delete the curve. This will not affect the contents of the container.

Fluid Effects > Add/Edit Contents > With Curve

Fluid Effects > Add/Edit Contents > With Curve > ❐

The following section describes the options of the Set Fluid Contents With Curve Options window.

Density

Sets the density value of the fluid contents that are inserted by the curve. The default amount of density is 1.000.

Velocity

Sets the velocity value (magnitude and vector) for the fluid contents that are inserted by the curve. The default value is 1.000.

Temperature

Sets the temperature value of the fluid contents that are inserted by the curve. The default temperature value is 1.000.

Fuel

Sets the fuel value of the fluid contents that are inserted by the curve. The default fuel value is 1.000.

Color

Sets the color value of the fluid contents that are inserted by the curve. The default color is red.

Operation

Lets you Add to or Replace the contents of the affected voxels. Replace is on by default.

Number Of Curve Samples

Sets the number of samples that are calculated along the curve. For example, if you set the number of curve samples to 1, only one fluid sample on one voxel is generated. For best results, set the number of samples to a number that is greater than the number of voxels you want to affect. The maximum number of samples is 1000.

Radius

Defines the radius in which the fluid contents are inserted along the curve. The radius is measured in the same units as those set in your global user defined preferences. For more information, search the online help for Working Units.

Curve-Based Velocity

Sets the velocity of the fluid contents inserted along the curve to the value specified in the Velocity field of the Set Fluid From Curve options. When this option is on, the velocity's magnitude decreases at high curvature points along the curve and increases at low curvature points. When this option is off, the velocity is stabilized at the specified velocity value and the velocity draw arrows all appear the same length. Curve-Based Velocity is off by default.

Set Initial State

Sets the selected fluid container's Initial State when the contents are applied. Set Initial State is on by default.

Ponds

Ponds are 2D fluids that use a spring mesh solver and a height field. For information on Pond attributes, search the online help for 2D fluid container attributes. With the Pond options and attributes, you can set the size and color of your fluid surface.

You can generate waves, bubbles, and ripples in the fluid surface using Wakes. See "Wakes" on page 105. Increasing the size of your pond extends the range of your waves and ripples.

The Pond menu items function in almost the same manner as the Ocean menu items. For information on Pond menu items and attributes, search the online help for Ocean menu items and attributes.

Create Ponds

To create a Pond fluid

1. Select Fluid Effects > Pond > Create Pond > ❐.

   The Create Pond window appears.

2 Set the Pond options. See "Fluid Effects > Pond > Create Pond" on page 105.

3 Do one of the following:

- Click Create Pond to insert a pond fluid container with the defined size into your scene. The Create Ponds window closes.
- Click Apply to insert a pond fluid container with the defined size into your scene. The Create Ponds window remains open.
- Click Close to disregard any change to the pond size and close the Create Pond menu.

Fluid Effects > Pond > Create Pond

Fluid Effects > Pond > Create Pond > ❐

Size

Defines the size of your Pond fluid. The size of the Pond can be modified by using the container properties of the Pond fluid shape. The default size is 20.000.

Wakes

With the menu item Create Wake, you can create boat wakes, add additional turbulence to an ocean, or generate bubbling and ripples.

A Wake fluid is a fluid container with a Spring Mesh solver. Wake fluids do not use the Navier Stokes solver like regular fluids, but use the new Spring Mesh solver. A fluid emitter is used to drive the motion of the Wake fluid.

Note You can only use Wakes with Ponds or Oceans.

Ocean Wakes differ from Pond Wakes. For Oceans, a Wake is a fluid texture with a Spring Mesh solver that adds additional displacement and/or foam to the Ocean shader. For Ponds, a Wake is a 2D fluid with a Spring Mesh solver that is rendered directly as a fluid.

Create Pond wakes

To place a Wake fluid in a Pond

1 Create a Pond fluid by selecting Fluid Effects > Pond > Create Pond.

A pond appears in your scene view.

2 Select the Pond or an object you want to link to the Wake fluid.

3 Create a wake by selecting Fluid Effects > Pond > Create Wake > ❐.

The Create Wake options window appears.

4 Set the wake options. See "Fluid Effects > Pond > Create Wake" on page 107.

5 Do one of the following:

- Click Create Wake to place a Wake fluid emitter in the current pond, or to place the Wake fluid emitter in your scene and parent it to the selected object. The Create Wake options window closes.
- Click Apply to place a Wake fluid emitter in the current pond, or to place the Wake fluid emitter in your scene and parent it to a selected object. The Create Wake options window remains open.
- Click Close to disregard any changes made to the Create Wake options, and close the Create Wake options window.

6 Set the Wake attributes.

For more information, search the online help for Fluid Emitter attributes.

Create an Ocean wake

To place a Wake fluid in an Ocean

1 Create an Ocean by selecting Fluid Effects > Ocean > Create Ocean.

An Ocean appears in your scene view.

2 Select the ocean and create a wake by selecting Fluid Effects > Ocean > Create Wake > ❐.

The Create Ocean Wake options window appears.

3 Set the wake options. See "Fluid Effects > Ocean > Create Wake" on page 107.

4 Do one of the following:

- Click Create Ocean Wake to place a Wake fluid container in the current Ocean. The Create Ocean Wake options window closes.
- Click Apply to place a Wake fluid container in the current Ocean. The Create Ocean Wake options window remains open.
- Click Close to disregard any changes made to the Create Ocean Wake options, and close the Create Ocean Wake options window.

5 Set the Wake attributes.

For more information, search the online help for Fluid Emitter attributes.

Fluid Effects > Ocean > Create Wake

Fluid Effects > Ocean > Create Wake > ❐

Wake Size

For Oceans, Wake Size sets the size attribute (located in the fluid shape container properties) of the Wake fluid.

Wake Intensity

This value determines the magnitude of the wakes. In the fluid emitter attributes, this value is Density/Voxel/Second. The default intensity is 5.00.

Note A negative Wake Intensity value pushes the fluid surface down while a positive value pushes the surface up.

Foam Creation

This value determines the amount of foam generated by the fluid emitter. In the fluid emitter attributes, this value is the Heat/Voxel/Second. For Oceans, this value directly affects the foam. The default amount of foam is 0.00.

Fluid Effects > Pond > Create Wake

Fluid Effects > Pond > Create Wake > ❐

Wake Size

For Ponds, the size of the Wake fluid is determined by the size attribute of the Pond fluid container.

Wake Intensity

This value determines the magnitude of the wakes. In the fluid emitter attributes, this value is Density/Voxel/Second. The default intensity is 5.00.

Note A negative Wake Intensity value pushes the fluid surface down while a positive value pushes the surface up.

Foam Creation

This value determines the amount of foam generated by the fluid emitter. In the fluid emitter attributes, this value is the Heat/Voxel/Second. For Ponds, this value corresponds with the temperature input on the shading ramp attributes. The default amount of foam is 0.00.

Fluid Effects > Make Motion Field

With Make Motion Field, you can accurately simulate objects moving through a fluid. This new field applies a force to its parent object, so that the object then appears to move or push the fluid.

Note Motion fields can only be used with 2D and 3D fluids.

Example

For the animation of a character walking through thick fog, you can apply a motion field to the character so that it appears to push through the fog while it is in motion.

Motion field attributes

Fluid Motion fields have the same attributes as regular Uniform Fields in Maya, with the exception of Push Intensity.

For more information, search the online help for Uniform Field attributes.

Push Intensity

Sets the magnitude of the Motion field. The greater the Push Intensity, the greater the amount of fluid that is pushed or moved by the Motion field's parent object.

Note The Push Intensity of a Motion field automatically increases and decreases according to the speed of its parent object.

Create Motion field

To create a Motion field

1. Create a fluid container with an emitter.
2. Select the fluid, and then the object that you want to move the fluid.
3. Select Fluid Effects > Make Motion Field.

   The Motion field appears, and is automatically parented to the object.

Workflow for using Motion fields

1. Create a Motion field.
2. In the Volume Control Section of the Motion field's attributes, select a Volume Shape that closely matches that of the object to which it is parented.
3. If necessary, transform the motion field to match the shape of its parent object.
4. Set the Push Intensity in the Motion field attributes.

   The Push Intensity slider is located in the Extra Attributes section under the motionField tab.

Cache Contents

You can view the contents of your fluid's cache with the Cache Contents attributes. These read-only attributes are a useful reference when working with cached fluids. Once a fluid is cached, you can view its contents from the *initialState_fluidShape* node or the *cache_fluidShape* node in the Attribute Editor.

Note	The initialState node displays the cache contents present at the start frame, and the cache node displays the cache contents present at the current time.

New Emitter Attribute

We have added the Jitter attribute to all emitters so that it can be turned on for normal emitters and off for Wakes. With normal fluid emitters, the emission sampling is jittered to provide smoother emissions over time. However, for Wakes, which use the Spring-Mesh solver, turning off jitter usually results in a more stable solution. For when Jitter is turned on for Wake emitters, boiling and sizzling effects occur. Jitter is off by default for Wake emitters.

New Fluids Command

You can access worldspace information about your fluid's voxels with the new *fluidVoxelInfo* MEL command. For example, use this command to locate the center of a voxel in worldspace. For more information about this command, select Help > MEL Command Reference from the Maya main menu bar.

New Fluid Examples

We have created new fluid examples to aid you in creating fluid effects with our new Ponds and Wakes. Select Fluid Effects > Get Fluid Example or Fluid Effects > Get Ocean/Pond Example to access fluid examples in the Visor. Select Fluid Effects > Fluid Examples on the Web to download fluid examples from the web.

9 Fur

Note Fur is available only in Maya Unlimited.

New Fur presets

On the Fur shelf we've added several new Fur presets, including Bison, Duckling, Calico Cat, Wet Otter, Wet Labrador, etc., and we've updated the existing presets (Sheep, Bear, Llama, etc.) . If you are an upgrading customer, these new presets will not automatically appear on your Fur shelf; follow the instructions below in "For upgrading customers" on page 111.

For upgrading customers

1. If you have a Fur shelf, delete it.
   - Select the Fur shelf tab.
   - Click the Shelf pull-down menu  and select Delete Shelf.
   - Select OK when prompted to delete the shelf.
2. Open the Script Editor (Window > General Editors > Script Editor).
3. In the Script Editor, type:

```
loadNewShelf "shelf_Fur.mel";

saveAllShelves $gShelfTopLevel;
```

4. Select Script > Execute.

Fur attractors on polygons

Now you can create attractors either as a grid, or on the selected faces of a polygon. Use attractors to add movement to Fur.

To create a grid of attractors on polygons

1. Select the polygon with fur on it and click the Select Tool.
2. Select Fur > Create Attractor.
3. Select the *A grid of attractors on the selected surface* option and then click Create.

To create a single attractor at a selected polygon face

1. Select the polygon with fur on it and click the Select Tool.

2. Right-click the polygon and select Face.
3. Select the face on the polygon where you want to add an attractor.
4. Select Fur > Create Attractor.
5. Select the *One attractor at the selected surface point(s)/face(s)* option and then click Create.

For more information see the Fur guide, Chapter 4, "Adding movement to Fur."

Attractors on multiple surface points/faces/surfaces

Now you can create attractors on multiple surface points/faces/surfaces simultaneously for both NURBS and polygons.

Fur clumping

You can now create clumps of fur, such as wet or matted fur. This provides a whole new range of fur looks.

This example has the Clumping Frequency mapped using a radial ramp to vary the size of the clumps over the surface. You can also paint this value, as well as the degree of Clumping and the Clump Shape.

In the Fur Description Attribute Editor we've added three attributes to create and control clumping. As with all Fur attributes, painting and mapping are supported.

In order to preview clumping accurately, set the Fur Accuracy attribute to 1, which is in the shape node of the Fur Feedback Attribute Editor.

Clumping respects other attributes, including Inclination, Roll, and Polar. For example, if Inclination is set to 1 so the fur is lying flat, then the clumps lie flat too.

Note With clumping there may be the appearance of gaps between the clumps on the surface of the object. To correct this use one or more of the following solutions:

- Apply the same color to the shader that is applied to the Fur's Base Color.
- Add an additional Fur Description of overall short fur that matches the color of the first Fur Description.
- Add some noise to Clumping, Clump Frequency, or other values.

Clumping

The degree to which the hairs are pulled in towards the centre of the clump. The higher the clumping value, the more the hairs are pulled in. The range is from 0 to 1. The default is 0, which means no clumping.

Clumping Frequency

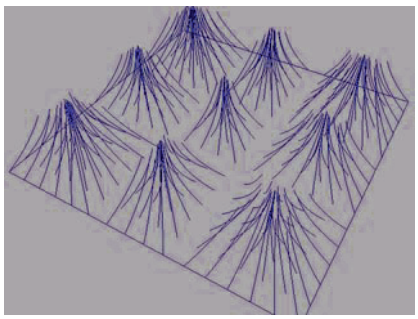
Controls how many clumps occur across the surface. The higher the frequency, the greater the number, and therefore the smaller the size of the clumps. The range is from 0 to 100. The default is 5.

As you increase the Clumping Frequency, the rendering time increases.

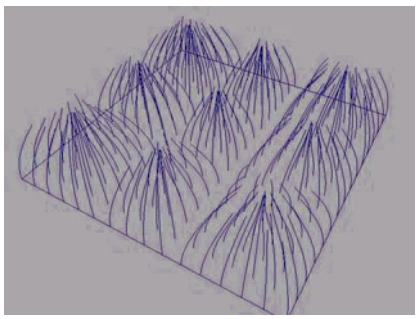
Unlike other Fur attributes, the number of feedback hairs (samples) affects the Clumping Frequency. For example, at a frequency of 100 there will be 1 clump for every feedback hair.

Clump Shape

Controls the shape of the curve of the hair as it is attracted to the center of the clump. Negative values create a concave shape and positive values create a convex shape. The range is from -10 to 10.



Clump Shape value of -10 is concave



Clump Shape value of 10 is convex

Clumping Noise attributes

All existing Maya Fur attributes have both Noise Amplitude and Noise Frequency attributes, and the same is true for clumping. See the Details section of the Fur Description Attribute Editor. Use these Noise attributes to add randomness and make the fur look more realistic.

Clumping noise	The degree of randomness around the strength of the clumping effect.
Clumping Frequency noise	The degree of randomness around the frequency of the clumps.
Clump Shape noise	The degree of randomness around the shape of the curve of attraction towards the centre of the clump.

Note: To apply clumping to fur scenes created before Maya 5, detach the Fur Description and then reattach it. This updates the Fur Description so it understands the clumping attributes. See the procedure below.

To apply clumping to fur scenes created before Maya 5

1. Select the object with the Fur Description.
2. Select Fur > Fur Description (more) > Detach > *FurDescriptionName*, where *FurDescriptionName* is the name of the Fur Description.
3. Select Fur > Attach Fur Description > *FurDescriptionName*, where *FurDescriptionName* is the name of the Fur Description.

To create clumps of fur on part of an object, for example, on the chest fur of a cat

1. Select the object with the fur on it.
2. Select Fur > Paint Fur Attributes Tool. The Paint Fur Attributes Tool Settings window appears.
3. Select Clumping from the Fur Attribute drop-down list.
4. In the Script Paint Tool window set Value to 0 and then click Flood. This removes clumping from the object.
5. Set Value to 1 and paint on the object where you want clumps.

To map or paint ranges that are greater than 0 to 1, such as Clumping Frequency

Set the attribute's Map Multiplier value to the maximum value of the range. In the case of Clumping Frequency, this value would be 100.

Now you can paint or map the attribute as usual. White will represent the Multiplier value (100), black will represent 0, and grayscale values will be distributed evenly between.

To map or paint ranges that can be negative, such as Clump Shape

1. Set the attribute's Map Offset value. For example, set the Map Offset to -10 for Clump Shape.
2. Set the attribute's Map Multiplier Value. For Clump Shape this would be 20 so the black to white map would represent the full range of -10 to 10.

New Map Width and Height attributes

We've added two new attributes for defining the size or resolution of equalizer and attribute maps.

Map Width

Defines the width of the equalizer or attribute map. The default is 256.

Map Height

Defines the height of the equalizer or attribute map. The default is 256.

Attribute maps

When mapping a texture and then baking to a file you can specify the attribute Map Width and Map Height in the Fur Description Attribute Editor so that baking operations create attribute maps according to these values.

When painting a fur attribute on a surface you can specify the attribute Map Width and Map Height in the Paint Fur Attributes Tool so the painting operation creates a map according to these values.

Equalizer Maps

The Equalizer Map Width and Equalizer Map Height attributes define the size (resolution) of the equalizer map, for example, 512 x 512. These attributes can be set in the Advanced Fur Rendering window if creating an equalizer map during Advanced Fur Rendering or in the Fur Globals window if doing regular rendering.

Mapping Fur attributes to animated file textures

Fur attributes can now be mapped to animated file textures. Map the attribute in the normal way, animate the file extensions and then click Bake.

10 Cloth

Note Cloth is available only in Maya Unlimited.

Start/Stop Simulation

We've modified the Start Simulation and Stop Simulation menu items in the Cloth menu to be Start Local Simulation and Stop Local Simulation so they specify the type of simulation.

Specify number of iterations for local simulation

You can specify the number of iterations to go through for a local simulation using the *localSimulationFramesMax* attribute in the CpSolver node. For example, this is useful if you only want to run the local simulation for 10 frames. In this case you would use the *setattr* command in the Command Line to change this attribute to 10.

Intermediate cache saving

We've added a Cache Save Interval attribute to the Solver Attribute Editor. The default value is 0, but you can set it to any value. For example, if you set it to 10, caches will be saved every 10 frames during simulation.

Cloth simulation is often processing intensive and sometimes time consuming. By saving simulations in small increments this can often overcome situations where an entire simulation is lost. As such the ability to save partial caches has been implemented.

Save Cache

We've added a Save button to the Solver Attribute Editor, beside the Cache Name attribute. This allows you to save the cache when you want to, ensuring that successful simulations are retained.

Query stiffness for seams

When you connect two pieces of cloth together using Cloth > Create Seam, a seam is added that allows you to control the stiffness. Most seams in real clothing have some stiffness as the material gets doubled, tripled or quadrupled.

The cpSeam MEL command now allows you to query the stiffness. In the Command Line or Script Editor, type:

```
cpSeam -query -stiffness;
```

11 MEL

New MEL commands

- **artUserPaintCtx**
- **attrControlGrp**
- **catchQuiet**

  Similar to **catch** but does not print an error message.
- **dgtimer**

  See "Improve scene efficiency with the dgtimer command" on page 119.
- **fluidVoxelInfo**
- **pairBlend**
- **parentConstraint**
- **polyReduce**
- **rehash**

  See "Turn on script path caching to improve network performance" on page 123.
- **renderer**

Improve scene efficiency with the dgtimer command

Overview

The new Maya DG debugging tool (**dgtimer**) allows you to:

- Measure the amount of time spent in the compute methods of each node in the scene file.
- Determine the inclusive computation time for a DG chain (a node plus its descendents).
- View the number of times each node's compute method was executed.
- Detect nodes which have never been executed.

How it works

- Implemented by the new **dgtimer** MEL command.
- Uses built-in hardware timers where available and thus has virtually no overhead.

- Each node can be thought of as having its own timer which can be reset, turned on or off individually.
- Only measures "compute" time (which includes data propagation time). Other statistics such as dirty propagation time are not currently being recorded but could be future enhancements.

Usage

Global options

-on

Turns on node timing. Can be specified with -name to turn on timing for a single node, with -type for all nodes of a given type, otherwise all nodes are turned on. Turning on timing causes the computation time for nodes which are on to sum into the node's timer value.

-off

Turns off node timing and is the converse of the -on flag.

-reset

Resets the node's timer values to zero seconds. Can be specified with the -name, -type or -on.

-q-query

Prints the value(s) of the specified node's timers. Can be used with the Query options listed below.

Options which can be used with any of the global options

-name nodename

Specifies the name of a node to be affected by the dgtimer operation.

-type typename

Specifies the node type to be affected by the dgtimer operation.

-h-hierarchy

Can be used with -name or -type to affect all descendents of the selected node(s).

Query options

-ct -combineType

Causes the query to combine all nodes of the same type on a single line of output.

-m -maxDisplay numLines

Limit the display to the most expensive numLines entries.

-o -outputFile fileName

Specifies a file that the query will be written to (the default is stdout). A special case is `-outputFile MEL`, which allows easy grabbing in a MEL script.

-th -threshold *percent*

Truncates reporting after the percentage of the total execution time drops below *percent*.

Query output format

Output columns when using -query:

Rank

The position of a given node (or node type when using -combineType) as sorted by Self time.

ON

If this node's time is currently on, a Y is displayed, otherwise an N is displayed.

Self time

The total amount of time in seconds spent executing the node (or node type's) compute method.

Percent

The Self time expressed as a percentage of the total Self time for all nodes.

Cumulative

A running total of Self time.

Inclusive

The total computation time for the node (or node type) and all its descendents in the DG.

Count

The total number of times the node (or node type) has been computed.

Type Name

The type of the node and the name of the node (the name is omitted when `-combineType` is specified).

Examples

Turn on timing, play the scene, and then dump the timer values to stdout:

```
dgtimer -on -reset
playback -wait
dgtimer -maxDisplay 10 -query
```

This generates the following output:

```
MAYA DEPENDENCY GRAPH TIMING INFORMATION
----------------------------------------
Global DG timing is currently: ON

Total time since last global timer reset:
Total real time  : 2.1784 sec
Total user time  : 1.44 sec
Total sys time   : 0.07 sec
Real time in DG eval: 1.37719 sec

Per-node timing information:
Rank ON  Self time Percent Cumulative  Inclusive  Count  Type Name
   1 Y     1.2366  89.79%     1.2366     1.2596     327  cpClothSolver cpSolver1
   2 Y     0.0225   1.63%     1.2591     0.0231     720  transform     locator
   3 Y     0.0103   0.75%     1.2694     0.0247      29  gravityField gravityFieldShape1
   4 Y     0.0049   0.36%     1.2743     0.0054      30  pointEmitter  emitterShape1
   5 Y     0.0048   0.35%     1.2791     1.2637      30  mesh          clothShape1
   6 Y     0.0011   0.08%     1.2802     0.0011     121  time          time1
   7 Y     0.0010   0.07%     1.2812     0.0010     174  transform     particle1
   8 Y     0.0001   0.01%     1.2813     0.0001      66  cpPanel       panelShape1
   9 Y     0.0001   0.01%     1.2815     0.0001      95  cpSeam        seamShape1
  10 Y     0.0001   0.01%     1.2816     0.0001      66  cpPanel       panelShape1
-------------------------------------------------------------------------------

288        1.2463 100.00%     1.2463     2.7160    1969
```

Turn off timing for all nodes, reset all timers to zero, and then turn on timing for node cpSolver1 and all its descendents. Query the timer and output to a file on disk.

```
dgtimer -off -reset
dgtimer -on -name cpSolver1 -hierarchy
dgtimer -name cpSolver1 -outputFile /home/toon1/timer_info
```

Turn on script path caching to improve network performance

We've added the ability to cache script paths to MEL. This lets MEL find scripts more efficiently.

To ensure this change does not affect core MEL functionality, the caching feature is disabled by default. To turn caching on, set the `MAYA_CACHE_SCRIPT_PATH` environment variable in the `Maya.env` file in your prefs directory.

We encourage you to try this feature if you use many copies of Maya on a network. Caching can significantly reduce network traffic when any part of a user's script path points to a network location.

When caching is on, Maya will not be able to tell when scripts are added to or removed from the cached script directories. Use the **rehash** command to update the cache.

New catchQuiet structure

The new **catchQuiet** structure works like **catch**, however it does not print an error message.

11 | MEL

> New catchQuiet structure

12 Translators

New features in translators

The following new file import/export and translation features are available:

- IGES for Linux and Mac OS X
- Studio import changes
- DXF/DWG import/export
- OBJ .mtl (material) file support
- OpenFlight changes for version 1.1

IGES for Linux and Mac OS X

This functionality is now available on Linux and Mac OS X through a plug-in. The IGES option is available as a File Type in the Import and Export options dialog boxes when this plug-in is loaded.

Studio import

This functionality is available through a plug-in. The studioImport option is available as a File Type in the Import option dialog boxes when this plug-in is loaded.

Many bugs in the studioImport functionality have been fixed in Maya 5.

You can set the following options in the Import Options dialog box when studioImport is selected:

Up Axis

You can select one of Y, Z, or From File. This allows you control over the co-ordinate system.

Raytrace

If selected, Maya will optimize the import for raytracing. If not checked, it chooses ray casting (default).

Include Cameras

If selected, cameras are brought in from the Studio data. Default is off.

DXF/DWG import and export

The ability to import and export DWG format is new in Maya 5. The ability to import and export DXF format is new on Linux and Macintosh in Maya 5. This enables Maya to read and write AutoCAD files. All versions from 1 to 2000 are supported.

This functionality is available through a plug-in. The DXF and DWG options are available as File Types in the Import and Export options dialog boxes when the dwgTranslator plug-in is loaded.

You can set the following options in the Import Options dialog box when DWG_DXF is selected:

Override file units with

Allows you to control what units are being used in Maya. This will map the file units to the unit selected. If this option is not selected, the units in the file will be used.

Select one of millimeters, centimeters, meters, inches, feet, yards, miles.

Scale factor

Default is 1.0. You can select the scaling factor.

You can set the following options in the Export Options dialog box when DWGExport or DXFExport is selected:

Output file format

By default, this is AutoCAD 2000. Select another option, if necessary.

Units

Select one of millimeters, centimeters, meters, inches, feet, yards, miles.

Scale factor

Default is 1.0. You can select the scaling factor.

Polygon mesh options

Tessellation	Select one of No Tessellation, Triangulate, or Quadrangulate.
Export as	Select one of PolyMesh face (default), Separate polygons, or 3DFace. These are AutoCAD entities that give you better control. You select them depending on what you want to do in AutoCAD.

NURBS Surface Tessellation Options

Type	Triangulate or Quadrangulate

Method General, standard, or count.

Chord Height Ratio, Fractional Tolerance, Minimal Edge Length, 3D Delta

For more information on these options, see the documentation on the NURBS to polygons tool.

OBJ .mtl file support

Maya now supports the import and export of `.mtl` files on all platforms. `.mtl` files define material properties as used in `.obj` files.

OpenFlight changes (version 1.1)

OpenFlight Menu

An OpenFlight menu is added to the main window when the OpenFlight plug-in is installed. The menu contains the following menu items:

- "OpenFlight > Create Light Points" on page 127
- "OpenFlight > Create Light Points on Curve" on page 128
- "OpenFlight > Edit Light Points Color" on page 128
- "OpenFlight > Edit Light Points Normal" on page 128

OpenFlight > Create Light Points

Invokes the fltLightPoints command to create a new set of light points in the scene.

OpenFlight > Create Light Points > ❐

Number of Light Points

Sets the number of light points.

Distance Between Light Points

Sets the distance between light points.

Light type

Choose one of Omnidirectional, Unidirectional, or Bidirectional.

Light Normal

Only active when the light type is unidirectional or bidirectional. Set the light normal.

Light Color

Sets the light color.

OpenFlight > Create Light Points on Curve

Invokes the fltLightsOnCurve script to create light points along a selected curve.

OpenFlight > Create Light Points on Curve > ❒

Number of Light Points

Sets the number of light points.

Light type

Choose one of Omnidirectional, Unidirectional, or Bidirectional.

Light Color

Set the light color.

OpenFlight > Edit Light Points Color

Used to change the color of selected light points.

To change the color of selected light points

1. Select the light points to modify.
2. From the OpenFlight menu, select Edit Light Points Color.

   The Light Points Color Editor appears.
3. Select the color to apply to these light points in the color slider.
4. Click the Apply (or Apply and Close) button to apply the color to the selected light points.

This dialog box works with light points selected in object mode and with light points selected in component mode.

OpenFlight > Edit Light Points Normal

Allows you to change the normal of any selected light points.

To change the normal of any selected light points

1. Select the light points to modify.
2. From the OpenFlight menu, select Edit Light Points Normal.

   The Light Point Normal Editor appears.

3 Enter the value of the new normal to apply to these light points.

4 Click the Apply (or Apply and Close) button to apply the normal of the selected light points.

This dialog box works with light points selected in object mode and with light points selected in component mode.

Light point functionality

Light point functionality has been extended to display the effects of several more attributes of light point shapes:

- Directional Type
- Intensity
- Directional Ambient Intensity
- Back Intensity
- Horizontal Lobe Angle
- Vertical Lobe Angle
- Roll Lobe Angle
- Normals Display
- Lobe Display

Both Normals Display and Lobe Display have no Creator equivalent. They are used to control the visibility of the normal and lobe of light points as you develop your scene inside of Maya. You cannot display lobes of omni-directional lights.

Currently the back color only displays as red regardless of the actual value set. This default color does respond to the back and ambient intensities to enable more sophisticated simulation.

Additional Light Point Maya Node Attributes

Name Long (Short)	Type	Default	Flags
DisplayNormals (dn)	Boolean	false	RWSK
DisplayLobe (dl)	Boolean	False	RWSK

fltLightPoints Command

A new flag has been added to the fltLightPoints command to specify the directional type of the light point when it gets created:

Flag:

-dt (ce) Type must be one of "OMNIDIRECTIONAL", "UNIDIRECTIONAL", or "BIDIRECTIONAL". By default, light points are omnidirectional.

-dnml (ce) Enable or Disable the display of normals (true/false)

Examples:

```
// this creates a light point string with 5 light points and
visible normals
fltLightPoints -c 5 -dnml true;
// this makes the normals of the selected light points
string invisible and
// changes the light type to be Unidirectional.
fltLightPoints -e -dnml false -dt UNIDIRECTIONAL;
```

Shading Models—Flat Shading

OpenFlight objects have a flat shading flag, which specifies whether the object is to be drawn with flat shading or Gouraud (smooth) shading. This flag is now connected with the Smooth Shading attribute of polygons in Maya (as found in the Render Stats tab of the Attribute Editor for the shape).

While OpenFlight supports the flat shading flag at the object level as well as at the face level, Maya only supports the flag at the object level. Thus, the flat shading flag of any object imported into Maya must be set identically for the object and all its faces.

Illumination

The illumination flag of OpenFlight objects specifies whether the object is to be illuminated by nearby lights or whether it is exclusively self-illuminating.

When importing a self-illuminating object, the following attributes of the corresponding Maya object are turned off: Casts Shadows, Receive Shadows, Visible in Reflections, and Visible in Refractions. When the imported object is not self-illuminating, all these attributes are turned on.

When exporting a Maya object to OpenFlight, the self-illumination flag is set if and only if the Receive Shadows attribute of the Maya object is turned off.

Light Sources

Support has been added to Maya for OpenFlight light sources. They can be imported and exported into OpenFlight files, with the following restrictions:

Import

- Modeling lights are not supported
- OpenFlight Infinite lights are imported into Maya as directional lights
- OpenFlight Local lights are imported into Maya as ambient lights
- OpenFlight Spot lights are imported into Maya as spot lights

Export

- Directional lights are exported as infinite lights
- Ambient lights are exported as local lights
- Spot lights are exported as spot lights
- Light types not supported by OpenFlight (area lights, point lights) are exported as infinite lights
- Modeling lights are not supported

Notes
- One light palette is created for each light source
- The orientation of the light palette is always Yaw = 0, Pitch = 0

Other limitations

No transformations on externally referenced nodes will be saved out to OpenFlight format. To transform a referenced file from within the current scene, the DAG root objects in the referenced file should be grouped, and any transformations should be applied to the group node.

Known Issues

The following outlines the known issues in OpenFlight:

- It is not possible to change the Maya display color of a unidirectional or bi-directional light. This color always defaults to red. It is expected that future releases will have the ability to map back colors to RGB display.
- An attempt is made to map Eye Points to Cameras in Maya; however, the mapping appears incorrect in some cases. Eye points are not exported from Maya.
- Track Planes are not supported.
- The only way to freeze a DOFs co-ordinates from within Maya is to export the scene as an OpenFlight file and then read it back in.
- Articulations on group nodes are not supported.
- Maya's LODs need to be extended to better handle the flexibility of the OpenFlight LODs.
- UI-based tools are missing to support Switch nodes, and LODs.
- If you perform a Freeze Transformations on a translated Light Point, Maya versions older than 4.0.3 will crash. This can be fixed by updating to Maya 4.0.3.
- File textures may only be applied to the color attribute of a Maya shader. Textures applied to other attributes are ignored.
- The only export type supported is OpenFlight 15.7.

13 API and DevKit

This release contains many improvements to the Maya API. New classes have been added to the API along with improvements to existing classes. In addition, we have new examples and updates to existing examples.

New classes and header files

- MFnParticleSystem

  Provides access to particle information. The dynamics of a particle node are evaluated at a chosen time and information such as particle name, position, age, etc. can be accessed.

- MFnVolumeLight

  For creation and manipulation of volume lights. The light shape (box, sphere, volume, cone) and the light direction can be specified. Additional attributes such as arc, coneEndRadius, emitAmbient, color ramp and penumbra ramp can be accessed and set.

- MItInstancer

  A particle instancer node iterator to traverse all instancer nodes in the dependency graph. Filter types can be applied to the iterator.

- MIOStream.h

  A header file that controls the including of the iostream system functionality in the API. Developers can define REQUIRE_IOSTREAM to include “iostream” rather than “iostream.h” on Linux.

- MLockMessage

  Allows listening for events associated with Maya node and plug locking.

  When you attach an MLockEvent callback, you can listen for queries to a plug or node’s lock state.You can also control how Maya responds to the lock query (that is, you can override the default behavior of a lock). You can use this to implement finer locking granularity than what Maya provides.

- MPx3dModelView

  Creates custom model views. Works with MPxModelEditorCommand to create a user defined model editor that can be used in a window or scripted panel.

- MPxModelEditorCommand

  Creates custom editors. Provides flags and options of the model editor command and works in conjunction with MPx3dModelView.

- MPxObjectSet

  Creates new types of sets. Attributes such as dag set members and nodes which use the set are available from this class.
- MPxPolyTweakCommand

  A command base class used for moving polygon UVs.
- MRampAttribute

  Affects ramp attributes of MFnVolumeLight. This class is used to add, delete and set entries for color and curve ramps.

Examples

New examples

- blindDataMesh

  Demonstrates the use of a hardware shader that receives its input from blind data.
- cgFxShader (Windows only)

  Demonstrates the integration of hardware shading and the cgFx language.
- flipUVCmd

  Demonstrates the use of the new MPxPolyTweakUVCommand class to flip mesh UVs.
- lockEvent

  Demonstrates the API callbacks for node and plug locking.
- maTranslator

  Demonstrates the use of the MPxFileTranslator class to write out a close approximation of the Maya ASCII file format.
- meshOpCmd

  Demonstrates the use of the new high level polygon API methods added to MFnMesh.
- volumeLightCmd

  Demonstrates the use of the new MFnVolumeLight class.
- particleSystemInfoCmd

  Demonstrates the usage of the MFnParticleSystem class by writing particle information frame by frame.

Important changes to existing examples

- marqueeTool can now be used with software overlays. You must enable the USE_SOFTWARE_OVERLAYS define and recompile the plug-in.
- apiMeshShape has now been improved significantly to fix problems in the original example. In addition, this example has been updated to take advantage of the new functionality added to MPxSurfaceShape.
- The `simpleHwShader` example is obsolete and is no longer shipped. Developers should instead look at the `hwUnlitShader` because it is more realistic.

Important changes to existing classes

M3dView

Support for additional view information.

New enum for use with the MPx3dModelView class.

`DisplayObjects`

Methods:

```
MString viewSelectedPrefix(MStatus *ReturnStatus) const;
```

Returns the prefix name used when displaying the camera name in the heads up display when the view selected is on.

```
MStatus setViewSelectedPrefix(MString &prefix);
```

Set the prefix name used when displaying the camera name in the heads up display when the view selected is on.

```
bool showViewSelectedChildren(MStatus *ReturnStatus) const;
```

Tests if the selected view displays all of the children of the objects that are flagged for the view selected.

```
MStatus setShowViewSelectedChildren(bool);
```

Allows only the objects in the view selected set and their shapes to be drawn.

```
static MStatus getM3dViewFromModelPanel(const MString
&modelPaneName, M3dView &view);
```

Return the view given a panel.

```
static Mstatus getM3dViewFromModelEditor(const MString
&modelPaneName, M3dView &view);
```

Return the view for the model editor.

MDGModifier can lock and unlock nodes

You can now lock and unlock nodes with the MDGModifier class. This lets you implement undo of node locking operations.

```
MStatus setNodeLockState( const MObject & node, bool newState
);
```

MFileIO now can prevent users from saving over the current file

You can set a new mode through the MFileIO class to prevent the user from saving over the current scene file. When the user tries to save the current scene, Maya will present a Save As dialog box.

```
static bool mustRenameToSave(MStatus *ReturnStatus = NULL);
```

Return if the user is forced to rename their file in order to do a save.

```
static MStatus setMustRenameToSave(bool);
```

Set whether or not the user is forced to rename their file in order to do a save.

```
static MString mustRenameToSaveMsg(MStatus *ReturnStatus =
NULL);
```

Get the message Maya displays when the user is forced to rename prior to a save.

```
static MStatus setMustRenameToSaveMsg(MString &);
```

Set the message Maya displays when the user is forced to rename prior to a save.

MFnCamera

You can now access and modify the transformations that control film back roll with the following new methods:

```
MStatus setHorizontalRollPivot( double horizontalRollPivot );
```

Set the horizontal roll pivot for film back roll.

```
double horizontalRollPivot( MStatus * ReturnStatus = NULL )
const
```

Returns the current horizontal roll pivot value.

```
MStatus setVerticalRollPivot( double verticalRollPivot );
```

Set the vertical roll pivot for film back roll.

```
double verticalRollPivot( MStatus * ReturnStatus = NULL )
const
```

Returns the vertical roll pivot's value.

```
MStatus setFilmRollValue( double filmRollValue );
```

Set the film roll value for film back.

```
double filmRollValue( MStatus * ReturnStatus = NULL ) const;
```

Returns the current roll value in radians.

```
MStatus setFilmRollOrder( RollOrder filmRollOrder );
```

Set the order in which the film back rotation is applied with respect to the pivot point.

```
RollOrder filmRollOrder( MStatus * ReturnStatus = NULL )
const;
```

Returns the current roll order.

```
MStatus setPreScale( double sf );
```

Set the pre scale value.

```
double preScale( MStatus * ReturnStatus = NULL ) const;
```

Return the post projection matrix's pre-scale value

```
MStatus setPostScale( double sf );
```

Set the post scale value.

```
double postScale( MStatus * ReturnStatus = NULL ) const;
```

Return the post projection matrix's post-scale value.

```
MStatus setFilmTranslateH( double translate );
```

Set the horizontal film translate.

```
double filmTranslateH( MStatus * ReturnStatus = NULL ) const;
```

Returns the horizontal film translate value.

```
MStatus setFilmTranslateV( double translate );
```

Set the vertical film translate.

```
double filmTranslateV( MStatus * ReturnStatus = NULL ) const;
```

Returns the vertical film translate value.

```
MFloatMatrix postProjectionMatrix( MStatus * ReturnStatus =
NULL ) const
```

Returns the post projection matrix used to compute film roll on the film back plane.

MFnDependencyNode

We have improved this class to prevent the user from adding duplicate attributes on a node (duplicate attributes lead to low-level problems in Maya and should never be created).

Support for per-node flags have been added:

```
static unsigned allocateFlag( const MString pluginName,
MStatus* ReturnStatus=NULL );
```

Reserve the use of a bitflag on all nodes.

```
static MStatus deallocateFlag(const MString pluginName,
unsigned flag);
```

Relinquish the use of a bitflag on all nodes.

```
static MStatus deallocateAllFlags(const MString pluginName);
```

Relinquish the use of all reserved bitflags on all nodes.

```
MStatus setFlag(unsigned flag, bool state);
```

Set the value of a bitflag on a node.

New methods to query node settings:

```
MObject reorderedAttribute( unsigned index,MStatus*
ReturnStatus=NULL);
```

Returns the attributes according to the reordering that is required for file I/O.

```
bool isNewAttribute( const MObject& attr,MStatus*
ReturnStatus=NULL);
```

Returns if the attribute was added to this node within the current scene.

```
bool isDefaultNode(MStatus* ReturnStatus=NULL) const;
```

Returns if the node is a default node.

```
bool canBeWritten(MStatus* ReturnStatus=NULL) const;
```

Returns if the node can be written to scene files.

```
bool isFlagSet(unsigned flag, MStatus* ReturnStatus=NULL)
const;
```

Return the value of a bitflag on a node.

MFnMesh

Support for creating mesh objects with UVs and performing high level polygon operations. High level polygon operations include splitting, subdividing, extruding, extracting, collapsing and duplicating.

Creation:

```
MObject create( int numVertices, int numPolygons,
      const MFloatPointArray &vertexArray,
      const MIntArray &polygonCounts,
      const MIntArray &polygonConnects,
      const MFloatArray & uArray,
      const MFloatArray & vArray,
      MObject parentOrOwner  = MObject::kNullObj,
      MStatus * ReturnStatus = NULL );
MObject create( int numVertices, int numPolygons,
```

```
      const MPointArray &vertexArray,
      const MIntArray &polygonCounts,
      const MIntArray &polygonConnects,
      const MFloatArray & uArray,
      const MFloatArray & vArray,
      MObject parentOrOwner  = MObject::kNullObj,
      MStatus * ReturnStatus = NULL );
```

High Level Polygon Operations:

```
Mstatus split( MIntArray &placements, MIntArray &edgeList,
      MFloatArray &edgeFactors,
      MFloatArray &internalPoints );
MStatus subdivideFaces(MIntArray & faceList,
      int divisionCount);
MStatus subdivideEdges(MIntArray & edgeList,
      int divisionCount);
MStatus extrudeFaces(MIntArray & faceList,
      int extrusionCount,
      MFloatVector* translation,
      bool extrudeTogether);
MStatus extrudeEdges(MIntArray & edgeList,
      int extrusionCount,
      MFloatVector* translation,
      bool extrudeTogether);
MStatus duplicateFaces(MIntArray & faceList, MFloatVector*
translation);
MStatus extractFaces(MIntArray & faceList, MFloatVector*
translation);
MStatus collapseFaces(MIntArray & faceList);
MStatus collapseEdges(MIntArray & edgeList);
```

Support for accessing UV shell IDs.

```
MStatus getUvShellsIds( MIntArray& uvShellIds,
      unsigned int & nbUvShells,
      const MString * uvSet = NULL ) const;
```

You can now turn off checking for duplicate points when creating polygons.

```
static void     setCheckSamePointTwice( bool check = true );
static bool     getCheckSamePointTwice( void );
```

MFnPlugin

Support for registering required functions for MPxModelEditorCommand proxy plug-ins.

```
MStatus registerModelEditorCommand(const MString&
commandName,
      MCreatorFunction creatorFunction,
```

```
      MCreatorFunction paneCreatorFunction);
MStatus deregisterModelEditorCommand(const MString&
commandName);
```

MItMeshEdge

Support for creating an iterator along the edges of a polygon. This is useful for working with the new high level polygon tools of MFnMesh.

```
MItMeshEdge( MObject & polyObject,
      MObject & component = MObject::kNullObj,
      MStatus * ReturnStatus = NULL );
MStatus reset( MObject & polyObject,
      MObject & component = MObject::kNullObj );
      // new default second parameter
```

MItMeshPolygon

Support for new tolerance parameter when getting a point at a UV location.

```
MStatus getPointAtUV( MPoint &pt, float2 & uvPoint,
      MSpace::Space space = MSpace::kObject,
      const MString * uvSet = NULL,
      float tolerance=0.0 );
```

MModelMessage has new callbacks

Add callbacks that are triggered before or after a node is duplicated.

```
static MCallbackId addBeforeDuplicateCallback(
      void (*func)(void* clientData ),
      void * clientData = NULL,
      MStatus * ReturnStatus = NULL );
static MCallbackId addAfterDuplicateCallback(
      void (*func)(void* clientData),
      void * clientData = NULL,
      MStatus * ReturnStatus = NULL );
```

MNodeMessage has new callbacks

Support for adding a callback that is triggered whenever a node is destroyed. This lets you know when a node has been removed from memory and is no longer in use by the user.

```
static MCallbackId addNodeDestroyedCallback(
      MObject& node,
      void (*func)(void* clientData ),
      void * clientData = NULL,
      MStatus * ReturnStatus = NULL );
```

MPlug

Additional basic utility support.

Support for querying if a plug was created internally:

```
bool isProcedural( MStatus* ReturnStatus = NULL ) const;
```

Set the value of an MPlug with the contents of a dataHandle. This method is intended for use during compute only:

```
MStatus setValue( MDataHandle & handle );
```

MPxDeformerNode

Support for additional customized editing behavior on plug-in deformer nodes. Allows a user to specify that custom deformer nodes use the same index when a shape is re-added to a deformer. This allows connections to be re-used.

```
void setUseExistingConnectionWhenSetEditing(bool state);
```

MPxFieldNode

Support for creating custom icons for dynamic fields.

```
virtual MStatus iconSizeAndOrigin(GLuint& width,
      GLuint& height,
      GLuint& xbo,
      GLuint& ybo   );
virtual MStatus iconBitmap(GLubyte* bitmap);
```

MPxFileTranslator

Support for file filtering and setting if the translator handles namespace correctly has been added.

```
virtual bool haveNamespaceSupport () const;
```

This method should be implemented to return true if a translator can deal with having Maya placing some or all of a file's nodes into a separate namespace.

```
virtual MString filter () const;
```

This virtual method may be overloaded in a derived class to set the filter extension that will be used by the file dialog.

MPxGeometryData

Support for getting and setting the matrix associated with this data.

```
void setMatrix(const MMatrix &);
```

```
const MMatrix &matrix() const;
bool matrix(MMatrix &) const;
```

MPxGlBuffer

Functionality previously unavailable on Linux is now supported. The following methods now work on Linux:

```
virtual MStatus open( short width, short height,
GLXContext shareCtx = NULL );
virtual GLXDrawable drawable( MStatus * ReturnStatus = NULL
);
virtual GLXContext context( MStatus * ReturnStatus = NULL );
```

MPxHwShaderNode

Support for accessing the vertex IDs in a hardware shader node. By using the vertex IDs and the Mesh object, a developer can access vertex blind data.

This method is now a pure virtual to ensure that all developers using it will get a compile error if they are still using the old signature.

```
virtual MStatus geometry( const MDrawRequest& request,
      M3dView& view,
      int prim,
      unsigned int writable,
      int indexCount,
      const unsigned int * indexArray,
      int vertexCount,
      const int * vertexIDs,
      const float * vertexArray,
      int normalCount,
      const float ** normalArrays,
      int colorCount,
      const float ** colorArrays,
      int texCoordCount,
      const float ** texCoordArrays) = 0;
```

This method now will have vertexCount and vertexIDs array passed in if the provideVertexIDs() method returns true.

```
virtual bool provideVertexIDs();
```

This method should be implemented to return true or false if vertex IDs are required in the `geometry()` method.

MPxNode

kObjectSet added to enum Type.

MPxSurfaceShape

Support for new shape functionality that solves previous limitations. User-defined shapes now contain new virtual methods that can be implemented to properly support deformations, tweak nodes, freeze transformations and undo.

New enumeration:

```
MVertexCachingMode
```

Allows shape to implement proper behavior for undo of point translations & freezeTransforms:

```
virtual void transformUsing( const MMatrix& mat,
      const MObjectArray& componentList,
      MVertexCachingMode cachingMode,
      MPointArray* pointCache);
```

Allows the shape to properly handle tweak nodes:

```
virtual void tweakUsing( const MMatrix& mat,
      const MObjectArray& componentList,
      MVertexCachingMode cachingMode,
      MPointArray* pointCache,
      MArrayDataHandle& handle );
bool convertToTweakNodePlug(MPlug& plug) const;
```

An implementation of these methods allows full support for adding deformers to the shape:

```
virtual MObject cachedShapeAttr() const;
MMatrix getWorldMatrix( MDataBlock &, unsigned int ) const;
```

MPxTransform

Support for turning on non-affine calculations that can occur by using the MPxTransform class.

```
static MStatus setNonAffineMatricesEnabled(bool);
```

Set if non-affine transformations can be used.

```
static bool isNonAffineMatricesEnabled(MStatus
*ReturnStatus);
```

Query if non-affine transformations are allowed.

MRenderUtil

Support for additional information that makes the lighting model more realistic. This includes diffuse reflectance, maximum specular reflectance, light attenuation and hemisphere coverage.

```
static float diffuseReflectance(
```

```
      int lightBlindData,
      const MFloatVector& lightDirection,
      const MFloatVector& pointCamera,
      const MFloatVector& normal,
      bool lightBackFace,
      MStatus *ReturnStatus = NULL );
```

Returns the diffuse or lambertian reflectance for a given light source and surface.

```
static MFloatVector maximumSpecularReflection(
      int lightBlindData,
      const MFloatVector& lightDirection,
      const MFloatVector&  pointCamera,
      const MFloatVector& normal,
      const MFloatVector& rayDirection,
      MStatus *ReturnStatus = NULL );
```

Returns the vector corresponding to the point on the light source that provides the maximum specular reflection.

```
static float lightAttenuation(
      int lightBlindData,
      const MFloatVector& pointCamera,
      const MFloatVector& normal,
      bool lightBackFace,
      MStatus *ReturnStatus = NULL );
```

Returns light attentuation factor of a light.

```
static float hemisphereCoverage(
      int lightBlindData,
      const MFloatVector& lightDirection,
      const MFloatVector& pointCamera,
      const MFloatVector& rayDirection,
      bool lightBackFace,
      MStatus *ReturnStatus = NULL );
```

Returns the fraction of the light that is transmitted by an object.

```
static void sendRenderProgressInfo (MString &pixFile, int
percentageDone);
```

Sends batch rendering status to Maya.

MRenderView

The following methods have a new flag "doNotClearBackground." Plug-in shaders can choose to not clear the buffer before receiving an image. If set to true, Maya does not clear the background image before rendering.

```
static MStatus startRender( unsigned int width,
      unsigned int height,
      bool doNotClearBackground = false );
static MStatus startRegionRender( unsigned int imageWidth,
```

```
      unsigned int imageHeight,
      unsigned int regionLeft,
      unsigned int regionRight,
      unsigned int regionBottom,
      unsigned int regionTop,
      bool doNotClearBackground = false );
```

MStatus

We've added two new macros for checking status.

`CHECK_MSTATUS_AND_RETURN(result,returnVal)`

New macro for checking MStatus objects and returning 'returnVal' if not successful.

`CHECK_MSTATUS_AND_RETURN_IT(result)`

New macro for checking MStatus objects and returning 'result' if not successful.

Support for getting and setting default attribute values

The following classes have support for getting default attribute values.

- MFnEnumAttribute
- MFnNumericAttribute
- MFnTypedAttribute
- MFnUnitAttribute
- MFnLightDataAttribute
- MFnMatrixAttribute

The methods are:

MFnEnumAttribute:

```
MStatus setDefault( short index );
MStatus setDefault( const MString &fieldString );
MStatus getDefault( short &index ) const;
MStatus getDefault( MString &fieldString ) const;
```

MFnLightDataAttribute:

```
MStatus getDefault( float & defDirectionX,
      float & defDirectionY,
      float & defDirectionZ,
      float & defIntensityR,
      float & defIntensityG,
      float & defIntensityB,
      bool  & defAmbient,
```

```
bool  & defDiffuse,
bool  & defSpecular,
float & defShadowFraction,
float & defPreShadowIntensity,
unsigned int & defBlindData);
```

MFnMatrixAttribute:

```
MStatus getDefault( MMatrix & def );
MStatus getDefault( MFloatMatrix & def );
```

MFnNumericAttribute:

```
MStatus getDefault( bool & def1 );
MStatus getDefault( char & def1 );
MStatus getDefault( int & def1 );
MStatus getDefault( int & def1, int & def2 );
MStatus getDefault( int & def1, int & def2, int & def3 );
MStatus getDefault( float & def1 );
MStatus getDefault( float & def1, float & def2 );
MStatus getDefault( float & def1, float & def2, float & def3
);
MStatus getDefault( double & def1 );
MStatus getDefault( double & def1, double & def2 );
MStatus getDefault( double & def1, double & def2, double &
def3 );
```

MFnTypedAttribute:

```
MStatus getDefault( MObject & defaultCustomData );
```

MFnUnitAttribute:

```
MStatus getDefault( double & defaultValue );
MStatus getDefault( MTime & defaultValue );
MStatus getDefault( MAngle & defaultValue );
MStatus getDefault( MDistance & defaultValue );
```

Other important changes

Windows

The plug-in wizard for Developer Studio has been updated for Maya 5.

Macintosh

We now support a basic form of building plug-ins from Code Warrior Stationery on the Macintosh. A developer can generate a mel command and a dependency graph plug-in project.

For developers who are familiar with Unix command line tools, a Makefile is now available for building plug-ins on the Macintosh.

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> Macintosh

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