



USING MAYA: ANIMATION

VERSION 3

USING MAYA: ANIMATION

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INTRODUCING MAYA: ANIMATION

Thank you for buying Maya—Alias | Wavefront’s award-winning computer animation package. The following pages describe how to approach the Maya documentation so you can learn and use your software most effectively.

About the Animation book

Using Maya: Animation has four parts, each with several chapters:

- Part 1, *Animation and Maya*, introduces Maya animation features, explains animation controls, and describes how to work with sound and previewing tools.
- Part 2, *Keyframe Animation*, explores how to work with Maya’s keyframe features, including the Graph Editor and Dope Sheet.
- Part 3, *Nonlinear Animation*, explains how to use the Trax Editor to layer and mix character animation sequences independently of time.
- Part 4, *Path Animation*, tells how to use motion paths and motion capture.

See “How to use this book” on page 3 for more details.

About the Maya documentation set

Whether you use Maya Unlimited, Maya Complete, or Maya Builder, you receive a full set of documentation. Since Maya ties together several different kinds of software, we’ve included different books to describe how to use it.

Where do I begin?

The following paragraphs should help you decide where to start reading and learning about Maya.

- 1 **When you install Maya Complete, Maya Unlimited, or Maya Builder**, refer to one of the installation guides for guidance.

For example, see *Installing Maya 3.0 on Windows NT* if you're installing Maya Complete or Unlimited on an NT or Windows 2000 system.

Important

In response to customer requests, we've changed the licensing procedure in Maya 3.0. Please read the installation instructions from cover to cover, even if you have installed previous versions of Maya.

- 2 **If you've used Maya before** and want an overview of new features, see *What's New in Maya 3*.

This booklet provides a summary of new features across all modules.

Next, you may want to review the *Maya 3.0 Release Notes* for brief descriptions of limitations in the software and successful ways to work around them.

- 3 **If you're a first-time Maya user**, see *Learning Maya* for a comprehensive, step-by-step tour of the Maya software before you read any other documentation.

A CD included at the back of the book contains online documentation of the tutorials as well as all required image and Maya support files. Additional copies of this book are also available from your local technical bookstore.

The remaining documentation assumes that you have at least a working familiarity with Maya, so it's important to start with *Learning Maya*.

- 4 Now, you're ready to move on to the *Using Maya* series.

The Using Maya series

The *Using Maya* books describe how you can use Maya's user interface to create professional 3D graphics animations and visual effects. Each book is devoted to a different area of the software.

The *Using Maya* series includes these books:

Essentials	provides a guide to Maya's user interface and basic tools. <i>Using Maya: Essentials</i> also defines a number of concepts that are common to all of Maya. <i>Using Maya: Essentials</i> was called <i>Using Maya: Basics</i> in previous releases.
NURBS Modeling	describes Maya's NURBS modeling and tells how to get the most out of it.
Polygonal Modeling	describes how to interactively create, modify, and color polygonal models.
Subdivision Surfaces Modeling	describes the enhanced subdivision surfaces modeling tools which are available only in Maya Unlimited.
Character Setup	tells how to use Maya's deformer, skeleton, skinning, constraint, and character features.
Animation	describes Maya's basic animation software, which is based on keyframes and motion paths. This book also provides information on motion capture and introduces other Maya animation techniques, such as character setup.
Dynamics	describes how to animate using natural forces. You can use dynamics to make effects such as tumbling dice, waving flags, and exploding fireworks.
Rendering	describes how to prepare for rendering, render a scene, and view your rendered images. This book also describes how to create light, shadow, and light effects, shade and texture surfaces. It also tells you how to set up cameras and views and create a background. The information in <i>Using Maya: Rendering</i> is arranged by production task. The online book, <i>Maya Reference: Rendering</i> describes Maya's rendering-related menu options, attributes, and windows. The information in this book is organized around the user interface.
Paint Effects	describes how to use Paint Effects to paint real-time rendered strokes onto or between 3D objects or onto a 2D canvas.
Cloth	describes how to create and animate realistic clothing using Maya Unlimited's Cloth software. This book includes four tutorials to get you started, as well as a complete user's guide.

Fur	describes how to use Maya Unlimited Fur to create realistic, self-shadowing fur and short hair on multi-surface models.
Live	describes how to use Live, Maya Unlimited's automated match-moving tool. You can use Live to match Maya scenes with live footage by reconstructing 3D locations and camera or object movement from a shot.

The Maya Technical Library

When you're ready to use Maya to its fullest potential, you'll want to explore the technical library. These documents tell how to use Maya's powerful command language and expressions. They also provide information that will help you use Maya with other software packages.

Note

The books in the Maya Technical Library are not included in a printed document set. However, html files for these documents are on your product CD for online viewing. PDF files are also provided unless otherwise specified.

MEL	describes how to use the Maya Embedded Language (MEL) to enter commands and write scripts.
MEL Command Reference	includes technical descriptions of the individual MEL commands. <i>MEL commands are provided in html format only, no PDF files are supplied.</i>
Expressions	describes how to use expressions to control attributes. Expressions are ideal for controlling attributes that change incrementally, randomly, or rhythmically over time. They are also useful for linking attributes between different objects—where a change to one attribute affects the other.
DG Node Reference	is for technical users who want more information on the DG node attributes. <i>The DG Node Reference is provided in html format only, no PDF files are supplied.</i>
Maya File Formats	is for technical users with programming experience who want to either edit Maya files or write translators to or from the Maya file formats.

Maya Developer's Tool Kit	describes how to use the Maya API to load, write, and edit plug-ins. This book includes instructions for creating your own plug-ins. The <i>Maya Developer's Tool Kit</i> also features on-line links to example plug-ins.
Maya Translators	is for people who are bringing data into Maya or exporting data to other software packages.
Maya Game Translators	describes how to install and use Maya game translators. Information is provided for VRML2 and GE2, as well as the RTG file format. This book also includes information on using the MDt API.
Rendering Utilities	describes how to use command-line and stand-alone utilities that are part of Maya, such as fcheck, as well as the options for the command line renderer. <i>Rendering Utilities</i> was called <i>Utilities</i> in previous releases.

Using Maya's online documentation

For your convenience, the Maya documentation is online in html format. (This help requires version 4 or higher of either Netscape Communicator or Internet Explorer.) We include the complete Maya Unlimited documentation set, no matter what version of the software you have purchased.

Printing online books

To allow you to print copies of the documentation, we've provided PDF files of most documents. These files require the Adobe Acrobat reader.

To print the online books, insert your Maya CD, navigate to the pdf directory, and open library.pdf.

The Glossary

For 3.0, we've provided an online glossary so you can look up meanings of words you encounter which are new or confusing.

Search tools

Due to customer requests, we've provided an enhanced Library search tool in Maya 3.0. You can use the Library Search tool without installing the documentation files on a server. To access the Library Search tool, return to the main Maya Library page and select Library Search.

A Book Search tool is also provided in the left frame of most books. Use this tool to look for an item in the book you are viewing currently.

Online indexes

When you are viewing a specific book, you can access that book's index. You can also use the Global Index to view entries throughout the document set (except the *MEL Command Reference* and the *DG Node Reference*).

Using Maya's printed documentation

A complete printed documentation set includes:

- *Installing Maya* — describes how to install and license your software
- *Learning Maya* — provides comprehensive step-by-step tutorials
- *Maya Release Notes* — lists limitations in the software and suggests workarounds for them
- *What's New in Maya* — describes the new features we've added for this release
- *Maya Quick Reference Card* — a guide to Maya's most frequently used keyboard shortcuts. The Quick Reference Card also outlines the steps you use to create your own hotkeys.
- *Troubleshooting Rendered Images* — a quick reference card to help you identify problems with rendered images
- Books in the *Using Maya* series — as listed previously
- *Maya Global Index* for print — which provides page numbers for entries in the printed document set. This book is different from the online index.

Printed documentation conventions

The printed documentation follows these conventions:

- MEL commands, program code, expressions, and error messages appear in courier font:

This is computer code

- Items in cascading menus are identified by an arrow. For example, “select Particles > Make Collide” means “select the Make Collide option from the Particles menu.”



Image by Cristoph Berndt

PART 1

ANIMATION AND MAYA



1

INTRODUCING ANIMATION

With Maya, you can create the illusion of life. You can animate virtually anything you can imagine, no matter how surreal. Maya simplifies your work in creating the essence of animation—timing and motion.

Animation is a complex art form that takes years of experience. Maya offers a complete range of animation methods, including keyframing, nonlinear animation, path animation, motion capture, dynamics, and procedural animation with expressions. Whichever animation methods you use, Maya offers precise control over playback, sound, and previewing.

If you are an animator at a large studio, you might have the scenes and characters already prepared for you by modelers, character setup experts, and technical directors. In this environment, you can focus on the challenges of animation and let others work on modeling, character setup, and other technical challenges. If you are an animator working alone or in a small group, you might work on all animation tasks. This gives you greater creative control but requires broader knowledge.

This chapter covers the following topics:

- “How to use this book” on page 3
- “How to learn more about animation” on page 4

HOW TO USE THIS BOOK

Using Maya: Animation, is a task-oriented reference. It describes the features of the Animation menu set, as well as many other animation-related editors and tools.

As you use Maya’s animation features, use this book as a reference to find out more about the basic tasks of animation. This book is not meant to be read straight through, but skimming through it can provide you with an overall picture of Maya’s animation features.

How to learn more about animation

This book assumes you have some prior animation experience and understand Maya's basic features. To learn more about the animation process, consider the training resources described in the next section.

For details on other menus in the Animation menu set, see *Using Maya: Character Setup*. For details on procedural animation with expressions, see *Using Maya: Expressions*. For details on dynamics, see *Using Maya: Dynamics*.

HOW TO LEARN MORE ABOUT ANIMATION

Training courses

Alias | Wavefront's training courses introduce character animation and provide in-depth knowledge of Maya's advanced features. To learn more about character animation, take the *Character Animation in Maya* course.

Course schedules and descriptions are available at www.aliaswavefront.com (Express Link to Training). For current information on course availability, pricing, and registration, send email to training-info@aw.sgi.com, call 416-362-8558, extension 5699 or 1-877-927-7478 (option #4), or fax 416-369-6138.

Training videos

Training videos are also available, including the video, "The Making of Bingo," in which Chris Landreth describes the award winning Maya animation *Bingo*. This video focuses on important character animation topics.

For more information, send email to aliasinfo@ams-leads.com, using the phrase "Training Videos" in the subject line. Be sure to specify whether you are ordering PAL or NTSC. You can also order by fax (1-978-840-0245) or by phone (North America: 1-800-447-2542, International: 1-978-466-7623).

Web resources

Alias | Wavefront's *Assistant Online* magazine has Maya tutorials on various topics, including animation. For more details, see www.aliaswavefront.com.

2

ANIMATION FEATURES

Maya includes features for animation development, keyframe animation, nonlinear animation, path animation, and motion capture animation.

This chapter covers the following topics:

- “Using the animation development environment” on page 5
- “Using keyframe animation” on page 5
- “Using nonlinear animation” on page 6
- “Using path animation” on page 6
- “Using motion capture animation” on page 6

USING THE ANIMATION DEVELOPMENT ENVIRONMENT

Maya’s animation development environment includes features for controlling animation playback, sound, and animation previewing. These features are an essential part of your animation environment. For more information, see Chapter 3, “Introducing Animation Development.”

USING KEYFRAME ANIMATION

Keyframe animation creates action from keys you set on attributes at various times (or frames). A key specifies the value of an attribute at a particular time. Maya interpolates how the attribute changes its value from one key to the next. Each key specifies a defining characteristic of the action. For more information, see Chapter 7, “Introducing Keyframe Animation.”

USING NONLINEAR ANIMATION

The Trax Editor provides a way to layer and mix character animation sequences nonlinearly— independently of time. You can layer and blend any type of keyed animation, including motion capture and path animation. The Trax Editor is ideal for developing complex character animations in combination with other Maya features. For more information, see Chapter 12, “Introducing Nonlinear Animation.”

USING PATH ANIMATION

With path animation, you can animate an object along a path specified by a NURBS curve. For example, you might want to animate the path of a camera moving through space. To do this with keyframe animation would require you to laboriously create and edit many keys for the motion of the camera. By having the camera move along a curve, you can more easily adjust the camera’s path by editing the curve. For more information, see Chapter 14, “Introducing Path Animation.”

USING MOTION CAPTURE ANIMATION

Some animation is hard to recreate with keyframes, nonlinear animation, or path animation. It’s also hard to express some action with the mathematical formulas of expressions. For example, even if you are a highly skilled animator, animating a complicated karate sequence with keyframe animation might take more time than is in your schedule.

It would be easier to capture the motion of a human karate expert, then bring that motion capture data into Maya. You can apply the motion capture data to your character and refine the action with other techniques. For details, see Chapter 16, “Introducing Motion Capture.”



Image by Cristoph Berndt

PART 2

ANIMATION DEVELOPMENT



3

INTRODUCING ANIMATION DEVELOPMENT

Animation development is about setting up Maya's animation environment for playback, sound, and previewing. For information on these topics, see the following:

- Chapter 4, "Using Animation Controls"
- Chapter 5, "Using Sound"
- Chapter 6, "Previewing Animations"

4

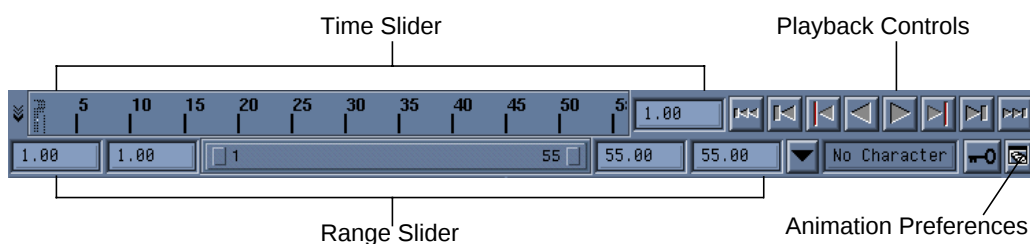
USING ANIMATION CONTROLS

With Maya's animation controls, you choose how to key and play an animation. This chapter covers the following topics:

- “Understanding Animation Controls” on page 11
- “Using the Time Slider” on page 12
- “Using the Range Slider” on page 14
- “Using the Playback Controls” on page 16
- “Using the Animation Controls menu” on page 16
- “Current character settings” on page 19
- “Automatic keyframing setting” on page 19
- “Editing animation preferences” on page 19
- “Frame rate heads up display” on page 24

UNDERSTANDING ANIMATION CONTROLS

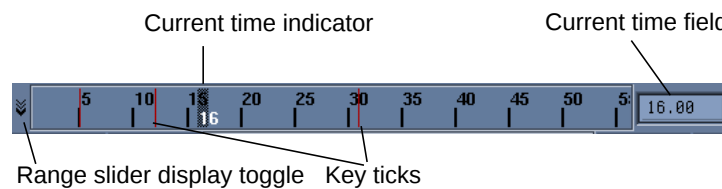
Maya's controls for developing the timing of animations include the Time Slider, Range Slider, and Playback Controls. You can also quickly access and edit animation preferences from the animation controls area.



Between the Range Slider and the Animation Preferences button are the current character control features and the automatic keyframing (Auto Key) button. For details on characters, see *Using Maya: Character Setup*. For details on automatic keyframing, see “Setting keys automatically” on page 44.

USING THE TIME SLIDER

The Time Slider controls the playback range, keys, and breakdowns within the playback range.



Using key ticks

Key Ticks are red marks in the Time Slider where you’ve set a key for the selected object. Breakdowns are a special type of key displayed as green marks in the Time Slider (see “Setting breakdowns” on page 45). The visibility of Key Ticks can be turned off or on in the Preferences window.

The Current Time Indicator is a gray block on the Time Slider. You can drag it to move forward and backward in your animation.

To change the current time:

- Click with your left mouse button anywhere on the Time Slider.
The scene jumps to that time in the animation.
- Drag the mouse in the Time Slider.
or
- Hold down your keyboard’s k key as you drag horizontally in any view.
The scene updates with your mouse action.
- Click the Time Slider with the middle mouse button.

or

- Hold down the k key and middle-mouse drag horizontally in any view.
Your scene does not update, but the Current Time Indicator moves to show your new current time. This is useful, for example, if you want to key an object at some frame based on a prior position of other objects.

By default, dragging in the Time Slider updates only the active view. All views can be set to update by changing Playback settings to Update View All in the animation Preferences window.

The k key operations work the same in all Maya windows that display a timeline, for instance, the Graph Editor.

Time Units

The ruler markings and associated numbers on the Time Slider display time. To define the playback rate, select the desired Time from the Settings Category of the Preferences window. Maya defaults to measuring time as 24 frames per second, the standard frame rate for film.

Note

By default, Maya plays your animation in seconds. You can change the Time setting without affecting your animation's key-based behavior. However, expressions that use the frame variable might not work correctly if you change the Time setting. It's good practice to specify the Time setting before you begin animating your scene.

Current time field

The entry field to the right of the Time Slider indicates the current time expressed in the current Time unit. You can change the current time by entering a new value. Your scene moves to that location in time, and the Current Time Indicator updates accordingly.

To move and scale a range of animation in the Time Slider:

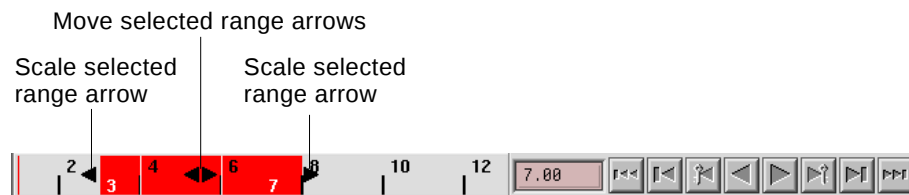
- Shift-drag along the Time Slider to select a range of time.

The selected time range is red, with start and end frames shown in white numbers at the ends of the selection block.

USING ANIMATION CONTROLS | 4

Using the Range Slider

- Drag the black arrows at either end of the selected range to scale the keys in that range along the Time Slider.
- Drag the black double arrows at the center of the selection to move the keys in that range along the Time Slider.



- To select the entire range of the Time Slider, double-click the Time Slider.

Hiding the Time Slider

You can hide or display the Time Slider by selecting Display > UI Elements > Time Slider. Hiding the Time Slider provides more Maya view space.

USING THE RANGE SLIDER

The Range Slider controls the playback range reflected in the Time Slider.



You can toggle whether the Range Slider is displayed or hidden by selecting Display > UI Elements > Range Slider. Hiding the Range Slider also hides the Animation Preferences button and the Auto Key button.

Animation Start Time

This field sets the start time of the animation.

Animation End Time

This field sets the end time of the animation.

Playback Start Time

This field shows the current start time for the playback range. You can change it by entering a new start time, including a negative value. If you enter a value that is greater than the Playback End Time, the Playback End Time is adjusted to one time unit greater than the Playback Start Time.

Playback End Time

This field shows the current end time for the playback range. You can change it by entering a new end time. If you enter a value less than the Playback Start Time's value, the Playback Start Time is shifted to one time unit less than the Playback End Time.

You can also edit the preceding settings from the animation Preferences window.

Range Slider bar

The Range Slider bar lets you control the playback range of your animation up to the limits of the Animation Start/End settings.

To change the playback range using the Range Slider bar:

- Drag the Range Slider bar to change the playback range.
- Drag the boxes at the ends of the Range Slider to scale the playback range.
- Double-click the Range Slider bar. The playback range is set to the range values in the Animation Start/End fields of the Preferences window. To return to the prior playback range, double-click the Range Slider bar again.

Hiding the Range Slider

The range slider display toggle next to the Time Slider allows you to quickly control Range Slider display.

Range slider display toggle



USING THE PLAYBACK CONTROLS

The Playback Controls are buttons for playing and stepping through your animation. The playback range is displayed in the Time Slider.



Playback Controls

-  Press Go To Start button to go to start of playback range.
-  Press Step Back Frame button to step back one time.
Default hotkey: Alt . (period) key.
-  Press Step Back Key button to step back one key.
Default hotkey: . (period) key.
-  Press Play Backwards button to play backwards.
Pressing ESC key will stop playback.
-  Press Play Forwards button to play forwards.
Default hotkey: Alt V. Pressing ESC key will stop playback.
-  Press Step Forward Key button to step forward one key.
Default hotkey: , (comma) key.
-  Press Step Forward Frame button to step forward one time (or frame).
Default hotkey: Alt , (comma) key.
-  Press Go To End button to go to end of playback range.
-  Press Stop button to stop playback. This button is displayed only when an animation is playing, replacing either the Play forwards or Play Backwards buttons. Default hotkey: Esc key.

USING THE ANIMATION CONTROLS MENU

If you right-click anywhere in the Time Slider, a menu is displayed for animation control operations. These operations work on keys of the currently selected objects.

Copy, Cut, Delete and Paste

Cut, Copy, and Delete affect the keys at the current time or in the selected ranges. Cut and Copy place the selected keys on an internal clipboard for pasting.

Paste > Paste Connect pastes copied keys the same as if you select Edit > Keys > Paste with the Connect option turned on.

Copy, Cut, and Delete operate on integer time ranges. For example, if your current time is 5, these items act on the range of 5 up to 6, but not including any keys at time 6.

Paste puts any copied or cut keys from the clipboard at the current time. There are two ways to paste keys into the Time Slider:

- Click the time where you want the pasted keys to start. Existing keys beyond that time will be shifted by the time range of the pasted keys.
- To fit the keys into a particular time range, Shift-click the Time Slider to select a time range. The keys will be scaled to fit that range. Existing keys in the selected area are removed.

To copy and paste keys from the Time Slider

- 1 Shift-click and drag in the Time Slider to select a range of keys from a keyed object.
- 2 Right-click the Time Slider and select Copy.
- 3 Select the receiving object.
- 4 Move the Current Time Indicator to the position where you'd like to have the copied animation pasted.
- 5 Right-click the Time Slider and select Paste > Paste.

Note

Additional cut and paste options are available by choosing Edit > Keys (see Chapter 8, "Setting Keys").

Tangents

The Tangents item will set the tangent of the keys at the current time, or all the keys in a selected time range.

Sound

This menu lets you select an imported sound to be displayed on the Time Slider.

Snap

Use Snap to force selected keys to snap in time to the nearest whole time units.

Keys

- Convert to Key will convert selected Breakdowns to normal keys.
- Convert to Breakdown will convert normal keys to Breakdowns.
- Add Inbetween will add a single Inbetween.
- Remove Inbetween will remove a single Inbetween.

Playback Looping

To select playback looping options, right-click the Timeline and select Playback Looping > Once, Oscillate, or Continuous. These are the same options as those in the Preferences window.

Set Range To

- Start/End sets the playback range to the Start and End values set in the Playback Range numeric input fields.
- Min/Max sets the playback range to the first and last keys of the scene.
- Selected sets the playback range to the range defined by the current selection on the Time Slider.
- Sound Length sets the playback range to the duration of a sound currently loaded into the Time Slider.
- Preferences sets the playback range to the values in the Preferences window.

Playblast

Selecting this opens the Playblast window. Selecting the option box (□) opens the Playblast options window.

CURRENT CHARACTER SETTINGS

For more information about characters and setting the current character (by default, No Character), see *Using Maya: Character Setup*.

AUTOMATIC KEYFRAMING SETTING

The Auto Key button controls Maya's automatic keyframing feature. For details, see "Setting keys automatically" on page 44.

EDITING ANIMATION PREFERENCES

Editing preferences includes the following:

- "Editing Keys preferences" on page 19
- "Editing Sound preferences" on page 20
- "Editing Timeline and Playback preferences" on page 21
- "Editing working time unit preferences" on page 24

Editing Keys preferences

To edit preferences:

- 1 Click on the Animation Preferences button.

Auto Key Specifies whether Maya will automatically set keys on a previously animated object's attributes when you change the values of those attributes. This preference has the same effect as the Animation Controls' Auto Keyframe Toggle button next to the Animation Preferences button. Click on or off. Default is off.

Weighted Tangents Click on or off. Default is off.

Editing animation preferences

- Default In Tangent** Specifies the default *in tangent* type. The type of in tangent controls the shape of the animation curve right before a newly set key.
- Spline rounds the animation curve smoothly before a newly set key.
 - Linear specifies the animation curve is a straight line from the previous key to a newly set key.
 - Clamped specifies the animation curve is smoothly rounded (like the Spline selection) before a newly set key unless the previous key is very close. If so, the in tangent and the previous key's out tangent are both straight (like the Linear selection), making the animation curve between the keys straight.
 - Flat specifies the animation curve is flat (horizontal) before a newly set key.
 - Stepped specifies the animation curve makes a sudden, discrete change from the previous frame (or time) to the keyed frame (or time). The animation curve changes without gradation. The animation curve would be vertical if the Default Out Tangent is also set to Stepped.
- Select Spline, Linear, Clamped, Flat, or Stepped.
- Default Out Tangent** Specifies the default *out tangent* type. The type of out tangent controls the shape of the animation curve right after a newly set key.
- Spline rounds the animation curve smoothly after a newly set key.
 - Linear specifies the animation curve is a straight line after a newly set key.
 - Clamped specifies the animation curve is smoothly rounded (like the Spline selection) after a newly set key unless the next key is very close. If so, the out tangent and the previous key's in tangent are both straight (like the Linear selection), making the animation curve between the keys straight.
 - Flat specifies the animation curve is flat (horizontal) after a newly set key.
 - Stepped specifies the animation curve is horizontal from the newly set key to the next key.
- Select Spline, Linear, Clamped, Flat, or Stepped.

Editing Sound preferences

To edit preferences:

- 1 Click the Animation Preferences button. In the Categories box, select Sound.

- Waveform Display** Specifies how much of a soundtrack's waveform (amplitude representation) is displayed in the Time Slider.
- Top displays the top half of the waveform.
 - Bottom displays the bottom half of the waveform.
 - All displays the entire waveform.
 - Click Top, Bottom, or All. Default is Top.
- Repeat on Hold** Specifies that a sound continuously repeats at the current time as you hold down the mouse button until you drag the Current Time Indicator to the next time in the Time Slider. Useful for locating a particular sound in a soundtrack. Click on or off. Default is off.
- Repeat Size** Specifies how much sound is repeated at the current time when Repeat on Hold is on. 1 specifies the smallest segment of sound—about one-third of a time unit in duration, with the other two-thirds being silent. 2 specifies about half a time unit of sound, the rest being silence. 3 specifies that the sound loops for that time unit. Available if Repeat on Hold is on.

Editing Timeline and Playback preferences

To edit preferences:

- 1 Click on the Animation Preferences button.

Timeline

- Playback Start/End** Specifies playback range's start and end times. The playback start and end times specify the Time Slider's playback range. The playback range is always within the animation range. Note that you can also specify the time units (see "Editing working time unit preferences" on page 24).
- Animation Start/End** Specifies animation range's start and end times. The animation start and end times specify the Range Slider's range. Note that the playback range always stays within the animation range, so changing the animation start and end times can also change the playback start and end times. Default animation start time is 0.00. Default animation end time is 40.00. Note that you can also specify the time units (see "Editing working time unit preferences" on page 24).

Editing animation preferences

Height	Specifies the Time Slider's height (the vertical space it occupies). Increasing the height is especially useful when you are working with sound. Double or quadruple the height for a better display of sound waveforms. Click 1x (normal height), 2x (double height), or 4x (quadruple height). Default is 1x.
Key Ticks	Specifies how the line markers that indicate keys appear on the Time Slider. None specifies that key ticks are not displayed. Selecting None is useful if you have a lot of keys and want to improve workspace selection performance. Active specifies that key ticks are displayed, with associated keys available for selection and editing. Channel Box specifies that key ticks appear only for the currently selected channels in the Channel Box. This is useful if you are using the Time Slider to edit keys on particular channels of an animated object. Click None, Active, or Channel Box. Default is Active.
Options	Options include Timecode and Snapping. Timecode specifies that Maya display the current time in video standard timecode. The current time is displayed next to the Current Time Indicator in the Time Slider. You can specify an initial timecode value with Timecode Offset. Default is off. Snapping specifies that Maya step through animation times by integer values, snapping to the nearest integer. Default is on. If working with sound or small time ranges, you can turn off Snapping for smoother scrubbing.
Timecode Offset	Specifies the timecode of the initial time on the Time Slider. Useful for matching videotape timing. Available if Timecode is on. Default is 00:00:00:00. Playback
Update View	Specifies whether the scene plays in all the workspace views (All) or only in the currently active view in which you have just been working (Active). If your workspace layout includes several views (for example, selected from Panels > Layouts), you can improve performance by having the scene play in only the currently active view. Click Active or All. Default is Active.
Looping	Specifies what will happen when the scene plays forward and then reaches the playback end time (or if playing backwards, the playback start time).

Once specifies that the scene plays once and then stops.

Oscillate specifies that the scene plays forwards (or backwards) and then plays backwards (or forwards) until you stop playback.

Continuous specifies the scene plays forward to the playback end time (or plays backward to the playback start time) and then begins again at the playback start time (or playback end time) until you stop playback.

Click Once, Oscillate, or Continuous. Default is Continuous.

Playback Speed

Specifies the speed at which your scene plays. Note that you can also specify the playback time units (see “Editing working time unit preferences” on page 24).

Free specifies that Maya displays all the frames, updating each before displaying the next. The speed depends on how long it takes your workstation to compute and draw each frame. You can specify the playback frame increment in the Playback by preference field.

Normal specifies that Maya plays in the normal real time of 30 frames per second (fps). Maya may not display all frames, depending on your workstation’s capabilities, the scene’s complexity, and the display mode (for example, wireframe or smooth shading).

Half specifies that Maya plays in real time at 15 frames per second (fps).

Twice specifies that Maya plays in real time at 60 frames per second (fps).

Other lets you specify an exact ratio of actual playback speed to normal real time speed (30 fps). With Other on, you can enter a value by which the real time playback speed will be multiplied. For example, to play at one-quarter normal real time speed, click Other on and enter 0.25 in the field.

Select Free, Normal (30 fps), Half (15 fps), Twice (60 fps), or Other. Default is Free.

Playback by

Specifies playback increments if Playback Speed is set to Free. For example, if you enter 4, Maya will play only every fourth frame (or time). Default is 1.000. Note that you can also specify the playback time units.

Editing working time unit preferences

To edit time unit preferences:

- 1 Click on the Animation Preferences button. In the Categories box, select Settings.

Time

Sets the working time unit for animation. The Time Slider displays time values in the unit chosen. The Time Slider values update when you change the time units. You can specify the time unit as frames or as clock values.

Frame selections include Game (15 fps), Film (24 fps), PAL (24 fps), NTSC (30 fps), Show (48 fps), PAL Field (50 fps), and NTSC Field (60 fps). Clock values include milliseconds, seconds, minutes, and hours. The terms *frame* and *time* refer to working time units as displayed in the Time Slider.

Technically the term frame applies only when Time is specified in frames per second (fps). In general, time can refer to frames or to clock values.

FRAME RATE HEADS UP DISPLAY

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

5

USING SOUND

When creating an animation, you may want to hear the soundtrack to aid in synchronizing the placement of keys with points in the soundtrack. This chapter has the following topics on how to work with sound files:

- “Importing sound” on page 25
- “Displaying sound” on page 26
- “Playing sound” on page 26

IMPORTING SOUND

Maya supports all uncompressed AIFF on the IRIX platform and AIFF and WAV audio files on Windows NT.

There are three ways to load a sound file into your scene:

- Use File > Import. A file browser lets you select the name of the sound file to import.
- Locate the file on the desktop and use the middle mouse button to drag the file into one of the Maya modeling views.
- Locate the file on the desktop and drag the file into the Time Slider.

If you use the third option, the peaks of the sound waves are visible in the Time Slider, and the Time Slider is ready to play or scrub the sound.

When a sound file is loaded into a scene, an audio node is created with the same name as the filename. This node has a reference to the location of the sound file. If you move the sound file to a different location, you will have to make sure that you change the filename referenced by your audio node.

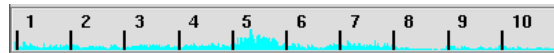
Note that Playback Speed must be set to Normal in order to play sound properly.

DISPLAYING SOUND

Although you can import as many sound files into a scene as desired, only one soundtrack can be displayed and played at a time in the Time Slider.

To display sound on the Time Slider, right-click the Time Slider to see a list of audio nodes in your scene. To select the soundtrack, find the audio node of the soundtrack you want to hear, then select that menu item. The sound's waveforms appear in the Time Slider. The sound file plays during playback.

You can change the playback range to the duration of the current sound file by right-clicking the Time Slider and selecting Set Range To > Sound Length.



To disable sound during playback, use the Time Slider Key Edit menu and select > Sound > Off. To access the sound options for audio nodes, use the Time Slider Key Edit menu and select > Sound > *filename* □.

Sound File

This is the name of the file referenced by this audio node. When the Time Slider displays this sound, it will look for the soundtrack to play in this file. If you move this file to another location or it is renamed, you can update the new location of the file here.

Start Time

This is the time the soundtrack starts to play, in current time units. For example, if the selected Time Units is Film (24 fps), a Start Time of 48 starts the soundtrack after 2 seconds of animation.

If you import a sound file into your scene, and decide later that you no longer need that soundtrack, you can delete the audio node from the Script Editor window or the Outliner.

To delete an audio node, select it using Edit > Delete > *filename*. Alternatively, use Edit > Delete All By Type > Sounds.

PLAYING SOUND

To hear a soundtrack, you must import the sound file then ensure that the audio node corresponding to the sound file is displayed in the Time Slider. There are two ways you can hear a sound file in Maya:

- Sound scrubbing—sound is heard as the Current Time Indicator is scrubbed on the Time Slider.
- Sound playback—sound you hear is synchronized with the animation play.

Sound scrubbing

If you click with the left or middle mouse button and drag in the Time Slider, the soundtrack will play as you drag it. This can be useful for locating a specific time at which a particular sound or portion of sound begins. For example, if your soundtrack includes, “Hi Dave,” you may wish to locate the exact frame at which the “D” sound begins so you can synchronize the character’s mouth forming a “D” sound with the soundtrack.

Tip

It may be easier to find the beginning of a sound by having the sound repeat until you drag the Current Time Indicator to the next time in the Time Slider. To enable this feature, open the Animation Preferences window and turn on the Repeat Sound option.

Sound playback

In order to hear sound during the playback of an animation, the playback speed must be set to a constant rate so that Maya can determine how slowly or quickly to play the soundtrack.

To set the playback speed, click the Animation Preferences button then set the Playback Speed option. Sound will play back as long as the speed setting is not set to Free.

Choosing a Playback Speed of Normal will play the soundtrack (and the animation) in real-time.

Animating with two contiguous sound files

Suppose you create an animation that begins with a flash of lightning, then plays the sound of thunder, then ends with the sound of rainfall. You have two different sound files, thunderstorm.aiff and rainstorm.aiff.

The following example describes how to import and play the two sound files after the animation.

To use contiguous sound files with animation:

- 1** Create a lightning animation.
- 2** To import the sound files, open the window where you've put your sound files. Drag the thunderstorm.aiff file onto the Time Slider. A thunderstorm audio node is created, and you will see the sound waves in the Time Slider.
- 3** Drag the rainstorm.aiff file onto a Maya view. A rainstorm audio node is created. The Time Slider continues to display the thunderstorm sound.
- 4** The animation starts with 3 seconds of lightning. The thunderstorm sound starts after 3 seconds of play. Select Display > Sound > thunderstorm  and change the Start Time to 72 (3 seconds at the default Time Unit of 24 frames per second).

You will now see the sound waves representing the thunderstorm sound appear in the Time Slider starting at time 72.

- 5** To play your animation with sound, open the Animation Preferences window and ensure that Playback Speed is set to Normal. Then press Play.
- 6** The rain sound begins at 5 seconds (or time 120 on the Time Slider), so open the Display > Sound > rainstorm  window and set the Start Time to 120.
- 7** Press Play to view (and hear) your animation.

To view your animation with both soundtracks (the thunderclap sound followed by the rain sound), you will have to render your animation to video and overlay each of the soundtracks onto tape.

Repeat Size

Set Repeat Size in the Preferences when you want to adjust the 'snapshot' of the sound file that is played back when Repeat on Hold is enabled. A setting of 1 is the smallest segment of sound. It is approximately one third of a time unit in duration, with the other two thirds being silence. A setting of two is approximately half of a time unit of sound, with the other two thirds being silence. A setting of 3 causes the sound to loop for that time unit.

6

PREVIEWING ANIMATIONS



Movie player window
previewing a playblast of an
animation.

As you work on an animation, you'll often want to preview the playback at a speed close to final production speed. To save time while previewing, you'll need to balance the quality of graphics with playback performance.

This chapter covers the following topics:

- “Setting playback options” on page 30
- “Maximizing playback performance” on page 30
- “Playblasting an animation” on page 32

SETTING PLAYBACK OPTIONS

You can use a number of playback options to control the way your animation plays back. To edit these options, click the Animation Preferences button. For more information, see “Editing animation preferences” on page 19 in Chapter 4.

MAXIMIZING PLAYBACK PERFORMANCE

Ideally, you could click the Play button and your animation would play back full-screen, fully shaded, and in real-time without dropping any frames. Although this is possible with smaller animations, the more complex a scene is, the more computations required before displaying each frame.

Here are some tips that can improve playback performance:

Windows

- Make sure the main Maya window is the top window on your desktop. Close all other windows, especially the Graph Editor and Dope Sheet, which update during playback. Also close IRIX shell windows or windows from other applications.
- Before beginning playback, select Display > UI Elements > Hide UI Elements to hide all panes in the main Maya window except for the modeling views.

View display

- Ensure that the Update View setting in the Preferences window is set to Active.
- If you have a very large scene, zoom in on the area you want to view.
- If you are not interested in certain types of objects, use the Show menu in the view pane to turn off the display of those objects. Note that hiding the object completely (using Display > Hide > Hide Selection) will result in better performance.
- Turn off the display of the Grid and the Axes from the Display menu.
- Use alternate shading modes for your view during playback by using the Shading > Interactive Shading menu in the view panel.

The performance with the different shading modes from best to worst is: Bounding Box, Points, Wireframe, and Normal.

- Use Lighting > Use Default Lighting.
- Turn off hardware texturing and back face culling (Shading > Hardware Texturing and Shading > Back Face Culling).

Object Display

- Use Display > Hide > Hide Selection to hide any objects (particularly non-animated objects) that you don't need for previewing.
- Hiding components of objects (pivots, selection handles, CVs, and so on) and, in particular, hiding motion path markers (Display > Hide > Markers) can improve drawing speed of your scene.
- Turn on Display > Fast Interaction. In this mode, objects will be drawn in a resolution that is based on their screen size. In other words, the further an object is from the camera, the lower its drawn resolution.
- Use Display > Object Display > Template to put non-moving objects in template mode. Template objects will not be redrawn during playback if they are not moving. Furthermore, template objects will always be drawn in wire mode, even when the view is shaded. It is therefore useful to put large currently insignificant objects in the scene into template mode while working on other objects in the scene.

Note that if the camera of the view is animated, template mode will not improve performance of redrawing the view.

- Use Display > NURBS smoothness to reduce the number of evaluations along each span of a NURBS object. The Hull mode is the fastest to draw. The Rough, Medium, and Fine modes can be quickly accessed using the 1, 2, and 3 keyboard hotkeys.

Computation

- Select Window > Settings/Preferences > Performance Settings to turn off computation of expensive nodes.

For example, if you are currently more interested in evaluating the skeleton movement than the skin deformation, temporarily turning off computation of flexors (or other deformations) will reduce the computation for playback of this character.

Playblasting an animation

Turning off Trim Display if you have animated trimmed surfaces will also increase playback speed.

- Use the Modify > Disable Nodes menu to disable computation of any unnecessary nodes.
- When animating, it may be easiest to key all the attributes of an object using the Keys menu. However, you may be keying many attributes that you are not actually animating. In this case, you will end up with a lot of flat curves, which are expensive to compute and do nothing to your animation.

You can delete all these flat curves in your scene by selecting Edit > Delete by Type > Static Channels. Note however, that a flat curve (setting just one key) on an attribute is required in order to continue animating that attribute with Auto Key.

PLAYBLASTING AN ANIMATION

The Playblast window lets you preview an animation quickly by performing a screen grab of the view at each frame then “blasting” the resulting images to a desktop movie player or the fcheck utility. The images can be saved either as a movie file or as a sequence of images in various formats.

Using the Playblast Options window

By default, Playblast previews the animation using the active view and the current time range in the time slider to determine the animation range. The default scale is 0.5, which makes the Playblast image resolution one-quarter the size of the active view. After running through the animation once, a window opens showing the animation.

Note

Source images for the movie file are taken directly from the screen display. If the display area has other windows on top of it, the resulting movie file will be affected.

To open the Playblast Options window, select Window > Playblast , or right-click to open the Keys menu on the Time Slider and select Playblast .

View	If turned on, Playblast will display the images using either movieplayer or fcheck, depending on the Output Format setting. If turned off, blasted images are only saved to file according to the Output Format setting. (For more information on the fcheck options, see <i>Using Maya: Rendering</i> .)
Show Ornaments	This displays the camera name and the axes at the origin and bottom left of the view.
Viewer	• Playblast uses the desktop video playback application specified in your Windows NT environment to view the Playblasted images. If fcheck is chosen, the fcheck utility is used to preview the Playblasted images. • fcheck—if this is selected, the output is a series of individual frames following the format specified with the Output Format setting in the Render Globals. See <i>Using Maya: Rendering</i> for more information on the supported formats.
Compression (Windows NT)	Compression only applies if the Output Format selected is Mediaplayer. • AVI is the only supported Playblast format on Windows NT.
Output Format (IRIX)	• Playblast uses the SGI utility movieplayer (by default) to view the Playblasted images as a movieplayer file. If fcheck is chosen, the fcheck utility is used to preview the Playblasted images. • Movieplayer—saves Playblasted images as a single “.mv” file in the SGI standard movieplayer format. • fcheck—if this is selected, the output is a series of individual frames following the format specified with the Output Format setting in the Render > Render Globals. See <i>Using Maya: Rendering</i> for more information on the supported formats.
Compression (IRIX)	Compression only applies if the Output Format selected is Movieplayer. • MVC2—an SGI video compression scheme with slow compression and fast decompression. This is the default setting. • MVC1—an SGI video compression scheme with faster compression but slower decompression than MVC2.

Playblasting an animation

- JPEG—standard JPEG compression.
- RLE—uses run-length encoding compression which is particularly suited to scenes in which there are large areas of single colors.
- None—provides no compression.

Display Size

There are three options for controlling the resolution of the playblast images that are created. In each of these three cases, the final size of the images will be further scaled by the amount in the Scale option.

- From Window—makes the Playblast images the same size as the Active view.
- From Render Globals—makes the Playblast images the size specified by the Width and Height attributes in the default Resolution tab of the Window > Render Globals window.
- Custom—enables two fields below the Display Size option that allow you to specify the Width and Height of the Playblast images.

Scale

Whereas the Display Size option gives you control over the size as well as the aspect ratio of the images, the Scale option lets you further refine the size of the Playblast images by applying a scale factor to the resolution specified in the Display Size option.

The default is 0.5, which is one-quarter the size of the Display Size (0.5 of the width and 0.5 of the height).

Remove Temporary Files

Turn on this option to delete the temporary files created by playblasting when you end your Maya session. Temporary files are written typically to the C:\temp directory on Windows NT, and /var/tmp/ or /tmp/ on IRIX.

Save to File

Turn this on to save a movie file or image sequence to disk. If turned on, an entry field lets you enter a filename. You can also click a Browse button to locate an appropriate directory. If the Output Format selection is Movieplayer, the file saved is in movieplayer format. If the format is fcheck, the format is read from the Image Format attribute in the defaultRenderGlobals tab of the Render Globals window.

Note

Playblast creates temporary files that are written typically to the C:\temp directory on Windows NT, and /var/tmp/ or /tmp/ on IRIX.

Movie File

If you use the Browse button to specify the file name for your Playblast image(s), a full path name will be specified.

If a filename with no path is specified for the movie file, the location of the file image(s) is set by your current project setting. If the Images location is specified in the current project window (File > Project > Edit Current), the Playblast image(s) is created in the Images location. Otherwise, the images are created in the default location of the project.

To playblast an Animation (IRIX):

- 1** Create or open an animation.
 - 2** Open the options window by selecting Window > Playblast .
 - 3** Set Display Size to From Window. Click inside a view to make it Active.
 - 4** Click the Playblast button.
 - 5** The scene plays in the Active view for the playback range in the Time Slider. After each time frame is drawn, Maya takes a screen grab of the active view.
 - 6** A movie player window opens and previews the playblast animation.
- To cancel a Playblast, press the Esc key.

Note

If a sound file is displayed in the Time Slider while Playblast is run and Output Format is set to Movie, the sound file is included in the resulting saved file.

**Playblasting
fcheck files**

For more information on the fcheck utility, see the online *Maya Utilities* documentation, Chapter 4, “fcheck.”

PREVIEWING ANIMATIONS | 6

Playblasting an animation

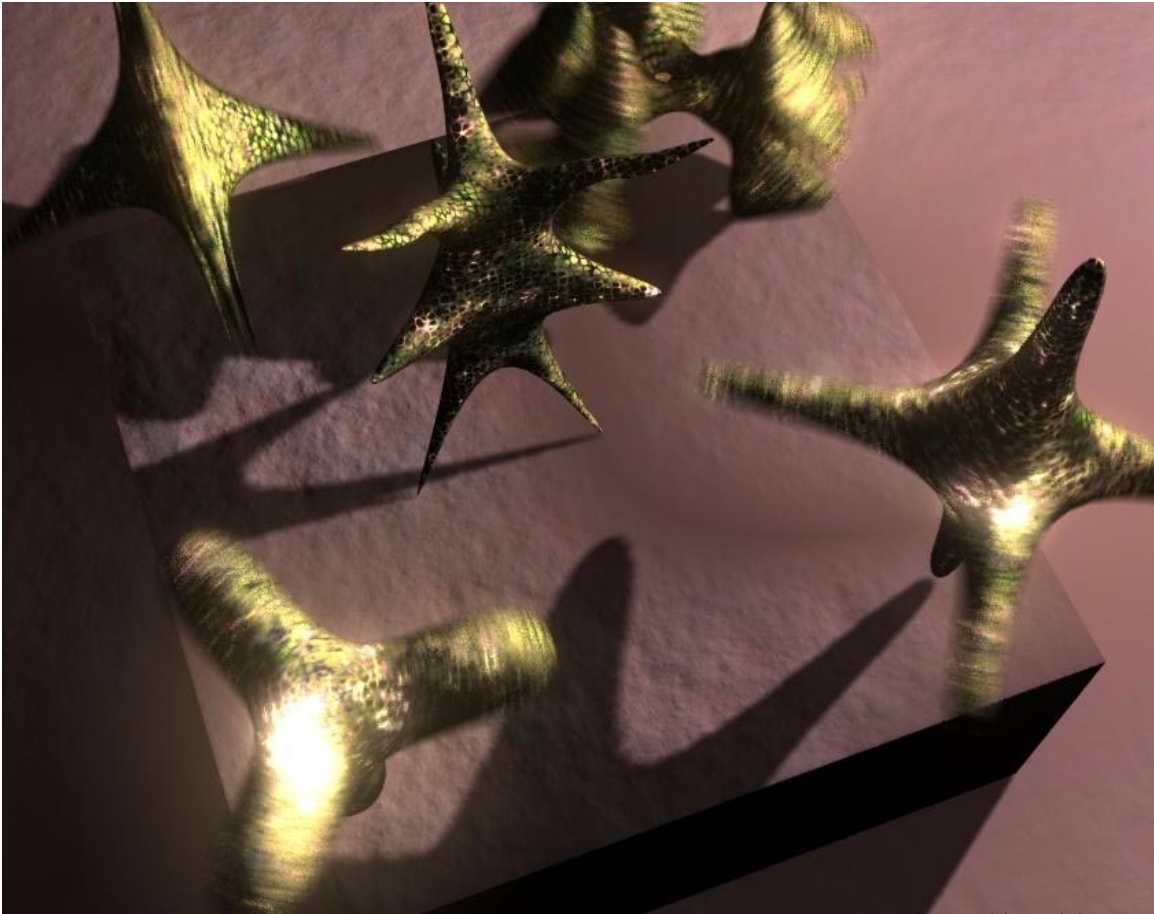


Image by David B. Fisher

PART 3

KEYFRAME ANIMATION



7

INTRODUCING KEYFRAME ANIMATION

In keyframe animation, you create action by setting keys on attributes at various times (or frames). Each key specifies a defining characteristic of the action.

For more information on keyframe animation, see the following:

- Chapter 8, “Setting Keys”
- Chapter 9, “Editing Keys”
- Chapter 10, “Using the Graph Editor”
- Chapter 11, “Using the Dope Sheet”

8

SETTING KEYS

Setting keys is the process of creating the keys that specify timing and motion. This chapter covers the following topics:

- “Understanding keys” on page 41
- “Setting keys” on page 42
- “Setting breakdowns” on page 45
- “Adding inbetweens” on page 47
- “Setting driven keys” on page 48
- “Using the Channel Control window” on page 55
- “Using animated snapshot and animated sweep” on page 58

UNDERSTANDING KEYS

Animation is the process of creating and editing the properties of objects that change over time. Keys are arbitrary markers that designate the property values of an object at a particular time.

Once you create an object you want to animate, you set keys that represent when the attributes of that object change during your animation. Setting a key involves moving to the time where you want to establish a value for an attribute, setting that value, then placing a key there. In effect, you are recording a snapshot of the attribute at that time.

There are several ways to set a key for an attribute:

- The Animate menu has entries for setting and controlling keys.
- Path animation uses 3D curves to set the direction of animated objects.
- The Attribute Editor and Channel Box have menu items for setting keys for the attributes displayed.
- You can use keyboard hotkeys to set keys for transformation node attributes.

Setting keys

- The Graph Editor lets you set and edit keys for existing animation.
- The Dope Sheet lets you set and edit keys for existing animation.

Related MEL commands

See the online *MEL Command Reference* for details on these commands:

- `autoKeyframe`
- `setKeyframe`
- `setDrivenKeyframe`
- `setKeyPath`

SETTING KEYS

You can set a key by selecting **Animate > Set Key**. The attributes set by this menu item depend on the Set Key option settings.

Setting key options

To set key options:

- 1 Select **Animate > Set Key** .
- 2 In the options window that appears, set the following options and click the Set Key button:

Set Keys on	Specifies which attributes will have keys set on them. All Keyable Attributes sets keys on all attributes of the selected object(s). All Manipulator Handles sets keys on attributes affected by the selected manipulator. For example, when using the Move Tool, keys will be set on the Translate X, Y, and Z attributes only. Current Manipulator Handle sets keys on attributes affected by the selected manipulator handle. For example, when using the Move Tool's X translation handle, keys will be set on the Translate X attribute only.
Set Keys at	Current Time sets keys at the current time only. Prompt causes Maya to prompt for the times when you want to set keys.
Hierarchy	Selected sets keys only on attributes of the selected object.

	Below sets keys on attributes of the selected object and its child objects.
Channels	All Keyable sets keys on all the channels of the selected object. From Channel Box sets keys on the selected channels of the selected object.
Control Points	Sets keys on the control points of the selected objects. Control points are NURBS CVs, polygonal vertices, or lattice points. Be aware that if Control Points is on and you key an object with many control points, for example, a complex NURBS surface, you'll set a large number of keys. This slows Maya operation. If you also set Hierarchy to Below, you might slow Maya operation even more. Turn on these options only when necessary. If you delete the construction history of an object with keyed CVs, the animation won't work correctly.
Shapes	Sets keys on the attributes of an object's shape node and transform node. If off, keys will be set only on the attributes of the transform node.

Setting keys

To set keys:

- 1 Select the objects that have the attributes you want to key.
- 2 Select **Animate > Set Key**.

A key is set based on the Set Key options.

Hotkeys for setting keys follow:

Hotkey	Action
S	Sets a key as Animate > Set Key
Shift-W	Sets keys for translation; as Move Tool
Shift-E	Sets keys for rotation; as Rotate tool
Shift-R	Sets keys for scale; as Scale tool

Setting keys automatically

Auto Key automatically sets keys on attributes when you change the current time and attribute value. A key must already exist for an attribute before you use Auto Key.



Off



On

To use Auto Key:

- 1 Turn on Auto Key on the Range Slider.
- 2 Set a key on any attribute of an object.
- 3 Go to a new time in the timeline.
- 4 Change the value of the previously keyed attribute.

A key is created for the attribute. You can create another key by going to a new time and changing the value of the attribute again.

Holding current keys

Hold Current Keys sets keys for all animated attributes of a selected object at the current time. This menu item is most useful with Auto Key because Auto Key sets keys only for attributes that change value.

For example, suppose you animate a character's walk cycle. When a foot is on the ground, its position must be held for a number of frames. If you were to use Auto Key alone, a value must change before a key is set; Hold Current Keys sets a key for the foot even though the values do not change.

Example of using Hold Current Keys with Auto Key:

- 1 Turn on Auto Key.
- 2 Select the attributes you wish to use Hold Current Keys on; set a key at the starting position.
- 3 Create a walk cycle where a foot touches the ground at time 30.
Later in the walk cycle, for example, at time 60, another key is needed for this position.
- 4 Instead of figuring out exactly which attributes are being keyed, move to 60 and select Animate > Hold Current Keys.

Setting keys in the Attribute Editor

The Attribute Editor displays attributes you can edit and animate. To set keys, right-click an attribute box or name and select Set Key from the pop-up menu. This menu is not available for attributes you cannot key.

Example of animating an object's color in the Attribute Editor

- 1** Create a sphere.
Open the Attribute Editor. Select the lambert1 tab.
- 2** Click the color swatch to open the Color Chooser.
Select a color as the original color of the object.
- 3** Below Common Material Attributes on the lambert1 tab, right-click Color and select Set Key.
A Key Tick does not appear on the Time Slider because the color attribute is not designated as keyable.
- 4** Go to the last frame of the animation.
- 5** In the Color Chooser, select a color as the final color of the object.
- 6** On the lambert1 tab, right-click Color and select Set Key.
- 7** Play the animation. (Press 5 on your keyboard to see the color on the object.)

Setting keys in the Channel Box, Graph Editor, and Dope Sheet

You can use the Channel Box for keying operations on attributes of selected objects. See *Using Maya: Essentials*. You can use the Graph Editor to edit and key animation curves for previously animated objects. See Chapter 10, “Using the Graph Editor.” You can use the Dope Sheet to do timing and keying of objects. See Chapter 11, “Using the Dope Sheet.”

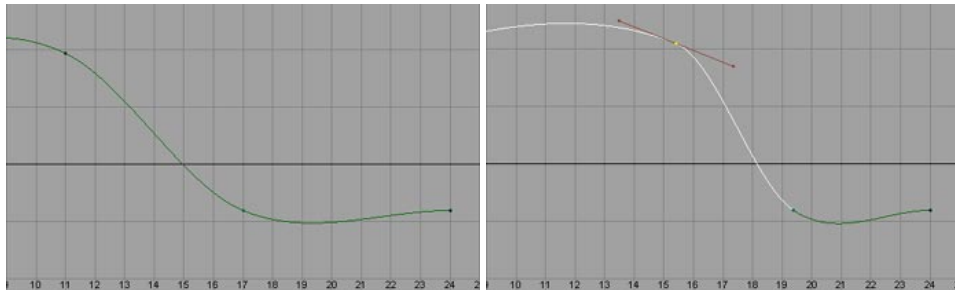
SETTING BREAKDOWNS

Breakdowns are special keys that maintain proportional time relationships with adjacent keys. Use Breakdowns to adjust the timing of an animation while holding attribute values at points on the animation curve. Breakdowns are green ticks on the time slider and green points in the Graph Editor.

SETTING KEYS | 8

Setting breakdowns

Breakdowns that do not have adjacent keys are *unbounded*. These work like regular keys when you place, edit, and move them. Breakdowns have editable tangents. When one or more Breakdowns are bounded by regular keys, the Breakdowns modify their position in time to reflect any changes to the time positions of the regular, bounding, keys.



The key at time 11 is moved;
the breakdown at time 17 modifies its position proportionately.

Creating Breakdowns

Breakdowns are set using **Animate > Set Breakdown**. The options available for Breakdowns are identical to **Animate > Set Key** ☐.

To convert regular keys to Breakdowns, right-click a key tick and select **Keys > Convert to Breakdown**.

In the Graph Editor, you can convert all the keys in an animation curve to Breakdowns. Select the animated attribute in the Outliner part of the Graph Editor, then select **Keys > Convert to Breakdown**.

To convert a Breakdown into a key, right-click a key tick or selected range of keys and select **Keys > Convert to Key**.

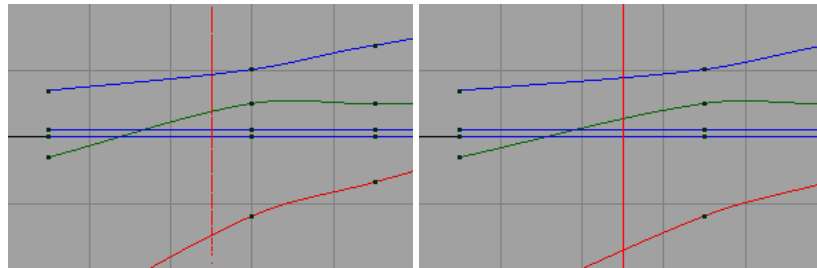
In the Graph Editor, all Breakdowns of an animation curve may be converted to keys. Select the animated attribute in the Outliner part of the Graph Editor and select **Keys > Convert to Key**.

ADDING INBETWEENS

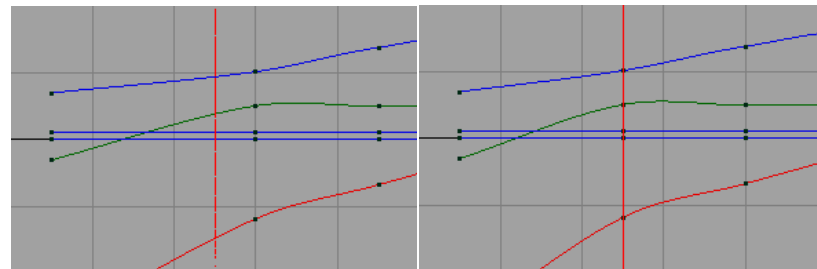
Inbetweens offer a way to adjust animation timing by adding or removing one frame or time unit. Keys and Breakdowns preserve their tangent characteristics, resulting in a minimal change to existing animation curves.

Use the Key Edit menu (right mouse button on the Time Slider) and select **Keys > Add Inbetween** to insert an Inbetween at the current time. In the Graph Editor, use **Keys > Add Inbetween** to insert an Inbetween at the current time.

Use **Keys > Remove Inbetween** to remove an Inbetween at the current time. When using **Remove Inbetween**, the space between keys is decreased. This might cause keys to conflict and act unexpectedly.



Using Add Inbetween



Using Remove Inbetween

Using **Add Inbetween** will cause the animation's keys to be shifted by one whole time unit forward from the current time.

Using **Remove Inbetween** will cause the animation's keys to be shifted by one whole time unit backward from the current time.

SETTING DRIVEN KEYS

Maya has a special *driven key* that links one attribute value to another. In regular animation keys, an attribute has values keyed to times in the Time Slider. For a driven key, an attribute has values keyed to the value of a driving attribute.

A change in a *driver* attribute alters the value of the *driven* attribute. For instance, you can set driven keys to make a door open when a person walks in front of the door.

An attribute can be driven by multiple attributes. For instance, you can make a muscle bulge when an elbow rotates. You can make the muscle bulge even more when the wrist rotates.

When you set driven keys, Maya creates a Graph Editor curve that shows the relationship between the linked attributes. For regular animation keys, the Graph Editor's vertical axis lists attribute values, and the horizontal axis lists animation time values.

For driven keys, the Graph Editor's vertical axis lists driven attribute values, and the horizontal axis lists driver attribute values. For each attribute value of the driver, the curve shows the associated value of the driven attribute. You can edit the curve to alter the relationship. You can't animate driven attributes with regular keyframes.

The Time Slider is not involved in a driven key relationship and displays no red markers for the keys. Playing or scrubbing the animation alters the value of a driven attribute only if you animate the value of the driving attribute over time.

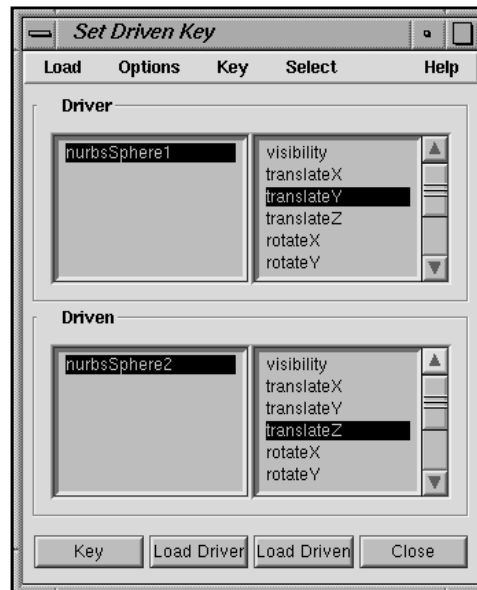
Linking two attribute values

To link two attributes:

- 1 Choose **Animate > Set Driven Key > Set** .

If you select an object before making the menu selection, the Set Driven Key window lists and selects it as the driven object by default.

- 2 In the workspace, select the object that has the attribute to be the driver.
- 3 In the Set Driven Key window, click the Load Driver button.



The object and its attributes appear in the upper part of the window.

- 4 In the Set Driven Key window, select the attribute to be the driver.
- 5 In the workspace, select the object that has the attribute to be driven.
Note that the driven and driver attributes can be in the same object.
- 6 Click Load Driver.

The object and its attributes appear in the lower part of the window.

- 7 In the Set Driven Key window, select the attribute to be the driven attribute.
- 8 In the Channel Box or elsewhere, set values for the driver and driven attributes.
- 9 Click the Key button in the Set Driven Key window.

Maya creates a key that links the selected attributes at the current values. The object with the driven attribute becomes magenta in the workspace. The color indicates the object has a driven attribute.

- 10 Set new values for the driver and driven attributes.
- 11 Click Key again.

Maya creates a key that links the attributes at their new values. You can link the attributes with as many keys as necessary. The default interpolation between the keys is linear. To tune the relationship between the driver attribute and driven attribute, use the Graph Editor.

Linking multiple attributes

You can use two or more driver attributes to control a single driven attribute. You can also drive more than one driven attribute with the same driver attribute. The technique is similar to linking two attributes, with the following exceptions:

- Load all appropriate objects into the Set Driven Key window. For example, select all driver objects in the workspace, then click Load Driver.
- You can set a key for only one driver attribute at a time in the Set Driven Key window. You can't select two driver attributes at the same time. You must key each driver attribute to a driven attribute separately. You can select and key multiple attributes in a driven object.
- When you load two or more objects into the Driver or Driven lists of the Set Driven Key window, no attributes appear for the objects. Click an object in either list to select it and see its attributes.

Examining objects with driven key attribute values

You can examine objects with their driven key attribute settings. This is helpful when you're editing the Graph Editor curve or setting more driven keys.

To see objects with their driven key attribute values:

- 1 In the workspace, select the object that has the driven attribute.
- 2 From the Set Driven Key window, select Key > Go To Next or Key > Go To Previous.

To loop through all the keys, use these menu items repeatedly.

Enhancing work flow

To speed your work as you set driven keys, you can:

- load the driver linked to a loaded driven object
- add an object to the existing Driver or Driven list

- load only the shape node of the selected transform node
- list nonkeyable attributes for an object
- select an object in the Set Driven Key window without corresponding workspace selection
- select a driven object from the Set Driven Key window

To load the driver linked to a loaded driven object:

- 1 Select the driven object in the workspace or Outliner.
- 2 Click Load Driven.
- 3 In the Set Driven Key window, select Load > Current Driver.
The driver object appears in the Driver list of the window.

To add an object to the existing Driver or Driven list:

- 1 Select the object in the workspace or Outliner.
- 2 In the Set Driven Key window, turn off Options > Clear On Load.
- 3 Click Load Driver or Load Driven.

To load only shape nodes of selected transform nodes:

- 1 Select the transform node of the object in the workspace or Outliner.
- 2 In the Set Driven Key window, turn on Options > Load Shapes.
- 3 Click Load Driver or Load Driven.

To list nonkeyable attributes for an object:

- 1 Select the object in the workspace or Outliner.
- 2 In the Set Driven Key window, turn off Options > List Keyable Attributes for driven.
- 3 Click Load Driven.

The Set Driven Key window displays the keyable and the nonkeyable attributes for the object. You can use the Channel Control editor (Window > General Editors > Channel Control) to control whether an attribute is keyable or nonkeyable.

To select an object only in the Set Driven Key window:

In the Set Driven Key window, turn off Options > AutoSelect.

When you select an object in the Set Driven Key window, it's not selected in the workspace.

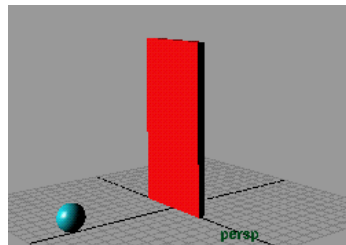
To select a driven object from the Set Driven Key window:

- 1 Select the object name in the Driven list of the Set Driven Key window.
- 2 Choose Select > Driven Items.

This selects the object in the workspace.

Example of setting driven keys

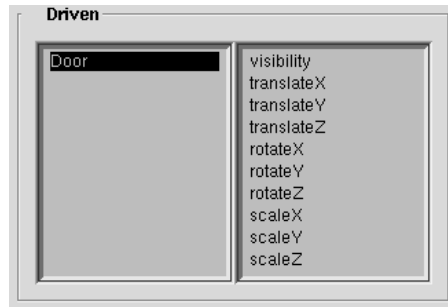
The following example shows how to set driven keys to slide a door upwards when a ball moves toward it. The translateX attribute of an object named Ball is the driver attribute. The translateY attribute of an object named Door is the driven attribute.



Ball's translation towards the door drives Door's upward translation.

To link the attributes:

- 1 Select Door in the workspace.
 - 2 From the Animation menu bar, choose Animate > Set Driven Key > Set-.
- The Set Driven Key window appears with Door in the Driven list.
- 3 Click translateY in the Driven list.



This is the attribute to be driven by Ball's movement.

- 4 Select Ball in the workspace or Outliner.
- 5 In the Set Driven Key window, click Load Driver.
Ball appears in the Driver list.
- 6 Click translateX in the Driver list.

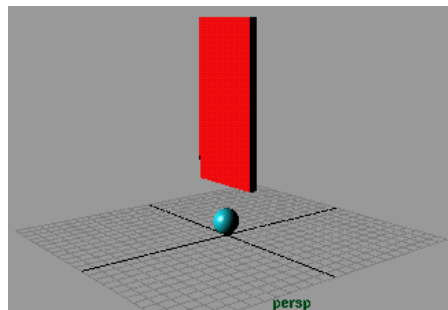
This is the attribute that will drive Door's movement.

The Key button is no longer dim. You can set a driven key only after you select an attribute in the Driver list and in the Driven list.

- 7 In the Set Driven Key window, click Key.

This sets a driven key that links the current X translation of Ball to the current Y translation of Door. Whenever Ball's translateX attribute is at this position, Door's translateY position will be at its current position.

- 8 Move Ball to Door's position and move Door above Ball:



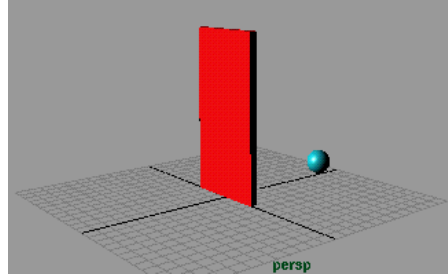
- 9 Click Key again.

SETTING KEYS | 8

Setting driven keys

This sets another driven key that links the X translation of Ball to the Y translation of Door.

- 10** Move Ball to the right of Door. Lower Door to its previous position:



- 11** Click Key again.

This sets another driven key that links the attributes.

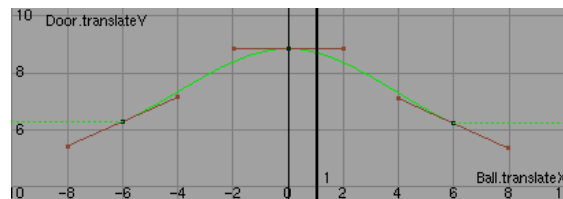
The three keys that were set in this procedure link the attributes at their keyed values. Maya interpolates the linked values to generate the values between the keys. Because interpolation is linear by default, Door rises smoothly when you drag Ball toward it from either side.

Playing the animation doesn't move Ball or Door. Driven keys link one attribute to another. They don't link attributes to times in the Time Slider.

- 12** Select Window > Animation Editors > Graph Editor.

- 13** Select Door.

The Graph Editor shows the driven keys that link Door's translateY value to Ball's translateX value:



The column of numbers on the left lists the driven attribute values. The row at the bottom lists driver attribute values. The bell-shaped curve shows the relationship between the values—Door's translateY value rises as Ball's translateX value approaches 0.

Door's translateY value has a steady value near 6.5 when Ball's translateX value is less than -6 or greater than 6. In other words, Door is in its closed position when Ball is further than 6 units from the X-axis 0 position.

You can change the shape of the curve to make Door rise faster, slower, and higher as Ball approaches it. You can also cut, copy, paste, and delete the driven keys in the Graph Editor.

You can use regular animation keys, expressions, motion paths, or other techniques to animate Ball's translateX value. For example, you can animate Ball moving back and forth under the sliding door. The animated translateX value of Ball drives Door's translateY value as the animation plays.

You cannot animate a driven attribute with such techniques after you set driven keys for it. You can control an attribute with only one technique.

USING THE CHANNEL CONTROL WINDOW

The Channel Control window has two tabs. The Keyable tab is used to edit the keyability of attributes, and the Locked tab is used to edit attribute locks.

Assigning attributes

Certain attributes are assigned a keyable status by default in Maya. For example, objects are assigned the following keyable attributes:

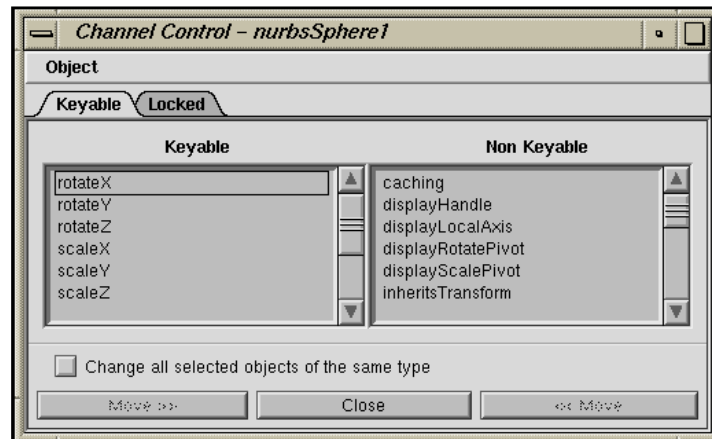
- Rotate X, Y, and Z
- Scale X, Y, and Z
- Translate X, Y, and Z
- Visibility

To edit the keyable status of attributes, use the Keyable tab of the Channel Control window.

The Keyable tab of the Channel Control window consists of two columns listing the attributes of selected objects. Attributes' keyability depends on which column they are listed in. Multiple objects, even of different types, can have their attributes managed simultaneously.

SETTING KEYS | 8

Using the Channel Control window



Example of editing keyability:

- 1 Create a sphere and a spotlight. Select both.
- 2 Open the Channel Control window (Window > General Editors > Channel Control). Click on the Keyable tab to bring that window forward.
- 3 Click on the Change all selected objects of the same type checkbox to enable the editing of attributes common to the selected objects of both objects (the light and the sphere).
- 4 Remove the visibility attribute for the light and the sphere. Select visibility from the Keyable list of attributes.
- 5 Press the Move>> button to transfer the attributes from the Keyable column to the Non Keyable column.

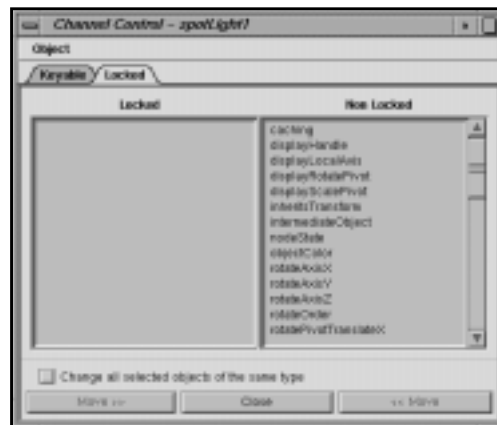
Visibility is no longer keyable for either of these objects, and no longer appears in the Channel Box or Dynamic Keys menu.

- 6 Click Object in the top left of the Channel Control window. A pop-up menu of the currently selected objects is displayed. Select spotLight1 from the list. Note that the window title bar displays the name of the selected object.
Now assign as keyable the pivot of the spotlight only.
- 7 Disable the Change all selected objects of the same type option by clicking in the associated checkbox.

- 8 From the Non Keyable list, select rotatePivotTranslateX, rotatePivotTranslateY, and rotatePivotTranslateZ. Because these attributes are adjacent, you can click the first one and Shift-click the others to select them. (For nonconsecutive attributes, Ctrl-click the desired items to add to the selection.)
- 9 Press the right <<Move button to place the attributes in the Keyable list column. These attributes are now available for keying in the Channel Box and dynamic keys menu.

Locking attributes

To disable editing of attributes without removing them from the Channel Box or designating them non-keyable, use the Locked tab of the Channel Control window to change the locked status of the attributes.



The process of managing attributes in the Locked tab of the Channel Control window is the same as that used in the Keyable tab.

When attributes are locked, they become unavailable for editing. They appear in gray in the Attribute Editor and the Channel Box.

Note

Locked attributes may also be unlocked in the Attribute Editor by pressing the right mouse button in the field of the locked attribute.

USING ANIMATED SNAPSHOT AND ANIMATED SWEEP

You can create path-driven geometry from animated curves and objects using **Modify > Animated Snapshot** and **Modify > Animated Sweep**.

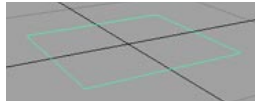
Using Animated Snapshot

Animated Snapshot creates copies of animated objects at intervals of a playback range. Animated Snapshot works on NURBS or polygonal geometry. You can't use Animated Snapshot on objects animated with dynamics and Inverse Kinematics.

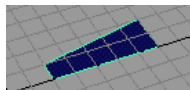
The following example shows how to use Animated Snapshot.

Creating a spiral staircase:

- 1 Select the Animation menu set before doing these steps.
- 2 Select **Create > NURBS Primitives > Plane** to create a simple planar surface.



This will be the bottom step of the staircase. If desired, scale the plane and move its CVs to make the plane look more like a step.



- 3 Translate the step so one of its narrow edge touches the origin. Press your keyboard's Insert key to display the step's pivot point. Translate the pivot point to the origin. Press the Insert key again to exit pivot point mode.
- 4 Rewind the animation and select **Animate > Set Key** to set a key at the start time.
- 5 Slide the Current Time indicator to the end of the playback range. (Specify a short playback range, for example, 24 frames.)
- 6 Translate the step upwards along the Y-axis about 10 units, then set a key.

This creates the end position of the step's vertical travel.

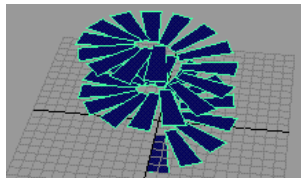
Using animated snapshot and animated sweep

- 7 Enter 720 for Rotate Y in the Channel Box, then set a key.
This creates the end position of the step's rotation.
- 8 Rewind and play the animation to observe the step's movement.
- 9 Select the step.
- 10 Select **Modify > Animated Snapshot** ☐ to open the Animation Snapshot Options window.
- 11 For Time Range, turn on Time Slider, then set By Time to 1.

These settings will create snapshot copies of the animated geometry at a regular interval for the entire Time Slider range. The By Time value sets the time interval when snapshots are taken.

If, instead, you turn on Start/End for the Time Range option, you can enter a Start Time and End Time (time range) for the animated geometry.

- 12 In the Animation Snapshot Options window, click the Snapshot button to create the staircase. Wait several moments for the operation to complete.



The original object and animation is unchanged. In the Outliner, the copies of the steps exist under a new group, snapshotGroup.

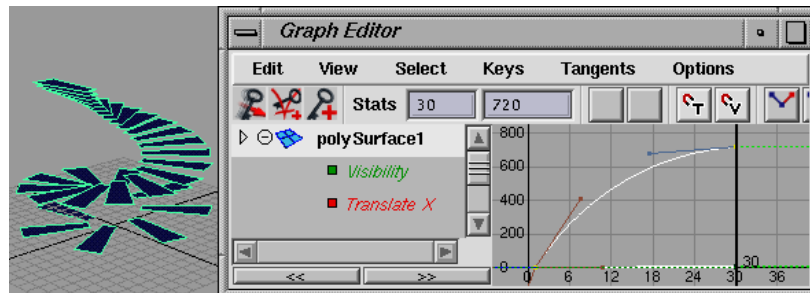
Editing Animated Snapshot-Generated Geometry

When Construction History is enabled during an Animated Snapshot, you can edit the animation to affect the generated geometry.

The following illustration is an example of using the Graph Editor to edit the animation curves which were used to generate the staircase example above.

SETTING KEYS | 8

Using animated snapshot and animated sweep



Tip

To create geometry using Animated Snapshot from animation types such as Expressions or Inverse Kinematics, you can effectively convert the object's animation type to animation curves using **Edit > Bake Simulation > Bake Simulation**.

Using Animated Sweep

Use Animated Sweep to create surface geometry from an animated curve. Animated Sweep operates on animated object transformations that have explicit connections to all the nodes connected to the geometry. Geometry animated by dynamics, inverse kinematics, and self-referencing expressions, for example, cannot be used to generate Animated Snapshot geometry. This menu item is similar to performing an Animated Snapshot of a curve and a subsequent Loft.

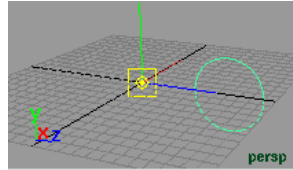
A simple example of an Animated Sweep would be to create a spiraling tube that decreases in size, much like an animal's horn.

Example of creating a spiral horn:

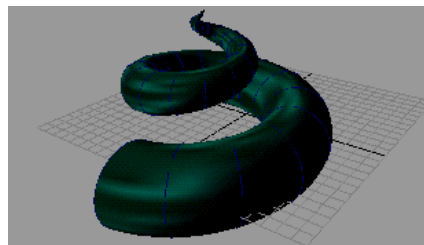
- 1 In the Modeling menu set, create a circle by selecting **Create > NURBS Primitives > Circle**.
- 2 Move the circle 8 units along the Z-axis.
- 3 Scale the circle until it has a radius of approximately 3 units.
- 4 Rotate the circle 90 degrees (so that it is now perpendicular to the grid).

Using animated snapshot and animated sweep

- 5 Change the circle's pivot to the origin, so that it will rotate around the origin in the animation. Press Insert on the keyboard. Enter the values 0 0 0 in the Transform Attributes entry field, or drag the pivot point to the origin. Press Insert again when the pivot is positioned.



- 6 Switch to the Animation Menu set (F2 on the keyboard).
- 7 Ensure that the Current Time Indicator is at the start of the Time Slider, and set a key for the circle's transforms (Keys > Set Key). This is the starting position of the circle for this animation.
- 8 Move the Current Time Indicator to the end of the playback range.
- 9 Set Rotate X to 720 to rotate the circle approximately two revolutions.
- 10 Move the circle up the Y-axis approximately 10 units.
- 11 Scale the circle to 0.
- 12 Set a key for the transformations (Animate > Set Key).
You have established the end state for the circle.
- 13 Press Play to observe the animation of the circle.
- 14 Select Modify > Animated Sweep ☐. Ensure that the Time Range is set to Time Slider, and that the By Time value is set to 1.
- 15 Click the Anim Sweep button.



Using animated snapshot and animated sweep

The Animated Sweep Settings Window

In addition to the Time Range and By Time settings, Animated Sweep provides control over the surface geometry generated. These options are identical to Surfaces > Loft.

Animated Snapshot and Sweep performance options

Enabling and Disabling Snapshot Nodes

Because Animated Snapshot and Animated Sweep evaluate the animation and create geometry for each By Time position, considerable processing time occurs for complex objects and animation. You can disable Animated Snapshot and Animated Sweep calculations by selecting **Modify > Disable Nodes > Snapshots**.

You can turn on disabled Animated Snapshot and Animated Sweep calculations by selecting **Modify > Enable Nodes > Snapshots**.

Construction History

Animated Snapshot and Animated Sweep create construction history. This means you can edit the animation used to generate the Animated Snapshot and Animated Sweep geometry. Be aware, though, that you can save considerable processing time in complex Animated Snapshot and Animated Sweep operations by turning off construction history.

You can also delete construction history at a later point by selecting **Edit > Delete by Type > History** once the Animated Snapshot and Animated Sweep geometry is complete.

9

EDITING KEYS

This chapter covers the following topics:

- “Understanding key editing” on page 63
- “Cutting keys” on page 65
- “Copying keys” on page 67
- “Pasting keys” on page 70
- “Cutting, copying, and pasting keys between scenes” on page 73
- “Deleting keys” on page 73
- “Scaling keys” on page 75
- “Snapping keys” on page 79
- “Baking simulations” on page 81

UNDERSTANDING KEY EDITING

You can rearrange, remove, and duplicate keys and sequences of keys. For example, you can copy the animated properties of one object onto another, or you can stretch a chunk of animation over a longer period of time than you originally keyed.

Keys clipboard

The keys clipboard is a temporary storage area for keys and animation curve segment information. Storing new information on the keys clipboard replaces any information previously on the keys clipboard.

The same keys clipboard in Maya is available throughout all editors and windows. For example, information placed on the keys clipboard with a Cut operation in the Graph Editor may be pasted onto an object in a modeling view using Edit > Keys > Paste Keys.

The keys clipboard is not an editor nor is it viewable in any window in Maya. Exiting Maya clears the clipboard.

Keyset

A keyset is a set of keys within a specified time range on one or more animation curves. (The term *set* is used here in a general sense and should not be confused with Maya's sets and partitions.) A keyset may include just one key on one animation curve, or may include many keys on many animation curves. The animation curves could all be on the same object, or on many objects.

If the objects are related in some hierarchical way (grouped or parented), the hierarchical relationships are included in the keyset. Consequently, you can cut or copy a keyset from some hierarchically related objects and paste the keyset to hierarchically related objects that are similar. The animation of the objects will be applied to the other objects, even to the point of maintaining the hierarchical relationships between the keys and animation curves.

Related MEL commands

MEL commands related to editing keys include the following:

- copyKey
- cutKey
- pasteKey
- scaleKey
- snapKey
- keyTangent
- bakeResults

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

CUTTING KEYS

Cutting a keyset is essentially the same as copying keys to the keys clipboard then deleting them. When cutting, you can first set the cut key options (Edit > Keys > Cut Keys ) or you can immediately cut (Edit > Keys > Cut Keys) with the currently set options.

Setting cut keys options

To set cut keys options:

- 1 If you want to cut now, select the key(s) or keyset that you want to cut.
- 2 Select Edit > Keys > Cut Keys .
- 3 Set the cut keys options:

The Cut Keys Options window is displayed.

Hierarchy

Specifies how a keyset will be cut from a hierarchy of grouped or parented objects.

Selected specifies that the keyset will include only the animation curves of the currently selected object. Default is on.

Below specifies that the keyset will include the animation curves of the selected object and all the objects below it in the hierarchy. The keys clipboard keeps track of the hierarchical relationships of the keys and animation curves in the keyset. You can paste the keyset to a hierarchy of objects whose hierarchical structure is the same as the one the keyset was cut from. If the hierarchical structure is not the same, Maya will paste the keys in a way that best matches the keyset's hierarchical relationships to the hierarchical structure of the objects. Default is off.

Channels

Specifies the channels (keyable attributes) whose animation curves will be included in the keyset.

All Keyable specifies that the keyset will include the animation curves of all keyable attributes of the selected object. Default is on.

From Channel Box specifies that the keyset will include the animation curves of only those channels currently selected in the Channel Box. Default is off.

Cutting keys

Driven Channels	Specifies that the keyset will include any driven keys. The driven keys enable the values of keyable attributes (channels) to be driven by the values of other attributes (see “Setting driven keys” on page 48). Default is off.
Control Points	Specifies whether the keyset will include all the animation curves of a selected deformable object’s control points. Control points include NURBS control vertices (CVs), polygonal vertices, and lattice points. For instance, if you select a NURBS surface’s transform node then you select Edit > Keys > Cut Keys with the Control Points option on, the animation curves for the surface’s CVs will be cut along with the animation curves for the surface’s translation, rotation, scaling, and so on. Default is off. Note that if you just select a CV and select Edit > Keys > Cut Keys with Control Points off, only the animation curves for the selected CV will be cut. However, with Control Points on, all the animation curves for all the CVs will be cut, even if only one of the surface’s CVs is selected. In general, turning Control Points on is useful when you are doing a lot of animation at the control point level (for instance, CV-intensive animation) and don’t want to have to select each control point.
Shapes	Specifies whether the keyset will include the animation curves of a selected object’s shape node as well as its transform node. Typically, when you select an object in the workspace, the object’s transform node is selected. To cut the animation curves of the object’s shape node as well as its transform node, be sure Shapes is on. To cut the animation curves of the transform node only, turn Shapes off. Default is on.
Time Range	Specifies the time range of the keyset’s animation curves. All specifies no limit on the time range. Start/End specifies a time range from Start Time to End Time. Time Slider specifies the time range is the Time Slider’s playback range.
Start Time	Specifies the start of the time range (available if Start/End is on).
End Time	Specifies the end of the time range (available if Start/End is on).
Help Images	Displays an image in the Cut Keys Options window that illustrates cutting to the keys clipboard within a specified time range.
Method	Specifies whether the keyset will include keys only or keys and animation curve segments (available if Start/End or Time Slider is on). Keys specifies that the keyset will include only keys.

Segments specifies that the keyset will include keys and animation curve segments. This is useful when you want to cut the segments of animation curves that lie between keys. For instance, you might not have any keys in the time range you've selected, but you want to cut the animation curve action in the time range. To preserve the shape of the animation curve segments, Maya will create keys at the time range's start and end times if keys do not already exist at those times.

Adjustment Specifies how the keyset is copied to the keys clipboard after it has been cut (available if Segments is on).

None specifies cutting keys within the specified range. If there are keys remaining adjacent to both ends of the deleted area, the animation curve(s) produced will retain the out tangent and in tangent of the key in the cut area.

Collapse specifies removing keys within the specified range. Any keys preceding the cut are moved to the start time of the cut area, effectively "shuffling forward" the animation curve to fill the resulting gap.

Connect Adjusts the keys clipboard curves in value and adjusts the segment of the original curve following the pasted segment. This prevents discontinuity in the animation (available if Collapse is on).

- 4 Click the Cut Keys button to cut keys.

COPYING KEYS

You can copy keys to the keys clipboard. When copying, you can first set the copy key options (Edit > Keys > Copy Keys ☐) or you can immediately copy (Edit > Keys > Copy Keys) with the currently set options.

Copying multiple animation curves to multiple attributes

When copying and pasting keysets that include multiple animation curves to multiple attributes, pay particular attention to the order that you select them, as this will impact the order in which they are pasted.

Setting copy keys options

To set copy keys options:

- 1 If you want to copy now, select the key(s) or keyset that you want to copy.
- 2 Select Edit > Keys > Copy Keys .

The Copy Keys Options window is displayed.

- 3 Set the copy keys options

Hierarchy

Specifies how a keyset will be copied from a hierarchy of grouped or parented objects to the keys clipboard.

Selected specifies that the keyset will include only the animation curves of the currently selected object. Default is on.

Below specifies that the keyset will include the animation curves of the selected object and all the objects below it in the hierarchy. The keys clipboard keeps track of the hierarchical relationships of the keys and animation curves in the keyset. This will enable you to paste the keyset to a hierarchy of objects whose hierarchical structure is the same as the one the keyset was copied from. If the hierarchical structure is not the same, Maya will paste the keys in a way that best matches the keyset's hierarchical relationships to the hierarchical structure of the objects. Default is off.

Channels

Specifies the channels (keyable attributes) whose animation curves will be included in the keyset.

All Keyable specifies that the keyset will include the animation curves of all keyable attributes of the selected object. Default is on.

From Channel Box specifies that the keyset will include the animation curves of only those channels currently selected in the Channel Box. Default is off.

Driven Channels

Specifies that the keyset will include any driven keys. The driven keys enable the values of keyable attributes (channels) to be driven by the values of other attributes (see "Setting driven keys" on page 48). Default is off.

Control Points

Specifies whether the keyset will include all the animation curves of a selected deformable object's control points. Control points include NURBS control vertices (CVs), polygonal vertices, and lattice points. For instance, if you select a NURBS surface's transform node then select Edit > Keys > Copy

Keys with the Control Points option on, the animation curves for the surface's CVs will be copied along with the animation curves for the surface's translation, rotation, scaling, and so on. Default is off.

Note that if you just select a CV and select Edit > Keys > Copy Keys with Control Points off, only the animation curves for the selected CV will be copied. However, with Control Points on, all the animation curves for all the CVs will be copied, even if only one of the surface's CVs is selected. In general, turning Control Points on is useful when you are doing a lot of animation at the control point level (for instance, CV-intensive animation) and don't want to have to select each control point to copy the animation.

Shapes	Specifies whether the keyset will include the animation curves of a selected object's shape node as well as its transform node. Typically, when you directly select an object in the workspace (for instance, in the perspective view), what is selected is the object's transform node. To copy the animation curves of the object's shape node as well as its transform node, be sure Shapes is on. To copy the animation curves of the transform node only, turn Shapes off. Default is on.
Time Range	Specifies the time range of the keyset's animation curves. All specifies no limit on the time range. Start/End specifies a time range from Start Time to End Time. Time Slider specifies the time range is the Time Slider's playback range.
Start Time	Specifies the start of the time range (available if Start/End is on).
End Time	Specifies the end of the time range (available if Start/End is on).
Help Images	Displays an image in the Copy Keys Options window that illustrates copying to the keys clipboard within a specified time range.
Method	Specifies whether the keyset will include keys only or keys and animation curve segments (available if Start/End or Time Slider is on). Keys specifies the keyset will include only keys. Segments specifies that the keyset will include keys and animation curve segments. This is useful when you want to copy the segments of animation curves that lie between keys. For instance, you might not have any keys in the time range you've selected, but you want to copy the animation curve

Pasting keys

action in the time range. To preserve the shape of the animation curve segments, Maya will create keys at the time range's start and end times if keys do not already exist at those times.

- 4 Click the Copy Keys button to copy keys.

Copying a key or keyset

To copy a keyset:

- 1 If you want to copy now, select the key(s) or keyset that you want to copy.
- 2 Select Edit > Keys > Copy Keys.

The selected keyset is copied to the keys clipboard.

PASTING KEYS

You can paste a keyset from the keys clipboard. When pasting, you can first set the paste key options (Edit > Keys > Paste Keys ) or you can immediately paste (Edit > Keys > Paste Keys) with the currently set options.

Pasting multiple animation curves to multiple attributes

When copying and pasting keysets that include multiple animation curves to multiple attributes, pay attention to the order you select them. This affects the order in which they are pasted.

Setting paste keys options

To set paste keys options:

- 1 If you want to paste now, select a time range.
- 2 Select Edit > Keys > Paste Keys .
- 3 Set the paste keys options:

The Paste Keys Options window is displayed.

Time Range

Specifies the time range of the keyset's animation curves.

Start transfers the animation information to the selected objects so that the animation starts at the time specified in the Start Time field.

Start/End transfers the animation information to the selected object or objects, scaling the animation to fit into the specified time range as entered in the Start Time and End Time fields. Animation information from the keys clipboard is either scaled or clipped depending on the setting of the Clipboard Adjustment option.

For example, if the animation information on the keys clipboard consists of two keys four frames apart, specifying a start/end time range of 8 to 18 will scale the pasted keys across 10 frames.

Current transfers the animation information to the selected objects so that the animation starts at the current time as displayed in the Animation Controls.

Clipboard transfers the animation information to the selected object or objects, preserving the duration and timing of the animation information on the keys clipboard.

Time Offset Adds the number entered in the numeric input field to the time values on the keys clipboard prior to pasting.

Value Offset Adds the number entered in the numeric input field to the attribute values on the keys clipboard prior to pasting.

Copies To facilitate replication of animation information, use the Copies field to enter a value that represents the number of times the animation will be copied.

Multiple copies are appended sequentially. For example, you could create the repetitious animation of a rotating lamp assembly of a lighthouse by keying one rotation of the lamp, copying the animation information, and then pasting multiple copies back onto the lamp.

Help Images Enabling Help Images provides illustrations of the effects of the various paste settings.

Clipboard Adjustment **Preserve** pastes the contents of the clipboard into their new positions on the curve without any changes.

Scale becomes enabled when Start/End is selected. The complete contents of the clipboard curves are stretched or compressed to fit into the specified paste Time Range.

Pasting keys

	Fit becomes enabled when Start/End is selected. The contents of the clipboard are preserved (that is, not stretched or compressed) and as much as will fit into the specified time range is pasted into the new area.
Paste Method	Insert places the clipboard contents before any existing keys in the specified time range. The keys from the original curve that were after the specified time range are shifted in time by the pasted range times. Replace becomes enabled when Start/End or Clipboard is selected. The clipboard contents overwrite any existing keys in the specified time range. Merge adds the clipboard contents to any existing keys on the curve. In the case where a clipboard key is at the same time as an existing key, the clipboard key replaces the existing key.
Replace Region	These fields are enabled when Paste Method is set to Replace. Time Range replaces keys and curve segment information in the specified time range with the contents of the keys clipboard. Entire Curve is available only when the Time Range setting is Clipboard. The Entire Curve setting replaces the animation curve(s) on the pasted attributes with the contents of the keys clipboard, in effect deleting any existing animation curves on these attributes and applying the new curves from the keys clipboard.
Connect	This option adjusts the keys clipboard curves in value so there's no discontinuity in the animation at the start of the pasted segment.

- 4 Click the Paste Keys button to paste keys.

Pasting a key

To paste a key or keyset:

- 1 If you want to paste now, select the key or keyset to which you want to paste.
 - 2 Select Edit > Keys > Paste Keys.
- The selected keyset is pasted from keys clipboard.

CUTTING, COPYING, AND PASTING KEYS BETWEEN SCENES

You can cut, copy, and paste animations of characters, skeletons, and other objects to objects in another scene.

One way is to export and import animation using the animImportExport plug-in. However, if you copy an animation to the keys clipboard, it stays on the clipboard when you do File > New and File > Open. This means you can retrieve a scene with animation, select a character and copy the animation, then retrieve another scene (with the same character in it) and paste the animation into it.

In summary, animation on the keys clipboard is persistent across File > New and File > Open selections, which means you could retrieve a scene with animation and copy it, and then retrieve another scene with the same character and paste the animation onto it.

DELETING KEYS

Deleting a keyset is removing the keyset from animated objects without saving the keyset to the keys clipboard. When deleting, you can first set the delete key options (Edit > Keys > Delete Keys ) or you can immediately cut (Edit > Keys > Delete Keys) with the currently set options.

Note that there is no deleteKeys MEL command; the related MEL command for deleting keys is cutKeys -clear.

Setting delete keys options

To set delete keys options:

- 1 If you want to delete now, select the key(s) or keyset that you want to delete.
 - 2 Select Edit > Keys > Delete Keys .
- The Delete Keys Options window is displayed.
- 3 Set the delete keys options:

Objects

Selected specifies to delete keys only from the currently selected objects.

All deletes keys on all objects, including objects that you can't usually select in a modeling window (such as construction history nodes).

Deleting keys

Hierarchy	Specifies how a keyset will be deleted from a hierarchy of grouped or parented objects. Selected specifies that the keyset to be deleted will include only the animation curves of the currently selected object. Default is on. Below specifies that the keyset to be deleted will include the animation curves of the selected object and all the objects below it in the hierarchy. Default is off.
Channels	Specifies the channels (keyable attributes) whose animation curves will be included in the deleted keyset. All Keyable specifies that the keyset will include the animation curves of all keyable attributes of the selected object. Default is on. From Channel Box specifies that the keyset will include the animation curves of only those channels currently selected in the Channel Box. Default is off.
Driven Channels	Specifies that the keyset to be deleted will include any driven keys. The driven keys enable the values of keyable attributes (channels) to be driven by the values of other attributes (see “Setting driven keys” on page 48). Default is off.
Control Points	Specifies whether the keyset to be deleted will include all the animation curves of a selected deformable object’s control points. Control points include NURBS control vertices (CVs), polygonal vertices, and lattice points. Default is off.
Shapes	Specifies whether the keyset to be deleted will include the animation curves of a selected object’s shape node as well as its transform node. Typically, when you directly select an object in the workspace (for instance, in the perspective view), what is selected is the object’s transform node. To delete the animation curves of the object’s shape node as well as its transform node, be sure Shapes is on. To delete the animation curves of the transform node only, turn Shapes off. Default is on.
Time Range	Specifies the time range of the keyset’s animation curves. All specifies no limit on the time range. Start/End specifies a time range from Start Time to End Time. Time Slider specifies the time range is the Time Slider’s playback range.
Start Time	Specifies the start of the time range (available if Start/End is on).
End Time	Specifies the end of the time range (available if Start/End is on).

- Help Images** Displays an image in the Delete Keys Options window that illustrates deleting within a specified time range.
- Method** Specifies whether the keyset to be deleted will include keys only or keys and animation curve segments (available if Start/End or Time Slider is on).
- Keys** specifies that the keyset will include only keys.
- Segments** specifies that the keyset to be deleted will include keys and animation curve segments. This is useful when you want to delete the segments of animation curves that lie between keys. For instance, you might not have any keys in the time range you've selected, but you want to delete the animation curve action in the time range. To preserve the shape of the animation curve segments, Maya will create keys at the time range's start and end times if keys do not already exist at those times.
- 4 Click the Delete Keys button.

Deleting a key or keyset

To delete a key or keyset:

- 1 If you want to delete now, select the key or keyset that you want to delete.
- 2 Select Edit > Keys > Delete Keys.

The selected keyset is deleted. It is not saved to the keys clipboard.

SCALING KEYS

To change the duration of a range of keys and animation curve segments, you can scale keys. When scaling, you can first set the scale key options (Edit > Keys > Scale Keys ☐) or you can immediately paste (Edit > Keys > Scale Keys) with the currently set options.

Note

If tangents of the fixed type (see Chapter 10, "Using the Graph Editor" for a description of the fixed tangent type) are within the range of keys and animation curve segments to be scaled, the shape of the animation curve may not be preserved.

Setting scale keys options

To set scale keys options:

- 1 If you want to scale now, select the key(s) or keyset that you want to scale.
- 2 Select Edit > Keys > Scale Keys .
The Scale Keys Options window is displayed.
- 3 Set the scale keys options:

Objects	Selected specifies to scale keys only from the currently selected objects. All specifies to scale keys on all objects, including objects that you can't usually select in a modeling window (such as construction history nodes).
Hierarchy	Specifies how a keyset will be scaled from a hierarchy of grouped or parented objects. Selected specifies that the keyset to be scaled will include only the animation curves of the currently selected object. Default is on. Below specifies that the keyset to be scaled will include the animation curves of the selected object and all the objects below it in the hierarchy. Default is off.
Channels	Specifies the channels (keyable attributes) whose animation curves will be included in the scaled keyset. All Keyable specifies that the keyset will include the animation curves of all keyable attributes of the selected object. Default is on. From Channel Box specifies that the keyset will include the animation curves of only those channels currently selected in the Channel Box. Default is off.
Driven Channels	Specifies that the keyset to be scaled will include any driven keys. The driven keys enable the values of keyable attributes (channels) to be driven by the values of other attributes (see "Setting driven keys" on page 48). Default is off.
Control Points	Specifies whether the keyset to be scaled will include all the animation curves of a selected deformable object's control points. Control points include NURBS control vertices (CVs), polygonal vertices, and lattice points. Default is off.

Shapes	Specifies whether the keyset to be scaled will include the animation curves of a selected object's shape node as well as its transform node. Typically, when you directly select an object in the workspace (for instance, in the perspective view), what is selected is the object's transform node. To scale the animation curves of the object's shape node as well as its transform node, be sure Shapes is on. To scale the animation curves of the transform node only, turn Shapes off. Default is on.
Time Range	Specifies the time range of the keyset's animation curves. All specifies no limit on the time range. Start/End specifies a time range from Start Time to End Time. Time Slider specifies the time range is the Time Slider's playback range.
Start Time	Specifies the start of the time range (available if Start / End is on).
End Time	Specifies the end of the time range (available if Start / End is on).
Method	Scale/Pivot applies multipliers to the selected range for time and value. This also sets a pivot point from which the scaling will take place on each axis. For an example, see "Scaling with time pivot method" on page 78. Start/End compresses or expands the selected range to fit in the range specified in New Start / End Times.
Time Scale/Pivot	Specifies the time multiplier. First field specifies the value that multiplies all the times of the keyset. Second field specifies the pivot point from which the scaling will take place.
Value Scale/Pivot	Specifies the value multiplier. First field specifies the value that multiplies all the values of the keyset. Second field specifies the pivot point from which the scaling will take place.
New Start/End Times	Specifies the time range into which the keyset will be compressed or expanded (available if Start / End is on).

- 4 Click the Scale Keys button.

Scaling a keyset

To scale a keyset:

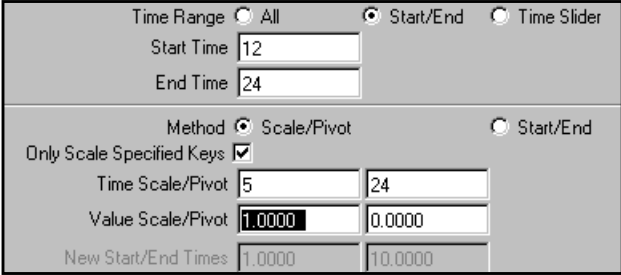
- 1 Select the keyset that you want to scale.
- 2 Select Edit > Keys > Scale Keys.

Scaling with time pivot method

Suppose you want to halve the duration of the segments between times 12 and 24. To retain the look of the animation, you can scale the animation's duration from a designated Time Pivot.

To scale the time of a range of keys using Time Pivot:

- 1 Select the object. View the effect of the scaling action in the Graph Editor.
- 2 Select Edit > Keys > Scale Keys  to open the Scale Keys Options window.
- 3 To compress the range between 12 and 24, select the Start/End Time Range option and enter these values, respectively, in the available fields.
- 4 To scale the animation without affecting the curves of the animation before and after this range, select the Scale/Pivot Method and enter the following values:



The Scale Keys Options window is shown with the following settings:

- Time Range:** ☐ All, ☒ Start/End, ☐ Time Slider
- Start Time:** 12
- End Time:** 24
- Method:** ☒ Scale/Pivot, ☐ Start/End
- Only Scale Specified Keys:** ☒
- Time Scale/Pivot:** 5, 24
- Value Scale/Pivot:** 1.0000, 0.0000
- New Start/End Times:** 1.0000, 10.0000

This retains the time value of the animation after time 24:

- 5 Click the Scale Keys button to perform the function.

Note

Keys and animation curve segments adjacent to the scaled region will be shifted in time by the amount the scaled range has been compressed or expanded, but their shapes will be preserved.

In the above example, the keys formerly at time 0 have been “pulled” to time 6 as the region of 12 to 24 was compressed by half (with the Time Pivot set at 24).

SNAPPING KEYS

Use Snap to cause selected keys to snap in time to the nearest whole time unit values or attribute values. Use Select Unsnapped to check for keys not at whole time units. These settings also affect the Snap button on the Graph Editor, but not the Time Slider Edit Keys > Snap menu item (which snaps the time values of selected keys only).

When snapping, you can first set the snap key options (Edit > Keys > Snap Keys ☐) or you can immediately snap (Edit > Keys > Snap Keys) with the currently set options.

Setting snap keys options

To set snap keys options:

- 1 If you want to snap now, select a time range.
- 2 Select Edit > Keys > Snap Keys ☐.

The Snap Keys Options window is displayed.

- 3 Set the snap keys options:

Objects

Selected specifies to snap keys only from the currently selected objects.

All specifies to snap keys on all objects, including objects that you can't usually select in a modeling window (such as construction history nodes).

Hierarchy

Specifies how keys in the selected keyset will be snapped from a hierarchy of grouped or parented objects.

Selected specifies that the keys to be snapped will include only the keys on the currently selected object. Default is on.

Below specifies that the keys to be snapped will include the keys on the selected object and all the objects below it in the hierarchy. Default is off.

Channels

Specifies the channels (keyable attributes) whose keys will be snapped.

All Keyable specifies that the keyset will include the animation curves of all keyable attributes of the selected object. Default is on.

From Channel Box specifies that the keyset will include the animation curves of only those channels currently selected in the Channel Box. Default is off.

Snapping keys

Driven Channels	Specifies that the keyset to be deleted will include any driven keys. The driven keys enable the values of keyable attributes (channels) to be driven by the values of other attributes (see “Setting driven keys” on page 48). Default is off.
Control Points	Specifies whether the keyset to be deleted will include all the animation curves of a selected deformable object’s control points. Control points include NURBS control vertices (CVs), polygonal vertices, and lattice points. Default is off.
Shapes	Specifies whether the keyset to be deleted will include the animation curves of a selected object’s shape node as well as its transform node. Typically, when you directly select an object in the workspace (for instance, in the perspective view), what is selected is the object’s transform node. To delete the animation curves of the object’s shape node as well as its transform node, be sure Shapes is on. To delete the animation curves of the transform node only, turn Shapes off. Default is on.
Time Range	Specifies the time range of the keyset’s animation curves. All specifies no limit on the time range. Start/End specifies a time range from Start Time to End Time. Time Slider specifies the time range is the Time Slider’s playback range.
Start Time	Specifies the start of the time range (available if Start/End is on).
End Time	Specifies the end of the time range (available if Start/End is on).
Snap	Times snaps keys along the time axis only. This is the default setting. Values snaps keys along the value axis only. Both snaps keys along both the time and value axes.
Snap Times to Multiples of	This value defines multiples of the time unit to snap to.
Snap Values to Multiples of	This value defines multiples of whole number attribute values to snap to.

BAKING SIMULATIONS

Baking a simulation allows you to generate a single animation curve for an object whose actions are being provided by simulation rather than by keys and animation curves (keysets). Many types of animation in Maya are not represented by, and therefore not available for, keyset editing. Examples include objects animated with inverse kinematics, by expressions, or along motion paths.

Baking a simulation is useful when you want to edit a single animation curve instead of all the contributing attributes that affect the behavior of a single attribute. Examples: an object affected by a driven key or an expression.

When baking, you can first set the bake key options (Edit > Keys > Bake Simulation ☐) or you can immediately bake (Edit > Keys > Bake Simulation) with the currently set options.

Setting bake simulation options

To set bake simulation options:

- 1 If you want to bake now, select the key(s) or keyset that you want to bake.
- 2 Select Edit > Keys > Bake Simulation ☐.

The Bake Simulation Options window is displayed.

- 3 Set the bake simulation options:

Hierarchy

Specifies how a keyset will be baked from a hierarchy of grouped or parented objects.

Selected specifies that the keyset to be baked will include only the animation curves of the currently selected object. Default is on.

Below specifies that the keyset to be baked will include the animation curves of the selected object and all the objects below it in the hierarchy. Default is off.

Channels

Specifies the channels (keyable attributes) whose animation curves will be included in the keyset.

All Keyable specifies that the keyset will include the animation curves of all keyable attributes of the selected object. Default is on.

	From Channel Box specifies that the keyset will include the animation curves of only those channels currently selected in the Channel Box. Default is off.
Driven Channels	Specifies that the keyset will include any driven keys. The driven keys enable the values of keyable attributes (channels) to be driven by the values of other attributes (see “Setting driven keys” on page 48). Default is off.
Control Points	Specifies whether the keyset will include all the animation curves of a selected deformable object’s control points. Control points include NURBS control vertices (CVs), polygonal vertices, and lattice points. Default is off.
Shapes	Specifies whether the keyset will include the animation curves of a selected object’s shape node as well as its transform node. Default is on.
Time Range	Specifies the time range of the keyset’s animation curves. All specifies no limit on the time range. Start/End specifies a time range from Start Time to End Time. Time Slider specifies the time range is the Time Slider’s playback range.
Start Time	Specifies the start of the time range (available if Start/End is on).
End Time	Specifies the end of the time range (available if Start/End is on).
Sample By	Specifies the frequency with which Maya will evaluate the animation and generate keys. Increasing this value decreases how often Maya sets keys for the animation. Decreasing has the opposite effect. The Sample By value is based on the Time Unit setting. It represents the frequency with which Maya will analyze the object’s animation and generate a key. A value of 1 creates a key at each time unit. Greater values decrease the frequency of generated keys, and smaller values increase the frequency.
Keep Unbaked Keys	This option preserves the keys that are outside the baked time range and only applies to directly connected animation curves. When on, bake simulation does not remove keys that are outside the bake range. When off, only the keys created within the specified time range during the bake will be present on the animation curve after the operation.
Sparse Curve Bake	This option operates only on directly connected animation curves. It produces bake results that create only enough keys to represent the shape of the animation curve.

Disable Implicit Control

This option disables the effect of controls such as IK handles once the bake simulation has been performed.

Baking a keyset**To bake a keyset:**

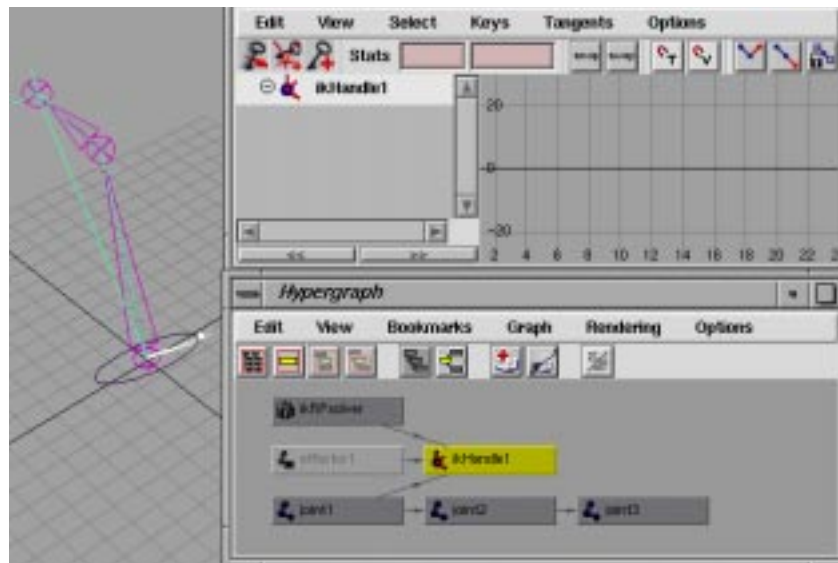
- 1 Select the keyset that you want to bake.
- 2 Select Edit > Keys > Bake Simulation.

Creating keys for an IK joint by baking

For example, while animation curves and key information exist for an IK handle (starting at a joint 1, for instance), there is no information available for the IK joint (a joint3, for instance) because the position of joint3 is determined by the animation on the IK handle. To view and edit animation information about joint 3, perform a bake simulation.

To use Bake Simulation to create keys for an IK joint:

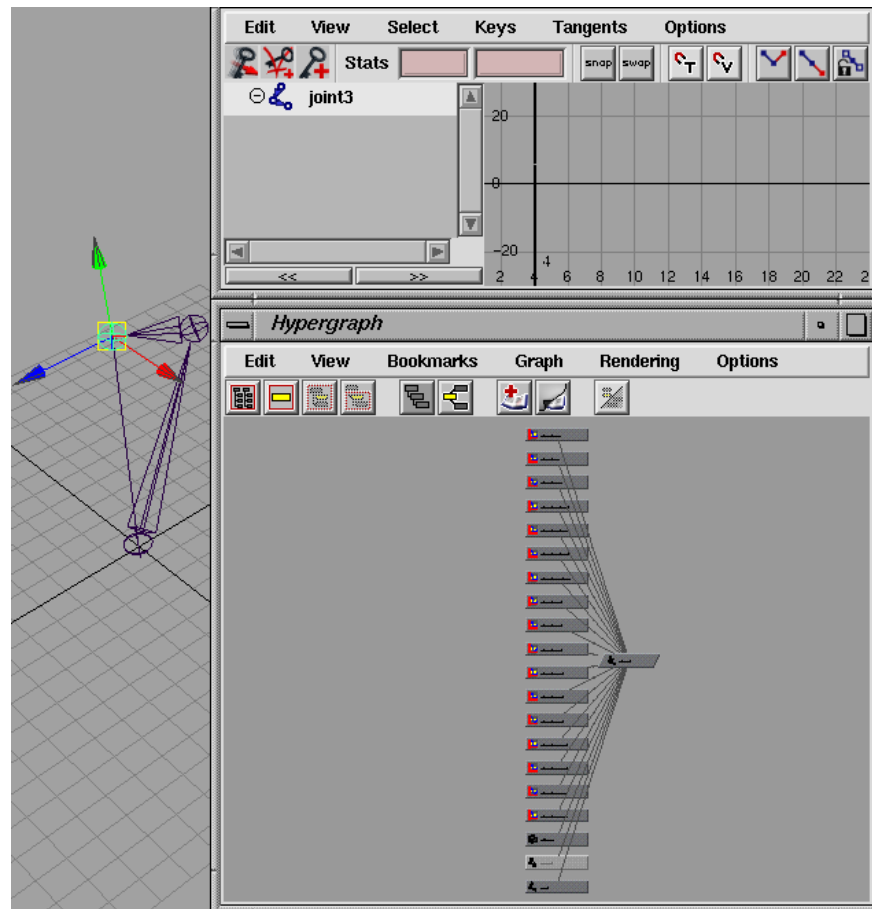
- 1 Select the joint.



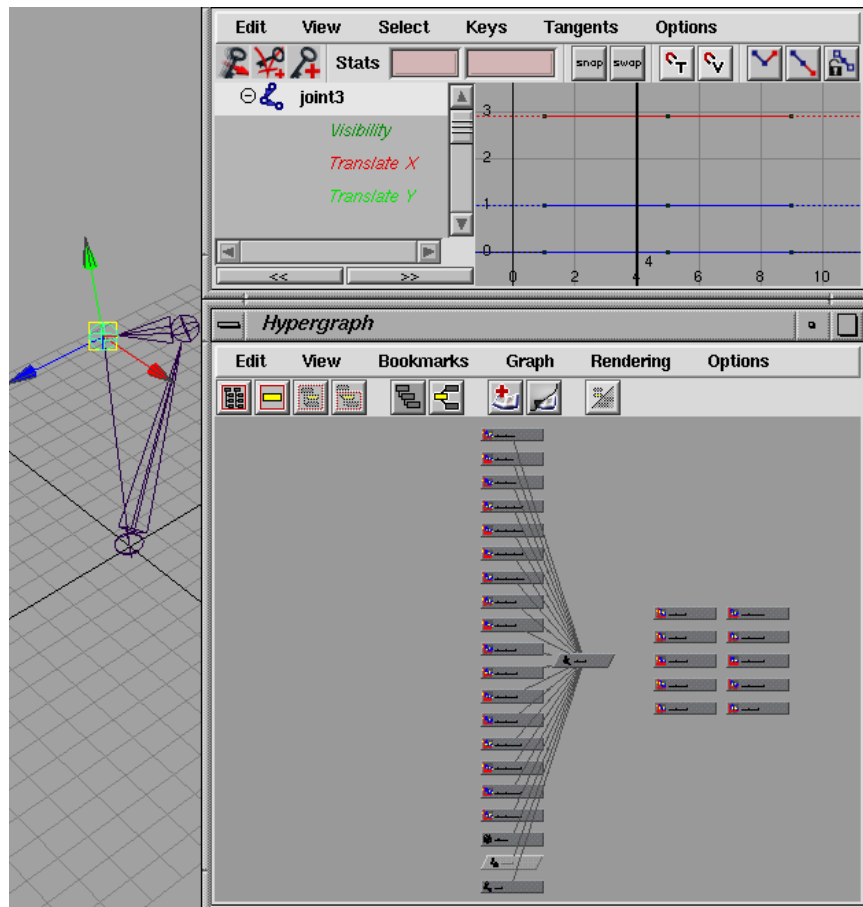
EDITING KEYS | 9

Baking simulations

- 2 Select Edit > Keys > Bake Simulation  to open the Bake Simulation Options window.
- 3 Set the Sample By value to 4 to generate keys every four Time Units.
- 4 Ensure that the Disable Implicit Controls option is turned on to retain the animation imparted by joint1 as part of the IK chain.

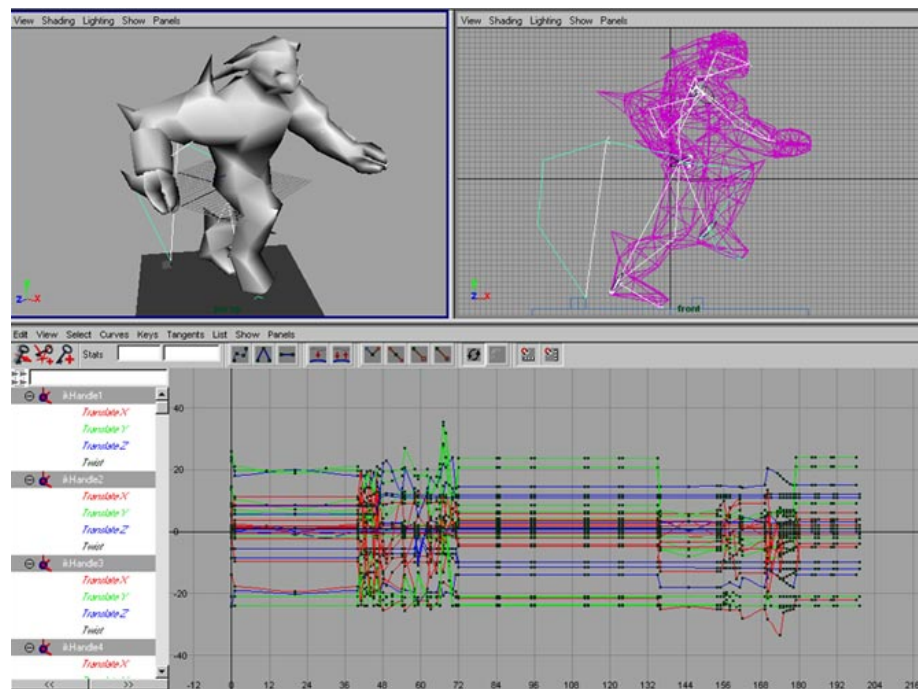


- 5 Click the Bake button. Maya steps through the animation. It evaluates the scene for each time interval specified in the Sample By field (in this case, 4) and places a key at that time.



10 USING THE GRAPH EDITOR

With the Graph Editor, you can edit visual representations of keys and animation curves (keysets).



This chapter covers the following topics:

- “Working with animation curves” on page 88
- “Using the Graph Editor menu bar” on page 89
- “Using the Graph Editor toolbar” on page 105
- “Using the Graph Editor Outliner” on page 108
- “Using the Graph Editor graph view” on page 109

- “Euler angle filtering with Graph Editor” on page 112

WORKING WITH ANIMATION CURVES

Use the Graph Editor to manipulate animation curves. Animation curves are of keys represented as points, curve segments between keys, and tangents that control how curve segments enter and exit a key.

The Graph Editor is available as a panel in the modeling view or as an independent window. To place the Graph Editor in a modeling view, select the modeling view in which you want the Graph Editor to appear, and then select Panels > Panel > Graph Editor. To open the Graph Editor as an independent window, select Window > Animation Editors > Graph Editor.

The Graph Editor has these components:

- the menu bar
- the toolbar
- the Outliner
- the graph view

The Graph Editor works only with keys and animation curves, so certain types of animation are not viewable here. Expressions and inverse kinematics are examples of types of animation that are not available for editing in the Graph Editor.

Note

Use Show Results to produce a representational animation curve from animation that is not normally viewable as animation curves. Show Results does not enable editing of these curves, however.

USING THE GRAPH EDITOR MENU BAR

The Graph Editor menu bar contains tools and operations for manipulating animation curves and keys within the graph view of the Graph Editor. Note that you still have access to the main menu bar while working with the Graph Editor.

The Edit menu

Many of these menu items appear and behave in a similar fashion to the main Edit menu in the modeling view. However, as the Graph Editor works directly with animation curves and attributes, there are no hierarchy options available within the settings windows for the edit operations.

Undo/Redo

Undo cancels the last operation. Redo does the last undone operation again.

Cut

Cut removes existing keys from a selected attribute and places a copy of that information on the keys clipboard. If a curve segment is selected in the graph view, this area will be removed when you choose Edit > Cut. If no curve segment is selected, Cut will operate on the item selected in the Outliner portion of the Graph Editor.

Copy

Copy copies existing keys from a selected attribute and places that information on the keys clipboard. If you select a curve segment in the graph view, this area will be removed when you choose Edit > Copy. If no curve segment is selected, Copy will operate on the item selected in the Outliner portion of the Graph Editor.

Paste

Paste adds keys from the keys clipboard to an attribute. Pasted keys can be merged with existing keys, inserted at a time (displacing existing keys), or used to replace keys at a time.

Delete

Delete removes existing keys from an attribute. It works the same way as Cut except it doesn't put a copy of the removed keys on the keys clipboard.

Scale

Scale operates on a selected range of keys, expanding or compressing the animation to correspond to a new time range. Scale will operate on the entire range of keys if an attribute is selected in the Outliner portion of the Graph Editor and a curve segment is not selected.

With the Only Scale Specified Keys option on, you can scale keys that are in a selected region of the Graph Editor. The keys outside the region remain unaffected by the scaling.

Snap

Snap causes selected keys to snap in time to the nearest whole time unit values or attribute values. Use Select Unsnapped to check for keys not at whole time units. The default is to snap to nearest time units. Select Edit > Keys > Snap Keys ☐ to view the options window and edit the settings.

Select Unsnapped

Selects all keys from the selected channel, or any keys in the Graph View if no objects or attributes are selected that are not at a whole time unit.

The View menu

This menu controls which components are visible, and therefore editable, in the graph view of the Graph Editor. This is useful for controlling the amount of information displayed in the graph view, as well as specifying which of the animation curve components are available for editing.

Note

When framing the desired range, the Graph Editor may scale the area in the graph view horizontally and vertically to display the desired range.

Frame All

Frame All adjusts the graph view to fit all animation curves in the window.

Frame Selected

Frame Selected adjusts graph view to fit selected animation curves or curve segments in the window.

Frame Playback Range

Frame Playback Range adjusts the graph view to fit the playback range in the window.

Center Current Time

If you change the view in the Graph Editor and want to shift the view so the current time is in the middle of the editor, select Center Current Time from the View menu.

Auto Frame

This option automatically adjusts the graph view to fit the display of the animation curves associated with a selected object or objects. Manual adjustment of the graph view area is discussed on page 112.

Show Results

When types of animation that do not create animation curves (such as motion paths and Expressions) are part of your animation, you can use Show Results to see a graphic representation of the behavior of these animation types.

Any numeric attribute can drive Show Results. This is useful for looking at animations driven by anything other than a single animation curve.

Note

To edit these types of animation, you must transform them into animation curves by performing a Bake Channel.

Screen Based samples the result of what one pixel represents in time. This may not accurately reflect the actual animation (especially if you are zoomed out). However, by adjusting the sampling rate, you can choose between curve accuracy and update time. A higher sampling rate means more accurate representation but longer computation time.

When Screen Based sampling is turned on, the sample rate specifies the number of pixels per sample. When it's turned off, the sample rate specifies the number of frames or current time units per sample.

Performance options are used to specify when the result curves are updated.

- Delayed—result curves are updated when the mouse is released.
- Interactive—result curves are updated as the mouse is moved.

Show Buffer Curves

Turning this on will cause the Graph View to display the original shape of edited curves. See “Swap buffer curve and Buffer curve snapshot buttons” on page 107.

Keys

In order to operate on a component of an animation curve, you must make it viewable by loading it into the Graph Editor. By default, objects selected in a modeling view are automatically loaded in the Graph Editor.

Keys are represented in the graph view as black points, and when selected, they are highlighted yellow.

Always

Setting the viewable status of keys to Always results in keys being visible at all times in the graph view of the Graph Editor.

Never

Setting the viewable status of keys to Never hides keys in the graph view. Because keys are no longer available for picking, you can no longer edit them.

Active Only

When the viewable status of keys is set to Active Only, keys are available only when you select the curve they are associated with.

Tangents

In order to operate on a component of a tangent, you must make it available by being designated as viewable.

Tangents are represented in the graph view as brown handles tangential to the curve segment of the animation curve. When selected, they are highlighted green.

Note that if Unify Tangents has been turned on for a curve segment (see page 100), the handles on both sides of the key will be adjusted uniformly when you edit the selected handle. If Break Tangent is in effect, each tangent handle operates independently of the other.

Always

Setting the viewable status of tangents to Always results in tangents being visible at all times in the graph view of the Graph Editor.

Note

If you wish to operate on tangents and you've disabled curves and keys in the Select menu of the Graph Editor, set the visibility of tangents to Always so they are available for selection.

Never

Setting the viewable status of tangents to Never hides tangents in the graph view. Because tangents are no longer available for selection, you can no longer edit them.

Active Only

When the viewable status of tangents is set to Active Only, tangents are available only when you select their associated curve or curve segment.

Infinity

Infinity turns on or off the display of the animation curve extrapolated outside the first and last keys of the curve.

Note that the curves before the first key and after the last key will be constant by default (see page 96).

The Select menu

These options control which components of an animation curve are available for selection and editing.

Note

When you select components of an animation curve in the graph view of the Graph Editor, a box appears in the Outliner corresponding to the attribute whose components are currently selected.

All

All enables selection of any of the components of an animation curve.

Curve

Curve constrains your selection to animation curve segments.

Key

Key constrains your selection to keys.

In Tangent

In Tangent constrains your selection to the in tangents of a key. In tangents are the tangents that describe the shape of the curve segment entering a key.

Out Tangent

Out Tangent constrains your selection to the out tangents of a key. Out tangents are the tangents that describe the shape of the curve segment leaving a key.

Note

To select a tangent when the Key and Curve selections are disabled, you must select View > Tangents > Always.

The Curves menu

The Curves menu items process entire animation curves.

Pre and Post Infinity animation curves options

Animation curves are extrapolated outside the first and last keys of the curve. Curves before the first key and after the last key will be flat (no change in value over time) unless you set the pre and post infinity controls to anything other than constant. You can use these options to automatically generate specific types of repeating animation.

Note

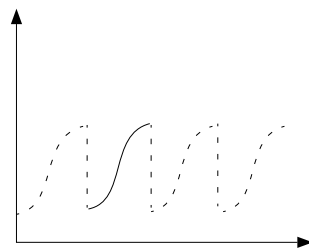
If you want to create editable animation of a repetitious or cyclical nature, you can bake a channel with Infinity turned on (see page 93).

Pre

The Pre and Post settings define the behavior of an animation curve before and after the first key of that curve.

Cycle

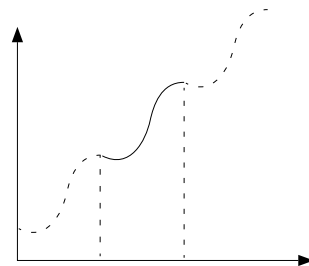
The Cycle setting repeats the animation curve as a copy infinitely.



Cycle

Cycle with Offset

The Cycle with Offset setting repeats the animation curve infinitely, except it appends the cycled curve's last key's value to the value of the first key's original curve.

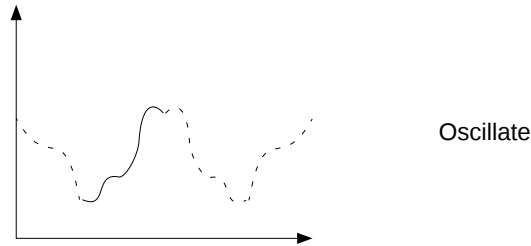


Cycle with Offset

Using the Graph Editor menu bar

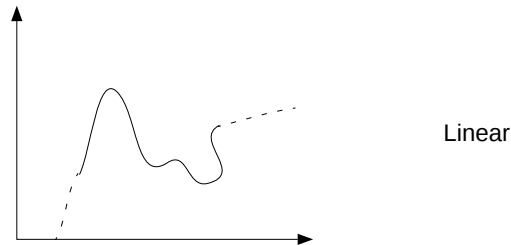
Oscillate

The Oscillate setting repeats the animation curve by reversing its values, and therefore shape, with each cycle, creating an alternating backwards and forwards effect.



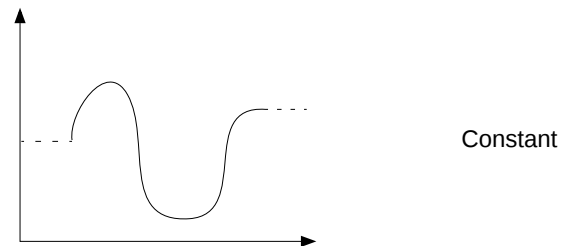
Linear

The Linear setting extrapolates the value of the first key using its tangent information. It projects a linear curve infinitely beyond.



Constant

The Constant setting maintains the value of the end keys. This is the default setting for animation curves in Maya.



Curve Smoothness

This setting controls the smoothness resolution of curves in the graph view. Decreasing the resolution lessens the time to display the graph view.

Note that this setting has no impact on the behavior of animation curves, and it affects only the display of the curves in the graph view.

Bake Channel

This operation calculates a new animation curve for an attribute using the input nodes that contribute to its properties. This is different from the Edit > Keys > Bake Simulation operation. This operation is useful when you want to:

- edit a single animation curve instead of all the contributing attributes that affect the behavior of a single attribute. For example: an object affected by a driven key or an Expression.
- add keys to an existing curve;

To use Bake Channel to create animation curves for a driven key:

- 1 Open or create an animation in which an object is affected by a Driven Key.
- 2 Select the object which you wish to generate animation curves for.
- 3 From the Graph Editor window, select Curves > Bake Channel .
- 4 Select the Time Slider as the range to be processed, or specify a range by enabling the Start Time and End Time fields by clicking on the Start/End option.
- 5 Enter a value in the Sample By field.

The Sample By value is based on the Time Unit setting, and represents the frequency with which Maya will analyze the object's animation and generate a key.

A value of 1 will create a key at each time unit. Greater values will decrease the frequency of generated keys, and smaller values increase the number of keys created.

Note

Bake Channel operates only on animation that can be evaluated explicitly. Inverse Kinematics systems, Dynamics, and some Expressions cannot be operated on with Bake Channel.

To create animation curves from these animation types, you will need to perform Edit > Keys > Bake Simulation.

Keep Unbaked Keys

This is on by default. This option preserves the keys that are outside the baked time range and only applies to directly connected animation curves.

When turned on, bake simulation does not remove keys that are outside the bake range.

When turned off, only the keys created within the specified time range during the bake will be present on the animation curve after the operation.

Simplify Curve

Use this operation to remove keys that are not necessary to describe the shape of an animation curve. Excess keys may accumulate on an animation curve as a result of adding keys manually or performing operations such as Bake Channel. You may need to remove keys from an animation curve to reduce the graph complexity and provide larger spans for adjusting curve tangents.

To simplify a curve:

- 1** Select the curve.
- 2** Select Curves > Simplify Curve  to open the Simplify Curve Options window.
- 3** Set the Time Range to All.
- 4** Enter values in the Time Tolerance and Value Tolerance fields. These settings represent how much “averaging” will be performed on the curve.

Note

You may have to experiment with the Value Tolerance and Time Tolerance values to achieve the result you want.

- 5 Click Simplify.

Spreadsheet

This menu selection lets you edit the values and attributes of the selected animation curves in a spreadsheet format in the Attribute Editor.

Buffer Curves

Use Buffer Curve Snapshot and Swap Buffer Curves to compare changes to the current animation curve with its previous shape.

Using Buffer Curves

Use View > Show Buffer Curves in the Graph Editor menu to turn on the viewing of buffer curves.



To take a snapshot of a curve, select the animation curve and use Curves > Buffer Curve Snapshot or the Buffer Curve Snapshot button.

Edit the animation curve. Note that a gray curve representing the original curve is visible.



To swap the buffer curve with the edited curve, use Curves > Swap Buffer Curve or the Swap Buffer Curve button.

Test your animation by toggling back and forth between these curves freely.

Non-Weighted and Weighted Tangents

The default setting is non-weighted tangents, which provide simple handles for manipulating the tangent's angle. To change the weighting of an animation curve, use Curves > Weighted to change the curve's tangent type to weighted.

Note

You cannot mix weighted and non-weighted tangents in the same curve.

Weighted tangents represent the amount of influence a tangent's length has on an animation curve segment. By turning on Free Tangent Weight (see "Free Tangent Weight" on page 100), it is possible to simultaneously edit the influence and angle of the tangent quickly and intuitively. Users of desktop illustration packages will recognize the familiar Bezier-style behavior when in this mode.

The Keys menu

Break Tangents

Break Tangents allows manipulation of the in and out tangent handles individually so you can edit the curve segment entering or exiting the key without affecting its opposite handle.

Unify Tangents

Unify Tangents causes the manipulation of an in or out tangent handle to affect its opposite handle equally. Unify Tangents retains the relative position of the tangent handles even after tangents are individually adjusted (by editing tangents separately after choosing Keys > Break Tangents).

Lock Tangent Weight

Lock Tangent Weight specifies that when you move a tangent, only its angle can be changed. This forces the associated curve segment to retain the weight of the tangent. This applies only to weighted curves.

Free Tangent Weight

Free Tangent Weight specifies that when you move a tangent, its angle and weight can be changed. This allows the weight of a tangent to be adjusted as well as the angle. This only applies to weighted curves.

Convert to Key

Converts selected breakdowns to keys.

Convert to Breakdown

Converts selected breakdowns to keys.

Add Inbetween

Inserts an inbetween at the current time.

Remove Inbetween

Removes an inbetween at the current time.

The Tangents menu

Tangents describe the entry and exit of curve segments from a key.

This menu operates on the shape of curve segments around selected keys.

Note that these settings affect only existing animation curves segments' tangents.

Spline

Specifying a spline tangent creates an animation curve that is smooth between the key before and the key after the selected key.

The tangents of the curve are co-linear (both at the same angle). This ensures that the animation curve smoothly enters and exits the key.



You can select this type of tangent by clicking on this icon on the toolbar.

When animating fluid movement, a spline tangent is an excellent place to start. You use a minimum number of keys to achieve your look.

Linear

Specifying a linear tangent creates an animation curve as a straight line joining two keys.

If the in tangent type is linear, the curve segment before the key is a straight line. If the out tangent type is linear, the curve segment after the key is a straight line.



You can select this type of tangent by clicking on this icon on the toolbar.

When animating the color of a heating element on a stove, you would use linear to achieve that gradual change in color from charcoal gray to burning hot red.

Clamped

Specifying a clamped tangent creates an animation curve that has the characteristics of linear and spline curves.

The keys' tangents will be splines unless the value of two adjacent keys are very close. In this case, the out tangent of the first key and the in tangent of the second key will be interpolated as linear.

When animating a skeleton in a walk-cycle, you may notice a slipping of the pelvic and foot joint position. This occurs because the value of the keys on the curve are either the same or close to (within tolerance of) the value of the other. Maya assigns a default spline tangent to describe what occurs between these keys. This is why you get the joint positions slipping.

By setting the tangent type to clamped for these keys, the slipping is corrected and the tangents becomes a combination of linear and spline.

Stepped

Specifying a stepped tangent creates an animation curve whose out tangent is a flat curve.

The curve segment is flat (horizontal), so the value changes at the key without gradation.

The light from a strobe light turns on and off. To create a strobing effect, you would use a step tangent.

Flat

Sets the in and out tangents of the key to be horizontal (with a slope of 0 degrees).



You can select this type of tangent by clicking on this icon on the toolbar.

When a ball reaches its ascent, it hangs in the air for a brief time before starting its descent. You can create this effect by using a flat tangent.

Fixed

Specifying a fixed tangent allows a key's tangents to remain unchanged as the key is edited.

When animating a ball, you may find the ball isn't falling from a desired height, yet its impact with the floor and everything else is perfect. Using a fixed tangent lets you change the height of the ball while retaining the tangent's angle. This is different from Edit > Keys > Bake Simulation.

This process is useful when you want to:

- edit a single animation curve instead of all the contributing attributes that affect the behavior of a single attribute. For example: an object affected by a driven key or an Expression.
- add keys to an existing curve;

To use Bake Channel to create animation curves for a driven key:

- 1 Open or create an animation in which an object is affected by a Driven Key.
- 2 Select the object for which you wish to generate animation curves.
- 3 From the Graph Editor window, select Curves > Bake Channel .
- 4 Select the Time Slider as the range to be processed, or specify a range by enabling the Start Time and End Time fields by clicking on the Start/End option.
- 5 Enter a value in the Sample By field.

The Sample By value is based on the Time Unit setting. It represents how often Maya analyzes the object's animation and generates a key.

A value of 1 creates a key at each time unit. Greater values decrease the frequency of keys. Smaller values increase the number of keys.

Note

Bake Channel works only on animation that can be evaluated explicitly—not Inverse Kinematics, Dynamics, and some Expressions. To create animation curves from these animation types, use Edit > Keys > Bake Simulation.

This menu is used to control how tangents interact with keys during editing.

Tangents of weighted animation curves have not only an angle but also a weight. The higher the weight of a tangent, the more influence it has on the shape of the curve segment compared with the tangent at the other end of the curve segment.

Tangent weights are represented by the length of the tangent handle, and editable tangent weights are manipulated by dragging the handle's length.

In and Out Tangents

You may specify different types of tangents for the entry and exit tangents at a key.

In Tangent

This will specify a type of tangent for the in tangent only. Refer to the previous section, The Tangents menu, for a description of tangent types.

Out Tangent

This will specify a type of tangent for the out tangent only. Refer to the previous section, The Tangents menu, for a description of tangent types.

The List menu

Auto Load Selected Objects

When Auto Load is turned on, the objects that appear in the Outliner will change every time you make a selection to show the currently selected objects. If Auto Load is turned off, it locks the objects currently in the Outliner so you can continue to edit their animation curves even if you make a new selection in a modeling view.

Load Selected Objects

You can use this item only when Auto Load is off. When Auto Load is off, the objects appearing in the Outliner may be out of synch with what is currently selected in a modeling view. To reload the Outliner with the current selection, choose Option > Reload List.

Add Selected Objects

To work on the animation of one object in the Graph Editor and another object not loaded in the Outliner, select that object and choose Options > Add Selected to List. This will add the selected object to the Graph Editor Outliner without disrupting the layout of the objects and animation curves currently in the Graph Editor.

Bookmarks

To save the view of the animation of one or more objects in the Graph Editor, create a bookmark.

Bookmark Current Objects

When invoked, Bookmark Current Objects provides an option box so you can name bookmarks.

Bookmarks appear as a list in the Bookmarks menu as they are created.

Note that when bookmarks are loaded into the Graph Editor, Auto Load is automatically turned off.

The Show menu

This menu is the same as its counterpart in the Outliner. See “Using the Outliner” in *Using Maya: Essentials* for more information.

USING THE GRAPH EDITOR TOOLBAR

Move Nearest Picked Key Tool



This tool lets you manipulate individual keys and tangents with a single mouse action.

This tool differs from the Move Tool. It works on one key at a time, or on the closest selected key of an active curve without you having to precisely select a key point or tangent handle in the graph view.

Move Nearest Picked Key Tool Settings window

Double-click on the Move Nearest Picked Key Tool icon to open the Tool Settings window for this tool.

DirectKey Options (Move Option)

- moveOnly—disables the Move Nearest Picked Key tool’s ability to sweep throughout a curve’s keys (see moveOver, below).
- moveOver—the default setting lets the tool sweep through an active curve along the curve’s keys. This expedites the fine-tuning of animation curves.

Insert Keys Tool



Choose the Insert Keys Tool to place new keys on an existing animation curve. Click to select the curve to which you will add a new key.

Middle-drag to set the location of the new key. Releasing the mouse button places the key. The new key will have tangents that preserve the original animation curve segment’s shape.

Add Keys Tool



The Add Keys Tool lets you add keys to a selected animation curve anywhere in the graph view.

Middle-drag to set the location of the new key. Releasing the mouse button places the key. The new key’s tangents will be of the same type as the adjacent keys’ types.

Key Stats fields

The Key Stats fields numerically represent a selected key’s time and value. You can edit them by entering values from the keyboard, or relatively by using the following operators in the input:

Operator	Function
+=value	the entered value is added to the existing value
*=value	the entered value multiplies the existing value
-=value	the entered value is subtracted from the existing value
/=value	the entered value divides the existing value

Time Snap Tool



Using the Time Snap Tool forces keys moved in the graph view to the nearest integer time unit value.

Value Snap Tool



Using the Value Snap Tool forces keys in the graph view to the nearest integer value.

Note

Snap settings have no effect on tangent manipulation.

Swap buffer curve and Buffer curve snapshot buttons

Two buttons, *Swap buffer curve* and *Buffer curve snapshot*, are provided on the Graph Editor toolbar. Use these buttons to compare the changes to the current animation curve with a previously saved version.

These buttons also correspond to two Edit menu items, Curves > Buffer Curve Snapshot and Curves > Swap Buffer Curve. See “Buffer Curves” on page 99 for more information.

Break Tangents Tool



This tool provides easy access to the Graph Editor menu bar item Tangents > Break Tangents.

Unify Tangents Tool



This tool provides easy access to the Graph Editor menu bar item Tangents > Unify Tangents.

Free Tangent Weight Tool



This tool provides easy access to the Graph Editor menu bar item Tangents > Free Tangent Weight.

Lock Tangent Weight Tool



This tool provides easy access to the Graph Editor menu bar item Tangents > Lock Tangent Weight.

Spline Tangents Tool



This tool provides easy access to the Graph Editor menu bar item Tangents > Spline.

Linear Tangents Tool



This tool provides easy access to the Graph Editor menu bar item Tangents > Linear.

Flat Tangents Tool



This tool provides easy access to the Graph Editor menu bar item Tangents > Flat.

Identifying tangent characteristics

You can visually identify locked or broken tangents and weight locked tangents.

Locked or broken tangent display

The Graph Editor displays the status of locked or broken tangents. By default, a broken tangent displays in blue, and an unlocked tangent displays in green. When locked, both tangents display in the same color.

USING THE GRAPH EDITOR OUTLINER

The Graph Editor Outliner has many characteristics in common with the main Outliner (see *Using Maya: Essentials*). Features specific to the Graph Editor Outliner follow.

An animation curve is associated with a node in the Outliner portion of the Graph Editor. Selecting a node causes all of its animation curves to be displayed in the graph view.

Each item in the Graph Editor Outliner contains special additional information in the form of a small icon that collapses and expands the hierarchy of viewable channels.

Channels in the Graph Editor Outliner

If an object is animated by simple keyframe animation, for each attribute of the object you select, there will be one animation curve driving that attribute. In this case, each of the animated attributes (channels) of that object will be listed indented below the object.

Graph Editor outliner split control

You can split the Graph Editor's outliner so you can look at two different listings at the same time. This makes it a lot easier for you to go back and forth between working on different sets of animation curves.

To split the outliner, move the cursor towards the bottom of the outliner. You will notice that the cursor icon changes into an "up-down" icon. You can now drag the cursor to move the outliner separator, which creates a second outliner space.

USING THE GRAPH EDITOR GRAPH VIEW

The graph view of the Graph Editor displays animation curve segments, keys, and key tangents.

Clicking with the right mouse button anywhere in the Graph Editor causes a pop-up menu containing the Graph Editor menu bar items to appear.

In addition to the Graph Editor tools in the toolbar, you can use the Select Tool, Move Tool, and Scale Tool to manipulate keys in the graph view of the Graph Editor.

Select Tool



Use the Select Tool to select curves, segments, tangents, and keys in the graph view.

Sweep with the mouse button down to select the contents of an area. You can click an animation curve, tangent handle, or key point to select the individual item.

Move Tool



Use the Move Tool to select and manipulate components of the graph view.

Select the component you want (as described in the Select Tool), then select the Move Tool. Use the middle mouse button to move key points, tangent handles, and curves.

Note

The Move Tool has different options with the Graph Editor. To view these options, double click the Move Tool icon when the Graph Editor is the active window (press Alt on the keyboard with the cursor over the Graph Editor window).

Move Tool Settings Window

The MoveKey options are identical to the DirectKey options available for the Move Nearest Picked Key Tool in the Graph Editor toolbar.

Scale Tool



Use the Scale Tool to scale a region of animation curve segments and the positions of keys in the graph view.

In the Scale Tool Settings window, you can select two ways to scale keys in the graph view. To display the Scale Tool Settings window, double click the Scale Tool icon when the Graph Editor is the active window.

Scale Tool Settings window

ScaleKey Options

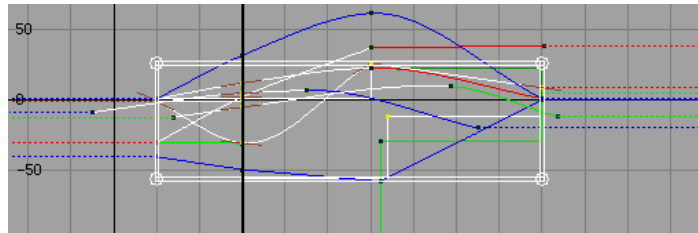
- Manipulator—lets you scale keys by using a manipulator box style.
- Gestural—changes the way keys are scaled in the graph view so the mouse position determines the scaling vectors.

To scale a region using Manipulator Scaling:

- 1 Set the scaling type to Manipulator in the Scale Tool Settings window.

- 2 Close the Scale Tool Settings window. With the left mouse button, select the region you wish to scale.

A white box with handles at its corners (the manipulator box) appears in the graph view, bounding the selected region.



- 3 Drag the manipulator box by the corner handles to stretch and compress the contents of the region. Reposition the region using the middle mouse button.

Note that the curve segments adjacent to the region being scaled are altered as you use the manipulator.

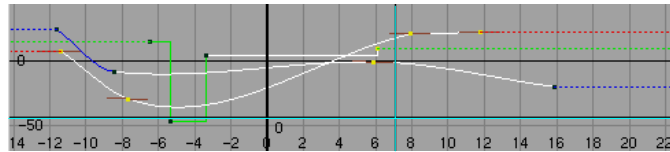
Note

Blocks of keys can be moved by clicking and dragging with the middle mouse button within the region of the manipulator box.

To scale a region using Gestural Scaling:

- 1 Set the scaling type to Gestural in the Scale Tool Settings window.
- 2 Close the Scale Tool Settings window, With the left mouse button, select the region you wish to scale.
- 3 Click with the middle mouse button where you want the scaling pivot point to be. Drag the cursor horizontally to scale the time values of the region. Drag vertically to scale the value information of the region.

A horizontal and vertical solid line intersect in a box to indicate the pivot point of the scaling action.



Moving around the graph view

You can scroll the graph view of the Graph Editor vertically and horizontally by holding down the Alt key while middle-dragging.

To scale the graph view uniformly, hold down the Alt key and drag the cursor with the middle and left mouse buttons.

To scale the graph view along the horizontal or vertical axis, hold down the Alt and Shift keys and drag horizontally or vertically with the middle and left mouse buttons.

EULER ANGLE FILTERING WITH GRAPH EDITOR

When you import motion capture data into Maya as animation curves, the curves might be mangled when the rotation values are restricted to a specific range. You can filter the curves to correct the mangling. In the Graph Editor, select the mangled animation curves (for example, Rotate X, Y, and Z), then select **Curves > Euler Filter**. The filtering is always applied to entire curves, not to selected curve segments within some time range.

11 USING THE DOPE SHEET

The Dope Sheet lets you edit event and sound synchronization and timing. This chapter covers the following topics:

- “Editing Animation with the Dope Sheet” on page 113
- “Using the Dope Sheet menu bar” on page 114
- “Using the Dope Sheet toolbar” on page 126
- “Using the Dope Sheet outliner” on page 128
- “Working in the Dope Sheet view area” on page 129

EDITING ANIMATION WITH THE DOPE SHEET

Use the Dope Sheet to manipulate key times, represented as colored rectangles in the view area. The blocks represent integer time units along the horizontal axis. The vertical axis represents the items currently loaded into the Dope Sheet outliner. The Dope Sheet consists of:

- Dope Sheet outliner
- menu bar
- toolbar
- view area

To place the Dope Sheet in a view, select the view then Panels > Panel > Dope Sheet. To open the Dope Sheet as an independent window, select Window > Animation Editors > Dope Sheet.

USING THE DOPE SHEET MENU BAR

The Edit menu

Many of these menu items appear and behave in a similar fashion to the main Edit menu in the modeling view. However, as the Dope Sheet works directly with animation curves and attributes, there are no hierarchy options available within the settings windows for the edit functions.

Note

The Dope Sheet, the Edit > Keys menu selection, and Time Slider all share a common keys clipboard. Keys copied or cut to the clipboard using one tool are available to the other tools.

Undo/Redo

Undo cancels the last operation. Redo does the last undone operation again.

Cut

Cut removes existing keys from a selected attribute and places a copy of that information on the keys clipboard. If a curve segment is selected in the graph view, this area will be removed when you choose Edit > Cut. If no curve segment is selected, Cut will operate on the item selected in the Outliner portion of the Dope Sheet.

Copy

Copy copies existing keys from a selected attribute and places that information on the keys clipboard. If you select a curve segment in the graph view, this area will be removed when you choose Edit > Copy. If no curve segment is selected, Copy will operate on the item selected in the Outliner portion of the Dope Sheet.

Paste

Paste adds keys from the keys clipboard to an attribute. Pasted keys can be merged with existing keys, inserted at a time (displacing existing keys), or used to replace keys at a time.

Delete

Delete removes existing keys from a selected attribute. It works the same as Cut except it does not place a copy of the removed keys on the keys clipboard.

Scale

Scale operates on a selected range of keys, expanding or compressing the animation to correspond to a new time range. Note that Scale will operate on the entire range of keys if an attribute is selected in the Dope Sheet outliner and a curve segment is not selected.

Snap

Use Snap to force selected keys to snap in time to the nearest whole time units. Use Select Unsnapped to check for keys not at whole time units.

Select Unsnapped

Selects all keys from the selected channel. If no objects or attributes are selected, it selects any keys in the View Area.

The View menu

This menu controls the layout of the Dope Sheet view area.

Note

When framing the desired range, the Dope Sheet may scale the area within the graph view horizontally and vertically to display the desired range.

Frame All

Frame All adjusts the graph view to fit all animation in the window.

Frame Selected

Frame Selected adjusts graph view to fit selected animation in the window.

Using the Dope Sheet menu bar

Frame Playback Range

Frame Playback Range adjusts the graph view to fit the playback range in the window.

Center Current Time

If you want to shift the view so the current time is in the middle of the editor, select Center Current Time from the View menu.

Auto Frame

This adjusts the graph view to fit the display when new curves associated with a selected object are loaded into the Dope Sheet. Manual adjustment of the View Area area is discussed on page 129.

Note

Auto Frame works differently in the Dope Sheet than in the Graph Editor.

Dope Sheet Summary

This option loads the Dope Sheet Summary into the Dope Sheet outliner. See “Using the Dope Sheet outliner” on page 128 for more information about summary objects.

Scene Summary

This option loads the Scene Summary into the Dope Sheet outliner.

The Curves menu

The Curves menu items are functions for processing animation curves.

Pre and Post Infinity animation curves options

In Maya, animation curves are extrapolated outside the first and last keys of the curve. Curves before the first key and after the last key will be flat (no change in value over time) unless you set the pre and post tangent controls to anything other than constant. You can use these options to automatically generate specific types of repeating animation.

Note

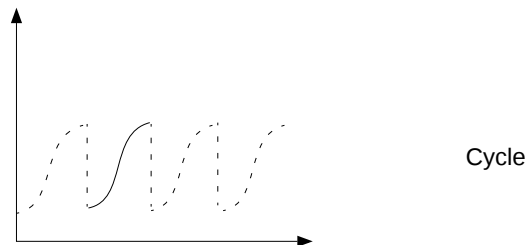
If you want to create editable animation of a repetitious or cyclical nature, you can bake a channel with Infinity turned on.

Pre

The Pre and Post settings define the behavior of an animation curve before and after the first key of that curve.

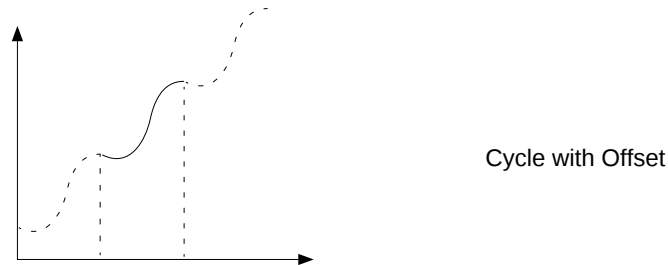
Cycle

The Cycle setting repeats the animation curve as a copy infinitely.



Cycle with Offset

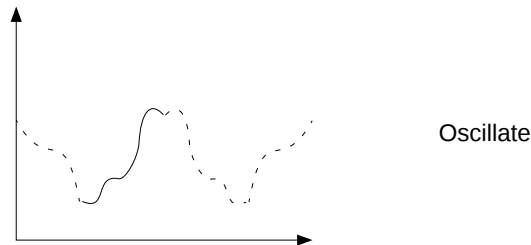
The Cycle with Offset setting repeats the animation curve infinitely, except it appends the cycled curve's last key's value to the value of the first key's original curve.



Oscillate

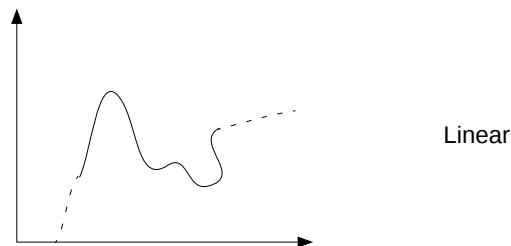
The Oscillate setting repeats the animation curve by reversing its values (and shape) with each cycle, creating an alternating backwards and forwards effect.

Using the Dope Sheet menu bar



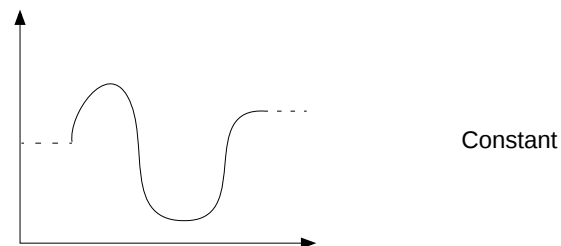
Linear

The Linear setting extrapolates the value of the first key using its tangent information. It projects a linear curve infinitely beyond.



Constant

The Constant setting maintains the value of the first key. This is the default setting for animation curves in Maya.



Curve Smoothness

This setting controls the smoothness resolution that will be used to draw all curves in the graph view. Decreasing the resolution decreases the processing time required to draw the graph view.

This setting has no impact on the behavior of animation curves. It affects only the display of the curves in the graph view.

Bake Channel

This operation calculates a new animation curve for an attribute using the input nodes that contribute to its properties. This is useful to:

- edit a single animation curve instead of all the contributing attributes that affect the behavior of a single attribute, for example, an object affected by a driven key or an Expression;
- add keys to an existing curve;

To use Bake Channel to create animation curves for a driven key:

- 1 Open or create an animation in which an object is affected by a driven key.
- 2 Select the object that you wish to generate animation curves for.
- 3 From the Dope Sheet window, select Curves > Bake Channel .
- 4 Select as the Time Slider as the range to be processed, or specify a range by enabling the Start Time and End Time fields by clicking on the Start/End option.
- 5 Enter a value in the Sample By field.

The Sample By value is based on the Time Unit setting. It represents the frequency with which Maya will analyze the object's animation and generate a key. A value of 1 will create a key for and at each time unit. Greater values will decrease the frequency of generated keys, and smaller values increase the number of keys created.

- 6 Click the Bake button.

Note

Bake Channel operates only on animation that can be evaluated explicitly. Inverse Kinematics systems, Dynamics, and some Expressions cannot be operated on with Bake Channel.

To create animation curves from these animation types, you will need to perform Edit > Keys > Bake Simulation.

Keep Unbaked Keys

The toggle is on by default. This option preserves the keys that are outside the baked time range and only applies to directly connected animation curves. When toggled on, bake simulation does not remove keys that are outside the bake range. When toggled off, only the keys created within the specified time range during the bake will be present on the animation curve after the operation.

Simplify Curve

Use this operation to remove keys that are not necessary to describe the shape of an animation curve. Excess keys may accumulate on an animation curve as a result of adding keys manually or performing operations such as a Bake Channel. You may need to remove keys from an animation curve to reduce the complexity of the graph view. You might also need to provide larger spans for adjusting curve tangents.

To simplify a curve:

- 1 Select the curve.
- 2 Select Curves > Simplify Curve  to open the Simplify Curve Options window.
- 3 Set the Time Range to All.
- 4 Enter values in the Time Tolerance and Value Tolerance fields. These settings represent how much “averaging” will be performed on the curve.

Note

You may have to experiment with the Value Tolerance and Time Tolerance values to achieve the result you want.

- 5 Click Simplify.

Spreadsheet

This menu selection lets you edit the attributes of the selected animation curves in the Attribute Editor spreadsheet.

Non-Weighted and Weighted Tangents

Specify the tangent weighting for selected keys. The default setting is non-weighted tangents, which provide simple handles for manipulating the tangent's angle.

Weighted tangents represent the amount of influence a tangent has on an animation curve segment. By turning on Free Tangent Weight, it is possible to simultaneously edit the influence and angle of the tangent quickly and intuitively. Users of desktop illustration packages will recognize the familiar Bezier-style behavior when in this mode.

The Keys menu

Convert to Key

Converts selected keys to breakdowns.

Convert to Breakdown

Converts selected breakdowns to keys.

Add Inbetween

Inserts an inbetween at the current time.

Remove Inbetween

Removes an Inbetween at the current time.

The Tangents menu

Tangents describe the entry and exit of curve segments from a key. This menu operates on the shape of curve segments around selected keys. Note that these settings affect only existing animation curves segments' tangents.

Spline

Specifying a spline tangent creates an animation curve that is smooth between the key before and the key after the selected key. The tangents of the curve are co-linear (both at the same angle). This ensures that the animation curve smoothly enters and exits the key. When animating fluid movement, a spline tangent is an excellent place to start. You use a minimum number of keys to achieve your look.

Linear

Specifying a linear tangent creates an animation curve as a straight line joining two keys. If the in tangent type is linear, the curve segment before the key is a straight line. If the out-tangent type is linear, the curve segment after the key is a straight line. When animating the color of a heating element on a stove, you would use linear to achieve that gradual change in color from charcoal gray to burning hot red.

Clamped

Specifying a clamped tangent creates an animation curve that has the characteristics of linear and spline curves. The keys' tangents will be splines unless the value of two adjacent keys are very close, in which case the out-tangent of the first key and the in-tangent of the second key will be interpolated as linear.

When animating a skeleton in a walk-cycle, you may notice a slipping of the pelvic and foot joint position. This occurs because the value of the keys on the curve are either the same or close to the value of the other. Maya assigns a default spline tangent to describe what occurs between these keys. This is why you get the joint positions slipping.

By setting the tangent type to clamped for these keys, the slipping is corrected and the tangents becomes a combination of linear and spline.

Stepped

Specifying a stepped tangent creates an animation curve whose out tangent is a flat curve. The curve segment is flat (horizontal). The value changes at the key without gradation. To create a strobing effect, you would use a step tangent.

Flat

Sets the in and out tangents of the key to be horizontal (with a slope of 0 degrees). When a ball reaches its ascent, it hangs in the air for a brief time before starting its descent. You can create this effect by using a flat tangent.

Fixed

Specifying a fixed tangent allows a key's tangents to remain unchanged as the key is edited.

When animating a ball, you may find the ball isn't falling from a desired height, yet its impact with the floor and everything else is perfect. Using a fixed tangent lets you change the height of the ball while retaining the tangent's angle. This is somewhat different from Edit > Keys > Bake Simulation.

This process is useful when you want to:

- edit a single animation curve instead of all the contributing attributes that affect the behavior of a single attribute, for example, an object affected by a driven key or an Expression;
- add keys to an existing curve;

To use Bake Channel to create animation curves for a driven key:

- 1 Open or create an animation in which an object is affected by a Driven Key.
- 2 Select the object that you wish to generate animation curves for.
- 3 From the Dope Sheet window, select Curves > Bake Channel ☐.
- 4 Select as the Time Slider as the range to be processed, or specify a range by enabling the Start Time and End Time fields by clicking on the Start/End option.
- 5 Enter a value in the Sample By field.

The Sample By value is based on the Time Unit setting. It represents the frequency with which Maya will analyze the object's animation and generate a key.

A value of 1 will create a key for and at each time unit. Greater values decrease the frequency of generated keys, and smaller values increase the number of keys created.

- 6 Click the Bake button.

Note

Bake Channel operates only on animation that can be evaluated explicitly. Inverse Kinematics systems, Dynamics, and some Expressions cannot be operated on with Bake Channel.

To create animation curves from these animation types, you will need to perform Edit > Keys > Bake Simulation.

This menu is used to control how tangents interact with keys during editing.

Tangents of weighted animation curves have an angle and a weight. The higher the weight of a tangent, the more influence it has on the shape of the curve segment compared with the tangent at the other end of the curve segment. Tangent weights are represented by the length of the tangent handle, and editable tangent weights are manipulated by dragging the handle's length.

In and Out Tangents

You may specify different types of tangents for the entry and exit tangents at a key.

In Tangent

This will specify a type of tangent for the in tangent only. Refer to the previous section for a description of tangent types.

Out Tangent

This will specify a type of tangent for the out tangent only.

The List menu

Hierarchy Below

Use Hierarchy Below to toggle the display of objects acting as summary objects for objects beneath them.

For example, in the following diagram, a cone with a Translate X channel is under a group with no animation on it. With Hierarchy Below On, the group1 node displays the animation information of its child node, the cone,

acting therefore as a summary group. With Hierarchy Below off, only the summary objects (Dopesheet Summary, Scene Summary) display summary information.



scene with Hierarchy Below off

scene with Hierarchy Below on

Auto Load Selected Objects

When List > Auto Load Selected Objects is on, the objects that appear in the Dope Sheet outliner will change every time you make a selection to show the currently selected objects. If List > Auto Load Selected Objects is off, it locks the objects currently in the Dope Sheet outliner so you can continue to edit their animation curves even if you make a new selection in a modeling view.

Load Selected Objects

You can use this item only when List > Auto Load Selected Objects is off. When Auto Load Selected Objects is off, the objects appearing in the Dope Sheet outliner may be out of synch with what is currently selected in a modeling view. To load the currently selected objects, select List > Load Selected Objects.

Add Selected Objects

To work on the animation of one object in the Dope Sheet and another object not loaded in the Dope Sheet outliner, select that object and choose Options > Add Selected to List. This will add the selected object to the Dope Sheet outliner without disrupting the layout in the Dope Sheet.

Bookmarks

To work with the animation of an object or a collection of objects in the Dope Sheet and save that current editing environment, create a bookmark.

Bookmark Current Objects

When invoked, Bookmark Current Objects provides an option box so you can name bookmarks. Bookmarks appear as a list in the Bookmarks menu as they are created.

Note

When bookmarks are loaded into the Dope Sheet, List > Auto Load Selected Objects is automatically turned off.

The Show menu

This menu is the same as its counterpart in the Outliner. See “Using the Outliner” in *Using Maya: Essentials* for more information.

USING THE DOPE SHEET TOOLBAR

Move Nearest Picked Key Tool



This tool lets you quickly manipulate individual keys and tangents with a single mouse action.

This tool differs from the Move Tool in that it will only operate on one key at a time. It will also operate on the closest selected key of an active curve without you having to precisely select a key point or tangent handle in the graph view.

Move Nearest Picked Key Tool Settings window

Double-click on the Move Nearest Picked Key Tool icon to open the Tool Settings window for this tool.

DirectKey Options (Move Option)

- moveOnly—disables the Move Nearest Picked Key tool's ability to sweep throughout a curve's keys (see moveOver, below).
- moveOver—the default setting enables the tool to sweep through an active curve along the curve's keys, which expedites the fine-tuning of animation curves.

Insert Keys Tool



Choose the Insert Keys Tool to place new keys on an existing animation curve. Use the left mouse button to select the curve to which you will add a new key.

The location of the new key is determined by pressing the middle mouse button, during which action you may scroll along the animation curve. The key is placed when you release the mouse button.

The new key will possess tangents that preserve the original animation curve segment's shape.

Add Keys Tool



The Add Keys Tool lets you add keys to a selected animation curve anywhere in the graph view.

Press the middle mouse button to determine the location of the new key. Releasing the mouse button places the key.

The new key's tangents will be of the same type as the adjacent keys' types.

Using Add Keys

The Add Keys Tool places a new key at the time and for the attribute where you click the middle mouse button. It works like the Add Keys tool in the Graph Editor with an important exception. Because the Dope Sheet view area does not display values, using the Add Key tool in this window results in keys being placed with their value set to the current value of the attribute.

Stats fields

The Stats fields numerically represents a selected key's time and value. You can edit them explicitly by entering values from the keyboard, or relatively by incorporating operators into the input. These operators are the same as those employed in the Channel Box (see *Using Maya: Essentials*):

Operator	Function
+=value	the entered value is added to the existing value
*=value	the entered value multiplies the existing value
-=value	the entered value is subtracted from the existing value
/=value	the entered value divides the existing value



This button toggles the Hierarchy Below option available in the List menu. See “Hierarchy Below” on page 124 for more information.



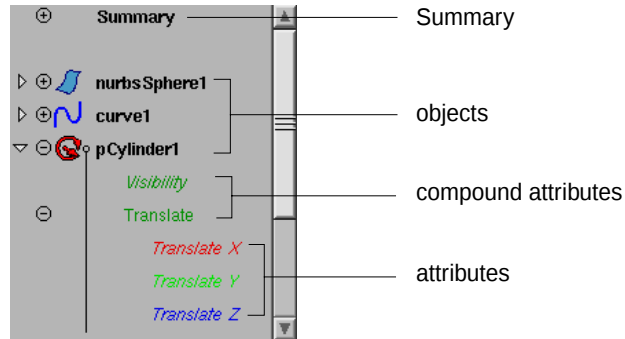
This button toggles the Auto Load Selected Objects option from the List menu. See “Auto Load Selected Objects” on page 125 for more information.



This button loads selected objects into the Dope Sheet View Area when Auto Load Selected Objects is not enabled. See “Load Selected Objects” on page 125 for more information.

USING THE DOPE SHEET OUTLINER

The Dope Sheet outliner hierarchically represents the attributes of selected objects. The Dope Sheet outliner organizes attributes in groups according to type and object. This lets you manipulate entire collections of attributes at once. For example, all of the rotation attributes of objects listed in the outliner are summarized and available for manipulation in the Summary group Rotate. The organization of this grouping descends as follows:



- Summary—all keys all selected objects by attribute type;
- objects—all the keyed attributes for the selected objects in the Dope Sheet outliner;
- compound attributes—all the individual attributes of a particular type, such as translation, rotation, and so on;
- attributes—individual attributes are the lowest level of the Dope Sheet outliner hierarchy.

Note

When Summary, object, and compound attribute groups are collapsed in the Dope Sheet outliner, attributes within a collapsed hierarchy are not selected and therefore not edited when you do actions in the view area.

WORKING IN THE DOPE SHEET VIEW AREA

The view area of the Dope Sheet displays keys hierarchically along the vertical axis. It displays time along the horizontal axis as cells or blocks.

Note

The time blocks represented in the view area of the Dope Sheet are integer value divisions of time; that is, the block at time 2 includes the range of animation information from 2 to 3, excluding information at time 3.

Working in the Dope Sheet view area

Animated attributes are bounded by solid lines to indicate their extents. The colors of the blocks define the placement of an attribute or group of attributes within the hierarchy of the Dope Sheet.

- blue—all keys of all displayed objects (Summary object)
- dark green—all of the keyable attributes for the selected object in the Dope Sheet outliner (object groups)
- light green—all of the individual attributes of a particular type, such as translation, rotation, and so on (compound attributes)
- black—keys for unselected individual attributes
- yellow—selected keys

The pop-up Dope Sheet menu bar

Clicking with the right mouse button anywhere in the view area causes a pop-up menu containing the Dope Sheet menu bar items to appear.

Sound in the Dope Sheet

Sounds will appear in the Dope Sheet view area according to the settings in the Preferences window.

Select Tool, Move Tool, and Scale Tool

In addition to the Dope Sheet tools in the toolbar, the Select Tool, Move Tool, and Scale Tool also are used to manipulate keys in the view area of the Dope Sheet. Because of the hierarchical nature of the Dope Sheet outliner, you can edit groups of attributes by type. This lets you perform powerful timing editing on large numbers of objects at once.

Moving around the view area

You can scroll the graph view of the Dope Sheet vertically and horizontally by holding down the Alt key on the keyboard and dragging with the middle mouse button.

To scale the graph view uniformly, hold down the Alt key and drag the cursor with the middle and left mouse buttons.

To scale the graph view along either the horizontal or vertical axis, hold down the Alt and Shift keys, and drag the cursor horizontally or vertically with the middle and left mouse buttons.

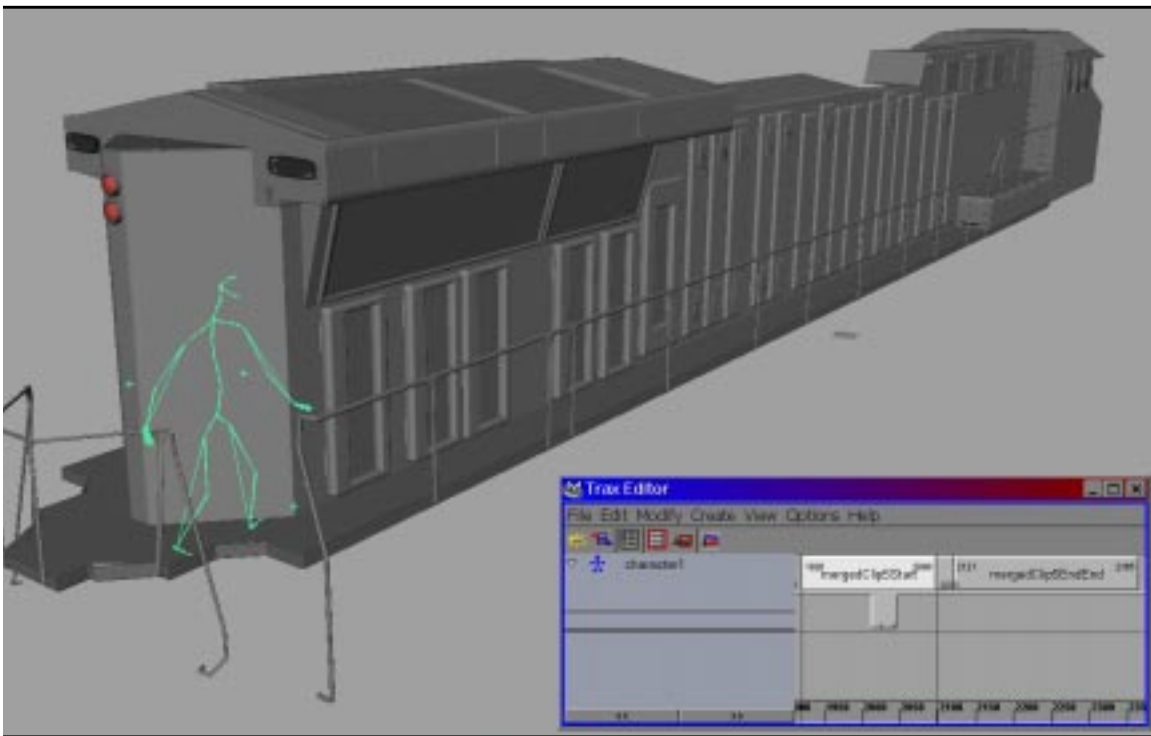


Image by Peter Miller

PART 4

NONLINEAR ANIMATION



12 INTRODUCING NONLINEAR ANIMATION

The Trax Editor provides a way to layer and mix character animation sequences nonlinearly—independently of time. You can layer and blend any type of keyed animation, including motion capture and path animation. The Trax Editor is ideal for developing complex animation for characters in combination with other Maya animation tools.

At the core of Trax Editor usage is the animation *clip*—an animation sequence you can apply to one or more characters. With the Trax Editor, you can copy, blend, split, synchronize, and otherwise rearrange clips. You can export clips and import them from other scenes, and you can store collections of clips that you can apply to new or existing characters.

The Trax Editor helps you explore subtle variations in the animation without losing your work. For instance, suppose you create a soldier walking, but decide you want to lift the legs higher to make the character march rather than walk. If you make the walk cycle a clip, you can set additional keys that adjust only the leg motion, not the rest of the character.

If you make the added leg motion a clip, you can blend the new leg motion with the old, or disable the new leg motion if you choose not to use it. By creating several clips with different leg motion, you can experiment with various clips until you get the desired results. None of your previous animation is destroyed in the process.

Before you use the Trax Editor, understand the concept of characters. See *Using Maya: Character Setup* for details.

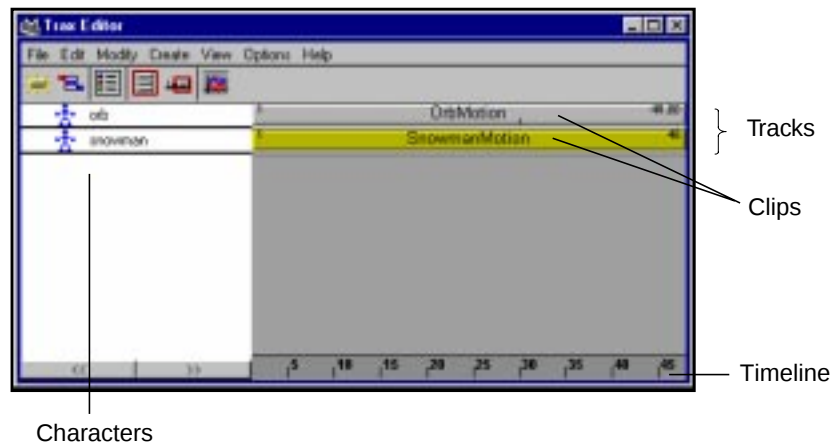
13 USING THE TRAX EDITOR

The Trax Editor lets you create and edit time-independent clips of character animation. This chapter includes these topics:

- “Understanding the Trax Editor” on page 136
- “Creating clips” on page 137
- “Working with clips” on page 138
- “Using poses” on page 155
- “Enhancing the display of the Trax Editor” on page 156
- “Importing and exporting source clips” on page 156
- “Exporting and editing character maps” on page 157
- “Importing clips by referencing” on page 159
- “Understanding clips and poses in the Visor” on page 159
- “Working with subcharacters” on page 161
- “MEL commands and dependency graph nodes” on page 162

UNDERSTANDING THE TRAX EDITOR

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



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

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

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

CREATING CLIPS

After you've animated a character, you can create a clip for all or part of its animation.

To create a clip:

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

Name

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

Keys

Leave Keys in Timeline leaves the character's keys in the Time Slider's Timeline and puts the clip in the Visor (see "Understanding clips and poses in the Visor" on page 159). This is useful if you won't use the clip currently but want to store it for future use. By leaving the keys in the Timeline, you can create another clip with the keys.

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

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

If you want to create several clips for different time ranges of a character's animation, turn off Leave Keys in Timeline and turn on Put Clip in Trax Editor and Visor. Create a clip with the entire range of desired keys, then split the clip into the desired animation segments. See "Splitting clips" on page 147.

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

Working with clips

Clip	Specifies where to put the clip you're creating: Put Clip in Visor Only is useful if you won't use the clip currently but want to store it for future use. Put Clip in Trax Editor and Visor lets you work on the clip in the Trax Editor now. This is the default setting.
Time Range	Specifies the clip's time range in the Trax Editor: Use Selected uses a time range you've selected in the Timeline for the clip. To select a time range, Shift-drag through the desired times in the Time Slider's Timeline. Use Time Slider Range uses a time range defined by the Playback Start and End times of the Timeline. Use Animation Curve Range uses a time range that spans the range of the character's animation curves. That is, the start time is the time of the first key on the character, and the end time is the time of the last key. Specify Start and End uses a time range you enter directly in Start and End boxes.
Start and End	Specifies the start and end times of the clip. Available if Specify Start and End is on.
Subcharacters	Include Subcharacters in Clip includes the animation for any subcharacters in addition to the character's animation. See "Working with subcharacters" on page 161.

WORKING WITH CLIPS

The following topics describe how you can edit clips.

- "Editing clip attributes" on page 139
- "Editing source clip attributes" on page 142
- "Cutting, copying, and pasting clips" on page 143
- "Duplicating clips" on page 145
- "Instancing clips" on page 146
- "Splitting clips" on page 147
- "Merging clips" on page 148

- “Blending clips” on page 149
- “Viewing and editing the animation curves of a clip” on page 151
- “Editing the original keys of a clip” on page 152
- “Disabling and enabling clips” on page 152
- “Adding and removing tracks” on page 153
- “Motion warping” on page 154
- “Adding and removing tracks” on page 153

Editing clip attributes

To edit clip attributes:

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

The following attributes are displayed:

Anim Clip Attributes

Weight

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

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

Offset

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

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

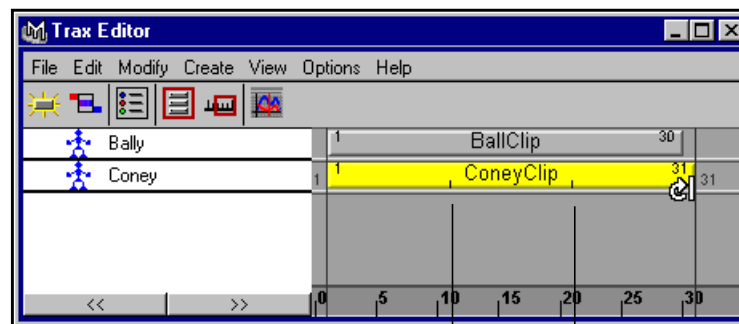
Relative adds the attribute’s clip value to its prior value.

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

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

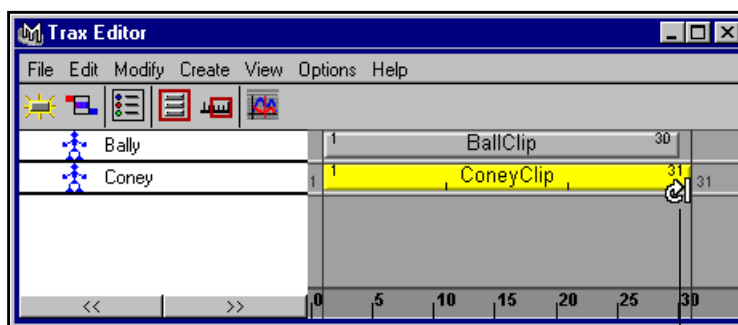
If two clips overlap in a pair of tracks for the same character, Maya adds the values of any redundant attributes, regardless of whether you use Absolute or Relative. This compounding effect is typically undesirable unless you blend the clips (see “Blending clips” on page 149).

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



Cycle markers

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

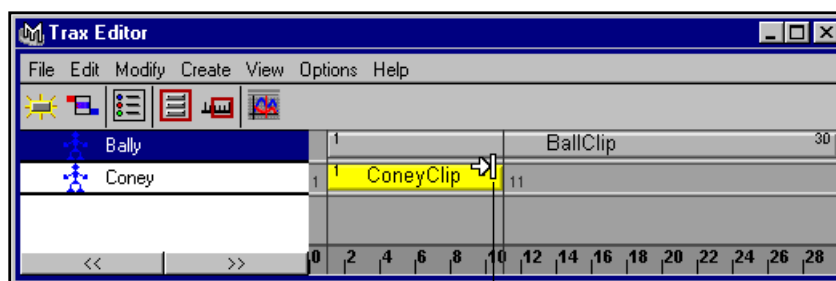


Cycle drag icon

Scale

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

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



Scale drag icon

Source Clip Attributes

For more information, see “Editing source clip attributes” on page 142.

Node Behavior

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

Extra Attributes

None, by default.

Tip

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

Editing source clip attributes

When you create a clip, Maya stores the entire range of the selected character's animation curves in a node named `clipnSource` in the Visor (see "Understanding clips and poses in the Visor" on page 159). A clip in the Trax Editor is a playback instance of the source clip. The playback range of the clip in the Trax Editor can be part or all of the range stored in the source clip.

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

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

To edit source clip attributes:

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

The following attributes are displayed:

Anim Clip Attributes

This area is dim because the attributes do not apply to the clip source. For more information, see "Editing clip attributes" on page 139.

Source Clip Attributes

Pose	If you created a pose for the character rather than a clip, the Attribute Editor displays the Pose option as being turned on. See “Using poses” on page 155 for details on creating poses. This option simply lets you know that this clip is a pose rather than an animation clip. Maya puts poses in the Visor.
Start	Specifies the start time of the source clip.
Duration	Specifies the amount of time the source clip range extends from the Start.

Node Behavior

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

Extra Attributes

None, by default.

Cutting, copying, and pasting clips

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

If you copy and paste a clip to the same character, you create a playback instance of the clip (see “Instancing clips” on page 146). If you copy a clip and paste it to a new character, you create a duplicate (see “Duplicating clips” on page 145).

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

It’s best to paste a clip only to a character that has similar attributes and objects as the original. If the two characters differ, you’ll typically need to do many extra steps described in “Exporting and editing character maps” on page 157.

To cut a clip:

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

To copy a clip from the Trax Editor:

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

To paste a clip to the same character:

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

To paste a clip to a different character:

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

Paste Method

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

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

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

By Current Map is relevant only if you are doing the steps in “Exporting and editing character maps” on page 157.

Example

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

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

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

Start Frame

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

Specifies where in the Timeline the clip will be pasted:

Current Time specifies the current time of the Timeline.

Timeline Start specifies the Start Time of the scene.

Clipboard Start specifies the Start Time of the clip.

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

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

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

If you middle-drag to a character from a source clip from the same character, Maya creates an instance of the clip (see “Instancing clips” on page 146).

If you middle-drag to a different character and you previously created a character map between the characters, Maya pastes the clip using the character map (see “Exporting and editing character maps” on page 157). Otherwise, Maya pastes using the By Node Name paste method. If you want to paste using a different method such as By Attribute Name, right-click the clip in the Visor and select Copy, then use Edit > Paste  and select the desired method.

Duplicating clips

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

For example, suppose you’ve created a jump clip you want to keep, but you also want to create a slightly different jump clip. Simply duplicate the clip, activate the duplicate’s keys, then modify them for the new jump. You won’t affect the original jump clip or any of its instances. For details on activating a clip, see “Editing the original keys of a clip” on page 152.

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

To set duplicate clips options:

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

Clip

Specifies where to put the copy of the clip.

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

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

Instancing clips

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

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

You can also use the Cycle attribute to play a clip repeatedly with the same savings in computing resources. However, cycling plays a clip repeatedly without allowing breaks between each playback of the clip. For details on cycling, see "Editing clip attributes" on page 139.

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

To instance clips:

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

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

Splitting clips

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

To set split clip options:

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

Source Clip

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

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

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

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

Split Time

Specifies where to split the clip:

Current Time uses the current time in the Timeline.

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

Tip

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

Merging clips

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

The benefits of merging clips follow:

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

To merge clips:

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

Name

Specifies the name of the merged clip.

**Keep originals
in Trax editor**

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

Blending clips

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

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

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

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

To blend clips:

- 1 Select the clips you want to blend.

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

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

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

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

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

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

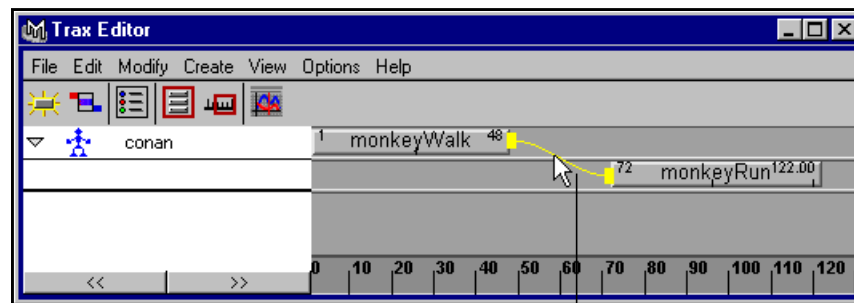
Ease Out changes attribute values quickly at the beginning and slowly at the end.

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

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

To edit the blended animation:

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

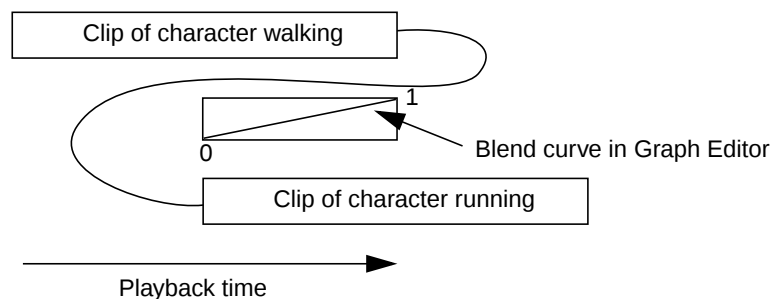


Click this curve to edit blended animation

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

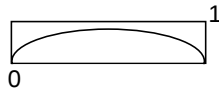
The Graph Editor displays the blend curve in a time range of 0 to 1, which represents the start and end of the blend. Maya ignores parts of the curve that are outside the range 0 to 1. The first clip to play in the animation is blended into the clip that plays second.

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



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

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



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

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

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

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

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

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

Viewing and editing the animation curves of a clip

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

To view and edit the animation curves of a clip:

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

Editing the original keys of a clip

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

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

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

If you set new keys on the clip that extend past the end of the original source clip's duration, the keys play while the clip is activated, but won't be included in the deactivated clip unless you modify the source clip's duration in the Attribute Editor. See "Editing source clip attributes" on page 142.

To edit the original keys of a clip:

- 1 Select the clip.
- 2 In the Trax Editor, select **Modify > Activate / Deactivate Clip**.

The keys appear in the Timeline and are available for editing.

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

- 1 Select the clip.
- 2 In the Trax Editor, select **Modify > Activate / Deactivate Clip**.

The keys are removed from the Timeline and are unavailable for editing.

Disabling and enabling clips

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

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

To disable clips:

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

To enable clips:

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

Adding and removing tracks

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

To add a track:

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

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

To remove an empty track:

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

Maya removes the selected character's lowest empty track.

Motion warping

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

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

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

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

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

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

USING POSES

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

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

To create a pose:

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

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

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

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

ENHANCING THE DISPLAY OF THE TRAX EDITOR

There are several ways to enhance the Trax Editor display:

To view only the current character's clips:

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

To view the Trax Editor only where clips exist:

In the Trax Editor, select View > Frame All.

To view the entire Timeline range:

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

To increase the view size of tracks:

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

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

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

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

IMPORTING AND EXPORTING SOURCE CLIPS

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

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

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

To export clips from your current scene:

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

To import clips:

- 1 In the Trax Editor, select File > Import Clip.
- 2 In the file browser window, select the file that contains the clip(s), then click Import.
The clip is listed in the Visor under Unused Clips & Poses.
- 3 To use the clip, middle-drag it to the Trax Editor or copy and paste it to a character with Trax Editor menu items.

EXPORTING AND EDITING CHARACTER MAPS

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

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

To export a character map and fix the mapping:

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

Map Method

Specifies how to format the map:

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

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

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

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

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

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

IMPORTING CLIPS BY REFERENCING

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

To import a clip by referencing:

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

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

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

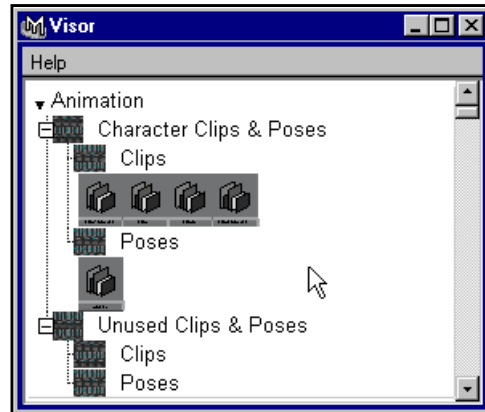
UNDERSTANDING CLIPS AND POSES IN THE VISOR

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

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

USING THE TRAX EDITOR | 13

Understanding clips and poses in the Visor



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

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

A pose is a snapshot you create of a character's current positioning for any moment in the Timeline. (See "Using poses" on page 155 for details.)

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

WORKING WITH SUBCHARACTERS

A subcharacter bundles related attributes of a character so you can key them in unison. If you set keys for a character, Maya also sets keys for all its subcharacters. With the Trax Editor, you can use subcharacters when you need to create one clip with a Relative offset and another for the same character with an Absolute offset. (See “Editing clip attributes” on page 139.)

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

Using clips on a character with subcharacters

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

To copy a source clip with subcharacter data to a new character, first export a character map that establishes a relationship between the two characters and their subcharacters. (See “Exporting and editing character maps” on page 157.) Then paste the source clip to the character and its subcharacters using the By Current Map option.

Using clips on a subcharacter

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

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

Creating subcharacters on a character with clips

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

MEL COMMANDS AND DEPENDENCY GRAPH NODES

MEL commands

MEL commands related to the Trax Editor are:

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

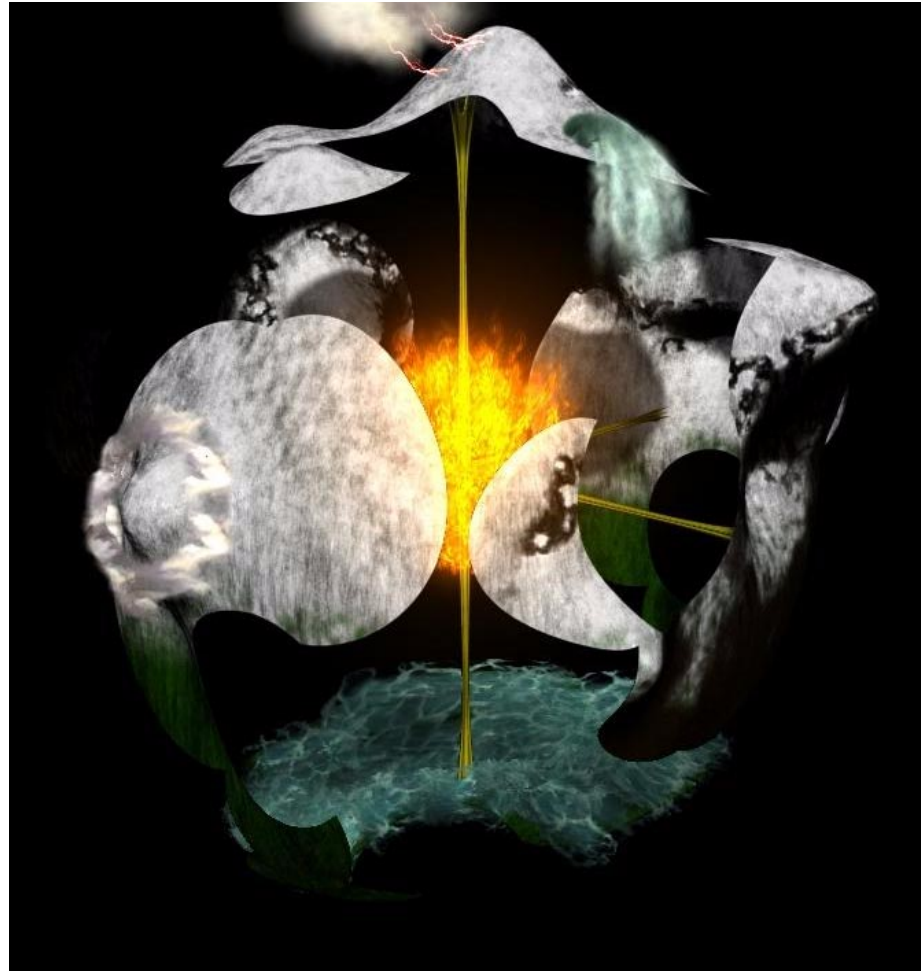
For more information about these commands, refer to the online *MEL Command Reference* documentation.

Dependency graph nodes

The dependency graph nodes related to the Trax Editor are:

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

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



PART 5

PATH ANIMATION



14

INTRODUCING PATH ANIMATION

Path animation is a way of animating an object's translate and rotate attributes by specifying a NURBS curve as the object's trajectory. You can use path animation to animate geometry (NURBS or polygonal), lights, cameras, particles, or any other object.

Path animation lets you edit the movement of the object by working with a NURBS curve. The object's rotation from side to side as the curve changes directions is automatic. If the object is geometry, it can also be automatically deformed to follow the contours of the curve. For details on path animation, see Chapter 15, "Animating Along Paths."

15 ANIMATING ALONG PATHS

Path animation is a way of animating an object's translate and rotate attributes by specifying a NURBS curve as the object's trajectory. This chapter covers the following topics:

- “Creating a path animation” on page 167
- “Animating along a path” on page 173
- “Animating along a curve on surface” on page 176
- “Aligning animation on a path” on page 177
- “Using motion path markers” on page 179
- “Setting a key path” on page 183
- “Using the Flow Path Object function” on page 184

CREATING A PATH ANIMATION

To create a simple path animation:

- 1 Create a NURBS curve. The curve is the path along which the object moves. The direction you create the curve is the direction the object moves.
- 2 Select the object you want to animate on the path, then Shift-select the curve.

Note

You can animate many objects along the same path curve by first selecting the objects, and then selecting the curve. You must select the curve to be used as the path curve last.

Creating a path animation

- 3 Select Animate > Paths > Attach to Path.

The object will move to the point on the curve where it will be positioned for the current time. You will also see two motion path markers with numbers on the curve. These markers indicate the position and time at which the object will move to those marker positions.

- 4 To view the animation of the object, press the Play button.

The Attach to Path options window

To set options, select Animate > Paths > Attach to Path .

Time Range

These settings define the start and end times where the object is positioned at the start and end of the curve.

Time Slider lets you use the time slider's current minimum and maximum times as the start and end times for the object to be positioned at the beginning and end of the curve.

Start creates only one marker at the start of the curve to indicate the time at which the object will be positioned at the beginning of the curve. This option is most useful if used in conjunction with the Motion Path Manipulator Tool to create new markers at different positions and times along the path. See page 177.

Start/End times indicate the times at which the object should be positioned at the beginning and end of the curve respectively.

Start Time

The Start Time is used if the Start option is specified in the Time Range.

End Time

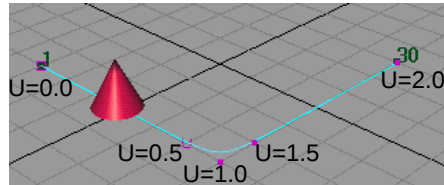
The End Time is used if the Start or Start/End option is used in the Time Range.

Parametric Length

Specifies the method Maya uses to position an object as it moves along a curve. There are two methods: the parametric space method and the parametric length method.

In the parametric space method, the markers represent positions in the U-parameter space of the curve. In the parametric length method, the markers represent positions as a percentage of the total curve length. The parametric length method is also known as the "fraction mode" method because the evaluation of the path is based on a fraction of the length of the path curve.

To understand the difference between the two methods, consider a curve that has uniform parameterization and unevenly spaced CVs:



The curve above was created with five CVs and uniform knot spacing. The beginning of the curve is at $U=0.0$ and the end of the curve is at $U=2.0$. The cone was animated with path animation from time 1 to 30.

If the path animation for the cone is created with the parametric length method, the cone will move evenly along the curve from times 1 to 30.

If the path animation for the cone is created with the parametric space method, the cone moves quickly from the first to the second CV, then slowly through the second to fourth CV, then quickly again from the fourth to fifth CV. This is because the second and fourth CVs are positioned at approximately $U=0.5$ and $U=1.5$ parameterization points of the curve. These points take up half the total parameterization of the curve.

In parameter space, the object moves smoothly from $U=0.0$ to $U=2.0$. In world space, there is little movement of the object from (roughly) times 8 to 23, which coincide with the large parameter distance that must be covered in the correspondingly small curve length.

The advantage of using the parametric space method is that if you have spent time adjusting the timing of the object's movement along the curve, CVs can be added to the beginning or end of the curve without affecting the timing of the motion on the existing part of the curve.

The advantage of using the parametric length method is that it is easy to obtain smooth timing of the object's motion without having to insert timing markers to refine the timing of the object along the path curve.

Turning off Parametric Length selects the parametric space method. Turning on Parametric Length selects the parametric length method.

Follow

If on, Maya computes the object's orientation as it moves along the curve.

Maya uses a front vector and an up vector to compute the orientation of the object. Maya aligns the object's local axes with the front vector and the up vector so that it knows how the object should be pointing upwards and frontwards as it moves along the curve.

Creating a path animation

At any point along the curve, the front vector aligns with the tangent to the curve, pointing in the direction of movement. The up vector is perpendicular to the tangent, but you must still tell Maya which perpendicular direction from the tangent is the up direction that you want. To do so, you specify a world up vector with which the up vector aligns. Use the World Up Type, World Up Vector, and World Up Object options to specify the world up vector.

You need to tell Maya which of the object's local axes should be aligned with the front vector, and which should be aligned with the up vector. To view the object's local axes, select the object and select **Display > Component Display > Local Rotation Axes**. Next, specify which local axis aligns with the front vector with **Front Axis**. Also specify which local axis aligns with the up vector with **Up Axis**. Finally, you specify the type of world up vector (**World Up Type**) with which the up vector itself aligns.

The world up vector gives you the ability to control what the up vector considers to be the up direction. One benefit of this is that you can correct any sudden flipping problems as the object moves along the curve. For example, you can have the world up vector be the local axis of some other object such as a locator. You can then directly control the orientation of the world up vector by manipulating the locator.

Front Axis

Specifies which of the object's local axes aligns with the front vector. This specifies the frontwards orientation of the object as it travels along the curve.

X aligns the local X axis with the front vector, specifying the X axis as the forward facing axis of the object.

Y aligns the local Y axis with the front vector, specifying the Y axis as the forward facing axis of the object.

Z aligns the local Z axis with the front vector, specifying the Z axis as the forward facing axis of the object.

Up Axis

Specifies which of the object's local axes aligns with the up vector. This specifies the upwards orientation of the object as it travels along the curve. The up vector aligns with the world up vector specified by the **World Up Type**.

X aligns the local X axis with the up vector, specifying the X axis as the upward facing axis of the object.

Y aligns the local Y axis with the front vector, specifying the Y axis as the upward facing axis of the object.

World Up Type

Z aligns the local Z axis with the front vector, specifying the Z axis as the upward facing axis of the object.

Specifies the type of world up vector that the up vector aligns with. Selections include Scene Up, Object Up, Object Rotation Up, Vector, and Normal.

Scene Up specifies that the up vector try to align with the scene's up axis instead of the world up vector. The world up vector is ignored. You can specify the scene's up axis in the Preferences window. The default scene up axis is the world space positive Y-axis.

Object Up specifies that the up vector try to aim at the origin of a specified object instead of aligning with the world up vector. The world up vector is ignored. The object whose origin the up vector tries to aim at is called the world up object. You can specify the world up object with the World Up Object option. If no world up object is specified, the up vector tries to aim at the origin of the scene's world space.

Object Rotation Up specifies that the world up vector is defined relative to some object's local space instead of the scene's world space. The up vector tries to align with the world up vector after transforming it relative to the scene's world space. The object whose origin the up vector tries to aim at is called the world up object. You can specify the world up object with the World Up Object option.

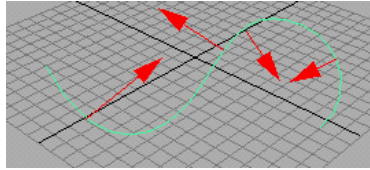
Vector specifies that the up vector tries to align with world up vector as closely as possible. The world up vector is defined relative to the scene's world space. (This is the default.) Use World Up Vector to specify the direction of the world up vector relative to the scene's world space.

Normal specifies that the axis specified by Up Axis will try to match the normal to the path curve. The interpretation of the curve normal is different depending on whether the path curve is a curve in world space, or a curve on surface curve.

If the path curve is a curve in world space, then the normal of the curve is the direction that points to the center of curvature of the curve at any point on the curve. This is best illustrated by the arrows in the diagram below, which indicate the normal to the curve at various points:

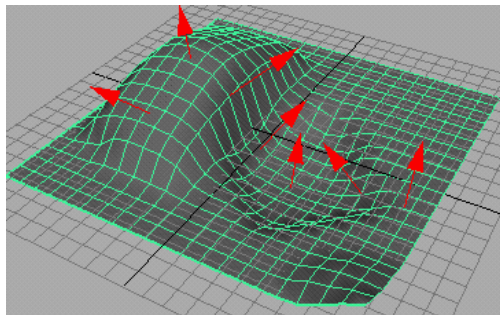
ANIMATING ALONG PATHS | 15

Creating a path animation



Note that the normal to a curve will flip 180 degrees when the curve changes from a convex to concave (or vice versa) shape. This makes the Normal option for the Up Direction not very desirable when using a world-space curve in your path animation.

If the path curve is a curve-on-surface, then the normal to the curve is the normal to the surface at that point on the curve. The Normal option will give the most intuitive results when the path curve is a curve-on-surface.



- World Up Vector** Specifies the direction of the world up vector relative to the scene's world space. Because Maya's world space is "Y-up" by default, the default world up vector points in the direction of the world space's positive Y-axis (0.0000, 1.0000, 0.0000).
- World Up Object** Specifies the object the world up vector tries to align with if World Up Type is set to Object Up or Object Rotation Up. For example, you could specify the world up object as a locator that you can rotate as needed to prevent any sudden flipping problems as the object moves along the curve.
- Inverse Up** If this option is on, Up Axis tries to align itself with the inverse of up vector.
- Inverse Front** Reverses the frontwards direction an object is pointing along the curve. This is especially useful when you are trying to orient a camera so that it points frontwards along a curve. For example, you have got the camera pointing

backwards along the curve, but are having difficulty getting the camera to point frontwards. By clicking Inverse Front on, you can have the camera point forwards along the curve as desired.

Bank

Banking means the object will lean in towards the center of the curvature of the curve that it travels along (like a motorcycle going around a corner). The bank option is only available if the Follow option is on, as banking also affects the rotations of the object.

The path animation automatically computes how much banking should occur depending on how curved the path curve is. You can adjust the banking using Bank Scale and Bank Limit.

Bank Scale

If you increase the Bank Scale, then the banking effects will be more pronounced. For example, if the Bank Scale is set to 2, then the object will bank twice as much as the default that is computed.

Note

You can enter a negative number for Bank Scale. This will cause the object to lean out, away from the center of the curvature of the curve, rather than in towards the curvature. For example, you could use this in animating characters thrown from side to side in a roller coaster.

Bank Limit

The Bank Limit lets you restrict the amount of leaning. For example, the Bank Scale may be increased to obtain pronounced effects, but then this may cause the object to lean too much where the curve is very curved. This option will limit the leaning to the given amount.

Note

No banking occurs where the curve is a straight line.

ANIMATING ALONG A PATH

This section explains how to set the times at which the object should be at different points of the curve as you move the object along the path curve. In this case, you create a path animation using the Motion Path Manipulator Tool to move the object along the path curve.

ANIMATING ALONG PATHS | 15

Animating along a path

In the following example, the Motion Path Manipulator Tool is used to move a simple model of a fighter spacecraft along a path.

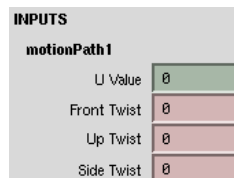
To use the Motion Path Manipulator Tool:

- 1 Create an object to animate along a path curve.
- 2 Create the path curve for the object.
- 3 Select the fighter object, and Shift-click the curve to select it, and choose **Animate > Paths > Attach to Path**  to open the option box.

Set the Time Range option to Start, set the Start Time to 1.0, and ensure that the Follow option is on, and then press Attach.

The fighter will move to the beginning of the curve. You will notice that if you scrub in the Time Slider, the fighter will not move along the curve, because it has a position for only one time.

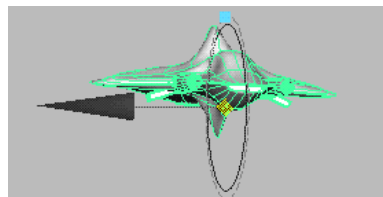
- 4 With the fighter selected, you will notice that in the INPUTS section of the channel box, one of the items listed is motionPath1. This is the node that is controlling the path animation. Click on this node in the Channel Box to select the motionPath1 node. Its attributes will be listed in the bottom part of the INPUTS section in the Channel Box.



- 5 To use the Motion Path Manipulator Tool to move the fighter along the path curve, select the Show Manip Tool from the Maya toolbar.



You will notice at this point that a manipulator appears around the object.



The Motion Path Manipulator has two handles:

- use the handle in the center of the manipulator is used to position the object along its path animation;
 - use the handle on the circle is used to control the front twist attribute of the path animation, that is, how much to twist around its front axis. This latter handle can be used to manually set the banking of the object.
- 6 The fighter is currently positioned at the start of the curve where it will be for time 1. Click in the time slider and move to time 10. To move the fighter to its position at time 10, click on the light blue centre handle of the manipulator, and drag the fighter along the path.
 - 7 To set a key for this object at this position, we must set a key for the U Value attribute of the motionPath1 node. This can be done either from the Keys menu, or by clicking on the U Value attribute of the motionPath1 node in the Channel Box, and invoking the Channels > Key Selected function from the Channel Box.

INPUTS	
motionPath1	
U Value	0.818
Front Twist	0
Up Twist	0
Side Twist	0

- 8 Continue repeating the last two steps until the fighter has reached the end of the curve. Then press the Play button in the Animation Controls to view your path animation.

Tip

You can avoid having to repeatedly set a key for the U Value attribute in the Channel Box if you turn Auto Key on.

You can use the same workflow if you want to animate the banking of the object by using the front twist handle of the manipulator.

ANIMATING ALONG A CURVE ON SURFACE

A path animation can use a curve-on-surface as the path curve. The workflow is identical to that when the curve is in world space; however, there is extra flexibility in controlling the “up” orientation of the object.

To animate an object along a surface:

- 1 Choose Create > NURBS Primitives > Plane to create a NURBS plane.
- 2 Select Modify > Transformation Tools > Proportional Modification Tool to introduce contours on the plane.
- 3 Select Modify > Make Live, then draw a curve on the plane.
- 4 Create an object to animate along the path, and Shift-click on the curve-on-surface to select it.
- 5 Select Animate > Paths > Attach to Path ☐ to open the Attach to Path Options window. Ensure that either Follow or Parametric Length is on, and set the Up Direction to Normal so that the object will stay normal to the surface. Press Attach, then Close.

Note

You may also wish to turn on the Inverse Up option, depending on the direction of the normals to the surface, and which side of the surface you would like your object to be animated along. If you don't know which side the surfaces normal point, you can always turn the Inverse Up option of the motion path on or off after the path animation is created, by opening the Attribute Editor (see Window > Attribute Editor).

- 6 Click Play to see your animation.

You can make the animation even more complex by animating the CVs of the curve-on-surface or by creating a lattice or cluster deformer on the surface and animating this deformer object. The object animated by the path animation will stay normal to the surface at all times.

Note

If your surface was made 'live', it will not appear shaded, even if Smooth Shade All is turned on. The surface must be made unlive to appear shaded. To learn how to make things unlive, see *Using Maya: Essentials*.

ALIGNING ANIMATION ON A PATH

A path animation controls the position and rotation of an object along a curve. Note the following:

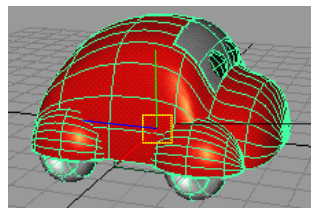
- the point of the object positioned along the curve is the rotate pivot;
- to control the front and up of your object on a path, use local rotation axes.

Positioning your object on a path curve

The point of your object that attaches to the path animation curve is the rotate pivot. Move the rotate pivot of the object to the part of your object that you would like resting on the curve during the path animation.

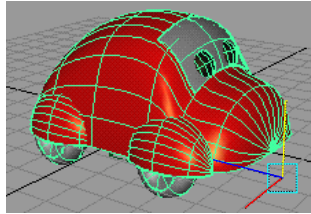
To position an object on a path:

- 1 Select the object to be animated along the path curve.
- 2 Press the "e" key to show the rotate manipulator.



rotate pivot manipulator

- 3 Press the Insert key on the keyboard. This is a quick way to select the rotate pivot of the currently selected objects.
- 4 Use the rotate pivot manipulator to position the rotate pivot at the point on the object that should be attached to the path curve.



- 5 Press the Insert key again to exit from rotate pivot selection and return to object selection. You can now use the Paths > Attach to Path to create your path animation.

Note

If you forget to position the rotate pivot on your object before creating your path animation, you can always repeat these steps after the path animation has been created.

The positioning may not seem intuitive, however, as it will appear as if the object is moving instead of the rotate pivot, as you move the rotate pivot. This is because the motion path is continually recomputing, and thus repositioning the object so that the rotate pivot will stay on the path curve.

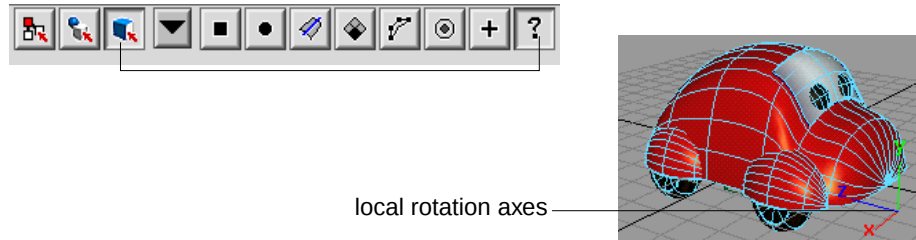
Orienting your object on a path curve

If you use the Follow option, then the Front Axis and Up Axis options will determine which of the three local rotation axes sets the front and up of the object respectively.

To re-orient your object on a path, you can change the local rotation axes of the object. The following example will demonstrate how to do this.

To orient an object on a path:

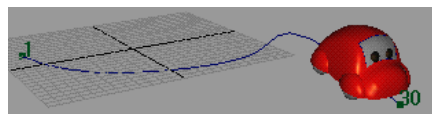
- 1 Select the object to be animated along the path curve.
- 2 Select component selection mode, and then click on the right-most component icon to turn on the display of local rotation axes.



- 3 Click on the rotate tool, and select the local rotation axes. Rotate these axes so that one points in the direction of the front of your object, and another axis points in the up direction of the object.
- 4 Shift-click on the curve.
- 5 Choose **Animate > Paths > Attach to Path**  to open the Attach to Path Options window and with Follow on, set the Front Axis to be the axis you chose to represent the front of your object in Step 3, and set the Up axis to be the axis you chose to represent the up direction of your object.
- 6 Return to object selection mode and click Attach to create your path animation.

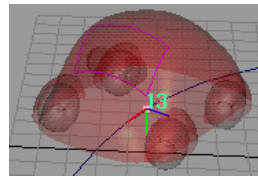
USING MOTION PATH MARKERS

When you create a path animation, you'll notice that markers with numbers are drawn along the path curve. These are motion path markers, and each one represents a key of an animation curve. The time of the key is the number drawn on the marker.

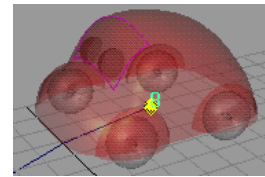


There are two types of motion path markers: position markers and orientation markers. Position markers are created when you select **Paths > Attach to Path**. Orientation markers can be created by hand to refine the automatic rotations that are computed for the object when the Follow option is used.

Using motion path markers



position marker



orientation marker

The value of a position marker is the U parameter value (or percentage of the curve, if the path animation is in Fraction Mode,) of the marker's position on the curve. The value of an orientation marker is the amount of rotation for its Twist parameter.

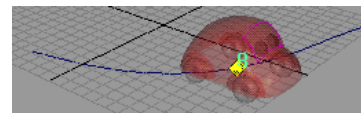
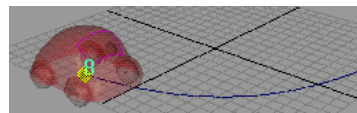
Having the markers displayed in the modeling window is very useful for editing the timing of the path animation. This saves having to open the Graph Editor to edit the timing curve of the path animation.

Editing the position of position markers

After creating the path animation, you may find that you would like the object to travel a little further or not so far along the curve at a given marker time. You can make this adjustment by changing the position of the marker along the curve.

To reposition a marker:

- 1 Select the marker you would like to reposition.
- 2 Use the Move Tool to reposition the marker along the curve.



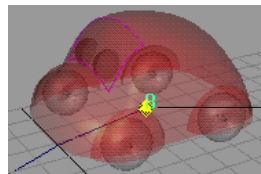
Creating and editing orientation markers

Orientation markers represent keys for the Front, Side, and Up Twist attributes of the motion path node. These Twist attributes are rotations that are added to the default rotations computed by the path animation when you use the Follow (and optionally Bank) option.

Creating your own orientation markers is useful if you want to refine the default rotations computed by the path animation. The following example demonstrates how you can use orientation markers to add rotations to your path animation.

To use orientation markers:

- 1 Create an object and a curve to be used for the path animation, and choose **Animate > Paths > Attach to Path** .
 - 2 Set the Time Range to Time Slider and turn the Follow option on. Click **Attach** to create the path animation.
- Notice the playback of the animation smoothly animates along the path curve. To make the object appear as if its path was bumpy, animate the side twist attribute of the motion path, which is the rotation around the side axis of the object.
- 3 Drag in the Time Slider to the first time of the path animation.
 - 4 Click on the motion path node in the Channel Box to view its attributes, and select the side twist attribute.
 - 5 In the Channel Box, select **Channels > Key Selected** to key this attribute. You have now created an orientation marker. The orientation marker is represented in the view by a small triangle with a number next to it.



orientation marker

Note

Keying the front, side, or up twist attributes creates orientation markers.

- 6 Drag in the time slider further along in time.

- 7 Click in the numeric field of the side twist attribute in the Channel Box. Using the middle mouse button, click and drag in the modeling view to adjust the side twist of the motion path node. When you are satisfied with the amount of twist, click on the side twist attribute in the Channel Box, and select Channels > Key Selected.
- 8 Repeat the last two steps until you have reached the end of the path curve.

Note

If you are not satisfied with the twist adjustment at one of the orientation markers, you can select the orientation marker and use the Rotate Tool to rotate the orientation marker to the desired amount.

Editing the timing of markers

After creating the path animation, you may find that the object reaches a marker a little too early or late in time. You can make this adjustment by changing the time of the marker.

To change the time of a marker:

- 1 Select the marker for which you would like to change the time.
- 2 Open the Attribute Editor (Window > Attribute Editor) and click in the Time field to change the time of the marker.

Adding and removing markers

You can remove a marker simply by selecting it and deleting it. To create a new marker, all that is required is to set a key.

To create a new position marker, set a key on the U Value attribute of the motion path node.

To create a new orientation marker, set a key on the front twist, side twist, or up twist attribute of the motion path node.

SETTING A PATH KEY

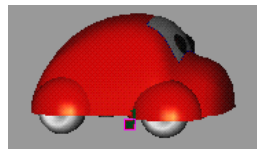
Use **Animate > Paths > Set Path Key** to animate the position of an object using a key animation workflow, creating a path animation instead of animation curves.

The following example demonstrates how to use this function.

To create a path animation:

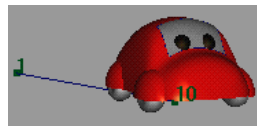
- 1 Create an object to animate, move it to its starting position, and set the current time to 1.
- 2 Select **Animate > Paths > Set Path Key**.

Note that a single-CV curve has been created with a position marker at time 1.0.



- 3 Change the current time to 10 and move the object to its desired position at time 10.
- 4 Select **Animate > Paths > Set Path Key** again.

You will see a single-span curve is now drawn from the marker at time 1 to the current position of the object, where a new marker at time 10 has been created.



- 5 Continue changing the time and position by choosing **Animate > Paths > Set Path Key** for as long as you wish to animate the object's position.

Note that once you have created a path animation using the **Animate > Paths > Set Path Key**, you can use all of the other path animation tools as described in the previous sections to refine the basic path animation.

ANIMATING ALONG PATHS | 15

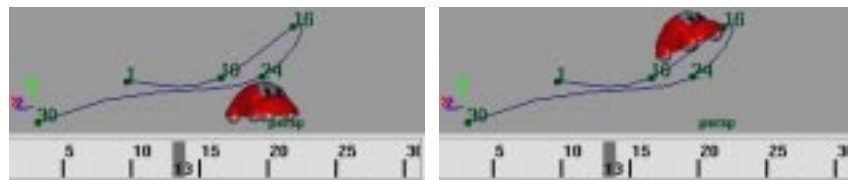
Using the Flow Path Object function

Similarly, you can select the object that was animated along a pre-existing path curve, and extend the length of its animation (and thus the path curve) by using the **Animate > Paths > Set Path Key** function.

Tip

If you decide you don't like the position of the object at a particular marker time, then change the current time to that marker's time, and move the object to its new desired position. Now invoke **Paths > Set Path Key** again, and the shape of the curve will change so that the marker is now at the object's new position.

You can change the shape of an existing path curve by changing the current time to position your object, moving the object to a new position and choosing **Animate > Paths > Set Path Key**. An example of animation before and after this menu item follows:



USING THE FLOW PATH OBJECT FUNCTION

If you have animated geometry (a NURBS or polygonal shape) along a path curve, you may choose to have the object deform as it travels along the path curve, matching the contours of the curve.

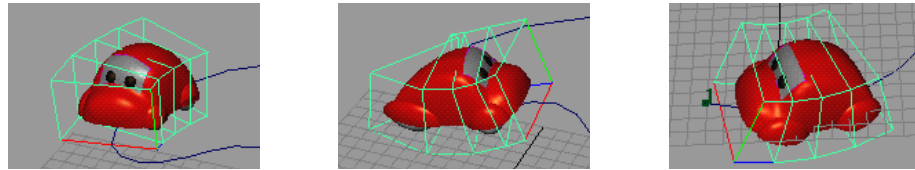
The Flow Path Object function creates a lattice around an object that was previously animated with path animation. There are two ways you can create the lattice: around the object, or around the path curve. Both methods will achieve the same result; however, you may find that one or the other is more convenient if you want to add deformations to the lattice afterwards to achieve some layered deformation effects.

By default, the lattice is created around the object. The following example will demonstrate how to flow an object along a path animation curve.

To flow an object along a path animation curve:

- 1 Create an object to animate, and a curve to be used for the path animation. Select the object, then Shift-click to select the curve, and choose **Animate > Paths > Attach to Path**.
- 2 With the object selected, select **Animate > Paths > Flow Path Object**.
A lattice is created around the object animated along a path curve.
- 3 Click **Play** to view the animation.

You will see that the lattice moves along the path curve, changing shape as the curve's curvature changes. This causes the object animated along the path curve to deform so that it follows the contours of the path curve.



You can also flow an object around a path curve and build the lattice around the curve. In this case, the object would flow through the lattice surrounding the curve, causing the object to deform as it passed through different parts of the lattice.

To flow an object with a lattice around the curve, choose **Animate > Paths > Flow Path Object**  to open the Flow Path Object Options window.

Divisions

These values represent the number of lattice sections that will be created. The Front, Up, and Side correspond to the axes that were specified when the path animation was created.

For example, if the path animation was created with the Front Axis set to Z, and the Up Axis set to Y (in the Attach to Path Options window). The Side Axis is therefore the remaining axis, that is, the X axis. Then, the Front Divisions will be the number of divisions in the lattice along the Front direction, which in this case will be the object's Z local rotation axis. Similarly for the Up and Side Divisions.

Lattice Around

Object—creates the lattice around the object.

Curve—creates the lattice around the path curve.

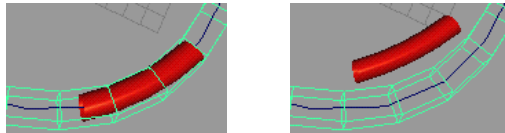
Using the Flow Path Object function

Local Effect

This option is most useful when the you create the lattice around the curve. If the lattice is large, you probably don't want to have the lattice points at one end of the lattice affect the object when it is close to the other end of the lattice.

For example, if the Lattice Around Curve option is chosen, and the Front Divisions is set to 30, this means that there will be 30 subdivisions of the lattice from end-to-end of the path animation curve. As the object moves through the lattice, it may only be surrounded by 4 or 5 divisions in the front direction at any one time. If Local Effect is off, then all the lattice points in the 30 subdivisions will affect the deformation of the object. This could cause the object to “drift” out of the lattice since it is being influenced by lattice points that are very distant from the object.

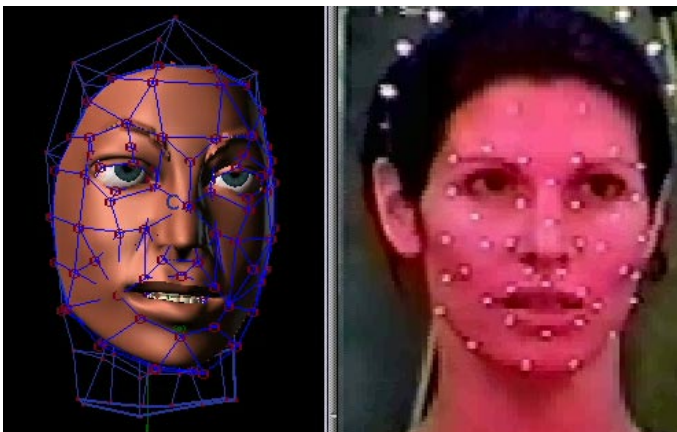
The two diagrams below show Local Effect for a Lattice Around Curve. In the first diagram, Local Effect is on; in the second one it is off.



In general, if Local Effect is on, the Local Effect Divisions should be set to approximately the number of divisions of the lattice that the object will cover.

Tip

If you are using the Lattice Around Object option and set the number of Divisions to a large number in order to have more precise control over the object's deformation, it may be a good idea to set the Local Effect Divisions to cover a smaller part of the object.



PART 6

MOTION CAPTURE ANIMATION



16 INTRODUCING MOTION CAPTURE

With motion capture, you record real physical motion using a motion capture device. You can use this real-life data to animate characters or objects in a scene.

Motion capture lets you generate large amounts of complex motion. You must plan your motion capture animations meticulously and set them up carefully.

This chapter covers the following topics:

- “Understanding motion capture” on page 190
- “Performing full-body motion capture” on page 190
- “Workflow summary” on page 192

UNDERSTANDING MOTION CAPTURE

Motion capture device

The *motion capture device* samples motion and records it. With a motion capture device, you can achieve real-time monitoring and recording of data.

Device vendors provide servers for the data-server devices supported by Maya. You can also write servers for custom devices using the Maya Motion Capture Developer's Tool Kit.

In general, the mouse and keyboard are not motion capture devices.

Server

A *server* is a stand-alone program that communicates with a device. Maya can talk to the server to get device data. Devices that require servers are called data-server devices.

Axis

A motion capture device provides information on different *axes*, arranged in a hierarchy. Axes give important information such as if the data is a rotation value, a translation value, or just a number. An axis can be connected (or attached) to an attribute in a Maya scene.

Attachment

The connection between a device axis and an object's attribute is called an *attachment*. The attachment informs the device which attribute in the scene you want to change.

Button

Some motion capture devices have *buttons*. A button can execute a command or act as a clutch for an axis. However, button presses cannot be recorded as motion capture data.

PERFORMING FULL-BODY MOTION CAPTURE

The most important task of any motion capture is to plan every step in advance. This is especially true for a large project.

To create a full-body motion capture:

- 1** Select a motion capture device.
- 2** Choose a method for calculating the motion.
The method is device-dependent and may use inverse kinematics, forward kinematics, constraints, or a combination of the three.
- 3** Build a skeleton based on the actor's proportions. If possible, digitize the actor's joint positions with your motion capture device.
- 4** Attach the performance skeleton to the device.
- 5** Connect the performance skeleton to the character skeleton.
- 6** Rehearse the actions to be performed.
- 7** Record the motion.
- 8** Review the recorded motion and insert it into your scene.

Tips for full-body motion capture

With full-body motion capture, carefully thought-out sensor placement and skeletal design are essential.

Using an optical system

If you use an optical system, just bring the data into Maya. You will need to make a virtual device to read in the motion. See the documentation for the *defineVirtualDevice* command.

We recommend using a single format for all of the motion you import into Maya. You can write a MEL script to define the virtual device that matches the data. With this method, you have to explicitly define the virtual device only once; other times you can run the script that calls the virtual device definition.

If no filtering is needed, try using the MEL *movIn* command. This does not require the construction of a virtual device.

To use all of the take management features and filters, you must define a virtual device and make attachments to it. Since most optical systems let you solve for joint angles, you can use forward kinematics. For a skeleton constructed with the same orientation as the solved optical skeleton, just attach the device to the rotations of the joints.

Workflow summary

Using a magnetic capture system

For a magnetic capture system, connecting the sensor axes to handles of RP of MC IK solvers works well.

Tips for working with the data

You can create a character based on the actor's body. If you are using a magnetic system, you can place sensors on opposite sides of each of the actor's joints. Record the sensor's location at each placement. You can construct a skeleton that has joints located between opposing sensor positions. If magnetic noise is not a problem, this will produce an accurate copy of the actor's skeleton.

If this is not possible or the character is dissimilar to the actor, create a skeleton based on the actor and solve for that skeleton. You can use constraints, expressions, and connections to map joint rotations and the root position from the actor skeleton to a character.

When you select a device using the Device Outliner, the Controls tab will show the take information for that device.

It is worth taking extra time to ensure that your data is as clean as possible. For option systems, this means rigorous calibration of both the space and the actor. For magnetic systems, the freer the space of magnetic noise, the better the result.

WORKFLOW SUMMARY

To create a simple motion capture sequence:

- 1** Create a target geometry in Maya.
- 2** Attach the geometry to the motion capture device.
- 3** Rehearse the motion for the actions that will be performed.
- 4** Record the motion.
- 5** Review the recorded motion and insert it into your scene.

17 PREPARING FOR MOTION CAPTURE

This chapter covers the following topics:

- “Using the Device Editor” on page 193
- “Defining motion capture devices” on page 195
- “Listing devices and attachments” on page 196
- “Attaching attributes and commands” on page 197

USING THE DEVICE EDITOR

You use Maya’s Device Editor to control the motion capture process. To display the Device Editor, select Window > Animation Editors > Device Editor.

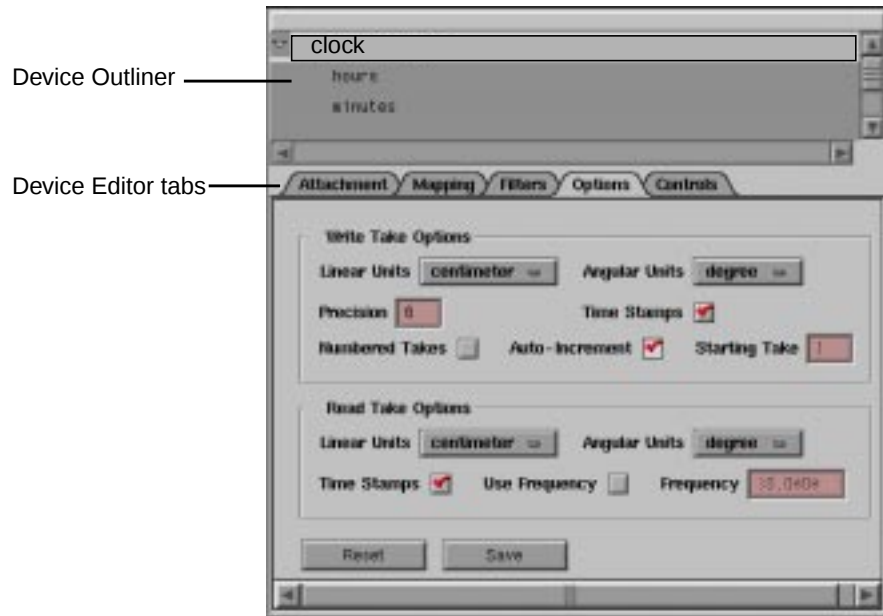
Device Outliner

The top section is the Device Outliner. The Device Outliner lists the defined devices, the device structures, and what the devices are attached to. For information on how to use the Device Outliner, see “Defining motion capture devices” on page 195.

Tab sections

The lower section provides several tabs that allow you to work with devices and manage motion capture data.

- The Attachment tab provides settings for making attachments as described in “Attaching attributes and commands” on page 197.
- The Mapping tab provides settings for modifying attribute attachments as described in “Changing the attachment and device mappings” on page 207.



- The Filters tab lets you define filters and resamplers that you can use when previewing motion data or converting it to animation curves. For details, see “Using filters and resamplers” on page 211.
- The Options tab has various options for writing and reading takes. See “Numbering takes” on page 208, “Reviewing takes” on page 213, and “Using multiple devices” on page 209.
- The Controls tab provides the settings for rehearsing, recording, and reviewing your motion capture sequences. These procedures are described in “Recording the motion” on page 204.

Learning about motion capture with mayaClockServer

To help you learn about motion capture, we’ve provided an example motion capture server, the *mayaClockServer* program. This program reads the system clock and outputs three rotation values in radians: the angle of the second hand, minute hand, and hour hand. You don’t need special hardware. The *mayaClockServer* is located in:

(IRIX) /usr/aw/mayaX.X/bin

(Windows NT) C:\Aw\MayaX.X/bin

To view `mayaClockServer` options, enter the following command from the IRIX shell or command prompt of the preceding directory:

```
mayaClockServer -h
```

We've also included an example script for using `mayaClockServer`. To see a demo of the clock, enter the following in the Script Editor:

```
mayaClockDemo
```

The script launches `mayaClockServer` using the MEL system command, defines a device named "clock," creates three analog clock hands, and connects the geometry to the clock.

Note

If you've already defined the clock device, undefine it and flush the undo queue before running the demo script.

DEFINING MOTION CAPTURE DEVICES

Most motion capture devices are *data-server devices*. To use a data-server device, you need a server. For more information on using the server for a specific device, see the documentation provided by the device vendor.

Some devices do not need servers. These devices are installed via the IRIX desktop. If such a device is visible to the IRIX desktop and supported by Maya, it will be listed in the Device Outliner when you start Maya.

For data-server devices, use the `defineDataServer` command to define the device in Maya. To do this, enter the following command in Maya's Script Editor after you start the device server:

```
defineDataServer -device <deviceName> -server <serverName>;
```

where:

- `<deviceName>` is a unique device name. Choose one that will be easy for you to remember later.
- `<serverName>` is the name of the communication interface defined to talk to the server, as defined in the server setup.

Listing devices and attachments

For example, if you started the clock device but it did not appear in the Device Editor, you would enter:

```
defineDataServer -device clock -s mayaClockServer
```

To undefine a device, use this syntax:

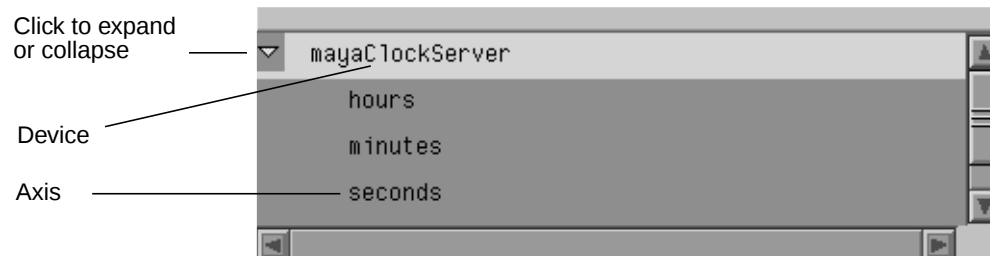
```
defineDataServer -device <deviceName> -undefine;
```

An important interaction exists between defining and un-defining data servers and the undo queue.

When you undo a *defineDataServer* command, the connection with the data-server device does not break until the *defineDataServer* command is off the undo queue. When you undo an undefine of a data server, the connection with the server does not break until the command is off the undo queue. The easiest way to remove the command from the undo queue is to use the *flushUndo* MEL command.

LISTING DEVICES AND ATTACHMENTS

The Device Outliner lists the devices and their attachments.



This is the only way to see how devices are attached to their target attributes. Since devices are not normal Maya dependency graph nodes, they do not appear in the regular Outliner or in the Hypergraph.

Expanding device listings

The devices and their attachments appear in the following order:

- The left-most items in the Device Outliner are the devices.

- The next level shows the axes, indented to indicate their positions in the device hierarchy.
- The final level shows the attachments between the device and an attribute.

To expand or collapse an item:

Click the arrow to the left of the item.

To expand or collapse all of the item's children:

Shift-click the arrow to the left of the item.

Example: Listing the mayaClock device

If you ran the *mayaClockDemo* MEL script, the clock name (*clock*) should be listed in the left column in the Device Outliner. (If it is not, follow the directions in “Defining motion capture devices” on page 195.)

To show all of the device's children, shift-click the arrow to the left of the clock name. The first level of children in the clock are the three axes: hours, minutes, and seconds.

For complex devices, an indented list of axes is displayed, each with its own children. Eventually a device listing ends with attribute attachments. The attachments describe how the device is connected to Maya attributes.

ATTACHING ATTRIBUTES AND COMMANDS

You use the Device Editor's Attachment tab to create attachments.

There are two types of attachments: attribute attachments and command attachments.

- An *attribute attachment* is a connection between an attribute and a device axis.
- A *command attachment* is a command that is issued when a button is pressed.

Attaching attributes

Attaching attributes to device axes



To attach an attribute to a device axis:

- 1 Select the Maya object.
- 2 In the Device Outliner, select the axis you want to attach.
- 3 Under the Attachment tab, type the name of the Maya node that has the attribute to attach in the Node box.

or

Click the right mouse button in the Node box to display a pop-up menu that lists all of the selected nodes and pick the node you want.

- 4 Type the name of the attribute in the Attribute box.

or

Click the right mouse button in the Attribute box to display a pop-up menu that lists all of the key-able attributes for the specified node and select an attribute.

- 5 Specify whether you want to make the attachment per Selection or per Object.

Choose Object for most motion capture purposes. When you explicitly connect the device to a target attribute, that connection always takes effect.

Choose Selection if you want to make the connection only for the currently selected object. This is useful when you are interactively manipulating objects with an input device, but not for basic motion capture work. If you use the Selection mode, the Node box is ignored.

- 6 If a device has a button, you can specify that a button acts as a clutch that makes the connection only while the button is pressed. Select a button name using the Clutch menu.

You cannot record a button press as motion capture data.

- 7 Click Add to make the attachment between the device axis and the attribute.

Attaching commands

You can use command attachments with devices that have buttons. When you press the button, the command associated with the button executes.

To attach a command to a button:

- 1 In the Device Outliner, select a button.
- 2 Under the Attachment tab, type the command you wish to execute in the Command box.
- 3 If you want the command to execute repeatedly while the button is pressed, turn on Continuous.

Generally, you will want to execute the command once per button press. To do this, turn Continuous off.

You can also execute a command every time any button is pressed or released, or if any axis changes on a specified device. The device must have at least one button.

To attach a command to any device change:

- 1 In the Device Outliner, select a device with at least one button.
- 2 Under the Attachment tab, enter the command you want to execute whenever any button on the device is pressed or released or whenever any axis on the device changes value.

To delete a command attachment or an attribute attachment, select the attachment in the Device Outliner and click Delete.

Modifying existing attachments

You can also modify existing attachments using the Attachment tab.

To modify attachment mapping:

- 1 In the Device Outliner, select the attachment.
- 2 Change the attachment values.
- 3 Under the Attachment tab, click Update.

To delete an attachment:

- 1 In the Device Outliner, select the attachment.
- 2 Under the Attachment tab, click Delete.

Remember, a single axis may have more than one attachment. If you accidentally delete an attachment, you can always undo the deletion.

Mapping device data

Sometimes the data coming from the device is in the wrong unit system or needs an adjustment to its scale or offset. You can modify the scale and offset values for incoming device data using the Mapping tab of the Device Editor.

There are two types of mappings: attachment and device mappings. Both affect the scale and offset of the device data. The device data is multiplied by the scale term and then the offset is added.

- *Attachment* mappings apply to attribute attachments. These mappings are recommended for motion capture work. You can undo them.
- *Device* mappings apply to axes. You *cannot* undo them.

Using device and attachment mapping together is error-prone and may produce unintentional results.

To modify the scale or offset of your motion capture data:

- 1 In the Device Outliner, select the axis or attachment you want to modify.
Select an axis if you want the Mapping tab to control a device mapping.



Select an attachment if you want the Mapping tab to control an attachment mapping.

- 2 Under the Mapping tab, select Absolute or Relative mapping.

With *Absolute mapping*, motion is scaled and offset with respect to the origin. If you move a device a foot away from the origin, the target attribute also changes its value to be one foot away from the origin. Absolute mapping is useful for motion capture.

With *Relative mapping*, motion is adjusted relative to the last device position without regard to the origin. If you move a device one foot to the right, the target attribute moves one foot to the right. Relative mapping is useful for desktop input devices that always return to some resting position.

- 3 If you are working with device mapping, choose whether you want to apply your mapping to World space or View mode.

Select World for motion capture work.

If View mode is used, the device coordinates are translated into the space of the active camera.

Saving attachments

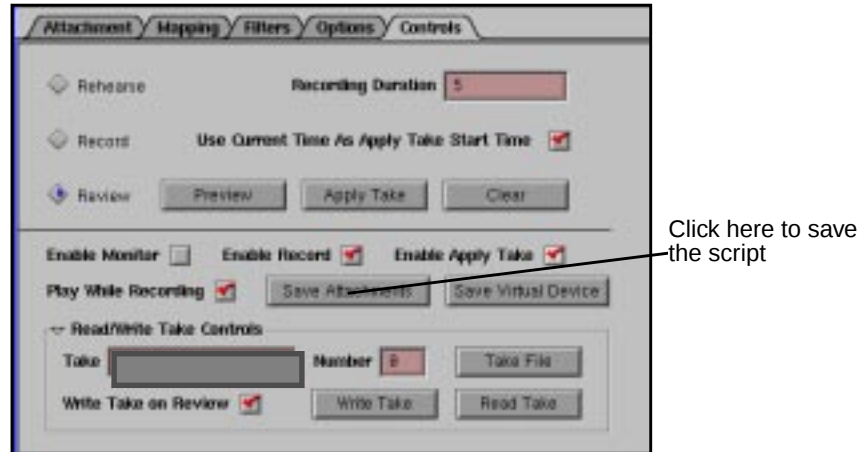
Since devices are not defined as dependency graph nodes, their definitions, attachments, and mappings are not saved in Maya files.

Creating an *attachments script* lets you reload the attribute attachments, command attachments, and mappings when you need them. This saves you having to attach the device to each of its target attributes every time you load a file. You must define the device before running the attachment script.

PREPARING FOR MOTION CAPTURE | 17

Attaching attributes and commands

The MEL script will remake all attribute attachments, command attachments, and mappings, provided the device is defined and the target attributes and nodes have the same names as when you saved the script.



To create an attribute attachments script:

- 1 In the Device Outliner, select the device, its axes, or its attachments.
- 2 Under the Controls tab, click Save Attachments.
- 3 Select a path and name for the attachments MEL script.

Save the script in your scripts path so Maya can see it when you want to reattach your scene.

- 4 Click OK.

The next time you load the scene, define the device, if needed, and run the attachments script from the Script Editor.

18 CAPTURING MOTION

This chapter covers the following topics:

- “Understanding capturing motion” on page 203
- “Rehearsing the motion” on page 203
- “Recording the motion” on page 204
- “Reviewing the motion” on page 205
- “Saving files to disk” on page 207
- “Using multiple devices” on page 209

UNDERSTANDING CAPTURING MOTION

For each motion sequence you want to capture, there are three different phases of the capture process: rehearse, record, and review. For each of these steps, you’ll use the Device Editor’s Controls tab.

REHEARSING THE MOTION

You may want to have the performer rehearse the motion you’re interested in before you record. If the scene is simple, you may be able to view the motion in real time.

Any animation curves attached to the target attributes are not affected by the Rehearse mode.

To rehearse the motion:

- 1 Under the Controls tab, select Rehearse.
- 2 Select Enable Monitor to specify that the target attributes are getting live data from the device.

When you switch from other phases, this step is performed automatically for all devices.

RECORDING THE MOTION

The settings for beginning recording are also under the Controls tab.

To record the motion:

- 1 Under the Controls tab, turn on Enable Record for each device you want to record.
- 2 Make sure the Recording Duration box has enough recording time (in seconds) for your planned motion.

It's best to add a few more seconds to the duration. Also, start recording before the actor begins a move.

- 3 Select Record.

All the record-enabled devices begin recording data, using the current time as a start time for the recording.

Tip

The recording frequency is determined by the device, not by the frame rate of Maya.

Once the duration is met, the recording stops and advances to the review phase. At this point, the data is not yet part of your Maya animation and is not saved to a Maya file.

Data that you can preview or convert into animation curves is called a *take*.

Tip

To stop a recording before the duration expires, select either Rehearse or Review under the Controls tab.

Review takes you to the review mode, the same as if the duration expired.

Rehearse doesn't bring the device data into Maya.

If you accidentally chose Rehearse and want to see the motion in your scene, click the Preview or Apply Take buttons. Click Preview to create a preview version of the take; click Apply Take to make an animation curve version of the take.

- 4 When you are ready to convert the take to animation curves, click Apply Take.

Important

If a device has a take and you select Record, that take is lost unless you first click Write Take to save it or Apply Take to convert it to animation curves.

REVIEWING THE MOTION

In the review phase, Maya applies the motion data you have recorded to the target attributes. Your preview data is applied to all devices and axes that have Apply Take enabled (as indicated by Enable Apply Take). Animation curves that are attached to the target attributes are not affected at this time.

During the review phase, you can click Preview to view the take in a preview form; this does not change the data. You can also click Apply Take to convert the take to animation curves in the review phase.

Viewing a take in preview form

A preview is done automatically when you enter the review phase. This lets you review the newly captured motion faster than by using Apply Take and leaves the animation curves unchanged. Preview data is not visible in the Graph Editor.

To view a take in preview form:

Under the Controls tab, click Preview.

When an attribute attachment is formed, a *node* (blendDevice) is attached to the target attribute. The blendDevice node determines whether you will view live device data (Enable Monitor) or the animation curve that is attached to the attribute.

In this form, the data is stored in the blendDevice node. Playing over the recorded time range will show the newly recorded data, leaving any animation curves unchanged.

If you save your scene to a Maya file, preview data is not saved as part of the scene. To save preview data, use the Write Take button (as described in “Saving files to disk” on page 207).

Note

If you are doing a batch render, be sure to save the motion as animation curves (using Apply Take). Otherwise the motion will not be part of the render.

Converting a take to animation curves

To convert the take to animation curves:

Under the Controls tab, click Apply Take.

When you convert the take to animation curves, the new data replaces any existing animation curves. Older data outside of the newly recorded time range still exists, but any old data within the recorded time range does not.

When the take is converted to either preview form or animation curves, all device mappings, attachment mappings, filters, and resamplers are applied to the take data.

Changing the attachment and device mappings

You can change the scale and offset values in a mapping without affecting the preview data or animation curves.

To change the attachment and device mappings on the take:

- 1 Change the values using the Mapping tab (as described in “Modifying existing attachments” on page 200).
- 2 Reapply the take by clicking Preview or Apply Take.

SAVING FILES TO DISK

You can write out a take as an ASCII file, then read the file back into the scene and review it later.

Motion capture files use the .mov file format. This file format is called “move” in the file browser. It is not related to any movie file format. For information on the .mov file format, see the online document, *Maya File Formats*.

Since a single scene may have dozens of motions, you probably do not want to save each move as a separate Maya file, especially after you have selected the final versions of the motion. It is much easier to save only the motion as a separate file.

To save a take to disk:

- 1 Under the Controls tab, click Take File to display a file browser. If this is a new file, specify a path and a filename.

The base filename appears in the box. From now on, if the Take box changes, the path stays the same; only the filename changes.

- 2 Once you’ve specified a valid filename, click Write Take to save the take to disk.

A take name is required for each device.

Note

If you want to save a take every time you enter the review phase, select Write Take on Review under the Controls tab.

Freeing memory

After applying the recorded data, the take data is still in a take buffer. For small takes this may not be a problem, but for large takes you may want to free this memory.

To free the take data for all devices:

Under the Controls tab, click Clear.

You cannot undo this action.

Numbering takes

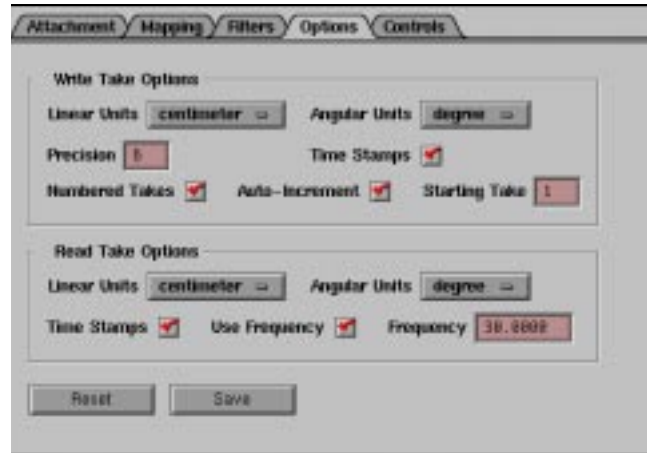
A particular motion may require three takes or more. Because it's hard to know which take is best as you record and because creating unique names for each version of the same move is error-prone, Maya provides an easy way to number your takes.

Take numbering inserts a number between the move name and its extension (by default, .mov). This number can be incremented to form a take number for that move. The take filename is constructed by inserting the value of the Number box before the extension of the name in the Take box.

For example, if the Take box displays *clock.mov* and the Number box displays a value of 2, the file is saved as *clock.002.mov*.

To number your takes:

- 1 Under the Options tab, select Numbered Takes.
Whenever the Take box changes, the Number box is reset to the value in Starting Take.
- 2 If you want to automatically increment the take number whenever a take is written, also select Auto-Increment.



- 3 When your motion data looks good and you want to convert it to animation curves, click the Apply Take under the Controls tab.

Example of viewing numbered takes

Take numbering also makes it easier to view different versions. For example, if you have five versions of the *clock.mov* file that used take numbering, you could view them by completing the following steps:

- 1 Select *clock.001.mov* using the take browser (the Take File button).
- 2 Read the takes into the device by clicking Read Take under the Controls tab.
- 3 See the first take in Maya by clicking Preview or Apply Take.
- 4 To see the second take, change the value in the Number box to 2, then click Read Take and Preview.

USING MULTIPLE DEVICES

You can record and work with many devices simultaneously.

Use the Controls tab to set recording options for each device. To view a device's current settings, select the device name in the Device Outliner, then select the Options tab.

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Using multiple devices

- If you do not want to record data for a device, turn off **Enable Record** in the **Controls** tab.
- If you do not want to apply data to the target attributes of a device, turn off **Enable Apply Take** under the **Controls** tab.

To record multiple devices:

- 1 Under the **Controls** tab, turn on **Write Take on Review**.
- 2 Specify a take name for each device.
- 3 Under the **Options** tab, select **Numbered Takes** and **Auto-Increment**.

With this method, each device automatically saves unique files for each take and you don't have to manually change the take number and take names.

19 ADJUSTING MOTION CAPTURE DATA

This chapter covers the following topics:

- “Using filters and resamplers” on page 211
- “Reviewing takes” on page 213

USING FILTERS AND RESAMPLERS

You can use filters and resamplers to affect your motion capture data. Filters and resamplers let you achieve effects such as demangling Euler angles or resampling data to a specific frequency with a given kernel. You use the Filters tab to create filters and resamplers.

Filters and resamplers are applied when you create a Preview, Apply Take, or Review. You cannot apply filters and resamplers while you monitor devices, only when you convert your data to animation curves using the Apply Take button or convert it to blendDevice nodes using the Preview button.

A resampler may change the temporal values of the data; a filter will not.

To create a filter or resampler:

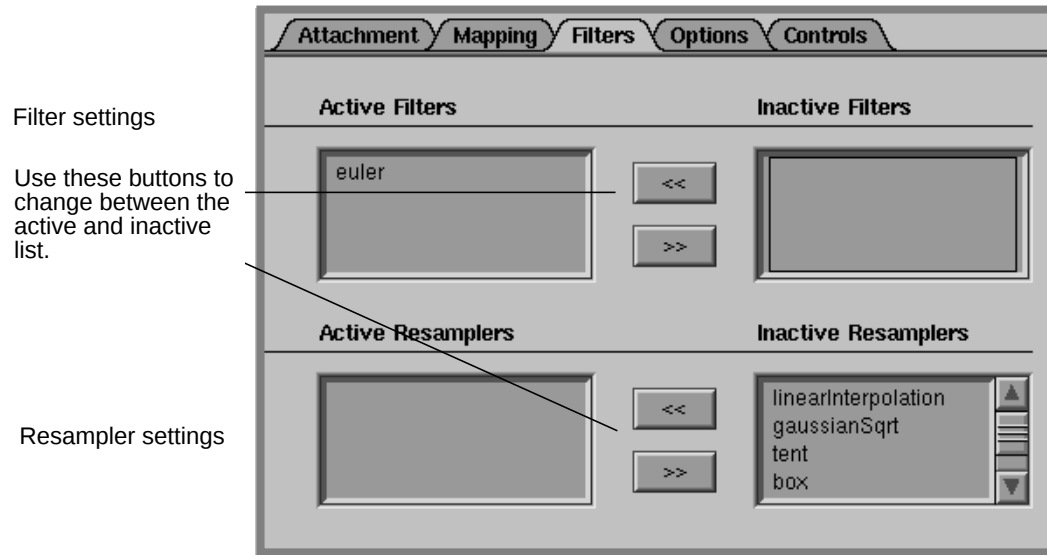
The same procedure applies to both filters and resamplers.

- 1 Right-click the Active or Inactive Filters (or Resamplers) list and select the filter (or resampler) name in the list to create it.

The filter or resampler name appears in the Active or Inactive Filters list.

- 2 To view or change the attributes of a filter or resampler, double-click its name in the list.

Using filters and resamplers



The Attribute Editor for the filter appears.

- 3 Select the Active or Inactive Filters. Right-click the Active or Inactive Filters boxes and select the Euler filter. The Euler filter is now listed in the box:

euler Demangles Euler angle data by removing discontinuities in the Euler angle curves. The filter does this by comparing current angle values to previous angle values, then using the least different angle values to replace discontinuities with smooth transitions.

- 4 Select the Active or Inactive Resamplers. Right-click the Active or Inactive Filters boxes and select Simplify, Closest Sample, Linear Interpolation, Box, Tent, or one of the Gaussian filters. The selected resamplers are now listed in the box:

simplify Resamples groups of nearly colinear samples into two linear samples.

closest Resamples samples at a fixed output rate using the closest sample.

linear Interpolation Resamples based on a linear interpolation between two closest samples.

box	Resamples based on a moving average of the samples.
tent	Resamples based on a weighted moving average from the following formula: $1 - x $
gaussianSqrt	Resamples based on a weighted moving average from the following formula: $2^{(-2x^2)}$
GaussianHalf	Resamples based on a weighted moving average from the following formula: $2^{(-4x^2)}$

- 5 To make a resampler active, click its name in the Inactive Resamplers list and use the << button.
- 6 To make a resampler inactive, click its name in the Active Resamplers list and use the >> button.

REVIEWING TAKES

It is not practical to connect a motion capture device to every machine on which you want to view captured motions. Instead, you use a *virtual device*. A virtual device behaves like a real device in review mode. You can make the same attachments to a virtual device as to a real device. You can read take data into a virtual device and apply it to the target attributes. Virtual devices cannot have buttons.

To define a virtual device based on a real device:

- 1 Select the real device in the Device Outliner.
Under the Controls tab, click Save Virtual Device.
- 2 Select the path and specify a MEL script name.

When you execute the MEL script, a virtual device is defined with the same name as the real device. If you have attachment scripts, they will work with the virtual device without any changes.

Reviewing takes

You can use virtual devices to import numeric data into Maya. In many cases, you can use the *movIn* command. However, if you are using filters or resamplers, we recommend using a virtual device. For more information, see the documentation for the *defineVirtualDevice* command.

To read data into a virtual device:

Reading data into a virtual device is the same as reading in data to a real device.

- 1 Under the Controls tab, click Take File.
- 2 Select the take using the browser that appears.
- 3 Click Read Take to load the take.
- 4 Click Preview or Apply Take to make the data visible in your animation.

To specify how Maya interprets incoming take data:

Use the Options tab to set the units used in the take and time-stamping of the data.

If a take has time-stamp data, turn on Time Stamps in the Read Take Options section.

If you want to ignore time-stamp information, select Use Frequency in the Read Take Options section and type a value in the Frequency box, in Hertz.

Since the .mov file format does not contain information about how data is to be interpreted, the order of data in the take file is important. The order of columns of data in the file must match the order of axes in the device.

If you are creating a virtual device by hand, the order of definition is extremely important and must match your data.

If time stamps were used with the write take, the first column of data is the time-stamp information. The take is applied with the starting time as the starting time of the recording.

If you turn on Use Current Time As Apply Take Start Time under the Controls tab, Maya uses the current time as the start time for the take when you click Preview or Apply Take.

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