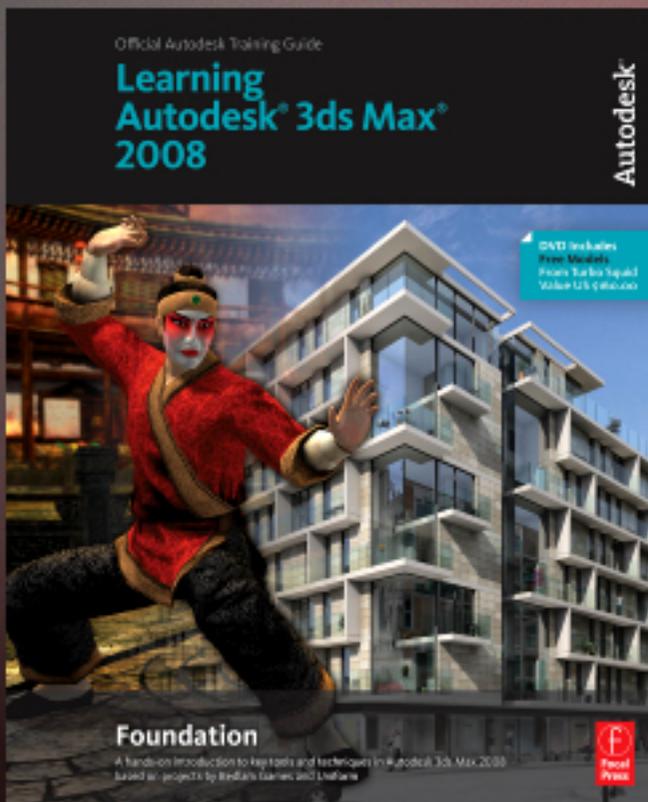


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# Learning Autodesk 3ds Max 2008

Autodesk  
ISBN 978-0-240-80927-4



## Lesson 04

# Animation Basics

This lesson will cover some basic animation techniques and terminology, as well as hierarchies and relationships between objects. Autodesk® 3ds Max® software provides tools for animation, but to animate well, you also need to understand and use the laws that govern animation.

**In this lesson you will learn the following:**

- How to change the undo level;
- How to create hierarchies;
- How to build a custom Schematic View;
- How to understand parent inheritance;
- How to control a pivot point;
- How to use the Time Slider;
- How to use the Curve Editor;
- How to select animation keyframes;
- How to change keyframe tangents.

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## Undo level

When you work with animation, it's important to be able to undo any modifications you have made. Make sure to set your preferences to have a high number of undo levels. By default, 3ds Max allows a small number of undos in order to reduce the memory usage of your computer. You will now specify the number of undo levels you would like.

- From the main menu, select **Customize** → **Preferences...**
- Select the **General** tab.
- In the **Scene Undo** option at the top-left corner, change the **Levels** value to a higher value, such as **50**.
- Click on **OK** to confirm the change.

**Note:** *Setting a high undo level is not a good thing to do when you are in production using large files. For this exercise you will do this, but if you are working on large design visualization projects you probably can't afford to increase the undo levels at all, in fact you may find you need to lower them to save on memory.*



## Building a hierarchy

Before animating objects, you need to make sure that the task will be as simple as possible. You will need to find the objects in your scene easily and animate them as intended. Placing objects logically into a hierarchy will do just that. To accomplish that, you will learn how to parent objects together as well as how to use the Schematic View dialog.

The following example explains how to create a hierarchy of objects.

### 1 Scene file

- **Open** the scene `04-animationBasics_01.max`

**Note:** *If you get a "File Load: Units Mismatch" message, accept the default setting and click **OK**.*



*This file contains an example scene of a robotic arm.*

### 2 The Schematic View

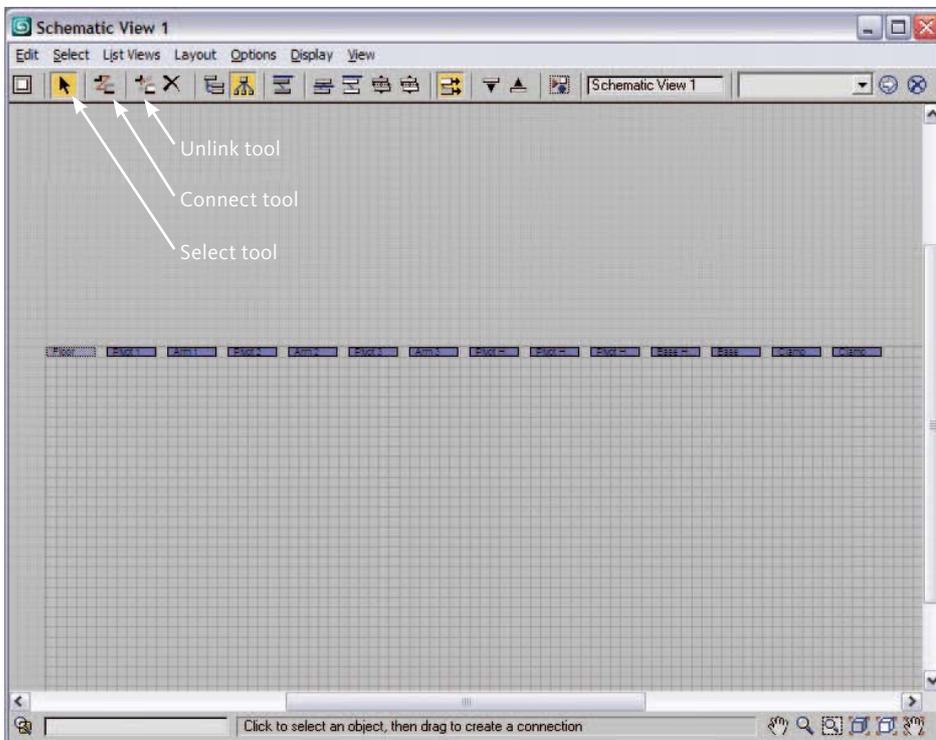
It is very important to understand the concept of a hierarchy. A hierarchy consists of a grouping of child nodes under parent nodes. When a parent node is transformed, all of its children will inherit its transformation.

- To better visualize what you are about to do, click the **Schematic View** button from the menu bar.



The Schematic View icon

The Schematic View dialog lists all the nodes in your scene along with their hierarchies. Currently, there is no hierarchy between the objects.



The Schematic View dialog

**Note:** You can zoom in and out in the **Schematic View** by scrolling with the **MMB** or with the **Zoom** tool, located in the lower-right corner.





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### 3 Parenting

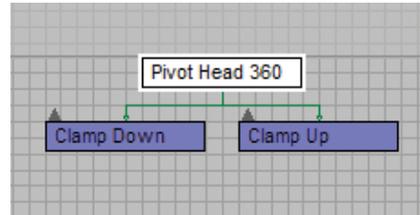
- In the Schematic View dialog, click on the *Clamp Down* node, hold down **Ctrl**, and click on the *Clamp Up* node to select both of them.

- Select the **Connect tool** icon

*The cursor will change to the icon that appears when you move it over a node.*

- **Click+drag** from one of the clamp nodes to the *Pivot Head 360* node.

*You will see a dashed line coming from each clamp node. When you release the mouse button, the two objects will be connected to their parent object. You may need to zoom into the view to find the nodes; you will find the view navigation tools at the bottom-right corner of the Schematic View.*



*The two nodes connected to their parent node*



**Tip:** You can unlink nodes by selecting them and then clicking the Unlink button.

### 4 Completing the hierarchy

- Organize the hierarchy so that it looks like the following:



*The completed hierarchy*

**Note:** You don't have to use Schematic View to create hierarchies; in fact most users just create hierarchies directly in the viewport using the **Select** and **Link** tool found on the main toolbar. Schematic View can be easier to use when you have a model like this one with many nicely named parts. The more complex the model, the more likely you'll use this Graph Editor.



## Customizing a Schematic View

A nice feature of the Schematic View is the ability to display a reference image in the background and lay nodes out on it for a better understanding of the scene's content and hierarchy.

**Tip:** You can create a custom Schematic View for any setup you build.

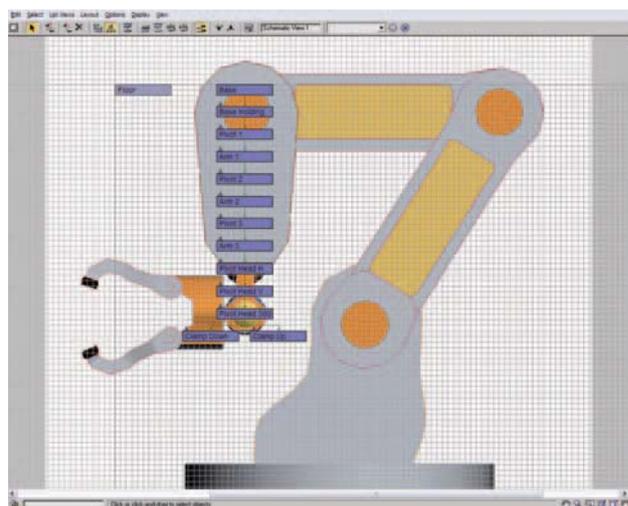


### 1 Create a custom Schematic View

You will customize the robot Schematic View to make the animation process easier.

- From the Schematic View menu, select **Options** → **Preferences...**
- In the **Background Image** option, click the **None** button.
- Browse for the image called *SchematicViewRobot.tif* from the *support\_files*. The file should be under the *project1\sceneassets\images* subfolder.
- Make sure that the **Show Image** option for the **Background Image** is activated.
- Click **OK** to exit the Preferences menu.

You will now see the background image in your Schematic View.



The background image loaded into the Schematic View dialog





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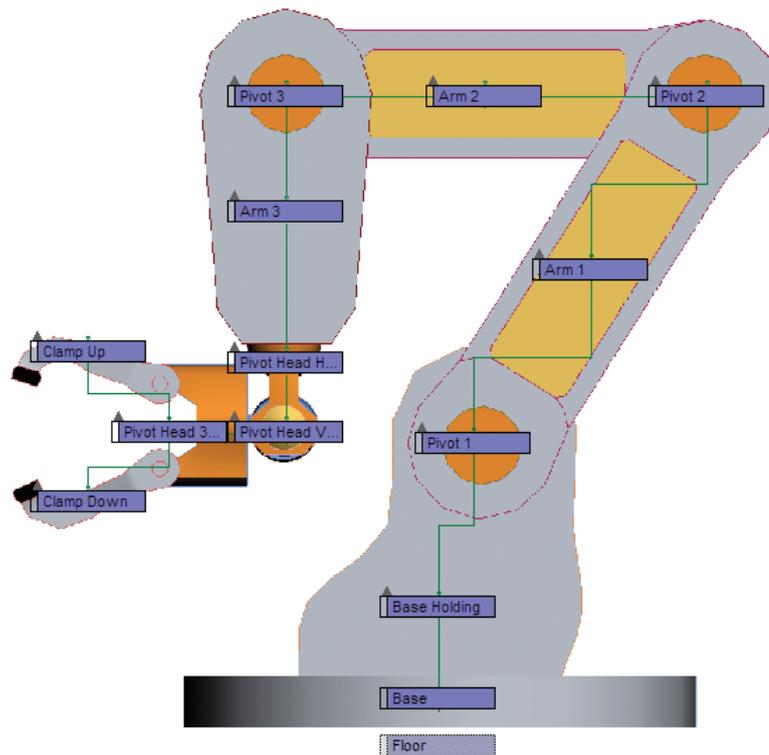
- Press the **g** hotkey to turn off the grid so the background image is easier to see.

**Note:** Make sure the **Keyboard Shortcut Override Toggle** is active to access the shortcuts specific to the **Schematic View**. Turn it on and off to activate it, if necessary.



2 Lay out the nodes on the reference image

- **Zoom** in the image until the nodes are reasonably sized in the reference image.  
*Only the nodes are affected when zooming in the view; the background remains static. This is because you have not yet locked the zoom and pan functions in the Preferences.*
- In **Options** → **Preferences**, activate **Lock Zoom/Pan** from the **Background Image** and click **OK**. Now you can zoom the background in the viewport to fit it to your Schematic View dialog.
- Place the nodes over each object they represent as shown in the following illustration.

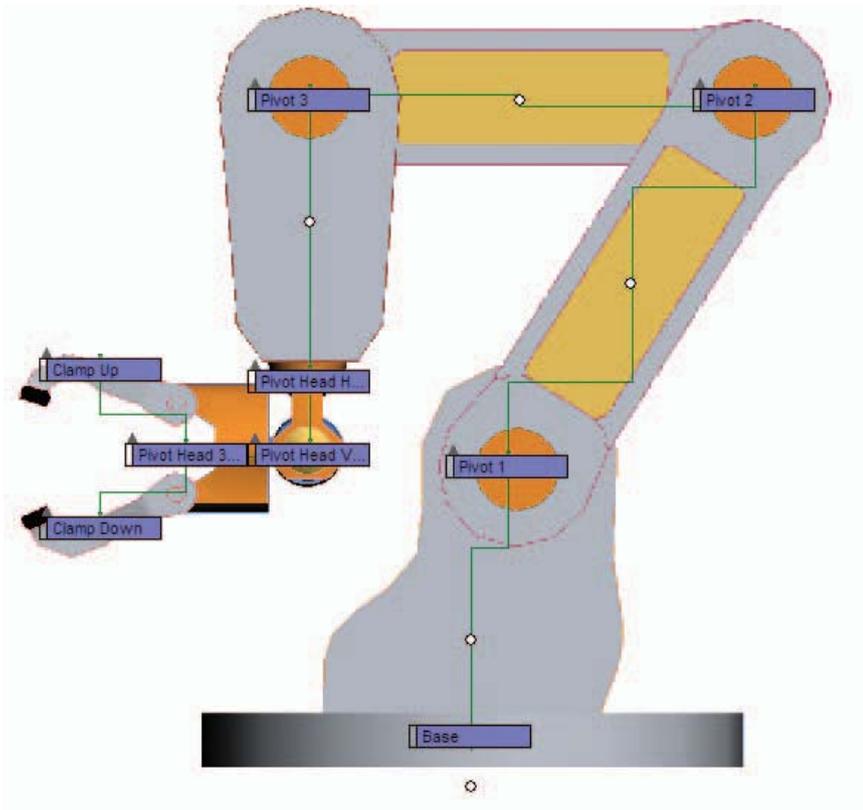


*The nodes placed on the reference background image*

**Note:** The easiest way to place the nodes is to start with the top parent of the hierarchy, since all the child nodes will follow. If you don't want the children to move, go to the Schematic View menu bar and turn off **Options** → **Move Children**.

- Select the nodes that are not intended for animation, such as the *Arms, Base Holding* and *Floor*.
- **RMB** in the Schematic View to bring up the quad menu and select **Shrink** → **Shrink Selected**.

*This will simplify the display of the nodes and make them easier to manipulate.*



*The final schematic view with animatable nodes only*





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3 Save and recall your custom layout

- **Rename** the schematic view to *Robot Arm* in the name field at top of the schematic view.



*The name box of the Schematic View dialog*

- Close the Schematic View dialog.
- When you need to recall the layout you have just created, you will be able to access it using the menu **Graph Editors** → **Saved Schematic Views** → **Robot Arm**.

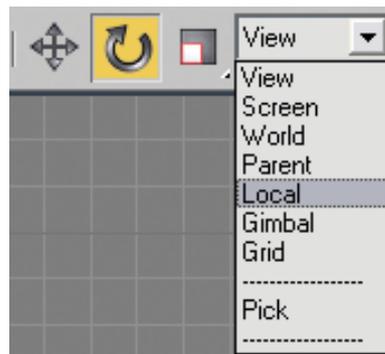
Getting ready for animation

Hierarchies play a big role in animation. For instance, if you transform a parent object, all of its children and grandchildren will follow that transformation. You must also make sure that every object's pivot is appropriately placed for the intended animation of the object and that the animator will not be able to break the setup inadvertently.

1 Reference Coordinates System

- Before you try to move an object, make sure that the *Reference Coordinate System* on the main toolbar is set to **Local**.

*The Reference Coordinate System list lets you specify the coordinate system used for a transformation (move, rotate, and scale). The Local system uses an individual coordinate system for each object, based on its pivot point.*



*The Reference Coordinate System list*

2 Pivots placement

Some objects may not have their pivots at a proper location by default. It is a good idea to revise and place the pivots where the rotation pivot of the object is intended.

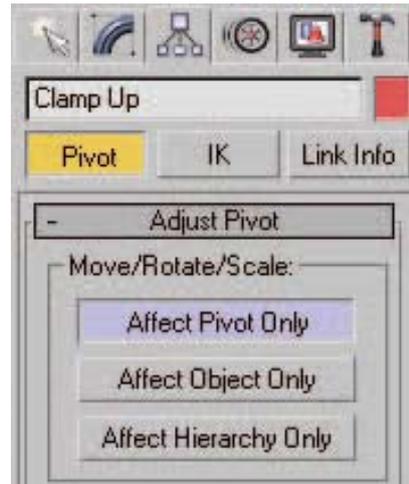
**Note:** By default, the pivot is placed in the middle of the object's bounding box.

You will now see how a well-placed pivot can greatly simplify your task when animating an object.

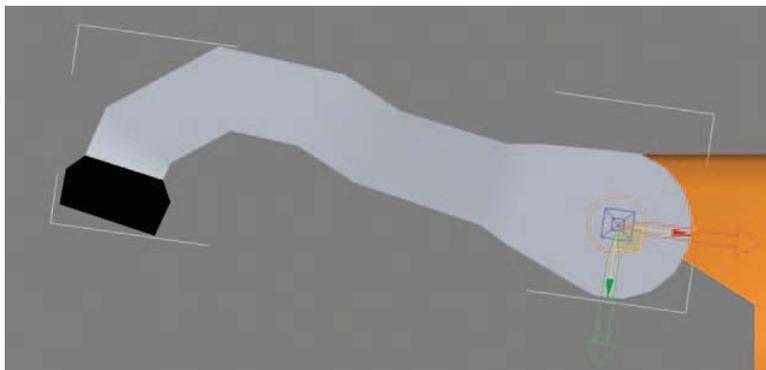
- Select the *Clamp Up* object and **rotate** it.

*The clamp is rotating from its center, which is not the appropriate motion.*

- **Undo** the previous action to bring the clamp back to its original position.
- Go to the left view using the **I** hotkey and **frame** the object.
- Still with the *Clamp Up* selected, go to the **Hierarchy** control panel and click the **Affect Pivot Only** button in the **Adjust Pivot** rollout.
- **Move** the pivot to the middle of the orange circle at the base of the clamp.



*The Affect Pivot Only button*



*The new clamp pivot position*

- Select the *Clamp Down* object.  
*Even if you change your selection, you will stay in Affect Pivot Only mode.*
- **Move** the pivot to the middle of the orange circle at the base of the clamp.
- Click the **Affect Pivot Only** button again to exit the tool.  
*Now the pivots are well placed and the robot's clamp can rotate the way it is supposed to.*

## PROJECT 01

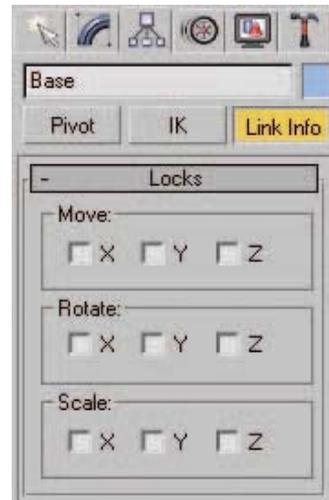
**3 Locking rotation**

When you're using the Rotate tool, the three rotation axes are available on the rotation gizmo, but mechanical objects are sometimes constrained to move in only one or two axes. You will lock the unnecessary axes to avoid animating them.

- Make sure you are in **Local** reference coordinate system.
- Select the *Base* object.
- In the **Hierarchy** control panel, change the sub menu from **Pivot** to **Link Info**.
- In the **Locks** rollout, in the Rotate group click in the check box of the **X** and **Y** axes.

*These two axes will no longer be part of the rotation transform gizmo.*

- Select all the other rotational objects.
- **Lock** the **X** and **Y** axes to lock the rotational axis at the same time.



*The Link sub-menu of the Hierarchy control panel*

**Note:** The **Lock** option locks the axes in the local reference coordinate system. The X, Y and Z axes can vary between objects, so you should double-check that they are all locked in the intended way.

**4 Freeze the objects**

Some parts of the robot will never be animated and should thus not be movable. It is useful to freeze them to make sure you will never accidentally select them during the animation process.

- Select the *Floor*, *Base Holding* and *Arm* objects.
- **RMB** to bring up the quad menu.
- Select the option **Object Properties...**
- In the **Display Properties** option box, deactivate the **Show Frozen in Gray** option.
- In the Interactivity group, turn on **Freeze**.

*This will freeze all the selected nonrotational joints.*



**5 Revise the setup**

Take some time to go through each node and make sure each one can only be manipulated for its intended purpose.

**6 Save your work**

- Save incrementally using the plus button and add “My” to the front of the name of the provided file.

**Animating the robot**

You now have enough knowledge of scene hierarchy and object inheritance to create your first simple animation. Before jumping into animation, you need to understand the controls that make it possible.

**The Time Slider**

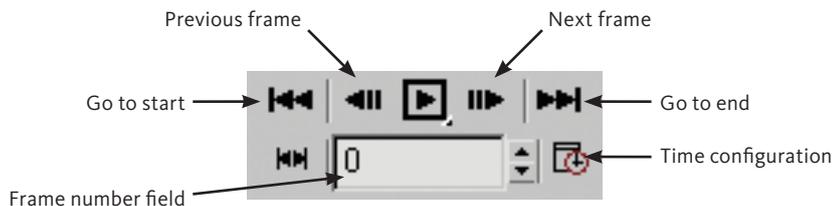
The Time Slider provides an easy way to move through the frames of an animation. To do this, just drag the Time Slider button in either direction. The Time Slider button is labeled with the current frame number, followed by the total number of frames. The arrow buttons on each side are used to move to the previous and next frame. You can use the < and > keys on the keyboard to do the same thing.



*The Time Slider*

**The Time controls**

The Time controls include buttons to play back the animation, to jump to the start or the end of the animation, or to step forward and back by a single frame or to the next/previous keyframe. You can also jump to an exact frame by entering the frame number in the Frame Number field.

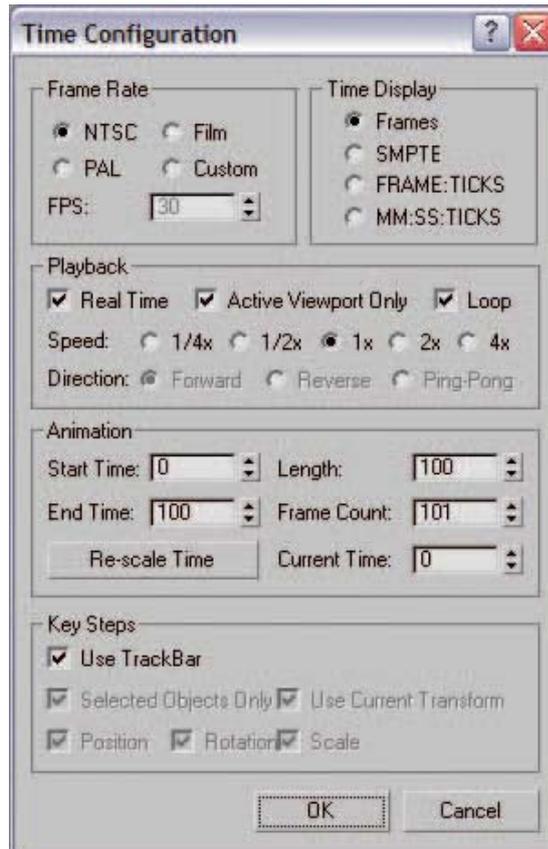


*The Time Control buttons*



## The Time Configuration dialog

The Time Configuration dialog is used to set the number of frames in your animation and let you set the speed for your animation playback.



*The Time Configuration dialog*

### 1 Animation length

The first step in creating an animation is to determine how long you want the animation to be. The length of your animation will depend on how many frames are played per second. By default, Autodesk® 3ds Max® plays animation at a rate of 30 frames per second (FPS), which is a standard rate used for TV. If you want your animation to last one second, you will need to animate 30 frames.

- Click on the **Time Configuration** button in the Time Control section.

- Change the **End Time** value to **59**.

*Notice that the **Frame Count** value has also change.*

- Click **OK** to change the animation length.

*The Time Slider now goes from 0 to 59, or 60 frames. This is two seconds of animation at 30FPS.*

**Tip:** You can quickly change the animation length by pressing the **Ctrl+Alt** hotkey and clicking on the timeline with the LMB to set the Start Time, the RMB to set the End Time, or the MMB to pan along the time.



## 2 Setting keyframes

When you keyframe an object, it defines a particular state on an object at a particular point in time. Animation is created as the object moves or changes between two different keyframe states. Luckily, you do not need to animate every single frame in your animation. When you set keyframes, 3ds Max will interpolate the values between the keyframes, giving you animation. To help you set your keyframes, you will use the Key Control section next to the Time Control buttons.



*The Key Control menu*

- **Open** the key filters dialog box with the **Key Filters...** button.
- **Deactivate** all the set key filters, except the Rotation from the list of the available filters. Leave Rotation turned on.
- Click the **Go to Start** button from the Time Control to make the current frame **0**.
- **Select** the *Pivot 3*.
- Click on the **Set Key** button to set a rotation key at frame 0 on *Pivot 3*.  
*A green key is now visible at frame 0 in the timeline.*

**Tip:** **Set Key** can also be executed by pressing the **k** hotkey.



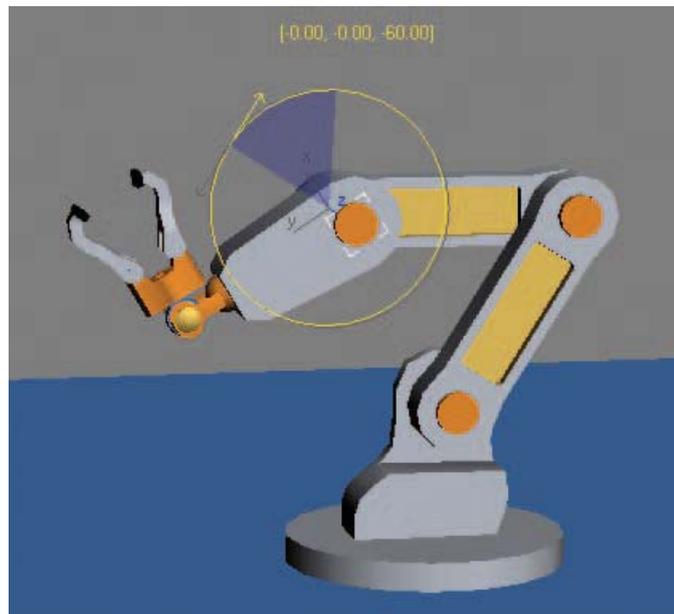
- Activate the **Auto Key** mode by clicking the AutoKey button, or with the **n** hotkey.  
*The Auto Key feature will automatically keyframe a modification on an object.*
- In the frame number field, type **30** and press **Enter**.  
*Notice the position of the current frame mark in the Time Slider.*



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- **Rotate** the *Pivot 3* object by **60** degrees up. This rotates the rest of the chain, which includes the Arm and two Clamp objects.

*During the rotation, you will see a blue arc that shows you the rotate angle you made and three digits that represent the exact value of the rotation. If, for some reason, you don't see the heads-up display of the values, you can watch the values in the coordinate fields at the bottom of the interface, directly below the trackbar.*



*The new arm rotation*

**Note:** After you release the LMB to complete your rotation, a keyframe will be added automatically into your timeline.

- Select the *Pivot Head Vertical* object.
- **Rotate** the object **60** degrees downward.

*Because you are in auto key mode, a keyframe is created on the current frame, but there is also a new one set on frame 0 with the original object position.*

- Select the *Pivot Head 360* object.
- **Rotate** it **90** degrees to the left.
- Select all children of the *Pivot Head 360* object by using the Page Down hotkey.

**Tip:** You can walk through your selections in the hierarchy by using the Page Up and Page Down hotkeys. However, you won't be able to go through a frozen object in the hierarchy.



- **Rotate** the clamps by about **25** degrees so they touch each other.
- Exit the **Auto Key** mode with the **n** hotkey



The robot's new position on frame 30

### 3 Play back the animation

- Click the **Go to Start** button, and then click the **Play** button in the playback controls section to see your animation. You can also use the **/** hotkey to play the scene.
- To stop the playback of the animation, click the **Play** button again or use the **/** hotkey again.
- You can drag the current frame by **click+dragging** in the Time Slider area.

**Tip:** You can also press the **<** and **>** hotkeys to navigate to the next and previous frames. If you hold either key down, it will play your animation forward or backward.





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### 4 Tweak the animation

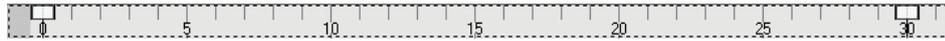
You now have a partially animated robot, but it is still missing refinement. Maybe you think the animation is too slow or too fast. In order to change the timing of the animation, you can drag keyframes directly in the Time Slider.

- With the *clamps* still selected, **press+drag** a selection in the timeline to select the two keyframes.

*The keyframe should be white when selected.*



**Tip:** You can also select the keyframes one by one by holding the **Ctrl** key and clicking on each keyframe.



*The selection box around the two keyframes*

- **Drag** the second keyframe to frame **59**.  
*The clamps animation now starts at frame 29 and stops at frame 59.*
- Click anywhere in the Time Slider to remove the keyframe selection.
- Select the Pivot Head Vertical object using the Page Up hotkey.
- Click on the keyframe on frame **0** to select it.

- **Drag** the selected keyframe to frame **15**.

- **Play back** your animation.

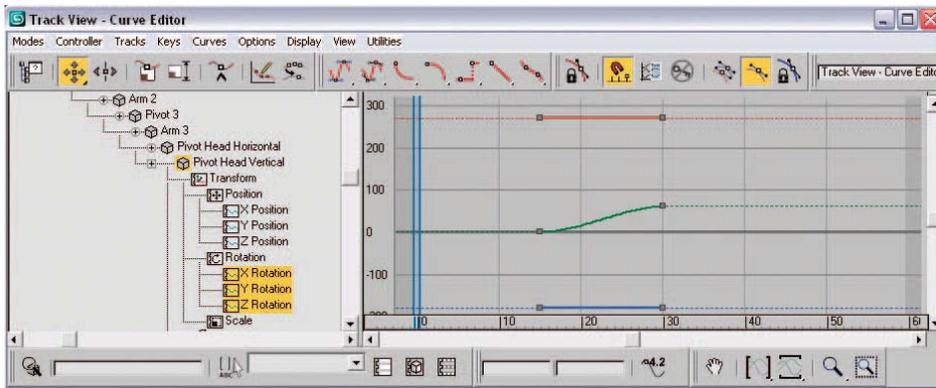
*You will notice that the clamps are closing later in the animation and the Pivot Head Vertical starts later but moves faster.*

### 5 Track View

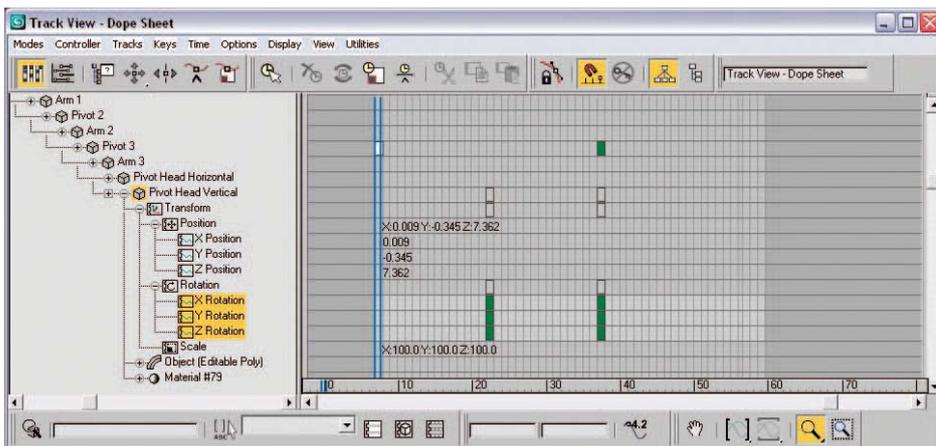
With Track View, you can view and edit all the keys that you create. Track View uses two different modes, *Curve Editor* and *Dope Sheet*. Curve Editor mode lets you display the animation as function curves, while the Dope Sheet mode displays the animation as a spreadsheet of keys and ranges.



**Note:** Keys and curves are color-coded for easier identification.



The Curve Editor



The Dope Sheet

- Select both *Clamps*.
- Select **Graph Editors** → **Track View – Curve Editor...**  
*In order to modify only the Rotate Y keyframes without affecting other animation curves, you can display only the desired curve in the Curve Editor. You will now modify the animation so the clamps progressively gain speed as they are closing.*
- On the list on the left side of the Track View, hold down the **Ctrl** key and click to deselect the **X Rotation** and the **Z Rotation** track that are highlighted in yellow to focus on the **Y Rotation** curve.

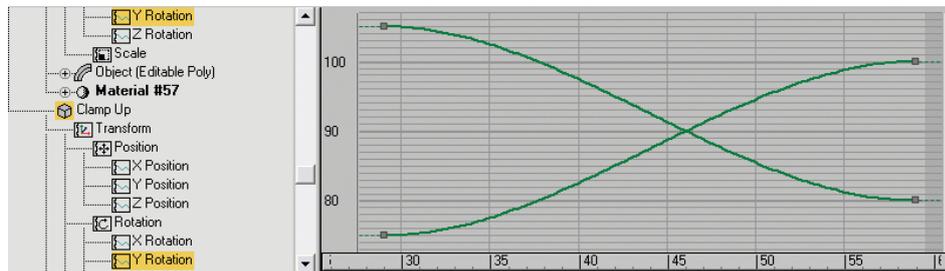


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- Use the **Navigation tool** at the bottom right of the track view to frame the selected curve.



The Navigation toolbar of the Curve Editor



The two clamp curves framed in the Curve Editor

## 6 Modifying keyframes

- **Press+drag** a selection box around the two keyframes at frame **59**.
- **Play back** your animation.
- While the animation is playing, change the tangents of the keyframe with the **Keys Tangents** toolbar.



The Set Keys Tangents toolbar

*Notice the difference in speed between the different tangent modes.*

- Choose the best tangent type for your animation by clicking the **Set Tangents to Fast** button.
- **Stop** the playback of your animation.
- Continue experimenting, by selecting different keyframes and changing their tangents with the Curve Editor for all the different parts of the robot. Once you like your animation, close the Curve Editor.

## 7 Save your work

- **Save** your scene as *Myo4-animationBasics\_02.max*.

## Conclusion

You have now touched upon some of the basic concepts of hierarchies and animation. Autodesk® 3ds Max® software utilizes more powerful tools than described here to help you bring your scenes to life, but these basic principles represent a great step forward. Besides learning how to parent objects together, you also learned about locks and link info, inheritance of transformation and animation and worked with two of the most useful graph editors—the Schematic View and the Track View dialogs.

The next lesson is a more in-depth look at most of the tools that you have been using since the beginning of this project. Once you have read this lesson, you will be able to make your own decisions about workflow, whether to use hotkeys, quad menus, use the menu bar or click on icons to launch most operations.

