

FTV124011-L

The Mechanics of Motion Automation in 3ds Max 2018

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Learning Objectives

At the end of this class, you will be able to:

- Learn how to wire parameters for rotational motion animation 3ds Max 2018.
- Learn to simulate pivot constraints using 3ds Max tools suitable for animation.
- Learn how to rig a mechanical assembly using bones and inverse kinematics.
- Learn how to create a keyframe animation to drive the assembly.

Description

Mechanical motion is all around. From a simple door hinge to a car cylinder piston, it's easy to forget that even simple real-world motions can be complex operations in 3D animation software. This class will explore several methods for automating complex motion animation in 3ds Max 2018 software. Designers will learn how to wire parameters and import the assembly into 3ds Max, and how to create similar constraints using 3ds Max tools. You will learn strategies for building a hierarchy based on animation requirements, as well as basic parameter wiring and the setting up of links and inverse kinematics to mimic specific constraints. The class will step through multiple short lessons that let you animate specific moveable parts. Finally, attendees will see what advantages each tool has for different steps in the animation of complex motion.

About the Speaker

Steven Schain is the post-production supervisor for all CADLearning products from 4D Technologies, as well as the content development manager of CADLearning's Media & Entertainment products for Autodesk, Inc. software, including 3ds Max and Maya. In 1998, Autodesk recognized Steven as one of only 16 Autodesk Training specialists worldwide. He has since contributed to Autodesk's certified courseware for 9 releases of 3ds Max, was a co-developer of Autodesk's ACI Program and 3ds Max's fundamental standards, and is currently an Autodesk Certified Instructor. As a premier Autodesk trainer, he has continued teaching end users, companies, and many others, including The Walt Disney Company, Guess, and the United States Army. As a 7-year veteran of Autodesk University, Steven has taught classes ranging from creating particle fountains in 3ds Max, to classes on 3D printing and entrepreneurship.

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Step by Step

This step-by-step walkthrough of the AU 2017 hands-on lab is meant to be a "steps only" guide to completing the lab. For additional images and explanations of the major sections, please refer to the course handout.

Animatable Assemblies Projects

Setting the Project Directory

1. In the **File** menu, choose **Set Project Folder...**
2. In the **Browse for Folder** dialog, navigate to the "**FTV124011-L_Project**" directory, then click **OK** to set it as the current project directory.

Configuring a Door Hinge

1. From the **File** menu, click **Open**.
2. Open the file, **Door Hinge_01.max**.

Preparing the Scene

Hiding scene layers

3. Make sure the **Scene Explorer** is set to **Sort by Layer**.
4. In the layers list, turn off the visibility for the **Cameras**, **Ground**, **House**, **Lighting**, and **Shapes** layers.

Hierarchies for Animation

Creating the Hierarchy

To start here use: **Door Hinge_02.max**

Grouping the Door

5. Change the **Scene Explorer** to **Layer Mode**.
6. In the **Layer Editor**, click the layer icon to the left of the **Front Door** layer text to make it the current active layer.
7. Click **Zoom Extents All** to zoom the viewports to the door.
8. Click off into space first to make sure you deselect any currently selected objects.
9. Then, using whatever method you desire, select the **Front_Door**, **Door_Kickplate** and **Door_Handle** objects. Make sure you **do not** select the **Point_Handle** object.
10. From the **Group** menu, choose **Group**, and name the group "**Front_Door_GP**", then click **OK**.

Adding a Door Pivot Helper

11. Click the **Create Tab** in the **Command Panel**.
12. In the **Create Tab**, choose the **Helpers** option.
13. Set the **Scene Explorer** to **Sort by Layer**.
14. Set the **Helpers** layer as the current layer by clicking the layer icon to the left of the **Helpers** label.

15. Click the **Point** helper object.

Before creating the Point object, let's make a few changes to the parameters.

16. In the **Display** group, make sure the **Axis Tripod**, **Cross**, **Box**, **Constant Screen Size** and **Draw On Top** checkboxes are checked.

17. Set the **Size** value to **2'0"**.

18. To create the Point object, click once in the Top Viewport.

19. Once the Point is created, click the **Modify** Panel.

20. In the **Name** type-in, change the name to "**Door_PVT**" and press **ENTER**.

Positioning the Point helper

21. With the **Door_PVT** selected, press "**W**" to activate the **Move** tool.

22. In the **Status** bar at the bottom of the interface, set the **X** value to **2'7.93"**, the **Y** value to **0'3.24"**, and the **Z** value to **3'0.0"**.

Setting up the Hierarchy

To start here use: **Door Hinge_03.max**

Linking the Door

23. In the **Scene Explorer**, select **Sort by Hierarchy**.

24. Select the **Display** menu and make sure the **Display Children** option is checked.

25. To begin creating the hierarchy for the door, select the **Front_Door_GP** object and drag it on top of the **Door_PVT** object and release the mouse button.

26. Select the **Point_Handle** object and drag it on top of the **Door_PVT** object and release the mouse button.

Locking Object Rotation

27. In the Top viewport, make sure the **Door_PVT** object is selected.

28. In the **Command** panel, click the **Hierarchy** tab, then **Link Info**.

29. To ensure the point helper only rotates in the Z-axis, check the X- and Y-axis locks for Rotate.

30. From the **Main** toolbar, choose **Select and Rotate**.

31. Rotate the point helper on any axis. When you're done, click **Undo** to get the point helper back to its original rotation.

Pay attention to the fact that the point helper object rotates only around the Z-axis, no matter which axis you select to rotate around.

Limiting the Rotation

32. With the **Door_PVT** helper selected, click the **Motion** tab.

33. Open the **Assign Controller** rollout.

34. In the controller list, open the **Transform**, then **Rotation** controllers.

35. In the controller list, select the **Z Rotation: Bezier Controller**.

36. Click **Assign Controller**.
37. In the **Assign Float Controller** dialog, select **Float List** from the available controllers. If the dialog does not dismiss automatically, click **OK**.
38. Back in the **Assign Controller** rollout, Open the **Z Rotation: Float List** controller.
39. From the list, select the **Available** controller.
40. Click **Assign Controller** again.
41. This time, select **Float Limit**, and click **OK**.
42. In the **Float Limit Controller** dialog, set the **Upper Limit** to **95.0**, and the **Lower Limit** to **0.0**.
43. Close the **Float Limit Controller** dialog.
44. From the **Main** toolbar, choose **Select and Rotate**.
45. Rotate the point helper on any axis. When you're done, click **Undo** to get the point helper back to its original rotation.
46. Right-click and select **Unhide All** from the quad menu.
47. In the **Unhide All** dialog, click **Yes** to unhide all the layers.

Wiring Parameters for Connected Animation

Wiring the Gear Shafts

Open the file **Gear Wiring_01.max** for this exercise.

1. Select the **small gear**.
2. Hold the **Shift** key, and select the **large gear**.
3. Right-click and choose **Freeze Selected** from the Quad menu.
4. Select the **Shaft_Small_Gear** object.
5. Right-click and select **Wire Parameters** from the Quad menu.
6. From the parameters options popup, choose **Transform > Rotation > Y Rotation**. A rubber band line will appear.
7. With the rubber band line active, select the **Shaft_Large_Gear** object.
8. From the parameter options popup, choose **Transform > Rotation > Y Rotation**.

The Parameter Wiring Dialog

9. In the parameter wiring dialog, click the **Two-way connection** option.
10. Leave this **Shaft_Small_Gear** object as the master for this animation. However, since this is a two-way connection, animating either shaft will rotate both.
11. In the expression for the **Shaft_Large_Gear** object, enter "**-Y_Rotation/2**."
12. Click **Connect** to connect the two parameters, wiring them together.
13. Close the parameter wiring dialog.

14. From the main toolbar, click **Select and Rotate**.
15. Select the **Shaft_Small_Gear** object.
16. Rotate the object around the Y-axis.

Rigging an Excavator Bucket Scissor Joint

Open the file **Excavator_Rig_01.max** for this exercise.

Adding the Bones

1. From the **Command** panel, click the **Create** tab, then click the **Systems** option.
2. In the object type rollout, click **Bones**.
3. Click towards the top of the screen in the front viewport at the center of **Bucket Link A1** top joint to create the start of the bone chain.
4. The end of the first bone should be at the pivot point where the two bucket links meet. Click there to create the first bone and start the second.
5. To place the end of the second bone, click at the pivot point for **Bucket Link A2** towards the bottom of the screen.
6. Right-click to create the second bone and add the bone end, then press ESC to exit the bone creation tool.

Linking the Assembly

7. From the Main toolbar, click **Select and Link**.
8. In the front viewport, **select** **Bucket Link A1**, hold the left mouse button and drag over the first bone in the chain. You'll see a rubber band line appear with a link icon.
9. Release the mouse button, and the bone will flash once, indicating it is linked as the parent of the Bucket Link A1 object.
10. Now select Bucket Link A2, hold the left mouse button and drag over the second bone in the chain.
11. Release the mouse button and the bone will flash once, indicating it is linked as the parent.
12. **Select** the first bone in the chain. Holding the left mouse button, drag the cursor over the **Dmy_Arm-Bucket Link** helper object.
13. Click **Select Object** in the Main toolbar to get out of Select and Link mode.

Creating the IK Chain

14. In the front viewport, **select** the first bone in the chain.
15. From the Main menu, choose **Animation > IK Solvers > HI Solver**. A rubber band line will appear from the origin of the first bone.
16. Click the last bone in the chain, the very small end bone, to create the IK chain.
17. Make sure the IK chain end effector is selected.
18. Click **Select and Link** from the main toolbar.

19. Click and drag from the end effector to the **Dmy_Bucket-Arm Link** helper object. The helper object will flash once to let you know that it has been linked as the parent of the end effector.
20. Click **Select Object** in the Main toolbar to get out of Select and Link mode.

Rotate the Bucket

21. In the viewport, select the **Rotate_bucket** ring. This object is a circle with rendering enabled for the viewport only, and is used as a rotation helper object.
22. From the main toolbar, click **Select and Rotate**.
23. Rotate the circle.

Animating a Rigged and Wired Assembly

Open the file **Excavator_Animate_01.max** for this exercise.

Creating Keyframe Animation

1. Click **Auto Key** in the lower right of the interface, to activate the auto keyframe animation feature within 3ds Max.
2. From the **Main** toolbar, click **Select and Manipulate**.
3. Drag the **body rotate** slider to about **-1.0**.
4. Drag the **bucket Z** all the way to the right, raising the bucket to its highest point.
5. Drag the **bucket X** all the way to the right, pushing it as far out from the main body as is available.
6. Drag the **bucket rotate** all the way to the left, extending the rotation of the bucket.
7. Drag the **time slider** to frame **100**.
8. Drag the **body rotate** slider back to **0**, and then drag the other three manipulator sliders over one notch. This will cause a keyframe to be made at frame 100 for these values.
9. Drag the **time slider** to frame **150**.
10. Drag the **bucket Z** slider all the way to the left, and the **bucket rotate** slider to about **2.8**.
11. Drag the **time slider** to frame **200**.
12. Drag the **bucket rotate** slider to about **4.0**, the **bucket X** slider to about **210.0**, and the **bucket Z** slider to about **-18.7**.
13. Scrub the **timeline** from frame **0** to frame **200** and watch the animation.
14. Slide the **time slider** to frame **270**.
15. Adjust the **bucket Z** value to about **37.6**, the **bucket X** to about **200**, and the **bucket rotate** to **4.5**.
16. Slide the **time slider** to frame **340**.
17. Adjust the **bucket rotate** value to about **1.7**, the **bucket X** to **250**, and the **bucket rotate** to **2.5**.
18. One last keyframe. Slide the **time slider** to frame **200**.

19. Adjust the body rotate back to **0.0**. This sets up a keyframe at frame 200 for the rotation of the body, keeping it stationary between frame 100 and frame 200.
20. Turn off Auto Key.
21. In the animation controls, click **Go to Start**.
22. Click **Play** to play back the animation.

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