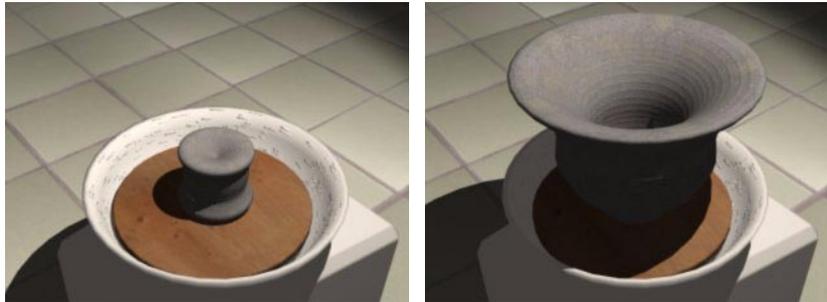




USING DISPLACEMENTS WITH WIRES

This tutorial will teach you how to dynamically drive the shape of wire solids using displacements on control wires.



ESTIMATED TIME REQUIRED

20 Minutes

LEARNING GOALS

In this tutorial you will learn how to:

- Create and save displacements on a control wire.
- Generate geometry primitives from wires.
- Animate wire displacements in order to dynamically drive the shape of a wire solid.

OVERVIEW

Mirai supports several types of polyhedra which are “spun” from wires. These include:

- Solids of Rotation
- Tubes
- Tube Solids
- Contour Solids

(You can read about all of these polyhedra types in Mirai’s online help.)

Polyhedra of this type, called *wire solids*, are formed by sweeping a wire, called a *control* or *contour wire*, around an axis. A useful property of all wire solids is that Mirai maintains a continuous link between the shape of the control wire and the topology of the solid itself. Therefore, when you move a point on the control wire, the topology of the corresponding wire solid changes accordingly. As you’ll learn in this tutorial, this link between control wires and wire solids lets you dynamically drive the topology of a wire solid by animating displacements on the control wire.

ANIMATING THE PRACTICE SCENE

- 1 In one of your configurations, open up the following windows:
 - The Animation Viewer
 - The Animation Timeline
 - The Animation Mixer
 - The Script Graph
- 2 [L] in the script selection field in the lower-left-hand corner of the Timeline.



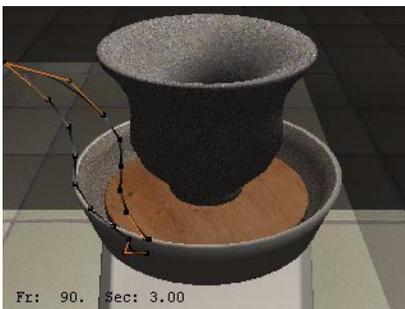
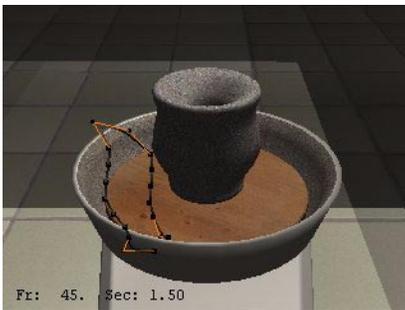
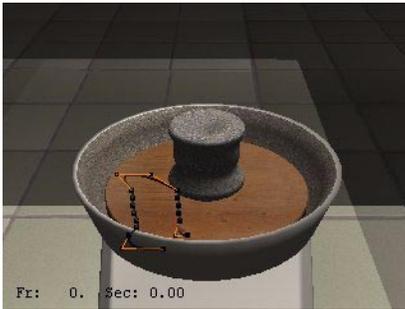
- 3 Select the “script” from the dialog box which appears. The script’s channels become visible in the Timeline.
- 4 In the Animation Viewer, use *Options>Render Domain* to display the scene in the *Mirai* domain.
- 5 Use *Options>Scene Lights* to illuminate the scene with the scene lights.

6 [L] on the Timeline's rewind button to display the script's first frame in the Animation Viewer.



7 Press "alt-s" to turn on shading for all of the visible objects.

8 [L] on the Timeline's animate button to view the animation. You'll see a pot form on a potter's wheel.

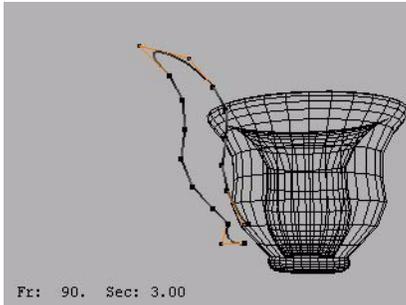


Notice that a wire is visible just to the left of the pot. This wire is the control wire and the pot is the wire solid. As the contour of the control wire changes, so does the topology of the pot. In fact, the wire is driving the topology of the pot throughout the animation.

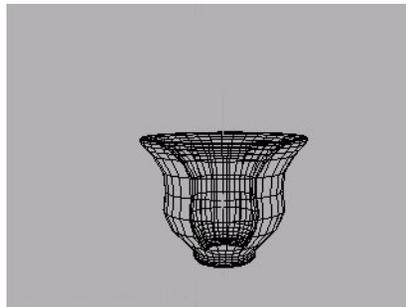
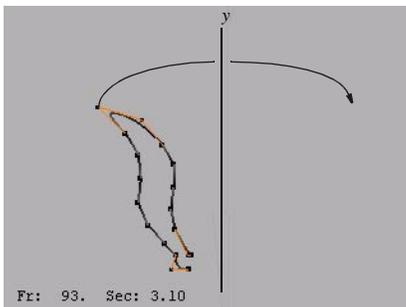
WIRE SOLIDS

The pot in this scene is formed from a *solid of rotation*, a type of wire solid. It's easy to see how solids of rotation are formed by looking closely at the practice scene:

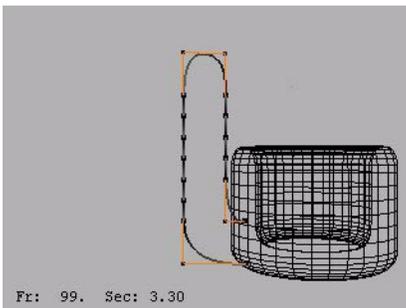
- 9 Ctrl [R] on the Animation Viewer, then [R] on the *Visibility* command.
- 10 In the dialog box that appears, toggle *off* visibility for all objects except the “contour-wire” and “pot.”
- 11 Press “alt-w” to display the objects in wireframe mode.
- 12 Aim the camera at the wire and press “z” to align the camera with the Z plane. You should now have view like this:



You can clearly see that the contour of the wire matches that of the solid of rotation. The solid was formed by sweeping the control wire around the vertical axis.



- 13 You can see the wire in its base state by clicking [R] on the body of the wire, clicking [M] on the *Displace* command, then clicking [L] on the “base” state on the pop-up menu. The wire assumes it’s base state, and the topology of the wire solid changes accordingly.

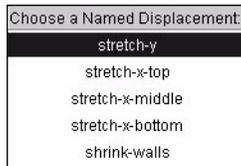


The animator saved the wire in this state, then saved all of the displacements discussed below relative to this state.

SAVING DISPLACEMENTS ON WIRES

Since Mirai maintains a link between control wire and wire solids, the easiest way to drive the topology of a wire solid is to displace points on its control wire. Just as you can with any body in Mirai, you can save a series of displacements on wires, then animate those displacements using the *Multiple Displace Shape* animation operation. This was the technique used in the practice scene.

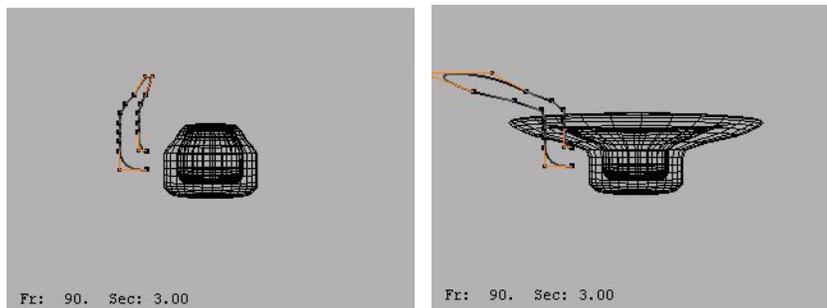
- 14 In the Animation Viewer, [R] on the body of the wire, then [L] on the *Displace* command. A menu of available displacements for the wire appears.



The animator created and saved the above series of linear displacements on the wire. Each was saved relative to the base state which you viewed above. For example, to create the “stretch-x-top” displacement, the animator set the wire to its base state, then used the *Axis Move* command *with the magnet option* to move the wire’s topmost points in the negative direction of the X axis. With the wire in this shape, the animator used the *Make State* command to save the new shape as a displacement.

You can try the “stretch-x-top” displacement for yourself:

- 15 [R] on the body of the wire, then [L] on the *Displace* command.
- 16 [L] on the “stretch-x-top” displacement. As you move your mouse back and forth, the displacement narrows or widens the top of the pot. The farther you move the displaced control wire points away from the Y axis, the wider the top of the pot grows.



ANIMATING DISPLACEMENTS ON WIRES

Once you’ve saved displacements on a control wire, it’s a simple matter to animate the displacements in order to dynamically drive the shape of the wire solid. You can see this in the practice scene.

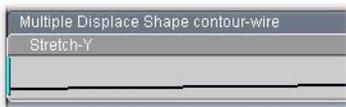
- 17 [L] on the Timeline’s rewind button to display the first frame of the animation in the Animation Viewer.

- 18** In Animation Timeline, click on the solid inverted triangle on the right of the “Multiple Displace Shape contour-wire” channel, so you can see its subchannels.

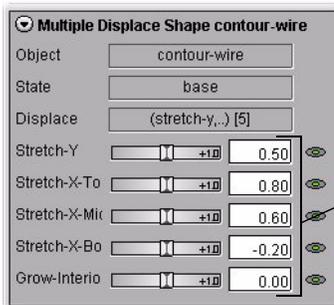


The channel includes subchannels for each of the displacements which were saved on the wire.

- 19** If you expand one of the subchannels, you can see the curve which controls the magnitude of the displacement throughout the animation. For example, you can see that magnitude of the “Stretch-Y” displacement grows with each frame of the animation.



You can control the magnitude of each displacement by editing the curve in the Timeline, or by adjusting the numeric values for any frame in the Animation Mixer (shown below).



numeric values for displacements at frame one

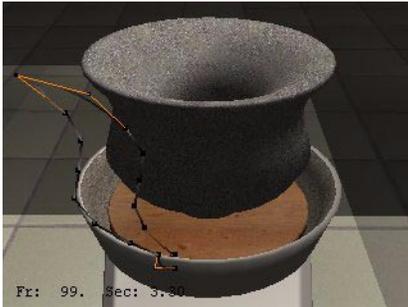
For example, suppose that you would like the pot to form with a fuller middle-section. Try this:

- 20** [L] on the last frame button on the Timeline to animate the script to the last frame.



- 21** Expand the “Multiple Displace Shape contour-wire” channel in the Animation mixer, so that you can view its subchannels.
- 22** Hold [L] on the slider for the “Stretch-X-Middle” channel and pull it slightly to the right to increase its value from 0.60 to approximately 1.00. Notice that as you adjust the value with the slider, the effect on the wire and wire solid is immediately visible in the Animation Viewer.

- 23** Press “alt-s” again to turn shading back on for the objects, then click the animate button to see the effect on the pot of the change in the magnitude of the displacement. You’ll see that it grows fuller in its middle section by the end of the animation.



By experimenting with different values for each wire displacement, the animator was able to achieve the effect of the a pot forming while spinning on a potter’s wheel. (The spinning motion itself is handled by two “Y Rotate” channels—one for the “pot” object and one for the “wheel” object.)

- 24** Try experimenting with entering different values for each displacement at various frames in the scene. For example, if you wanted to animate the throwing of a vase rather than a pot, you might enter a larger value for “Stretch-Y” and a smaller value for “Stretch-X-Top” at the last frame of the animation.

REVIEW

In working with the practice scene, you’ve learned the following:

- Mirai maintains a link between control wires and wire solids, so that you can drive the topology of a wire solid by altering the shape of its control wire.
- You can save displacements to wires, just as you can with any other body in Mirai.
- By animating displacements on control wires, you can achieve some very interesting effects on the topology of a wire solid.

As you’ve seen in this scene, displacing wires to drive the topology of a wire solid works well for animating the throwing of a pot. But you can imagine other uses for this technique as well. For example, you might animate the swaying of a rope using displacements on the control wire of a tube.