WIRE BASICS

This tutorial will teach you the basics of sketching wires and using them as contours for solid objects.

ESTIMATED TIME REQUIRED

30 Minutes

LEARNING GOALS

In this tutorial you will learn how to:

• Sketch wires that include straight segments, B-spline curves, and arcs.

• Replace straight segments in wires with curves, including Bezier curves.

• Use wires to form solid objects.

• Modify the shape of wire solids.

SCENE OVERVIEW

1 In one of your configurations, open up the following editors:

   • The Geometry editor

   • A Scene Graph

   • A Geometry Graph (You open this window by clicking Ctrl [R] on the Geometry editor, then clicking on *New Graph.*)

2 Use *File>Open Scene…* to open the practice scene entitled "wire-basics."

3 With the exception of "contour-wire-7," make all of the practice scene's 3D objects visible in the Geometry window.

**4** Adjust the camera as necessary to view all of the objects.
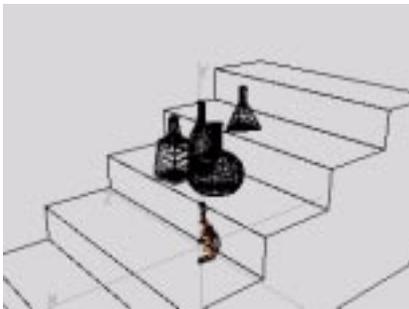
The bottles in the scene are *solids of rotation*, which were formed by "spinning" one of the wires around the Y axis. Each visible wire, called a *contour* or *control wire*, defines the contour of one of the bottles. In this tutorial, you'll first learn to sketch wires, then learn to spin them into solid shapes. In doing so, you'll add a couple of bottles to the practice scene.

SKETCHING WIRES

5 Aim the camera at one of the wires and truck in for a closer view.

6 Use the Geometry Graph to alternately make just one of the wires visible at a time, starting with "contour-wire-1."

As you view the wires, notice that they are composed of a mix of straight segments, B-spline curves, and arcs. For example:
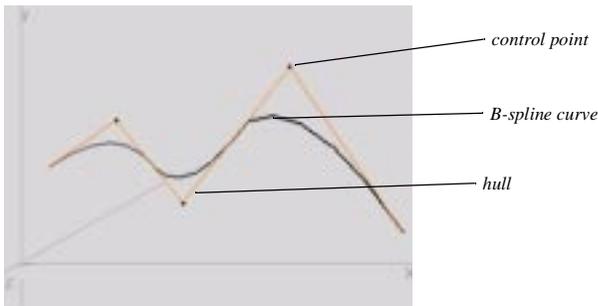

B-spline curve

arc

straight segment
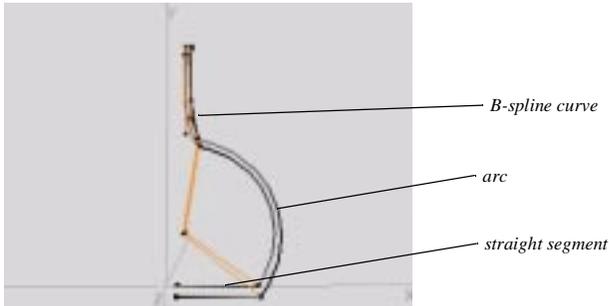
7 Use the Geometry Graph to make all of the wires invisible.

B-SPLINE CURVE SEGMENTS

First, you'll sketch a wire that is composed largely of B-spline curves. This wire will form the contour of a cola bottle.

B-spline curves are defined by control points. The control points, which make up the wire's *hull* (shown in orange below), bend the wire by exerting a magnetic-like influence over it.
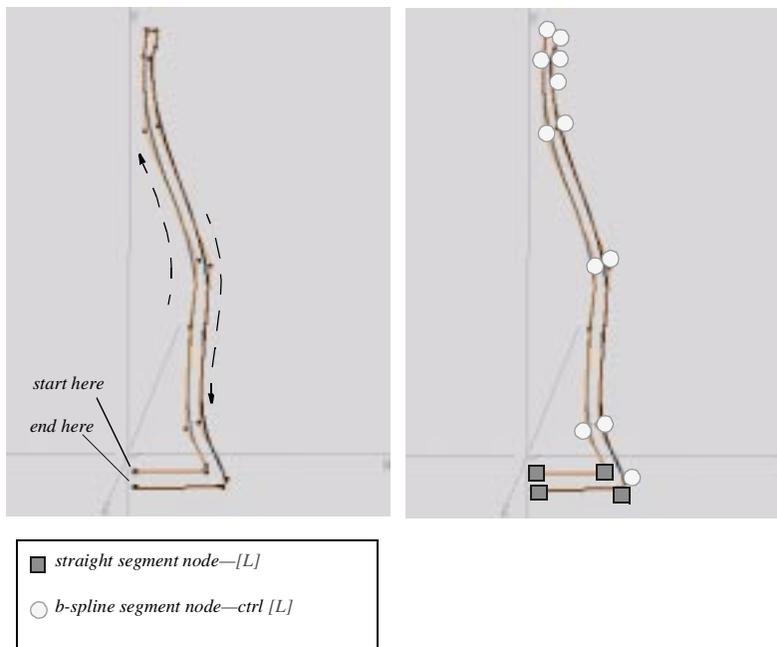

control point

B-spline curve

hull

NOTE: *Although you won't need to do so in this tutorial, you can use the* Set Weight *command to adjust the slope of a B-spline curve segment. This command scales the strength of the "pull" of a B-spline curve's control points.*

To sketch the wire:

8 Press F5 to add a new object. When the New Element dialog box appears, select *Wire* as the type of object you wish to add.

9 Make sure that *Type* is set to *Wire*, *Mode* is set to *2D*, and *Setup Menu* is unchecked. (These properties are described in the Mirai's online help.)

10 Click *Ok* to begin sketching. The Geometry window goes into 2D sketch mode, automatically aligning the camera with the Z plane and displaying a reference grid. (Sketching wires in 3D is covered in a separate tutorial.)

11 Begin drawing your contour wire using the figure below as a reference. The image on the left shows you where to start and end and in which direction to sketch. The image on the right shows which mouse click to use for each node.

start here
end here

■ *straight segment node—[L]*

○ *b-spline segment node—ctrl [L]*

As you sketch the wire, use the following mouse clicks:

- [L] to add a node for a straight segment.

- Ctrl [L] to add a control point for a B-spline curve.

- Shift [L] to undo your last node.

12 Start by sketching a straight segment to form interior portion of the base of the bottle. Add the first node by clicking [L] a short distance to the right of the Y axis.

13 Move your mouse a little further to the right, then [L] to finish off the straight segment of the interior portion of the base of the bottle.

14 Ctrl [L] to add a series of b-spline control points to form the inside curves of the bottle's body and neck. The more control points you add, the smoother each curve will be. Remember that you can use Shift [L] to undo your last node.

15 When you reach the top of the bottle, Ctrl [L] a couple of times to form a tight curve for the lip of the bottle, then begin sketching the outside contour of the bottle.

Having both an inside and outside contour will give the finished bottle both interior and exterior faces. If you don't need the detail of the inside of the bottle, you can sketch just the contour for the outside of the bottle.

16 Use the same series of clicks in reverse to sketch the bottle's outside contour.

**17** [R] to add the wire to the scene. The following dialog box appears:

18 Name the wire "contour-wire-5," then click the *Add Wire* button.

19 Use the Geometry Graph to make "contour-wire-5" invisible.

ARC SEGMENTS

Next, you'll sketch a wire that includes a couple of arcs. This wire will form the contour of a perfume bottle.

Arcs are curves which are defined by some portion of the circumference of a circle. When you add an arc, Mirai prompts you to select a center for the circle, then lets you select that portion of the circle's circumference which you wish to keep as the arc.

endpoint of the arc; defines the portion of the circle to keep

center of circle
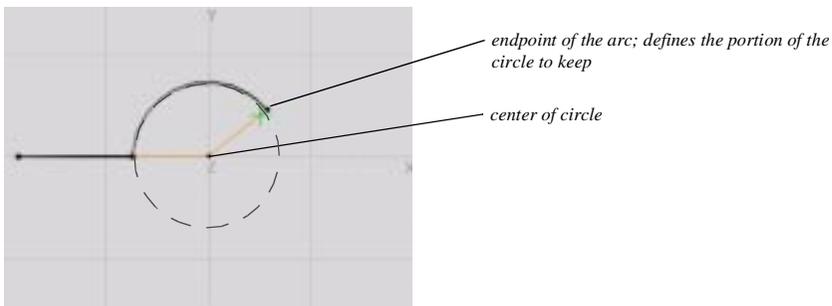
To sketch the second wire:

20 Just as you did above, use the New Element dialog box to create another wire. Click *Ok* to begin sketching.

21 Begin drawing this contour wire using the figure below as a reference. The image on the left shows you where to start and end and in which direction to sketch. The image on the right shows which mouse click to use for each node.
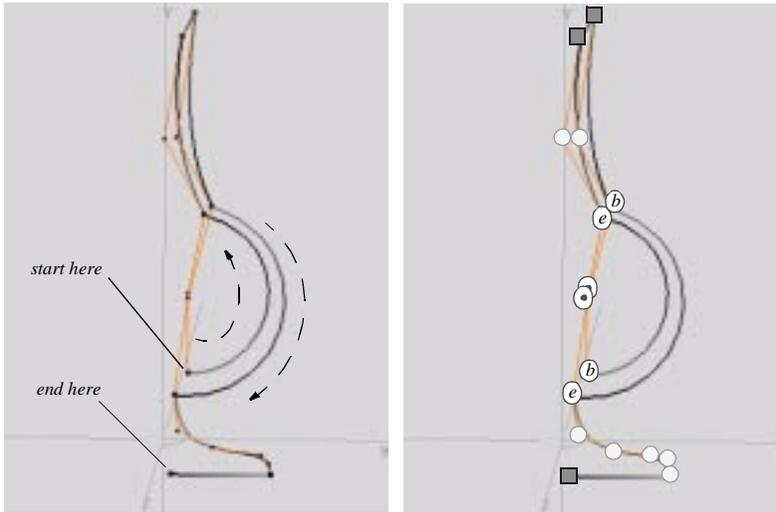
- ◼ *straight segment node—[L]*
- ◯ *b-spline segment node—ctrl [L]*
- ⓑ *arc starting point—[L] + alt [L]*
- ⊙ *arc center—[L]*
- ⓔ *arc end point—[L]*

As you sketch the wire, you'll use the same mouse clicks you used on the first wire with the addition of the clicks used to form an arc. Use the following sequence of clicks to form each arc:

- [L] encode the starting point of the arc, then alt [L] to size the circle on which the arc will be based.

- [L] encode the center point of the arc.

- [L] encode the end point of the arc.

22 Start by sketching the arc which forms interior of the bottles body. [L] to start the arc, then alt [L] to size its circle.

23 [L] to encode the arc's center just to the right of the Y axis, then [L] to end the arc at the beginning of the bottles neck.

24 Ctrl [L] to add a couple of b-spline control points to form the inside curve of the bottle's neck.

25 [L] to add a couple of straight nodes for the lip of the bottle.

26 Sketch the outside contour of the neck by paralleling the inside contour.

27 To form the outside contour of the bottle's body, make another arc just slightly larger in diameter than the inside arc.

28 Add a series of B-spline control points to form the bottle's base.

29 Make the bottommost segment of the outside contour a straight segment.

30 [R] to add the wire to the scene.

31 Name the wire "contour-wire-6" and click the *Add Wire* button.

32 Use the Geometry Graph to make the wire invisible.

REPLACING STRAIGHT SEGMENTS WITH CURVES

Mirai also lets you replace the straight segments of a wire with curves. This is a useful feature for getting a wire into a desired shape. Not only can you insert B-spline curves and arcs into wires, but also *Bezier curves*. Bezier curves are cubic curves that pass between two endpoints and are influenced by two interior control points.

Try inserting some curves into a practice wire:

33 Make "contour-wire-7" visible in the Geometry editor. Notice that this wire is solely composed of straight segments.

34 Aim the camera at this wire and use the "z" hot key to align the camera with the Z plane.

35 Select the topmost vertical segments of the wire, [R] on the collection, then [L] on *Replace with Bezier*.

select these segments
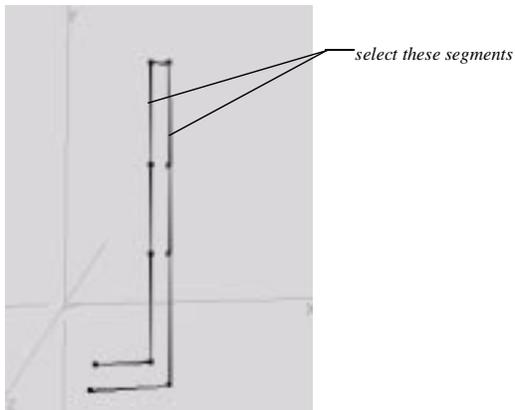
Mirai converts the two segments to Bezier curves, inserting two interior control points on each segment.
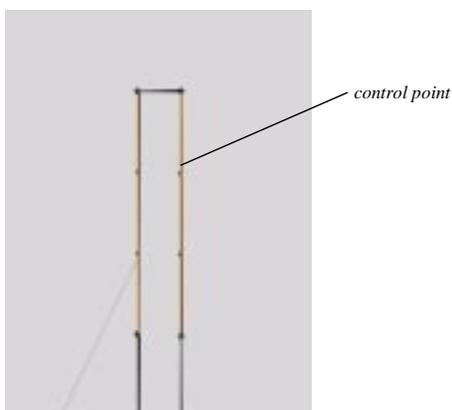
control point

You can define the slope of the Bezier curves by moving their control points:

36 Select the topmost control point on each segment and move them along the X axis. You'll see the curves emerge, each drawn by the "pull" of its control point.

37 Try using the *Replace with Arc* and *Replace with B-spline* commands on some of the other straight segments on the wire until you have another nice contour for a bottle. You'll see that it's possible to achieve virtually any contour shape you desire using a combination of these commands.

38 Use the Geometry Graph to make "contour-wire-7" invisible.

CREATING SOLIDS FROM WIRES

You can use wires to define the contours and cross-sections of polyhedra. Mirai supports several types of polyhedra which are "spun" from wires. These include:
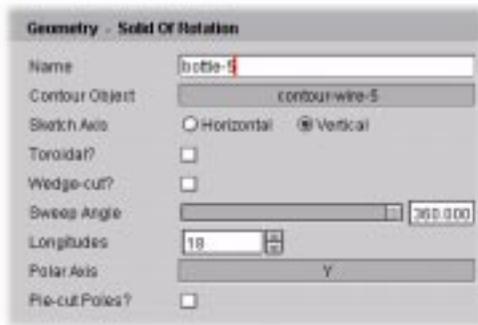
- Solids of Rotation

- Tubes

- Tube Solids

- Contour Solids

You can read about all of these polyhedra in Mirai's online help. For this tutorial, you'll focus on solids of rotation. A solid of rotation is an object created by sweeping a wire contour of the desired object around either the vertical or horizontal axis.

Follow the steps below to create two solids of rotation from the wires you sketched above:

39 Press F5 to add a new object. When the New Element dialog box appears, select *Solid of Rotation* as the type of object you wish to add.

40 Set the properties as shown in the figure below. (These are all described in Mirai's online help.)

> • Make sure to select "contour-wire-5" as the wire which will define the contour of the solid.

41 Click *Ok* to add the solid.

**42** By the same process, create another solid of rotation using "contour-wire-6" to define the contour.

43 Name the wire solid "bottle-6."

44 If you wish, create another solid of rotation out of the "contour-wire-7" wire, which you reshaped using the *Replace with Bezier*, *Replace with B-spline*, and *Replace with Arc* commands above.

45 Look over the new solids of rotation. For each, you should see results like this:
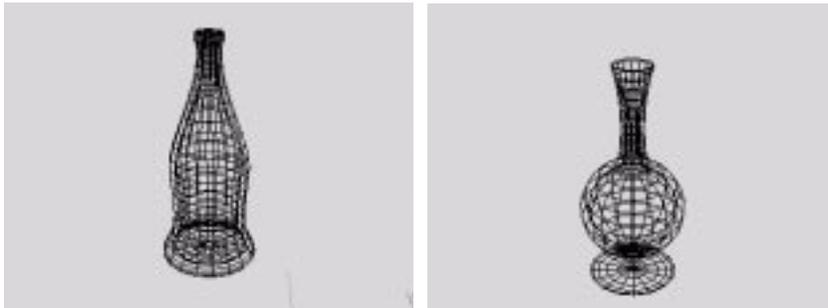

You created these solids simply by using the default properties for solids of rotation. However, realize that the solid of rotation properties give you a tremendous amount of flexibility in defining the shape of an object. For example, the triangular ("bottle-1") and square ("bottle-2") bottles in the practice scene were created by varying the value of the *Longitudes* property.
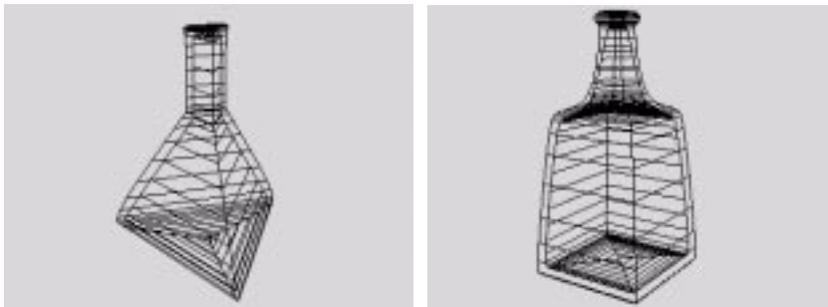
RESHAPING WIRE SOLIDS

Mirai maintains a link between the shape of the control wire and the topology of the wire solid. This lets you move nodes on a contour wire to modify the shape of the corresponding wire solid. You may wish to modify a bottle's shape in this manner if it doesn't look quite like you intended. For example, suppose you wanted to stretch your cola bottle along the Y axis, then make the main curve of its body a bit fuller. You would do the following:

46 Make "control-wire-5" visible and use the "z" hot key to align the camera with the Z plane.

47 Use the 3D lasso to select the nodes on the wire that form the bottle's lip:

- [R] on the points element sensitivity icon.

- Ctrl+Alt [L] on the Geometry editor, then drag [L] to draw the lasso around the points.
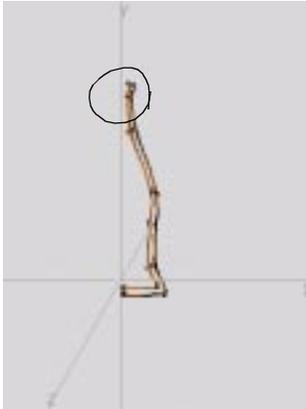
48 [R] on the point collection, then Alt [M] on *Axis Move*. (Pressing "Alt" invokes a magnet operation.) When prompted, [L] on *Y* as the axis, and select a point towards the middle-section of the contour to define the operation's falloff.

49 Move your mouse to the right to move the points upward along the Y axis. Notice that the magnet operation nicely preserves the wire's existing curves.
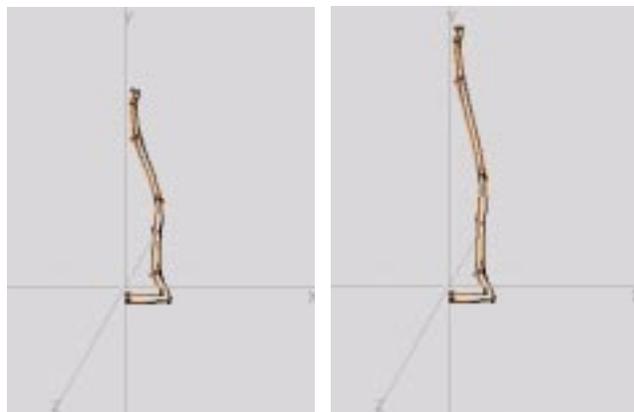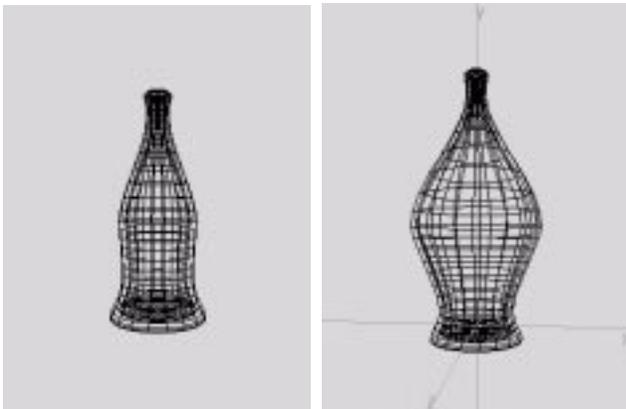
50 Use the 3D lasso to select the points which define the main curve of the cola bottle's body.

51 Use the *Axis Move* command with the magnet option to move the point collection away from the Y axis along the X axis.
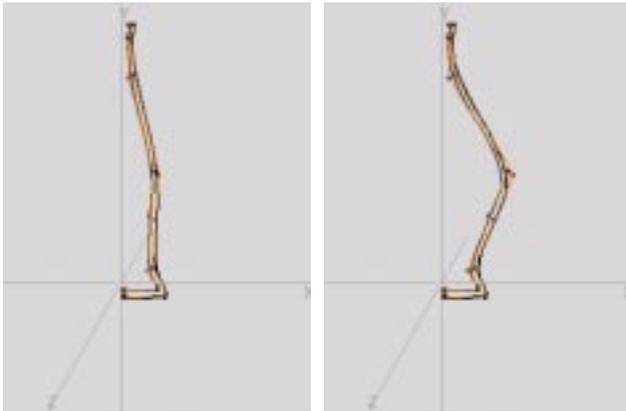

52 Make the "bottle-5" solid visible.

You can see in this example that the modifications to the contour wire have been propagated to the solid.

Try a few such modifications on the contour wires that you created above until you're happy with the overall shape of the corresponding solids.

RENDERING THE SCENE

You now understand the fundamentals of sketching wires and turning them into solids. With just a few modifications, you're ready to render the scene.

53 Use the Geometry Graph to make the "stairs" object visible.

54 Use the *Move* command to place "bottle-5" and "bottle-6" on the stairs.

55 Use the *Scale* command to scale the body of each bottle so that it is proportional with the rest of the scene.
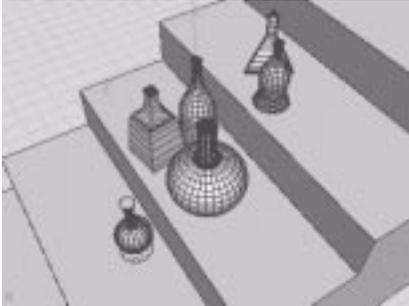
56 Apply a material to "bottle-4" and "bottle-5" Neither the "light-green-glass" nor "yellow-glass" materials are yet in use.

57 Assign the "light-group" light group to "bottle-4" and "bottle-5."

58 Position the camera for a nice view of the scene and use the *Render* command to see the results: