Tutorial 6: A Spoon Holder

Overview

In this tutorial, we use the SurfaceWorks-SolidWorks combination to create a spoon holder — one you might keep on your stove while cooking (see figure at right). The key here is change: the model is constructed so that everything can be adjusted until the optimal design is achieved.

Entity introductions:

- None

Concept and Function introductions:

- For nicely rounded ends, make last 2 control points perpendicular to end
- Select>Current Layer Filter
- Use a single curve in various forms as the lofting curves for lofted surfaces to guarantee that the curves all have the same parametric velocity resulting in a smoother surface shape

The basic steps:

- We begin with a .SLDPRT model composed of the planes and a sketch that will generate the spoon holder surface.
- In SurfaceWorks, we construct the supports for three surfaces, building in relationships that allow great freedom in refining the shape of the spoon holder. We then stitch the three surfaces together so they will be transferred into SolidWorks as a solid.
- In SolidWorks, we cut a shape to the side profile, cut a flat bottom, then shell the imported solid.
- Returning to SurfaceWorks, we make the final design refinements.

Adding SurfaceWorks Parents

1 **Start SolidWorks** and **Open SpoonHolderStart.sldprt** from \Integrated Tutorials.

2 Save this file as SpoonHolder.sldprt

'Sketch1', 'Plane4', 'Plane5' and 'Plane6' have already been added as SurfaceWorks parents.

3 In the FeatureManager, click on each of them and note what they look like in the model — Sketch1 is a line that lies in Plane6; Plane6 is at an angle from the horizontal; Plane4 and Plane5 are perpendicular to Plane6.

4 **Choose SurfaceWorks>Modeler**.

Check program settings

Let's check those program settings and make sure we're all starting with the same ones (the initial program defaults). This is what you should have:

On the **View menu**:

Status Bar should be **ON** (preceded by a checkmark; to turn an option on, simply click on the menu item or if it has a box next to it click on the box).

All **Toolbars** should be **ON**. To check this, click on **Toolbars**. The resulting list should have all of its boxes checked.

On the **Tools>Options, General**, tab:

Rotation Constraint should be set to **Free tumble**

On the **Tools>Options, Dragging** tab:

All the **snaps** should be **ON**

Prompt after drag should be **OFF** (no checkmark)

On the **Tools>Options, Performance** tab, under **Display Controls**:

Set **Degrees per keystroke** to **10**

On the **Tools>Options, Entity** tab, under **Quick Spline Defaults**:

Click the **B-spline** radio button

Set **Degree** to **3**

Click the **Alternate spline creation** check box.

Make the Initial Control Curve

What you see here in SurfaceWorks are the SolidWorks planes and the endpoints of the line — since we won't be needing it, we've already hidden the line.

1 Switch to the **Right view** and or <**F**> to **Zoom to Fit**.

2 (or <**G**> or **View>Grid**) to toggle the grid on.

3 Turn on **Point Nametags**.

We are going to insert a B-spline Curve using Quick Spline Mode.

4 to turn on **Quick Spline Mode.** Use the Grid and Status Bar to drop points at the following approximate locations:

Over 'xpt2' (watch for the cursor to change to)
Directly **under** '**xpt2**' at about **Y** = **-1.9** (negative)
Z = **-7.5**, **Y = -2.5** (negative)
Z = **-5.0**, **Y = -3.0** (negative)
Z = **-2.5**, **Y = -2.7** (negative)
Z = **0**, **Y = -.9** (negative)
Double click over '**xpt1**' to end the B-spline
Return to **Select Mode**

Your result should resemble Fig. 2.

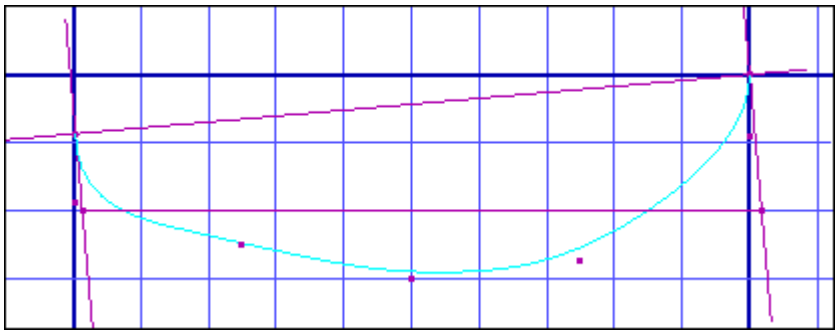

Fig. 2

Shape the Curve

1 and (**Top view** and **Zoom to Fit**).

2 or <**F7**> to **turn on Orthogonal Dragging**.

3 or **Select>Current Layer Filter** to **turn on the Current Layer Filter**. The number of the current layer is displayed at the left end of the right side of the Status Bar, in this case L:1. Selecting now is restricted to entities on Layer 1 — in the Available Entities pane, only the five points and B-spline curve are listed (as well as the default entities). SolidWorks entities come into SurfaceWorks on layer 0, and new SurfaceWorks entities are placed on layer 1.

4 Starting at the top, **drag** point '**pt5**' to the **right** about **1.5 units**.

5 Continue dragging points to the right, fashioning an hourglass-like profile:

'**pt4**' approximately **4.5** units
'**pt3**' approximately **0.25** unit
'**pt2**' approximately **2.5** units
'**pt1**' approximately **1.0** unit

6 **Rotate**  so you can see that what you've made is a 3D curve (the grid will disappear). [This should match distribution model SPOONHOLDER1.sldprt].

Add a Tangency Constraint

We want the 3D B-spline Curve to end normal to the plane in which its endpoints lie ('xpl7'). To do this, we'll use the other two planes we brought in from SolidWorks — they were created normal to 'xpl7'. We'll project the next-to-end points at each end of the B-spline onto the plane next to it, then replace them with the Projected Points as the next-to-end control points for the B-spline. The B-spline will then end tangent to the line between its end and next-to-end points. This will make it parallel to 'xplane2' which is normal to 'xpl7'.

1 Remove the **Current Layer Only** filter and turn off the **Grid** (which will not show if you have rotated).

2 **Select** '**pt1**' and '**xpt2**',  and  .

3 **Double-click** 'curve1' and on the **Display** tab, turn on the curve's **Polyline**. Notice that the polyline is not perpendicular to 'xpl7' (Fig. 3 Left).

4 **Select** '**pt1**' again and **make a**  **>Projected Point** or **Insert>Point>Projected Point**.
Name = '**pt6**'
Point = '**pt1**' (pre-selected)
Mirror = '**xplane2**'
OK

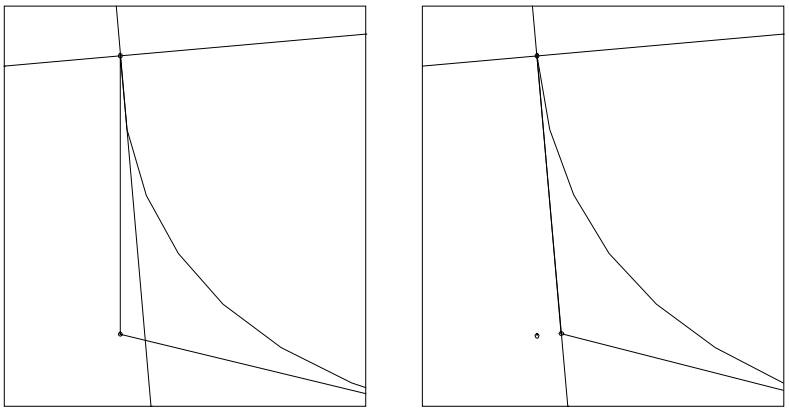

Fig. 3

5 With the new Projected Point ('pt6') in the Selection Set, **Ctrl+click to add 'pt1.'**

6 **<Shift+A>** or **Tools>Adopt Children, and click the Reverse Order box; OK.** The Projected Point, having adopted all the children of 'pt1', is now the second control point of 'curve1' and the curve ends normal to 'xpl7' (Fig.3 Right).

Did you notice that part of the polyline disappeared? Since the polyline runs from point to point, it is now lined up with 'xplane2' and is no longer visible.

7 **Zoom to Fit**, then repeat the projection process at the other end of the model, **projecting** '**pt5**' onto '**xplane1**': **Select 'pt5', Zoom to Selection** (if you want to see the action up close)**, F4** to make another **Projected Point** with **Name** = '**pt7**' and **Mirror = 'xplane1'**.

8 With '**pt7**' in the Selection Set, **Ctrl+click to add 'pt5'**, **Tools>Adopt Children, Reverse Order, OK**. Projected Point 'pt7' is now the next-to-last control point of 'curve1', and the curve ends normal to 'xpl7'.

9 **Turn off the polyline** for the curve and **hide** '**xplane1**' and '**xplane2**'

Make Two Other Control Curves

As you may have guessed, we're setting ourselves up to make a B-spline Lofted Surface that ends tangent to each of the two end planes. To do this we will use three control curves. We'll make these curves by projecting the B-spline Curve we just created.

Side Trip: When we loft, it is best to use a single curve in various forms as the lofting curves. This will guarantee that the curves all have the same parametric velocity resulting in a smoother surface shape. We will use this method again when we demonstrate the Blend Surface.

Let's be sure we're all looking at the same view again:

1 Return to the **Right view** , press the **right arrow key 7 times** and the **down arrow key 3 times** and then **Zoom to Fit.**

2 **Select the curve** ('curve1').

3 **>Projected Curve** or **Insert>Curve>Projected Curve**
Name = '**curve2**' (default)
Curve = '**curve1**' (pre-selected)
Mirror = ***X=0** (choose it from the Available Entities pane)
Display>Color = **bright red**
OK

4 **Turn off Point Nametags,** , and **turn on Curve Nametags,** .

5 **Select 'curve1' again** (the B-spline Curve) and use <**F4**> to make another **Projected Curve**:
Name = '**curve3**' (default)
Curve = '**curve1**' (pre-selected)
Mirror = '**xpl7**'
Color = **blue**
OK

6 Go to the **Front view** and **confirm** that 'curve2' (red) lies in X=0 plane.

7 Go to the **Right View**, and **confirm** that 'curve3' (blue) lies in 'xpl7'.

8 Press the **right arrow key 7 times** and the **down arrow key 3 times** and then **Zoom to Fit** (Fig. 4). [This should match distribution model SPOONHOLDER2.sldprt].

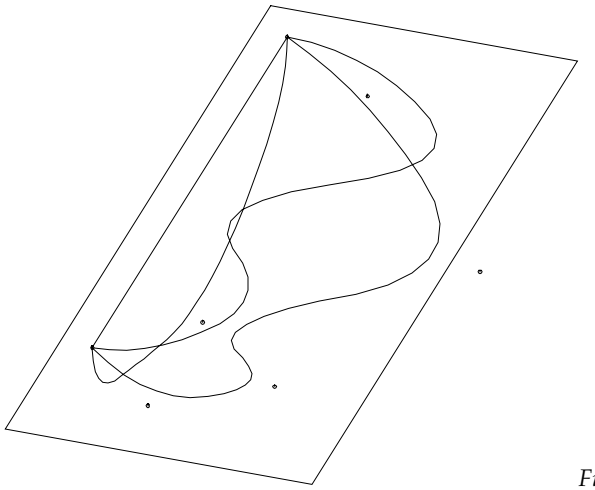

Fig. 4

Make the Surface

Now we'll make the surface, using the three control curves we've created.

1 **Select** '**curve3**' if it is not still in the Selection Set and **Ctrl+click** '**curve1**' and then '**curve2**' in that order to add them to the Selection Set.

2 Make a  **>B-spline Lofted Surface** or **Insert>Surface>B-spline Lofted Surface**
Name = '**surface1**' (default)
Degree = **2**
Control curves = (pre-selected)
OK (Fig. 5).

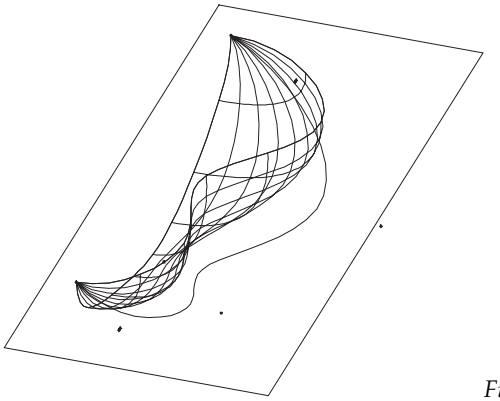

Fig. 5

Recall our discussions about tangency and B-splines. By projecting 'curve1' (the next-to-end control curve) onto the X=0 plane, thus making 'curve2' (an end control curve), we've made the surface's degree-2 B-splines lofting curves, and thus the surface itself, end normal to the X=0 plane. Similarly, we've made the surface end normal to the imported plane. We could mirror the surface all the way around and make a nice peanut...maybe another time.

4 **Rotate** (keep the mouse button down the entire time, so that you only release it once) and notice the surface-plane relationships, then return to the Previous view ( or **F8**).

5 With 'surface1' still in the Selection Set, make a  **>Mirrored Surface** or **Insert>Surface>Mirrored Surface**
Name = '**surface2**' (default)
Surface = '**surface1**' (pre-selected)
Mirror = '***X=0**'
OK (Fig. 6).

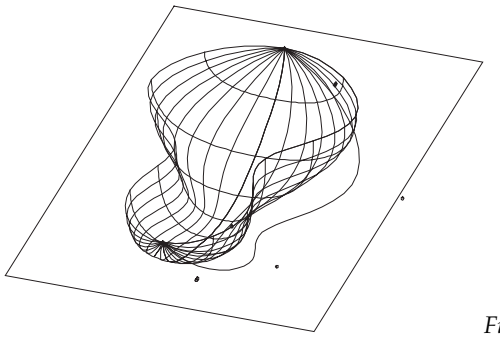

Fig. 6

So far, so good. In order to take this back to SolidWorks as a solid, we need to enclose the volume, then stitch the surfaces together. We can enclose the volume by adding another B-spline Lofted Surface, between 'curve3' and the upper edge of the Mirrored Surface. We'll need an Edge Snake on that edge in order to do this.

6 With 'surface2' still in the Selection Set, make a  **>Edge Snake** or **Insert>Snake>Edge Snake**
Name = '**snake1**' (default)
Surface edge = '**v=0**'
Surface = '**surface2**' (pre-selected)
OK

7 **Ctrl+click** the blue Projected Curve on the opposite side of the shell ('**curve3**'; projected onto 'xpl7'), and make a  **>B-spline Lofted Surface** or **Insert>Surface>B-spline Lofted Surface**
Name = '**surface3**' (default)
Degree = **2**
Control curves = (pre-selected)
OK

Now, we'll specify the stitching:

8 In the **Tools>Entity Transfer,**  , dialog box, in the **Stitch** buttons, click **Set All** to stitch all three surfaces; **OK**.

9 Return to SolidWorks, saving your changes (Fig. 7). The three stitched SurfaceWorks surfaces transfer into SolidWorks as an imported solid. This is the base solid for the model. [This should match distribution model SPOONHOLDER3.sldprt].

Fig. 7

Cut the Side Profile and Make a Flat Bottom

We have included a sketch (TopCut) that you can use to cut a nice shape for the upper side profile.

1 Go to the **Right** view

2 **Select** '**TopCut'**, and or **Insert>Cut>Extrude. OK** to accept the defaults (**Through All**).

As the model now stands, it wouldn't stand up — it would roll over. Let's give it a flat bottom. Still in Right View:

3 **Select** '**BottomCut**', or **Insert>Cut>Extrude** again. **OK** to accept the defaults (**Through All**) (Fig. 8).

Fig. 8

Refinements

1 **Rotate** the model until you can see the bottom, then **select the bottom face.**

2 or **Insert>Features>Fillet/Round**. Specify a **radius** of **.3** inch.

Shelling the Model

Let's shell the solid:

1 Rotate the part a little, so you can see the upper face, then select the upper face.

2 or **Insert>Features>Shell** it to a thickness of **.1** inch.

3 Rotate and admire the budding holder.

Final Refinements

1 Return to the **Right** view so you can see the flat bottom profile, and notice that the flat-bottom end of the part is at the left and the raised end is at the right (in this view).

2 **Press the down arrow key 4 times**.

Any cook will tell you that a spoon in a spoon holder should have its bowl downward and handle upward (so you don't get gooey fingers). As you can see by the location of the flat bottom (at left, in this view) of our spoon holder in relationship to its bulges, we have it rather backwards — the spoon holder should be wider at the bottom and narrower at the top.

3 Go back to SurfaceWorks and go to  (**Top** view).

4 **Hide** the plane ('**xpl7**'), then **Zoom to Fit**.

5 Turn on **Point Nametags** and the **Grid** and **Orthogonal Dragging**.

6 Drag the control points so that, in this view, the bottom of the hourglass-shape is wider and the top is narrower (e.g. you could leave the control points at the following values:

'**pt4**' approximately **2.5** units
'**pt2**' approximately **4.5** units

7 If you'd like, you also can edit the bottom profile curve in Right view.

8 Return to SolidWorks, saving the changes, to see the final spoon holder.

9 Rotate and admire one last time (Fig. 9).

Fig. 9

10 When you've finished examining the results, close the model; don't save changes.