Digitizing with Rhino: Ball tip probe compensation

Digitizing with ball tips requires some additional modeling compared to using point probes. This is because the digitizing arm is constantly telling Rhino where the center of the ball is, not what part of the ball is touching the part. This means that you must compensate for the radius of the ball when modeling.

Because most of the objects digitized with Rhino are complex shapes, it is not possible for Rhino to do automatic ball tip compensation (this is sometimes done in other software when digitizing planes, spheres, and cylinders).

Instead, you model the entire part as you digitized it, and then compensate for the ball tip radius later.

The following is a discussion of digitizing a simple surface with compound curvature, and how to compensate for the ball tip.

About the ball tip

Ball tip probes are made with small spheres at the end of the probe. They often look something like the following image:

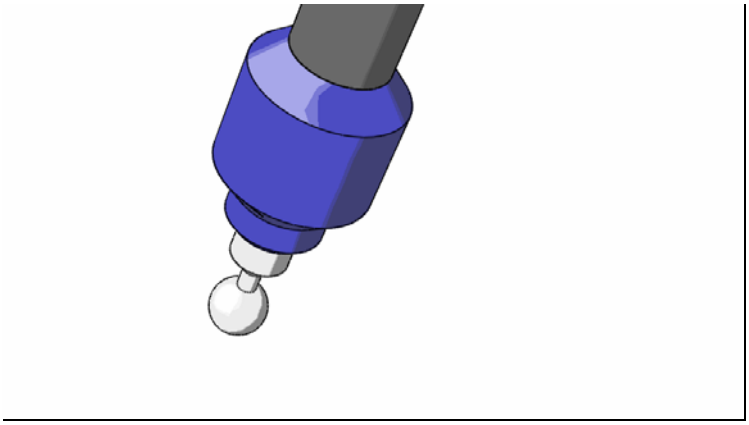


Figure 1: Ball tip probe.

When you digitize with a ball tip probe, the digitizer actually records the position of the center of the sphere. This leads to some ambiguity about the “real point” you digitized. For example, in the following image, the ball probe touches the inside corner of an object at points A and B. But the point recorded by the digitizer is the center of the sphere.

This means that all the data that you capture with the digitizer is off by the radius of the ball.

Figure 2 shows a ball digitizing an inside corner. The ball is touching the part in two places – both A and B, but the digitizer still reports one point, the center of the ball.

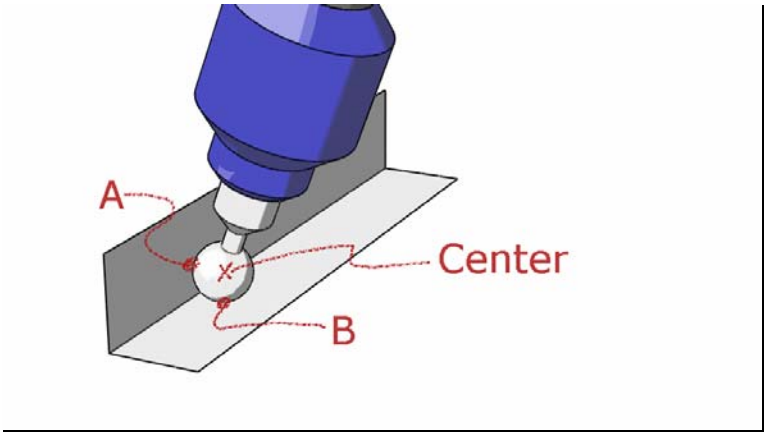


Figure 2: Ambiguous position of ball tip probe.

Ball tip probe compensation

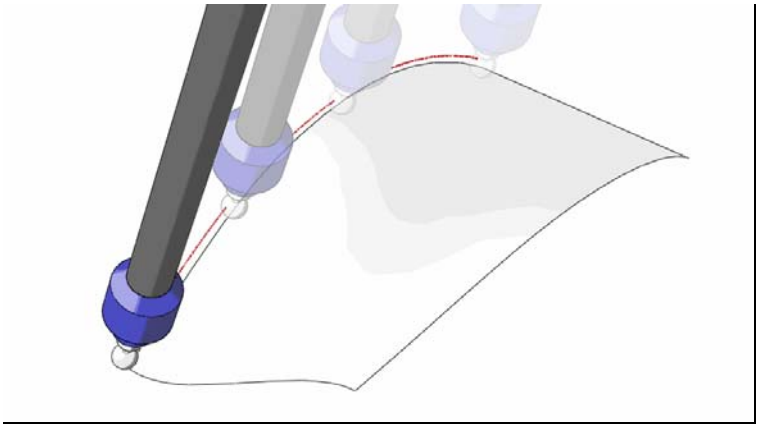
For arbitrary, free-form surfaces (the type Rhino is specially suited for modeling), ball tip probe compensation cannot be done automatically. This is because each point on the free-form surface needs to be offset in the direction of the normal of the surface. Instead, you must manually compensate for the ball tip.

First model the surface using the curves digitized at the center of the ball tip probe, then offset the surface by the radius of the ball tip. The following sequence of images shows this process. The red curve in each image is the curve that is actually digitized – notice how it passes through the center of the ball tip.

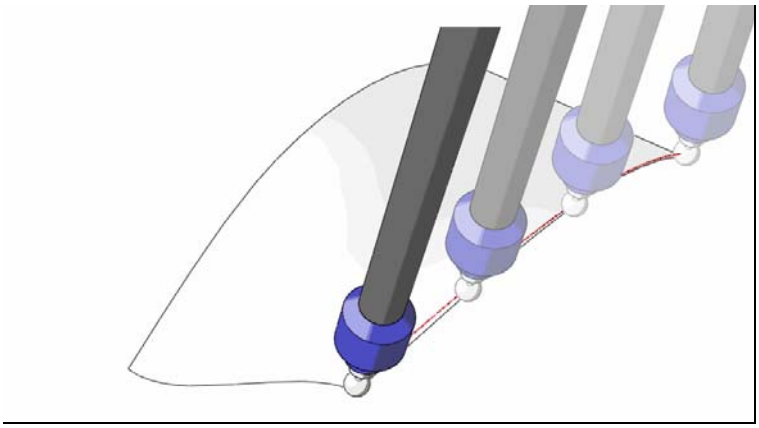
Digitizing a surface

1. From the **Curve** menu, click **Freeform**, then click **Interpolate Points**.
2. Follow the prompts and digitize several points along the curve – enough to capture the shape, but not so many that you introduce wobbles and noise in the curve.

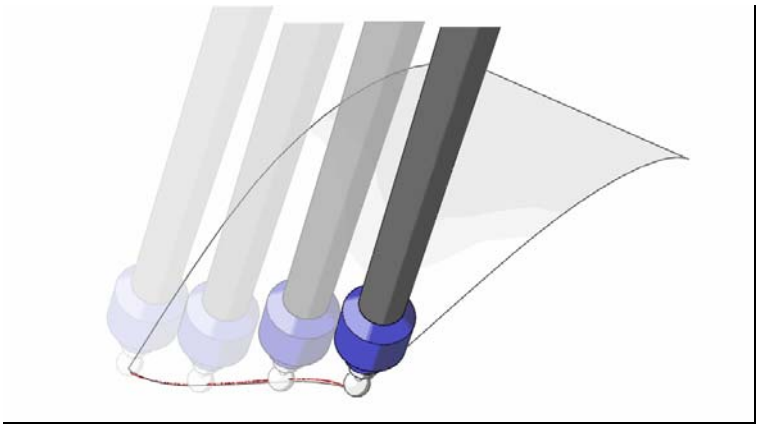
At this point, it is usually better to digitize as few points as possible to accurately capture the shape of the surface.



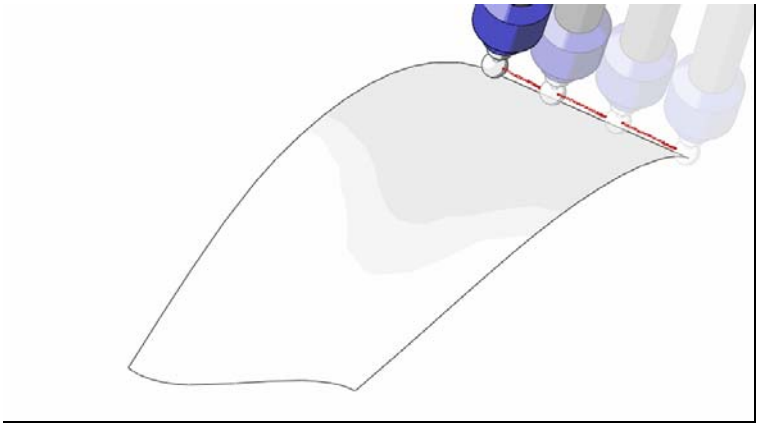
3 Digitize the bottom edge of the surface.



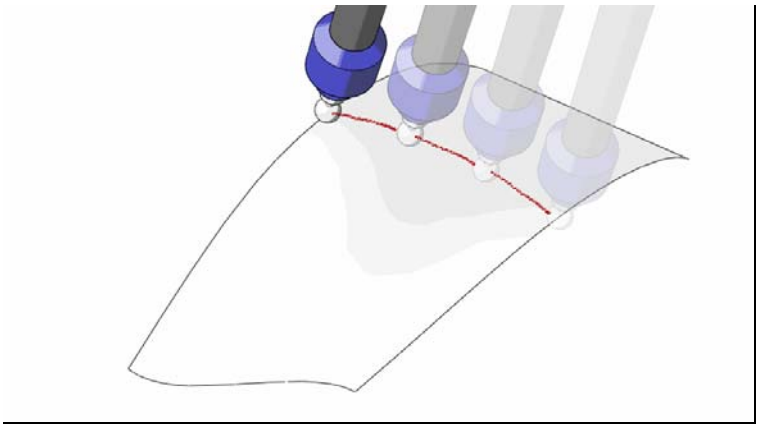
4 Digitize the left edge of the surface.

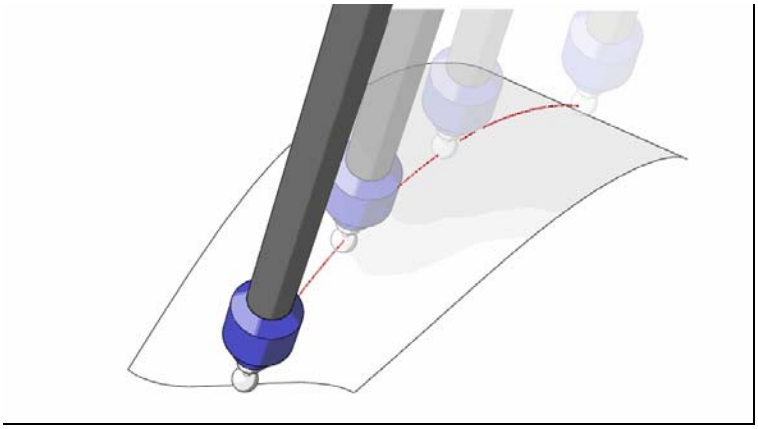


5 Digitize the right edge of the surface.

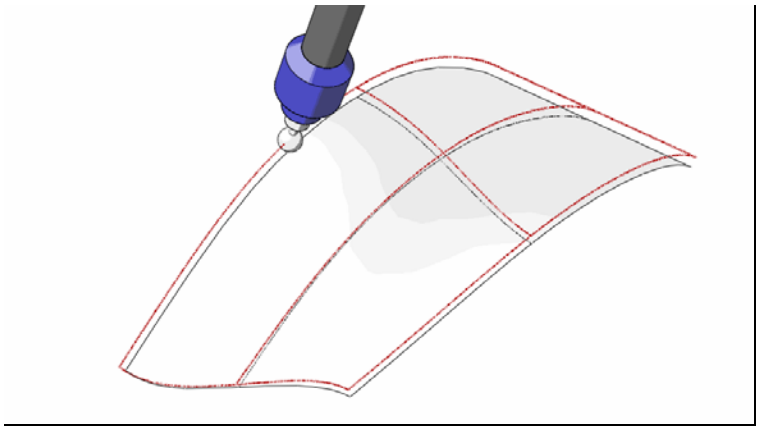


6 Digitize the center of the surface in both directions.

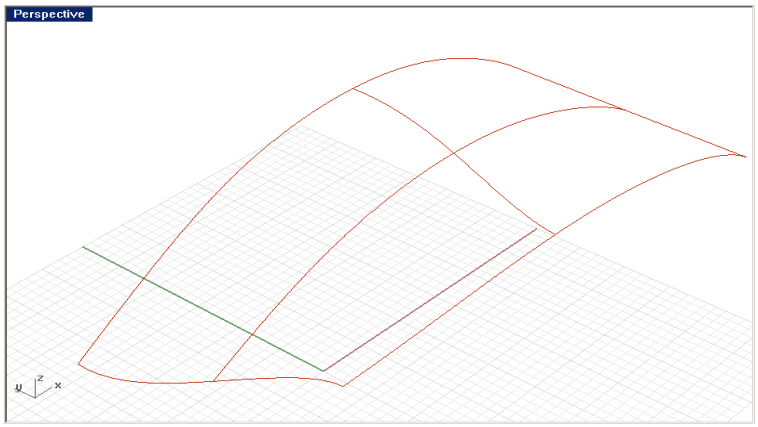




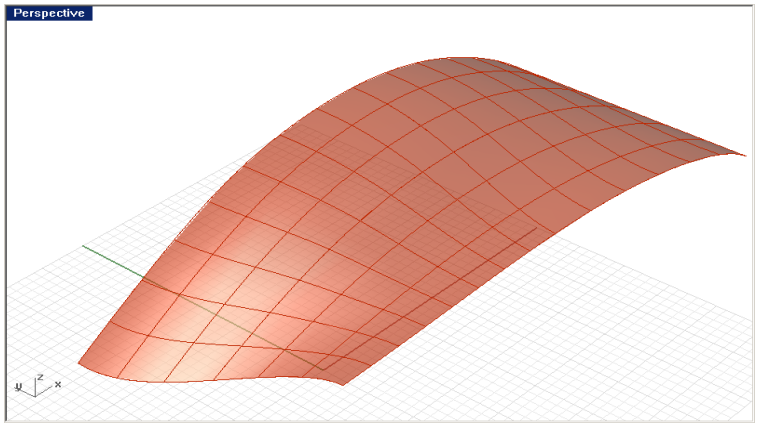
Here are all the curves you just digitized:



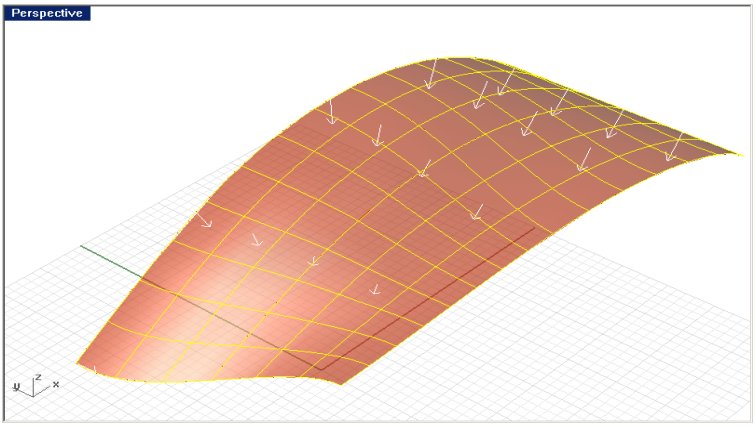
The digitized curves in Rhino:



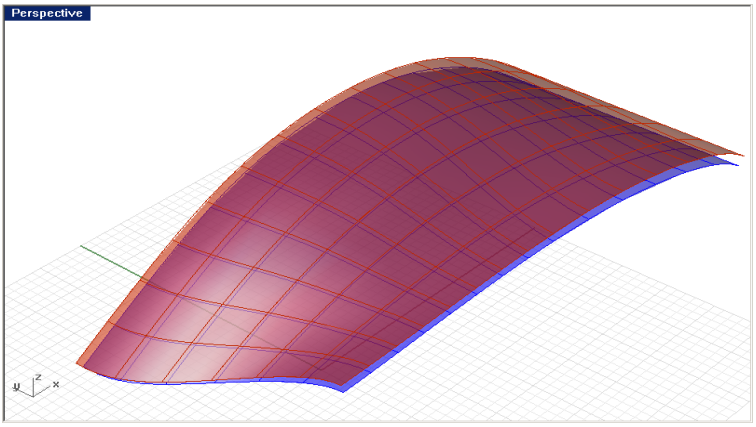
7 Create a surface through the curves using the **NetworkSrf** command (**Surface** menu: **Curve Network**).



8 Offset the surface by the radius of the ball using the **OffsetSrf** command (**Surface** menu: **Offset**).



The original surface with normal direction displayed.



The resulting offset surface.