

NURBS Creation Tutorial


Objective

Learn how to create NURBS surfaces from meshed objects. Follow the step-by-step workflow to create wireframe curves, split an object into several regions, construct quad meshes, and finally produce NURBS surfaces. You may also compare the NURBS surfaces and the triangle-meshed object to check for accuracy.

Import File

Click the Import command from the File menu (*File > Import*). The imported file name is shown in the Object Tree Window on the right side of the screen. Clicking an object in the tree window will select the object for use.

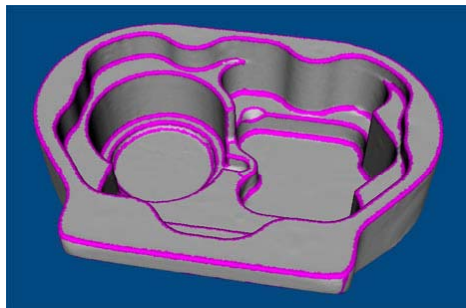
Start the Mesh to NURBS module

Click the Mesh to NURBS command from the Wire menu (*Wire > Mesh to NURBS*), or click the icon  in the Toolbar. A working panel is shown in the Parameter Window on the right side of the screen. The step-by-step workflow guides you through the process as shown in following steps:

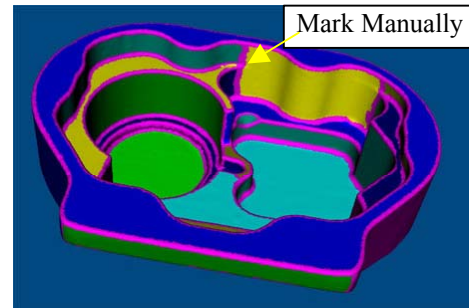
Step 1: Create Wireframe Curves

The software helps you extract edge curves and create wireframe curves.

1. Mark edges. Specify the **Curvature Sensitivity**, and click the **[Mark by Curvature]** button to mark high curvature edges automatically. You can then use the mark brush to paint over the edges directly as needed. Hold down **Ctrl** while painting to erase the paint color; hold down **Alt** to erase all paint colors on a brush path. Select the **Label Regions** checkbox to view separated regions (identified in different colors). Each region had better to be separated as a quadrangular-shaped patch.

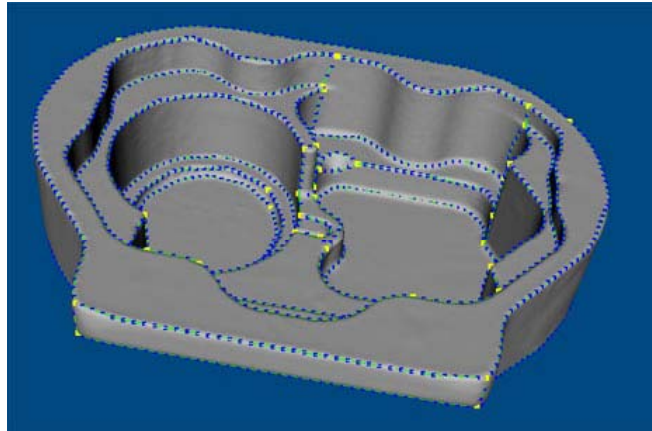


Mark by Curvature



Label Regions

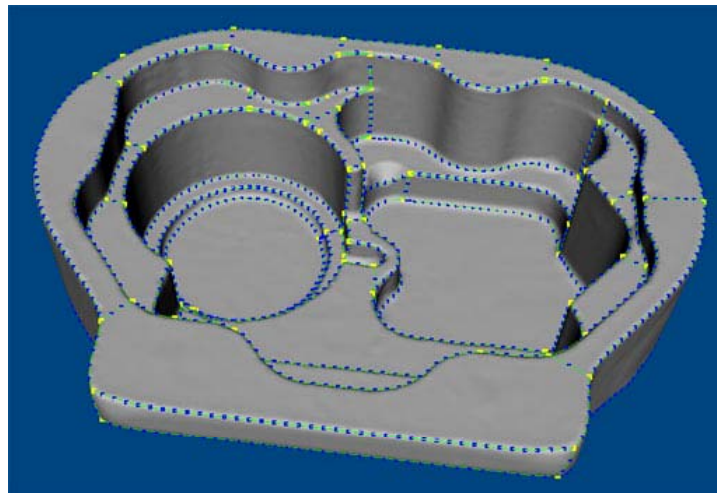
2. Extract curves. Once you are satisfied with the marked edges, press the **[Trace Edges]** button to create wireframe curves using the marked edges.






Create wireframe curves

Step 2: Edit Curves


The software provides a variety of editing tools to optimize wireframe curves.




Optimize wireframe curves


1. Draw curves. Press the button , sketch directly on the meshes, and double-click when done. Hold down **Ctrl** while drawing to make the sketched curve automatically contact the intersected curves.
2. Move curves. Press the button , click or drag the Left-Mouse-Button to freely move a control point. Hold down **Ctrl** while moving to snap the control point to a vertex; hold down **Shift** to smooth a curve; hold down **Alt** to make two end points contact each other.
3. Merge/Split curves. Press the button , drag the Left-Mouse-Button across the intersection point to merge two neighboring curves into a single curve. Hold down **Ctrl** to split a curve. Hold down **Shift** to merge all manifold curves.

4. Check floating points. Press the button . A dialog box will open and display the number of floating end points. The floating point is marked in the foreground color.

You may join two nearby end points together by pressing the Contact button  and dragging one end point toward another end point.

5. Adjust control points. You can subdivide the number of control points by specifying the **Segment Length** or **Segment Number**. You can also change the display color, size of control points, and the width of wireframe curves.


Two other editing tools may help with editing wireframe curves. The Convert tool ,

allows you to convert the selected surface curve into a wireframe curve. The Extend tool ,

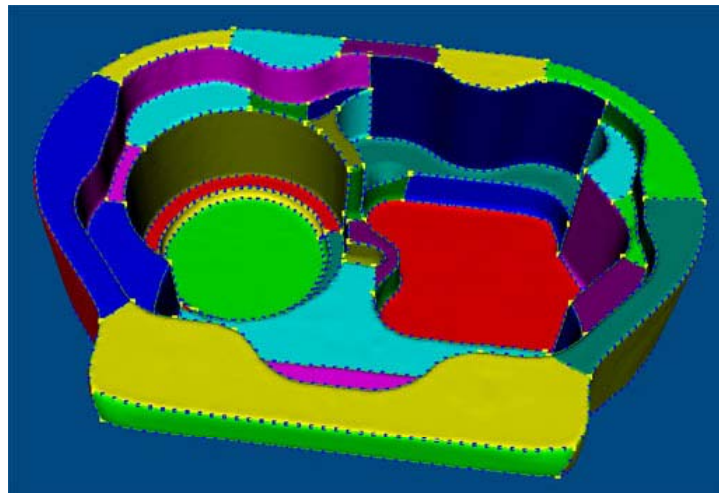
allows you to extend the desired wireframe curve for a given width.

Step 3: Create Regions

Press the [**Create Region**] button to split an object into several regions using wireframe curves. If there are non-manifold edges in a clipped region, e.g., small holes, overlapped triangles, etc., you can use the Analysis Wizard (*Wizard > Analysis*) to analyze and fix non-manifold edges before splitting the object.

You may fit a flat region to a plane by pressing the button  and clicking in the desired region. If two neighboring regions are displayed in the same color, you can change the


region color by pressing the button  and clicking in the desired region.

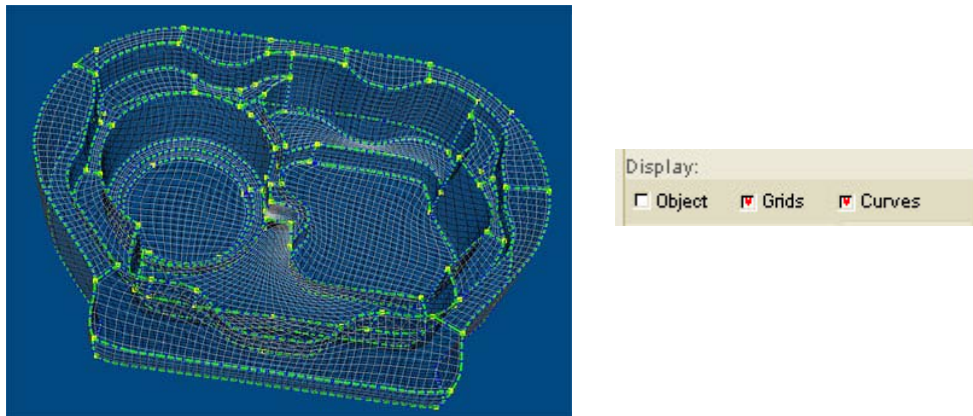


Create separate regions

Step 4: Construct Grids

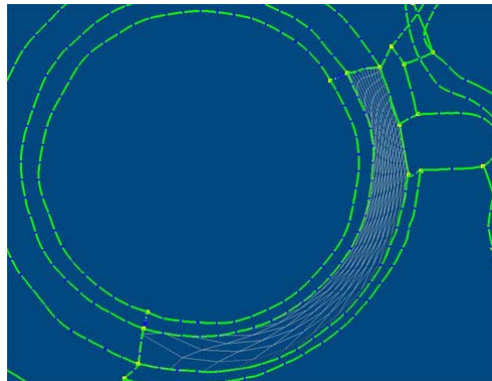
Press the [**Construct All**] button to construct grids for all regions based on the given resolution. To show the wireframe of an object, click *View > Display > Wireframe*, or click

the icon  at the top of the screen. To better view the grids, uncheck the **Object** box in the Display panel.

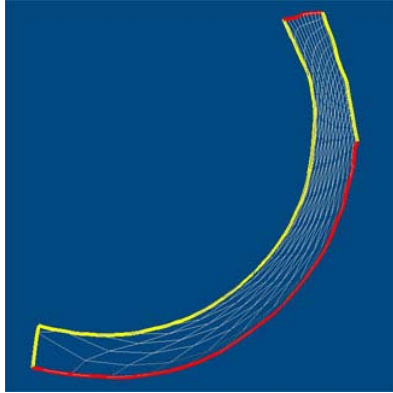


If the shape of the grids is undesirable, press the [**Delete All**] button to delete all grids. You can construct better grids for a desired region in the following steps:

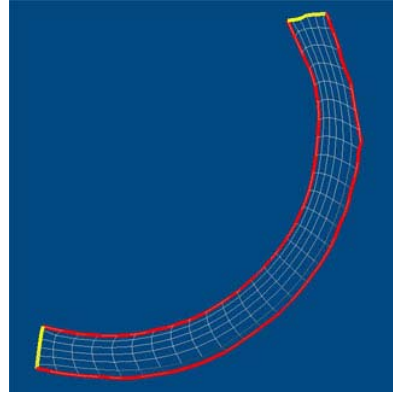
1. Construct grids for a single region. Press the [**Construct**] button, and click in a desired region to construct grids for the selected region. As the figure below shows, the grids are not well shaped. Hold down **Ctrl** and click in the region to delete the selected grids.



2. Redefine the U/V type of wireframe curves in the selected region. Press the [**Redefine U/V**] button, and click in the desired region to show the U/V type of wireframe curves. The U type is displayed in red. The V type is displayed in the foreground color. Hold down **Ctrl** and click near a curve to change the curve type to the U direction. Hold down **Alt** and click near a curve to change the curve type to the V direction. Press the [**Construct**] button to reconstruct the grids.



Original U/V type



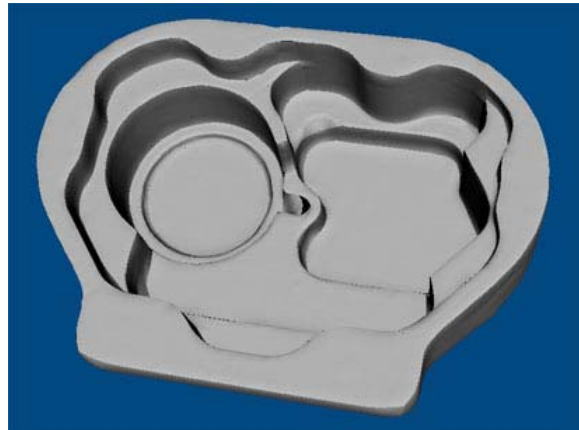
Redefined U/V type

Note: for ease of selection, it is better to leave the object visible and rendered as a surface when execute the construct grids and redefine U/V type commands.

If you would like to export quad meshes in the OBJ file format, press the **[Create Object]** button on the bottom of the panel. The software will combine all quad-meshed regions into a new object for exporting, which will appear in the Object Tree Window.

Step 5: Fit Surface

Fit NURBS surfaces to the triangle-meshed object with G1 continuity. Check the radio button "**Region**", specify the **Tension** to around 0.1, and the **Outlie Factor** to around 0.6. Press the **[Fit All]** button to fit NURBS surfaces to all regions in one operation. You can get a smoother surface by increasing the tension value. The **Outlie Factor** defines the position of the first row (column) relative to the boundary. The smaller the value of **Outlie Factor**, the closer the first row (column) is to the boundary.



NURBS Surfaces

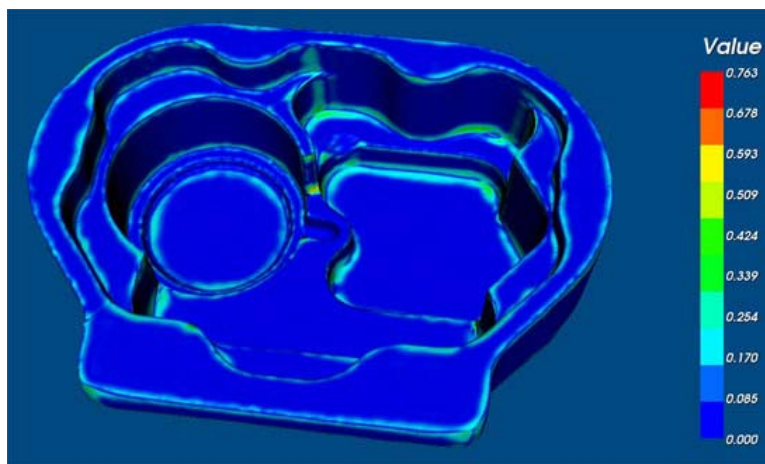
Please note that we didn't select the **Detect Sharp Edge** checkbox. So, the software will fit all edges with G1 continuity in this example. The G1 connection type produces smoother connections between neighboring regions. If this checkbox is selected, the software identifies sharp edges automatically based on the user-defined sensitivity. The identified sharp edges will be fitted with G0 continuity, and the other edges will be fitted with G1 continuity.

If a boundary edge needs to be stitched, check the radio button "**Boundary**", and press the [**Stitch**] button to stitch a boundary manually. If NURBS surfaces around corners need to be fitted separately, check the radio button "**Corner**", and press the [**Fit**] button or [**Fit All**] button to fit the corner areas. You can get a smoother corner by increasing the tension value.

If you would like to export NURBS surfaces in the IGES file format, press the [**Create Object**] button on the bottom of the panel. The software will combine NURBS surfaces into a new object for exporting, which will appear in the Object Tree Window.

Step 6: Inspection

Compare the NURBS surfaces and the triangle-meshed object. First, set the **Times of Grids** to 4, and press the [**Update**] button to change the resolution of NURBS surfaces. You may set the **Times of Grids** higher if increased accuracy is needed. Press the [**Perform Inspection**] button to check the deviation between the NURBS surfaces and the triangle-meshed object. Adjust the value of given parameters to update the color mapping on the surface.



End of Tutorial