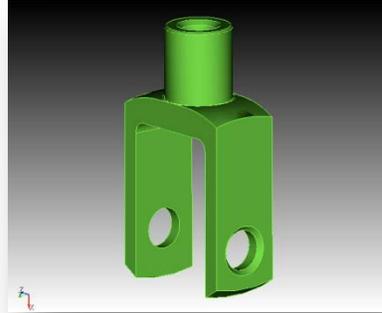# Trelis Power Tools GUI Tutorial

Overview

In this tutorial you learn how to use Trelis Power Tools to decompose and cleanup a geometry so that it can be properly meshed. The following features will be covered:

- Importing Geometry
- Analyzing Geometry
- Geometry Power Tools
- Webcutting
- Imprint/Merge
- Mesh Power Tools
- Meshing

Each step is described in detail in the following sections. For this tutorial you will need to have a basic understanding of the Trelis GUI functionality, including how to select entities, maneuver in the graphics window, operate the Command Panel, and use toolbars. If you have not already done so, we recommend completing the Getting Started with Trelis Tutorial first.

NOTE: Many of the steps in this tutorial include operations on specific entities that are identified by ID. When the solid modeling kernel is updated in Trelis the ID space may change. As such, you may not be able to rely on the IDs specified in this tutorial. Please look at the associated graphics to determine which entity/ID is being referred to.

Step 1: Import the Geometry

Begin by opening a new session of Trelis. To complete this tutorial, you will need to download the ACIS file that contains the geometry definition.
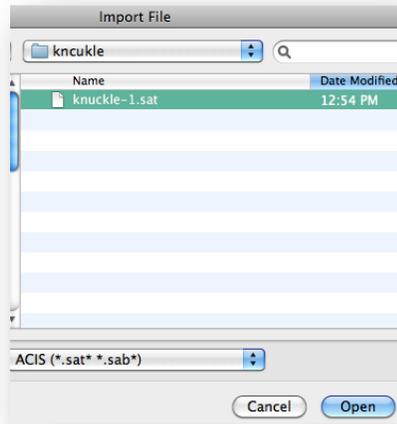
To Import the Geometry

1. Download geometry file **knuckle.sat**

Note: You will need to access this file from the Trelis web site under Support/Documentation.
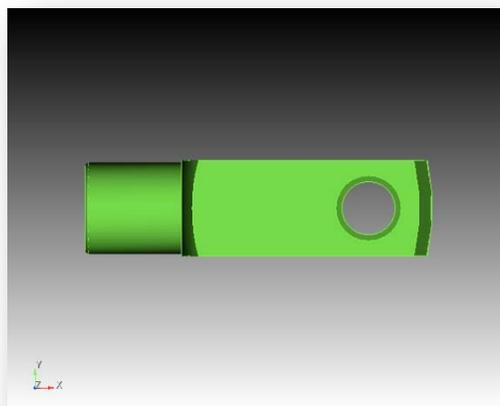
2. Select **Import** from the **File** menu.

The following dialog box will appear. Open the file by clicking on the name and selecting **Open**. If you do not see the file, make sure that you are in the right directory, and that the file type is set to ACIS.
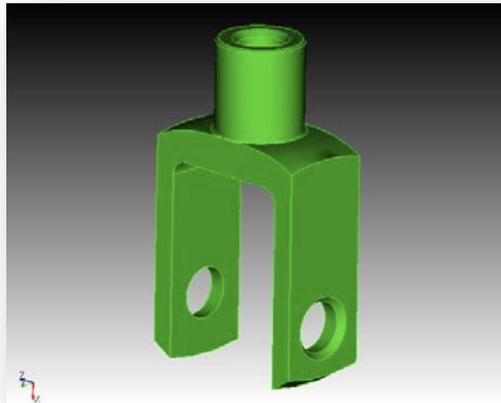
3. Leave all of the import settings on their default settings and click **Finish**.
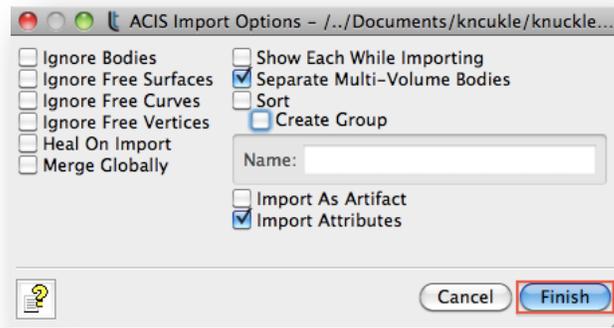
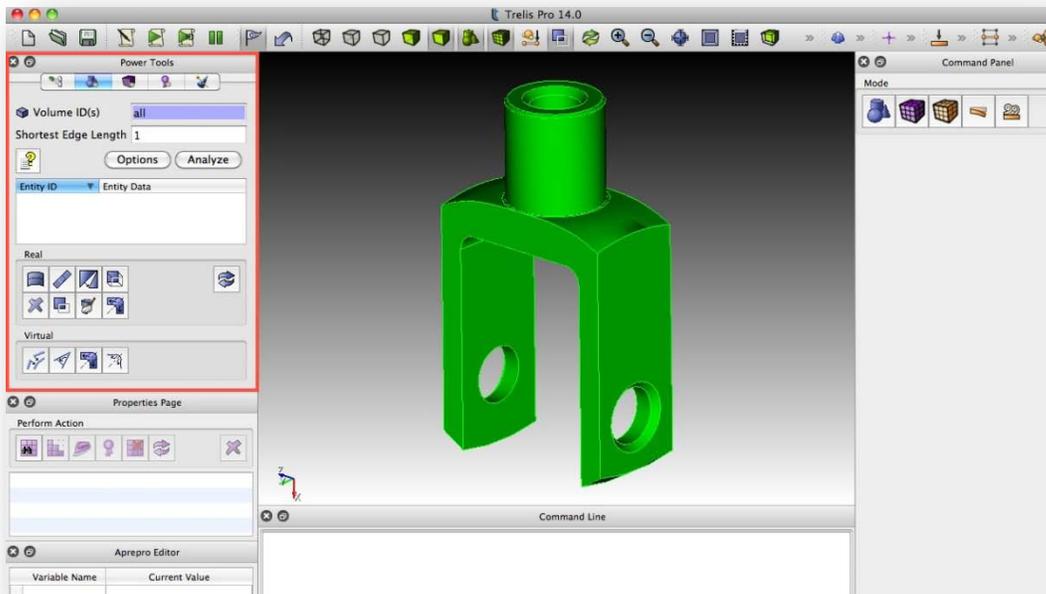Your graphics window will appear as follows

Use the mouse to rotate the image to get a better perspective.

Step 2: Analyze the Geometry

The Power Tools panel is located on the left side of the Trelis window. Tools for Geometry Diagnostics and Meshability can be found in the Power Tools panel.

Many geometries that are imported from other solid modeling software contain inconsistencies or small gaps that can cause meshing to fail. These problems are the result of differences in tolerances, file transfer loss, or inherent limitations in the parent system. In other instances, the geometry has no

inconsistencies, but may be unsuitable for meshing because of topology such as small angles, overlap, or features smaller than the desired meshing size.

Many of these problems can be fixed using the tools on the Power Tools menu. These include Split Surface, Heal, Tweak, Remove, Merge, Composite, Collapse Angle, Collapse Curve, and Collapse Surface. Some of these tools will be demonstrated in this tutorial.

To start, we need to analyze the geometry to see what is preventing the geometry from being meshable. We will then go through the proper steps to decompose and cleanup the geometry so it will mesh.

To Analyze the Geometry

1. Click on the **Diagnose Geometry** tab from the Power Tools panel.
2. Enter **all** in the **Volume ID(s)** field.
3. Enter **1** in the **Shortest Edge Length** field.
4. Click **Analyze**.
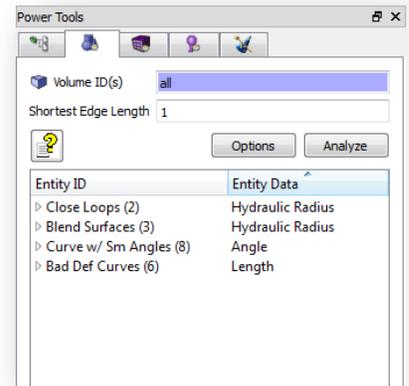
After the Analyze Button is pushed, a display area will appear as shown above. There are four suspected problems with this geometry: Close Loops, Blend Surfaces, Curves with Small Angles, and Badly Defined Geometry. The numbers in parentheses indicate the number of occurrences of this problem in the model. Clicking the arrow by each label will display the entities by ID with this problem. Clicking on the arrow by each entity will cause that entity's children or parents to be listed (depending on the entity and the type of geometry test). See documentation on Geometry Repair for more information about the display window.

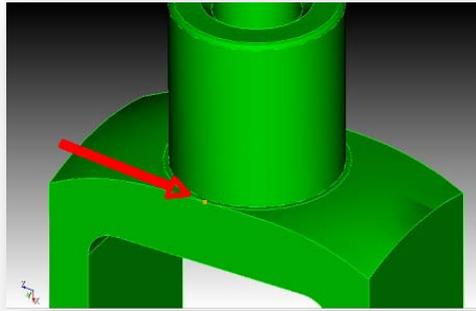Clicking on the name of an entity will highlight that entity in the graphics window.

- Select **Vertex 45** under Curves with Small Angles

Observe that this vertex is highlighted in the graphics window.
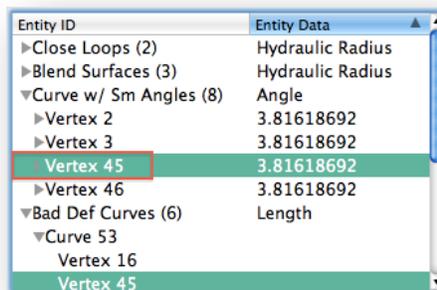
- Right click and select **Zoom To** from the list of options

The graphics window should look like this:

- Right Click on Vertex 45 and select **Reset Zoom** from the list of options

The image should now be reset to the previous graphics state.

You can experiment with some of the other options in the top half of the right click menu. They are:

- **Fly-in** - Animated zoom feature
- **Locate** - Labels entity
- **Draw** - Draw this entity by itself
- **Draw with Neighbors** - Draw this entity with all adjacent curves and surfaces
- **Clear Highlights** - Clear all highlighted entities

The **Reset Graphics** button can be found in the menu of buttons at the bottom of the **Diagnose Geometry** tab- Refreshes graphics screen; Pressing the reset graphics button on the menu may also reset the graphics window.

Step 3: Healing the Geometry

The first step to improving any geometry is to look for badly defined geometry and to fix it using the Autoheal tool in Trelis. It is always a good idea to run the Autoheal on imported geometry. In this example, the Power Tools has located some badly defined curves. This step will show you how to fix these curves.

To Heal the Geometry

1. With the **Diagnose Geometry** tab still open, Click the **Heal** button in the lower left of the panel. (Alternatively, you can manually
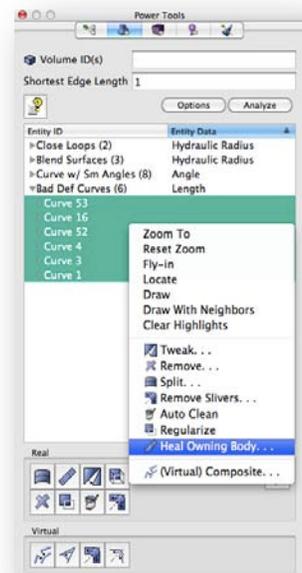
highlight all Badly Defined Curves, right click, and select **Heal Owning Body** from the list of options).

Note: The Diagnose Geometry Tool does not execute any geometry clean-up commands directly, but directs you to the place on the Command Panel where this function can be executed.

2. Now on the Command Panel, verify that **1** is in the **Volume ID(s)** field.
3. Select **Autoheal**.
4. Click **Apply**.

The output window on the Trelis GUI should appear with the following message. You may have to scroll to see the whole thing. The percentages before and after healing are 97% to 100%. Healing has been successful.
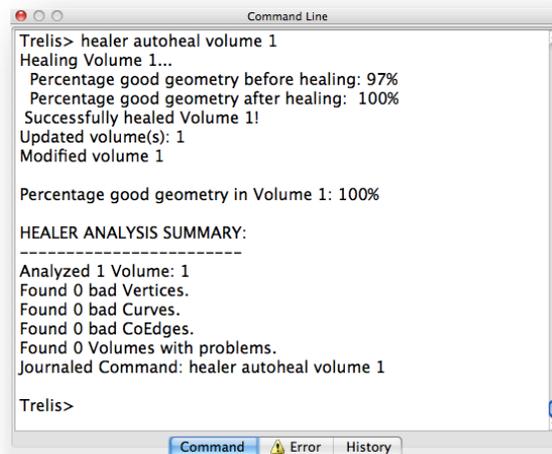
Run the geometry analysis test again to guarantee that all bad geometry has been removed.

Step 4: Removing Small Surfaces

Some surfaces are too small for analysis and should be removed from the model. In this example, Surface 15 and Surface 17 fall into that category, assuming that the distance between curves on these surfaces is smaller than the desired final mesh size.

To Remove Small Surfaces

1. Click on the **Diagnose Geometry** tab from the Power Tools panel.
2. Enter **all** in the **Volume ID(s)** field and enter **1** in the **Shortest Edge Length** field
3. Click **Analyze**.
4. Expand the **Closed Loops** from the **Entity ID** menu.

Surface 15 and 17 will appear and they both will need to be removed.

5. Click on **Surface 17** and then click the **Remove Button** from the **Real** menu. (Alternatively, you can also right click and select **Remove**). The Command Panel will appear with the **Remove** settings open. The Surface ID should also appear in the input field.
6. Verify that the **Extend** and **Remove Individually** boxes are checked.
7. Click **Apply**.
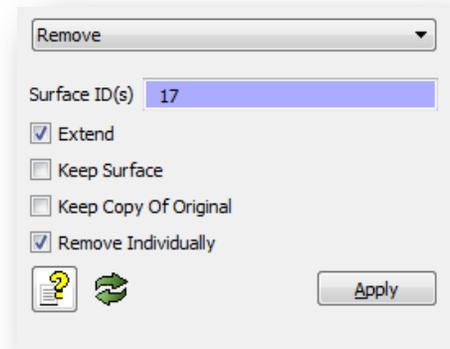
Repeat steps 1-7 for **Surface 15**.

Step 5: Web Cutting

Web cutting is this process of dividing volumes into sweepable regions by cutting with a plane.

Since the model has holes through it, sweeping is not possible from a single source and target. However, we can make the volume meshable by dividing the model into sweepable regions using a series of webcuts. To make the first Webcut

1. On the Command Panel, click on **Geometry** and then **Volume**.
2. Click on the **Webcut** action button.
3. Select **Plane Normal To Curve (vertex)** from the drop-down menu.
4. Enter **1** in the **Volume ID(s)** field. This can also be done using the **Pick Widget** function.
5. Enter **59** in the **Curve ID** field. This can also be done using the
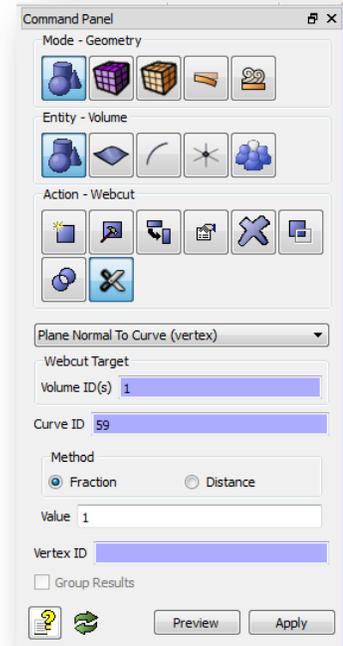
Pick Widget function.

6. Select **Fraction** from the Method menu.
7. Enter **1** in the **Value** field.
8. Click **Preview** and then **Apply**.
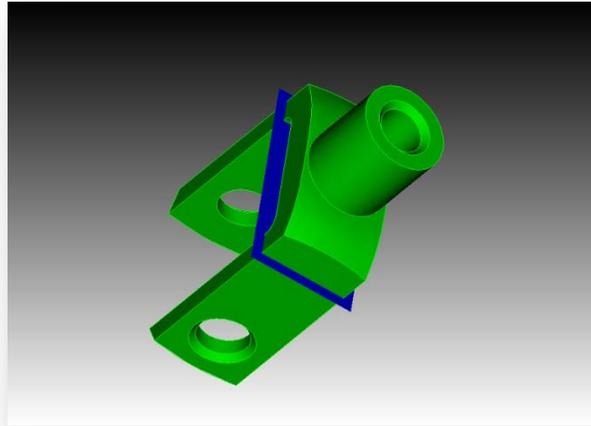

To make the second Webcut

1. With the **Webcut** window still open, enter **1** in the **Volume ID(s)** field. This can also be done using the **Pick Widget** function.
2. Enter **59** in the **Curve ID** field. This can also be done using the **Pick Widget** function.
3. Select **Fraction** from the Method menu.
4. Enter **0** in the **Value** field.
5. Click **Apply**.

To make the third, and final, Webcut

1. With the Webcut window still open, enter **4** in the **Volume ID(s)** field. This can also be done using the **Pick Widget** function.
2. Enter **31** in the **Curve ID** field. This can also be done using the **Pick Widget** function.
3. Select **Fraction** from the Method menu.
4. Enter **1** in the **Value** field.
5. Click **Apply**.
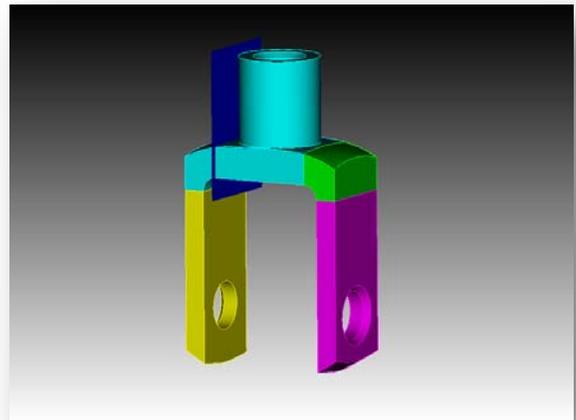
The final webcut model should look like this:
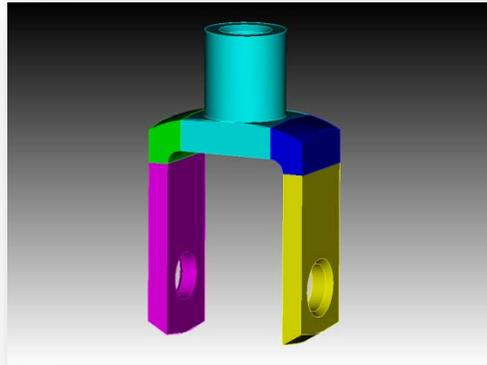
Step 6: Imprint/Merge

Imprinting is the process of projecting curves from one surface onto an overlapping surface. Merging is the process of taking two overlapping surfaces and merging them into one surface shared by two volumes, creating non-manifold geometry. Both imprinting and merging are necessary to make adjacent volumes have identical meshes at their intersection. Imprinting and merging is almost always necessary after webcutting.

To Imprint and Merge

1. On the Command Panel, click on **Geometry** and then **Volume**.
2. Click on the **Imprint Merge** action button.
3. Select **Imprint/Merge** from the drop-down menu.
4. Enter **all** in the **Volume ID(s)** field.
5. Click **Apply**.

Step 7: Mesh Power Tools

The Mesh Power Tool provides an easy and graphical way to determine if volumes are meshable. This tool will employ the AutoScheme feature in Trelis to select and assign schemes to meshable volumes. If a volume is not currently meshable, it will be flagged and highlighted. Use the Mesh Power Tool to determine if the volume is currently meshable and to apply schemes to the remaining volumes.

To check Meshability

1. Click on **Diagnose Meshability** from the Power Tools panel.
2. Enter **all** in the **Volume ID(s)** field.
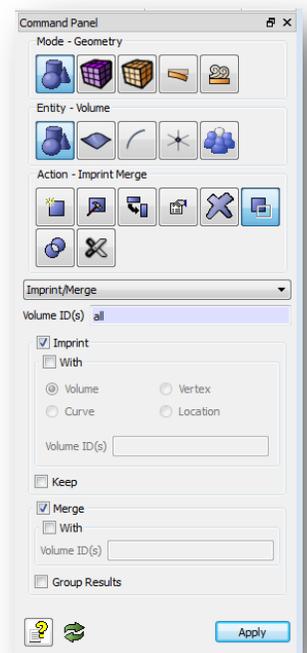
3. Click **Analyze**.

Note: All volumes that are meshable are highlighted in green, and all volumes that are not meshable are highlighted in red.

All of the schemes have now been set with a sweeping algorithm. The model is ready to be meshed. All volumes should appear green in the graphics window.
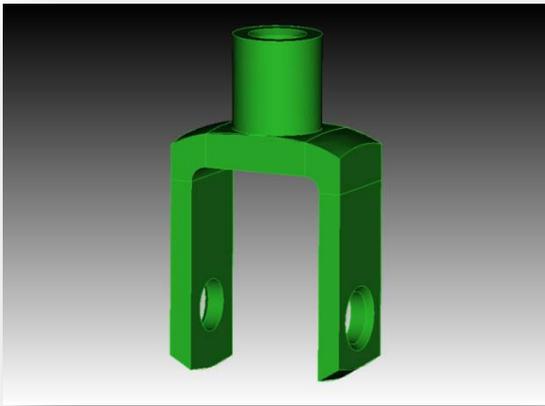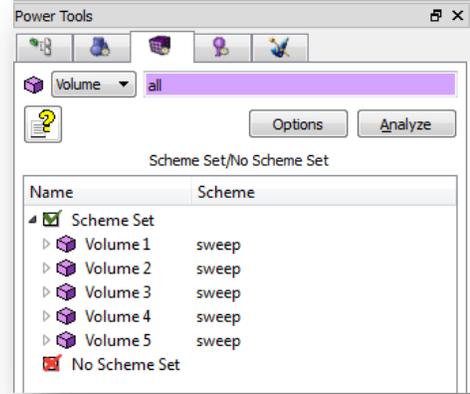
Toggle the **Reset Graphics** button (located at the bottom right corner of the Power Tools panel) to return volumes to their original colors.

Step 8: Meshing the Model

Now that you have used the Mesh Power Tools to apply schemes to the remaining volumes. The Geometry is ready to be meshed.
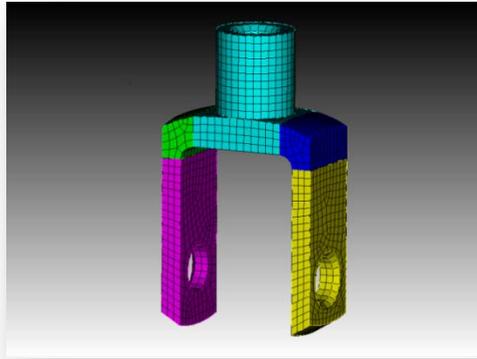
To Mesh the Geometry

1. On the Command Panel, click on **Mesh** and then **Volume**.
2. Click on the **Mesh** action button.
3. Enter **all** in the **Select Entities to Mesh** field.

Note: There is no need to press the Apply Scheme button since the scheme has already been set in the Meshing Tools.

4. Click **Mesh**.
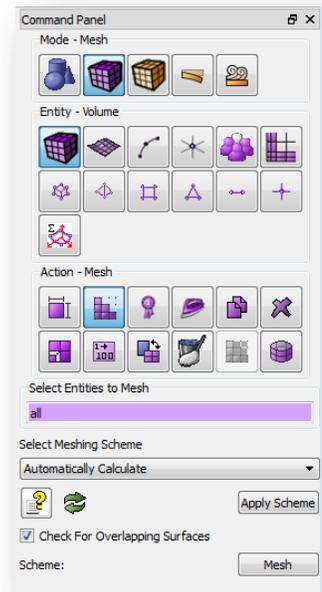
Congratulations! You have just completed the Power Tools Tutorial.