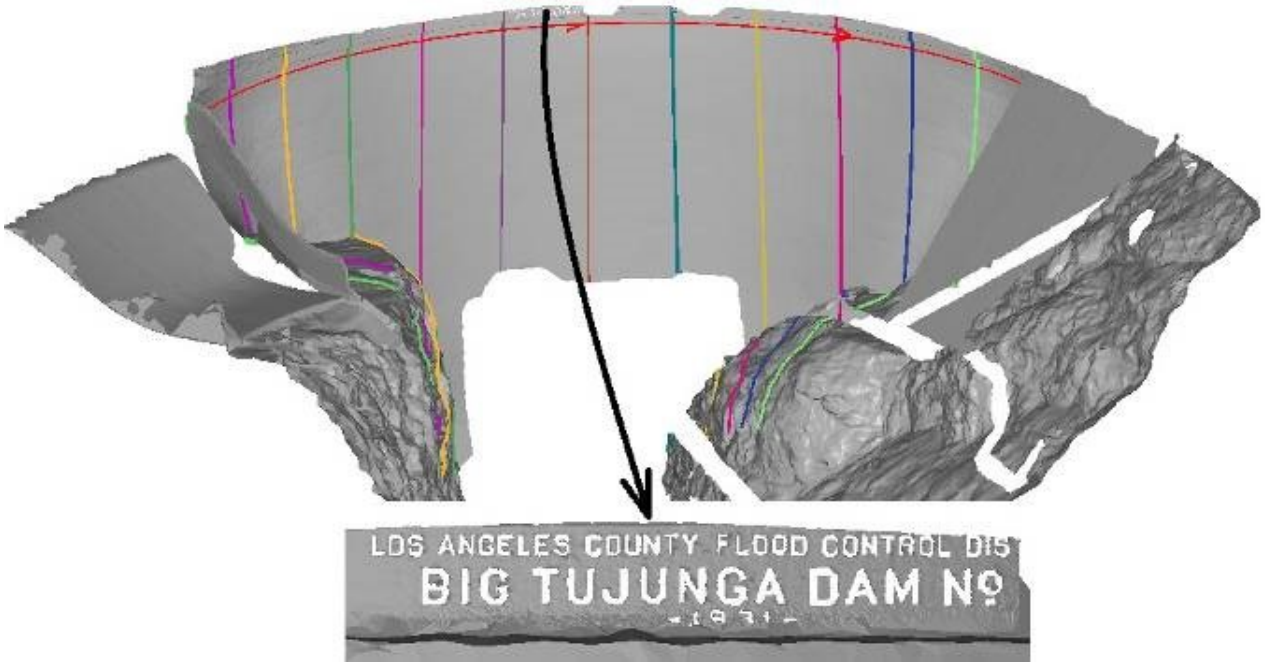
3DReshaper Practical Exercise

Ex2 - Meshing a dam



Introduction

In the software several meshing commands are available. The combination of these commands provides various meshing strategies.

Here we will show an example coming from a dam with several parts requiring special attention:

- The main dam part, which is a very smooth surface.
- Some rocks on each sides of the dam, which represent quite a rough surface.
- Some very sharp edges on the side of the dam walls.
- Some writings of the top of the dam.

Note that in the standard Reshaper Samples there is another example based on a point cloud of the Samothrace victory (famous statue in the Louvre museum in Paris) which is a very noisy point cloud representing a smooth surface. Then, a different strategy is used in the case of this statue.

Exercise overview

In this exercise, we will see how to mesh point cloud(s).

- Manually clean point cloud(s).
- Making a first mesh to see what happens and decide the strategy to be used.
- Making a regular mesh at a certain level of detail.
- Filling some holes and openned contours.
- Exploding a mesh into several pieces.
- Improving the accuracy of the mesh in certain zones.
- Deleting some triangles in a mesh.
- Re-meshing locally the edges so that they look sharp.
- Locally smooth noisy parts.
- Extract some features from the model: cylinder.
- Create a freehand section.
- Make some sections along a curve.

The file used in this tutorial is **DamRock.rsh**

1 Cleaning the cloud

- Select all the clouds that you see on the screen with a rectangle from right to left (except Cleaned Cloud).
- Launch the command Cloud \ Clean / Separate.
- Appropriately orient the view and click on the contour around the points that you want to delete.
- Remove the points with the bin icon.
- If necessary, select another group of noisy points.
- When your cleaning is finished, click **OK**.

To continue the exercise, use Cleaned Cloud, which has already been cleaned.

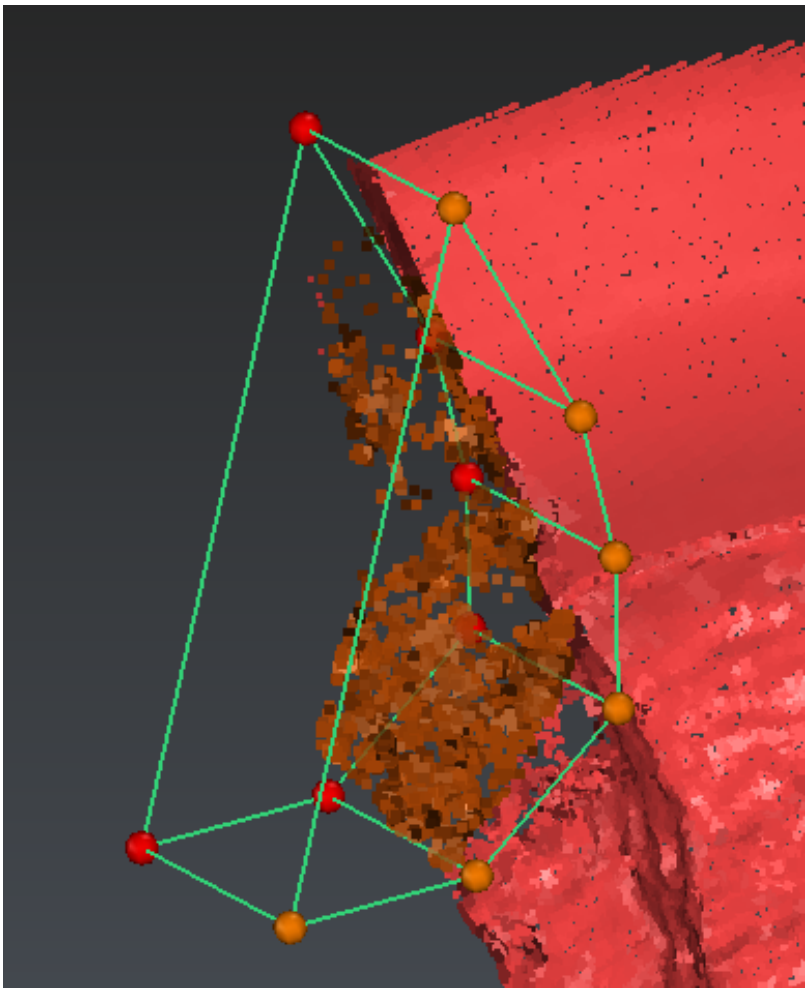


Figure 1: With the command Cloud \ Clean / Separate, you can select some points within a polygon. Control points are available to transform the polygon in a box.

2 Making a first mesh to see what happens

Generally when opening a new cloud, it is difficult to know what the meshing parameter ideal values are. When you launch the command Mesh \ 3D Mesh, the software computes parameters for you to get a result in less than 30 seconds regardless of the size of the point cloud. These default parameters usually give good results but sometimes need to be adjusted according to your model and your expectations.

- Select Cleaned Cloud.
- Launch the command Mesh \ 3D Mesh.
- Select **Regular sampling**, and change the default parameter and enter 1.5 for the **Average distance between points**.
- Select **Hole detection** and keep the computed value for **Triangle size**.
- Click **OK**. The first mesh should arrive in less than 5 seconds.
- When the mesh is on the screen, right click to select the Flat representation. The flat rendering is a mode which suppresses the artifact or smoothing effect coming from the graphic board.
- Note that you can swap the mesh normal typing the **i** key.
- You can display Cleaned cloud over the mesh to make a better analysis of the improvement(s) to make.

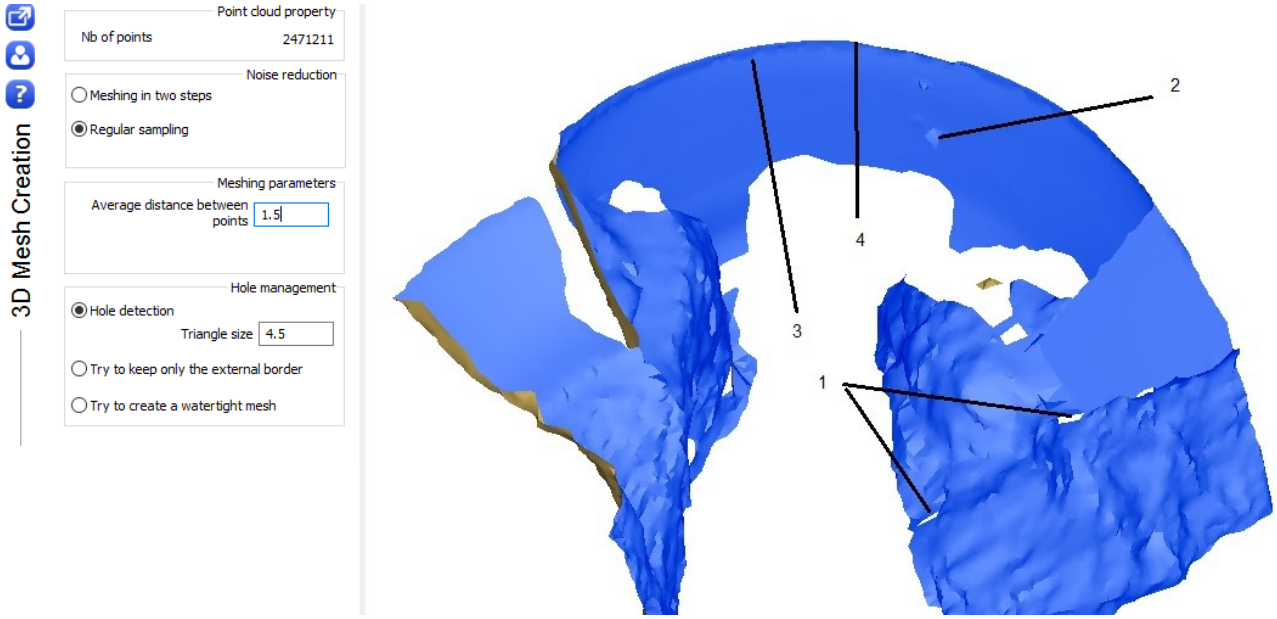


Figure 2: Making the first mesh with the default parameters to see what happens

You are now ready to analyze your first result. Here are the remarks that we can make after a brief sight:

1. Some areas where points are missing are completely filled by big triangles. These holes are about 2m wide. This would require to enter a value in the field **Hole detection, triangle size** below 2.
2. We get some aberrant points but the number of these points is really low. So an easy manual correction can be done afterwards.
3. The sharpness of the edges is not correct. This requires having smaller triangles.

4. The detail of the writings is not present in the mesh, however as these details are very small, we will include these details in a second step.

3 Making a regular mesh at a certain level of detail

The conclusion of the previous test is that the mesh should be done with a smaller triangle size:

- Make undo.
- Select again Cleaned Cloud.
- Launch the command Mesh \ 3D Mesh.
- Enter the value 0.3 for **Average distance between points** and 1.2 for **Triangle size**.
- Click **OK**.

Type **i** or **Reverse** with the contextual menu to show the bright side on the front of the dam.

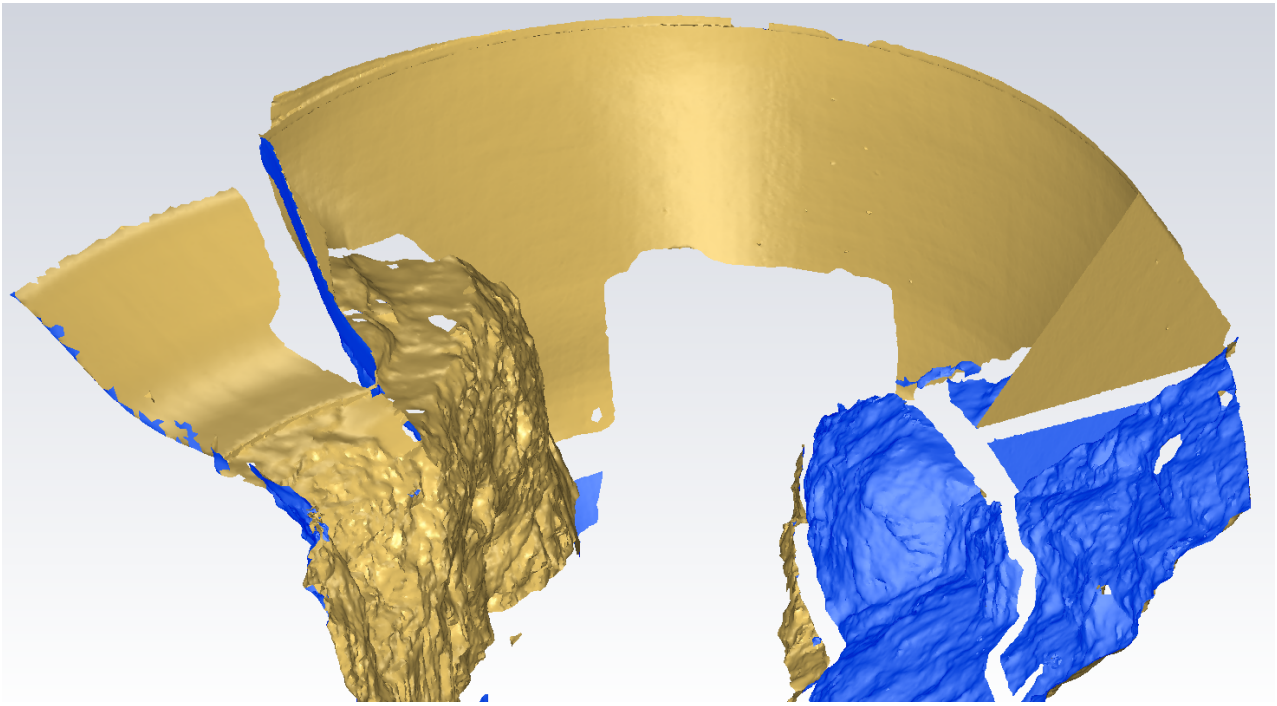


Figure 3: Meshing the dam with an average distance between points of 0.3m. The result is a mesh made of several disconnected parts: a compound mesh.

4 Explode the compound mesh and delete smallest parts

As you can see the resulting mesh is a “compound mesh”. This means that it is a group of several disconnected surfaces. We will now explode the compound into different independent meshes.

- Select the mesh.
- Launch the command Mesh \ Explode compound mesh.

If you look at the object Explorer you should see that the mesh group contains many pieces. All these pieces are sorted by size: the biggest part is the first and the smallest is the last. We suggest keeping only the 4 firsts parts. Select from the 5th to the last mesh and delete all these small pieces.

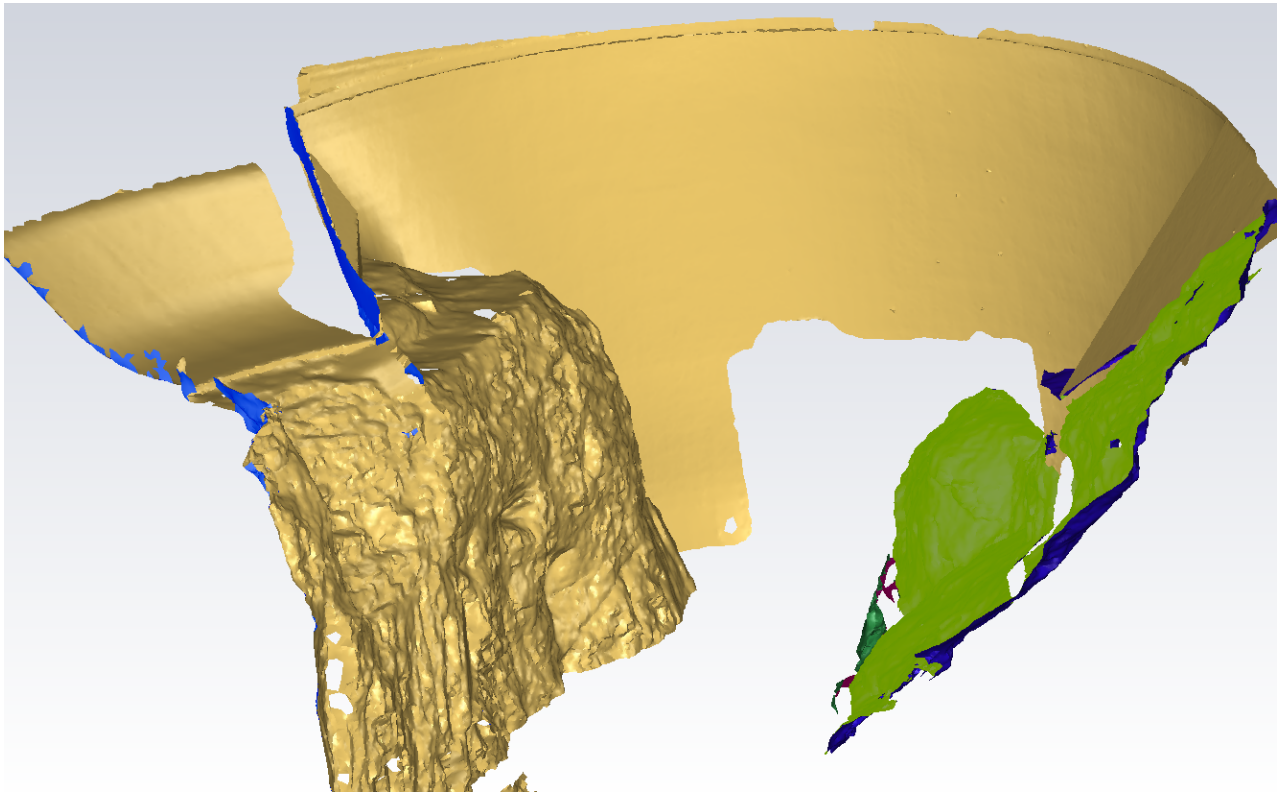


Figure 4: Explode the mesh into disconnected parts. You can select all the meshes and put them in the same color (Home \ Color and Aspect). It is easier to see on which mesh the normal color is reversed.

We can now group again the four biggest pieces inside the compound mesh.

- Select all the meshes that you want to put in the compound.
- Launch the command Mesh \ Group in compound Mesh.
- Say YES to the orientation of the normal so that all parts will have the same normal orientation.
- You can change the color of the new compound mesh. Select the mesh and choose a color in the contextual menu.

5 Filling some holes

We will now fill some holes. The automatic selection is often the fastest way to select the “smallest holes” to fill.

- Select the mesh.
- Launch the command Mesh \ Fill Holes.
- Select the option **By Length** (limit the free border length).
- Move the slider at a maximum value of 16 (do not put a bigger value; otherwise open contours will be selected).
- Select the option **Filling holes** and **Curvature filling** as shown on the picture.
- Click **Preview** and **OK, Next**.

If other holes need to be filled, you can now choose the option **By Click**. Click **OK, Exit** when this process is finished.

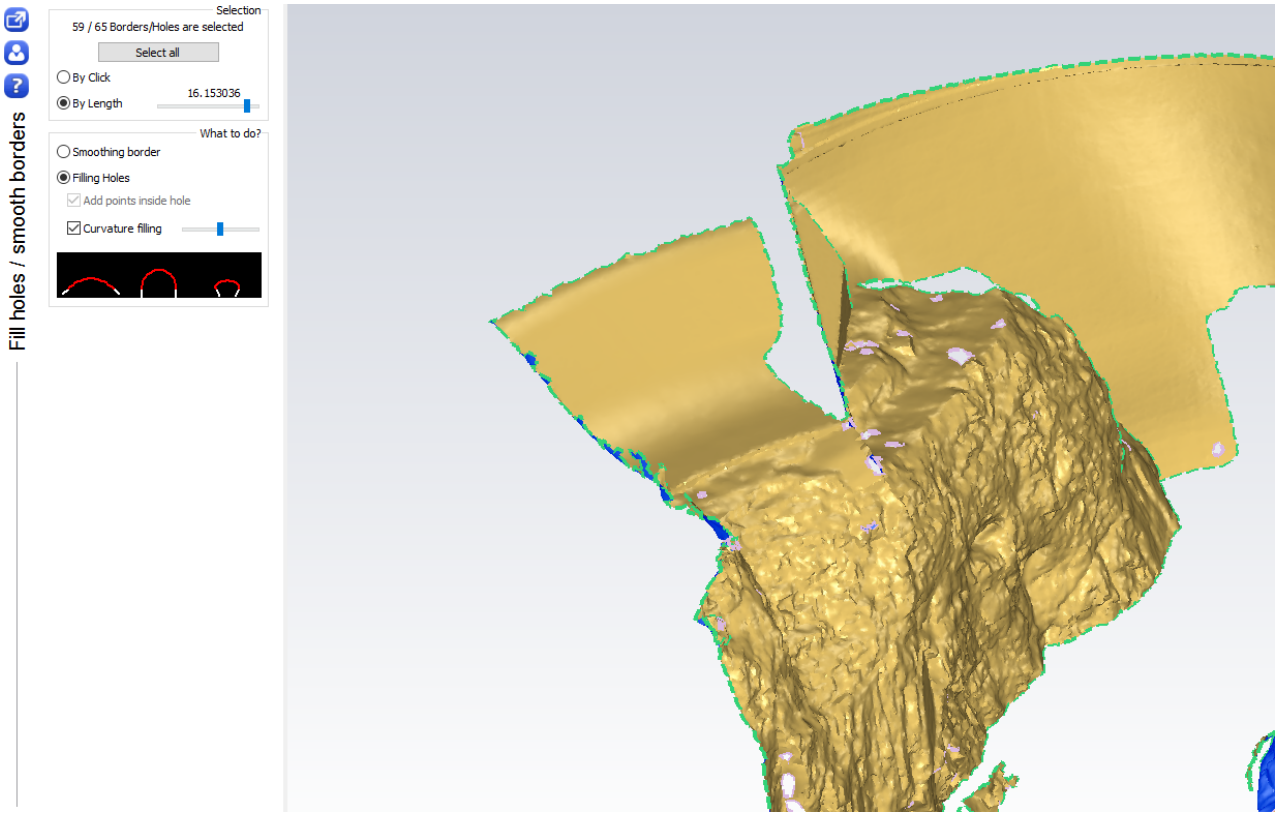


Figure 5: Automatic selection of the smallest holes to fill with curvature continuity.

6 Replacing some parts to remove some aberrant zones

At some points like on the image, you should see some defects on the surface. You can easily remove these aberrant zones.

- Select the mesh.
- Launch the command Mesh \ Smooth \ Replace a part.
- Draw a freehand contour to encircle the zone to correct.
- If you are happy with this correction, click **OK, Exit** otherwise click **Reset**.
- Do this operation for all the zones to be replaced.
- Note that for the small areas you can also use the Regular Smoothing tab and take the pencil tool. The shape will be locally modified when you press the left button of the mouse and move over the zone to smooth.

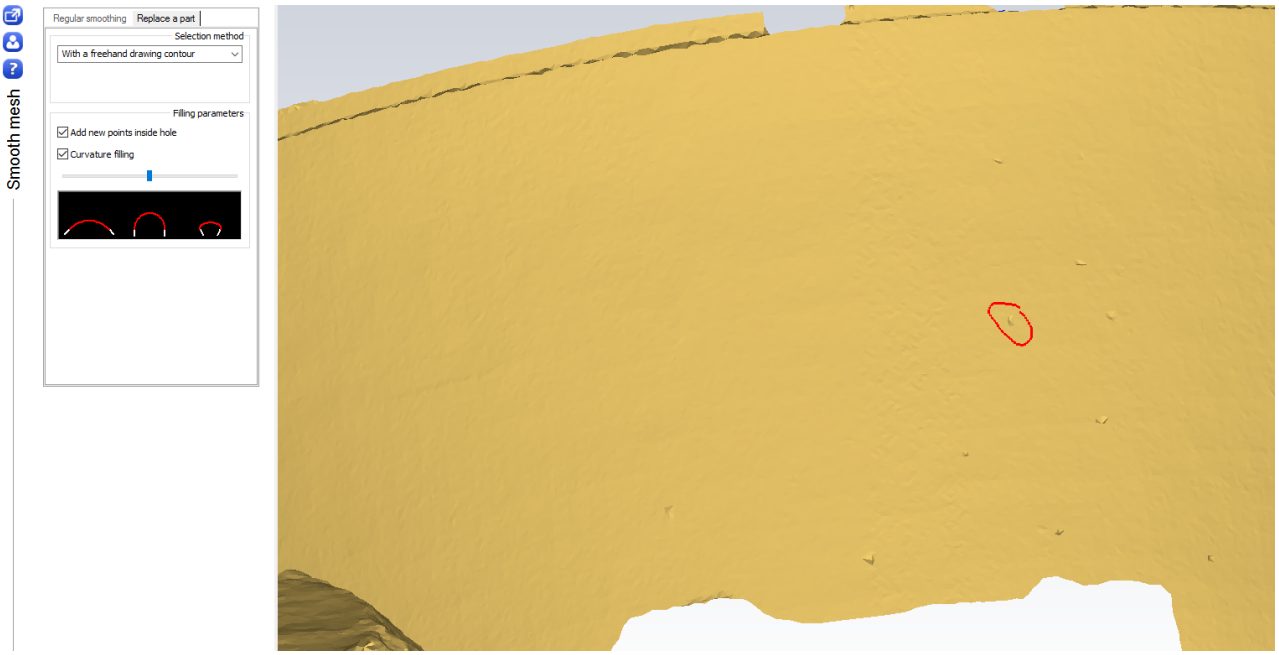


Figure 6: Aberrant zones can be easily replaced or locally smoothed.

Note that in some situation it is also possible to smooth the whole shape to get a better aspect but here we will not use this command because our intention is to keep the measurement points “as is”.

7 Making junction in between open contours

The model contains some zones that cannot directly be filled because they are open contours and not holes. In such cases, here are two possibilities:

7.1 Make a bridge to close the open contour

- Launch Mesh \ Bridge and click on the two free edges to close the hole.
- **Sew all the parts** and **OK, Exit**.

Then, launch Mesh \ Fill Holes and click on the hole to fill it.

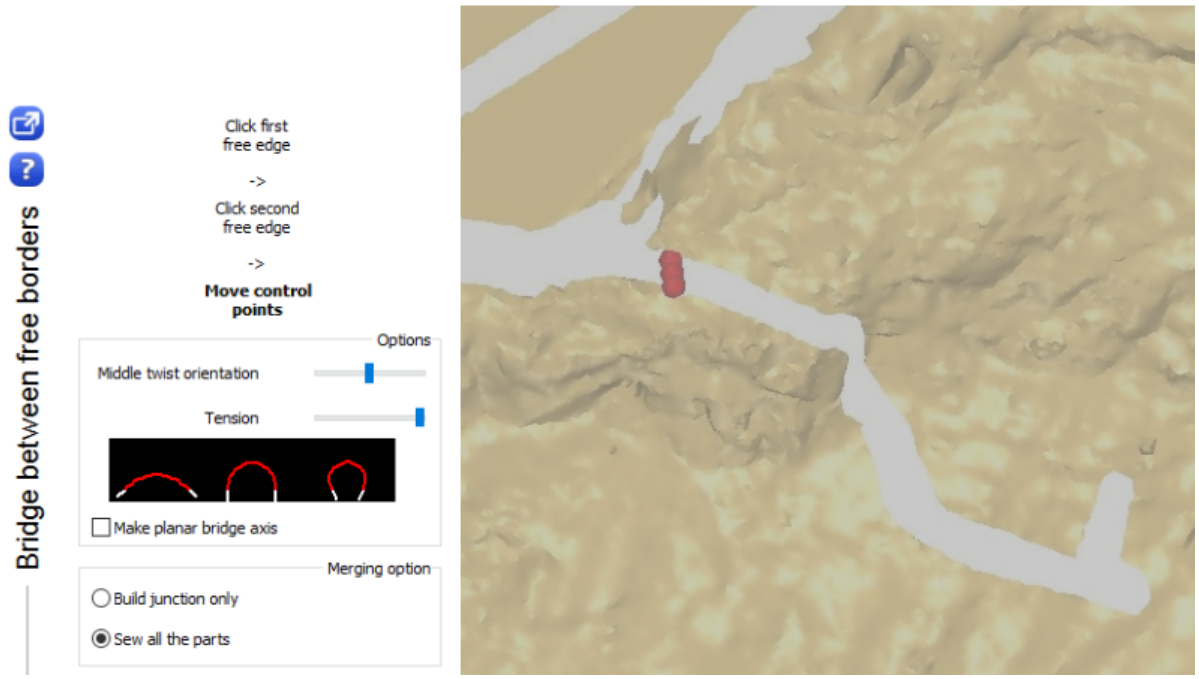


Figure 7: Making bridge allows you to separate big holes into smaller ones, which are easier to fill with curvature continuity using the command Mesh / Fill holes.

7.2 Make a junction between two contours

- Launch Mesh \ Join 2 Contours and select the two contours.
- **Make restriction** on the two contours as they are open. Wait for the computation to be done, then follow the instructions in the top of the dialog box.

Then, select **Sew all the parts** and click **OK**.

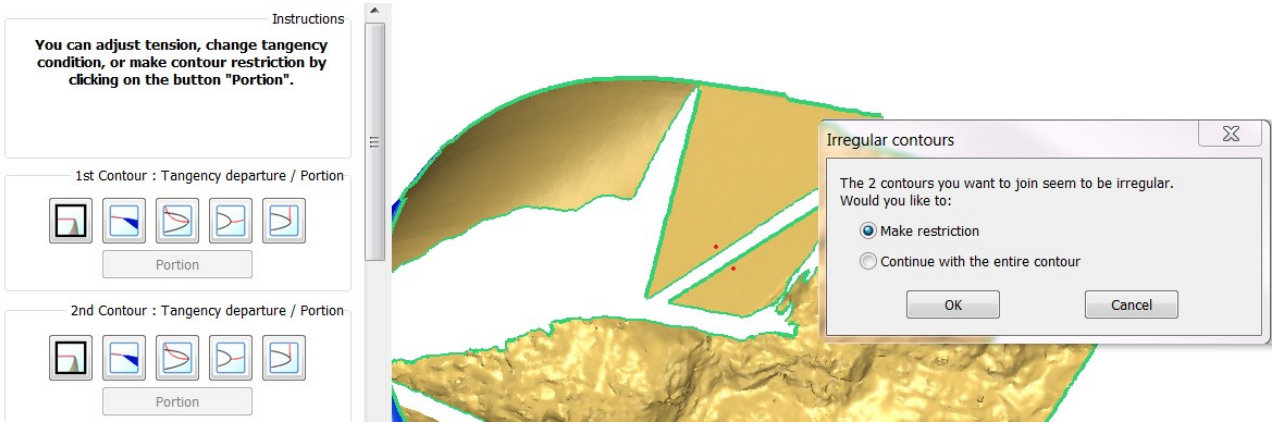


Figure 8: You can also create a mesh from two contours (multiline or hole border). A contour restriction is sometimes necessary.

8 Improving the accuracy of the mesh in specific zones

The model contains some sharp edge zones and we are going to improve the accuracy in these regions.

- Select the mesh and all the clouds whose name starts by “SharpAngle” (press the **CTRL** key to select several elements). Note that the clouds were previously split to prepare this tutorial.
- Launch the command Mesh \ Refine Mesh \ From a point cloud.
- Select the option **Take points of the cloud** and fill in the values as on the picture below.
- Click **OK**.

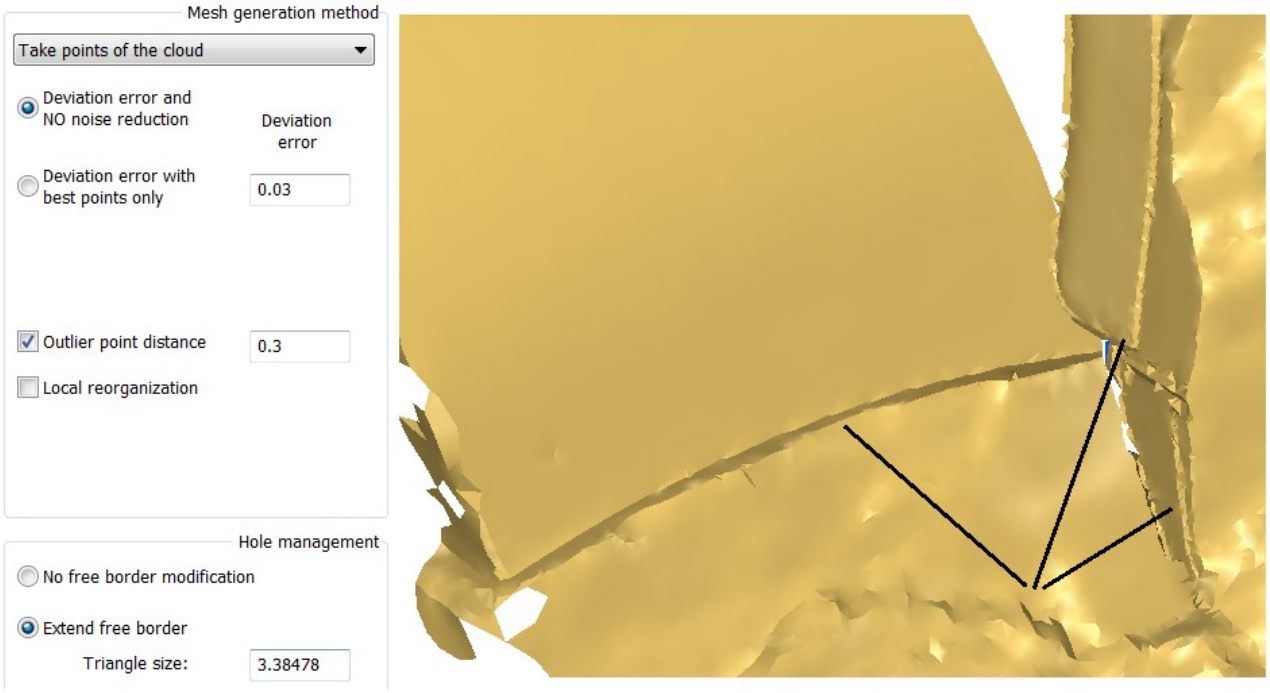


Figure 9: The "Refine Mesh" command improves the accuracy of the mesh

Note that there is another option in this command:

Interpolate new points creates some points that are not present in the cloud. This command assumes that the surface is continuous and creates the best “smooth surface” in the middle of the noise thickness. Here, we want to improve the sharp zone so we do not want to smooth. This is the reason why we prefer the option **Take points of the cloud**. As mentionned in the introduction, in the case of the standard tutorial, the Samothrace victory point cloud should be meshed using **Interpolate new points**.

We can also improve the zone of the writings.

- Select the mesh.

- Press the **CTRL** key to add in your selection the cloud “writings”. Note that the cloud was previously split to prepare this tutorial.
- Launch the command Mesh \ Refine Mesh \ From a point cloud.
- Select the options **Take points of the cloud** and fill in the values as on the picture below.
- Click **OK**.

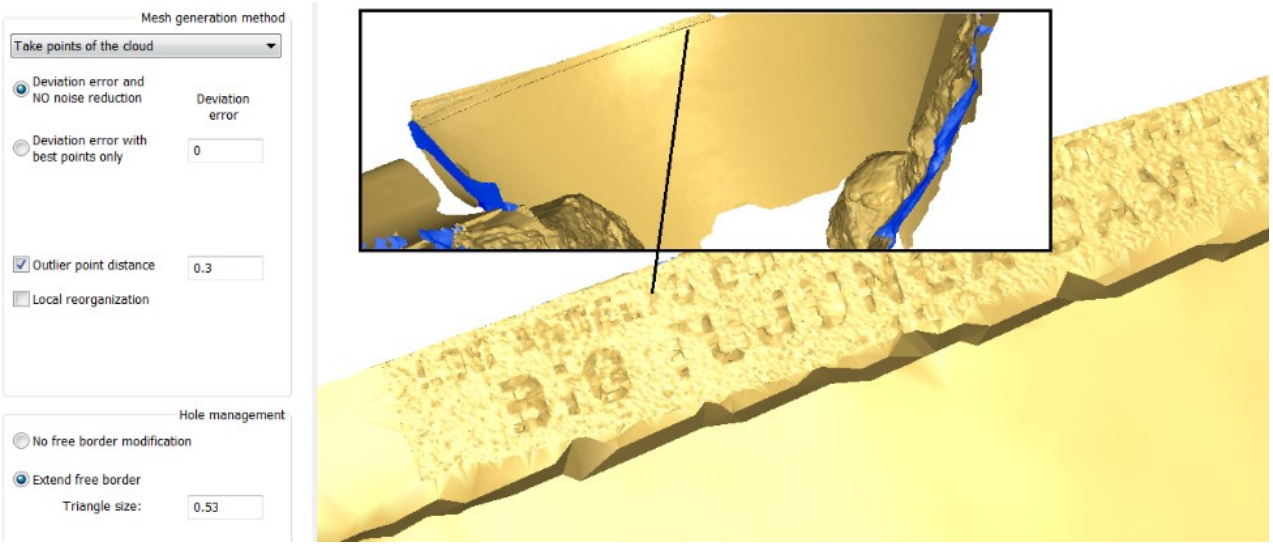


Figure 10: The Refine mesh command improves the accuracy of the mesh.

Note that a deviation error of 0 (zero) means adding all the points of the cloud. This could be dangerous for a big or noisy cloud.

9 Deleting some triangles of the mesh

We will now delete the triangles inside the letters of the writings.

- Select the mesh.
- Launch the command Mesh \ Clean / Separate.
- Select the triangles **According to their size** and adjust the threshold to take all triangles greater than 0.032 and smaller than 0.016.
- Click **OK** to close the dialog box but do not validate the command because this would also delete all the triangles outside of the writing zone.

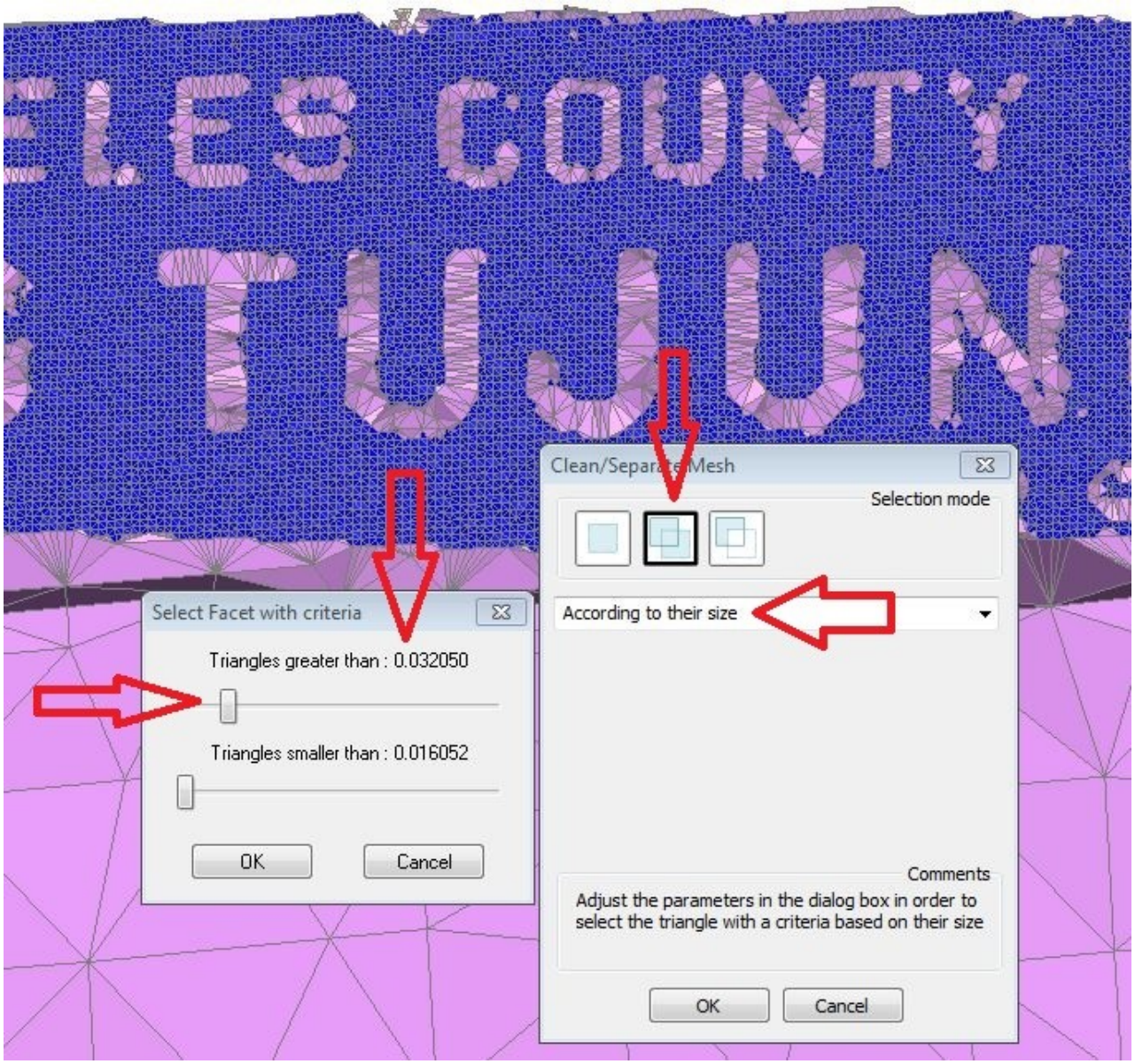


Figure 11: Selecting triangles by size to delete the inside of the letters.

We must now make a second selection in order to remove from the selection all triangles outside of the writing zone.

- Click on the farthest right icon to remove triangles from the current selection.
- Select the options as shown on the picture below.
- Click a contour as shown on the picture. Press **ENTER** to close the contour.
- Click **OK** to validate the command.
- A new dialog box will ask you the action to do with the selection. Choose **Delete Selected Facets**.

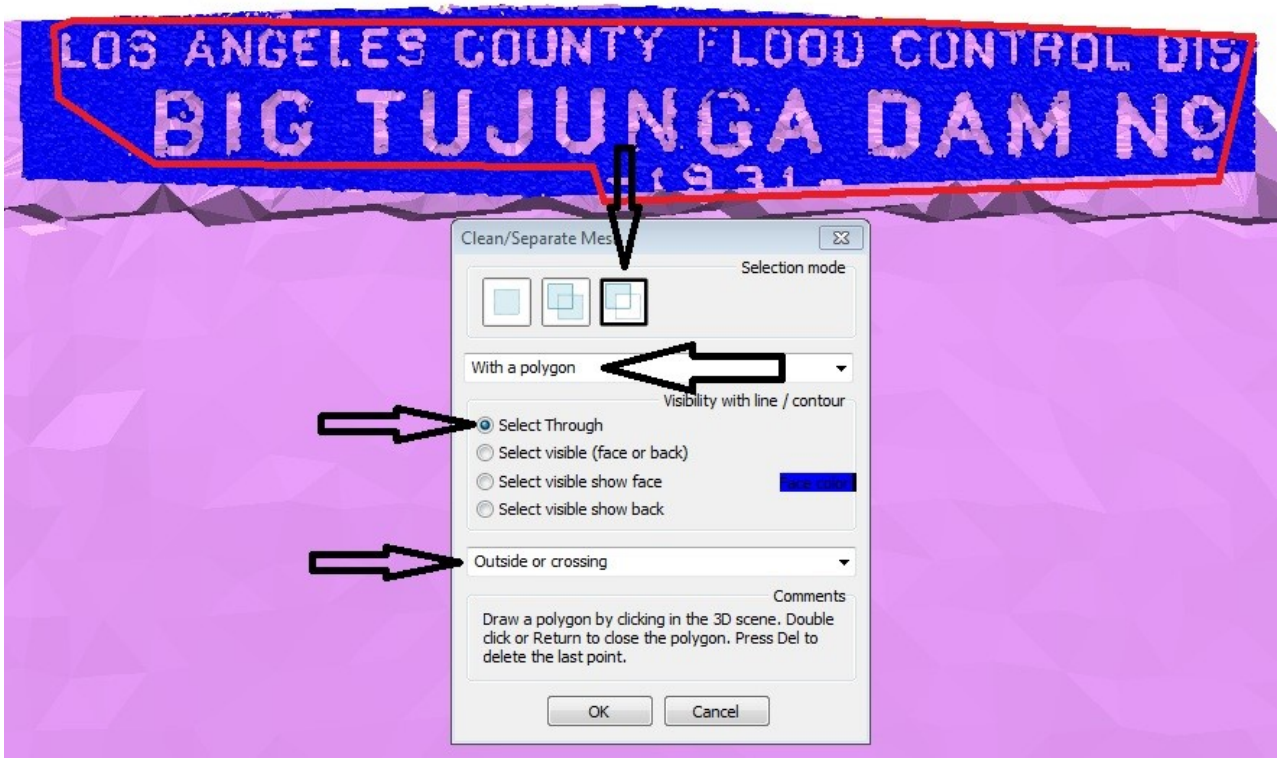


Figure 12: Removing some triangles from the selection outside the contour.

Figure 13: Result.

The command will detect that the result is made of several disconnected surfaces. Select the **Group all parts inside one Compound mesh**.

10 Re-meshing locally the edges so that they look sharp and smooth

On the model, you should see 2 types of defects: the edges that are supposed to be sharp and smooth are jagged. And some spikes are present in the smooth regions. The smoothing command will improve these two defaults.

- Select the mesh.
- Launch the command Mesh \ Smooth \ Regular smoothing.
- Open the advanced parameters.
- Move the intensity slider to zero to apply only the reorganization.
- And check **Smooth Free Border(s)**.
- Press **Preview**, then **OK, Next** to continue the smoothing.
- You can press **Preview** and **OK, Next** again to get an even nicer result.

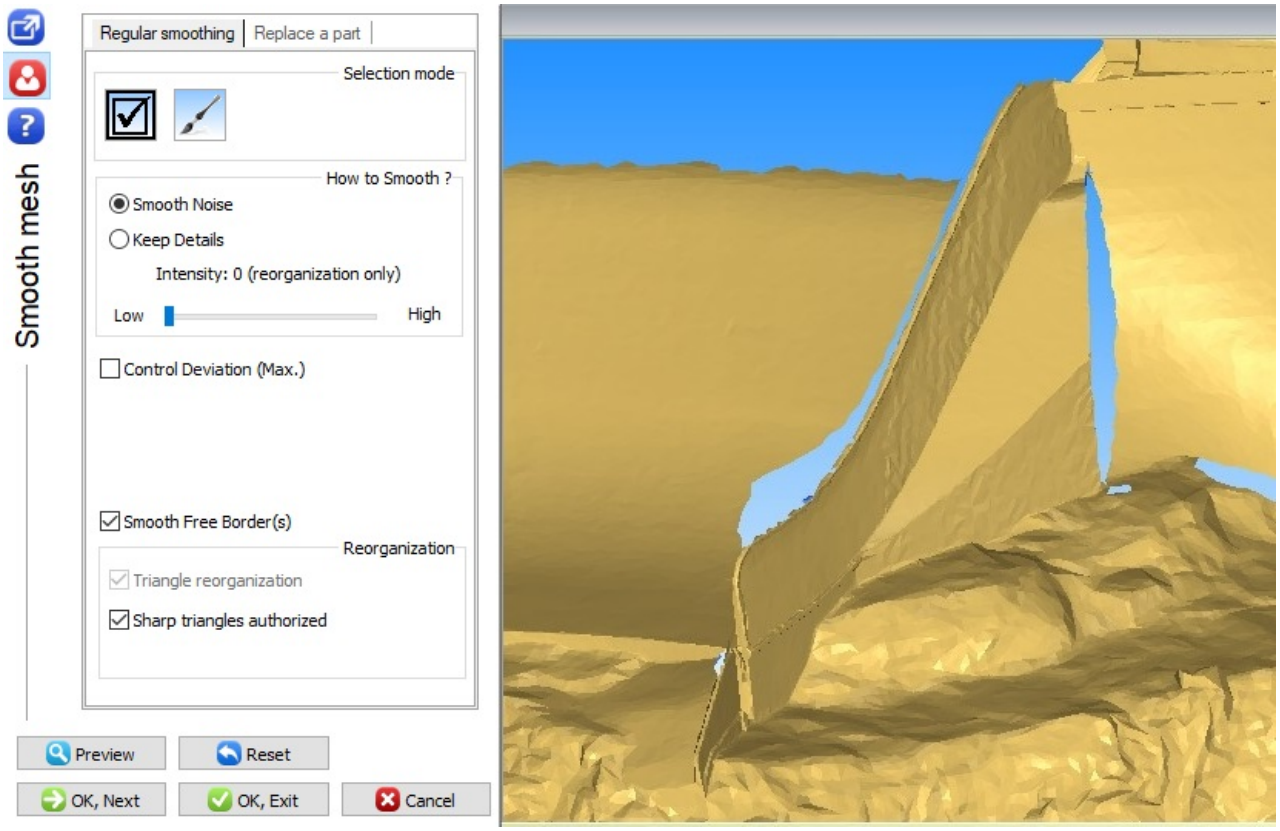


Figure 14: Using the smoothing command to make the edges sharper and to correct spiky regions.

Note that by default, the intensity slider is at 2 to globally smooth the entire model. A global smoothing is not the most appropriate choice in this case because only a part of the model is smooth (the dam structure).

Smoothing globally could round off the edges and the goal is exactly the opposite: we want to make them sharper! To make this, we will use a feature called “reorganization”, which re-meshes locally to follow the curvature and the sharp edges.

- Click on the **pencil** button. The cursor will change into a circle.
- Move the cursor over spikes and press the left button of the mouse. This will smooth the areas under the cursor.

Warning

Do not move the cursor too near to the edges to avoid any deterioration of the sharpness.

11 Extracting some features from the model: planes, cylinders

From this model, you can very easily extract some features like planes and cylinders.

- Select the mesh.
- Launch the command Measure \ Cylinder \ Extract Cylinder.
- Click 2 or 3 points using the **CTRL** key.
- In this case you will need to help the extraction indicating that the cylinder axis is fixed to Z axis.

You can slide the extraction tolerance to change the tolerance of your feature.

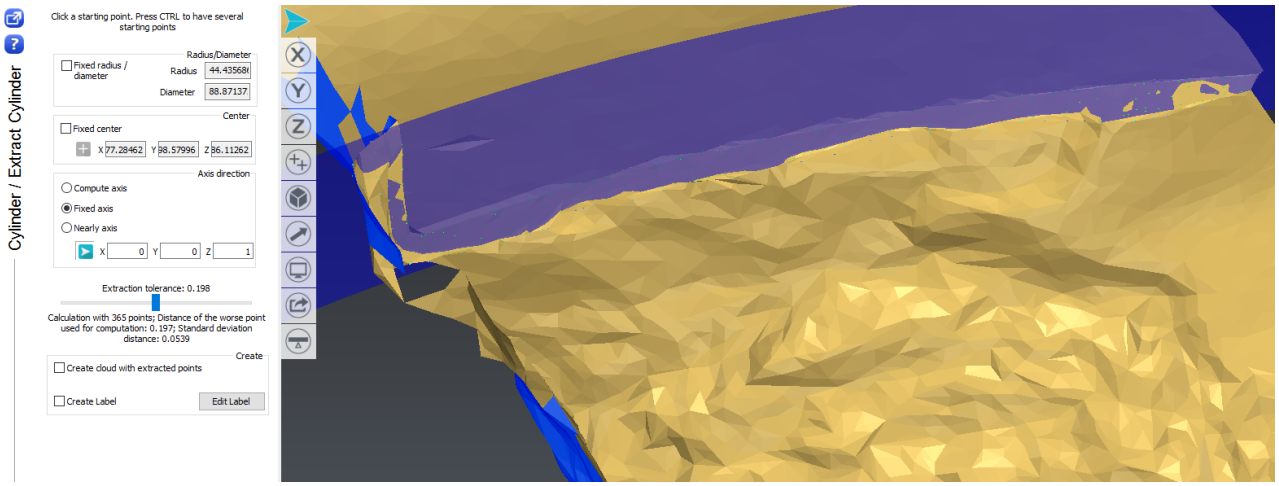


Figure 15: The Extract shape command allows you to create planes and cylinders among other geometrical shapes, fitting on your model.

Plane, cylinder and sphere extractions require one or few points. The other shapes extraction mode (**Using Nominal Feature**) requires first a nominal or reference shape.

Once your cylinder is created, you can check the **Create Label** button, then **Edit Label** to create an inspection label. A dialog box like on the picture below allows you to enter some information like the reference value, the tolerance. You can also disable some values that are not relevant for your inspection.

The position of the label is automatically calculated by the software.

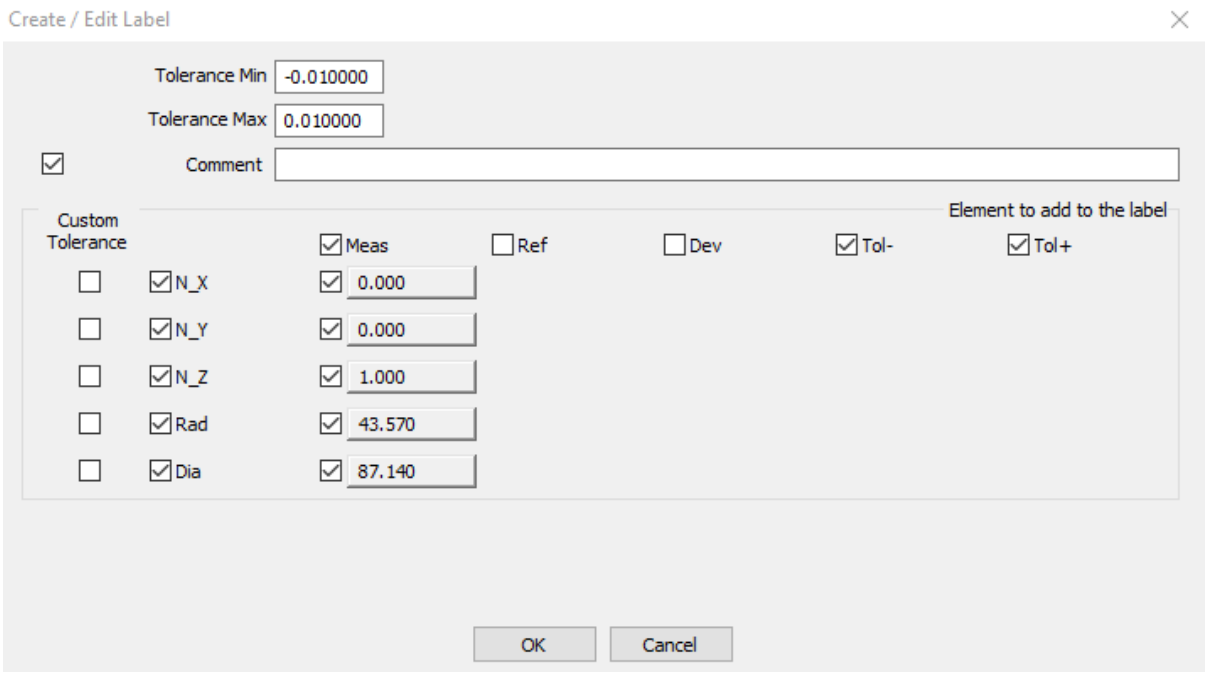


Figure 16: In the command Extract, you can create some labels to make further inspection reports.

12 Creating a freehand section

We will now create a section just below the top of the dam.

- Select your model.
- Launch the command Polyline \ Freehand sections.
- Choose the option **Unique planar section** and click 3 points on the model as shown on the right picture.
- Click **OK, Exit** to validate the result.
- Launch the command Polyline \ Cut Polylines.
- Click points on the polyline on the dam extremities.

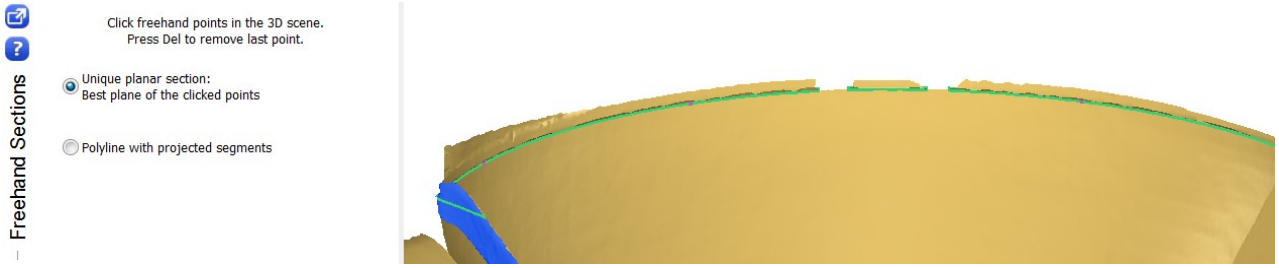


Figure 17: With the command Freehand sections you can make a planar section on the fly.

The main part of the section will become the reference line to create sections. You can delete all the other parts.

13 Creating some sections along a curve

We will now create some sections along the path that we have created.

- Select both your model and the polyline.
- Launch the command Polyline \ Sections along curve.
- Fill the dialog box as shown on the picture.
- You can also preview the sections as planes (Show Planes).

Click **Preview** and **OK** to validate the result.

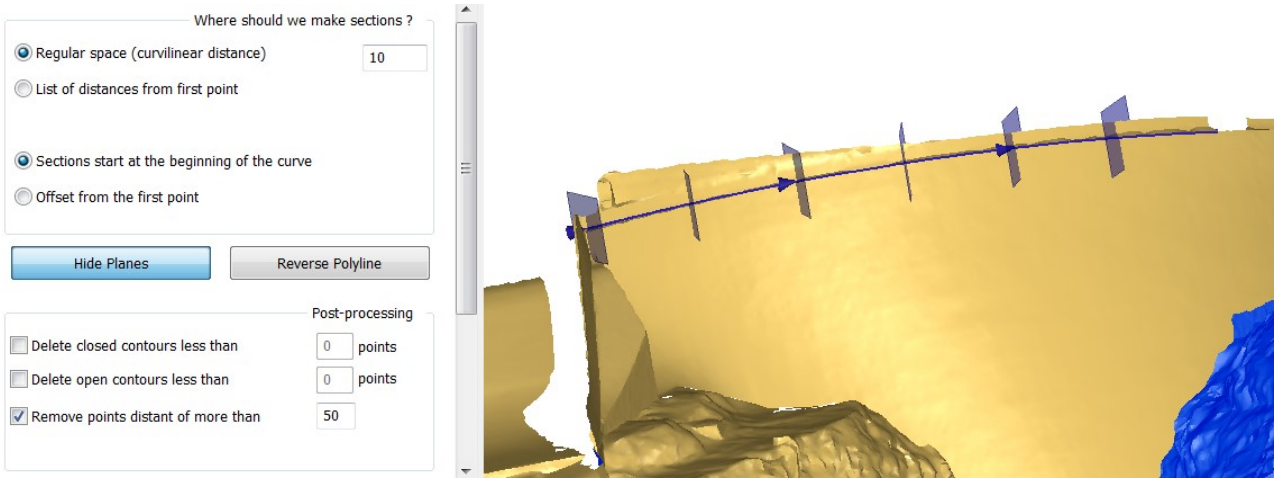


Figure 18: Using the command Sections along curve to make planar sections perpendicular to a path.

These sections can be used for different purposes:

- Export for CAD software using the DXF or IGES format.
- Split the mesh in several parts with the command Mesh \ Constraint Meshing.
- Reconstruct a CAD model inside the software. Note that the CAD reconstruction requires installing the CAD plug-in (that need to be selected during installation process) and the CAD license.