

Getting Started with Flatten module

Model and companion project for the Flatten module.

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This archive contains some tips and tricks to use the Flatten module in an effective way.

The goal is to start with the Flatten experimental module. You will learn how to create interactive contours by defining the unfolding surface while respecting the constraints of the module inputs. The contours will be manually defined on the classic dataset chocolate-bar.am on the boundaries between two materials with a mere pedagogical purpose.

The downloadable archive contains the following files:

- Project files (hx) in different stages of this tutorial
- This pdf file documenting an interactive procedure to build contours
- Videos showing the suggested manual contour creation procedure

How to build contours for the flatten module

In this section we will show how to build interactively the curves that will be used as Contours for the Flatten module respecting the input constraints. The input contours accepted by the module must satisfy the following constraints:

- a) The contours curves must be ordered spatially along one direction. This is the direction used to create the surface used to flatten the dataset.
- b) The contours curves must all have the same number of points.
- c) The contours curves must all be oriented the same way (clockwise or counterclockwise) with respect to the mentioned direction.

In this example we will input contours points at the interface between two different materials of the chocolate-bar.am dataset. The direction of choice will be the dataset Z one. We will create 3 curves of 16 points each at different Z values. To respect above mentioned constraints we will follow the positive Z axis (starting at the smallest Z value toward greatest ones) inputting points in counterclockwise order.

1. Open the chocolate-bar.am volume dataset from data\tutorials folder.
2. Create a Display> OrthoSlice module primarily for visualization and to facilitate entry points
3. Select as support plane for the first contour on the slice number 68: Figure 1

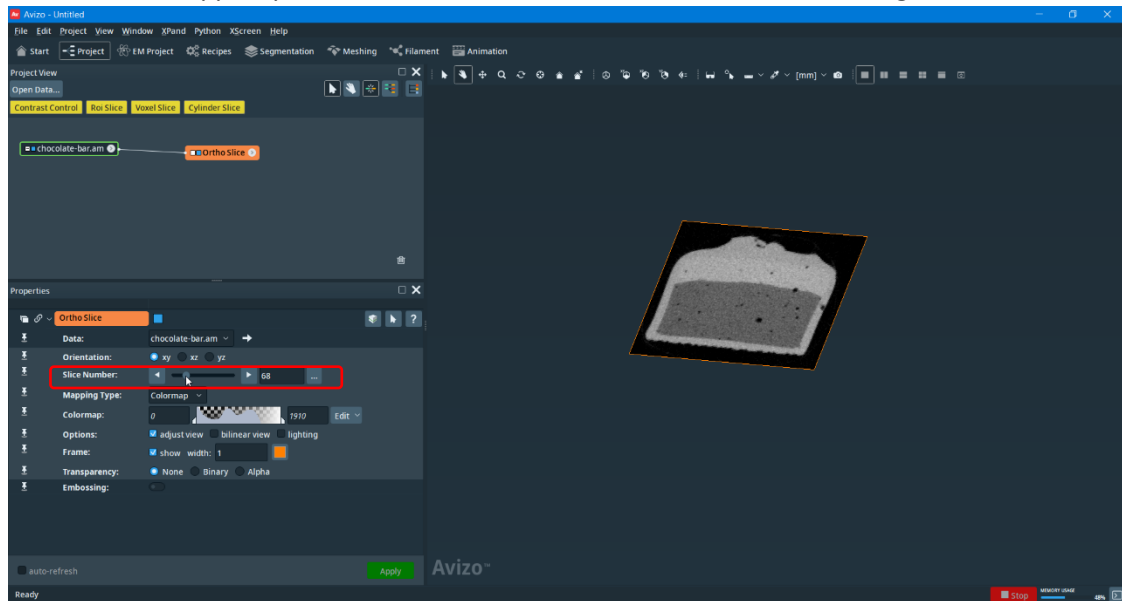


Figure 1

4. Create a Display> “Curved Slice” module from the chocolate-bar.am data
5. In this module’s “Properties” panel set:
 - a. Z as Slice direction (in general it is better to select the direction explicitly rather than chose the automatic or adaptive options).
 - b. Press “create Curve” button. See Figure 2

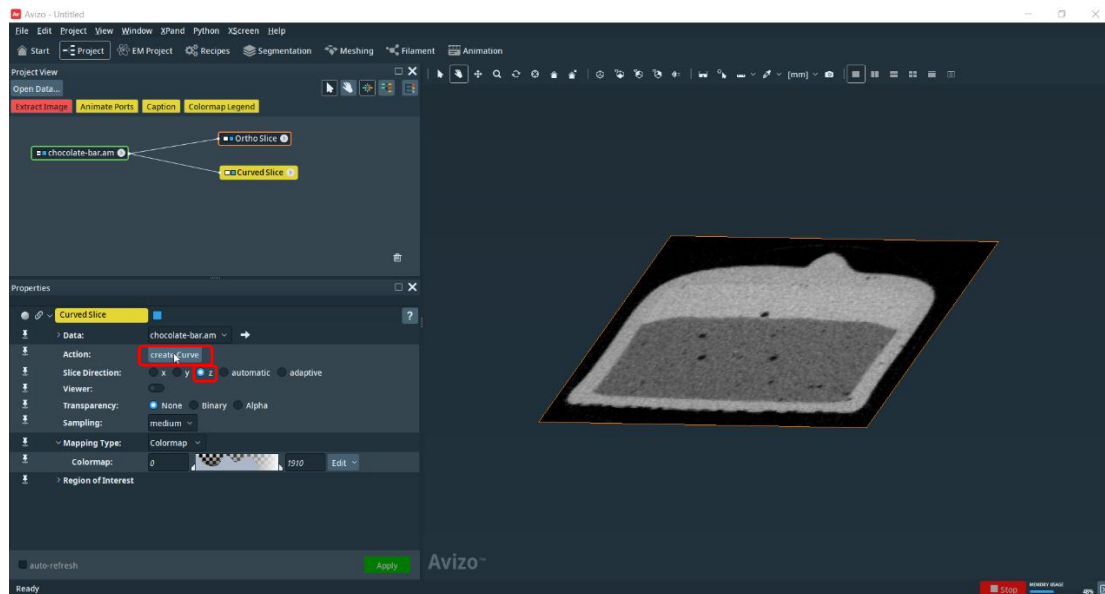


Figure 2

6. In the “Project View” three modules are created:

- a Curve
- a LineSetView
- a Base-Curve-Viewer.

7. Turn off the BaseCurve-Viewer visibility and select the Curve module. Figure 3

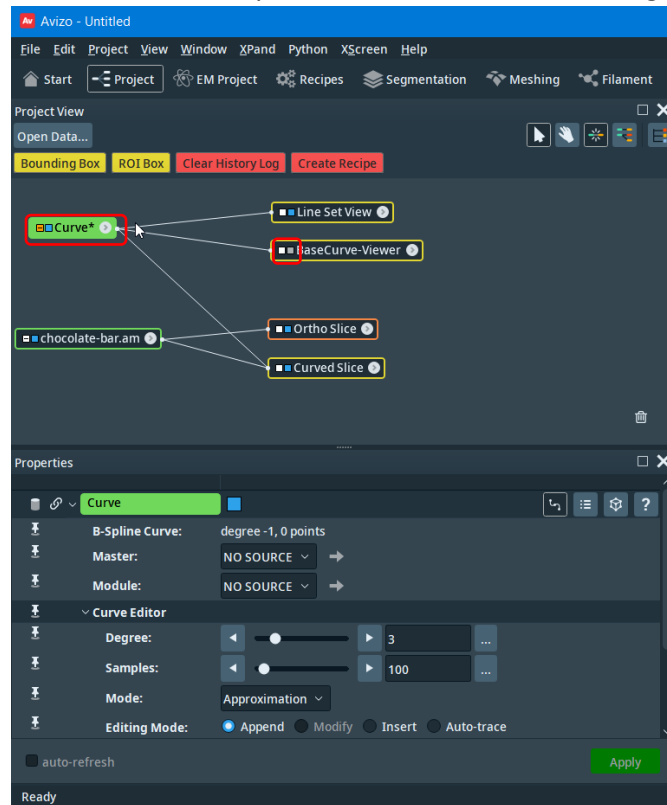


Figure 3

8. In the Curve modules properties

- set Degree port value to 1
- set Mode to "Approximation", See Figure 4

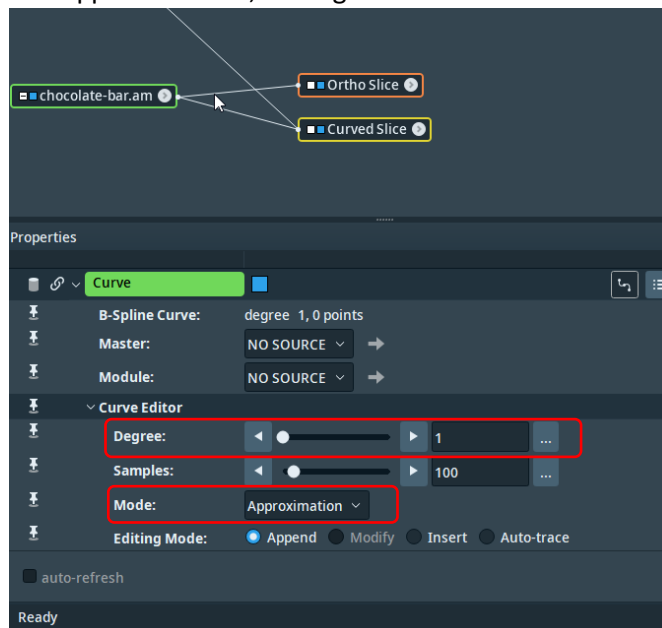


Figure 4

9. Set the viewer on the XY plane (in order to be on the plane normal to the extrusion direction (Z in our case)) and then switch to an Orthographic Camera and fit on the slice as for your convenience to input points more precisely: Figure 5

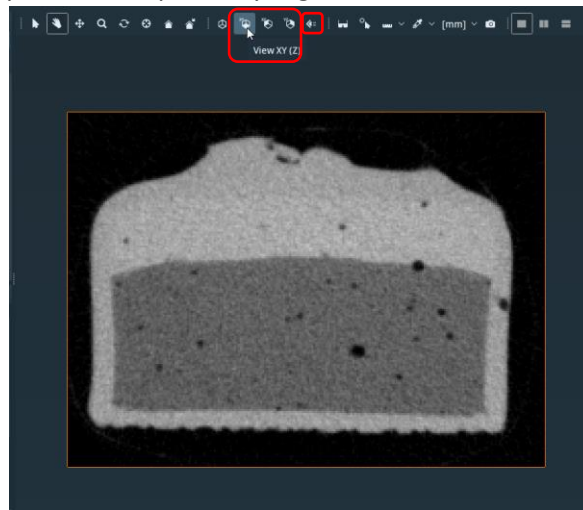


Figure 5

10. Switch to “Interact” pressing the Arrow icon in the toolbar Figure 6. Now you can select several points to approximate the underlying data structure boundary contour. To select them click the mouse middle button using a unique orientation order (proceeding for instance counterclockwise as in this example). The number of points and the order chosen are arbitrary, anyway it is mandatory to use the same number of points and the same orientation rule for all the contours). See Figure 9, Figure 8, Figure 9. The contours must not cross intersect and must not be necessarily closed.

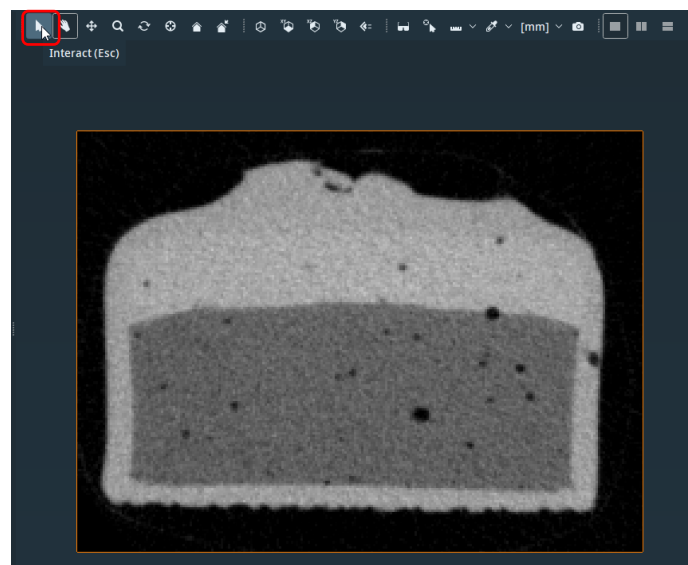


Figure 6

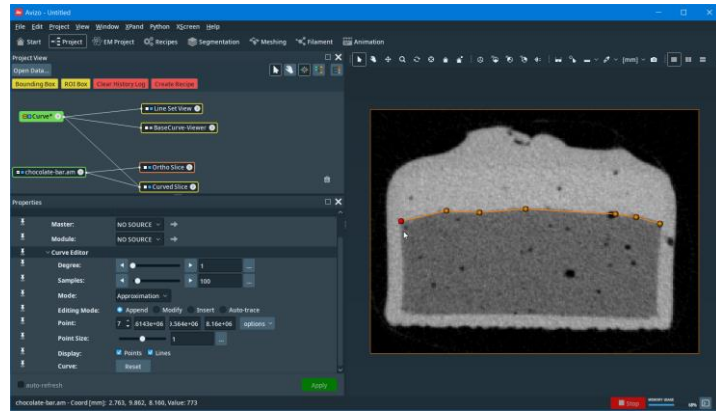


Figure 7

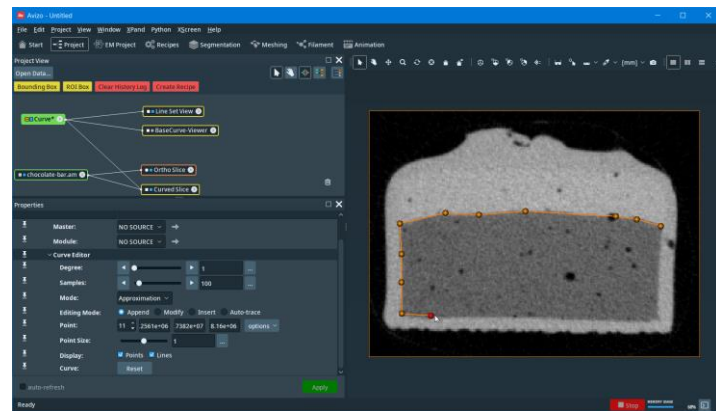


Figure 8

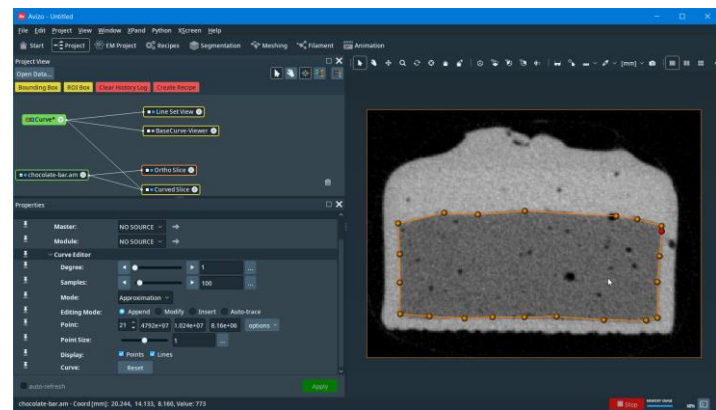


Figure 9

11. You can possibly edit the contour points by selecting the Modify option in the “Editing Mode” port. Once you are fine with your contour points you can exit the Interactive mode by clicking on the hand icon in the toolbar. The project Flatten1stContour.hx contains the project at the end of the construction of the first contour.
12. Set the next contour plane by moving, in the Orthoslice module, the “Slice Number” port. This plane, of course, has a significantly different boundary contour. Let’s suppose this is the case for the slice number 144. See Figure 10

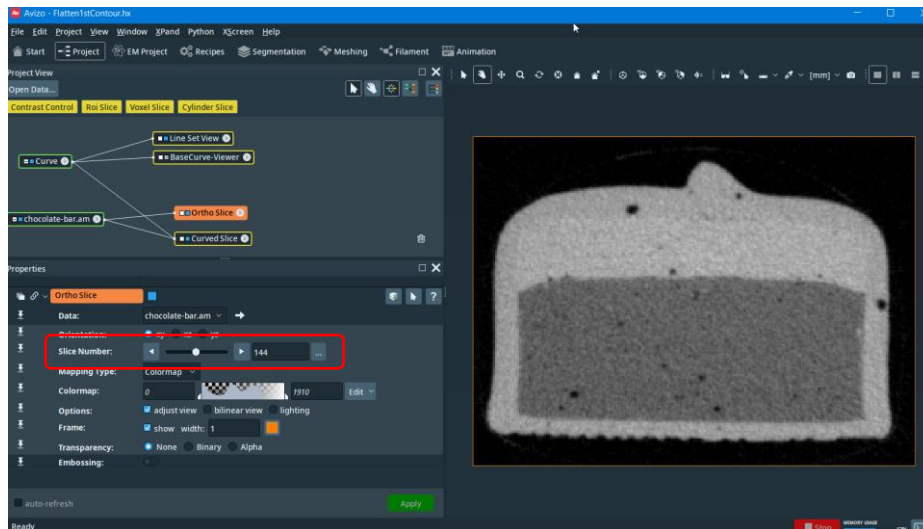


Figure 10

13. Press again the “create Curve” button in the Properties of the “Curved Slice” module. Select the “Curve2” module in the Project View and repeat steps documented above from the number 8. to number 11. respecting the same orientation and using the same number of points used before. The project Flatten2dnContour.hx contains the project at the end of the construction of the second contour.

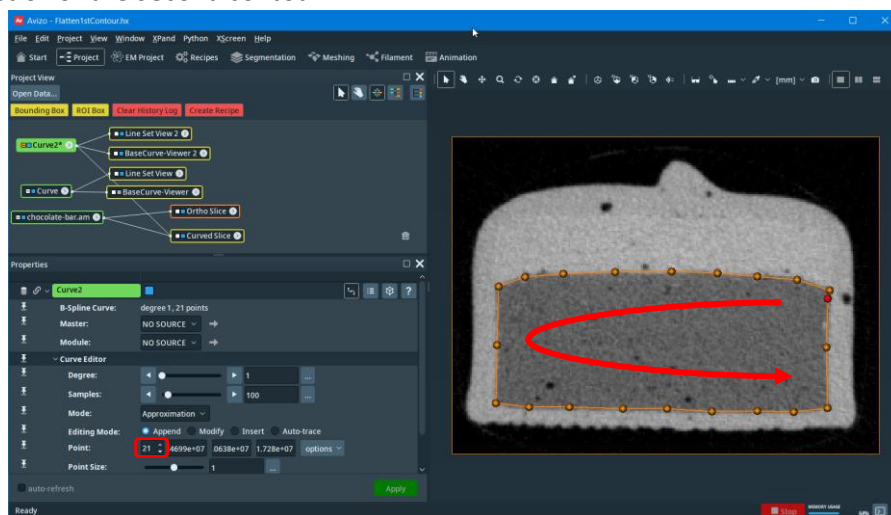


Figure 11

14. Repeat the construction of as many contours as you need. We will limit to just a final one on a third plane. Select the slice number 278 to define this plane. The former “Curve2” can be shown as to appreciate its difference from the current boundary, see Figure 12 .Press again the “create Curve” button in the Properties of the “Curved Slice” module. Select the “Curve3” module in the “Project View” and repeat steps documented above from the number 8. to the number 11. Again, it is mandatory to use the same orientation and the same number of points used before. The third curve is show in Figure 13. The project Flatten3rdContour.hx contains the project at the end of the construction of the third contour.

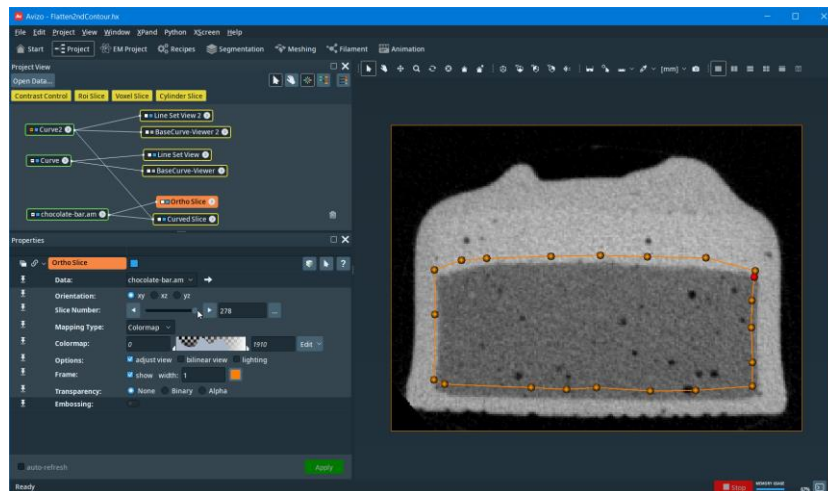


Figure 12

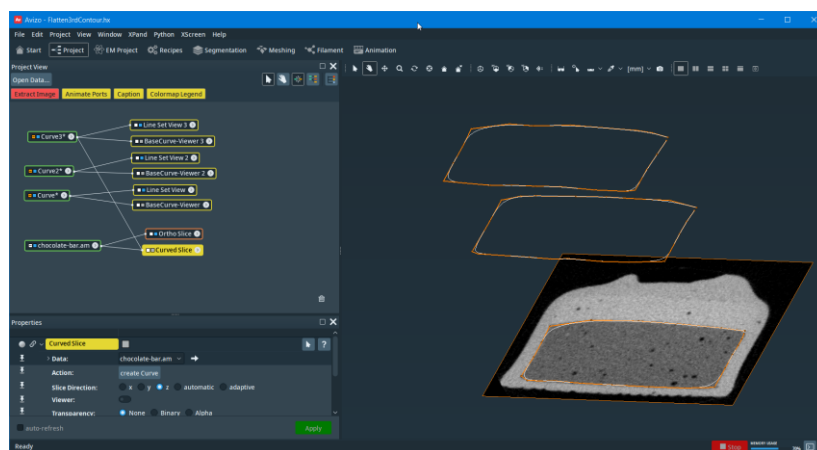


Figure 13

How to merge curves to be used as input

The flatten module mandates input curves to be provided as a unique line set. We will create this set of lines by mean of the “Merge Line Sets” module.

1. Right click on the “Curve3” module in “Project View” and select the Compute > “Merge Line Sets” and create it.
2. In the Properties of this module select the above created curves Curve3, Curve2 and Curve as inputs for ports Lines01, Lines02 and Lines03. The Merge Line Sets module allow to merge curves also with line sets. In case of more than 10 contours you can merge them over and over by using several “Merge Lines Set” in cascade. Figure 14 show the result of the Merge Line Sets “Lines.merged” by mean of a “Line Set View4” module. The project FlattenMerged.hx contains the project at the end of the merged of the three contours.

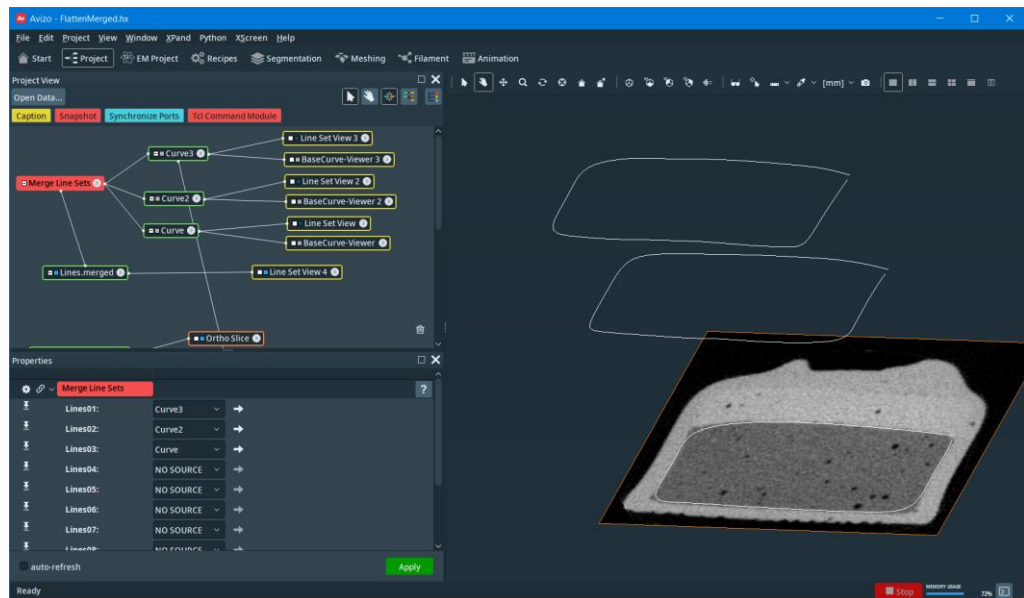


Figure 14

Apply Flatten module

We can now use the Flatten module applying it to the original chocolate-bar.am dataset.

1. Right click on this dataset representation in “Project View” and select Experimental > Compute > “Flatten” press the Create button.
2. In the Properties of this module, select in the “Contours” port “Lines.merged” line set as input value.
3. Select a thickness value for the volume region around the defined contours to flatten. The “Thickness” is in current display units. The “Number of Steps” is the number of voxels of the flattened scalar field. It will result from the rounded division of the value set in the “Thickness” by the value set in the “Step Size” port (initially set to the original voxel size value).
4. If you open the “Output” tear down group you can see that apart from the flat scalar field you can obtain as result of the module computation also the extruded grid, the flattened one as well as the extruded and flattened surfaces and triangle (Grids). See Figure 15 where the flattened scalar field and the extruded surface were selected.

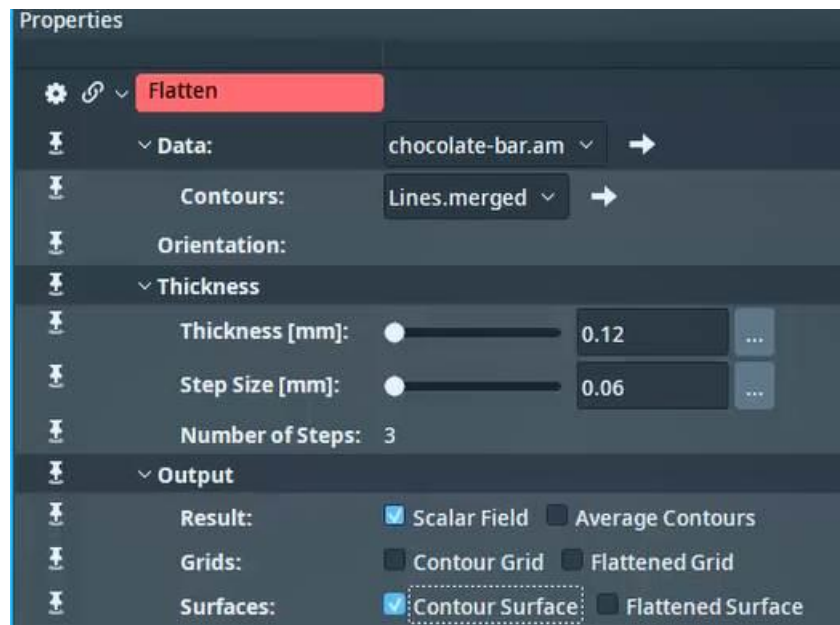


Figure 15

5. By pressing the “Apply” button the “chocolate-bar.flattened” scalar set will be created. You can visualize it by mean of a Volume Rendering module as shown by Figure 16. The project FlattenResult.hx contains the project at the end of the computation of the flatten module.

For example, in Figure 17 also the extruded surface “chocolate-bar.contourSurface” created as additional output by the Flatten module is displayed through a transparent “Surface View” module.

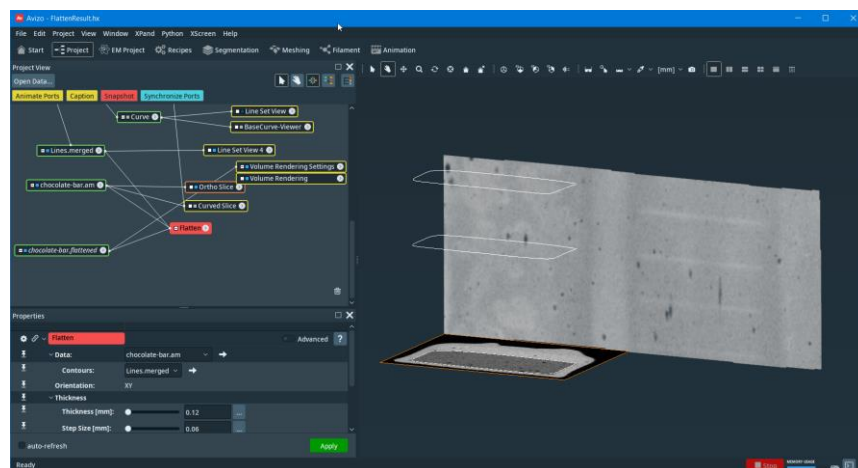


Figure 16

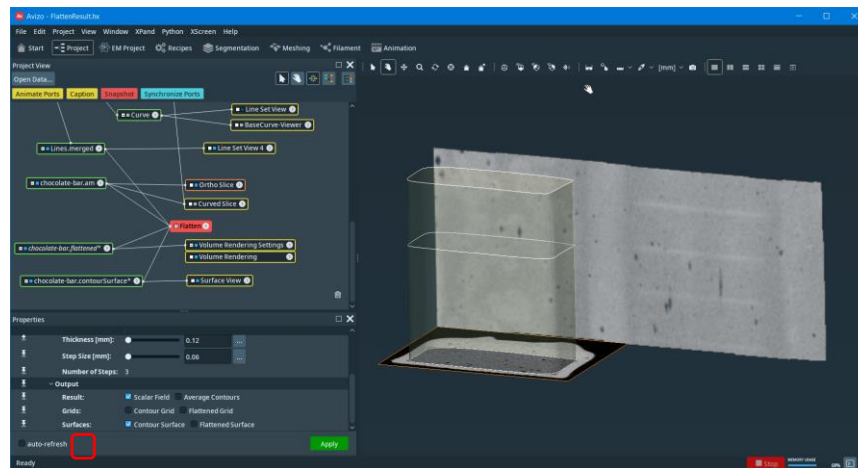


Figure 17

Hints

Sometimes the input contours points can be not perfectly lying on the same plane. This can result from picking error or floating number precision limit. In this case when trying to apply the Flatten module you are warned about the problem. See Figure 18 It is possible to increase the accepted relative error for contours points by setting a larger value in the “Max Deviation” port located in the Alignment group (visible if the Advanced options are enabled). See Figure 19

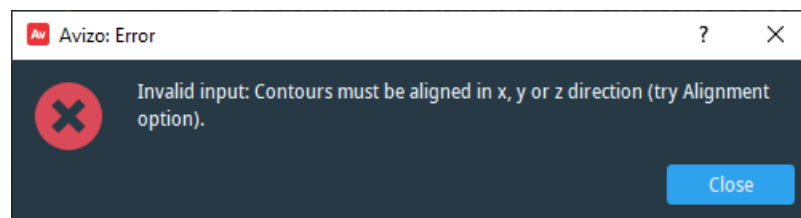


Figure 18

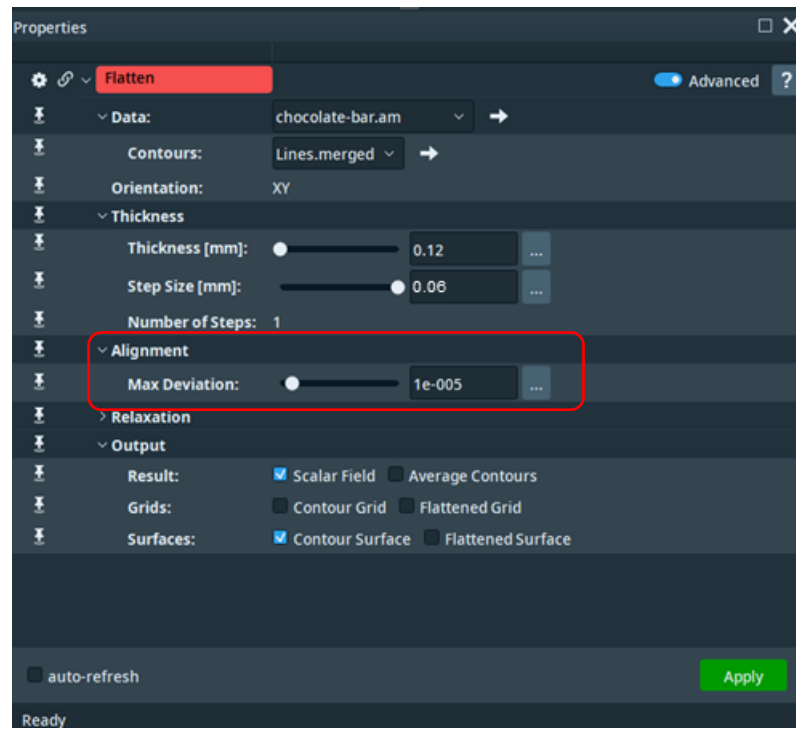


Figure 19