GroBoto v3 SeamNet Mesh Notes

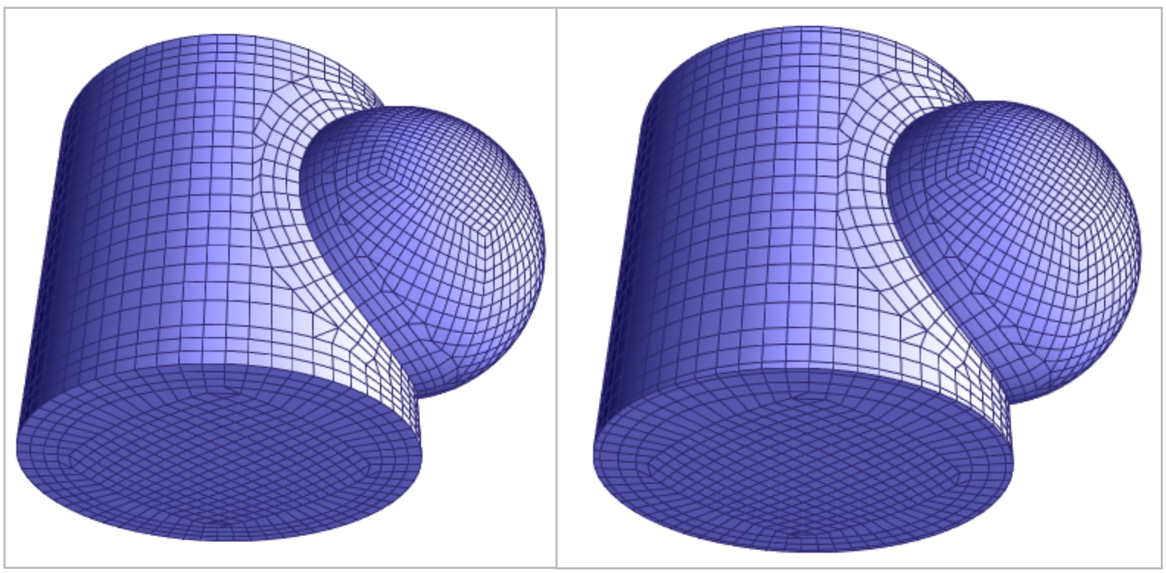
These notes offer some detailed descriptions of Seam Settings in the GroBoto OS X 3.0 release and Windows Beta 2.9.9e released in mid February 2011. These tools will continue to evolve throughout the v3.x cycle. **Tools Options and settings may change**.

Please check the GroBoto Site (www.groboto.com/v3Beta) for updates.

This document is divided into six sections:

1. **Seam Width & Crease**
2. **Seam Smoothing**
3. **Cap Settings**
4. **Shared Surface Seam Removal**
5. **Object Specific Seam Settings**
6. **Technical Notes**

1. Seam Width & Crease

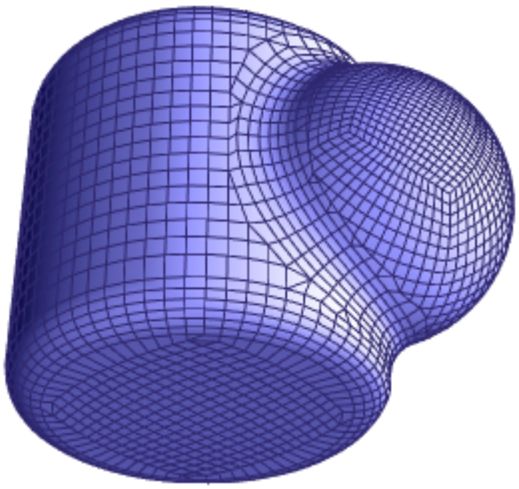


An important part of SeamNet Mesh are regular rows of quads along each seam (edge loop) where primitive surfaces intersect. These are seam strips. The Rows slider specifies how many rows of quads the strip has on each side of the seam (three in this case). The Width% slider specifies how wide is the strip (on each side) as a percentage of the regular quad size on this surface (quads outside of the strip). In this case it's 200%, twice the regular quad size. Since there are three rows, each row is about 200/3 = 67 percent as wide as the regular quad.

Usually all the rows are the same width. However, the width of the row closest to the seam can be controlled separately, using the Crease% slider. When this percentage is less than 100, the row right next to the seam is narrower than all the others. When it's more than 100, the row next to the seam is wider than the other rows. Row width is redistributed without changing the overall strip width. In the example above right, Crease% is 40.

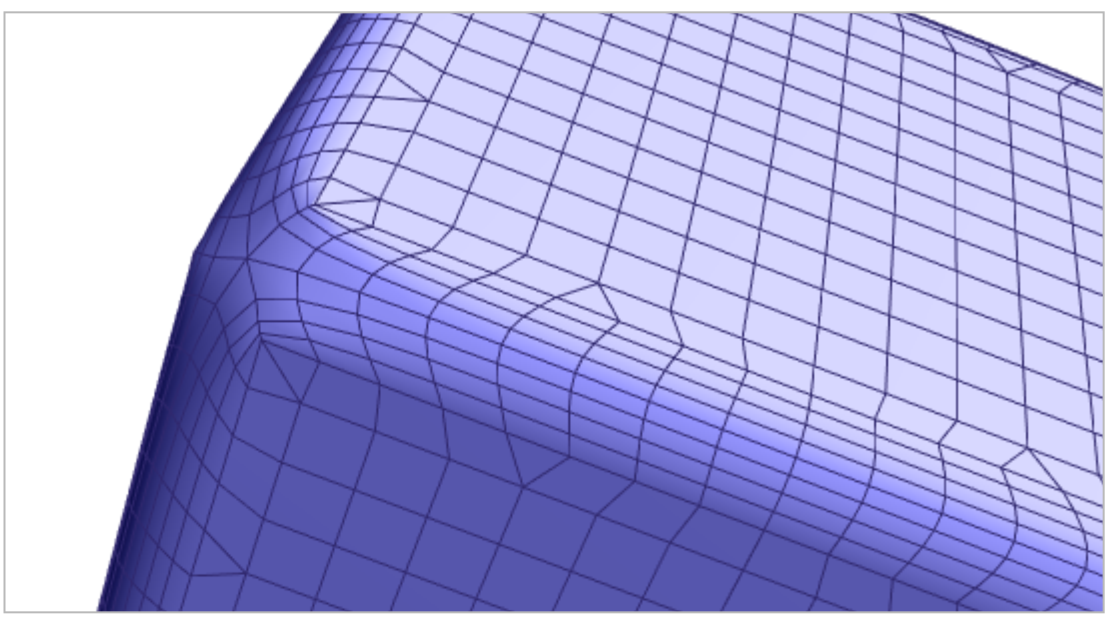
2. Seam Smoothing.

By default the edge between any two surfaces in Groboto is sharp, producing an abrupt change of the surface normal as we cross the seam. Smoothing modifies the surface within the seam strip, creating a rounded edge.

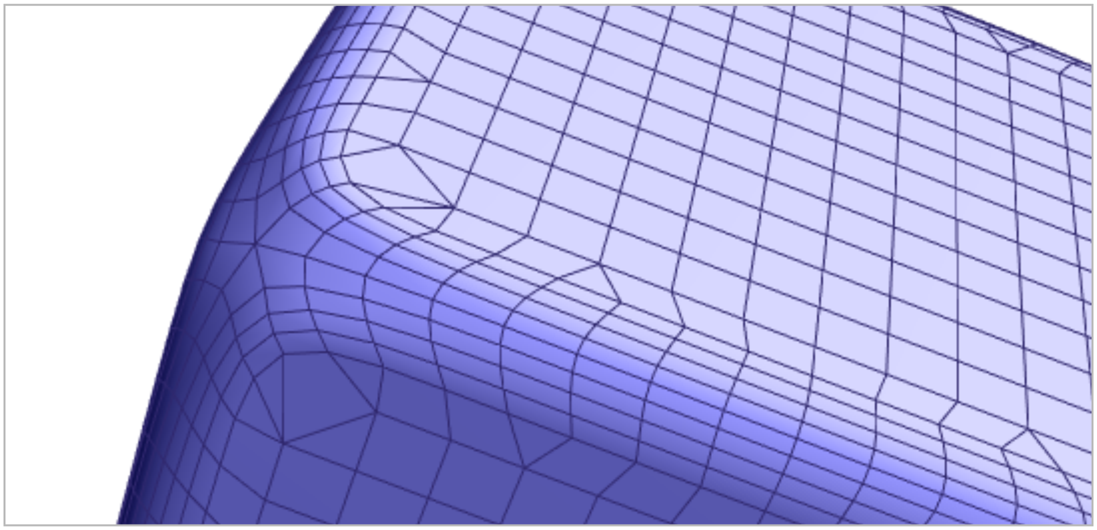


The most basic form of seam smoothing shown above is enabled by checking the Seam checkbox under Smoothing and setting its slider, typically to some value in the middle. Smaller values produce only a slight smoothing effect - the seam becomes a little less sharp, while the rows in the strip farther away from the seam hardly move at all. Greater values spread the smoothing effect farther from the seam, producing more gradual rounding. At some value (depending on the number of rows) full rounding is achieved and moving the slider farther to the right has no effect.

In many cases seam smoothing alone produces fairly awkward results at the corners, as seen here:



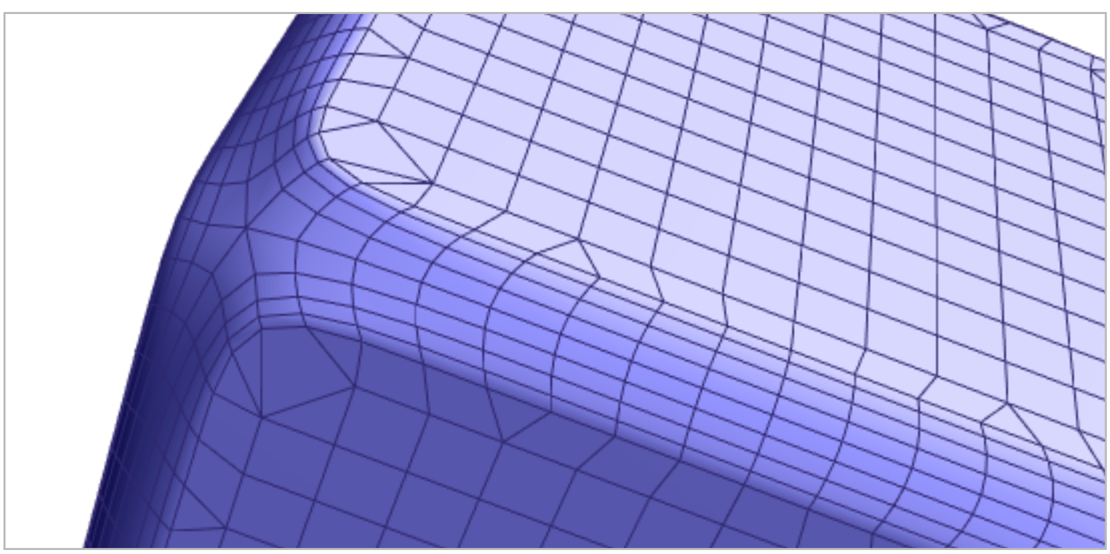
This happens because seam smoothing allows the middle of the seam strip to deform, but keeps the outer edges of the strip at a fixed position. When that outer edge suddenly changes its direction at a corner, the deformed strip rows pile up at the corner making it stick out very unpleasantly. Depending on the Width% setting the strip rows can actually slide under the corner. What's needed here is smoothing of the strip boundary before it is used as a fixed boundary when deforming the strip. This is done by choosing Round in the Border drop-down and setting its slider, typically to some pretty small value (3 as shown below):



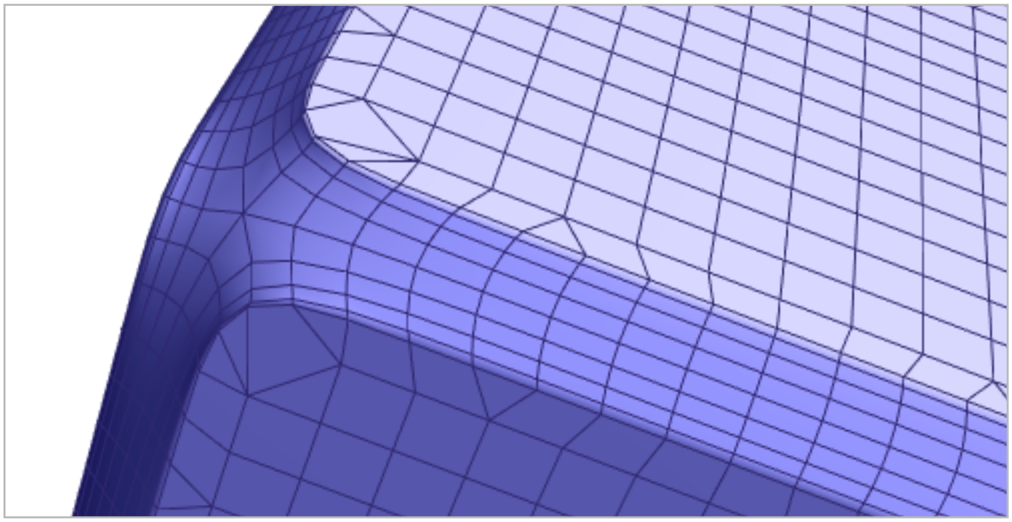
The boundary of the strip is rounded, allowing the deformed strip to flow very naturally through the corner area.

When using the above described two options in the Border drop-down - None and Round - the already mentioned Crease% setting has a significant effect on the shape of the deformed seam strip. The examples above were produced using the default setting of the Crease% slider. To signify its new role when used with smoothing, as soon as you enable seam smoothing by checking Seam, the default Crease% value changes to zero. Zero means neutral, the plain vanilla rounding effect. When the Crease% slider is moved to the left, the values become negative and the rounded seam flattens, becoming more like a bevel.

Here's the result at Crease% = -50:

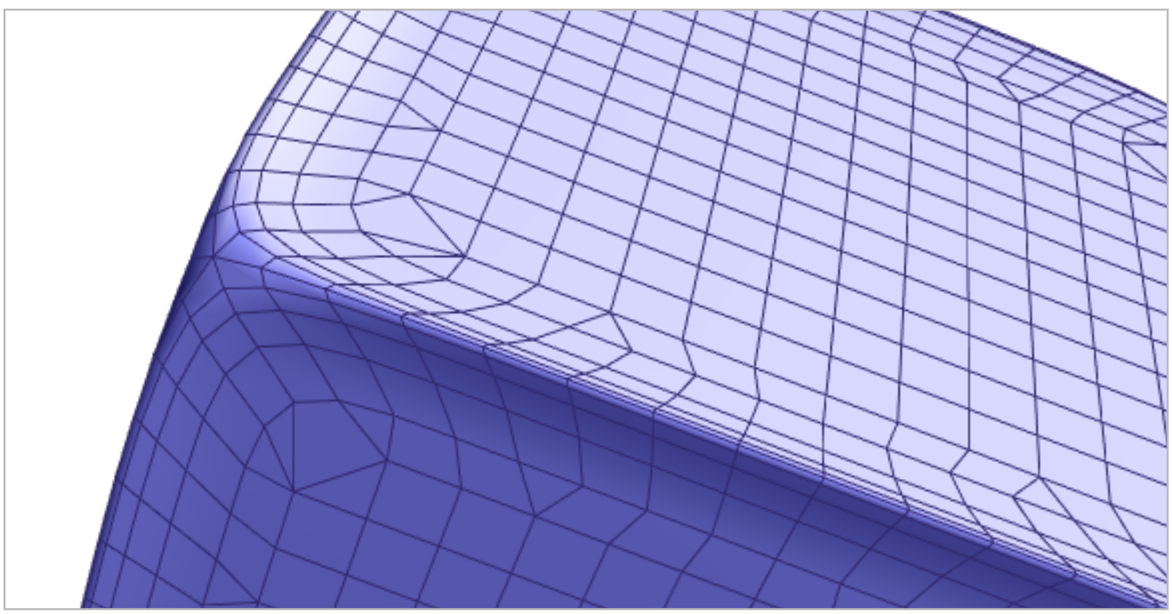


...and here the Crease% = -95:



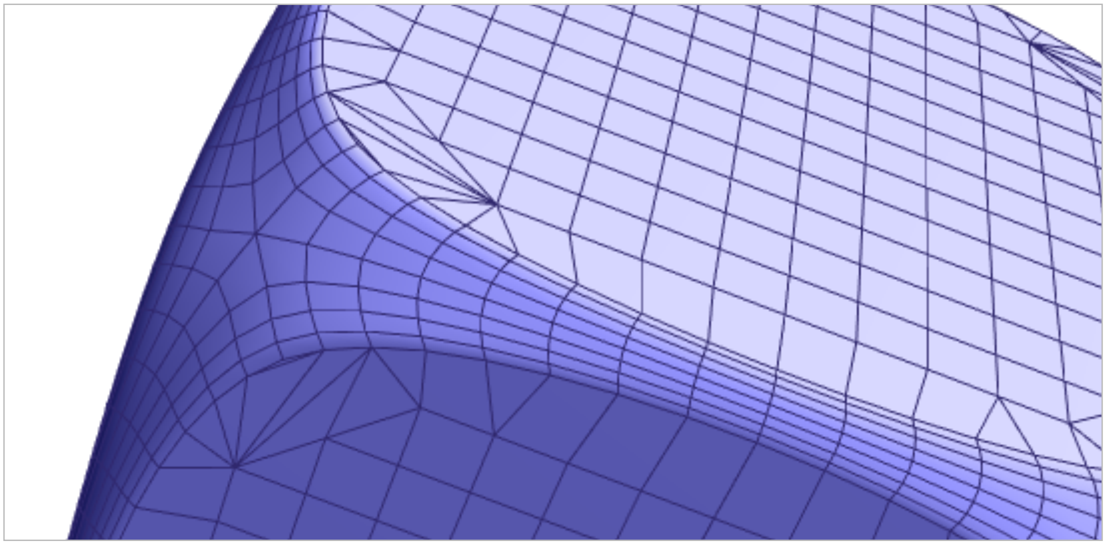
When Crease% slider is moved to the right the values become positive, and we have the opposite effect - the rows are squeezed towards the center of the strip, and for higher values they form a protruding ridge that rises even higher than the original sharp edge.

Below is the result at Crease% = 200:



An alternative approach to achieve natural seam smoothing near the corners is to use the Drift option in the Border drop-down. Rather than smoothing the strip boundary as a separate procedure before smoothing the seam strip, this goes ahead with strip smoothing right away, but without holding the strip boundary to its original position. The strip boundary freely slides along the surfaces on both sides of the seam (but it cannot leave the surfaces) and the boundary itself is rounded at the corners as the result of general strip relaxation.

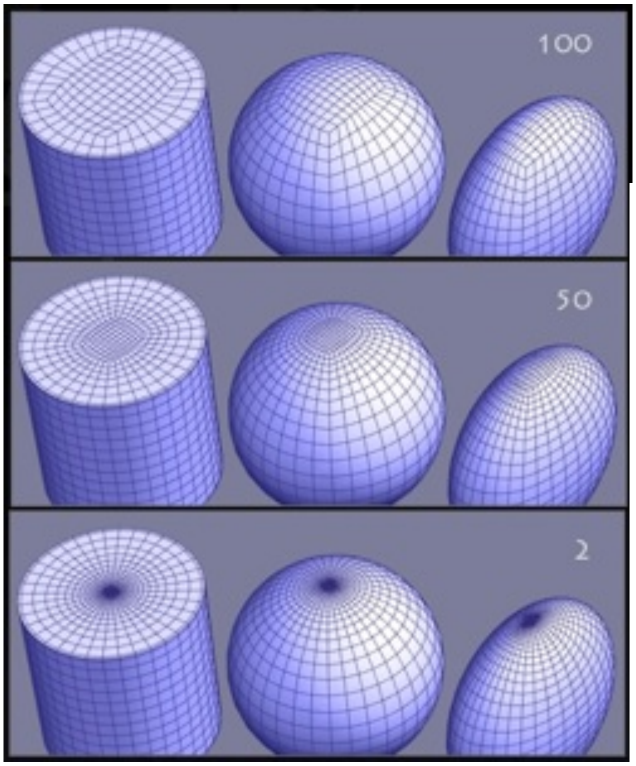
For smaller Seam slider settings the results of this single-stage Drift relaxation could be very similar to those achieved by the above method of first rounding the boundary, then relaxing the strip to conform to the boundary. With higher settings the results differ significantly:

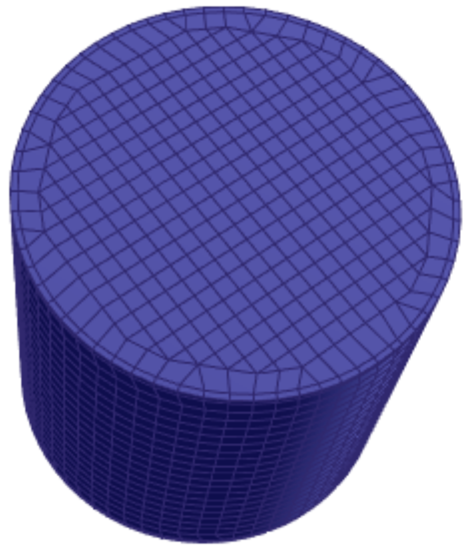


Comparing this to the image at the bottom of page 2, we see here considerable variation of the width of the strip - wide at the corners, narrow elsewhere. There the strip was essentially fixed width, other than a slight increase in width because of boundary rounding near the corner. Here nothing holds the boundary to any particular width; the greater the value of the Seam slider, the more it will drift away from its original position.

Finally, choosing Both in the Border drop-down combines both methods - the strip boundary drifts freely, but from a starting position defined by preliminary border smoothing.

3. Cap percentage.

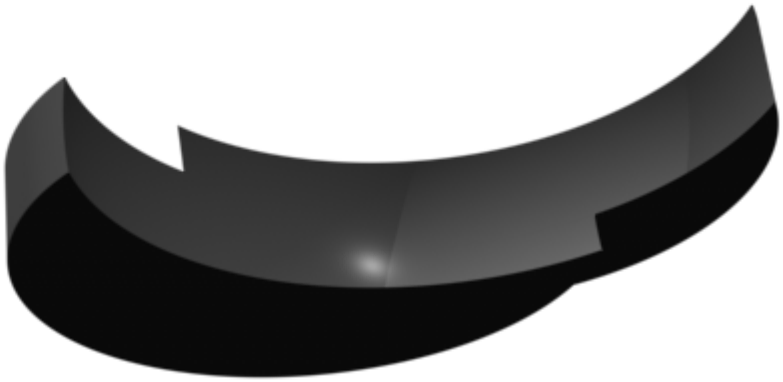




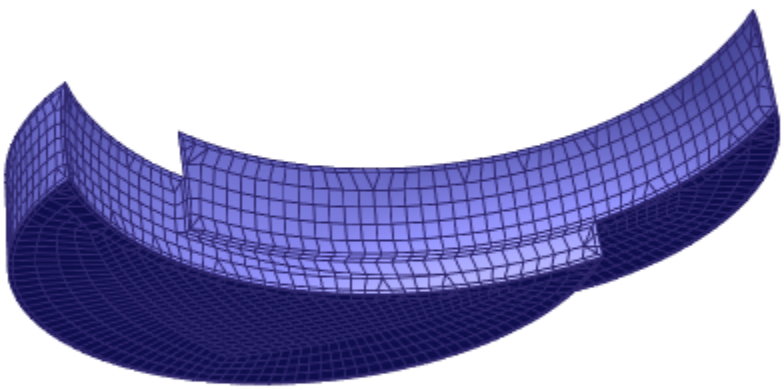
Most Groboto primitives have 'caps' - it could be a separate surface (on a cylinder) or just an area where the mesh pattern has to switch from circular to square (spheres and ellipsoids). Cap percentage controls the size of the square pattern area. Most often you'd want to leave it at 100%, producing maximum possible quad size given the overall density setting. Sometimes though you want the circular and radial pattern to continue towards the center - for instance, when you attach a smaller cylinder or sphere to the center of the cap of the larger cylinder. Just make the Cap% small enough so that the square mesh pattern disappears under the object you are attaching to the cap. On cylinders a special setting Cap% = 1 generates a simple uniform square mesh pattern on the cap, like the one used on square sides of a cube.

Usually a pattern like this is not desirable on the cap of a cylinder because of its irregular connection to the circular edge of the cap. There are cases where the uniform grid density it produces offers an advantage, such as the merging of caps of several cylinders into a single surface (see page 9).

4. Shared Surface Seam Removal.

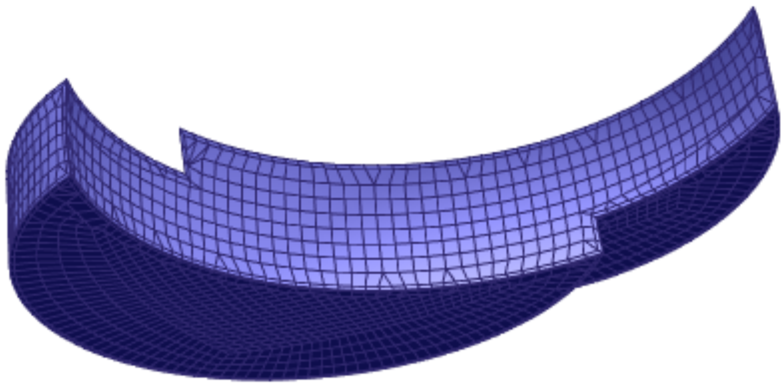


Here we have a simple Boolean cluster - two overlapping disks trimmed by a subtractive sphere. By default, the SeamNet mesh of this cluster looks like this:



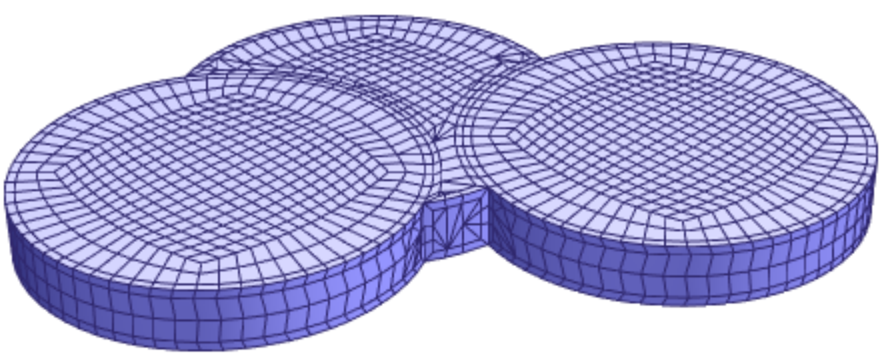
The surface facing us has a seam running through it, indicating the boundary between the two disks. If we do smooth-shaded rendering of this mesh we won't see the seam - it's the same surface on both sides of it:

However, the presence of this seam could reveal itself if we do something interesting with the mesh, like sculpting. To remove this seam choose Trim Only in the Shared Surface Seam Removal drop-down. Here's the resulting mesh:

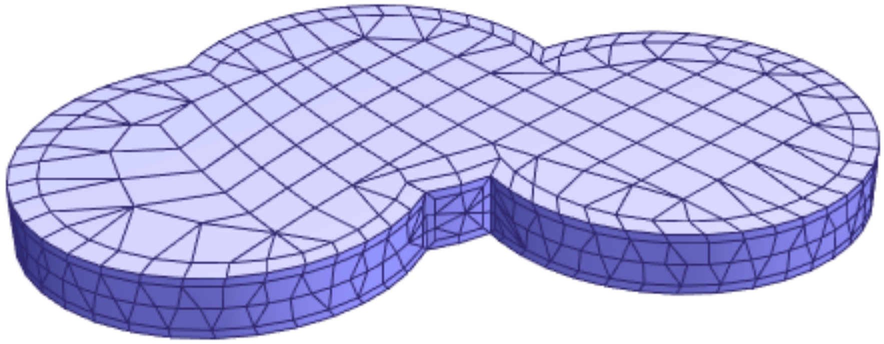


This seam removal option extends only to seams between different areas of the same Boolean trim surface. It is always OK to use because there is a consistent definition of the mesh grid on the entire trim surface, we just remove its artificial division into parts corresponding to different primary objects (disks in this case). There is another seam removal option - All in the drop-down - whose use can be illustrated by the following example:

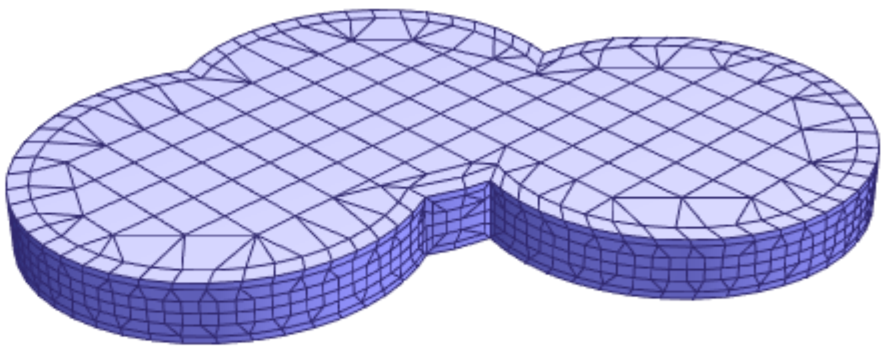
Here we have a number of disks whose cap surfaces coincide with each other (typically produced by duplicating the original disk and moving the duplicate along axes X and Z, but not Y). By default the SeamNet mesh of this arrangement looks like this:



Here we also might want to get rid of the seams between individual disks and generate one continuous clean mesh on the entire upper surface. However, unlike the case of the shared Boolean trim surface, where the mesh grids on different parts are consistent with each other to begin with, here each cap has its own grid which will not flow seamlessly into the grid on the next cap. Ugly as it is, the seam between different disks provides an important service - it stitches together two completely unrelated grids. If we go ahead and choose All in the Shared Surface Seam Removal drop-down, we get the following mesh:

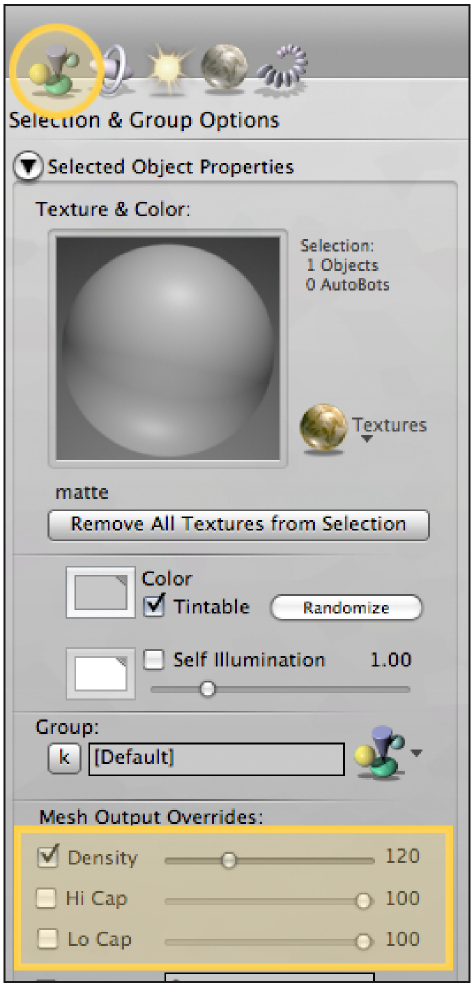


It simply takes the standard cylinder cap grid pattern - square grid inside, radial-circular outside - from one of the disks and extends it over the entire surface (the only difference is that it is scaled to reflect the larger size of the combined surface). Of course, in an irregular area like this the standard circular cap pattern offers no advantage and looks pretty ugly. We would be better off using a simple square grid pattern which we can enable by moving the Cap% slider mentioned on page 3 all the way to the left (1%).



This seam removal option should be used with some caution - unlike Trim Only, it might or might not generate a better mesh, depending on the particular arrangement of primitives.

5. Object-Specific Mesh Settings



Often the automatic mesh density settings that Groboto uses for different objects do not adequately take into account the particular roles these objects play in the scene. This shows up as significant discrepancy between mesh densities of two surfaces meeting at a seam. The cure is to manually set the density for one or both of these objects to achieve better harmony between the densities.

The Selected Object Properties tab of Groboto's Main panel has a section with Mesh Output Overrides. When one or more objects are selected checking the Density checkbox will override the global density setting for these objects with an object-specific setting as indicated by the slider. The same can be done for the Cap% setting (see page 3), separately for the two caps of cylinders, cones or sliced spheres (for spheres, ellipsoids and hyperRods only the Hi Cap setting is active, affecting both caps).

When working with Booleans the mesh density settings could be set separately for each primary and each trim, which can be really helpful when trying to set a consistent mesh density over the surface of a complicated Boolean cluster. When Toggle Booleans is ON trims are not visible as solid objects. After right-clicking on a Boolean cluster and choosing Activate Object's Boolean Editing they become visible as outlines. They should be selected by Alt-clicking on their outlines (lines turn from blue to red), at which point their mesh density could be set by the overrides slider. To look at the mesh click Preview (there is no need to exit the Boolean Edit setup). Uncheck Preview to get back to Boolean Editing. Primaries are selected by clicking on their solid bodies.

6. Technical Notes

Cube Size

This option is used to address a rarely encountered problem when the SeamNet mesh produced from a model has some small parts of the model missing (it can also show up as a message "Cannot generate mesh", creating no mesh at all). To produce a SeamNet mesh Groboto analyzes the model by slicing it with a cubic grid. The size of the cubes is adaptive and reflects the size of different objects in the scene and their parts. On rare occasions this adaptive mechanism fails, missing some small feature of the model. This can always be cured by reducing the size of the cubes with which Groboto analyzes the model. The Cube Size slider indicates the size of the cubes to be used, as a fraction of their normal size.

If the model meshes OK with standard size cubes using smaller cubes will not change the resulting mesh at all. This is not a mesh quality setting. Using smaller cubes slows down mesh generation and increases memory use (very significantly for complicated models and really low Cube Size settings). This feature should only be used when the default setting 1.0 produces an incomplete mesh or no mesh at all.

Unsupported Objects

Some Primitive Types are not supported by the SeamNet Mesh Generator. Some Primitives are automatically converted to simpler forms, others will not be included in the mesh at all.

Converted Primitives

- Beveled Boxes, Cones, Cylinders • Converted to Un-Beveled counterparts

Ignored Primitives (will be completely excluded from mesh)

- OctaCylinder
- OctaCylinder Beveled
- Eyelet