Lab 5 - Blender modeling and geometry processing with Meshlab

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0 Assignments

1. Blender
   (a) model either an object or a scene
2. Geometry processing with Meshlab
   (a) mesh object reconstruction from point clouds (Poisson,MLS, Marching cubes)
   (b) use tools Fill Hole/Mesh Repair to close a corrupted mesh
   (c) FAIRING: apply a fairing filter to a disturbed mesh
   (d) DECIMATION: simplify on multiple levels a mesh with a high number of elements
   (e) use the quality measure tools for surfaces (curvature)

1 Blender

1.1 Model either an object or a scene

The modeled scene in this assignment is called "a messy Japanese tea ceremony" and it includes:

- a table;
- a tray;
- a plant;
- 2 standing teacups;
- a fallen teacup with spilled tea;
- a teapot;
- tea leaves;
- a cloth.

All the aforementioned meshes have been modeled by the assignee following the beginner's tutorial on Youtube by Popolo di Blender.

1.2 Table

The table was simply modeled as a resized cube. The light was positioned right on top of the table, a bit low, so as to give the feeling of a hanging chandelier.

1.3 Tray

The tray was modeled starting from a cube and using the **Extrude** function to create the depressed area, typical of trays. Then, with the **Bevel** function the edges of the tray were refined to look a bit more blunt.

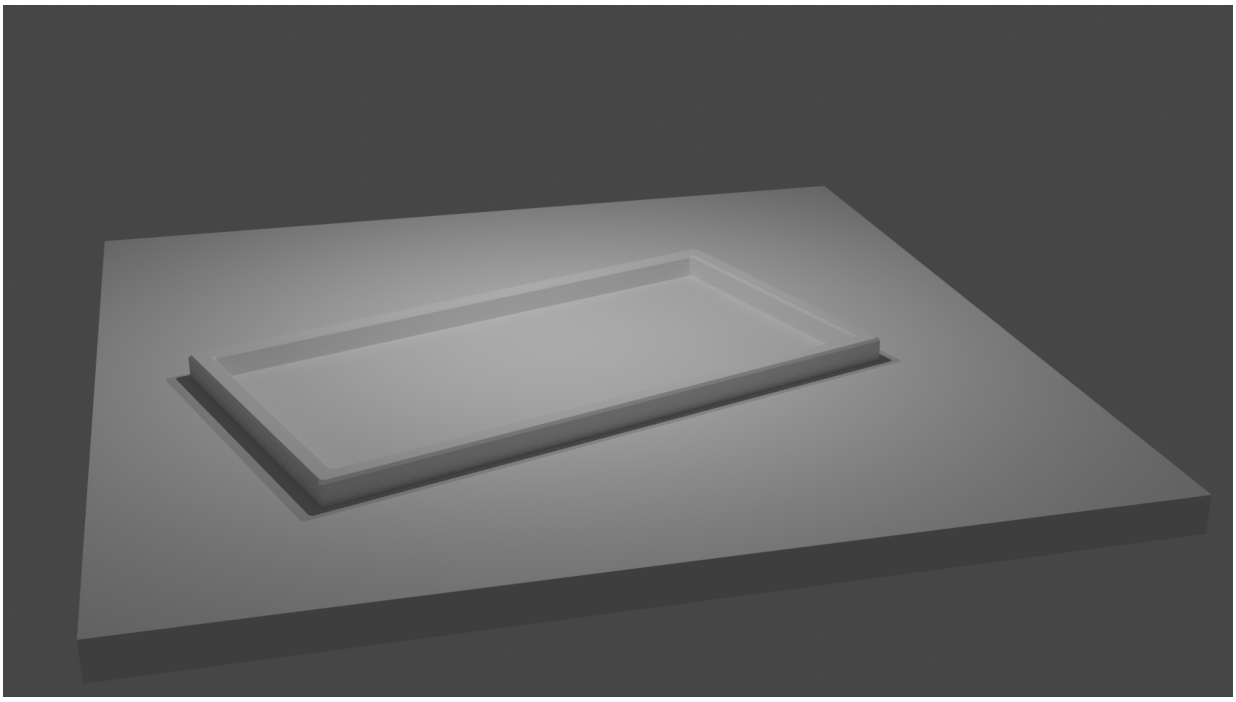


Figure 1: The table and tray.

1.4 Plant

1.4.1 Vase

The plant's vase has been modeled starting from a sphere and cutting the top 4 vertices loops and the bottom 2. A vertices loop has then been added right below the first one on top, and scaled to model the recessing border. At the bottom a face has been added to close it. Then, to give a more smooth and realistic look to the vase, two modifiers have been used and applied in the following order: **Solidify** and **Subdivision**.

1.4.2 Ground

To make it look like it's filled with ground it has been added an object starting from a vertices loop inside of the vase. duplicating the whole loop and using the **face/grid fill** operation to fill it. Then, to make it look rough like real ground, the **random proportional editing** was used.

1.4.3 Trunk and leaves

The **trunk** was modeled from a sphere, cutting the lower third of loops and then resizing it keeping the z axis fixed to obtain an elongated stick. Then, **a leaf** was modeled starting from a plane, subdividing it with the loop cut and then moving the vertices so that it looked like a leaf. To make it more curved like real leaves, the **sphere proportional editing** was used working along the side of the mesh. To give the leaf more thickness and smoothness, the Solidify and Subdivision modifiers were applied to the mesh.

Finally, to **generate the leaves on the trunk**, a **hair particle system** was added to the latter and set to use as mesh the object leaf. In this way, 100 leaves were generated and then transformed into independent objects with the command option **object/apply/make instances real** so as to fix the overlapping leaves and then remove the particle system from the trunk altogether.

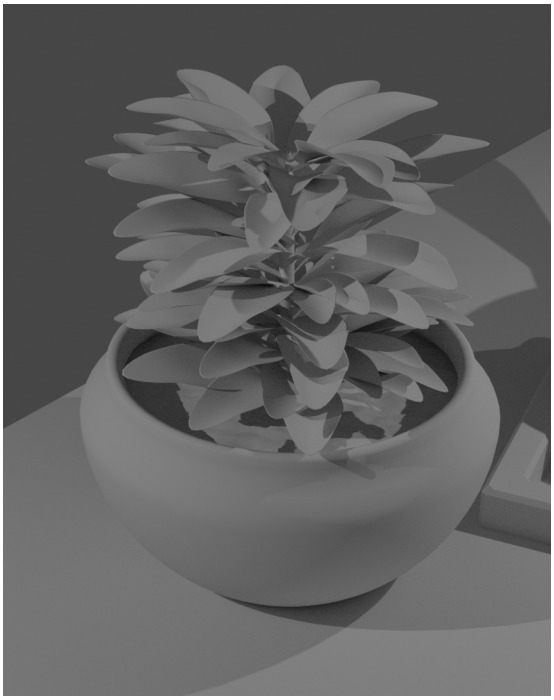


Figure 2: The plant.

1.5 Teacup

To model the teacup, a reference found on the internet was chosen and used as guide to model a sphere into a tradition japanese Chawan teacup. The techniques used were the same as for the plant's vase.

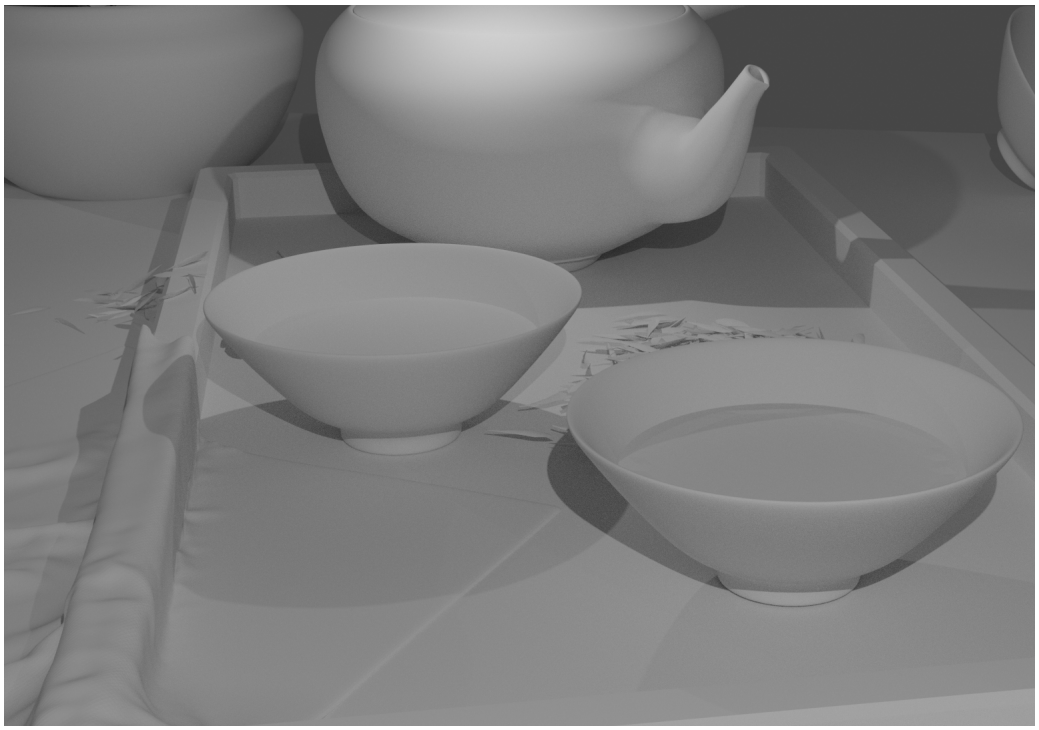


Figure 3: The cups.

1.5.1 Tea

To model the **tea inside the cups** the same technique as the one used for the plant's ground was used, but instead of using the random proportional editing, the **sphere proportional editing** was used.

To model the **spilled tea** two different techniques were used: a **particle system** similar to the one used for the plant's leaves was used to generate the droplets, which are a collection of 4 meshes of different sizes and forms modeled starting from a sphere, and **smooth proportional editing** on a flattened sphere to model the main pool of tea.

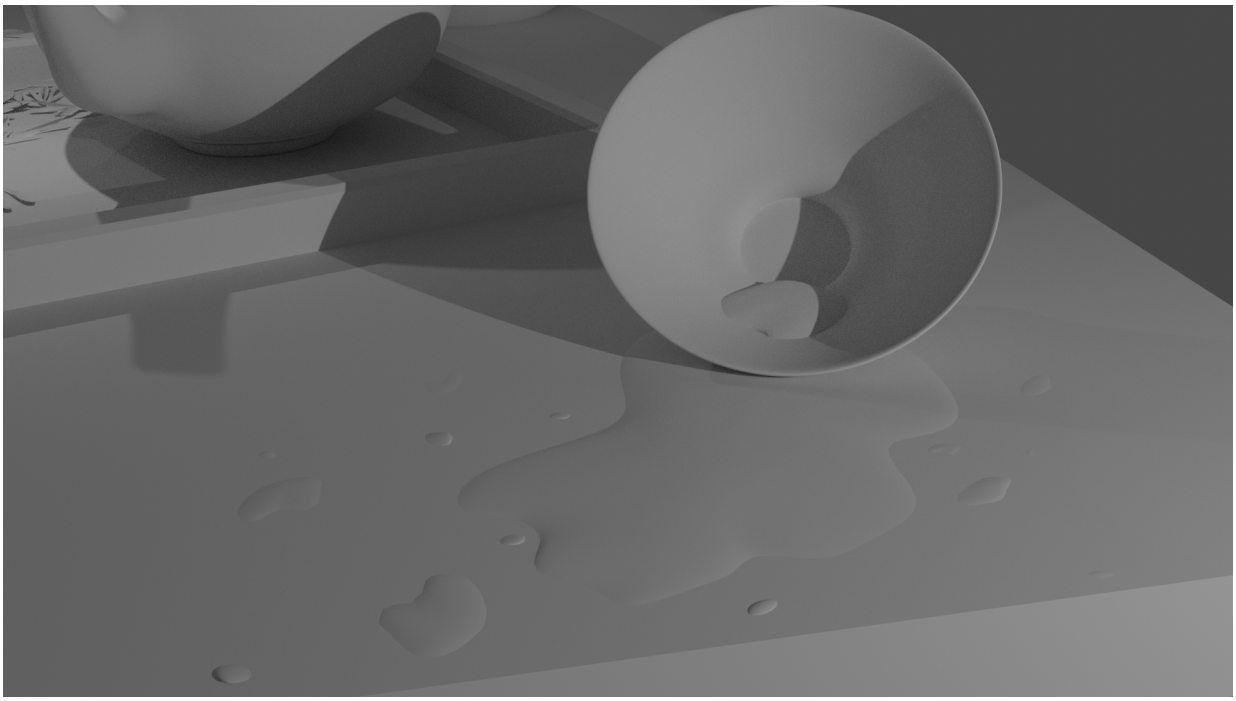


Figure 4: The fallen cup with spilled tea pool and droplets.

1.6 Teapot

The teapot was modeled keeping this reference as guide in the workspace and using a circle as a starting point. **Extrude** and **Scale** were then alternatively used to give shape to the **main body** of the teapot mesh. Once done, the **beak** and the **handle** were modeled by using the **Mesh: LoopTools add-on**. Thanks to this tool, a vertices loop replaced a selection of faces of the mesh and from there the Extrude and Scale tools were used to shape them.

The **lid** was modeled, after solidifying the mesh, starting from a circle. This was created from one of the inner loops of the top of the teapot and then using the same techniques as for the teapot.

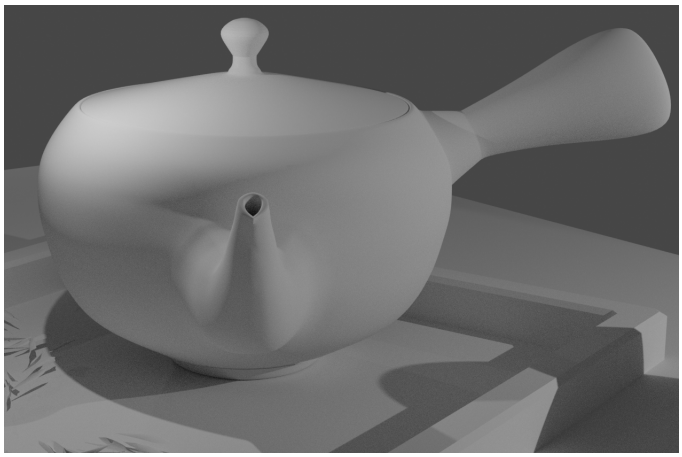


Figure 5: The teapot.

1.7 Tea leaves

To create the scattered tea leaves, four different leaves were modeled from a plane with the same techniques as the plant's ones, but without solidifying them so as to recreate a more "dry" effect. Then, a cube was used as a particle system generator, assigning to it the collection of leaves. To make a realistic "messy effect", the leaves were all given a **rigid body** and the settings were tweaked so that they would rotate when hitting the ground the least possible but have a randomized phase. Then, with a **simulation**, the leaves were scattered on the tray, in a smaller number, behind the teapot, falling part on the tray and part on the table.

Figure 6: The tea leaves scattered on the tray.

1.8 Cloth

The cloth was made using a plane and giving it the physics setting of **Cloth**. Then, the plane was modified with the **smooth proportional editing** and given some elevated areas. This way, the falling cloth was able to generate good amount of creases during the simulation.

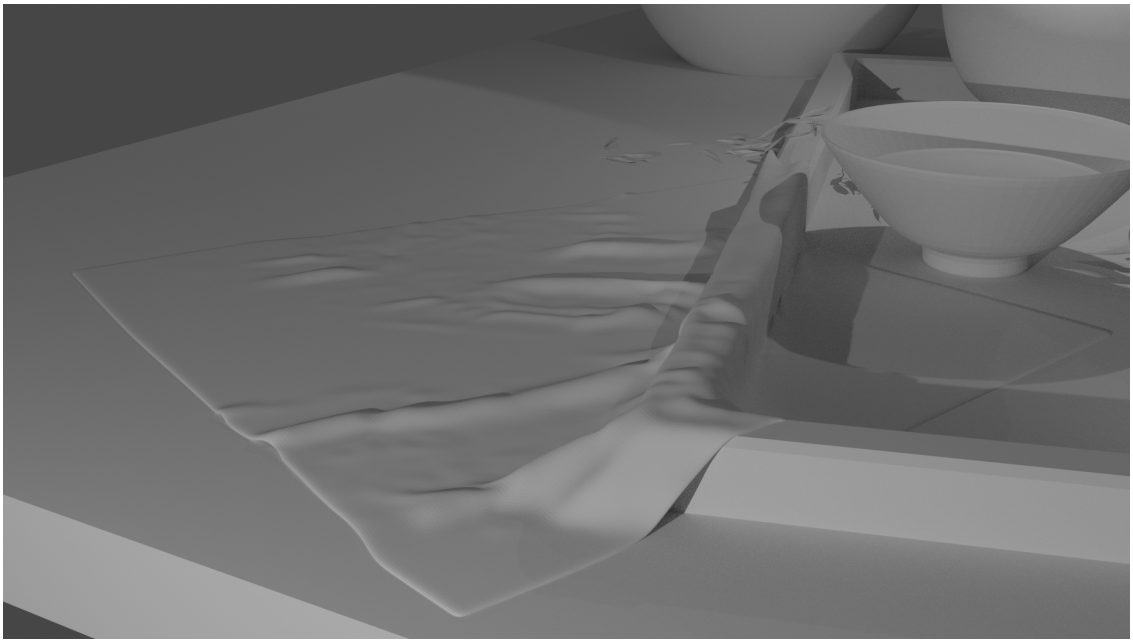


Figure 7: The cloth.

1.9 Final render

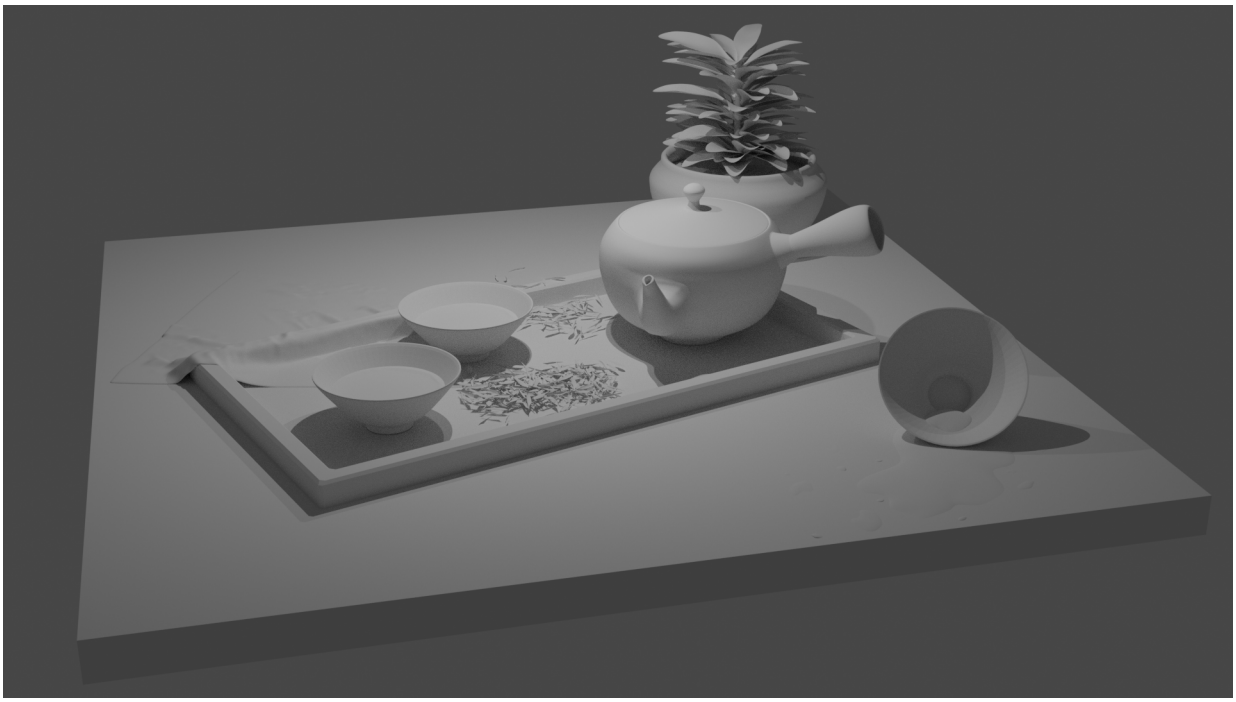


Figure 8: Complete scene. All the renders can be found here.

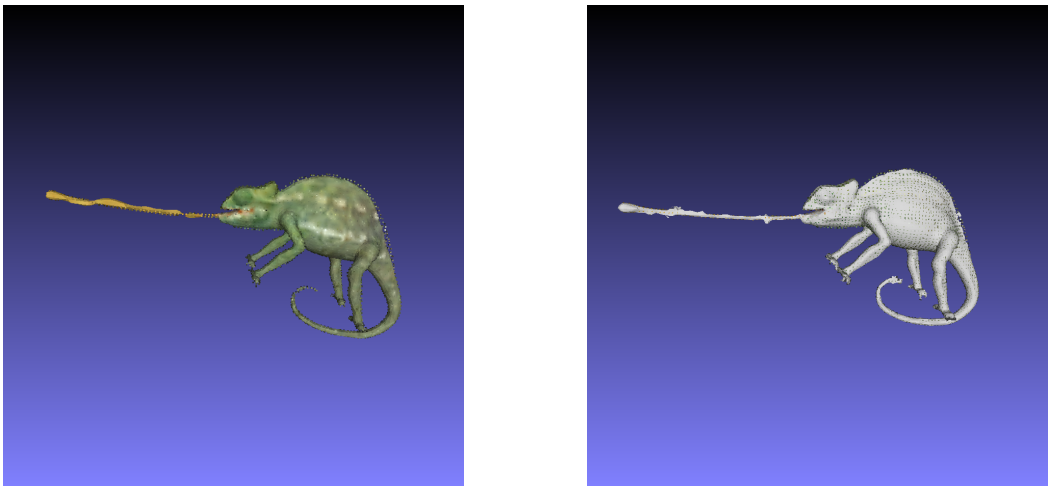
2 Geometry processing with Meshlab

The meshes used for this assignment are:

- Nettuno - downloaded from the visionair repository;
- Guided trim star - provided in LAB05;
- Chamaleon - provided in LAB05;
- Statue of Liberty - provided in LAB05.

2.1 Mesh object reconstruction from point clouds

Starting from the point collection of the **Chamaleon** mesh, the **Surface Reconstruction Screened Poisson** was used with default parameters, obtaining a mesh that was not complete. Then, the **Marching Cubes (RIMLS)** was used obtaining a much better mesh, but losing all the colors information.

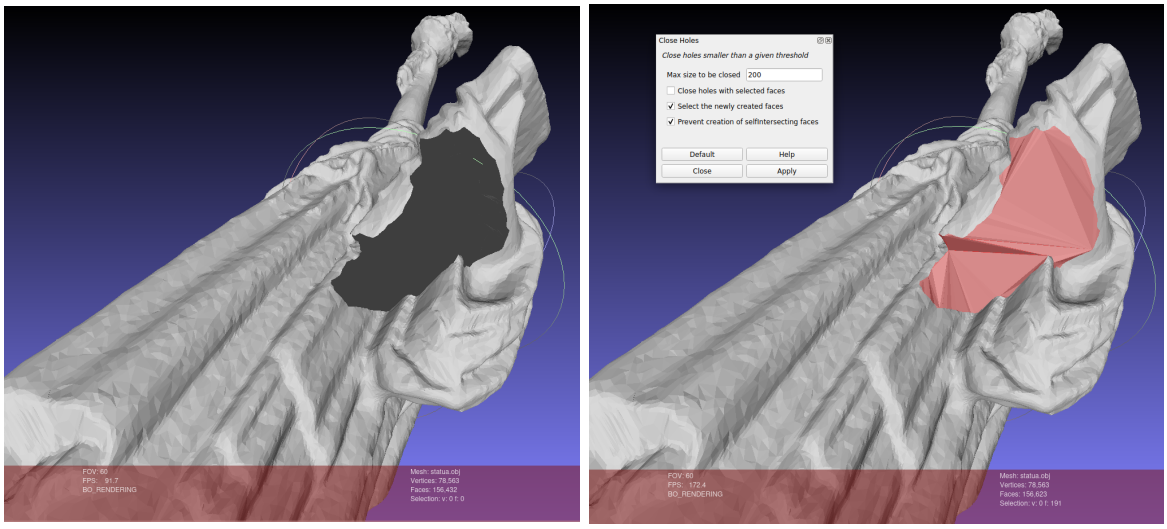


(a) Surface Reconstruction Screened Poisson. (b) Marching Cubes (RIMLS).

Figure 9: The results obtained with different algorithms.

2.2 Fill Hole/Mesh Repair

Using the **Close Holes** on the Statue of Liberty mesh, with a "size to be closed" value of 200 we can see that the program is able to close the hole underneath the hand clutching the book.



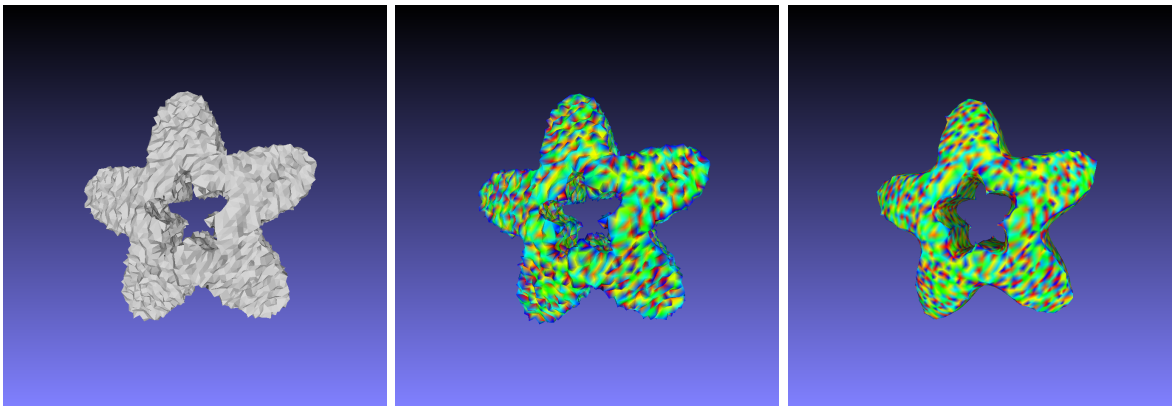
(a) Before. (b) After.

Figure 10: The result of the Close Holes function.

2.3 Fairing

The **Laplacian Smooth** was used on the Guided trim star mesh, obtaining a better result, but not quite so good - which depends on the shape and distortion of the mesh itself. Using the **Discrete**

Curvature coloring filter we can in fact see that, even applying the Laplacian Smooth multiple times, reaching complete flatness is pretty much impossible.

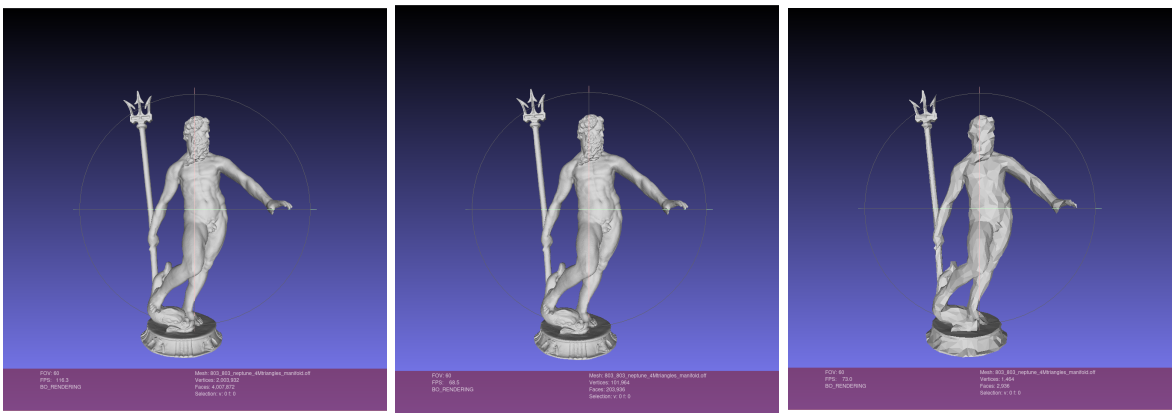


(a) (b) (c)

Figure 11: (a) the initial mesh, (b) the discrete curvature colored initial mesh and (c) the iscrete curvature colored mesh after 4 applications of Laplacian Smooth.

2.4 Decimation

Decimation was done on the Nettuno mesh by applying the filter **Simplification: Quadric Edge Collapse Decimation** and setting the target to 2M faces first, then 204k, then 24k and finally 3k. It's clear how much of the details are lost the more the number of faces is lowered.



(a) 4 million faces mesh. (b) 204 thousands faces mesh. (c) 3 thousands faces mesh.

Figure 12: For better resolution pictures see the repository folder.

2.5 Quality measure tools for surfaces (curvature)

Using on the decimated mesh the filter **Compute Topological Measures** we get the following results:

```
V: 1464 E: 4403 F:2936
Unreferenced Vertices 0
Boundary Edges 0
Mesh is composed by 1 connected component(s)
Mesh has 1 non two manifold edges and 4 faces are incident on these edges
Mesh has a undefined number of holes (non 2-manifold mesh)
Genus is undefined (non 2-manifold mesh)
```