

# MeshLab

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# MeshLab

- Version MeshLab 2016
- <http://www.meshlab.net/>
- Video Tutorial
- <https://www.youtube.com/user/MrPMeshLabTutorials>

# MeshLab

MeshLab doesn't have a undo.  
Please save your project frequently  
otherwise if MeshLab crashes or if  
you apply wrongly a filter that  
modifies your mesh you lose all  
your works.

# MeshLab – Mesh Data

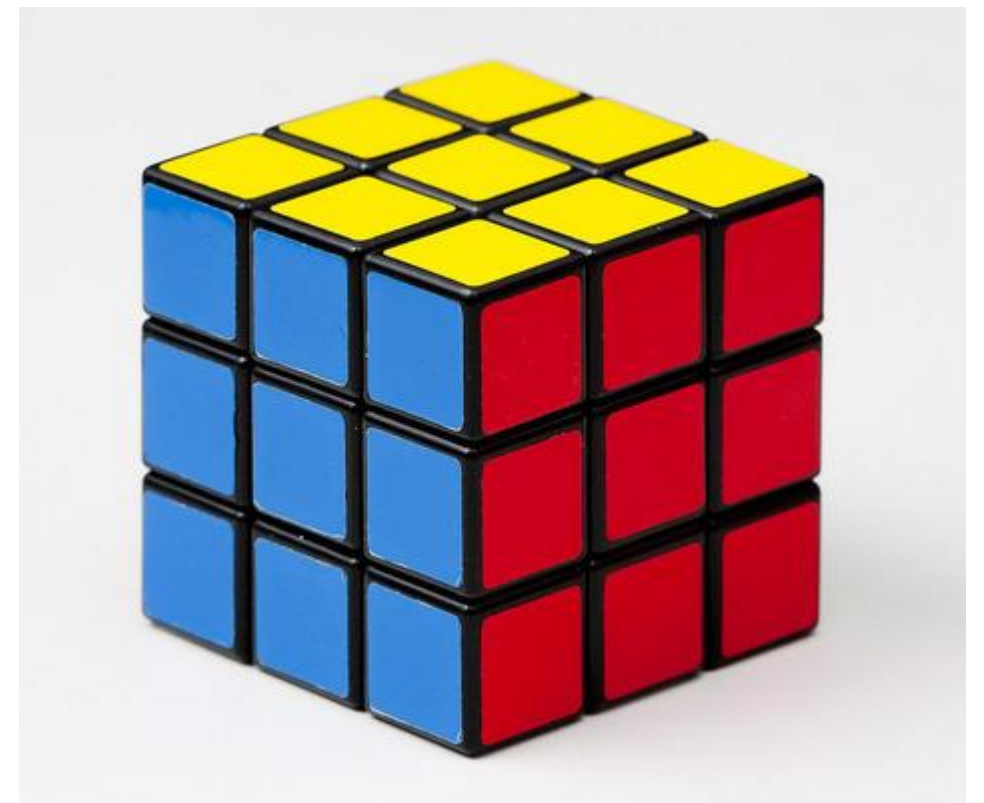
- Per-vertex attribute
  - Position
  - Normal
  - Color (VN)
  - Quality (VQ)
  - Texture Coordinate (VT)
  - Vertex Radius (VR)
  - Curvature value (VK)
  - Curvature direction (VD)

# MeshLab – Mesh Data

- Per-face attribute
  - Vertex reference
  - Normal
  - Color (FC)
  - Quality (VQ)

# MeshLab – Mesh Data

- Wedge – To assign a different attribute to the vertex depending on the face
  - Color (WC)
  - Texture Coordinate (WT)
  - Normal (WN)



# Trackball

- Paradigm: Object in-hand
- Help → On screen quick help



# Edit Tools

## Interactive tools

- Click on the tool icon to enter
- Click again to the icon to exit
- Click on the trackball icon to temporarily suspend from the edit mode, or press ESC
- Click again to the trackball icon to reactive the edit mode, or press ESC



TRACKBALL MODE



# Layers

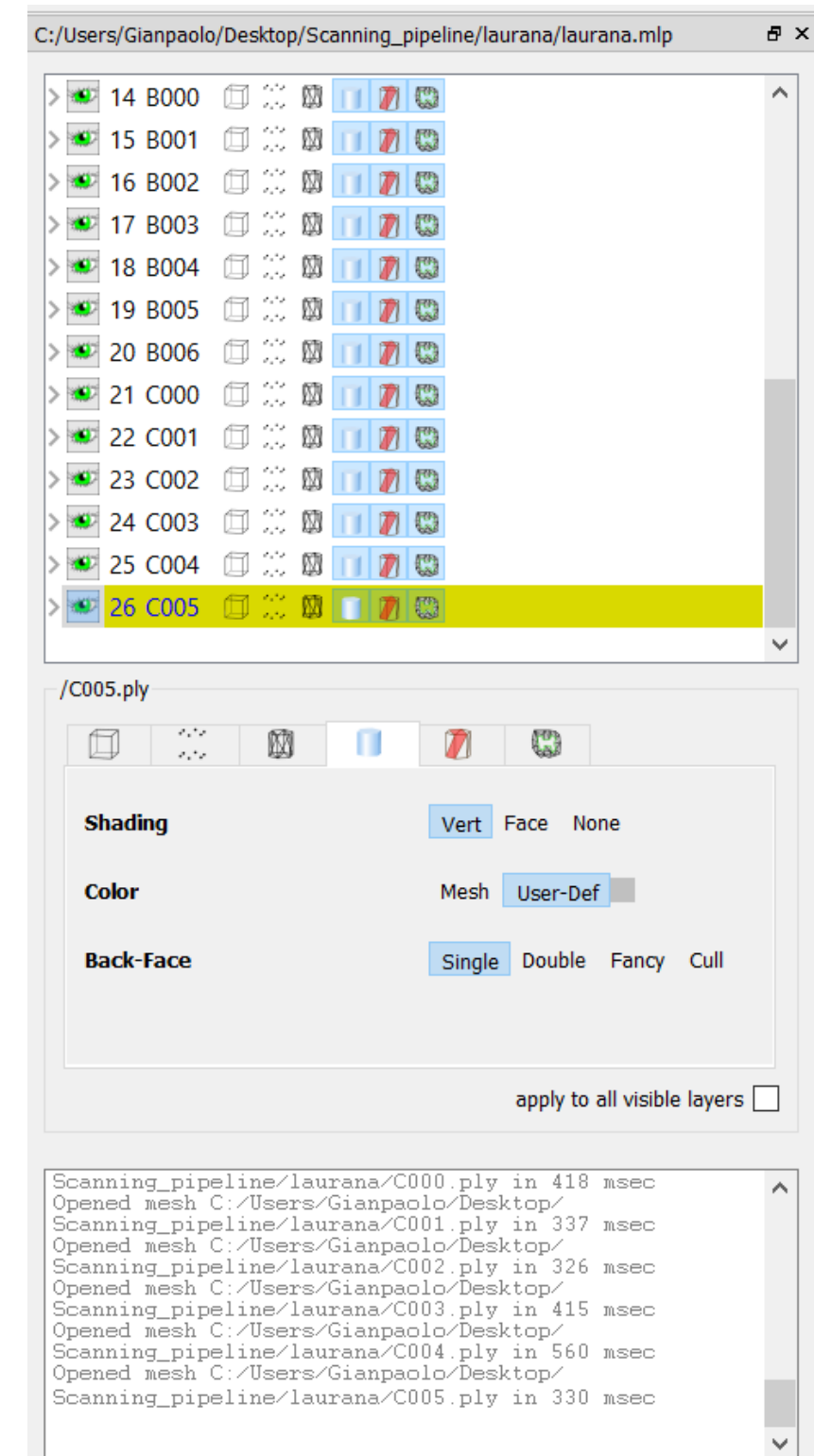


## Layer icons dialog

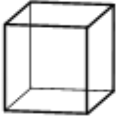





- Load different mesh on several layer
- Manage the layer visibility and rendering
- Help → On screen quick help

### Layer Window

Click on eye icon: Toggle visibility status of the layer  
Ctrl-Click on eye icon: Make Invisible all other layers  
Alt-Click on eye icon: Make Visible all other layers  
Shift-Click on eye icon: Invert visibility status of all the layers



# Rendering Modes

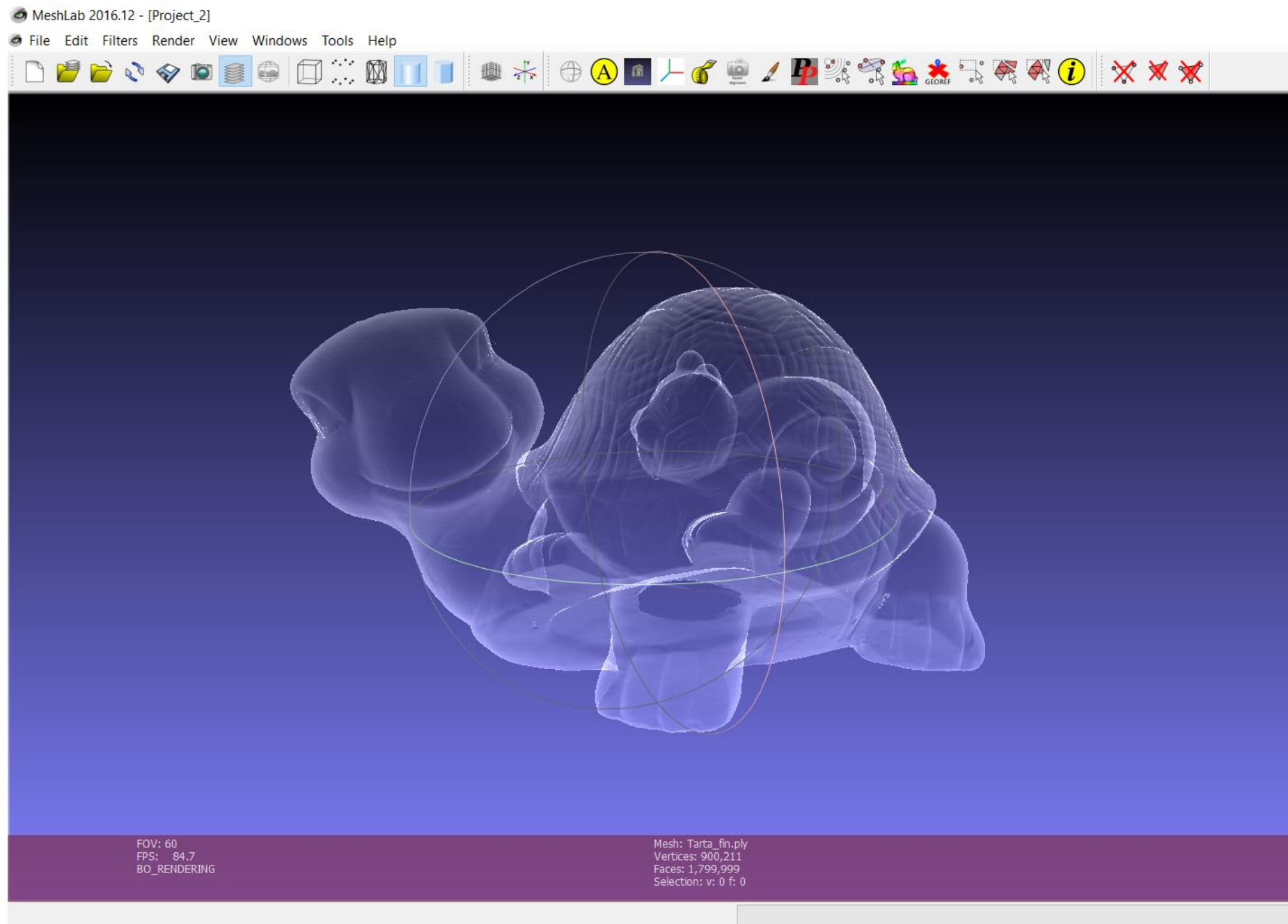
- Visualization of different data globally and for each single layer
  - Bounding box 
  - Point 
  - Edge 
  - Triangle 
  - Selection data 
  - Edge decorators 

# Decorator

- Visualization of additional information
  - Normal
  - Camera position
  - Quality information
  - Axis
  - Bounding box

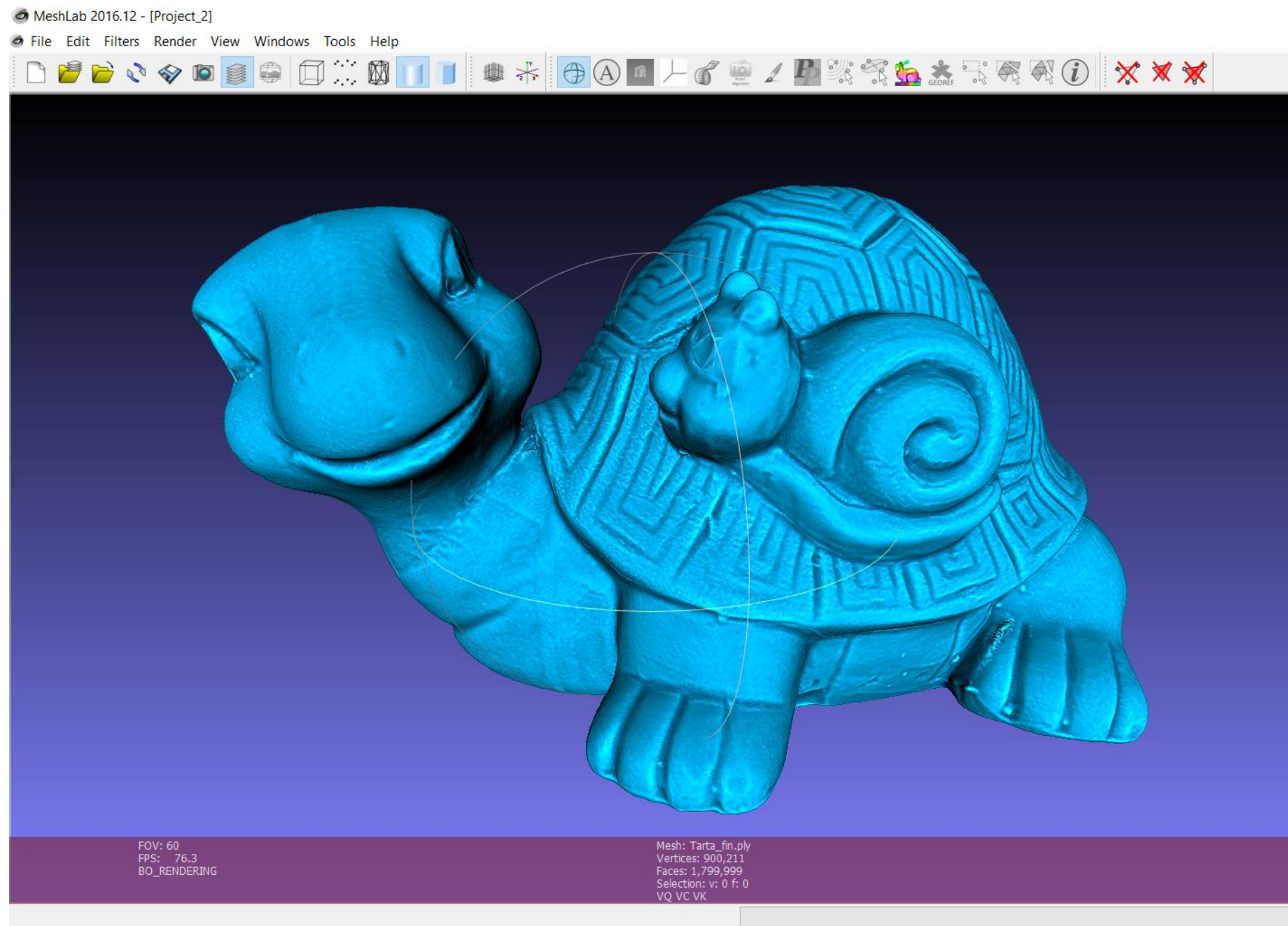
# Advanced Shading

- Render → Shader → xray






# Advanced Shading

- Render → Shader → Radiance Scaling






# Selection

- Interactive tool to select
  - Point 
  - Triangles 
  - Connected Component 
- Selection of all the element on the frustum of the selection area
- Keep pressed CTRL to add to the current selection
- Keep pressed SHIFT to remove from the current selection
- Keep pressed ALT to select only visible elements

# Selection

- Automatic filter (Filter->Selection)
  - Dilate
  - Erosion
  - Invert, None, All
  - Border
  - By view angle
  - By quality

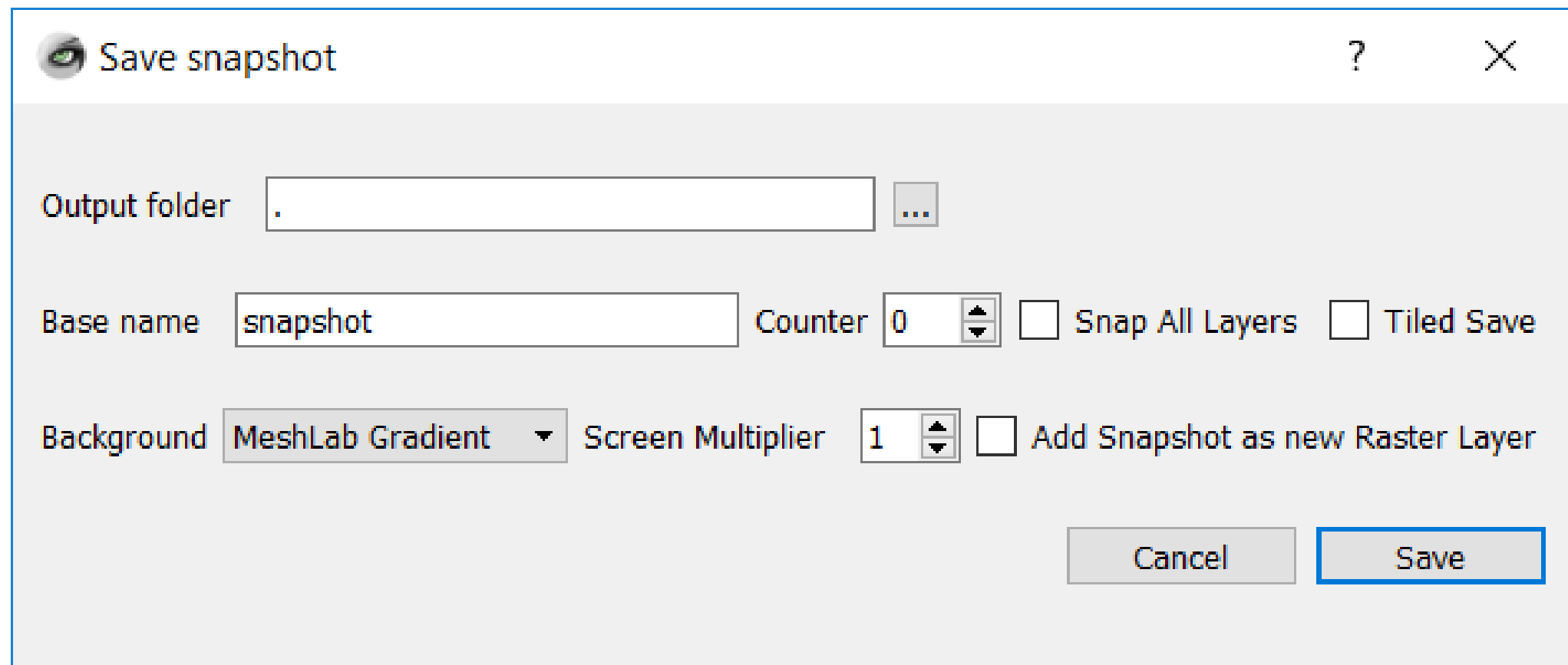
# Delete Selection

- Delete the current selection
- Only selected points and the incident faces 
- Only the selected faces but no the unreferenced vertices 
- The selected faces and the referenced vertices by the selected faces 



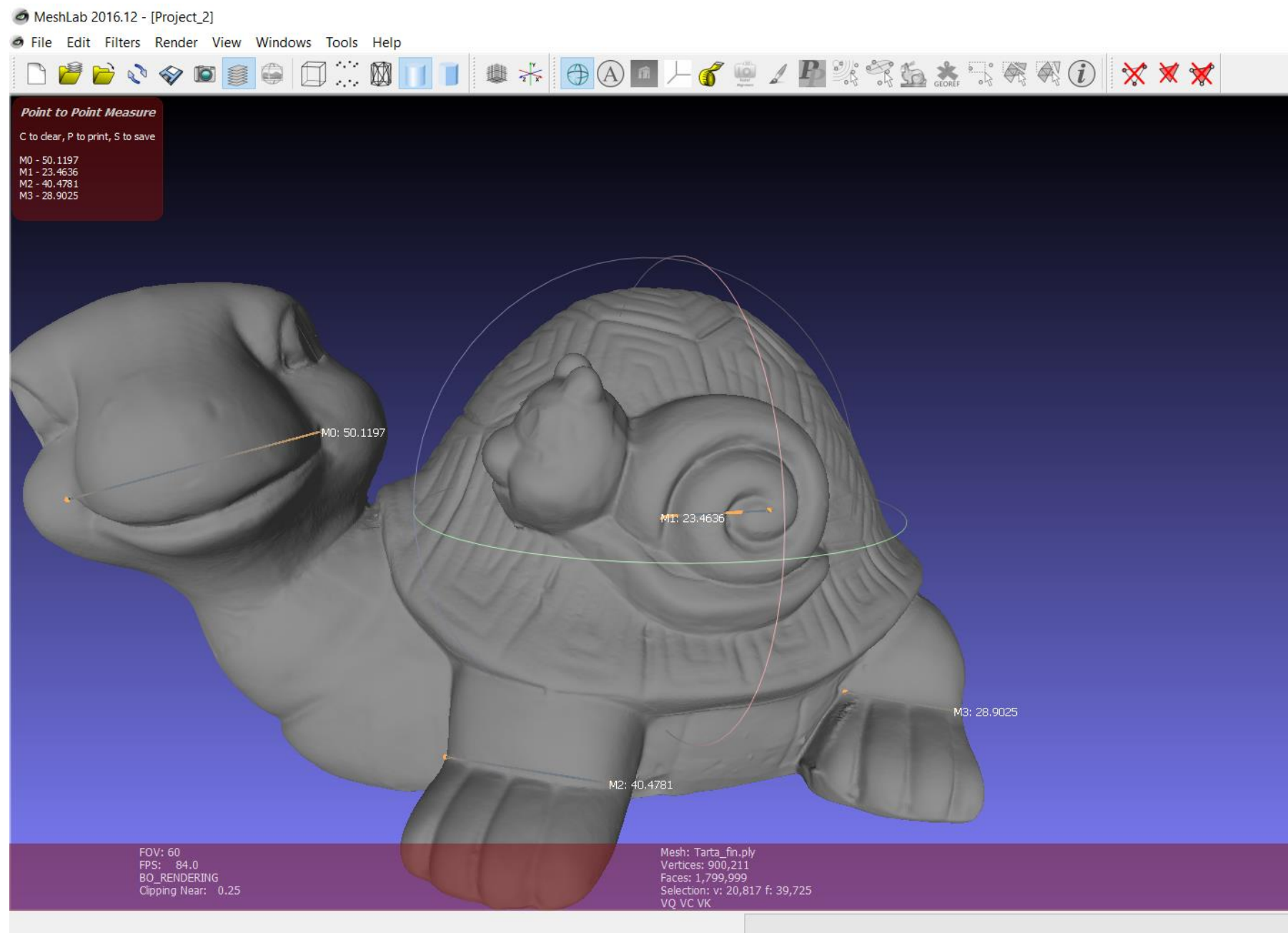
# Snapshot

- Save the current rendering as png image
- Save high resolution images using tiling



# Measuring Tools

- Take measure on your mesh 



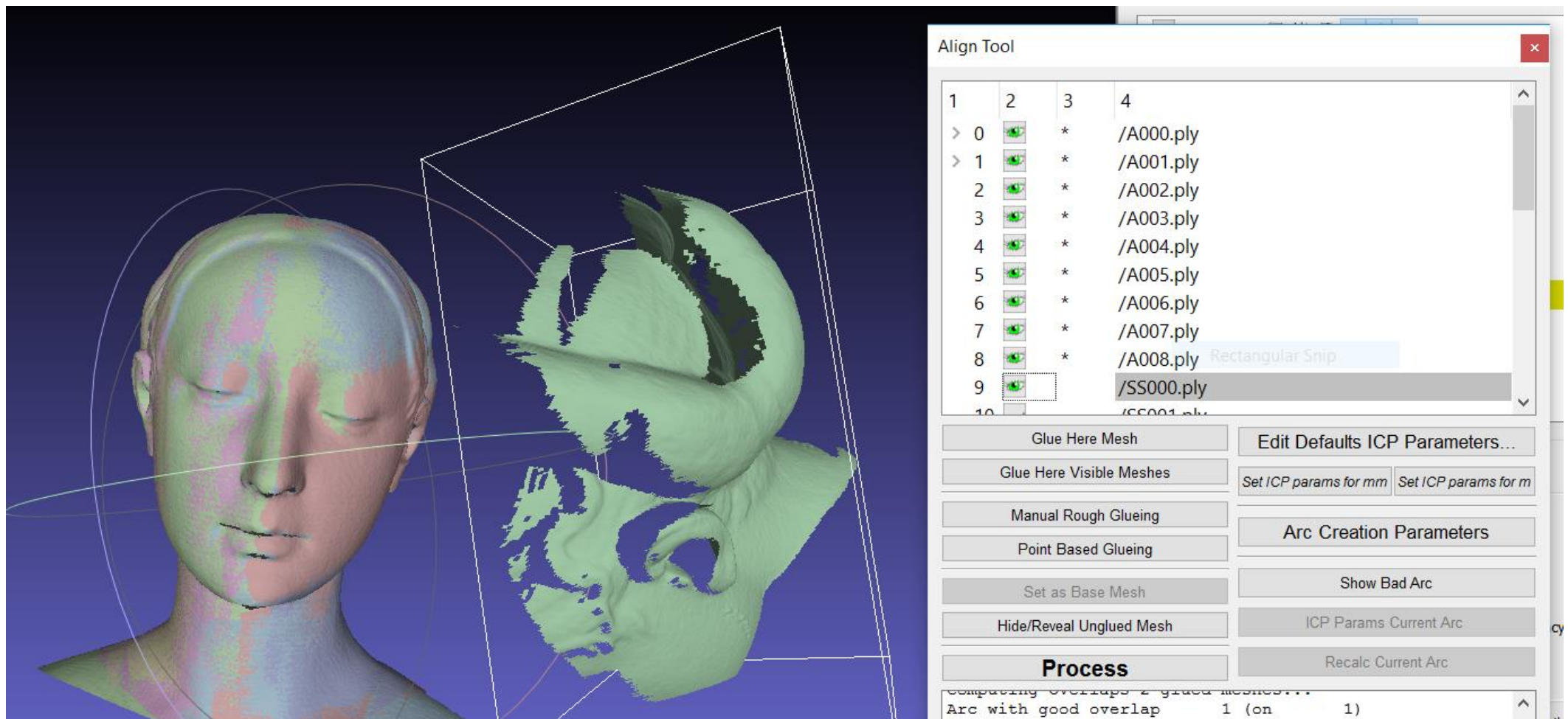
# Smoothing

- Filter → Smoothing, Fairing, Deformation →
  - Laplacian smooth
  - Scale dependent laplacian smooth
  - Taubin smooth
  - Laplacian smooth (surface preserve)

# Alignment Tools



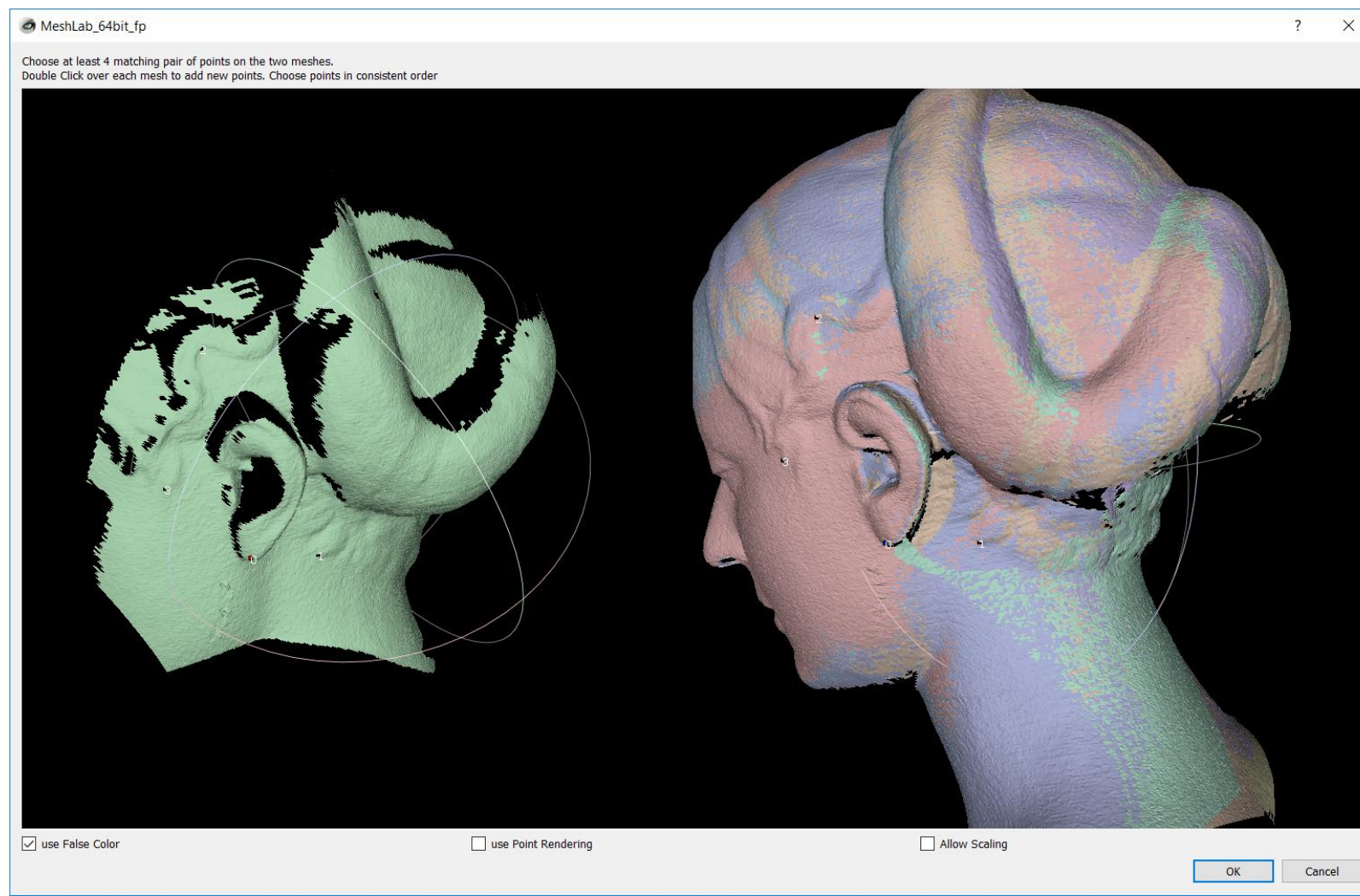
- Glue the first mesh
- For each other mesh, use Point Based Glueing to find the rough alignment
- Launch Process



# Alignment Tools

## Point based Glueing

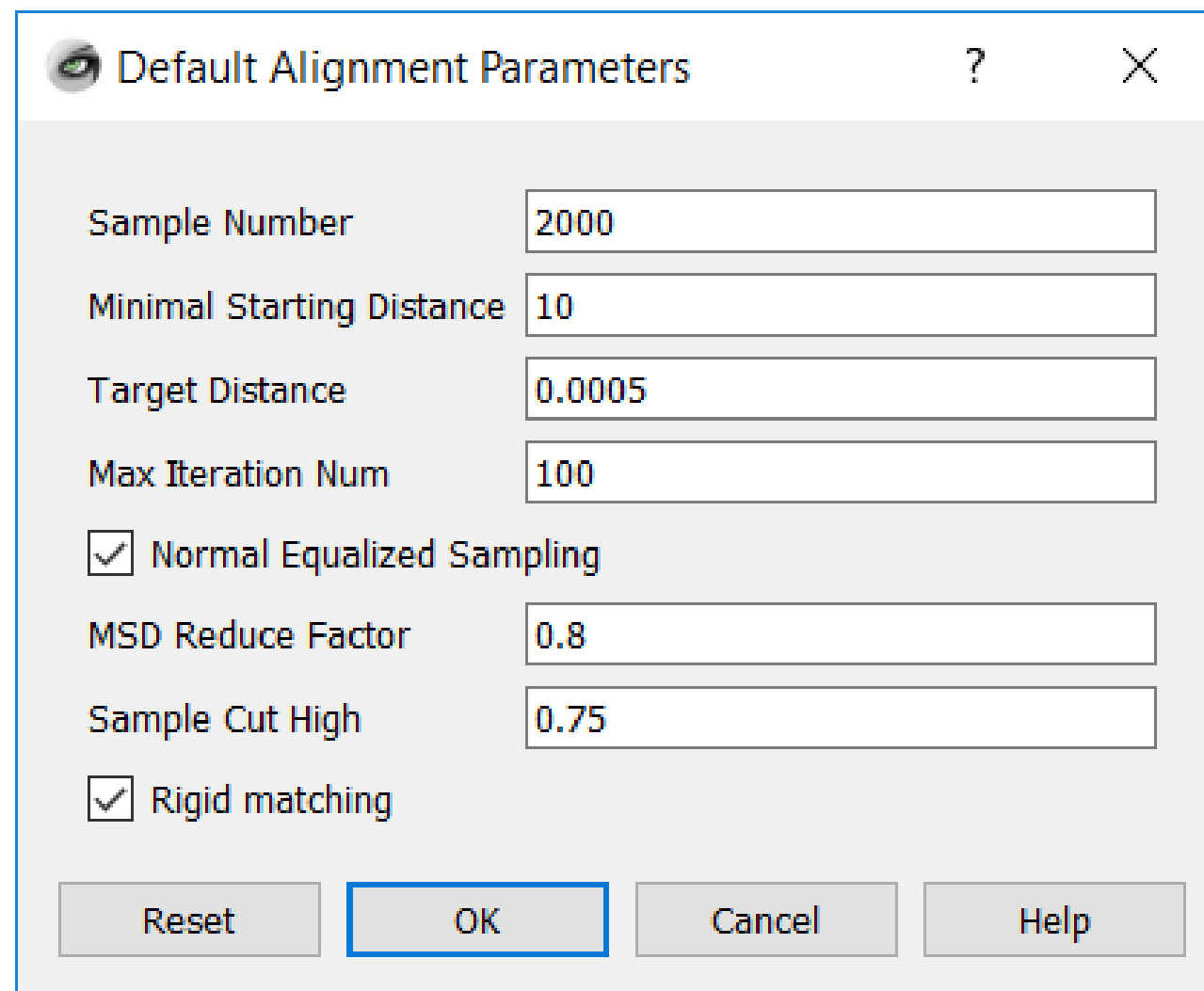
- Select by double click the correspondences, the order is important
- Keep pressed CTRL to remove a point



# Alignment Tools

## Launch Process

- Adjust the parameters (Edit Default ICP Parameters)



The screenshot shows a dialog box titled "Default Alignment Parameters" with a standard Windows-style title bar (minimize, maximize, close buttons). The dialog contains several input fields and checkboxes for configuring ICP parameters. The "OK" button is highlighted with a blue border.

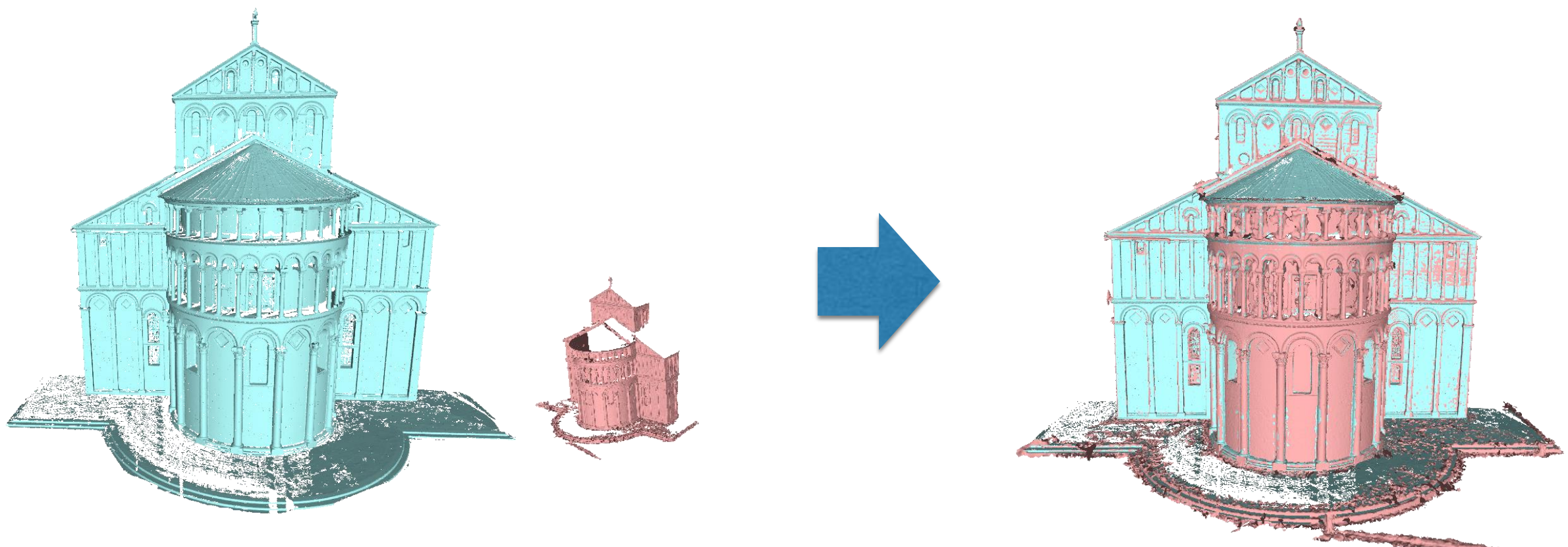
Parameter	Value
Sample Number	2000
Minimal Starting Distance	10
Target Distance	0.0005
Max Iteration Num	100
<input checked="" type="checkbox"/> Normal Equalized Sampling	
MSD Reduce Factor	0.8
Sample Cut High	0.75
<input checked="" type="checkbox"/> Rigid matching	

Buttons: Reset, OK, Cancel, Help



# Alignment with scale

- Measure a common feature between the mesh
- Compute the scale and apply the scale  
Filter → Normal, Curvature, Orientation → Transform: Scale, Normalize (uniform scale)
- Run the alignment procedure with no-rigid-option



# 3D Reconstruction

- Weighted average of per-scan distance field Filter → Remeshing, Simplification, Reconstruction → Surface reconstruction: VCG

## Surface Reconstruction: VCG

*The surface reconstruction algorithm that have been used for a long time inside the ISTI-Visual Computer Lab. It is mostly a variant of the Curless et al. e.g. a volumetric approach with some original weighting schemes, a different expansion rule, and another approach to hole filling through volume dilation/relaxations.*

*The filter is applied to **ALL** the visible layers. In practice all the meshes/point clouds that are currently visible are used to build the volumetric distance field.*

	world unit	perc on (0 .. 250.281)	
Voxel Side (abs and %)	<input type="text" value="2.5028"/>	<input type="text" value="1.000"/>	VoxelSide
SubVol Splitting	<input type="text" value="1"/>		The level of recursive splitting of the subvolume reconstruction process. A value of '3' means that a 3x3x3 regular space subdivision is created and the reconstruction process generate 8 matching meshes. It is useful for reconstruction objects at a very high resolution. Default value (1) means no splitting.
Geodesic Weighting	<input type="text" value="2"/>		The influence of each range map is weighted with its geodesic distance from the borders. In this way when two (or more) range maps overlaps their contribution blends smoothly hiding possible misalignments.
<input checked="" type="checkbox"/> Show Result			if not checked the result is only saved into the current directory
Volume Laplacian iter	<input type="text" value="1"/>		How many volume smoothing step are performed to clean out the eventually noisy borders
Widening	<input type="text" value="3"/>		How many voxel the field is expanded. Larger this value more holes will be filled
<input type="checkbox"/> Vertex Splatting			This option use a different way to build up the volume, instead of using rasterization of the triangular face it splat the vertices into the grids. It works under the assumption that you have at least one sample for each voxel of your reconstructed volume.
<input type="checkbox"/> Post Merge simplification			After the merging an automatic simplification step is performed.
PreSmooth iter	<input type="text" value="3"/>		How many times, before converting meshes into volume, the normal of the surface are smoothed. It is useful only to get more smooth expansion in case of noisy borders.

Default

Help

Close

Apply



# 3D Reconstruction

- Screened Poisson Surface Reconstruction  
Filter → Remeshing, Simplification, Reconstruction → Screened Poisson Surface reconstruction
- If “Interpolation Weight” is zero then Classical Poisson reconstruction
- “Reconstruction Depth”, maximum level of the octree

Screened Poisson Surface Reconstruction ×

*This surface reconstruction algorithm creates watertight surfaces from oriented point sets. The filter uses the original code of Michael Kazhdan and Matthew Bolitho implementing the algorithm described in the following paper:  
Michael Kazhdan, Hugues Hoppe, **"Screened Poisson surface reconstruction"** ACM Trans. Graphics, 32(3), 2013*

☐ Merge all visible layers

Reconstruction Depth

Minimum Number of Samples

Interpolation Weight

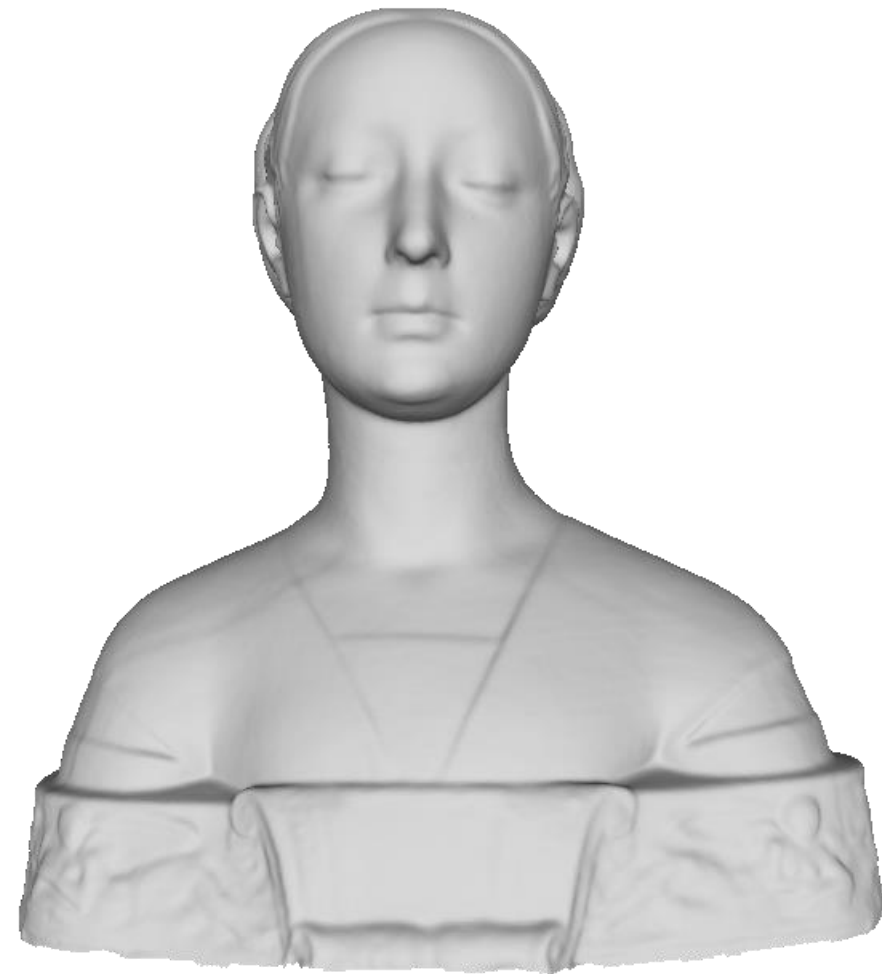
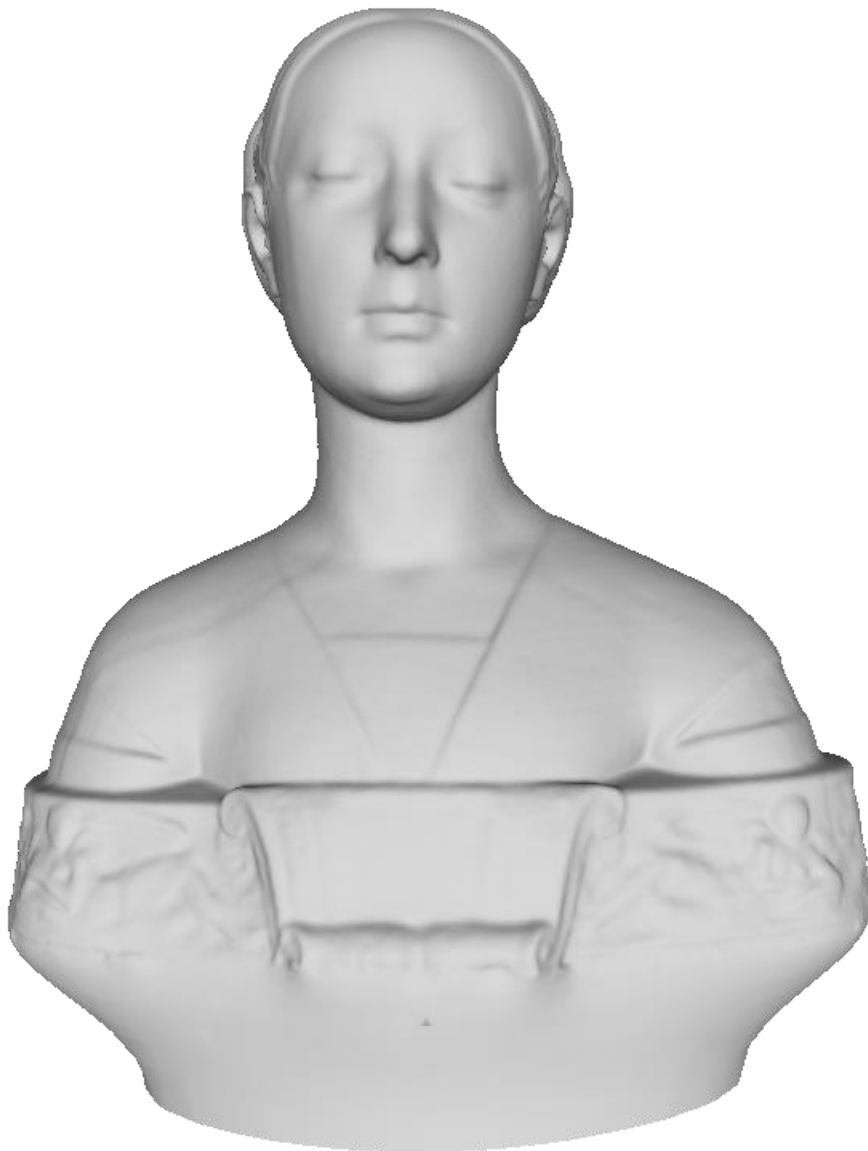
☐ Confidence Flag

☐ Pre-Clean

▼

# Cleaning Poisson Reconstruction

- Filter → Selection → Selection by vertex quality

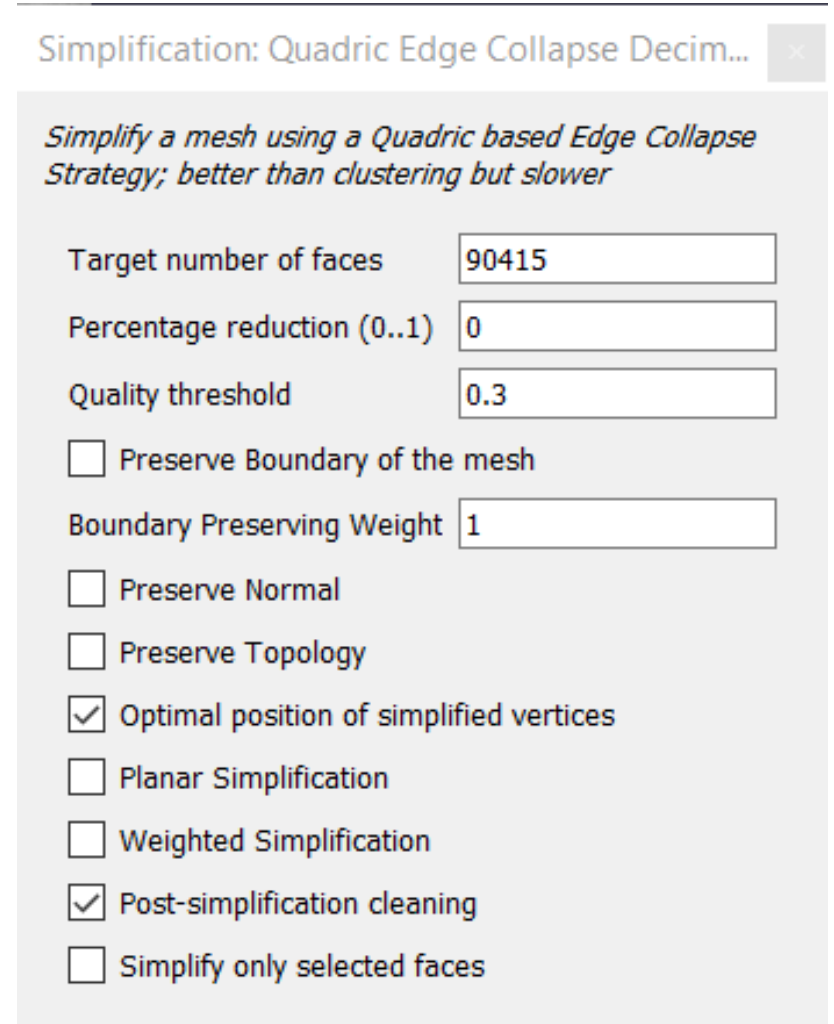
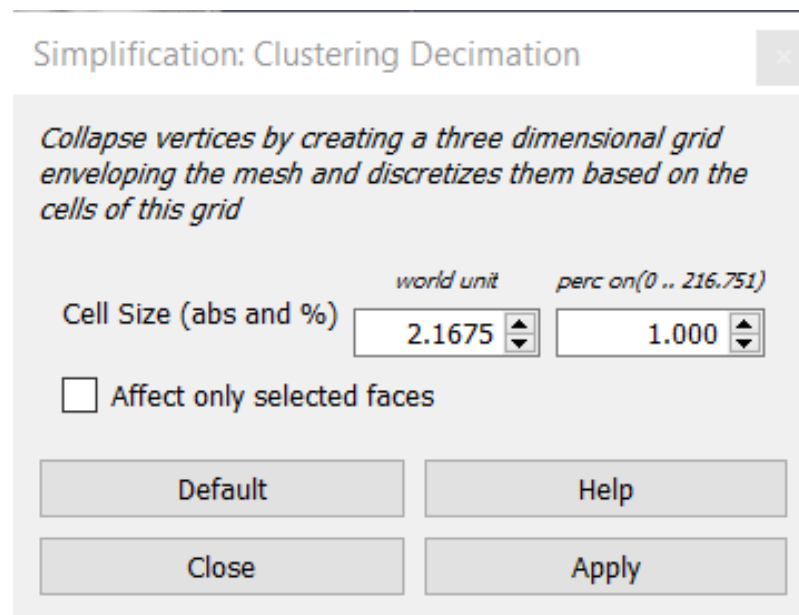


# Cleaning and Repairing

- Filter → Cleaning and Repairing
- Filter → Selection

# Simplification

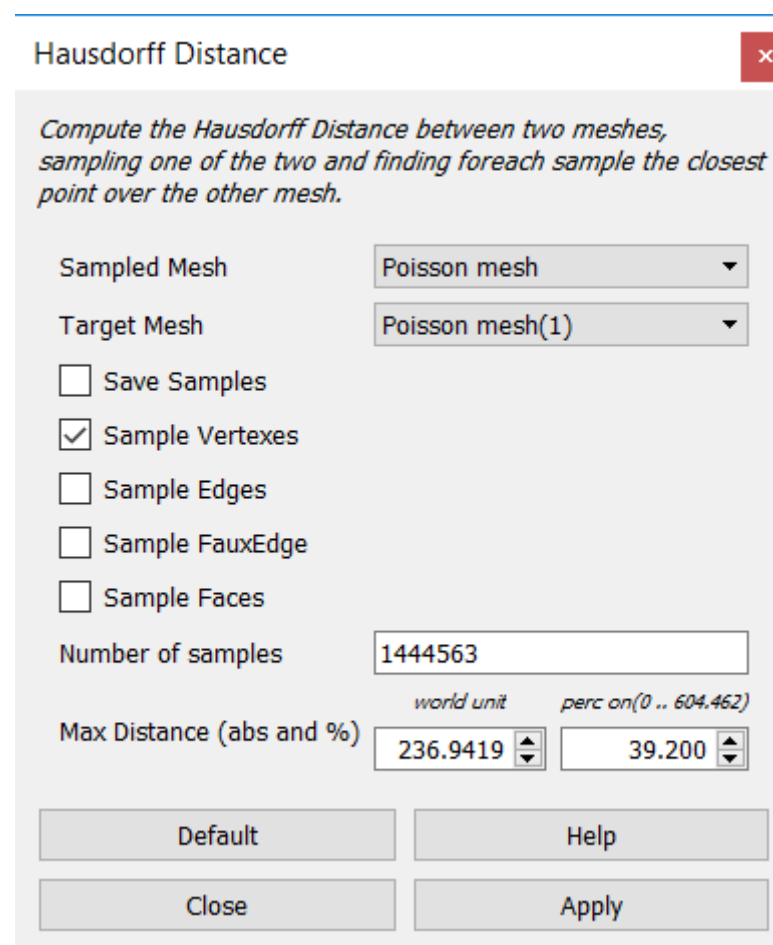
- Filter → Remeshing, Simplification, Reconstruction → Simplification: Clustering Decimation
- Filter → Remeshing, Simplification, Reconstruction → Simplification: Quadric Edge Collapse



# Surface Comparison

- Hausdorff distance – Measure distance between two meshes

Filter → Sampling → Hausdorff Distance

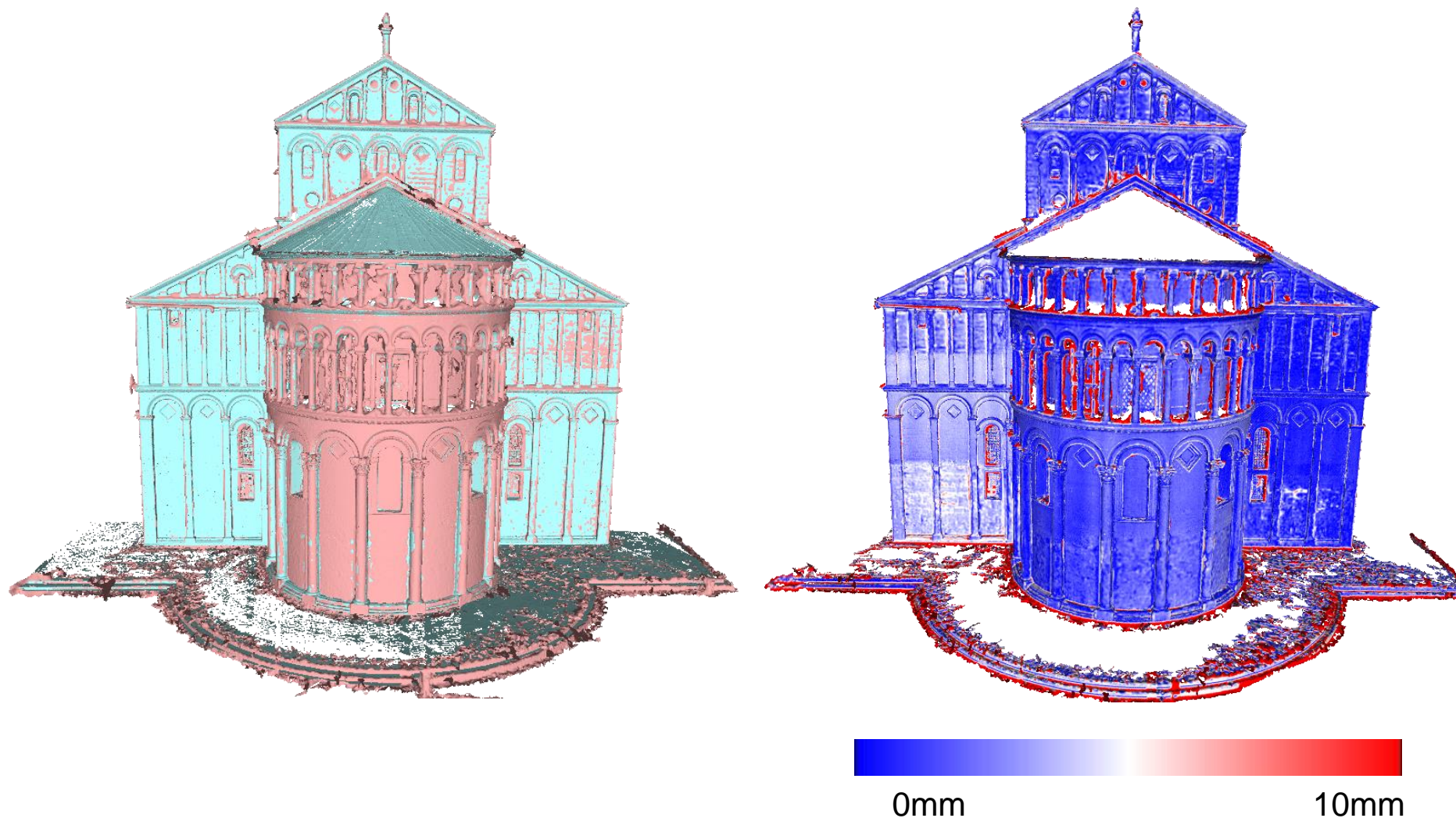


The screenshot shows a dialog box titled "Hausdorff Distance" with a red close button in the top right corner. The dialog contains the following elements:

- Description:** "Compute the Hausdorff Distance between two meshes, sampling one of the two and finding for each sample the closest point over the other mesh."
- Samplers:** Two dropdown menus. "Sampled Mesh" is set to "Poisson mesh" and "Target Mesh" is set to "Poisson mesh(1)".
- Sampling Options:** A list of checkboxes: "Save Samples" (unchecked), "Sample Vertexes" (checked), "Sample Edges" (unchecked), "Sample FauxEdge" (unchecked), and "Sample Faces" (unchecked).
- Number of samples:** A text input field containing the value "1444563".
- Max Distance (abs and %):** Two input fields. The first is labeled "world unit" and contains "236.9419". The second is labeled "perc on(0 .. 604,462)" and contains "39.200".
- Buttons:** Four buttons at the bottom: "Default", "Help", "Close", and "Apply".

# Quality Mapper

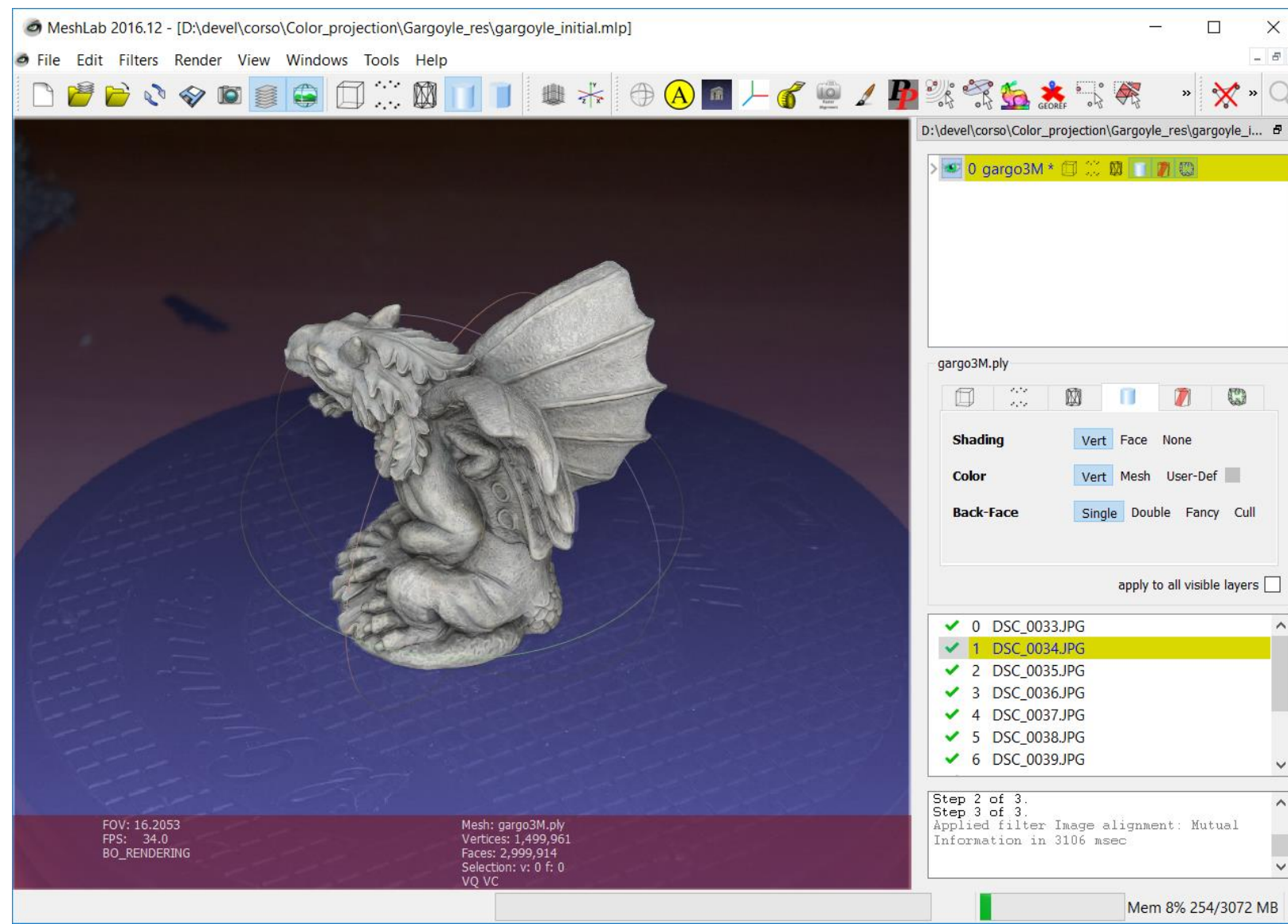
- Colorize the mesh according the quality value





# Camera Calibration

- Raster Layers
- View mesh from the point of view of the current raster



# Camera Calibration

- Filter → Camera → Image Alignment: Mutual Information

Image alignment: Mutual Information

*Register an image on a 3D model using Mutual Information.  
This filter is an implementation of Corsini et al. 'Image-to-geometry registration: a mutual information method exploiting illumination-related geometric properties', 2009, [Get link](#)*

Rendering Mode:

Combined

Starting shot

Current Trackball

Get Shot

☐

Estimate focal length

☒

Fine Alignment

Max iterations

100

Tolerance

0.1

Expected Variance

2.0

BackgroundWeight

2

Default

Help

Close

Apply



# Color Projection

- Render → Raster-to-Geometry projection



# Color Projection

- Per-vertex color
- Filter → Camera → Project active raster color to current mesh

Project active rasters color to current mesh

*Color information from all the active rasters is perspective-projected on the current mesh using basic weighting*

depth threshold

0.5

☐

Only on selecton

☒ use angle weight

☒ use distance weight

☒ use image borders weight

☒ use depth discontinuities weight

☐ use image alpha weight

Color for unprojected areas (#000000)

☐ Preview

Default

Help

Close

Apply

# Color Projection

- Texture
- Filter → Texture → Parametrization + texturing from registered rasters

Parameterization + texturing from registered rasters

*The mesh is parameterized and textured by creating some patches that correspond to projection of portions of surfaces onto the set of registered rasters.*

Texture size	<input type="text" value="1024"/>	Specifies the dimension of the generated texture
Texture name	<input type="text" value="texture.png"/>	Specifies the name of the file into which the texture image will be saved
<input checked="" type="checkbox"/> Color correction		If true, the final texture is corrected so as to ensure seamless transitions
Color correction filter	<input type="text" value="1"/>	It is the radius (in pixel) of the kernel that is used to compute the difference between corresponding texels in different rasters. Default is 1 that generate a 3x3 kernel. Highest values increase the robustness of the color correction process in the case of strong image-to-geometry misalignments
<input checked="" type="checkbox"/> Use distance weight		Includes a weight accounting for the distance to the camera during the computation of reference images
<input checked="" type="checkbox"/> Use image border weight		Includes a weight accounting for the distance to the image border during the computation of reference images
<input type="checkbox"/> Use image alpha weight		If true, alpha channel of the image is used as additional weight. In this way it is possible to mask-out parts of the images that should not be projected on the mesh. Please note this is not a transparency effect, but just influences the weighing between different images
<input checked="" type="checkbox"/> Clean isolated triangles		Remove all patches compound of a single triangle by aggregating them to adjacent patches
<input type="checkbox"/> UV stretching		If true, texture coordinates are stretched so as to cover the full interval [0,1] for both directions
Texture gutter	<input type="text" value="4"/>	Extra boundary to add to each patch before packing in texture space (in pixels)

Default Help

Close Apply

# Texture

- Render → Show UV Tex Param

