MeshLab

Gianpaolo Palma

MeshLab

- Version MeshLab 2016

  - http://www.meshlab.net/

- Beta version

  - https://ci.appveyor.com/project/cignoni/meshlab/build/artifacts

- 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.
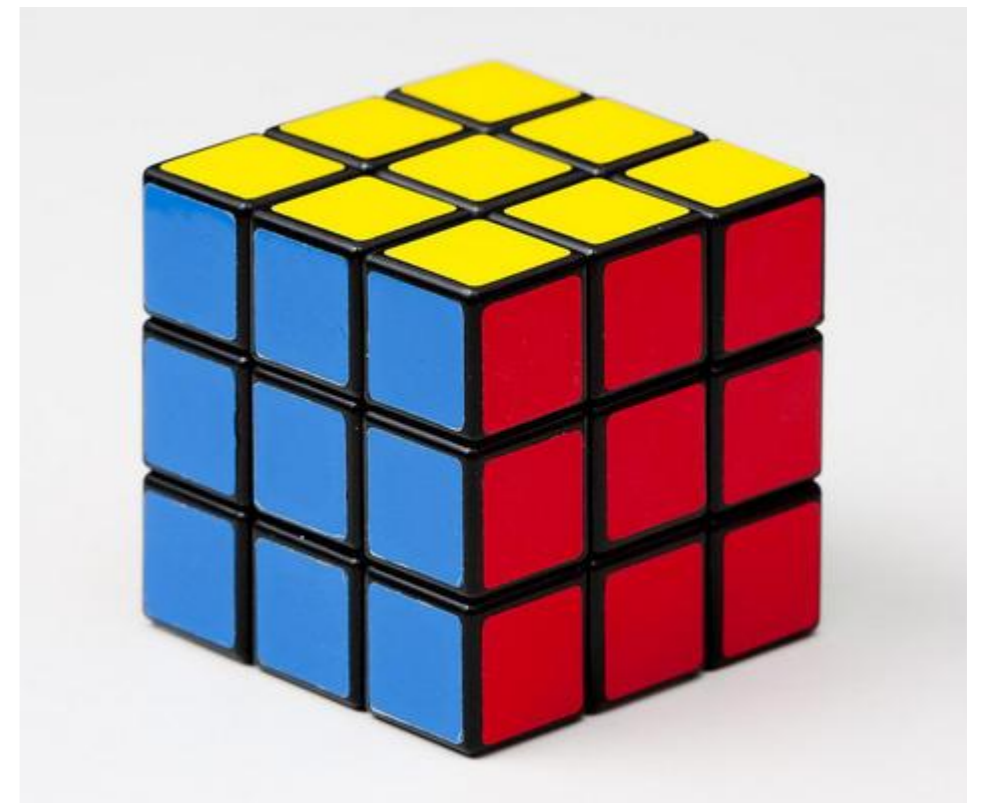
MeshLab – Mesh Data

- 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
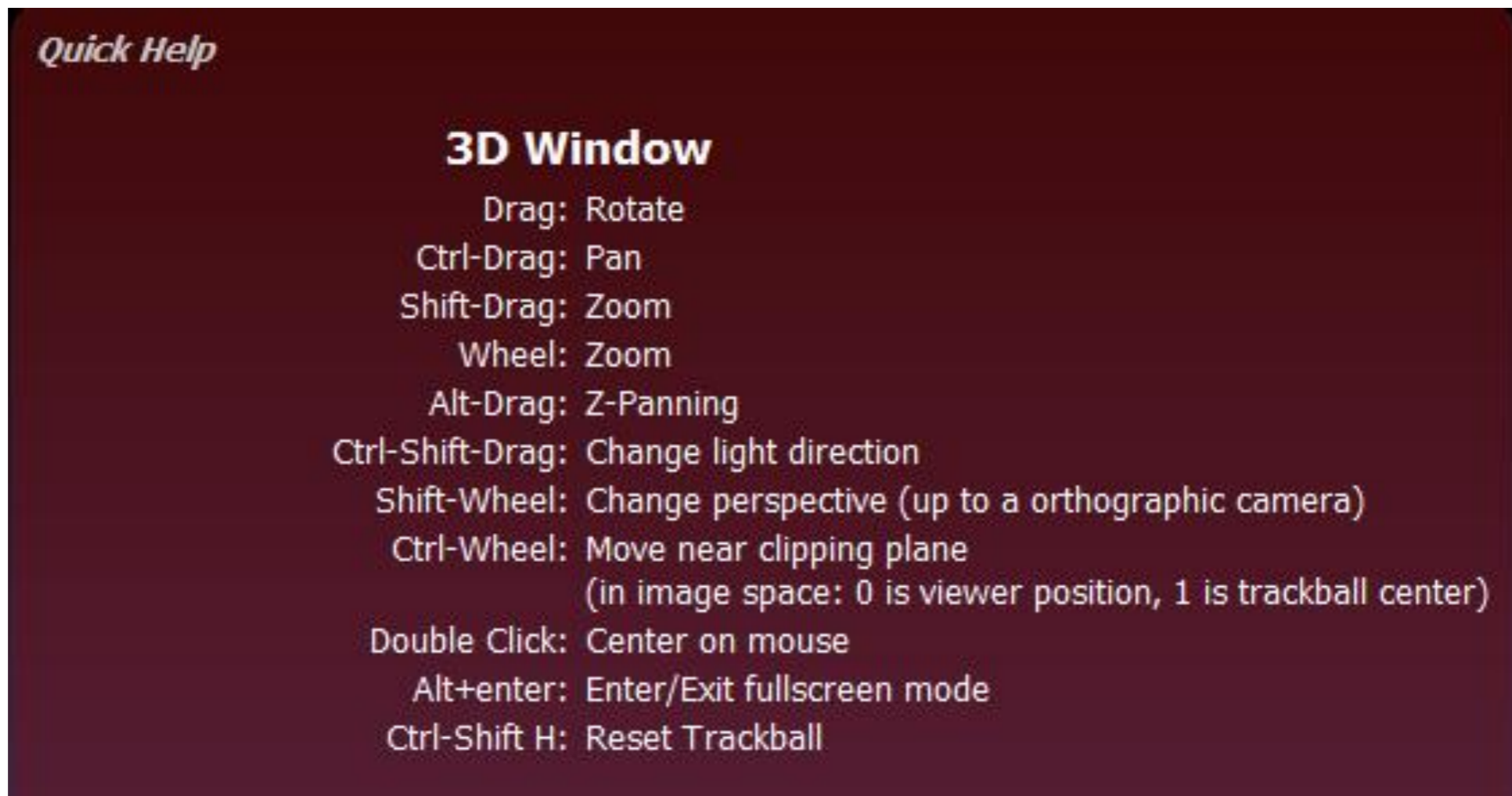   - Color (FC)
    - Quality (VQ)

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

Quick Help

3D Window

Drag:	Rotate
Ctrl-Drag:	Pan
Shift-Drag:	Zoom
Wheel:	Zoom
Alt-Drag:	Z-Panning
Ctrl-Shift-Drag:	Change light direction
Shift-Wheel:	Change perspective (up to a orthographic camera)
Ctrl-Wheel:	Move near clipping plane (in image space: 0 is viewer position, 1 is trackball center)
Double Click:	Center on mouse
Alt+enter:	Enter/Exit fullscreen mode
Ctrl-Shift H:	Reset Trackball

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
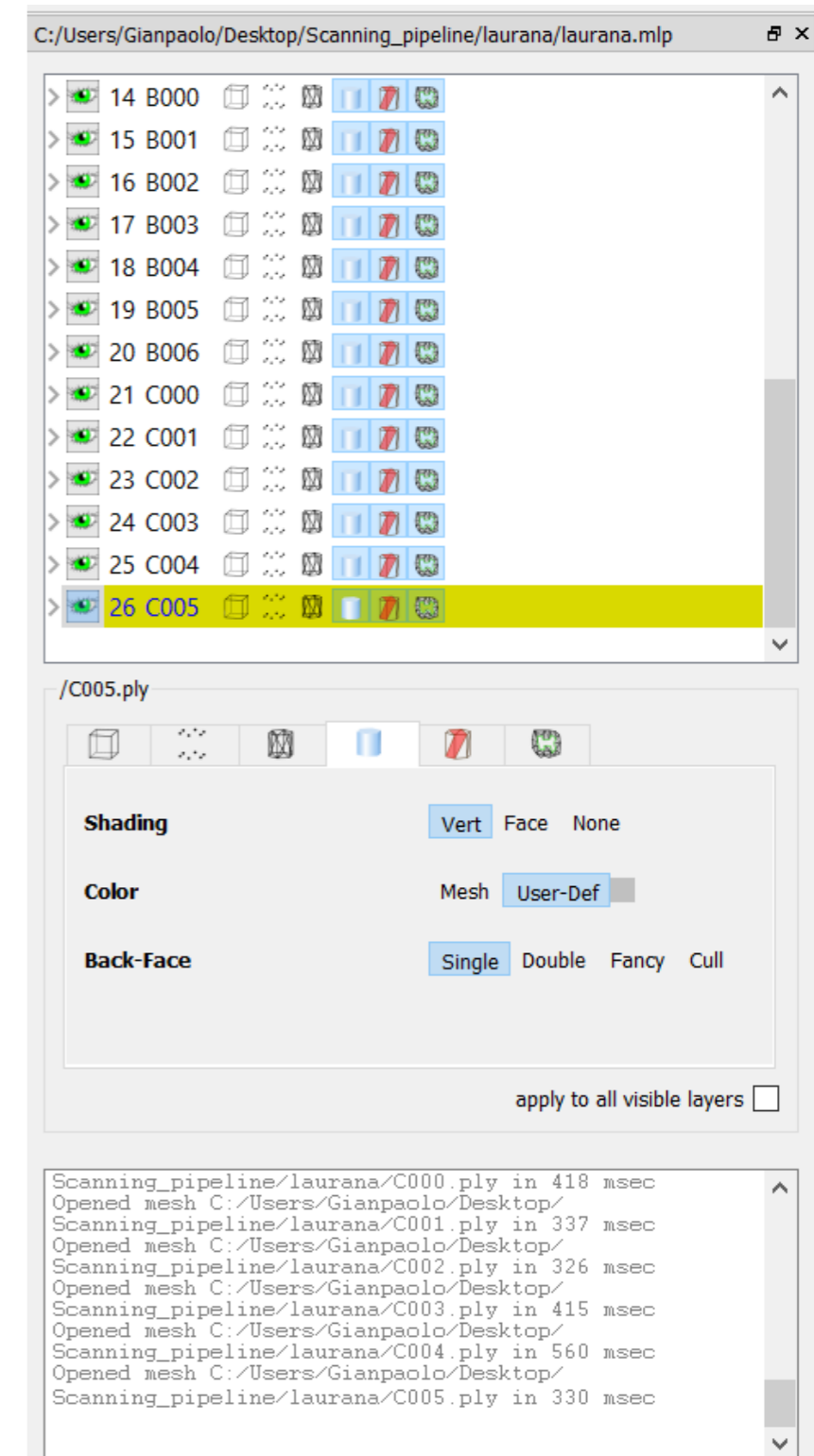
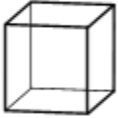TRACKBALL MODE

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 Invisibile all other layers
Alt-Click on eye icon: Make Visibile all other layers
Shift-Click on eye icon: Invert visibility status of all the layers

C:/Users/Gianpaolo/Desktop/Scanning_pipeline/laurana/laurana.mlp

	14 B000
	15 B001
	16 B002
	17 B003
	18 B004
	19 B005
	20 B006
	21 C000
	22 C001
	23 C002
	24 C003
	25 C004
	26 C005

/C005.ply

Shading   Vert Face None

Color   Mesh User-Def

Back-Face   Single Double Fancy Cull

apply to all visible layers ☐

Scanning_pipeline/laurana/C000.ply in 418 msec
Opened mesh C:/Users/Gianpaolo/Desktop/
Scanning_pipeline/laurana/C001.ply in 337 msec
Opened mesh C:/Users/Gianpaolo/Desktop/
Scanning_pipeline/laurana/C002.ply in 326 msec
Opened mesh C:/Users/Gianpaolo/Desktop/
Scanning_pipeline/laurana/C003.ply in 415 msec
Opened mesh C:/Users/Gianpaolo/Desktop/
Scanning_pipeline/laurana/C004.ply in 560 msec
Opened mesh C:/Users/Gianpaolo/Desktop/
Scanning_pipeline/laurana/C005.ply in 330 msec
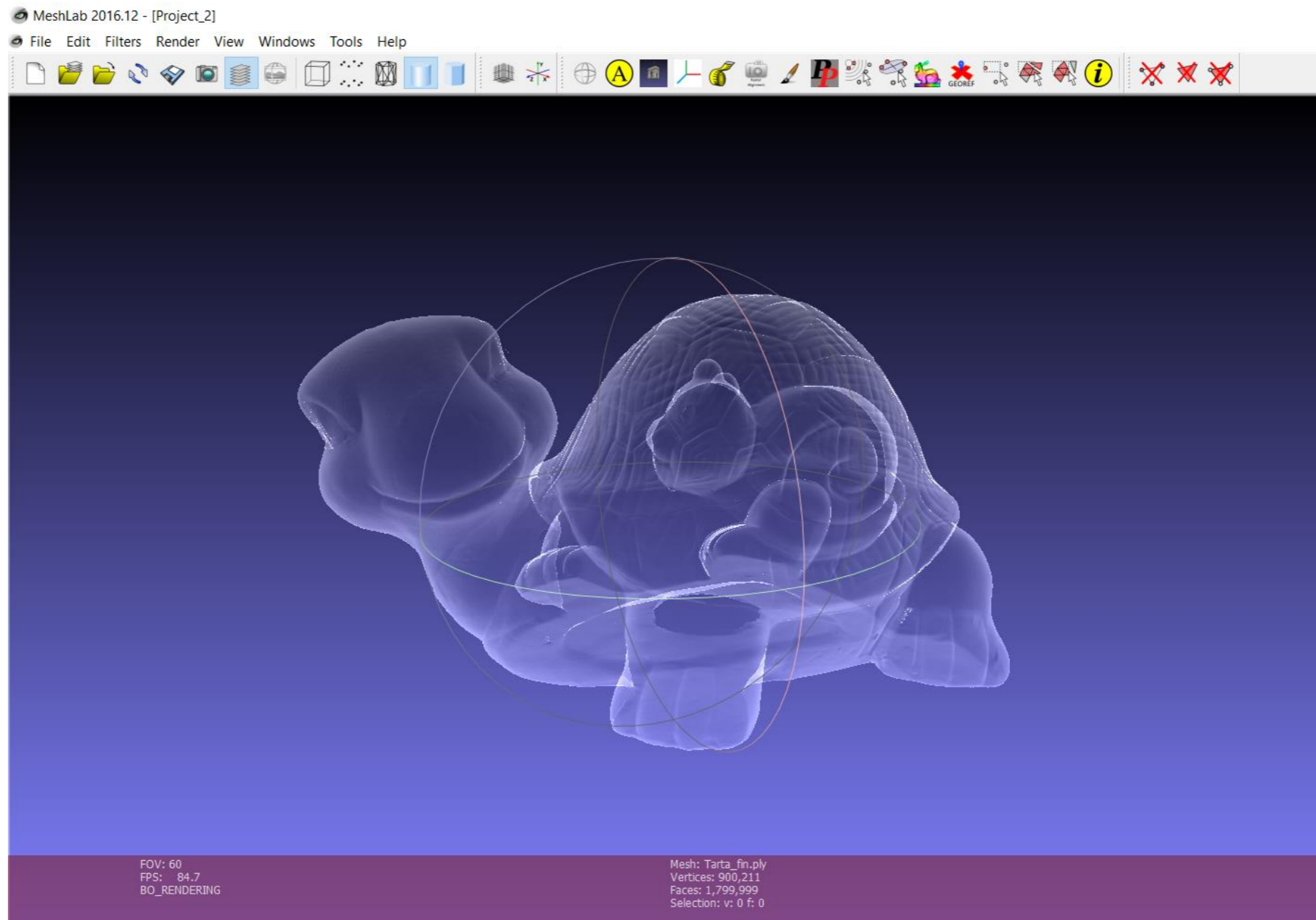
Rendering Modes

- 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
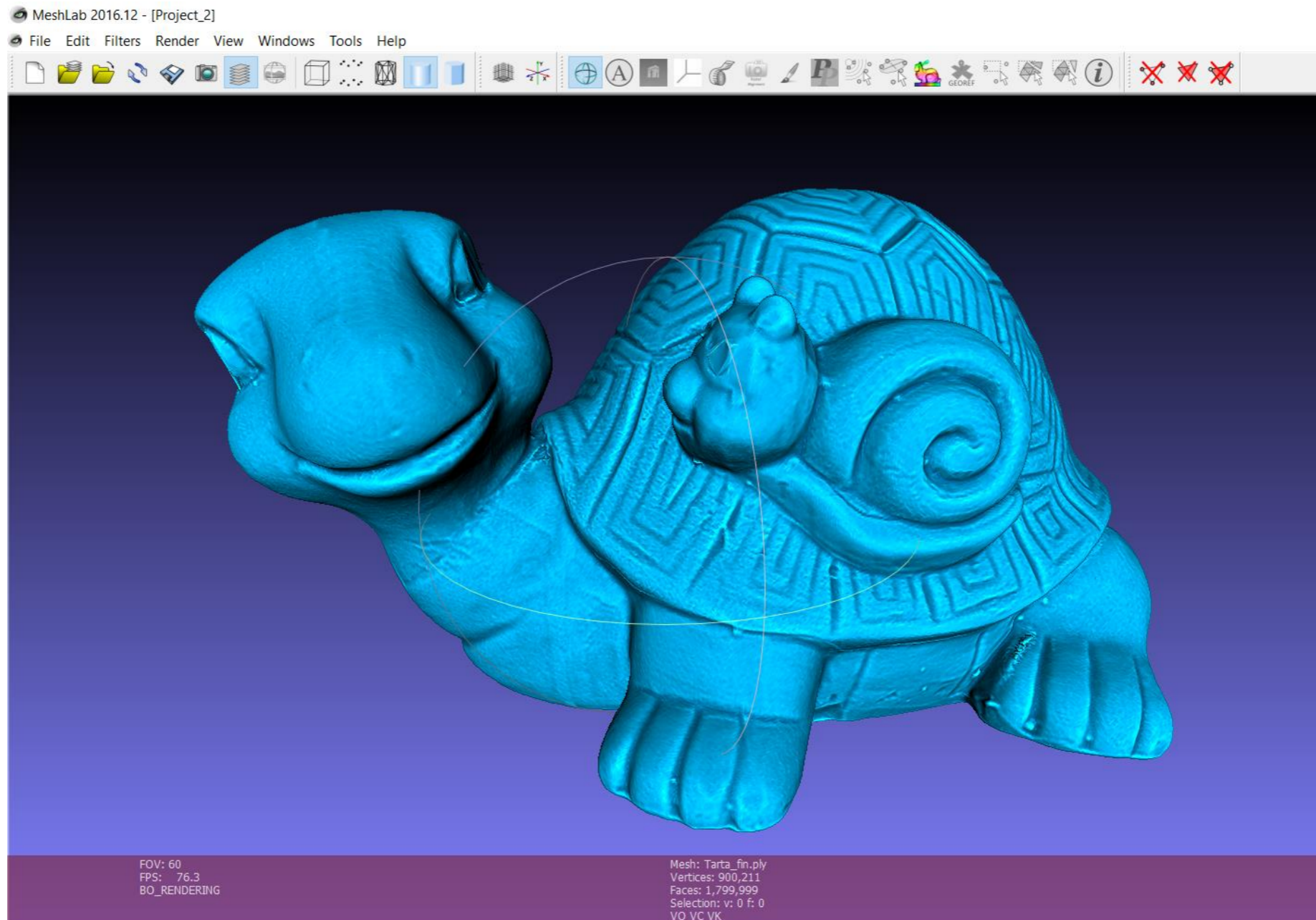
  - Axis

  - 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

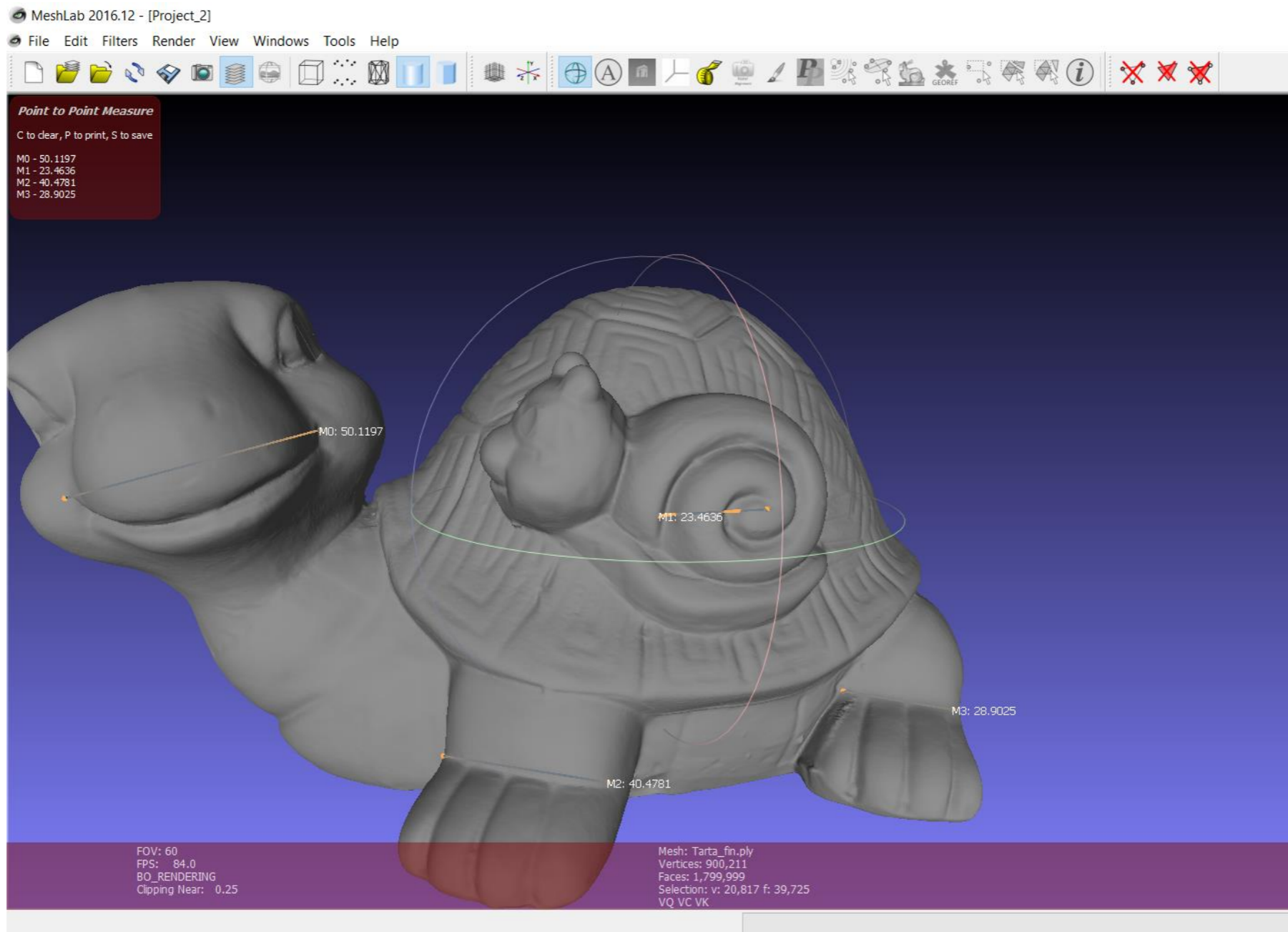 - The selected faces and the referenced vertices by the selected faces

Snapshot

- Save the current rendering as png image

- Save high resolution images using tiling
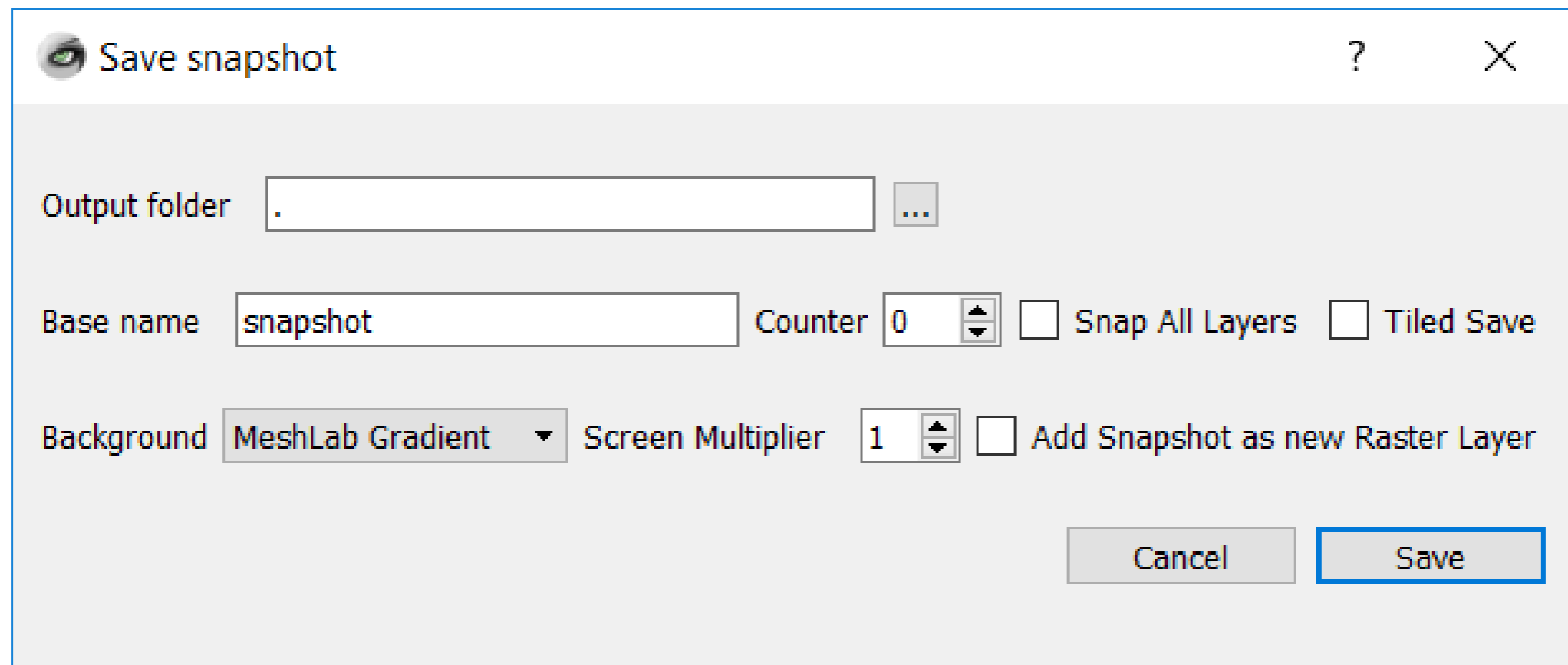
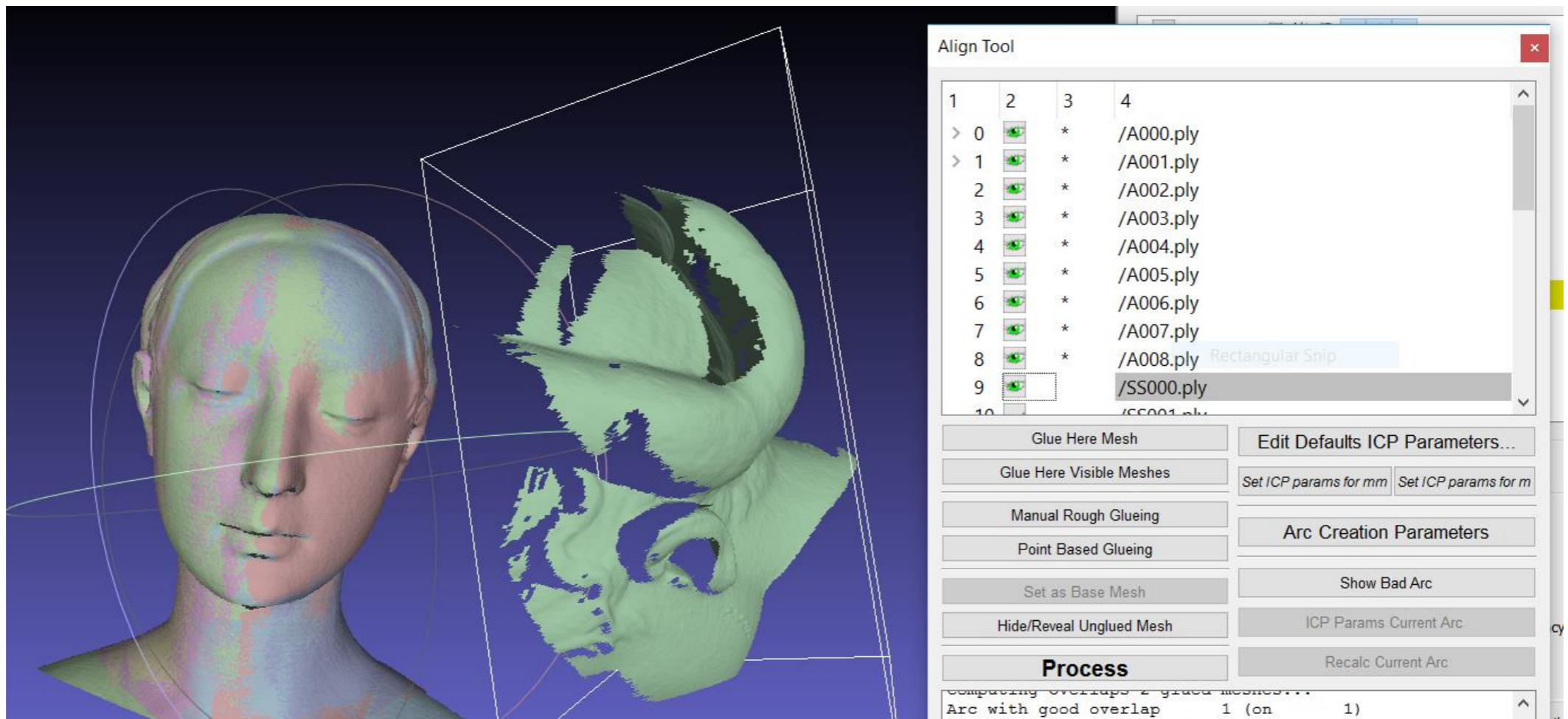# Measuring Tools

- Take measure on your mesh 📏

Smoothing

- Filter → Smoothing,Fairing,Deformation →

  - Laplacian smooth

  - Scale dependent laplacian smooth

  - Taubin smooth

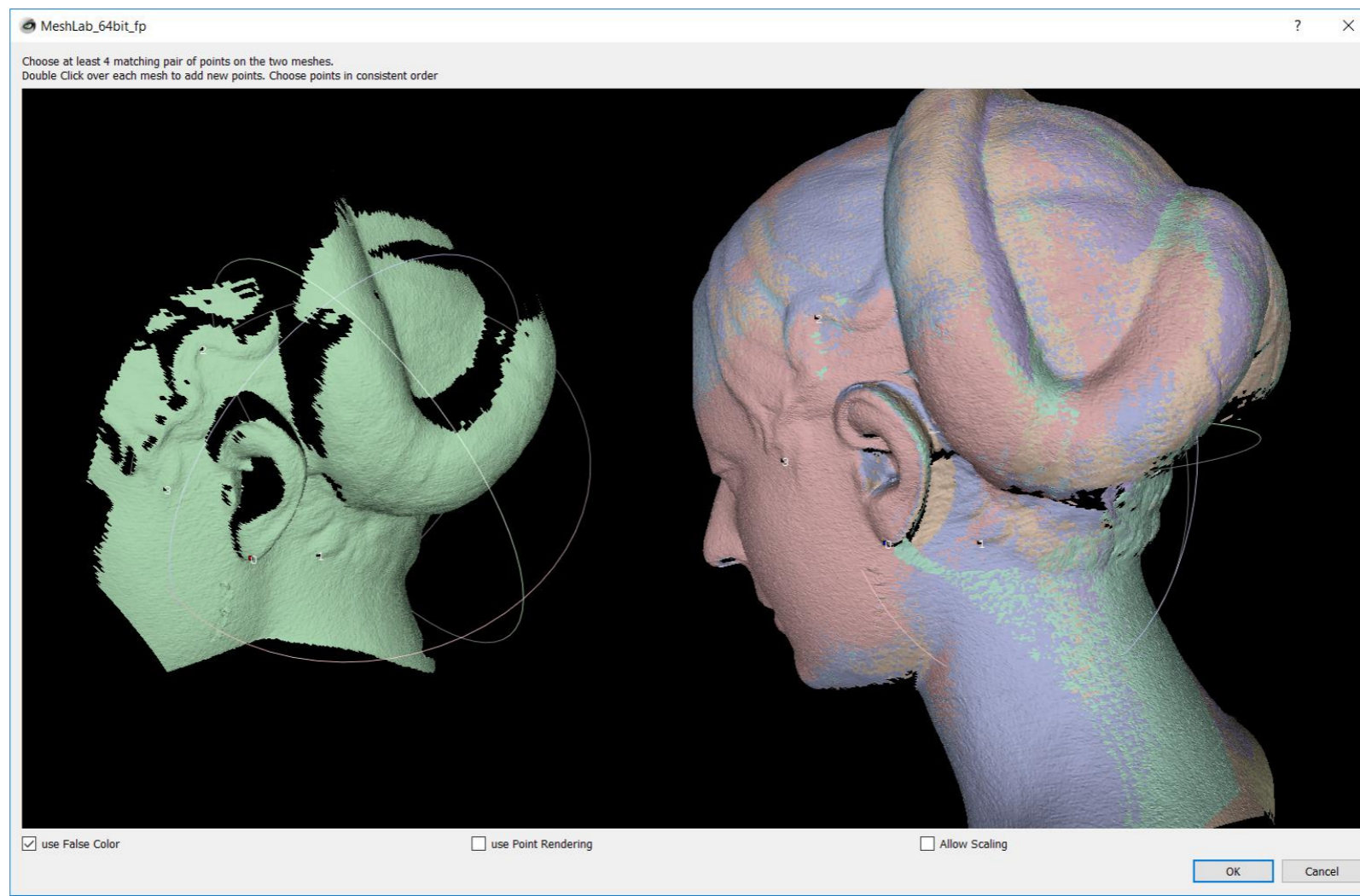 - Laplacian smooth (surface preserve)

Alignment Tools

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

Alignment Tools
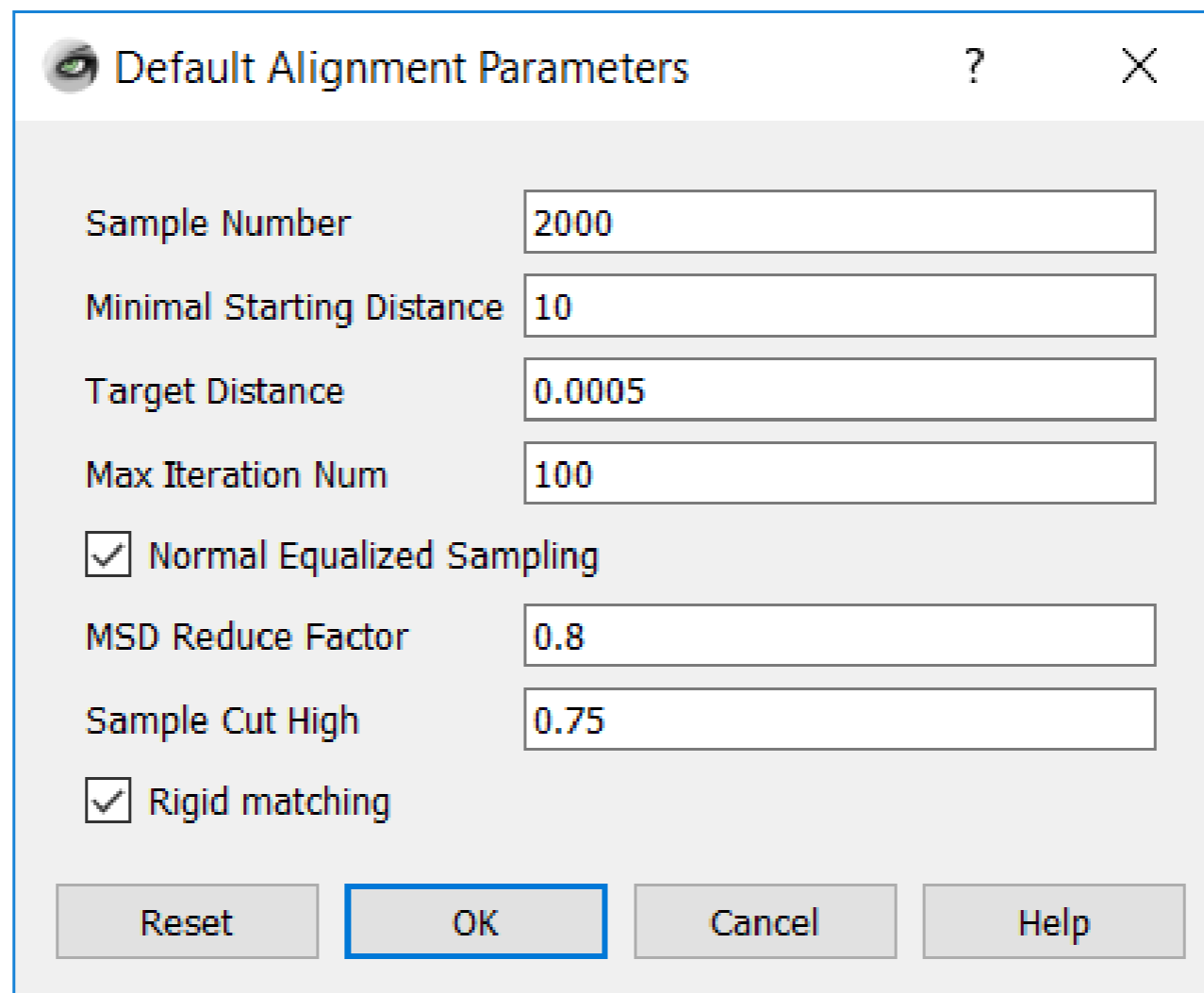
Point based Glueing

- Select by double click the correspondences, the order is important

- Keep pressed CTRL to remove a point

Alignment Tools

Launch Process

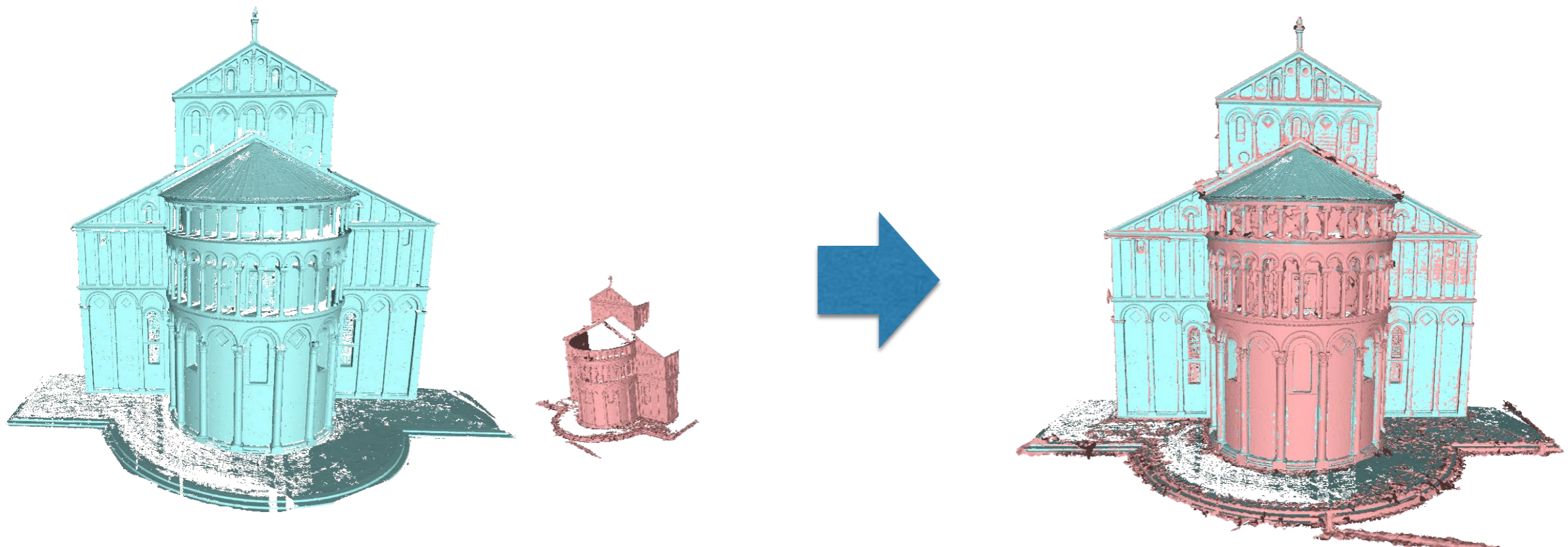- Adjust the parameters (Edit Default ICP Parameters)

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 reconstrction 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 %)	2.5028	1.000	VoxelSide

SubVol Splitting | 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 reconsruction objects at a very high resolution. Default value (1) means no splitting.

Geodesic Weighting | 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.

☑ Show Result | if not checked the result is only saved into the current directory

Volume Laplacian iter | 1 | How many volume smoothing step are performed to clean out the eventually noisy borders

Widening | 3 | How many voxel the field is expanded. Larger this value more holes will be filled

☐ 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.

☐ Post Merge simplification | After the merging an automatic simplification step is performed.

PreSmooth iter | 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.
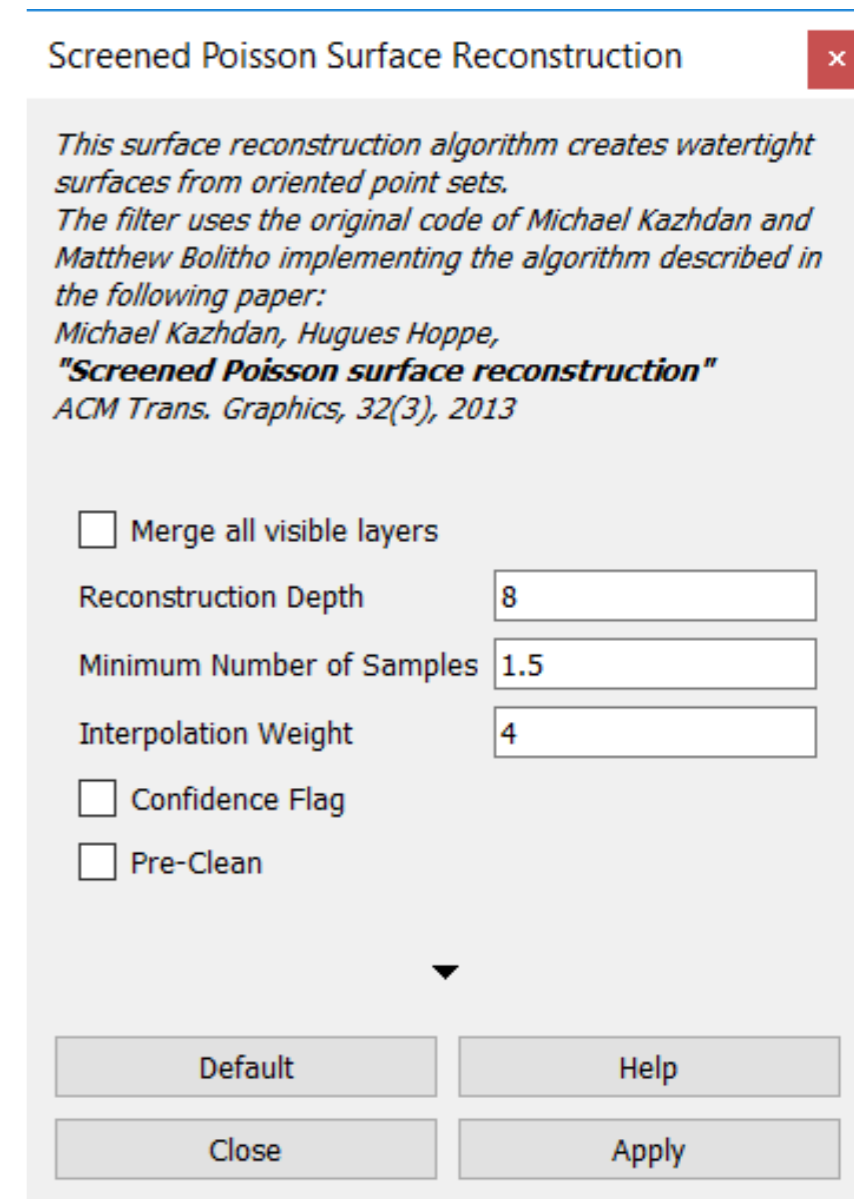
| Default | Help |
| Close | Apply |

3D Reconstruction

- Screened Poisson Surface Reconstruction
  Filter → Remeshing,Simplification, Reconstruction → Screened Poisson Surface reconstruction

- If "Iterpolation 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   8

Minimum Number of Samples   1.5

Interpolation Weight   4

☐ Confidence Flag

☐ Pre-Clean

▼

| Default | Help |
| Close | Apply |

Cleaning Poisson Reconstruction

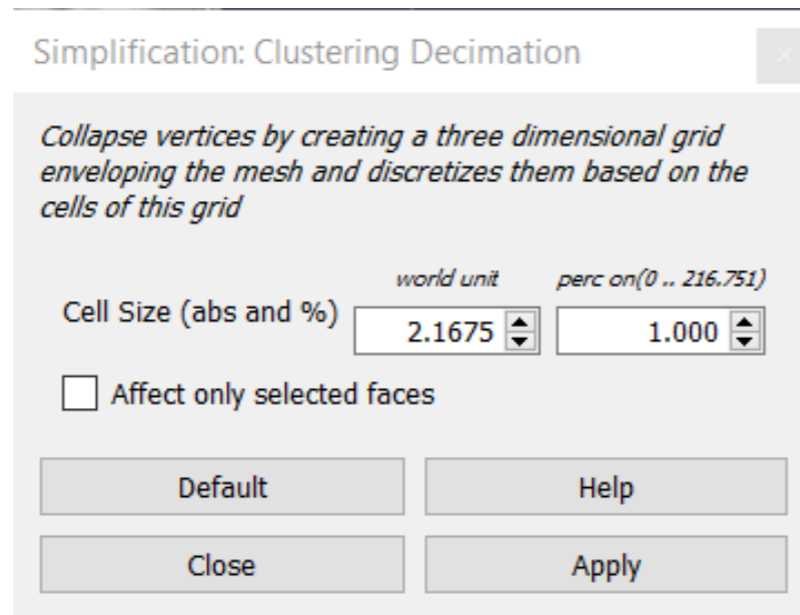- Filter → Selection→ Selection by vertex quality
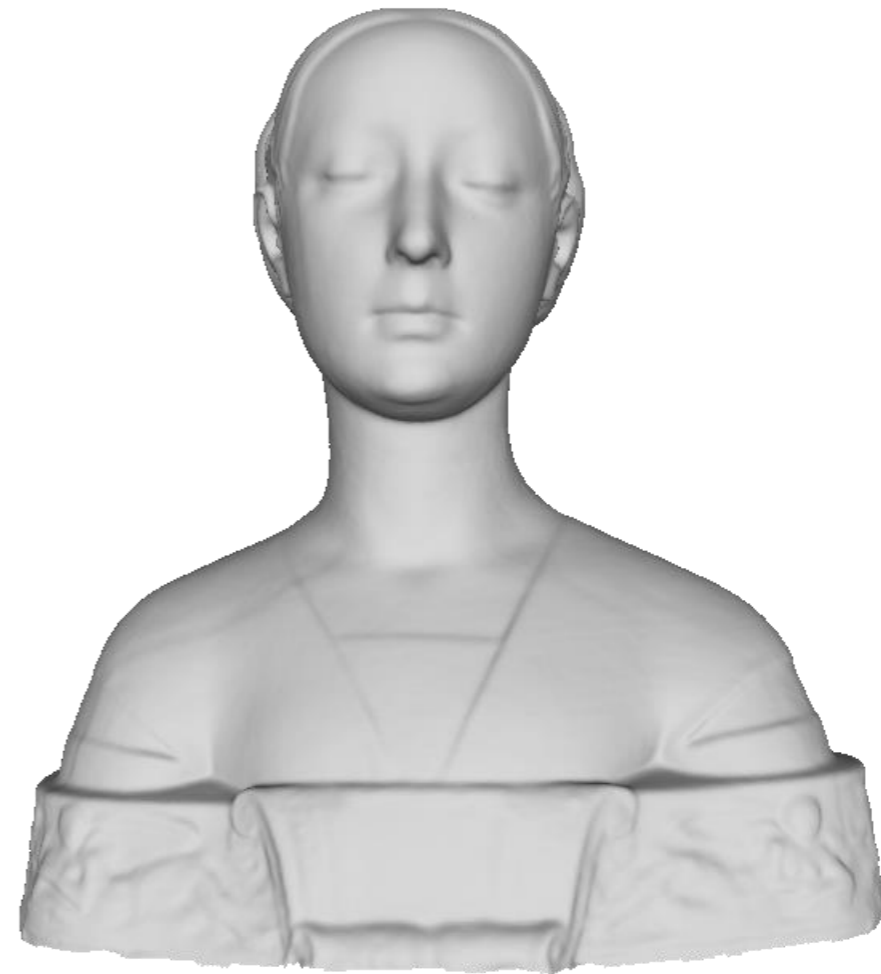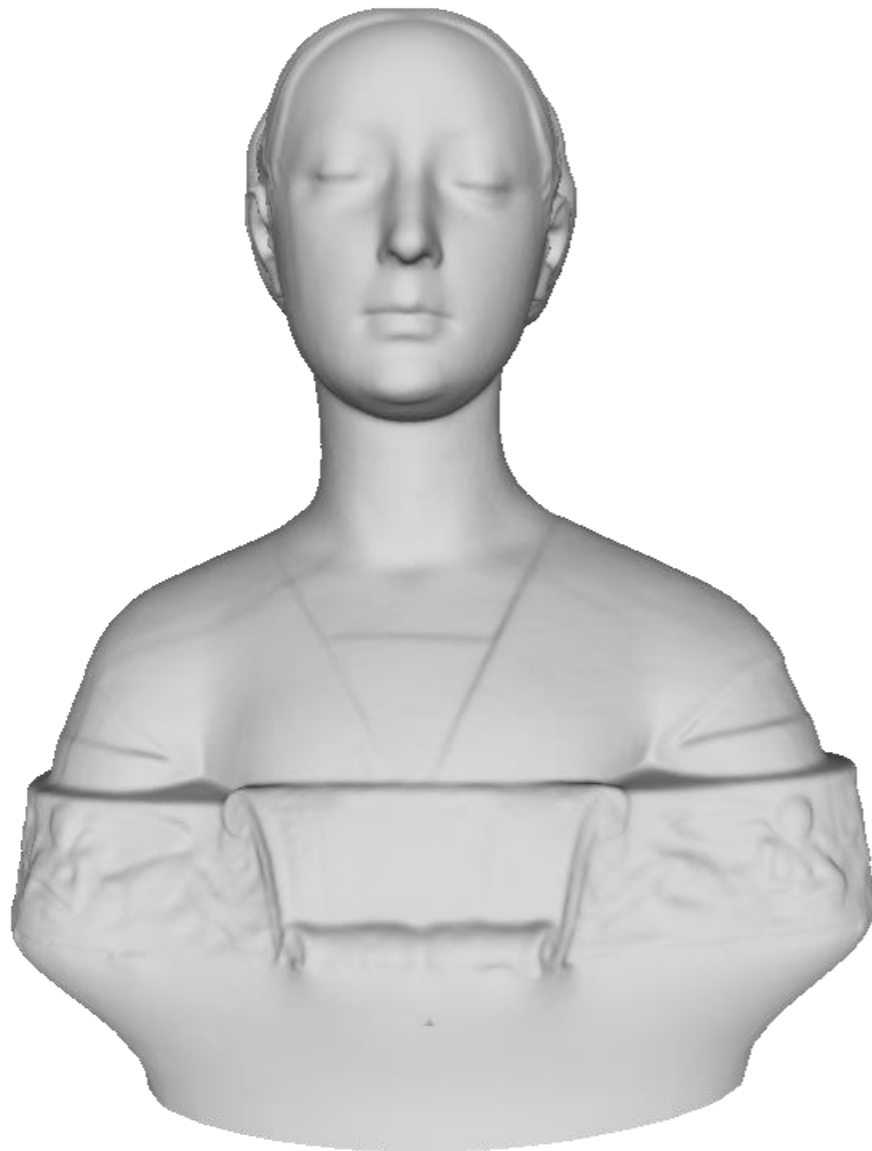
Cleaning and Repairing

- Filter → Cleaning and Repairing

- Filter → Selection

Simplification

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

Simplification: Clustering Decimation

Collapse vertices by creating a three dimensional grid enveloping the mesh and discretizes them based on the cells of this grid

	world unit	perc on(0 .. 216.751)
Cell Size (abs and %)	2.1675	1.000

☐ Affect only selected faces

Default	Help
Close	Apply

Simplification: Quadric Edge Collapse Decim...

Simplify a mesh using a Quadric based Edge Collapse Strategy; better than clustering but slower

Target number of faces	90415
Percentage reduction (0..1)	0
Quality threshold	0.3

☐ Preserve Boundary of the mesh

Boundary Preserving Weight	1

☐ Preserve Normal
☐ Preserve Topology
☑ Optimal position of simplified vertices
☐ Planar Simplification
☐ Weighted Simplification
☑ Post-simplification cleaning
☐ Simplify only selected faces

Surface Comparison

- Hausdorff distance – Measure distance between two meshes
Filter → Sampling→ Hausdorff Distance
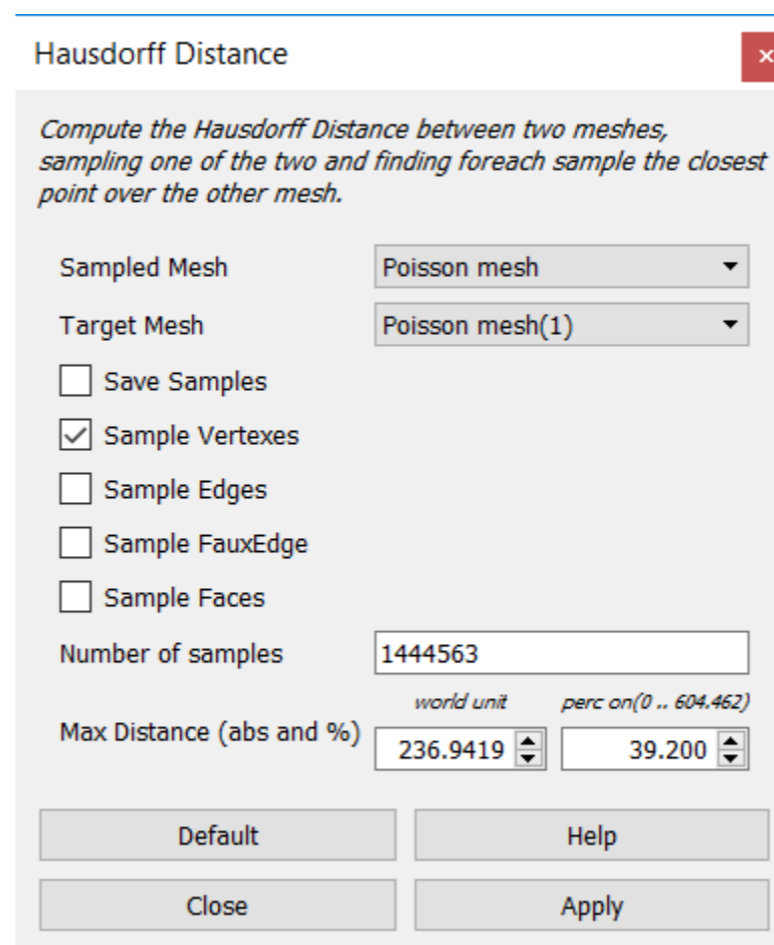
Quality Mapper

- Colorize the mesh according the quality value
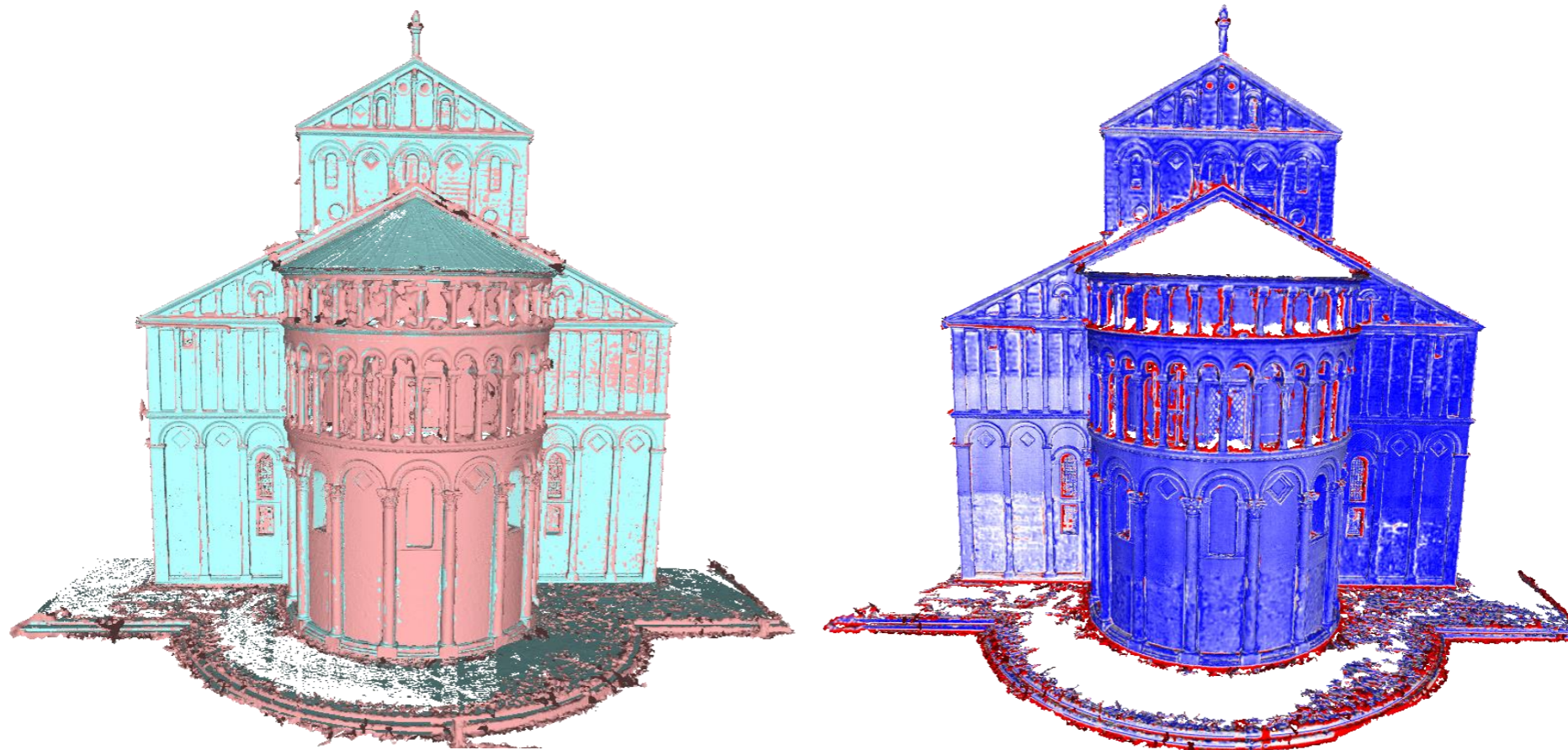
0mm   10mm

Camera Calibration

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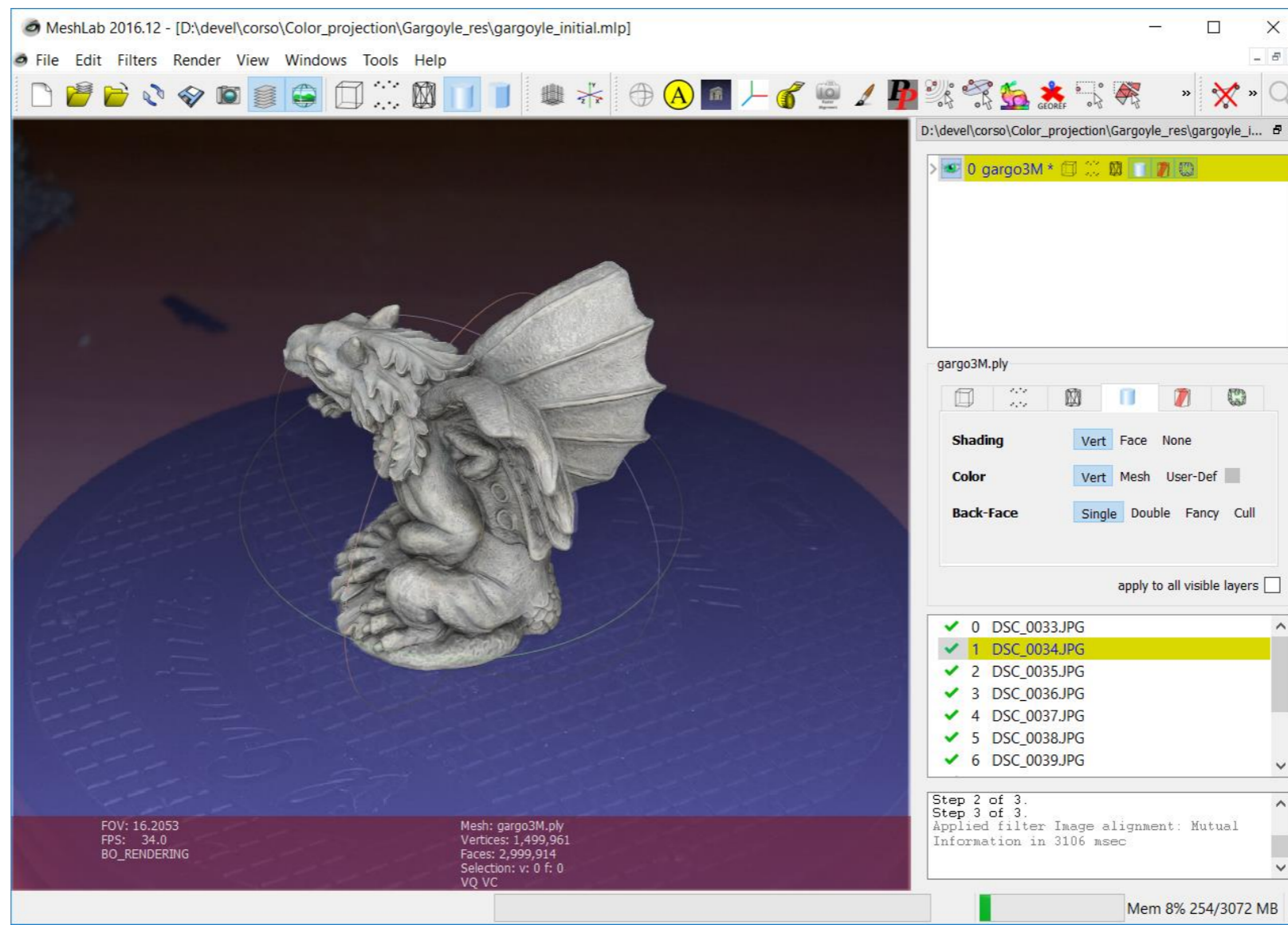
Camera Calibration

- Filter → Camera→ Image Alignment: Mutual Information

Color Projection

- Render → Raster-to-Geometry projection

Color Projection

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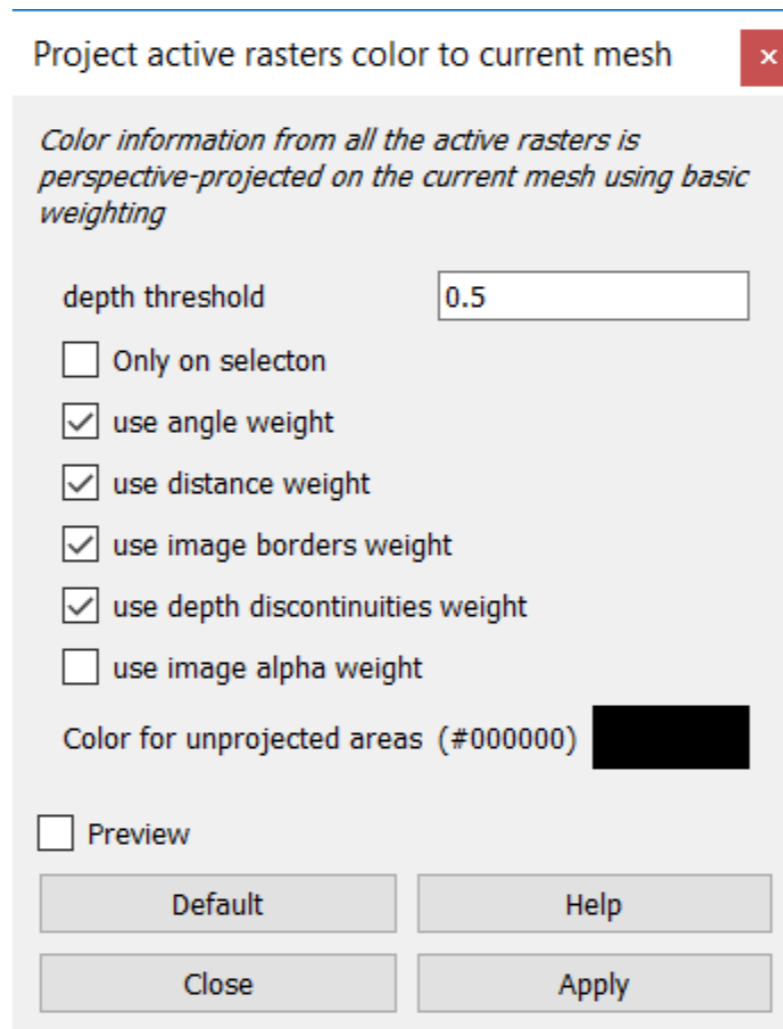
Color Projection

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

Texture

- Render → Show UV Tex Param