MeshLab
Simple Mesh Editing

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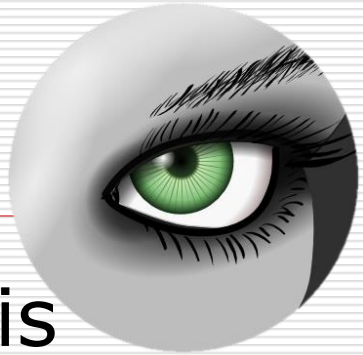
MeshLab Tutorials

Basic Mesh Editing

- **Cleaning**
  - Remove topological errors
  - Remove wrong/unwanted parts
- **Fixing**
  - Hole filling
  - Smoothing
- **Remeshing**
  - Simplification
  - Reconstruction
  - Refinement

Cleaning



Cleaning a mesh is an operation which is often necessary before, during and after the processing of a mesh

Cleaning involves the removal of geometrical inconsistency in the triangle mesh

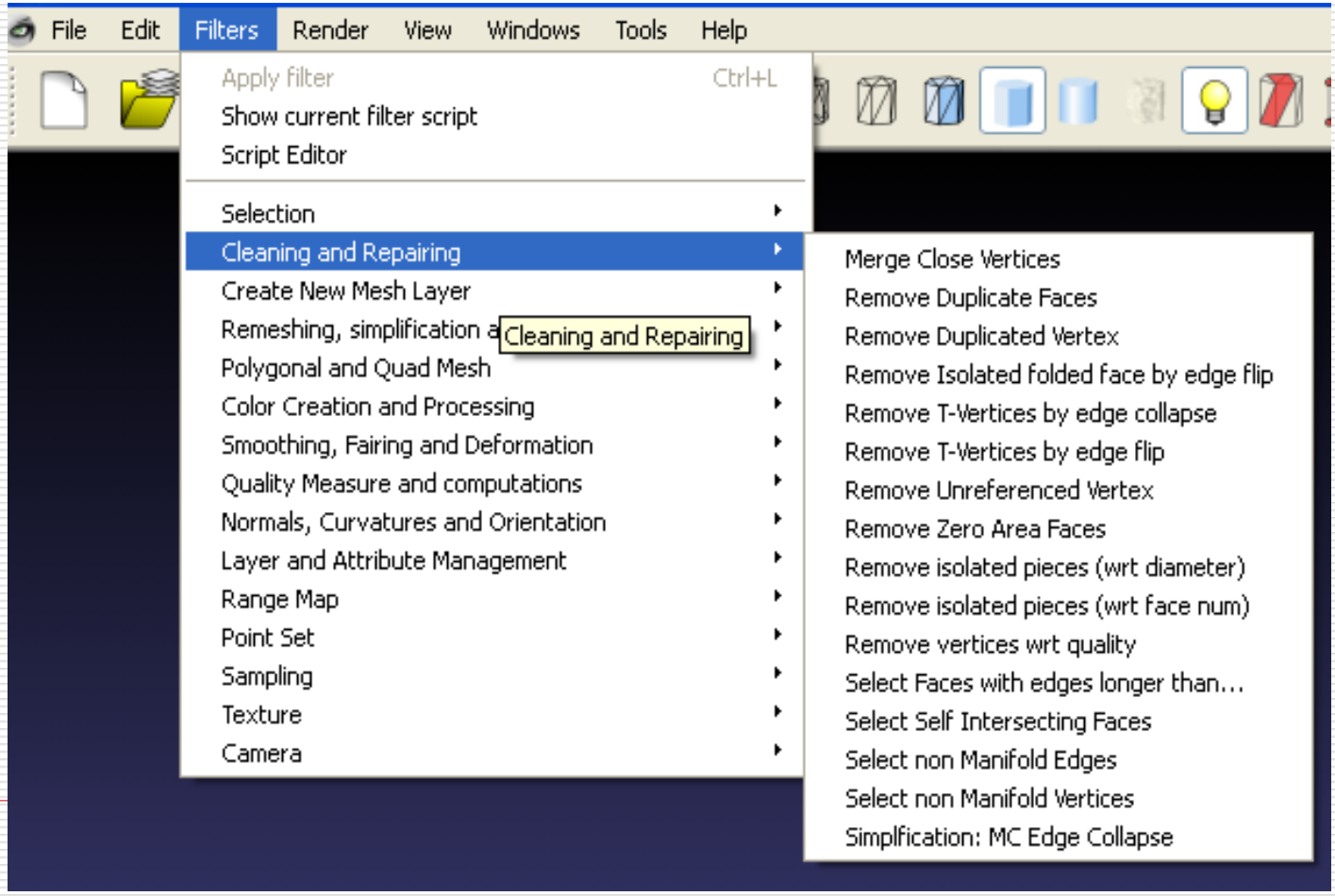
There’s a number of possible cleaning Operations, we will show the most common

Cleaning: general hints

- Some general hints:
  - Most opertaion on meshes have difficulties if some “topological errors” are present... If a filter or external tool crashes, try cleaning the mesh!
  - Save frequently (*no undo!*)
  - Some filters have the *preview* option, use it
  - A “nice” mesh is closed, with triangles of the same size, with a very clean topology…

Cleaning

- Most of the cleaning filters is in the Cleaning and repairing sub-menu



Cleaning: topology filters

- The basic filters are simple to use (no parameter) and usually not “dangerous”
  - Remove duplicated faces
  - Remove duplicated vertex
  - Remove Zero Area faces
  - Remove Unreferenced Vertex

Cleaning: other filters

- Other useful filters are used to remove from the mesh some "critical" parts

  They need simple parameters setting

  - Remove isolated components Parameter: # of faces (OR component size)
  - RemoveSelect faces with edges longer than… Parameter: edge threshold
  - Remove border faces
    Parameter: iteration (how many rows to be deleted)

Cleaning: select critical areas

- Other filters are used to select some specific “critical” parts, in order to remove them, later on
  - Select non manifold (vertices or edges)
  - Select faces with edges longer than…
  - Select Self Intersecting
  - Select border faces (is actually in the “selection” submenu)

Removing the unwanted

- General strategy: select the desired part and delete it... many ways to select:
  - Drag selection
  - Paint selection
  - Selection filters (like conditional selection)
- Three delete buttons:
  - Remove selected faces, keep the points
  - Remove selected faces and their points
  - Remove selected points, keep the faces

Fixing

Fixing means making the mesh more complete and less noisy...

This may be done just for cosmetic reasons, but also to cope with specific requirements.

The two most common operations: hole filling and smoothing.

Close Holes

Most of the meshes have holes, but some of the filters need “watertight” models.

- Hole filling is not always a trivial operation
- Some holes will always be impossible to automatically be closed
- Two tools to fill holes in Meshlab
  - Small Holes (automatic filter)
  - Large Holes (editing filter)

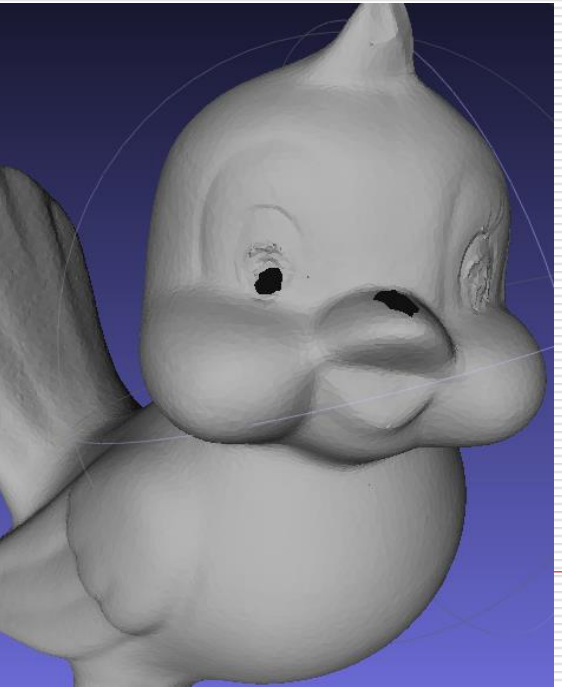
Close Small Holes

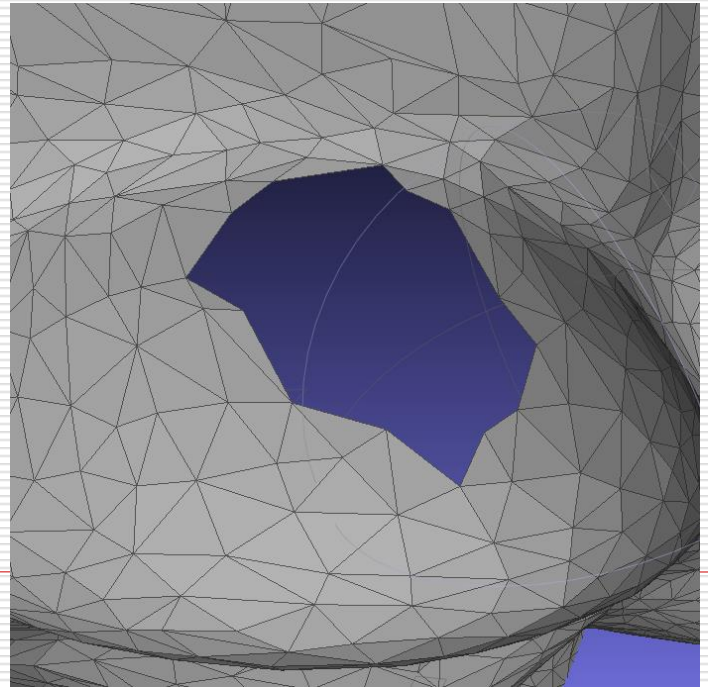
Holes which are “small” with respect to the mesh size, possibly almost planar...

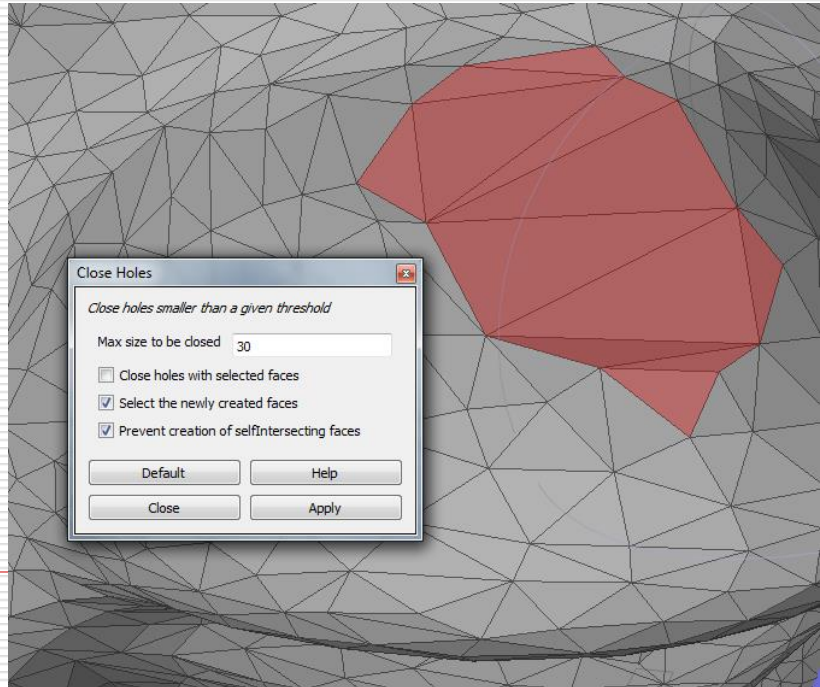
Simple filter:

Remeshing, simplification and reconstruction->Close Holes

Parameters: max size to be closed (in terms of perimeter lenght)







Close Small Holes (trick)

Holes are closed in a funny (unpleasant) way...
sometimes the filling geometry looks like a “patch”

- Enable “select newly created faces” on the *close holes* filter dialog, the newly created filling triangles will be selected
- Dilate the selection (one or two times)
- Apply a smooth filter (only on selected faces)

Another way

Use Poisson or other reconstructions!...

but be careful about the detail loss; you are resampling the surface

- Poisson always produce a closed surface
- VCG reconstructor may close local/small holes, but not complete large gaps

Smoothing

Smoothing operations are geometric manipulation of the triangular mesh

Geometrical noise is reduced at the price of some details...

Different reasons to do it:

Reduce sampling/reconstruction noise

Make more pleasant models

Reduce the visual impact of some editing filters

Smoothing

General purpose:

- Laplacian smooth (Fast, higly effective, but lots of detail lost)
- HC Laplacian (Better detail preserving, slower)
- Taubin Smooth

Other filters try to obtain smooth surfaces AND sharp details (experiment a bit with the params):

- Two-step smooth
- Taubin Smooth

On the other side, to increase the detail:

- Unsharp Mask (just like in photoshop)

Remeshing

Remeshing operations modify an existing geometry, by completing, removing, adding, changing the triangles.

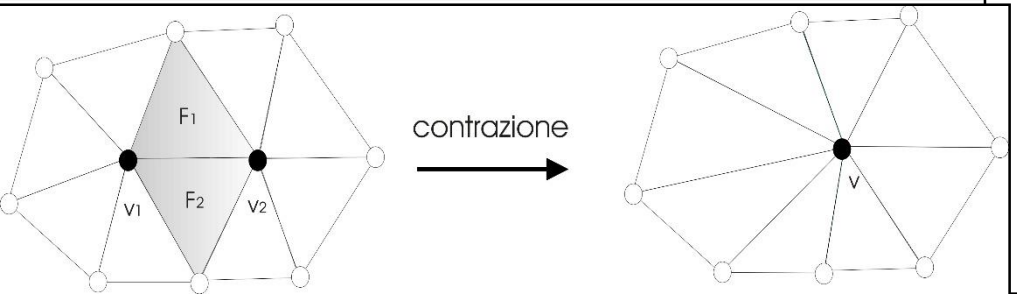
There’s a number of possible remeshing operations, and several ways to do each…

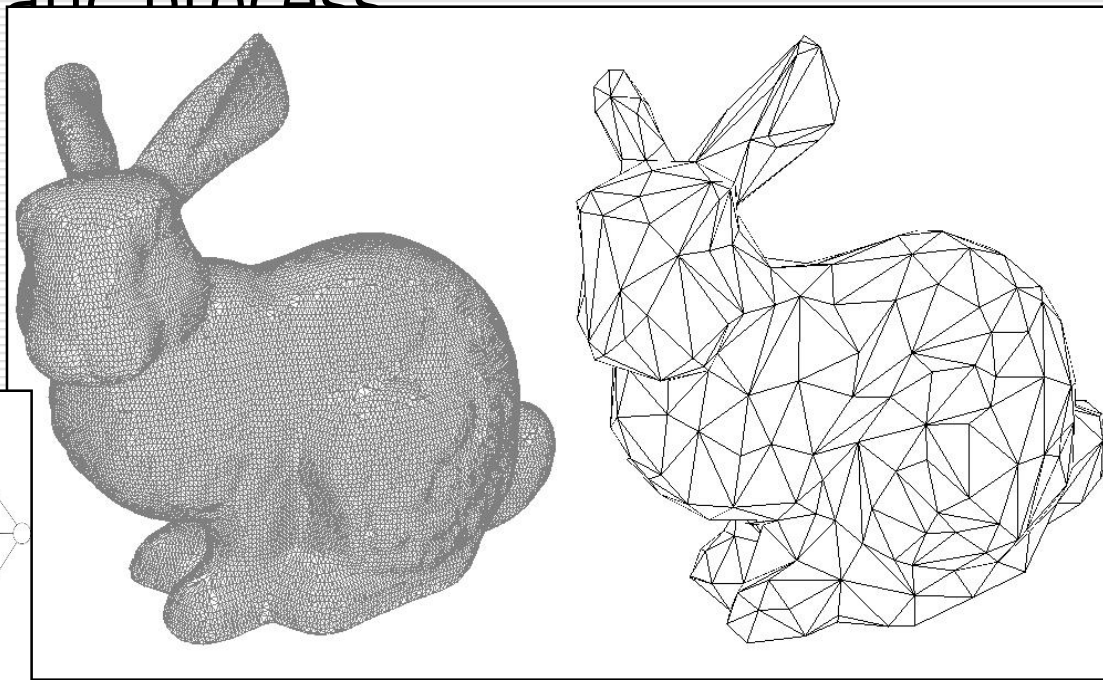
Simplification

The simplification reduces the number of triangles in a mesh removing triangles in order of "importance"

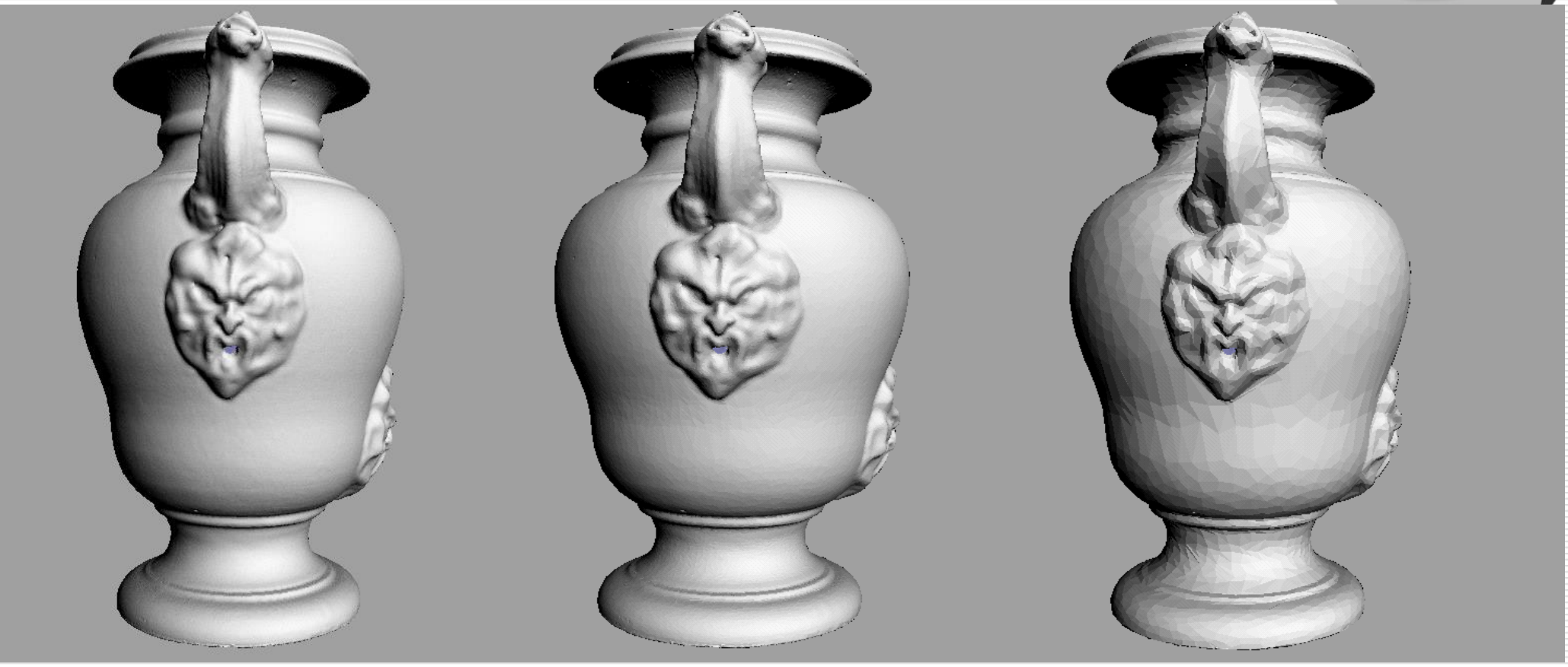
In this way, the geometrical complexity is reduced losing the least possible amount of information...

Simplification is an automatic process





Simplification



Original mesh
2.104.792 triangoli

130.343 triangles

19.936 triangles

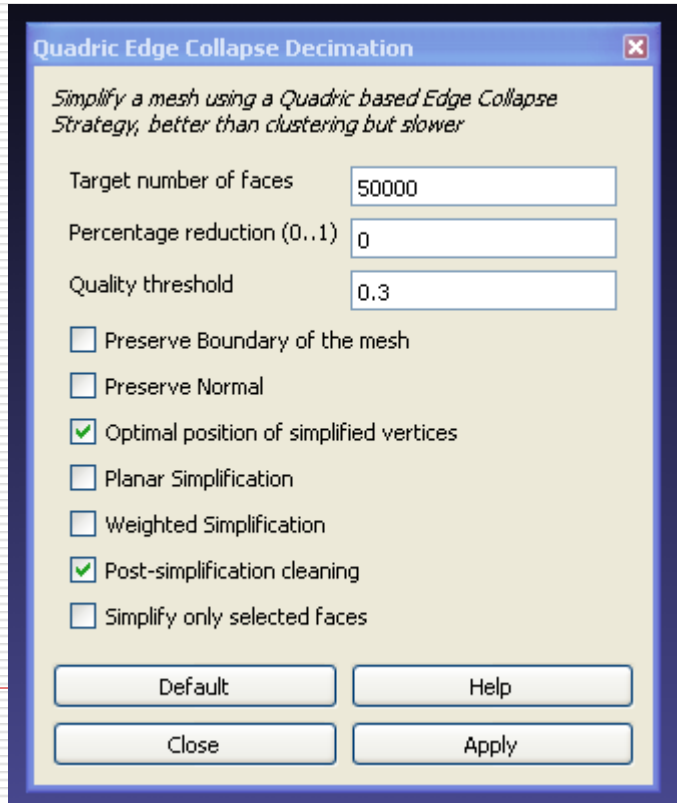
Simplification

Best simplification filter:

Remeshing, simplification and reconstruction
→ Quadric Edge Collapse Simplification

Parameters:

- Target number of faces OR percentage (of the original mesh size)
- Preserve mesh boundary [yes/no]
  (if yes, more memory is needed)
- Take additional care of flat areas [yes/no]
  (if yes, more memory is needed)
- Preserve surface normal [yes/no]
  (if yes, more memory is needed)
- Work on the whole mesh or only on selected part



Subdivision

- The subdivision increases the number of triangles in a mesh
- Several ways to do that
- Reliable one:

  Remeshing, simplification and reconstruction->MidPoint Subdivision Surfaces

  Parameters: Edge Threshold

Subdivision

- The subdivision increases the number of triangles in a mesh
- Several ways to do that
- More complex one:

  Remeshing, simplification and reconstruction->Refine User-Defined

  Parameters: refinement decided by the user (using also color and quality!)