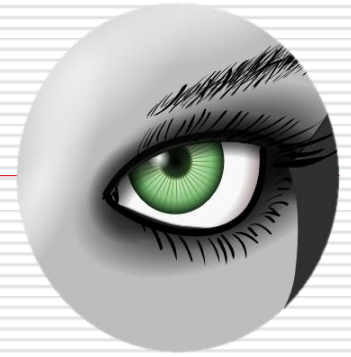# Grafica 3D per i beni culturali: MeshLab features 1
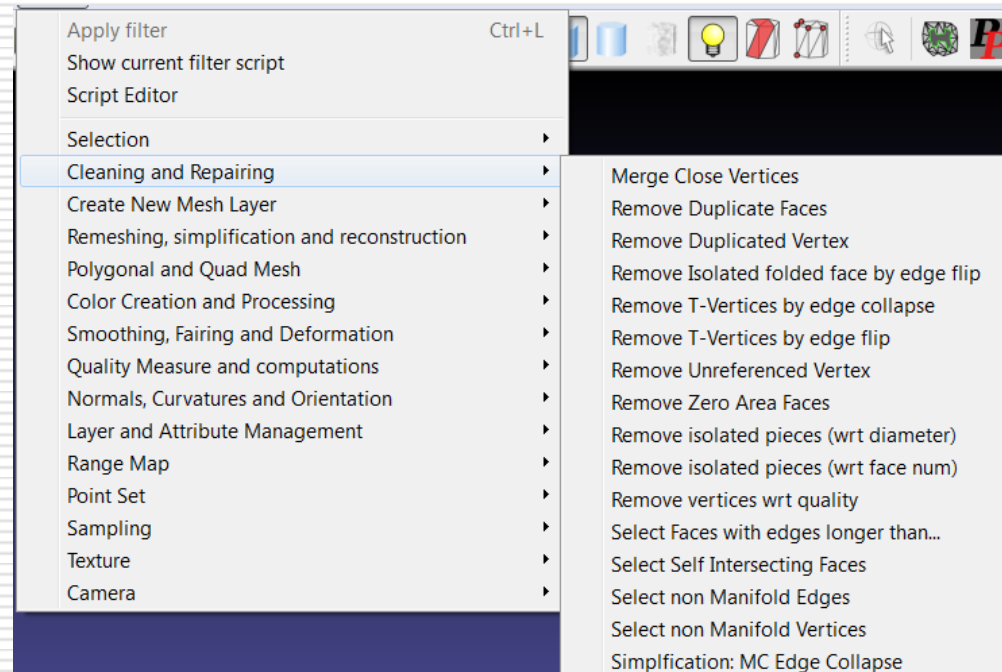
Lezione 8: 22-23 Marzo 2011

Cleaning

Cleaning

- Cleaning a mesh is an operation which is often necessary before, during and after the processing of a mesh
- There's a number of possible cleaning operations

Cleaning

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

Apply filter	Ctrl+L
Show current filter script	
Script Editor	
Selection	▶
Cleaning and Repairing	▶
Create New Mesh Layer	▶
Remeshing, simplification and reconstruction	▶
Polygonal and Quad Mesh	▶
Color Creation and Processing	▶
Smoothing, Fairing and Deformation	▶
Quality Measure and computations	▶
Normals, Curvatures and Orientation	▶
Layer and Attribute Management	▶
Range Map	▶
Point Set	▶
Sampling	▶
Texture	▶
Camera	▶

Merge Close Vertices
Remove Duplicate Faces
Remove Duplicated Vertex
Remove Isolated folded face by edge flip
Remove T-Vertices by edge collapse
Remove T-Vertices by edge flip
Remove Unreferenced Vertex
Remove Zero Area Faces
Remove isolated pieces (wrt diameter)
Remove isolated pieces (wrt face num)
Remove vertices wrt quality
Select Faces with edges longer than...
Select Self Intersecting Faces
Select non Manifold Edges
Select non Manifold Vertices
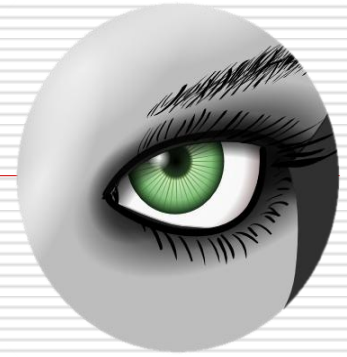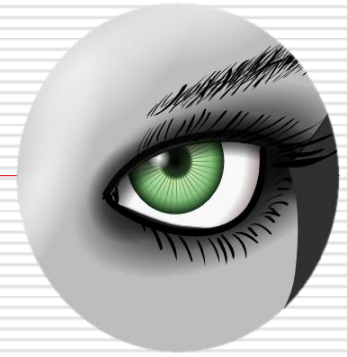Simplfication: MC Edge Collapse

Cleaning: basic filters

☐ The basic filters are simple to use (no parameter) and usually not "dangerous"

- Remove duplicated faces
- Remove duplicated vertex
- Remove Zero Area faces
- Select Non Manifold Faces -> Remove
- Select Non Manifold Vertices -> Remove
- Remove Unreferenced Vertex

Cleaning: other filters

- ☐ Other useful filters need simple parameters setting
  - ■ Remove isolated pieces
    Parameter: n. of faces
  - ■ Select faces with edges longer than…
    Parameter: edge threshold
  - ■ Select border faces
    Parameter: iteration
  - ■ Close holes: something between remeshing and cleaning, we'll see later
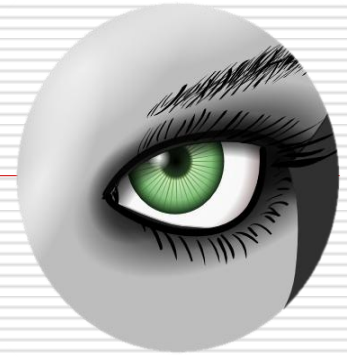
Cleaning: general hints

- ☐ Some general hints
  - ■ If a filter or external tool crashes, clean the meshes!
  - ■ Save frequently (no undo!)
  - ■ A "nice" mesh is closed, with triangles of the same size, a very clean topology...
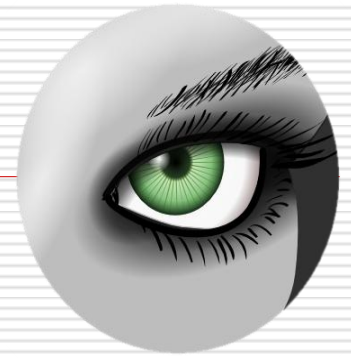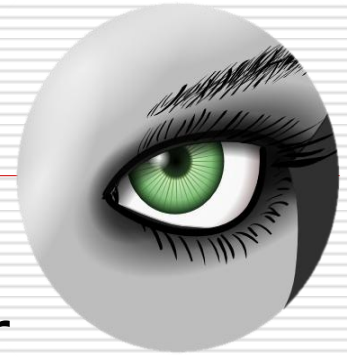
ReMeshing

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
- ☐ Several ways to do that
- ☐ Best one:

  Remeshing, simplification and reconstruction->Quadric Edge Collapse Simplification

  Parameters: Target number of faces, preserve boundary or normal

Subdivision

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

  Remeshing, simplification and reconstruction->Subdivision Surfaces: MidPoint

  Parameters: Edge Threshold

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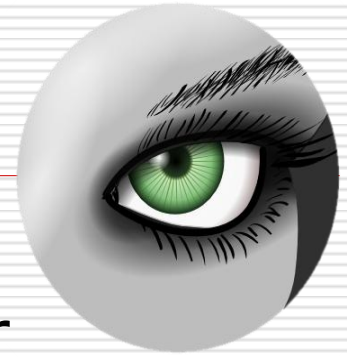
- ☐ The subdivision increases the number of triangles in a mesh
- ☐ Several ways to do that
- ☐ More complex one:

  Remeshing, simplification and reconstruction->Refine User-Defined

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

Close Holes

- ☐ Most of the meshes have holes, but some of the filters need "watertight" models.

- ☐ Hole filling is not always a trivial operation

- ☐ Two possible approaches to fill holes in Meshlab

1) Small Holes

  Remeshing, simplification and reconstruction->Close Holes

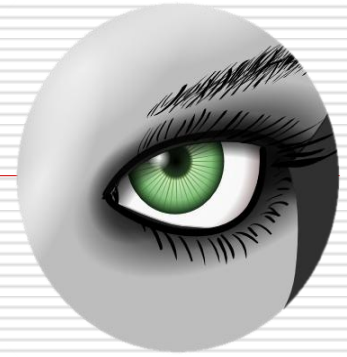 Parameters: max size to be closed

Close Holes

2) Bigger holes Holes

  Hole filling tool

- Select the holes to fill

- Fill and accept

- (Use of bridges to help the filling)

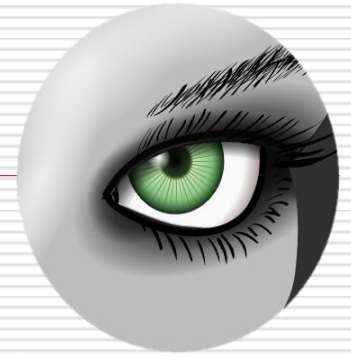3) Use Poisson or other reconstructions!
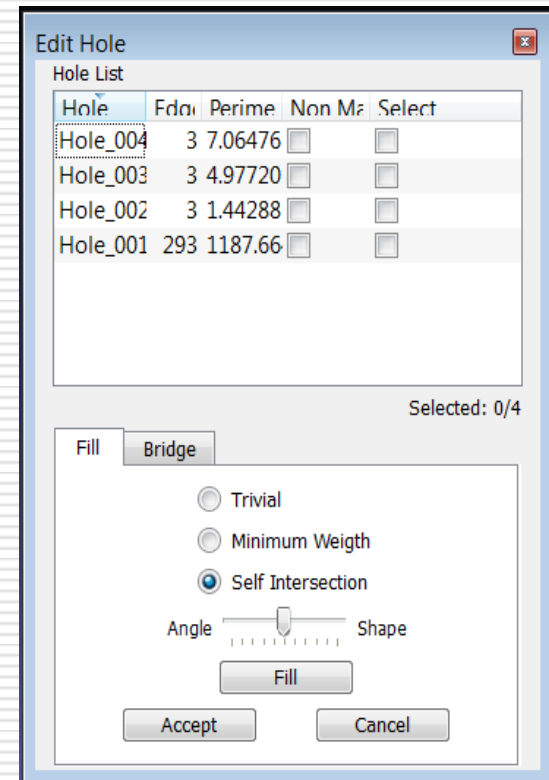
Optimization

In some cases (i.e. after the hole filling) it is necessary to optimize the triangulation of part of the mesh. This is usually reached via a combination of filters.

- Remeshing, simplification and reconstruction-> Subdivision Surfaces: MidPoint
- Remeshing, simplification and reconstruction-> Planar Flipping Optimization
- Smoothing, Fairing and Deformation-> Laplacian Smoothing (Surface Preserving)
- Remeshing, simplification and reconstruction-> Quadric Edge Collapse Decimation
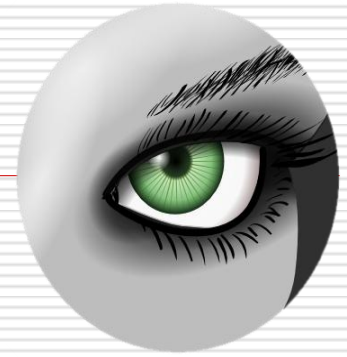
Parameterization

Parameterization is an important, yet critical, problem in mesh processing.

In the future…
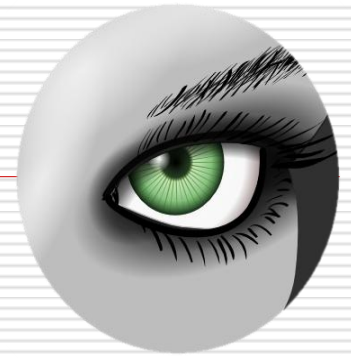
Measuring

Measuring

- The measurement of a mesh (of the difference between meshes) can be extremely valuable for a practical application of MeshLab
- There are different measures that can be extracted from one or more meshes
- To see most of the data, use the Layer Dialog!

Single Mesh: Topological Measures

- ☐ The topological measures are related to the mesh itself
- ☐ Some of them are: n. of faces/points, genus
- ☐ Filter:

    Quality measure and computations -> Compute Topological Measures
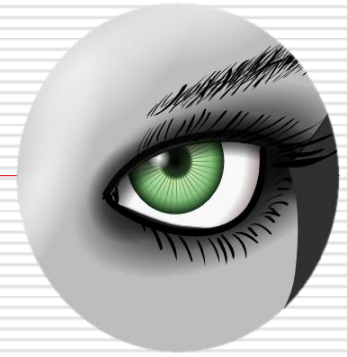
Single Mesh: Geometric Measures

- ☐ The geometric measures are related to the "real" size of the mesh
- ☐ Some of them are: volume, surface, bbox size
- ☐ Filter:

  Quality measure and computations -> Compute Geometric Measures

Single Mesh: simple direct measures

- [ ] It is possible to obtain simple measures with a couple of tools
- [ ] Point picking 🛈

  The coordinates of the picked triangle can be seen.
- [ ] Measuring 📏

  The Euclidean Distance between two points is given
- [ ] PickPoints 🅿🅿

  Veeeeeery basic annotation tool..

Multiple Mesh: Hausdorff distance

- ☐ Another type of measure is the one obtained between to meshes
- ☐ It is important that the meshes are perfectly aligned
- ☐ Filter

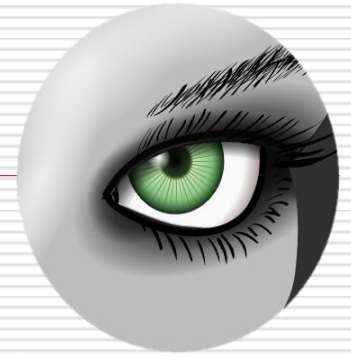 Sampling-> Hausdorff distance

  Parameters: N. of samples

Before going on…
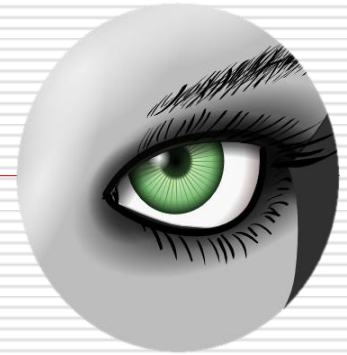
- [ ] Other kinds of measures/representations are related to the "position" of the mesh.

- [ ] In most cases is necessary to "align" the mesh to the axes, even though it's difficult to define what "align" means.

Normal, Curvatures and Orientation -> Transform

Coloring and Quality mapping

An alternative way to map measures on a 3D model is to use the color and/or the quality.

We'll see how to use it in one of the next presentations...

Next in line…

Next lesson:

■ More mesh processing and similia

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