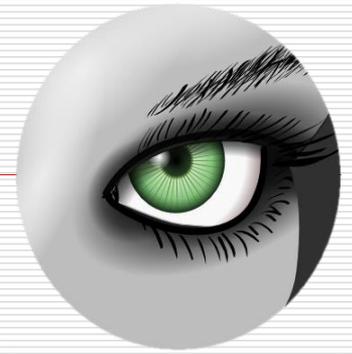


Grafica 3D per i beni culturali: MeshLab features

6 Marzo 2017



Cleaning

Cleaning

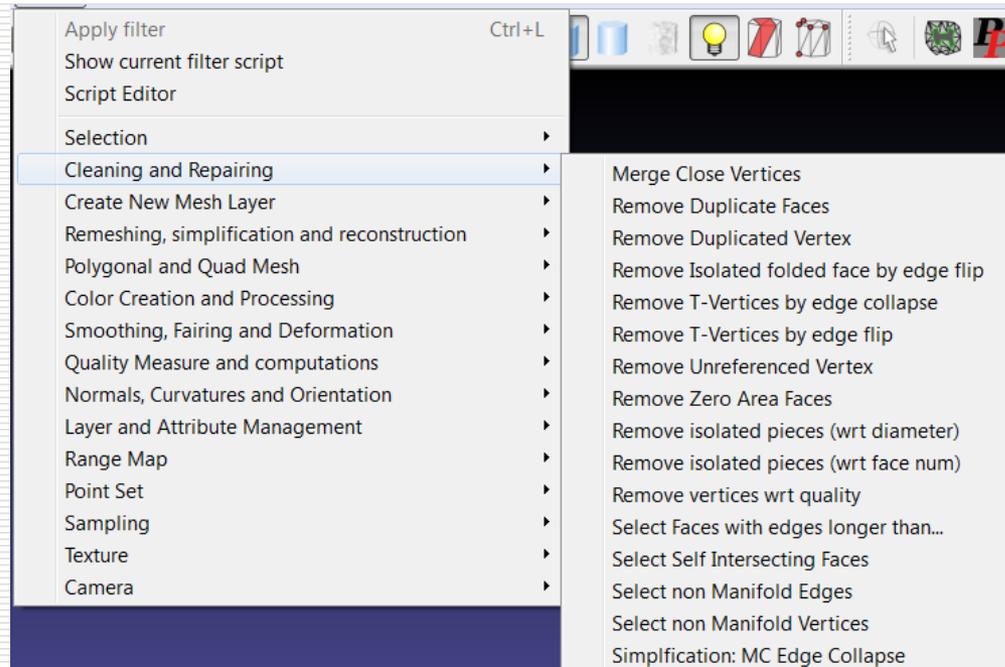


- ❑ Cleaning a mesh is an operation which is often necessary before, during and after the processing of a mesh
 - ❑ There's a number of possible cleaning operations
-

Cleaning



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



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 Edges -> 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
-

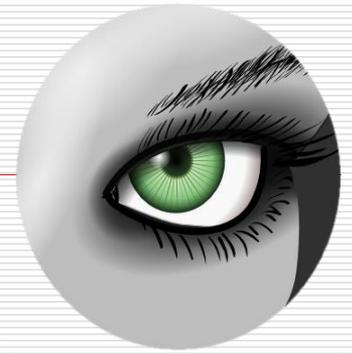
Cleaning: general hints



- 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...

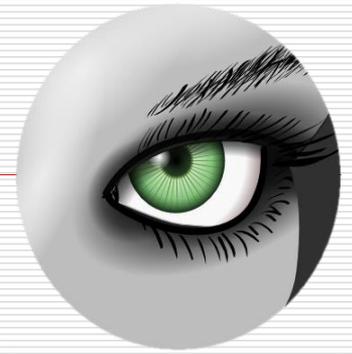
- Videotutorial playlist:

http://www.youtube.com/playlist?list=PLBBF41579E4B65566&feature=view_all



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

Videotutorial:

<http://www.youtube.com/watch?v=PWM6EGVVNQU>

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



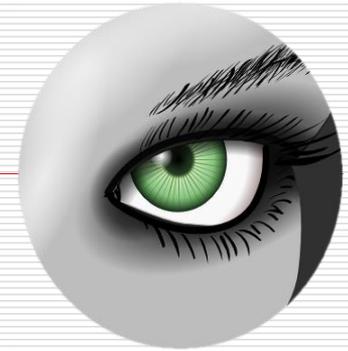
- ❑ The subdivision increases the number of triangles in a mesh
 - ❑ Several ways to do that
 - ❑ More complex one:
Remeshing, simplification and reconstruction->Refine User-Defined
Parameters: refinement decided by the user (using also color and quality!)
-

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

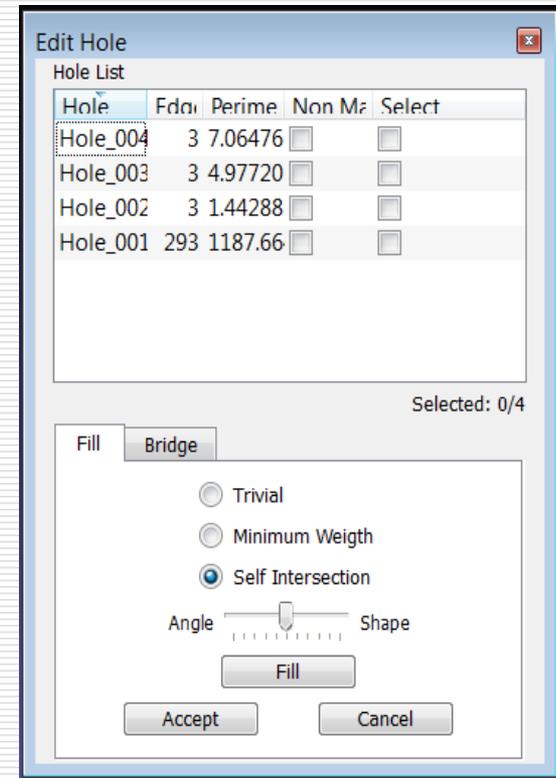


2) Bigger holes Holes

Hole filling tool 

- Select the holes to fill
- Fill and accept
- (Use of bridges to help the filling)

3) Use Poisson or other reconstructions!



Smoothing

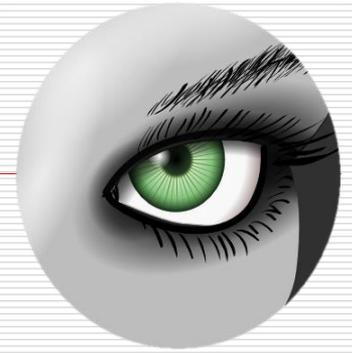


Smoothing operation helps in removing geometry noise.

It can be done in two ways:

- ❑ Using a filter: i.e. Filters->Smoothing, Fairing and Deformation-> Laplacian smooth (it can be applied only on selection)
- ❑ Using a painting approach, with the paint edit mode, and using the smoothing 



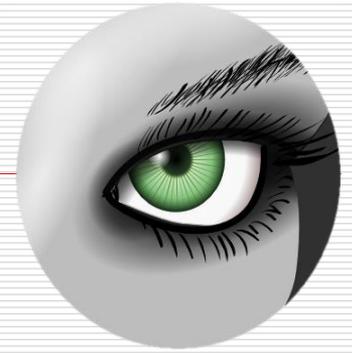


Aligning the model

Manipulator tool



- ❑ A good alignment of the model w.r.t. the reference system may be crucial for a lot of uses.
 - ❑ A lot of filters (under the “Trasform” group) enable to manipulate the model
 - ❑ The Manipulator tool offers a flexible alternative. Tutorial:
<https://www.youtube.com/watch?v=FGaNv23Xvtw>
-



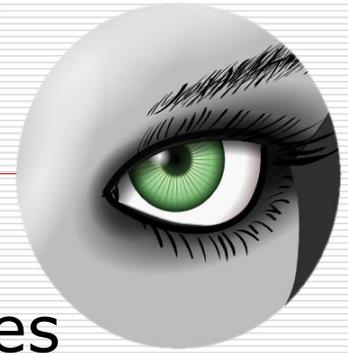
Measuring

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: simple direct measures

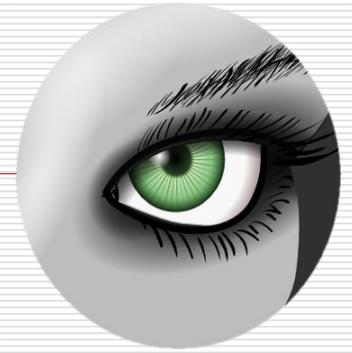


- ❑ It is possible to obtain simple measures with a couple of tools
 - ❑ Point picking 
The coordinates of the picked triangle can be seen.
 - ❑ Measuring 
The Euclidean Distance between two points is given
 - ❑ PickPoints 
Veeeeery basic annotation tool..
-

Multiple Mesh: Hausdorff distance



- Another type of measure is the one obtained between two meshes
 - It is important that the meshes are perfectly aligned
 - Filter
 - Sampling -> Hausdorff distance
 - Parameters: N. of samples
-



Coloring

Coloring



- ❑ The color attribute of a mesh can be extremely important both for the realism of visualization, the enhancement of features and lots of other things...
 - ❑ In MeshLab there are already a few features related to color, and others will come in the future.
-

Painting

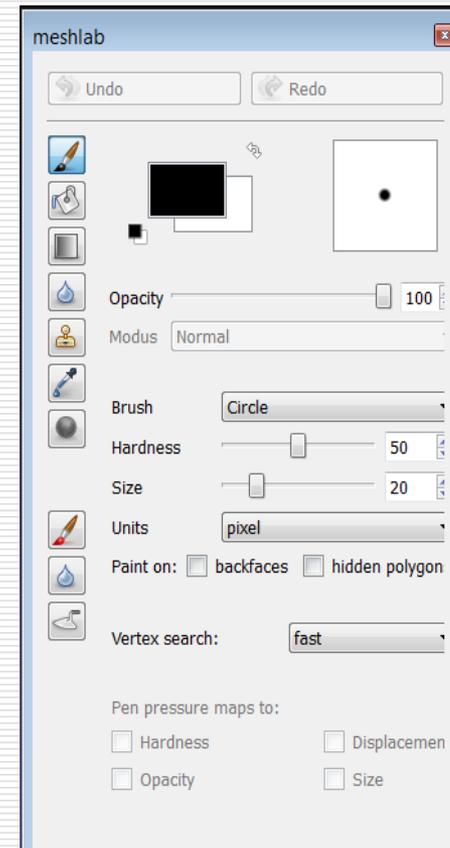


A simple “Photoshop style”
painting tool is available 

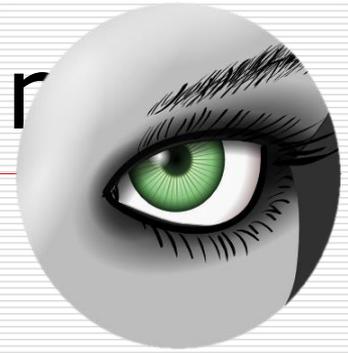
The features are the typical
ones:

- Pen
- Bucket
- Gradient
- Stamp
- ...

It also has the Undo!!!



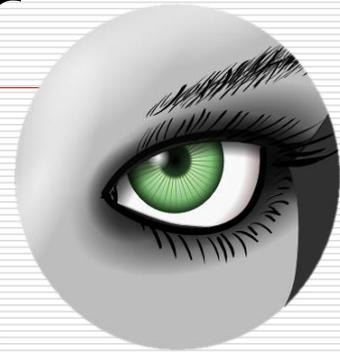
Coloring and Quality mapping



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

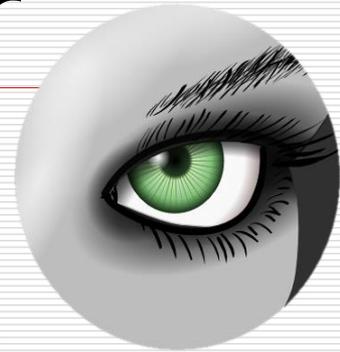
We'll see how to use it in the next presentation...

Coloring and Attribute transfer



- ❑ A very interesting feature is the possibility to transfer the color from a mesh to another mesh.
 - ❑ Some filters (especially the remeshing ones) tend to cancel the color.
 - ❑ Filter:
Sampling -> Vertex Attribute Transfer
Parameters:
Source and target Mesh, what to transfer
-

Coloring and Attribute transfer

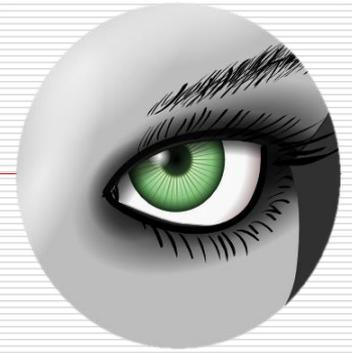


- There are three ways to see color in a mesh: color-per-vertex, color-per-face, texture
 - There are filters to transfer the color from one encoding to the other
 - Filters:
Color creation and processing -> Vertex to face, Face to vertex and Texture to Vertex Color transfer
-

Coloring processing



- If a mesh already has color on it (per-vertex or per-face only) it is possible to modify it using a number of “photoshop style” filters.
 - They are all in the “Color creation and Processing” menu. Some of them are
 - Fill
 - Invert
 - Gamma correction
 - Colourisation
 - Brightness and contrast
 - ...
-



Advanced Visualization

Advanced visualization

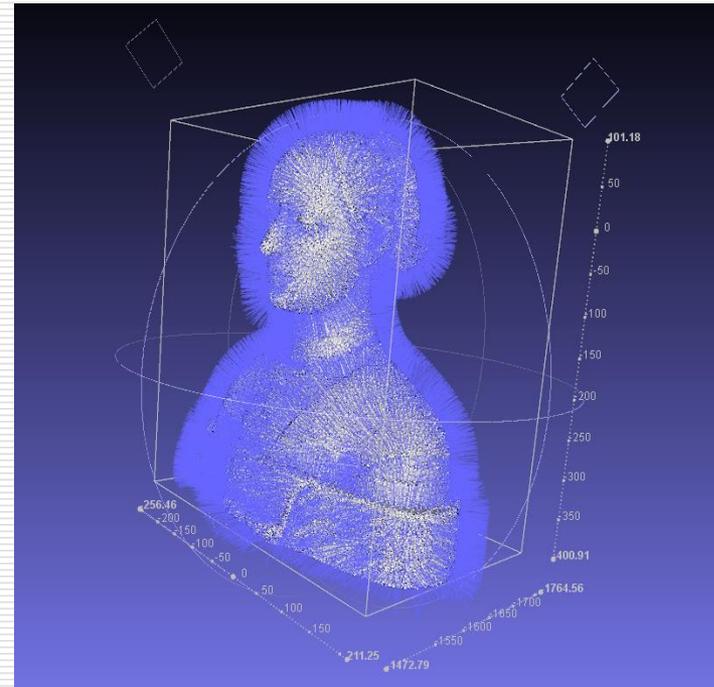


- ❑ One of the most important features of MeshLab is the possibility to easily visualize a mesh and create a snapshot.
 - ❑ There are a lot of functionalities to enrich visualization, enhance details, add information to the geometry...
-

Decorations



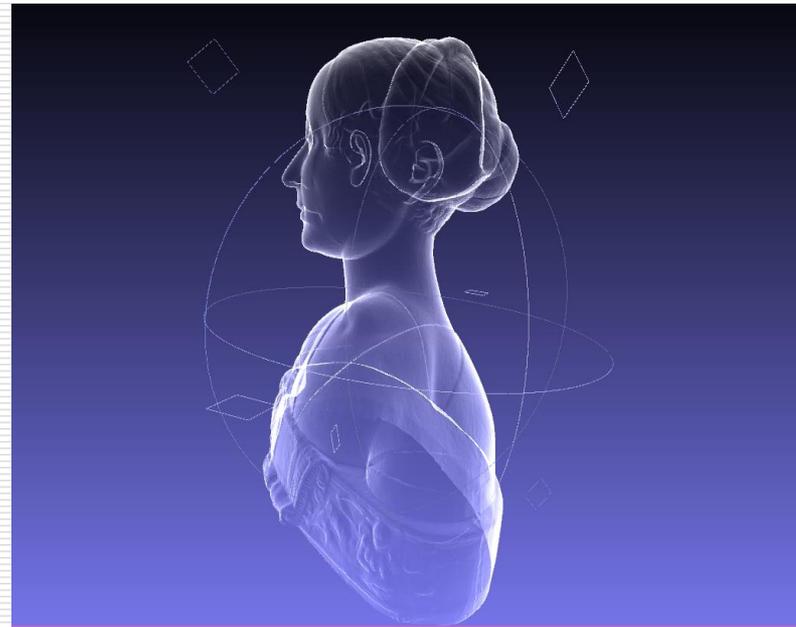
- ❑ A very simple way to add information to a rendering is the use of Decorations
- ❑ Menu:
Render
- ❑ Useful ones:
 - Axis
 - Quoted Box
 - Principal Curvatures
 - Face/Vertex Normals
 - ...



The Shaders



- ❑ The shaders use the GPU to make fast computations on geometry.
- ❑ Using simple shaders it's possible to obtain very nice visual results
- ❑ Menu:
Render-> Shaders
- ❑ Useful ones:
 - Xray
 - Toon
 - Hatch
 - Glass
 - ...

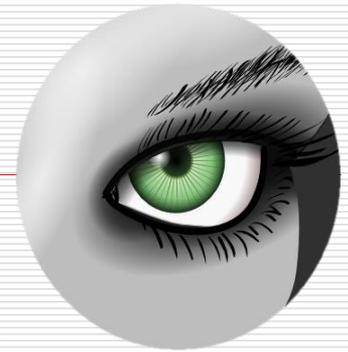


Ambient occlusion



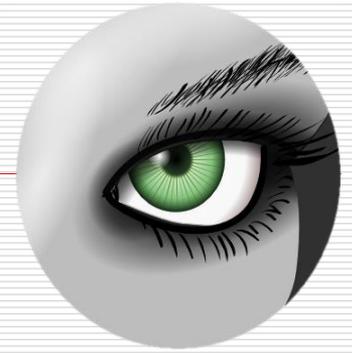
- ❑ If no color is available for a mesh, Ambient occlusion is a very nice way to present the geometry.
 - ❑ Filter:
Color creation and processing -> Vertex Ambient Occlusion
Parameters: Use VBO and/or GPU
 - ❑ It is possible to process the color to enhance the features!
 - ❑ Videotutorial:
<http://www.youtube.com/watch?v=wiNzvISGLAI>
-

User-defined coloring



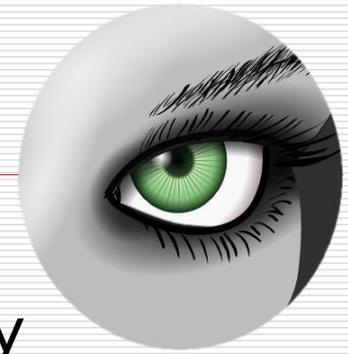
- Similar to User-defined refining
 - Filter:
Color creation and processing -> Per-Vertex Color Function
 - It is possible to process the color to enhance the features!
 - The same thing can be done on the Quality attribute
-

Discrete curvature



- ❑ An example of a nice coloring is the Discrete Curvature
 - ❑ Filter:
Color creation and processing -> Discrete Curvatures
 - ❑ This filter stores the curvature in the quality value, and shows it by coloring the mesh.
-

Quality mapper

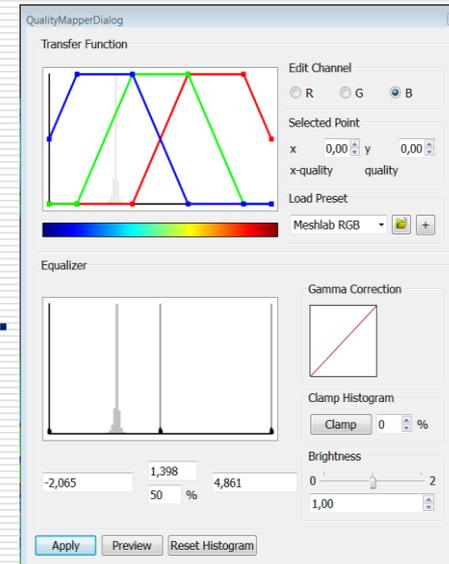


- Mapping the quality is a very useful way to enhance the important features of a mesh



- The Quality Mapper tool is very flexible and extremely valuable

- Parameters:
A LOT! Need to “play” with it...



Advanced visualization



- The presentation of a mesh is key in most of the cases
- MeshLab gives much more possibilities than what it could seem at a first sight
- If you are able to deal with all these aspects:
 - Light
 - FOV
 - Coloring
 - Position
 - Shaders
 - Background
 - ...

Then you can make really nice stuff. You just need to practice a bit more...

Next in line...

Next lesson:

- RTI Imaging

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