

# Models Preparation

## Single-res, Multi-res, Point-clouds

Lezione 14 Maggio 2015

# Models Preparation

## 3DHOP and 3D models

- ▶ 3DHOP can manage three types of geometries:
  - ▶ Single resolution 3D model
    - ▶ Triangular meshes, ideally <1MB, PLY file format, whole file downloaded from remote and directly rendered without optimization.
  - ▶ Multiresolution 3D model
    - ▶ Triangular meshes, large to huge sizes supported, converted in pre-processing to the NXS multiresolution format, progressively streamed from remote and adaptively rendered.
  - ▶ Point-clouds
    - ▶ Unstructured set of points, point color and normals supported, large to huge sizes supported, converted in pre-processing to the NXS multiresolution format, progressively streamed from remote and adaptively rendered.

# Models Preparation

## Instances & hotspots

- ▶ Any geometry (single-res, multires, pointcloud) may be used for both INSTANCES and clickable HOTSPOTS.
- ▶ Geometries may be replicated in the scene (many instances of the same geometry).

Same single resolution model used in multiple hotspots

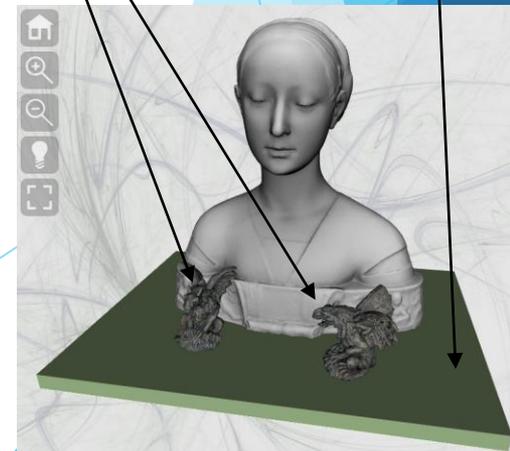
Multiresolution model

Multiresolution model

Small (86KB) single resolution model

Same multiresolution model instanced 2 times

Small (2KB) single resolution model



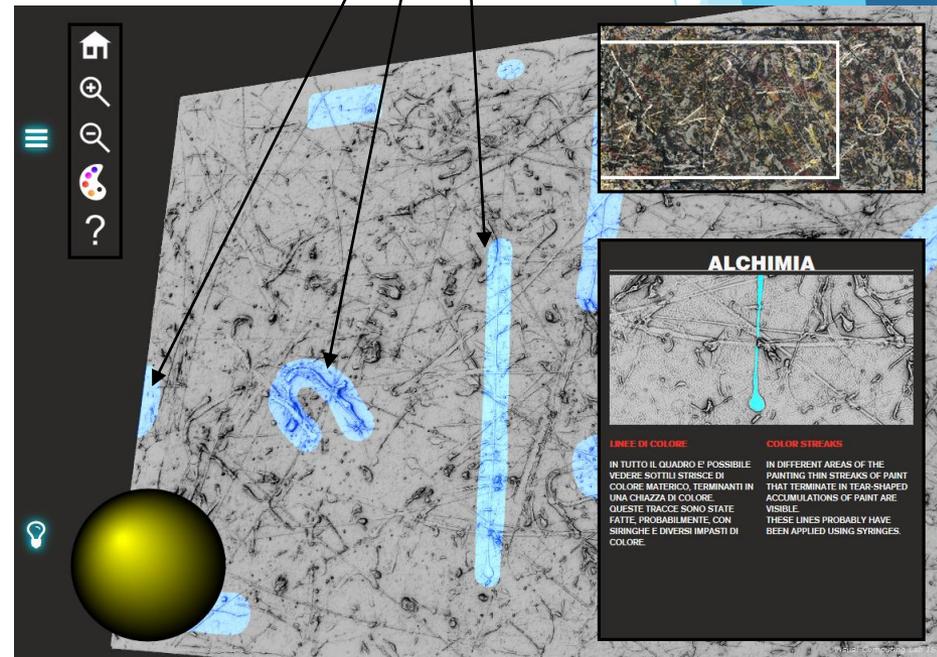
# Models Preparation

## Instances & hotspots



Point-cloud  
multiresolution  
model with normals

Multiresolution models (1M faces each)  
used as clickable hotspots



# Single Resolution

Small geometries

# Models Preparation

## Single resolution

- ▶ Standard 3D model: a mesh of triangles.
- ▶ The file is downloaded from remote in a single chunk and rendered inside 3DHOP.
- ▶ Per-vertex color is supported, texture is at the moment NOT supported.

# Models Preparation

## Small geometries, please

- ▶ Single-resolution models has to be **COMPLETELY DOWNLOADED** before they appear on the webpage
- ▶ No optimization during rendering, everything is drawn as it is.
- ▶ Anything that is above the 1MB limit should be converted to multiresolution!

# Models Preparation

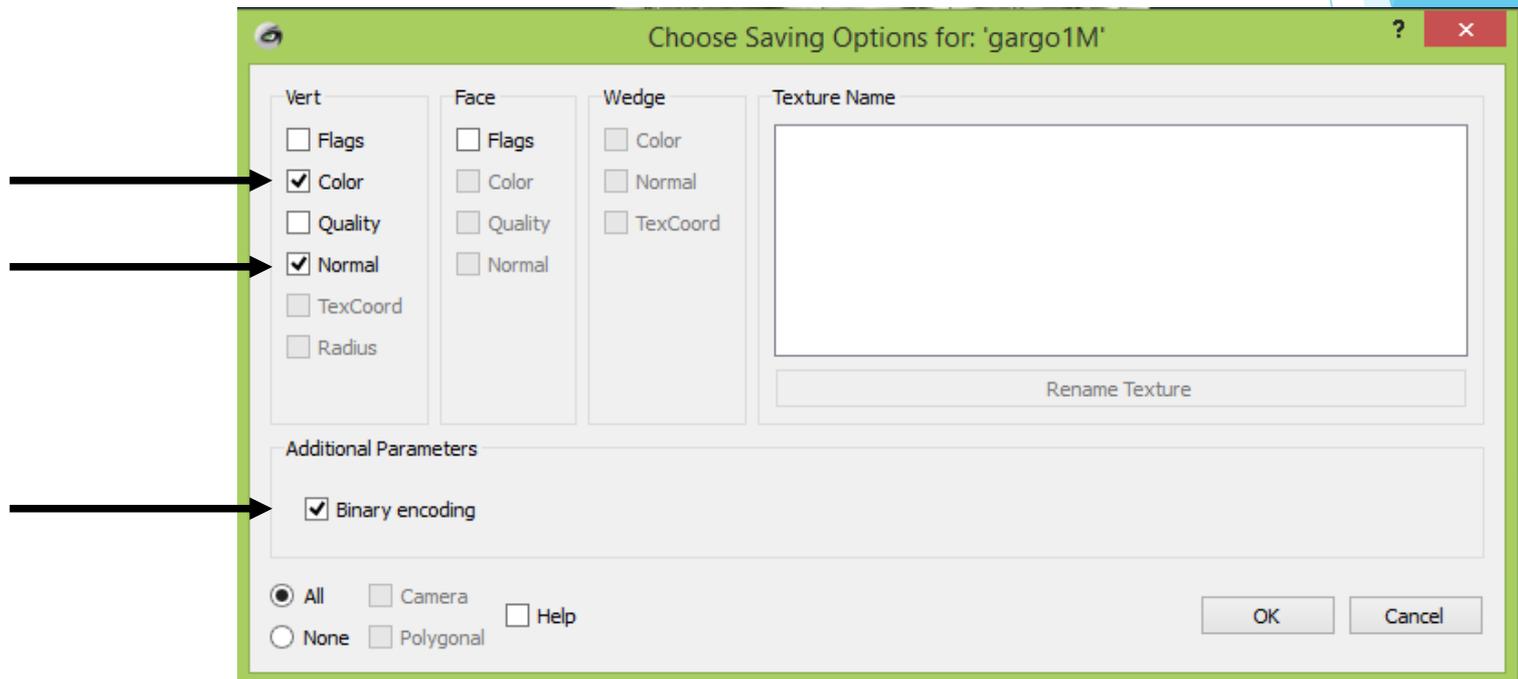
## Model preparation

- ▶ PLY file format is used for single resolution.
- ▶ Use MeshLab to convert your 3D model in PLY from other formats:
  - ▶ <http://meshlab.sourceforge.net>
- ▶ Some PLY exporters available in different tools save in ASCII format (much larger) or may have small incompatibilities, loading the file in MeshLab and then exporting does generally solve the problem.

# Models Preparation

## Model preparation

- ▶ When exporting, remember to check “normal” for vertices. If the mesh has vertex color, check “color” for vertices.
- ▶ Save in binary format to save space.



# Multiresolution

Lots of geometry

# Models Preparation

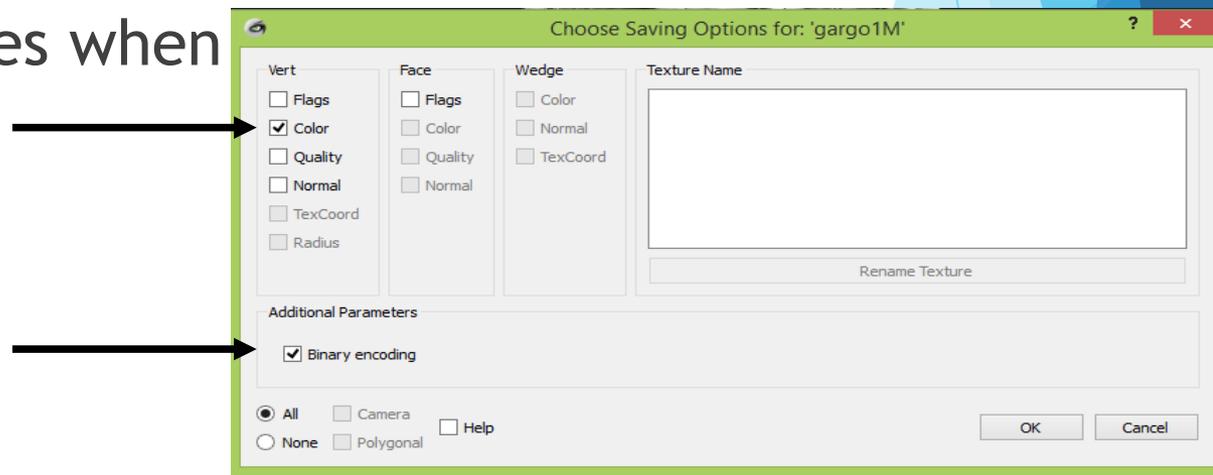
## High-res geometry

- ▶ Multiresolution is used to manage high-resolution triangular meshes inside 3DHOP.
- ▶ Multiresolution models are streamed from remote and adaptively rendered and optimized according to viewpoint and view distance.
- ▶ Very large 3D models (10-100 millions of triangles) can be efficiently rendered.

# Models Preparation

## Model preparation

- ▶ Conversion to multiresolution requires PLY file format.
- ▶ Use MeshLab to convert from other formats.
- ▶ Some PLY exporters available in different tools save in ASCII format (much larger) or may have small incompatibilities, loading the file in MeshLab and then exporting it is safe.
- ▶ Save in binary format, if the mesh has vertex colors, check “color” for vertices when exporting.



# Models Preparation

## Conversion

- ▶ Conversion tool is available from the download page of the 3DHOP website:
  - ▶ <http://3dhop.net/download/Nexus.zip>
- ▶ Download and unzip it in a folder.
- ▶ Inside the folder you will find:
  - ▶ readme.txt, with instructions
  - ▶ nxsbuild.exe, to do the conversion
  - ▶ nxsview.exe, to visualize NXS files
  - ▶ A batch file (Build\_Nexus.bat), for easier conversion
  - ▶ A PLY example file (gargo.ply), to test if everything works
  - ▶ DLLs and support files

# Models Preparation

## .BAT batch conversion

- ▶ Put the PLY(s) to be converted in the folder where the NEXUS tool is located.
- ▶ Open the Build\_Nexus.bat file with a text editor.
- ▶ Change the name of the source and target file, from this:
  - ▶ `nxsbuild gargo.ply -o output.nxs`
- ▶ To this:
  - ▶ `nxsbuild YOURMODELNAME.ply -o YOURMODELNAME.nxs`
- ▶ Save and close
- ▶ Double-click on Build\_Nexus.bat. A command line window will appear; when the window close, the conversion is finished

# Models Preparation

## .BAT batch conversion

- ▶ If the model has no color, you may add the “-c” to the script line.
- ▶ To convert multiple files, just add other lines in the .bat file:
  - ▶ `nxsbuild MODEL1.ply -o MODEL1.nxs`
  - ▶ `nxsbuild MODEL2.ply -o MODEL2.nxs`
  - ▶ `nxsbuild MODEL3.ply -o MODEL3.nxs`
- ▶ The batch will convert one model at a time

# Models Preparation

## Command line conversion

- ▶ Put the PLY to be converted in the folder where the NEXUS tool is located.
- ▶ Open a command prompt (cmd.exe), then go in the NEXUS folder.
- ▶ On the command prompt write this line command:
  - ▶ `nxsbuild YOURMODELNAME.ply -o YOURMODELNAME.nxs`
- ▶ When the program terminates, the conversion is done.

# Models Preparation

## Troubleshooting

- ▶ Drag the .NXS file on nxsview.exe: if the model is visible, the conversion ended ok.
- ▶ Try converting the example PLY (gargo.ply) and check the result. If you receive no error, the converter works on your machine.
- ▶ If your PLY file makes the converter crash, try opening it and saving it again with MeshLab after cleaning  
(see MeshLab videotutorials:  
<https://www.youtube.com/playlist?list=PLBBF41579E4B65566>).

# Point-clouds

Lots of points

# Models Preparation

## Point-clouds

- ▶ A point cloud is an unstructured set of vertices.
- ▶ Point color is supported, point normal is supported.
- ▶ Pointclouds are managed inside 3DHOP using the multiresolution format, they are streamed from remote and adaptively redered and optimized according to viewpoint and view distance.
- ▶ Very large clouds (10-100 millions of vertices) can be efficiently rendered.

# Models Preparation

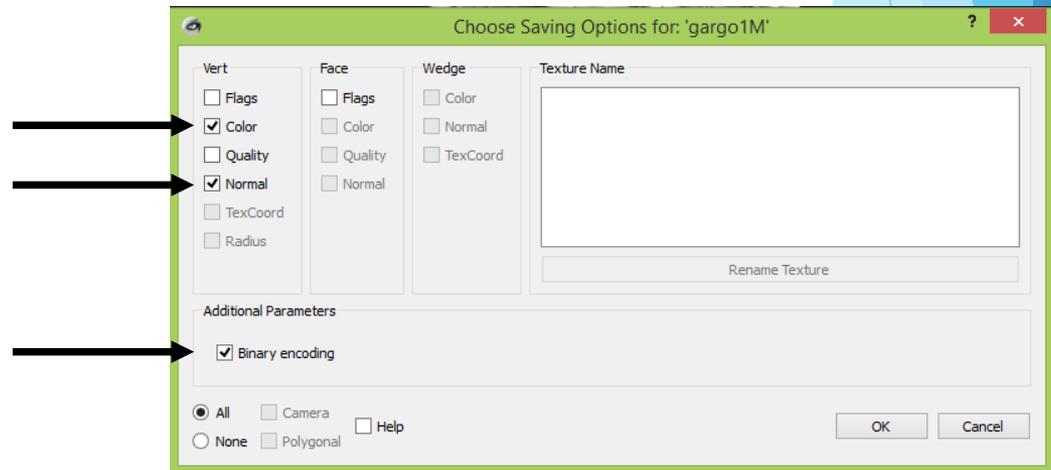
## Importing clouds

- ▶ Pointclouds has to be in PLY file format, and then converted in the NXS multiresolution format using the same tool used for triangular meshes.
- ▶ MeshLab does import different formats of pointclouds, which can be later exported as PLY:
  - ▶ .PTX (normals are automatically calculated)
  - ▶ .PTS
  - ▶ .XYZ
  - ▶ .txt (generic ascii list of points)

# Models Preparation

## Importing clouds

- ▶ If the cloud has normals, when exporting, remember to check “normal”. If the cloud has color, remember to check “color”.
- ▶ In MeshLab, there is a tool to calculate normals for pointclouds; it may not work on your cloud, depending on its shape, but it is worth a try.
- ▶ Save in PLY binary format to save space.



# Models Preparation

## Conversion

- ▶ Conversion is done in the same way it has been described for the multiresolution 3D models.
- ▶ Just follow the same instructions detailed in the previous section.

# Models Preparation

## Texture To Vertex Color

# Models Preparation

## Color per vertex?

- ▶ Multi-resolution methods are not suited for texture mapping.
- ▶ The color is better encoded per vertex, but how can you deal with textured models?
- ▶ Well, it's possible to transfer color information between the texture and the vertices, but it's necessary to be careful in preserving color detail.

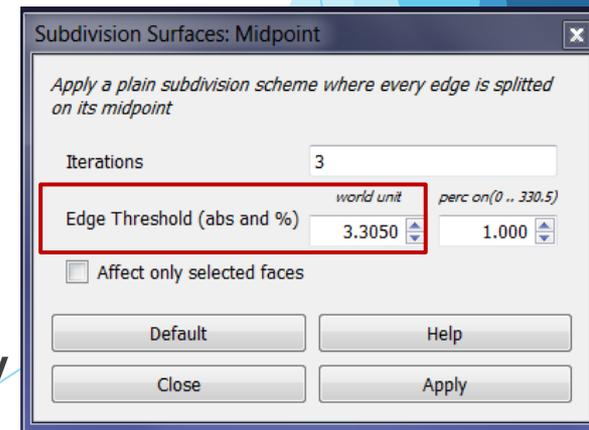
# Models Preparation

## Step one: a vertex, a texel

- ▶ If you want to preserve color detail, you need to have at least a vertex for each texel (pixel of the texture).
- ▶ Hence, you have to apply subdivision surfaces to bring the model to the needed size.
- ▶ Use (for example):

**Filters->Remeshing...->Subdivision surfaces: Midpoint**

and decrease the edge threshold until you get to the needed number of vertices (launch it several times if needed, don't put an exaggeratedly low value!)



# Models Preparation

## Step two: texture to vertex color

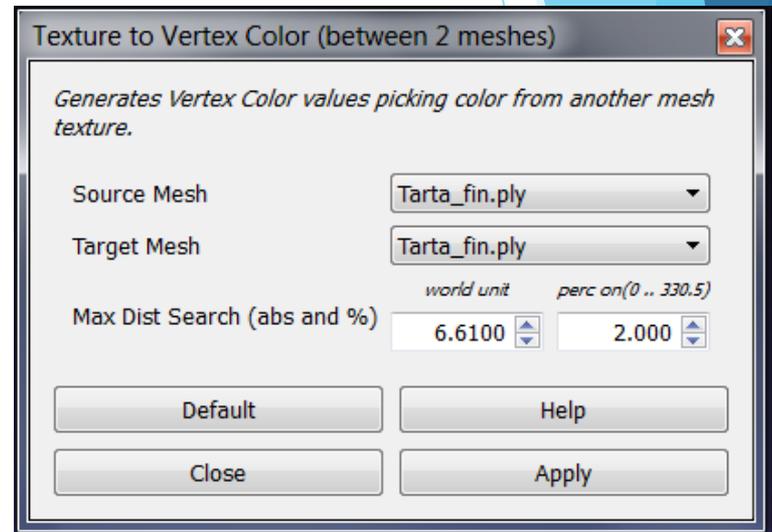
- ▶ Then, you just need to transfer the color from the texture to the vertices

- ▶ Use:

Filters->Texture->

Texture to vertex color

- ▶ Then save the model (without texture!) and transform it in an .nxs!



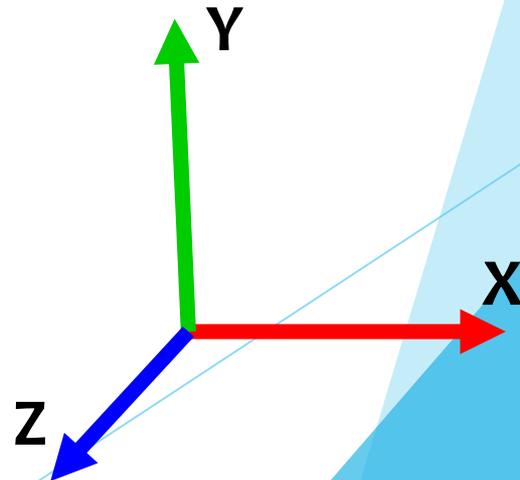
# Models Preparation

## Correctly Oriented Geometries

# Models Preparation

## 3DHOP axis

- ▶ 3DHOP uses the standard computer graphics reference system (right hand, Y is up).
- ▶ Looking at the screen:
  - ▶ X is the horizontal axis, growing towards right;
  - ▶ Y is the vertical axis, growing in the upward direction;
  - ▶ Z is the depth axis, growing towards you.



# Models Preparation

## Model orientation

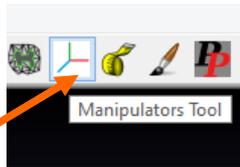
- ▶ Unless a transformation is specified for the mesh or the instance, 3DHOP renders the geometries as they are loaded.
- ▶ If your object is not straight, or has a different up vector (architectural models generally uses Z as vertical axis), it may be better to put it in the correct reference space before loading it inside 3DHOP.
- ▶ You may use MeshLab to rotate/translate/scale the model.
- ▶ Meshlab uses the same reference system as 3DHOP, if it is straight in MeshLab, it is straight in 3DHOP

# Models Preparation

## Model orientation

- ▶ A model may be rotated/translated/scaled using the filters under :

**Filters->Normals, Curvatures and Orientation-> Transform: XXXXXX**

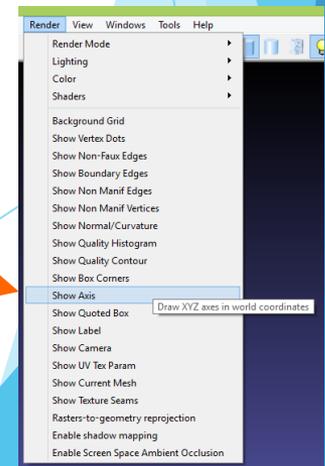
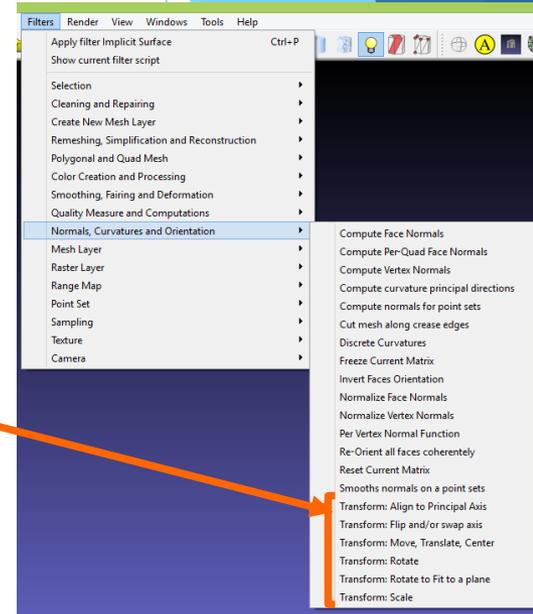


- ▶ Or by using manipulators:

<https://www.youtube.com/watch?v=FGaNv23Xvtw>

- ▶ It is a good idea to have the world axis visualized to see how the model is moving
- ▶ Remember to freeze matrix before exporting

**Filters->Normals, Curvatures and Orientation-> Freeze Current Matrix**



# Models Preparation Questions?

## 3DHOP:

- ▶ Email: [info@3dhop.net](mailto:info@3dhop.net)
- ▶ Web: [3dhop.net](http://3dhop.net)

## Contatti:

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- ▶ Web: [vcg.isti.cnr.it/~callieri](http://vcg.isti.cnr.it/~callieri)



3DHOP  
3D Heritage Online Presenter

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