



# **Grafica 3D per i beni culturali: Dense stereo matching, alternative e processing finale del modello (+ extra)**

Lezione 13: 4 maggio 2012

# Image-based 3D Reconstruction

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## □ Advantages:

- Automatic
- Fast (relatively to manual built)
- Good scalability (both small and huge model can be acquired)
- Non-expert users can create his/her 3D model.
- Cheap!

## □ Disadvantages:

- Accuracy (not so accurate)
  - Not all the objects can be acquired
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# SfMToolkit

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It's the same toolkit as PhotosynthToolkit, but it's completely local

- <http://www.visual-experiments.com/demos/sfmtoolkit/>

Good: completely local, no upload, control on parameters

Bad: completely local, sometimes it crashes...

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# Python Photogrammetry Toolbox

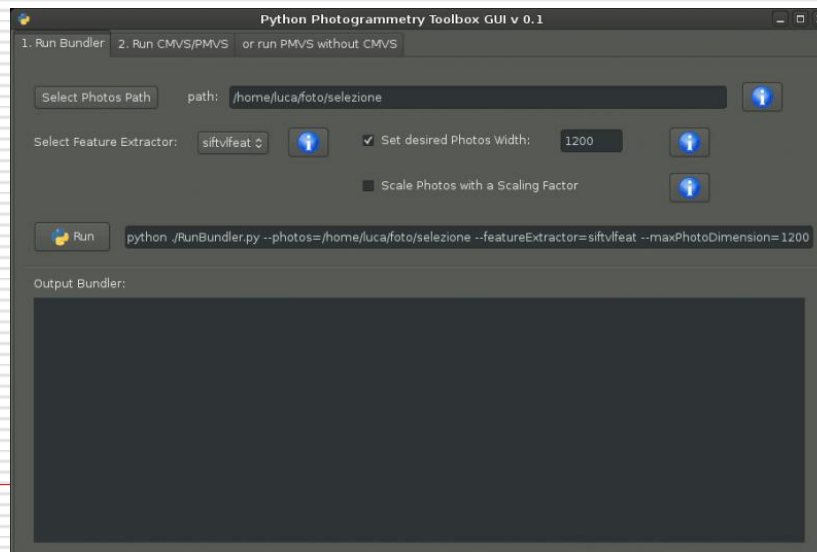
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Developed by Arc-Team, open source and free, for Debian and Win (32 and 64bit)

- <http://www.arc-team.com/>

Good: completely local, interface, control on parameters, video tutorial

Bad: completely local, a bit tricky to install...



# Autodesk 123Dcatch

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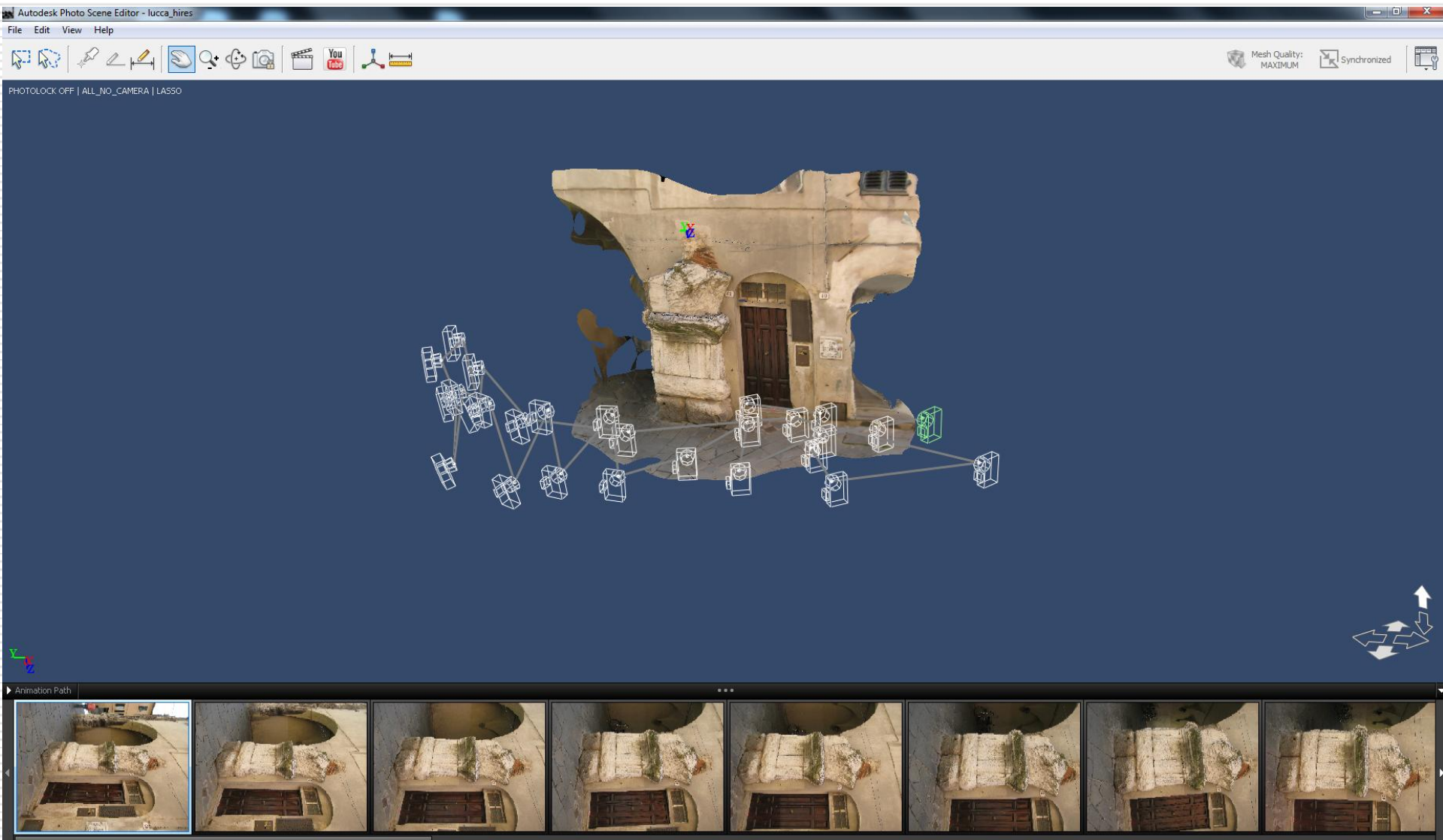
- Very well engineered tool...
- Works on a remote server, like Arc3D
- Produces a *complete, textured* model
- <http://www.123dapp.com/catch>

It is free (*for now*), and works very very well.

It is fast, works on difficult datasets and the results looks good. However, not really high resolution, and there is less control over the process. It is a good tool to start with...

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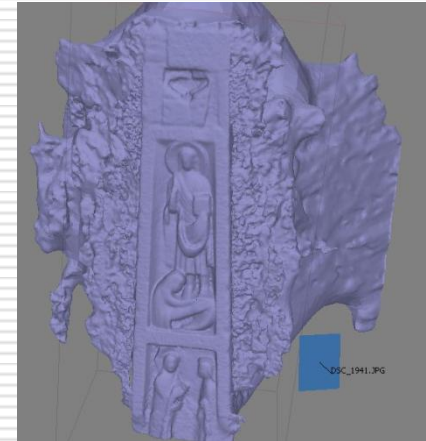
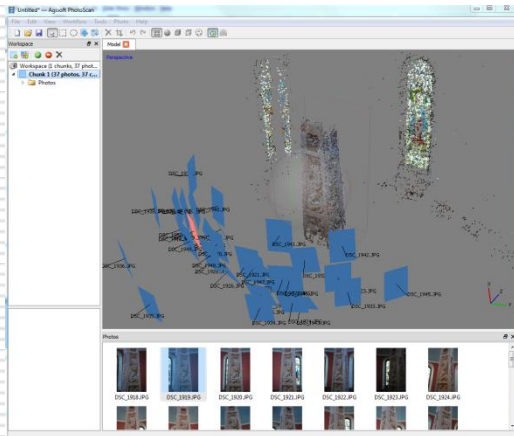
# Autodesk 123Dcatch



# PhotoScan

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- ❑ Commercial, low cost tool: 59 € for educational license, 179€ standard license. (win, mac & linux)
- ❑ Fast, work on local machine, directly produce textured model. Very robust and reliable... We have used it with good results on many diverse datasets.



- ❑ They also have a *free* tool to process images taken with stereo (two lenses) cameras....
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# Model creation with MeshLab

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After the 3D model is exported in MeshLab, there's a procedure to enhance it a bit and have a final result:

- Cleaning
  - Sampling
  - Poisson reconstruction
  - Poisson Model cleaning
  - Vertex Color Transfer
  - Cleaning
  - Scaling
  - Saving!
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# Model creation: Cleaning (1)

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The exported mesh (or point cloud) usually depicts portions of the space which are not the target one.

For this reason, it is better to remove these parts (using mainly the triangle, or points, selection), and reduce the total amount of data.

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# Model creation: Sampling

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The remeshing operation (Poisson) which will be launched in next step needs only a point cloud (with normals)

A possibly useful operation is to reduce the number of points using the

**Sampling->Mesh Element Subsampling**  
filter.

Usually reducing the n. of points to one half is ok.

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# Model creation: Poisson reconstruction

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The remeshing operation (Poisson) re-builds the geometry removing some of the typical initial noise. As usual, it's necessary to find the right value for the parameters...

Following the Poisson reconstruction, a cleaning stage is always necessary.

A simple but effective operation for the areas with big triangulation is the selection of a "seed" triangle and the use of

**Selection->Dilate Selection**

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# Model creation: Vertex Attribute Transfer

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The remeshing operation (Poisson) doesn't preserve the vertex color attribute

It's possible to retrieve it using the [Sampling->Vertex Attribute Transfer](#) filter.

In this way, you should have created a better 3D model!

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# Model creation: scaling issue

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If you want to scale the model to its real size, you need to have a measurement of a known element, and the corresponding measurement in MeshLab.

The scaling factor to be applied (using the Transform:Scale filter) is:

$$\text{ScaleFactor} = \text{RealMeasure} / \text{MeshLabMeasure}$$

Then you use the filter

Normals, curvatures and orientation->Transform: Scale

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# Model creation: composing different acquisitions

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It's possible to put together different acquisitions of portions of the same object.

The pipeline is the same as scanning (alignment and merging) but you need to take into account the scaling! For this reason you need to:

- 1) Scale the different portions individually (see previous slide)  
and/or
  - 2) Use the alignment tool with the "allow scaling" options (put a lot of correspondences!)
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## A final example: PhotoCity!

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<http://photocitygame.com/index.php>

<http://photocitygame.com/pointcraft/index.php>

A game to reconstruct the world!

Not so many users unfortunately, give a look at it,  
anyway.

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# Next in line...

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Next lesson:

- Color and 3D: issues and solutions

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