Grafica 3D per i beni culturali: Multiview stereo matching, the tools

10-15 Maggio 2018

Image-based 3D Reconstruction

- 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

Using the tools

For the 2017 edition of the corse, two tools have been chosen as the «official» ones:

- Regard 3D: local tool for 3D reconstruction and import/export from MeshLab
- Culture 3D Cloud: web service for remote processing

Regard 3D

The tool can be found in the official website (http://www.regard3d.org/) that includes a quite good documentation

The processing of data follows the usual workflow of multi-view stereo matching tools:

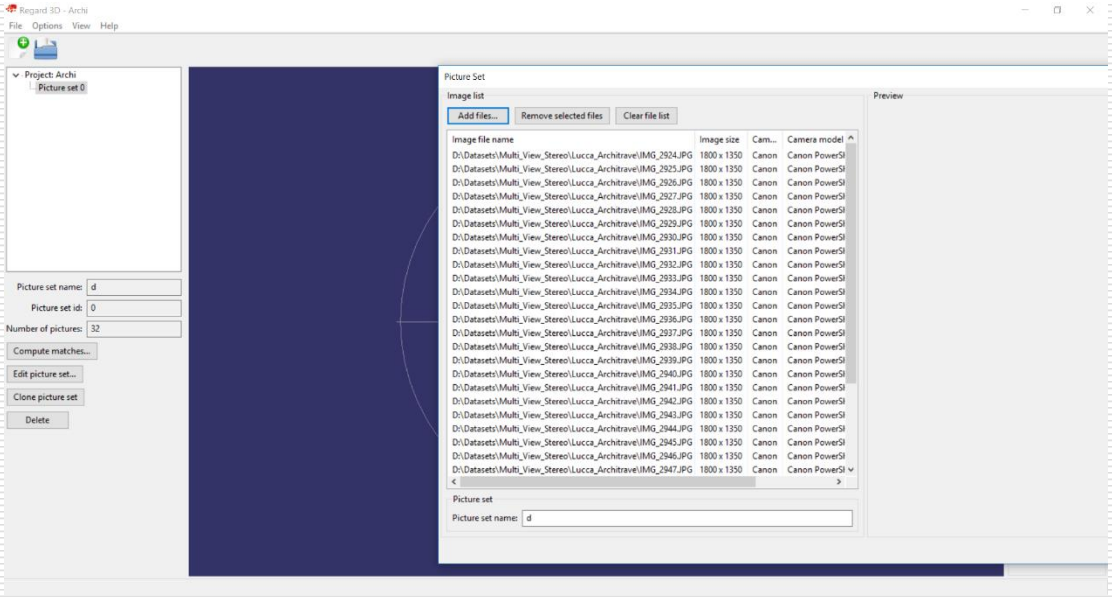
- Create a project
- Matching image features
- Calibration and orientation of camera
- Dense matching
- (Creation of a textured 3D Model)

Regard 3D: create the project

- Prepare a folder containing only the images you want to use for reconstruction (preserve the exif file if you process the data!)
- Launch Regard3D
- Choose «New project»
- Select the folder where the imges are, and choose a project name
- Choose «Add picture set» and select the images you want to add

Regard 3D: create the project

- NOTE: it is crucial that the tool is able to read the camera model and focal, otherwise it won't work.
- Don't remove the EXIF data if you process the images.



Regard 3D: compute matches

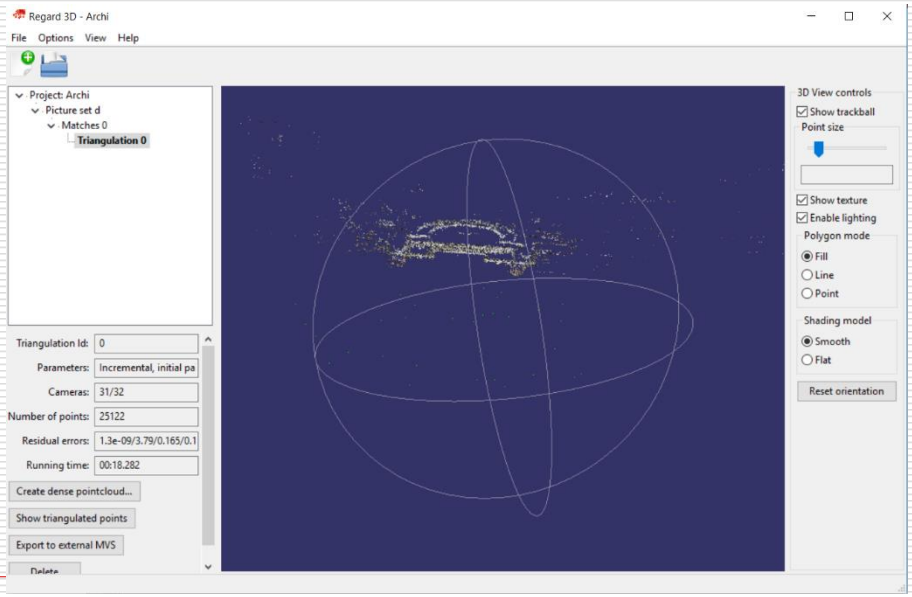
- Choose «compute matches»
- Two parameters are available: «sensitivity» and «matching ratio»: in the case of difficult dataset you may try to reduce the sensitivity to extract more keypoints
- At the end, with «show matching results» it’s possible to see how much stuff has been matched

Regard 3D: triangulation

- Choose «triangulation»
- Two possible approaches are available: «incremental» and «global»
- The «incremental» is the classic mode: the only control by user is to define the initial pair, which is by default the one with the highest number of matches
- The «global» works only when the focal length stayed the same throughout the acquisition

Regard 3D: triangulation

- NOTE: the incremental triangulation usually works, but nobody prevents you from trying both and see if any difference can be seen.
- Every operation in the project is stored independently, so you can decide from which output you can go on.



Regard 3D: dense matching

- Choose «create dense point cloud»
- Two possible approaches are available: «pmvs» and «mve»
- These are two algorithms that produce dense cloud: in general MVE produces denser clouds, but both reconstruction should be tried
- In both cases this is the longest step of computation!

Regard 3D: dense matching

- MVE reconstruction can be tuned with two parameters: «scale» and «filter width»
- «Scale» is related to the detail that is reconstructed. The smaller the better, but the smaller the longer it will take to process
- «Filter width» is related to the quality of the final reconstruction. The higher the better, but the higher the longer it will take to process

Regard 3D: dense matching

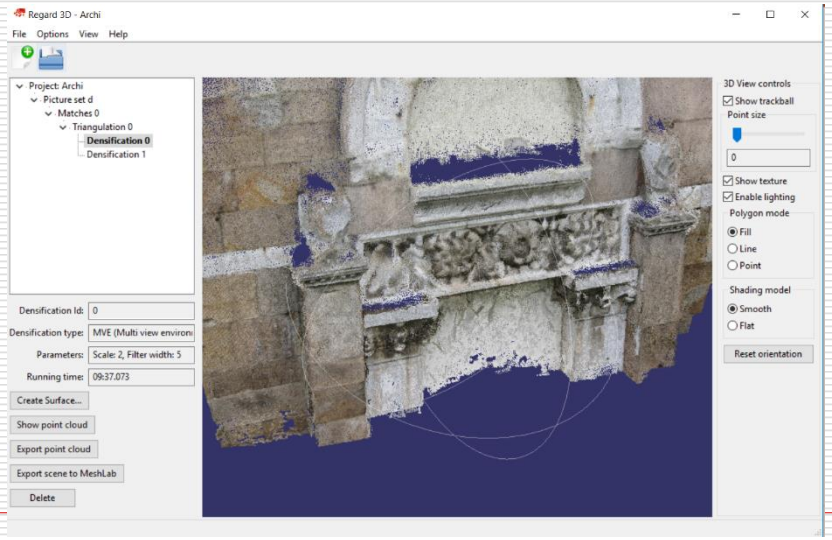
- PMVS reconstruction can be tuned with two parameters: «level» and «cell size»
- «Level» is related to the detail that is reconstructed. The smaller the better, but the smaller the longer it will take to process
- «Cell size» is related to the quality of the final reconstruction. The higher the better, but the higher the longer it will take to process

Regard 3D: exporting data

- Once that dense reconstruction is finished, two things can be done: export the point cloud or export a MeshLab project
- In the case of MeshLab export, a sceneMeshLab.mlp file will be created, and two folders (images and model) containing the images and the dense model. The project can be directly loaded in MeshLab

Final notes regarding Regard 3D

- Regard 3D contains also an additional step to create a triangulated version of the model, and also a texturing
- In the context of the course, this is demanded to MeshLab, since cleaning and better texturing can be obtained with this tool.



VisualSfM, install on Windows

To install it on a Win machine, you need to:

- Download and copy the executable from the website: 32bit and 64bit are available. It is possible to use the CUDA version if you have it on your machine. It's only faster in that case.
- Copy the CMVS and PMVS executable in the same place where Visualsfm.exe is. You can download the files from here . If you need a 32bit version send me a mail.

VisualSfM, install on Mac

The installation on Mac seems a bit more tricky, but at least everything needed is installed at once.

Check the installer provided by Dan Monaghan

VisualSfM, basic usage

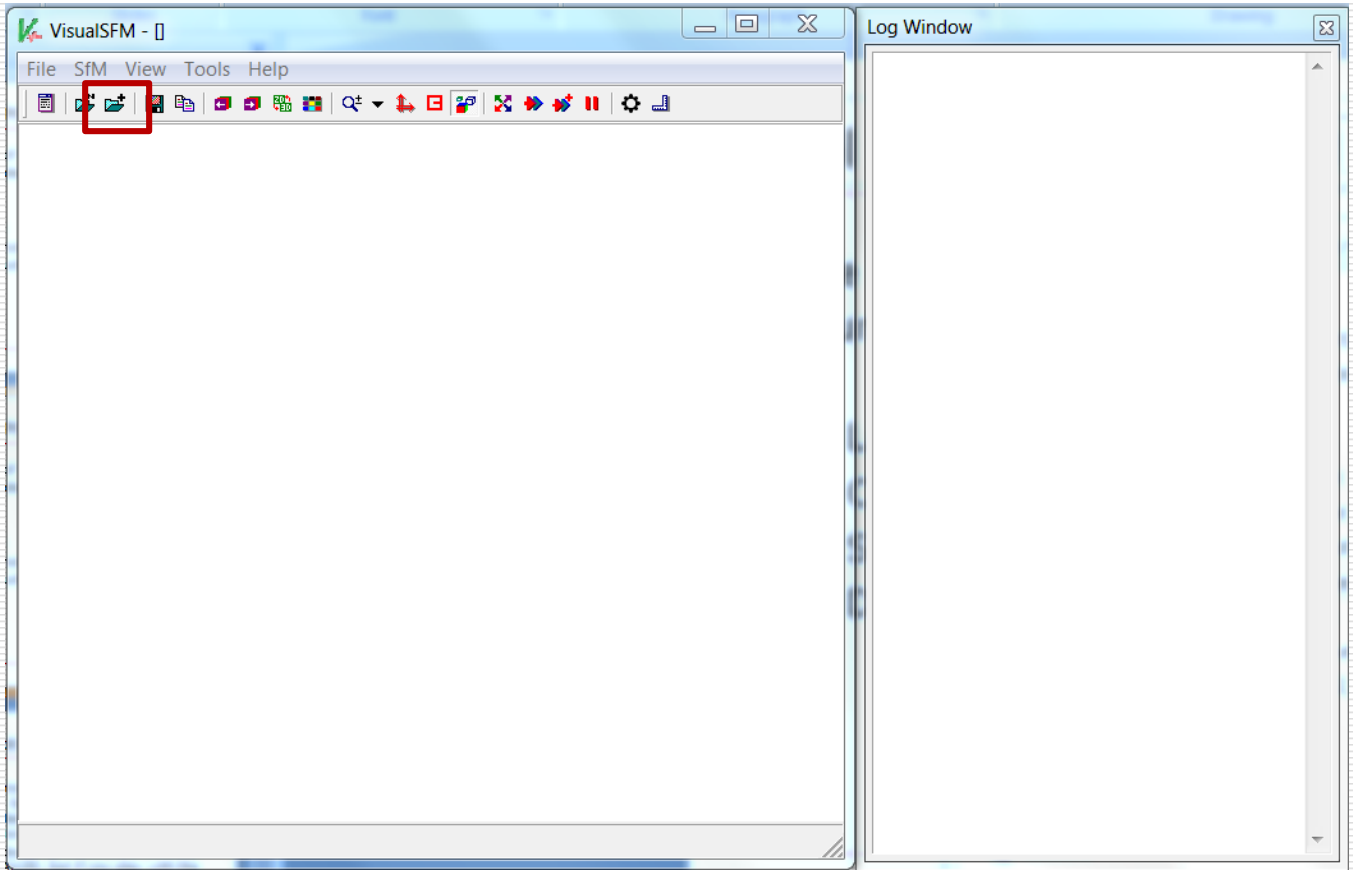
The basic pipeline of VisualSfM is quite simple.

Four steps are needed

- Load images
- Calculate Match
- Sparse Reconstruction
- Dense Reconstruction

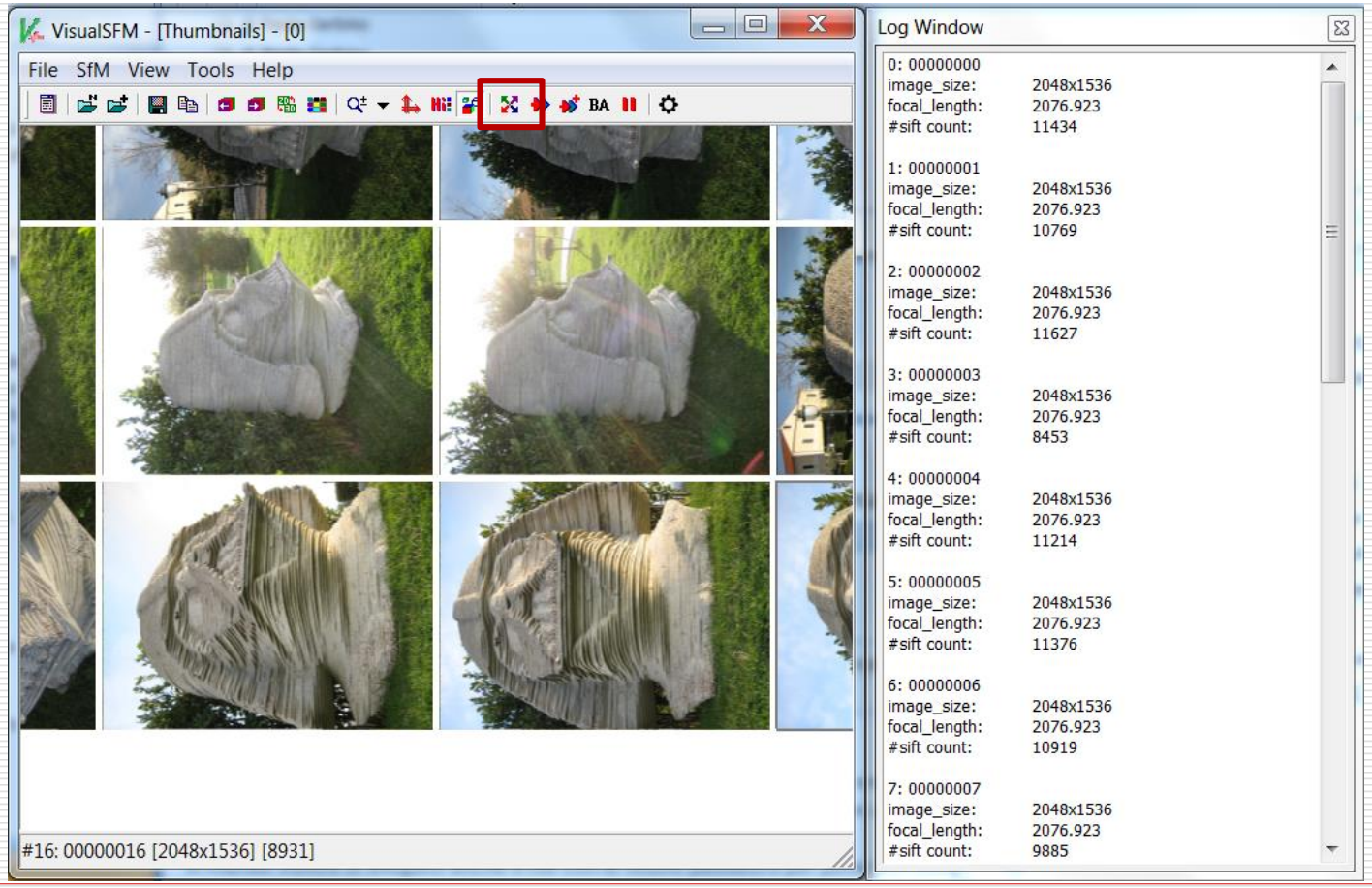
VisualSfM, load images

Select and load the input images



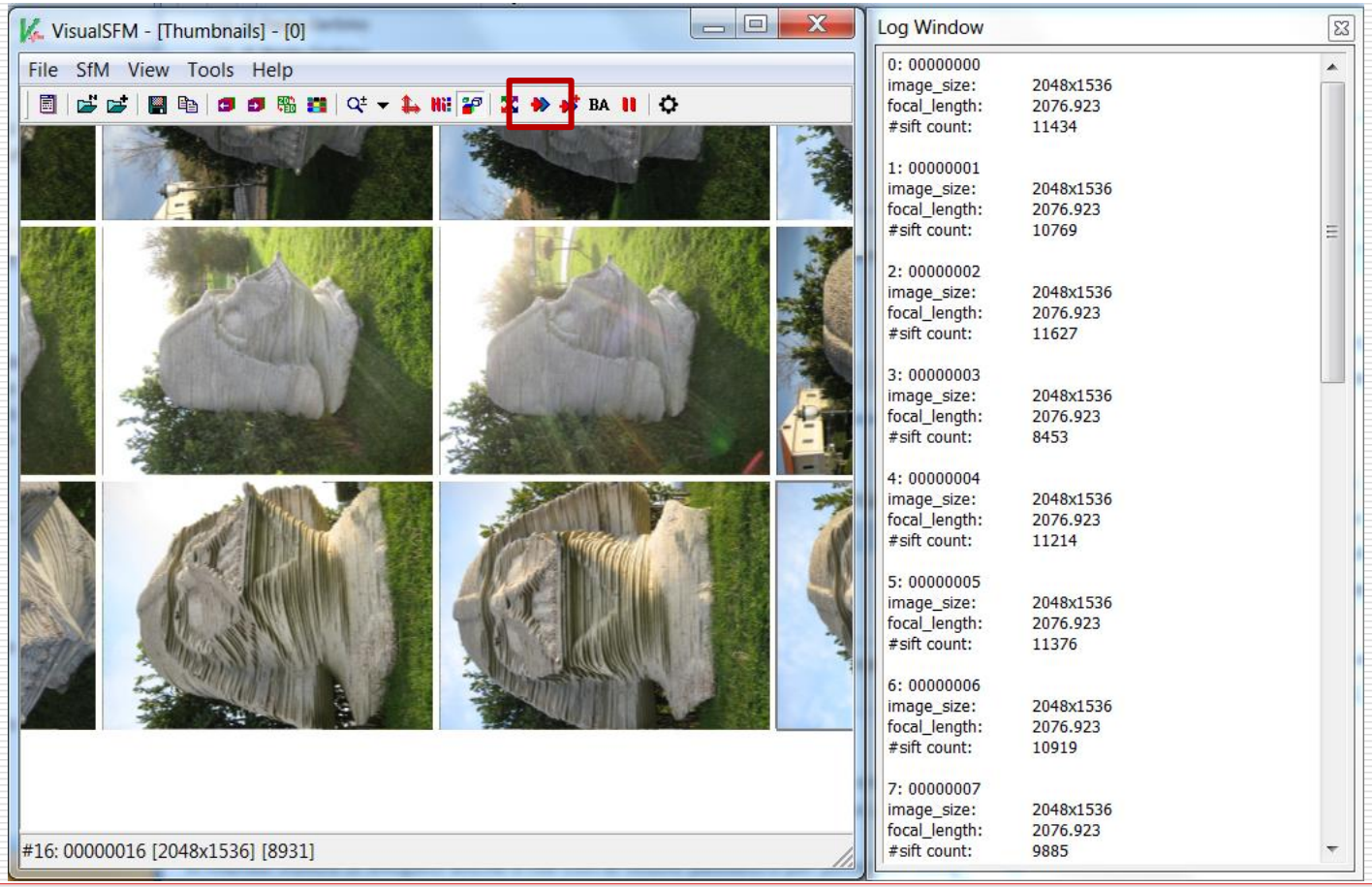
VisualSfM, compute matches

Compute the missing matches



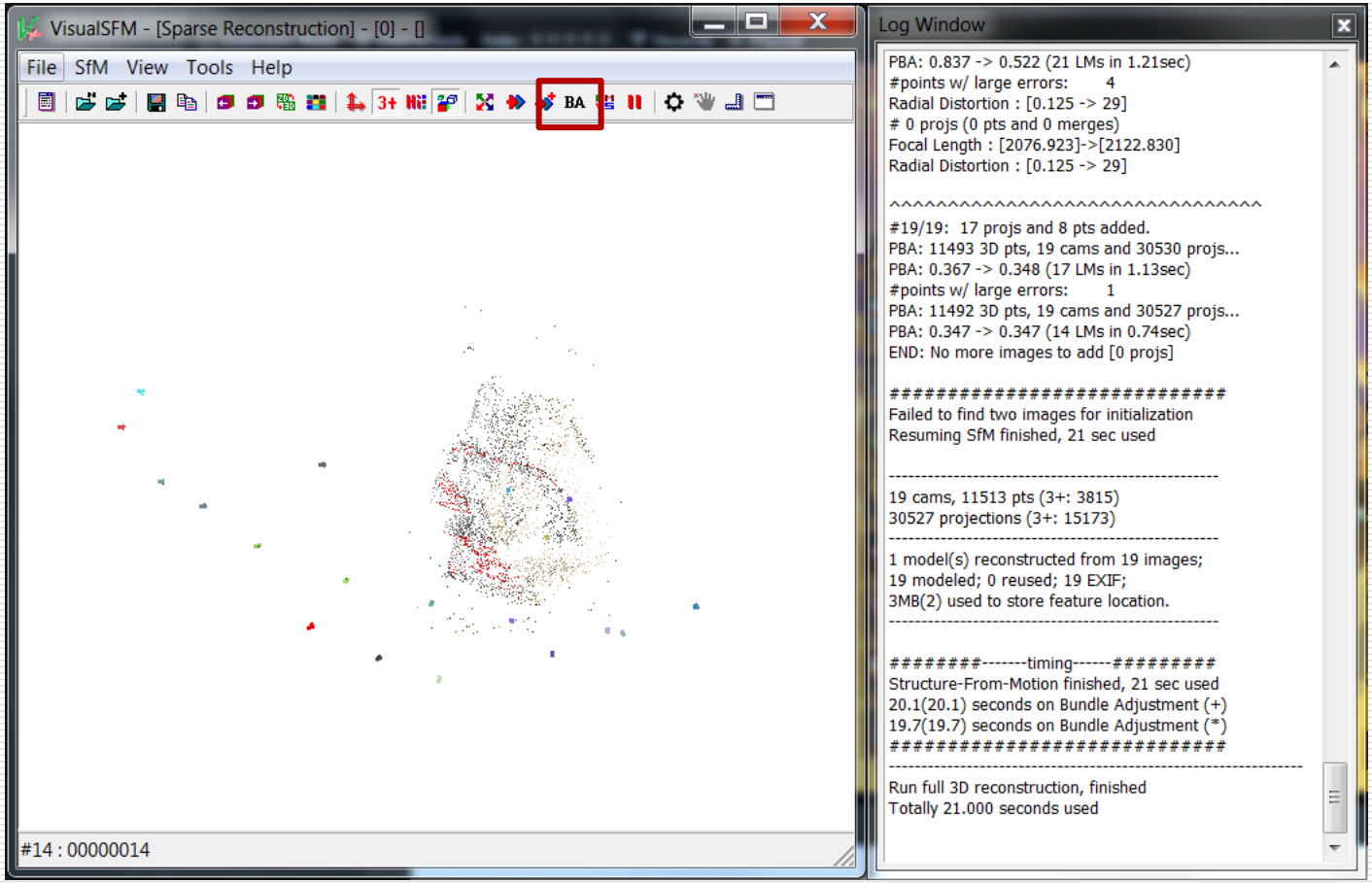
VisualSfM, sparse reconstruction

Generate sparse reconstruction



VisualSfM, sparse reconstruction

Run the bundle Adjustment to refine reconstruction



VisualSfM, sparse reconstruction

The sparse reconstruction provides an initial feedback about the reconstruction. You can check if:

-All the images have been calibrated (more than one cluster has been created, us PgUp and PgDown)
-The reconstruction is complete or some part is missing
-There are wrongly calibrated images

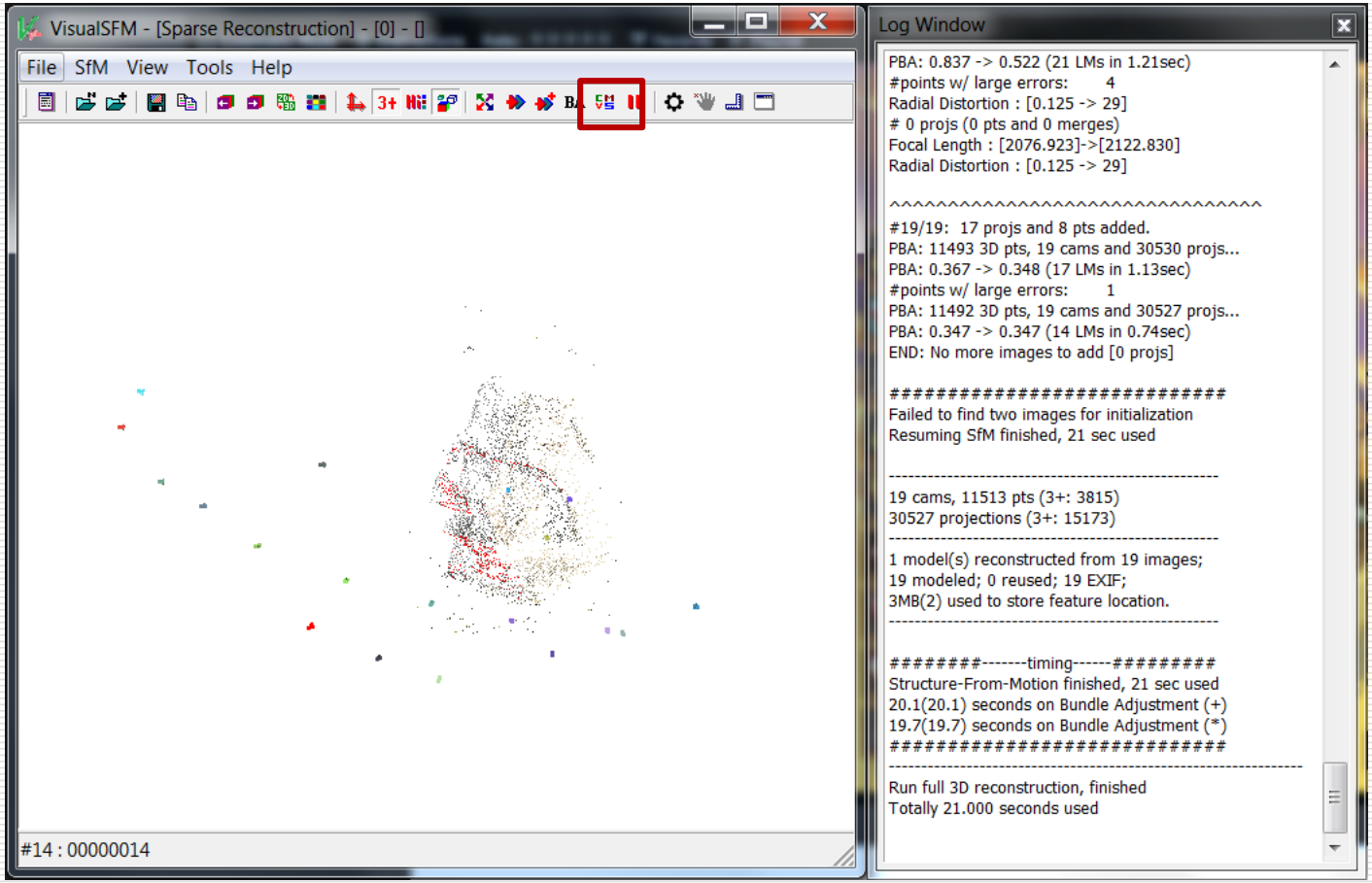
VisualSfM, sparse reconstruction

If the sparse reconstruction has problems you can:

- Change the input dataset (start from scratch, most of the matches will be kept in memory)
- Remove the wrong cameras (re-launch BA, or try to add them in reconstruction again)
- There are other ways to control the reconstruction, check the tool!

VisualSfM, dense reconstruction

Run the CMVS for Dense Reconstruction



VisualSfM, dense reconstruction

The Dense reconstruction ask you to create a new folder (save it where the images are!)

The final Dense reconstruction will be saved in this folder, inside the 00/models folder.
It will be called option-0000.ply

This will be the dense cloud that you will load in MeshLab to create the model!

Next in line…

Next lesson:

- Making the model in MeshLab

Contacts:

Matteo Dellepiane

c/o ISTI-CNR Via G. Moruzzi 1

56124 Pisa (PI)

Tel. 0503152925

E-Mail: dellepiane@isti.cnr.it

Personal website: http://vcg.isti.cnr.it/~dellepiane/

VCG website: http://vcg.isti.cnr.it