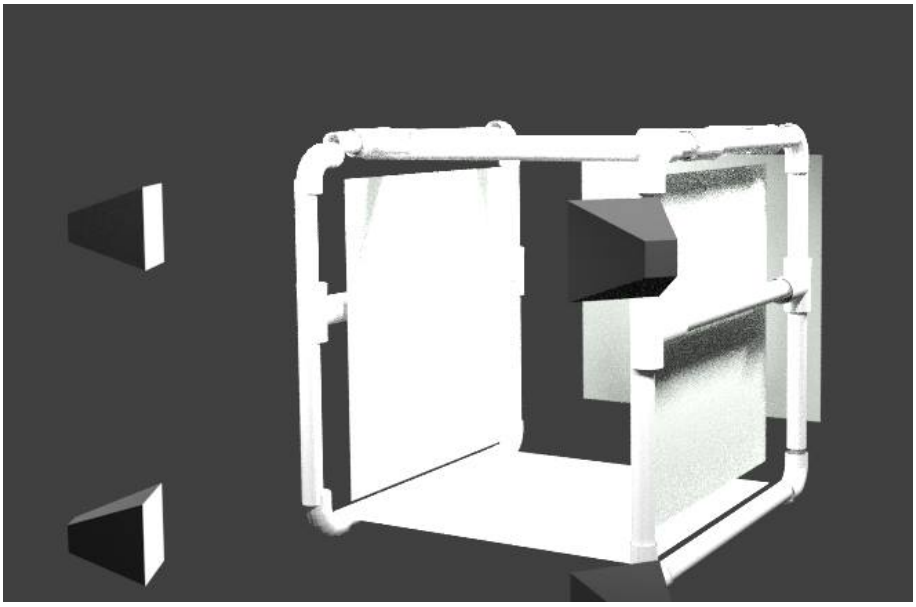
User Manual

Guide for Assembly

The frame is a 26 piece kit. The top length is cemented together to make it easier to put together as well as ensure the parts do not rotate. The other pipes fit together to form the image below.



There are four pipes that are approximately 5’ in length in the middle and on the bottom. The middle is connected with T pipe fittings and the bottom two are connected with elbow fittings. There are 8 pipes that are approximately 2.5’ in length that make up the height. These connect into the T fittings and the elbows that are connected to the 5’ pipes as well as the top pieces. These are the walls of the frame. The walls are connected together through 2 pipes that are also approximately 5’ in length. These are connected through the T fittings on the top pieces.

The acrylic bed is then laid on top of the middle pipes spanning the empty space. It should fit snuggly with the 3” cutouts under the braces on each side and reinforce the frame with its length and weight. The lights are setup such that the umbrellas are pointing towards the interior as this will diffuse the lighting and create an even illumination.

Guide for Taking Photographs for VisualSFM

Background

Photos for VisualSFM should be either taken with a still camera to ensure crisp photos of the object of interest at a resolution of at least 1280 x 720 or a video of equivalent resolution. It is advisable to take photos or video at a much higher resolution such as 5 megapixels or higher this will provide more detail and achieve a more accurate model. Videos can be dumped into individual frames. VLC media player has this capability. VLC media player's filter option called scene video filter under all setting inside preferences. The video should be played with the scene filter on and the pictures will collect into a folder that was specified when the filter was created. The issue with video is that while it's quicker than taking individual photos, there is motion blur that must be manually searched for to ensure that only the crisp photos are the ones being used by VisualSFM. This makes pictures easier to deal with but slower to create. As a rough guideline, photos should have at least around 60 percent overlap between the pictures to ensure that VisualSFM can match the two pictures more is better.

Best method for taking pictures

The basics of this method comes from a sphere.
Assume that a beach ball is to be the scanned object. The beach ball should be held with either fishing wire or placed on a transparent surface to allow pictures to be taken from above as well as under. To take the pictures the user sets the camera such that pictures are taken from a fixed distance from the beach ball while keeping the camera focused on the center of the beach ball. Then, the user circles around the beach ball taking pictures at that fixed distance and taking pictures at least two more pictures at different distance from the beach ball with each increment around the beach ball. This gets at least three pictures from each position and increases overlap significantly. The user starts from the top of the beach ball keeping the camera pointed towards the center while at that distance and takes pictures all around the beach ball. This process is repeated at increments going down towards the bottom of the beach ball. Ensure that the camera is always focused towards the center of the beach ball and at a fixed distance.

For more complicated objects such as a teddy bear or a shoe, the same process described above can be used. The areas of the object with complicated surfaces such as shoelaces with a shoe or decoration with a teddy bear should have more photos around those areas to get the details of those spots better.

For larger objects or long straight object, the sphere shape does not necessarily make sense to use. For these objects, a capsule shape should be used while still maintaining the guidelines of the sphere. A capsule is when a sphere is split into and joined on two ends of a cylinder. It's the shape of many pills used in the pharmaceutical industry.

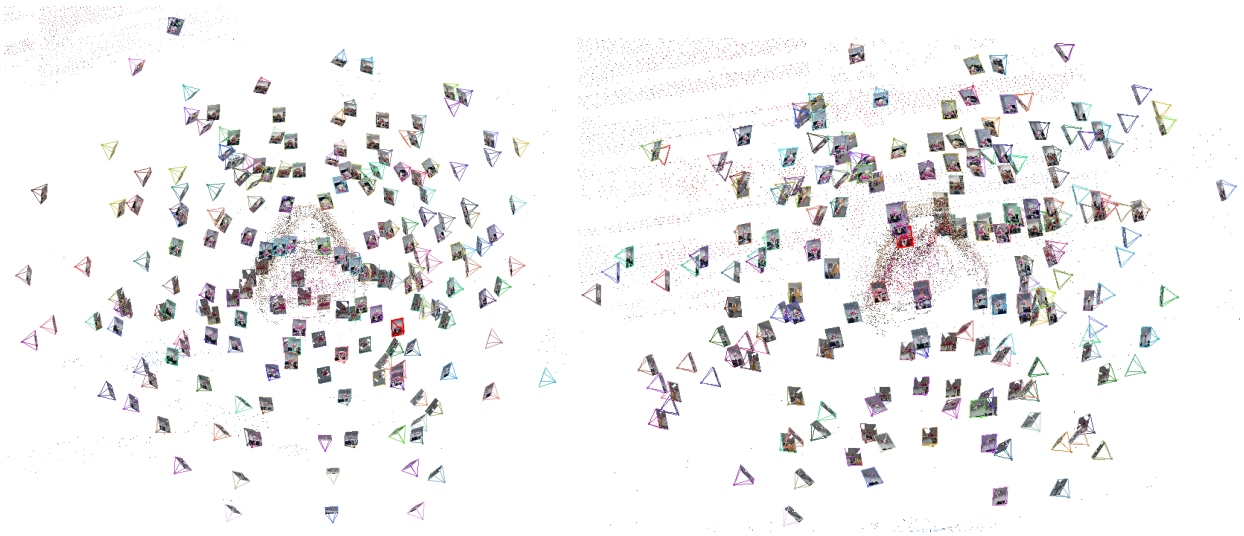
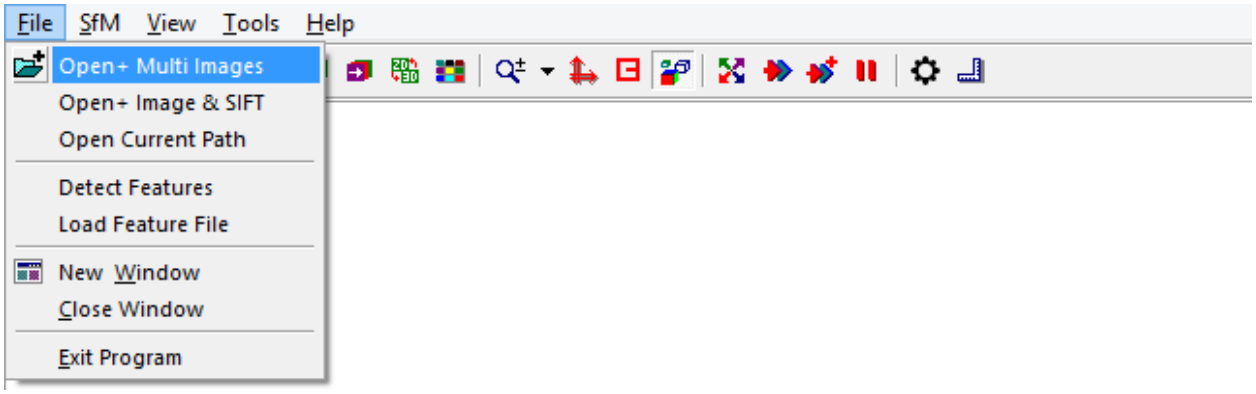


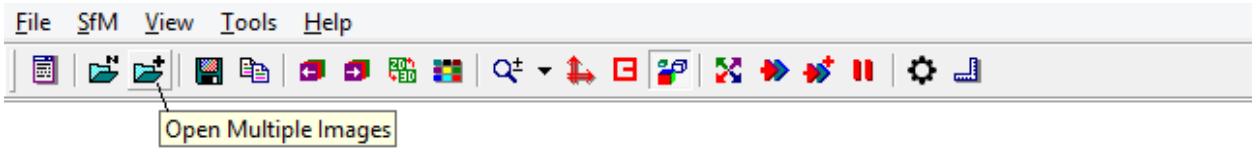
Figure 1: Examples of spherical method for object capture. Notice there are three pictures at each position with different distances.

VisualSFM

1) Click File and Open+ Multi Images

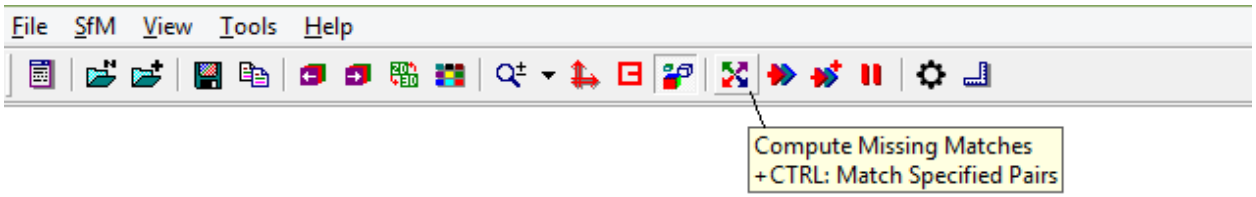


or



2) Select all of the images that will be apart of the mesh then click Open.

3) Click Compute Missing Matches in the tool bar.

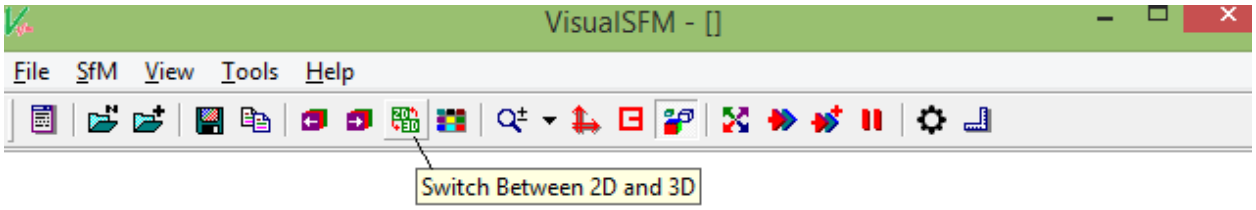


4) Wait until “Compute Missing Pairwise Matching, finish” message is in the Log Window. This may take a between a few seconds to a few hours depending on the performance of the machine it’s being ran on and the number of pictures.

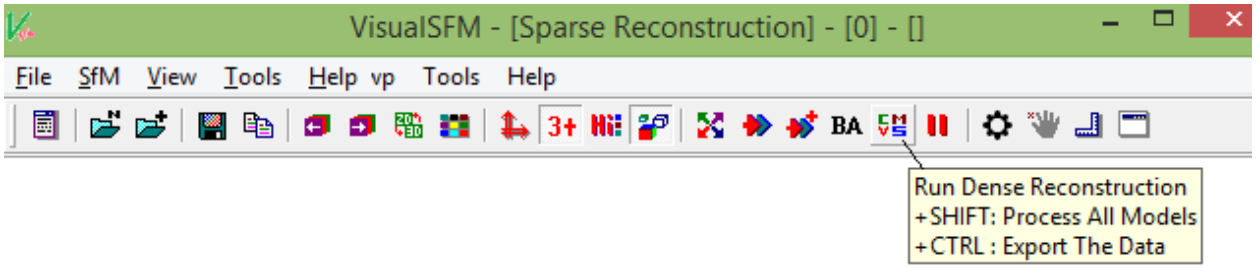
5) Click Compute 3D reconstruction in the tool bar.

6) Wait until “Run full 3D reconstruction, finished” message is in the Log Window.

7) If the top of VisualSFM does not says VisualSFM - [Sparse Reconstruction] then click the Switch Between 2D and 3D button to ensure that the CMVS button is available.



7) Click the CMVS, run Dense Reconstruction, button in the tool bar.



8) Name the file and click save.

9) Wait until “Run dense reconstruction, finished” message is in the Log Window.
This could take very long depending on the amount of pictures and the performance of the machine.

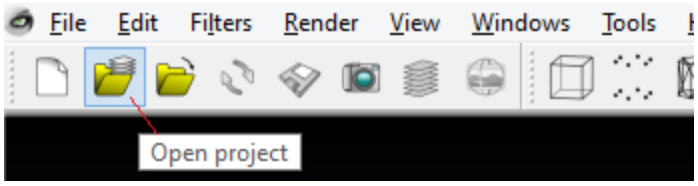
10) While the VisualSFM window is selected, Hitting the Tab Key on the keyboard will alternate between the sparse and dense view.

Tips:

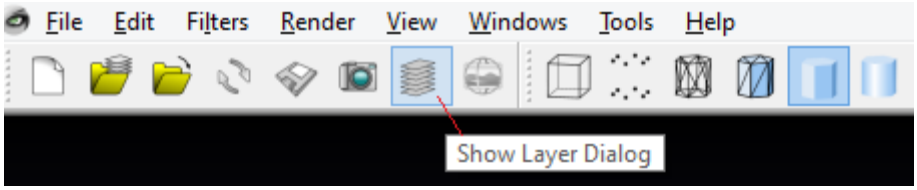
It is best to have only one sparse reconstruction. This means all the pictures that were taken are in one model and it creates the best point cloud. To check if VisualSFM generated more than one model the up and down arrow keys allow the user to switch between the models. If the user is unable to do so then there must only be the current sparse cloud that was created.

MeshLab

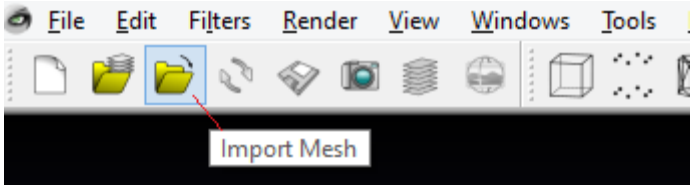
1) Open MeshLab version 1.3.4BETA or above.
2) Click on Open project.



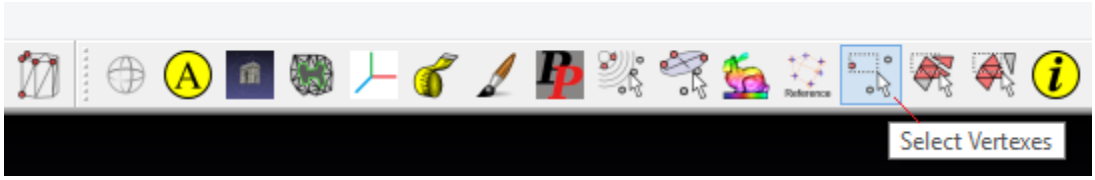
3) Navigate to the directory where VisualSFM put the dense reconstruction. Open the file that was created by VisualSFM. It should be a file with a .nvm extension.
4) Open the layers panel by clicking Show Layer Dialog

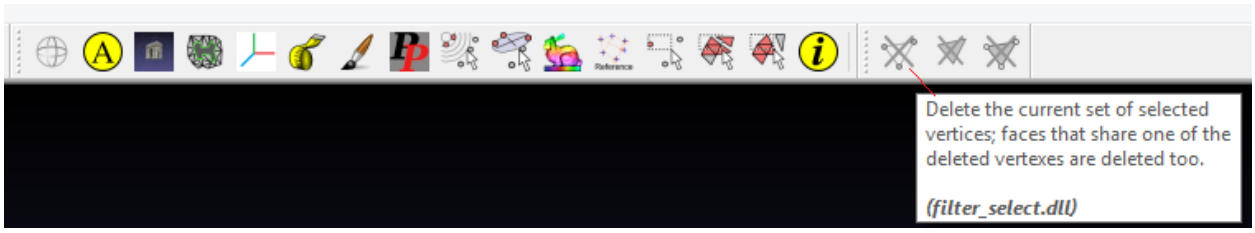


5) Right click on the mesh that was initially loaded by MeshLab and choose delete current mesh. This is the sparse reconstruction and does not have the details needed to recreate a good mesh.
6) Click on the Import Mesh button and open the file called example.0.ply where example is what that project was named when it was created. This is the dense reconstruction.

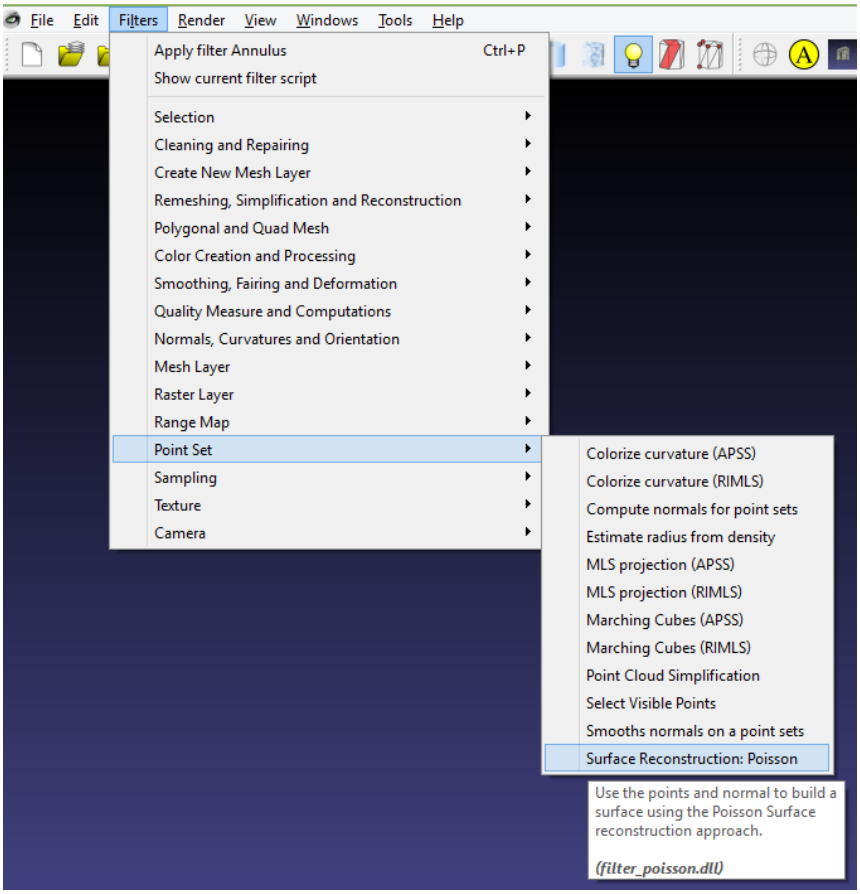


7) This is the clean up step where the dense reconstruction is cleaned to generate a better mesh. By clicking on Select Vertexes, the vertices of the dense reconstruction can be selected. This allows the user to select vertices for deletion. To delete the points selected, click the delete button shown below. This button corresponds to the Select Vertexes button. If the points are good, skip this step.



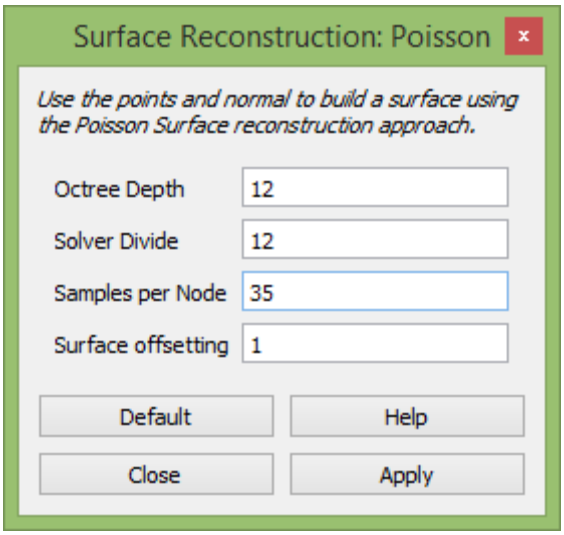


8) Now that the point cloud is cleaned and ready for reconstruction, make sure that the point cloud is selected in the Layer panel to the right. At the top of the window select Filter, then find Point Set, then click Surface Reconstruction: Poisson.

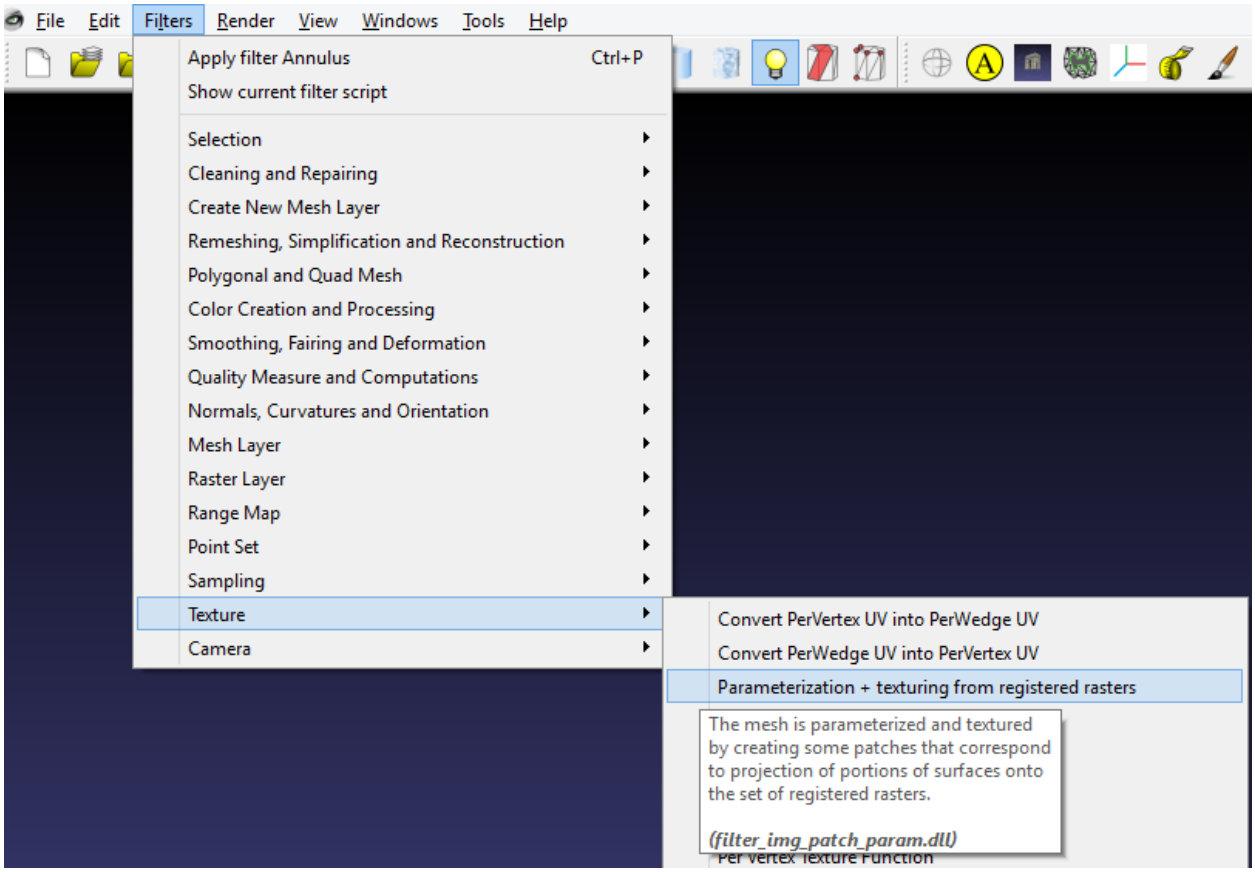


9) This part creates the actual mesh that could be printable if great care was taken when the photos were taken and during the clean up on step 7. In the Surface Reconstruction: Poisson window, choose 12 for the Octree Depth, 12 for the Solver Divide, 35 for the Samples per Node, and leave surface offsetting to 1. This combination of setting typically

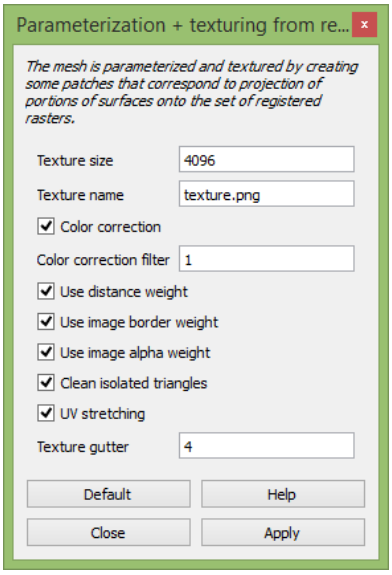
gave good result. If the mesh generated is not adequate enough, more samples tends to smooth out model as well as lessen the key features while less samples make the model rougher with more key features shown. The user is encouraged to test these setting to achieve a more appropriate mesh if desired.



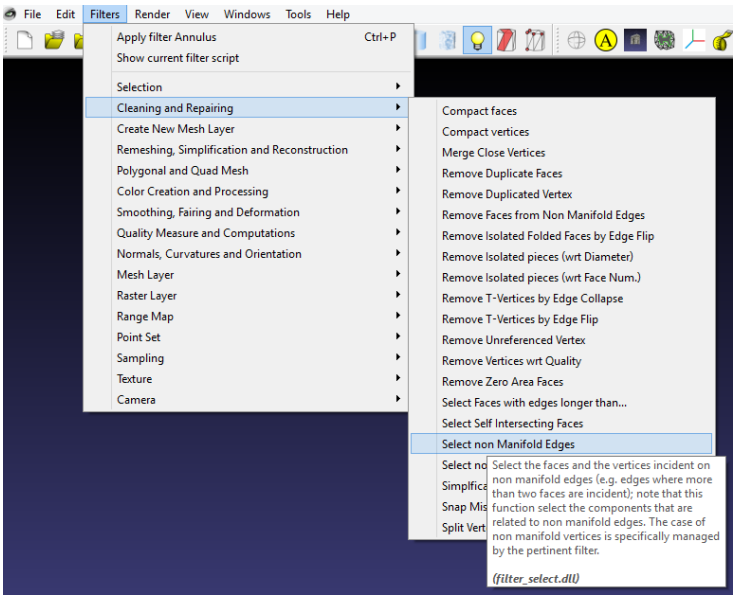
10) Now that there is a mesh that looks like the object being scanned, it's time to add the texture onto the object. Select Filters from the top, go down to Texture, then click on Parameterization + texturing from register rasters.



11) Now that the Parameterization + texturing from register rasters window is open, the setting are shown below that are typically used. The texture size can be reduced to 1024 for speed but if accuracy is desired higher texture sizes are better. If doing multiple different meshes, the texture name can be changed such that one texture won't overwrite another texture. Ensure that the poisson mesh that the texture belongs to is selected in the Layers panel to the right. Click apply.

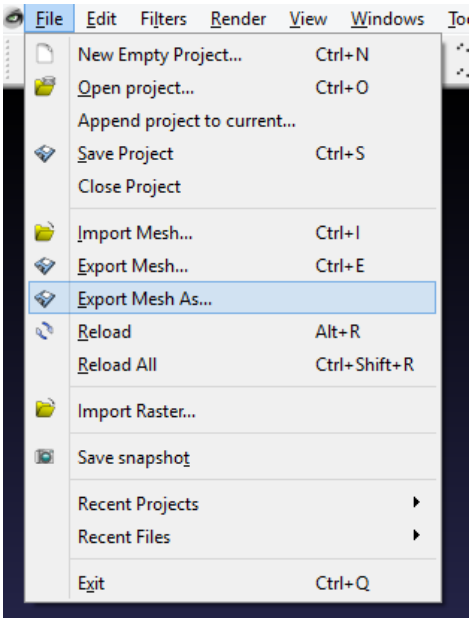


12) If there are non-manifold edges present in the mesh, select filter then go to Cleaning and Repairing. Click on Select non Manifold Edges. Click apply in the new window and then delete those edges.

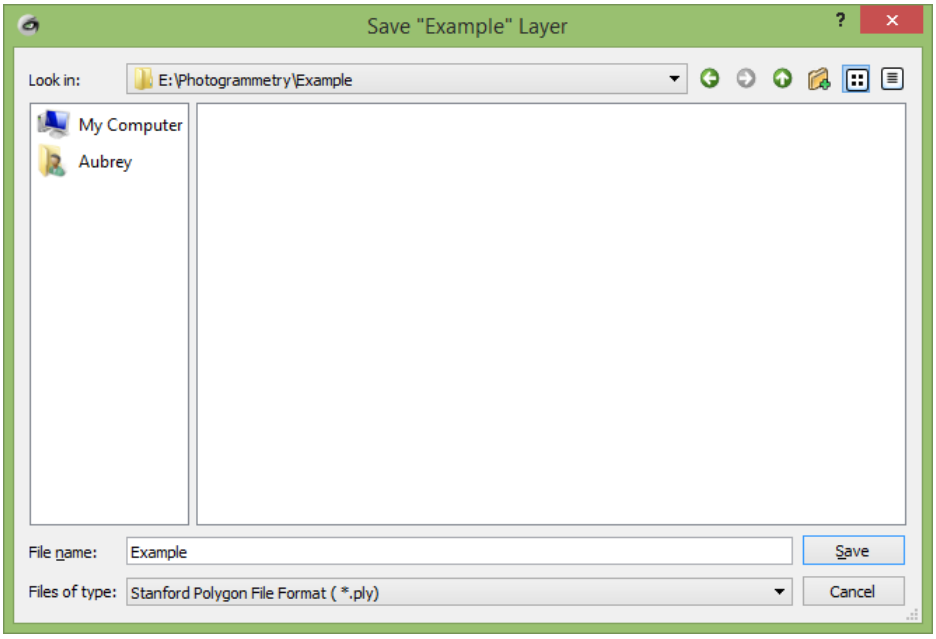


12) At this point the mesh is finished and it has a texture made for it. The next step will cover exporting the new mesh and associating a texture to it. If desired, MeshLab can render it with more color and more light. These settings are at the top. Select Render and the options will be in Lighting and Color.

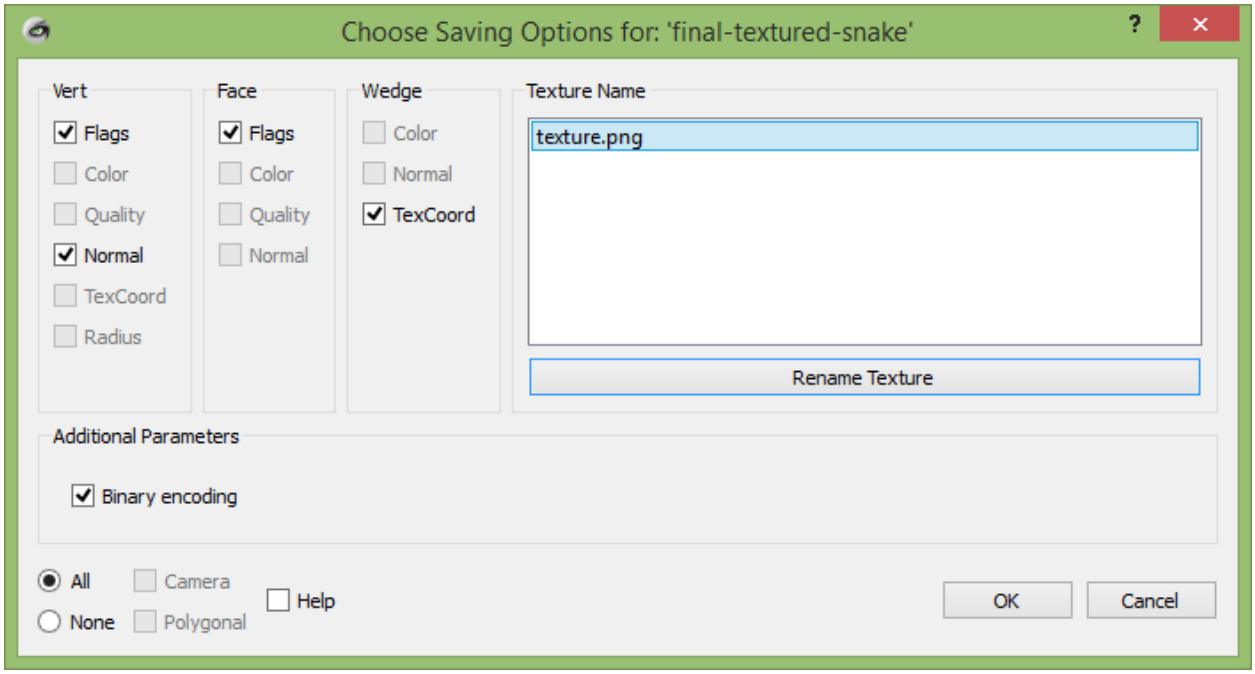
13) To export the newly created mesh, select file then go down to Export Mesh As…



14) In the save window, navigate to the directory that the mesh is to be created in and save it under a name. If a particular type of file is needed select the drop down menu Files of type: and select the appropriate file type.



15) Select the options shown below and select the texture that is to be associated with the model then click OK.



16) Move the texture to the same directory that the model is in and keep them together.

The model is finished. It can be opened in Meshlab again via the Import Mesh button or it can be opened in other softwares so long as the software can open the type of file that it was exported in.