Co-funded by the Erasmus+ Programme of the European Union

Erasmus+ Project ID: BIMVET3 2020-1-ES01-KA203-083262

This Erasmus+ Project has been funded with support from the European Commission. This publication reflects the views only of the authors, and the European Commission and Erasmus+ National Agencies cannot be held responsible for any use which may be made of the information contained therein

BLOCK V: New BIM Modelling Technologies 3D scanning and BIM models, photogrammetry 3D modelling and 3D printing.

Title: Photogrammetry. Post-Processing.

1- Aims.

To know different basic 3D element editing tools.

Know post-processing programmes open to competent users at little or no cost.

To be familiar with programmes for checking and obtaining data on competent three-dimensional elements at minimal or no cost.

Use the above digital resources to implement them in three-dimensional data checking and enhancement workflows.

To deepen the knowledge of 3D models and their geometry, polygonal meshes, types and classifications.

To deepen the knowledge of 3D models and their cataloguing according to the polygons that make them up.

2- Learning methodology.

Students will read this tutorial and watch the video.

The content of this theoretical-practical video is focused on the student being able to get to know various conventional terrestrial photogrammetric technologies as well as their

methodologies of action; showing the handling of attitudes and digital tools that the photogrammetric technician must learn.

In order to facilitate understanding, various aspects of the tools used that may be of importance for their use are explained, while the explanation is developed by means of 3 practical examples of the application of point clouds and three-dimensional data for post-processing, improvement of results and verification.

In order for the teacher to evaluate the use of the practice, each student will write a report and hand in their High Poly and Low Poly model, as well as the files that emanate from them, such as textures, polygon meshes, point clouds, Scalar Fiels, Histograms.

3- Tutorial duration.

Practice described in this tutorial corresponds to the management and repair of polygonal meshes. The explanatory development of the video is complemented with the content of this document, in which in addition to the explanation of the video, examples and practicable exercises that can be performed with the same methodology are also given, so that the development of this exercise could reach 5 hours.

4- Necessary teaching resources.

Computers compatible with RealityCapture requirements.

64bit machine with at least 8GB of RAM.

64bit Microsoft Windows version 7 / 8 / 8.1 / 10 or Windows Server version 2008+.

NVIDIA graphics card with CUDA 3.0+ capabilities and 1GB VRAM.

CUDA Toolkit 10.2, minimal driver version 441.22

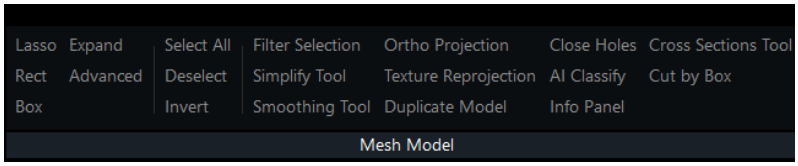
5- Contents and tutorial.

5.1- RealityCapture

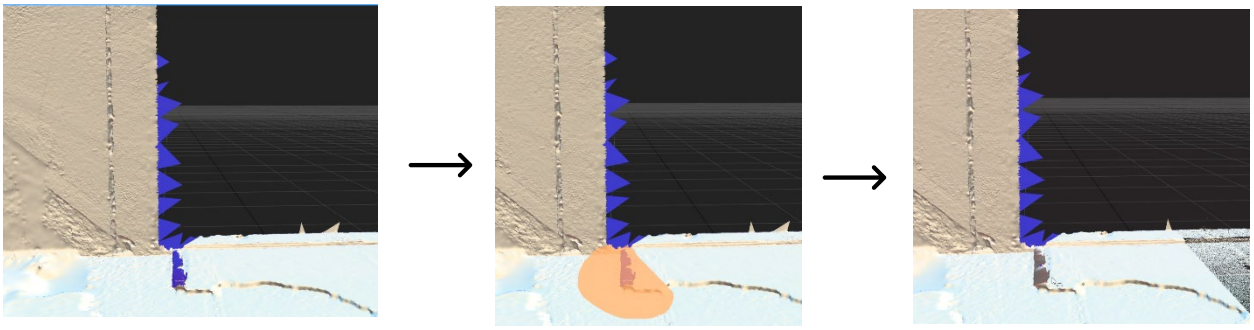
-Installing the software: The Reality Capture software is installed from its website https://www.capturingreality.com/DownloadNow It is necessary to register to use it, because although the information processing and editing is free, if you want to download the photogrammetric project, you must pay a small fee. It is possible to register via Google Account, Facebook or your Epic Games account if you have one.

- Post-processing: Once the desired three-dimensional model has been obtained, after having carried out the workflow, we proceed to make changes to the mesh and point cloud in post-processing. Photogrammetric data acquisition and point cloud management programs have various tools that can be used to improve or change the data obtained.

We access the upper panel to the section TOOLS where we will find numerous tools to apply on our model, we will focus on the tools "Close Holes", "Smoothing Tool" and "Simplify Tool".

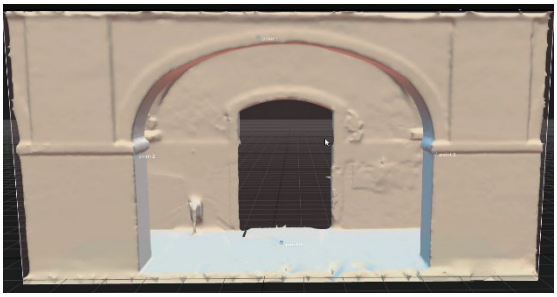


Close Holes Useful tool to close holes created in the polygonal mesh, these are usually generated by lack of information or erroneous information that causes the polygonal mesh to re-sink. To use it, you must select the affected area and apply it.

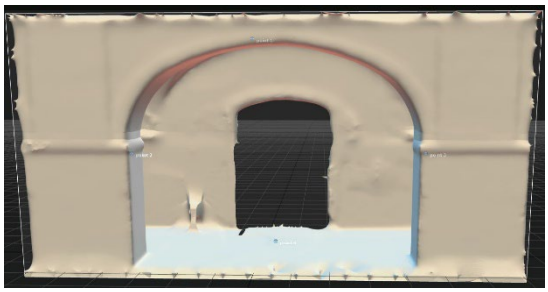


Smoothing Tool A tool used to smooth out surfaces of three-dimensional models, it can be applied to concise areas or to the whole model. This tool should be used with care as it can lead to significant loss of information.

Original

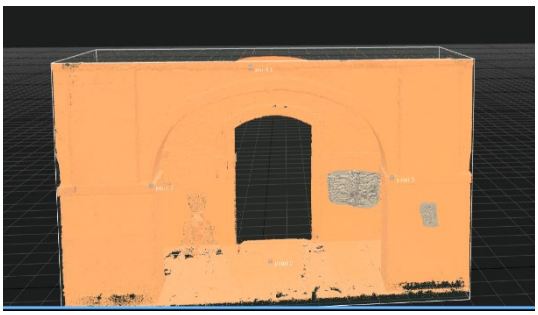


Smoothing x 0,2



Smoothing x 1,0

Simplify Tool Tool that helps to reduce the number of polygons in the three-dimensional mesh, it can work on specific areas applied by a selection or on the whole model. In the example an area is selected to reduce it from 29 million polygons to 6 million. The unselected areas with more polygons are clearly visible.



→

5.2- Meshlab

-Software installation: The Meshlab software is installed from its own web page https://www.meshlab.net/#download where you can find the download section, where you can download the file to the terminal from the browser itself, then unzip it and start a simple and quick automatic installation.

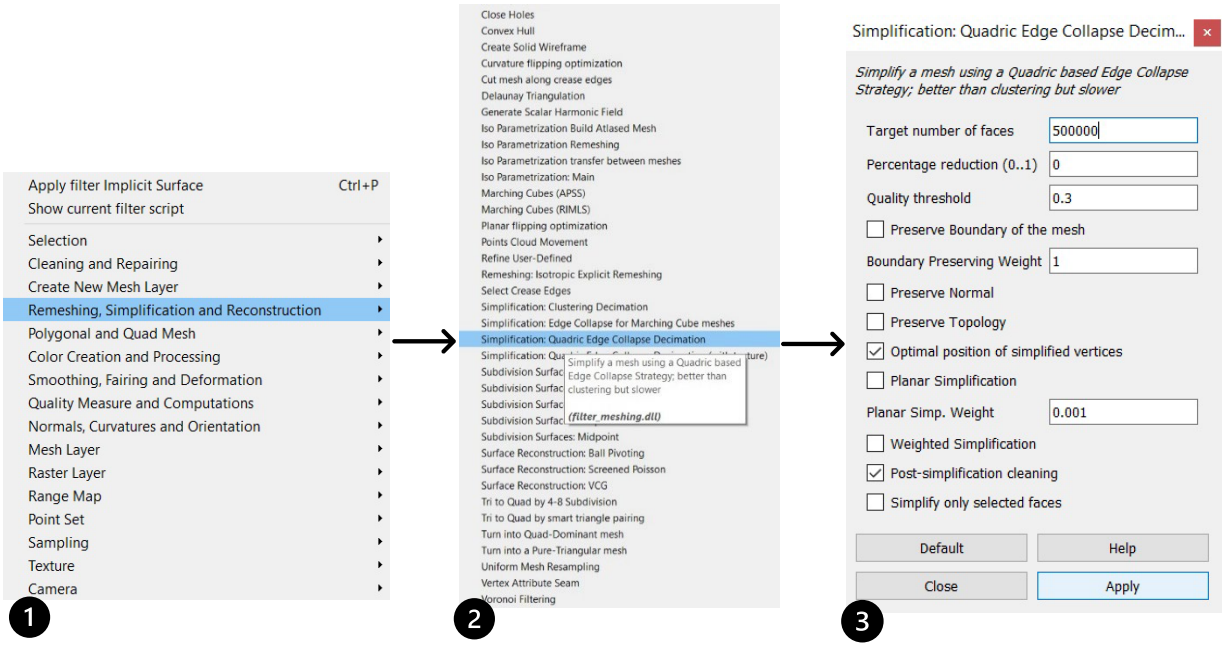
- Post-processing:

Meshlab offers an infinite number of functions for modifying polygonal meshes and point clouds, being able to vary numerous aspects such as the spacing between vertices, the shape of the polygons that make up the mesh, as well as the number of vertices and polygons that make up the model, in addition to numerous texturing and filtering functions.

The first exercise: It consists of generating a Low Poly model. Reducing the existing polygonal mesh.

Once the software is installed and started, go to the top panel and select the view

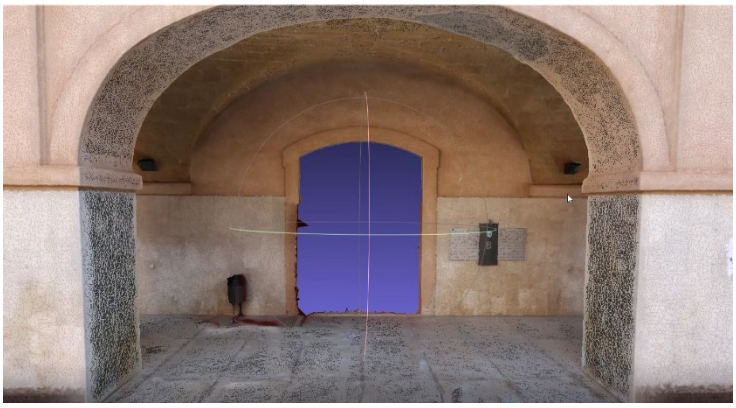
Filters Once selected, the following panels will open correspondingly according to the options shown in the images.



1. First of all, after clicking on a Filters general panel will be displayed with divisions that specify the feature or element of the 3D model that you want to transform, in this case, you want to simplify an existing mesh.

2. Subsequently, all the options that can help to redo the mesh or alter it quantitatively mainly, as well as tools to close gaps or simplification as in our case, we will select the option "Simplification Quadric Edge Collapse Decimation".

3. Once the tool has been chosen, the last panel will open, where we specify how we want to simplify the mesh, whether in percentage or with a predefined number of faces, in our case we will select the option of the number of faces and we will insert 500,000.

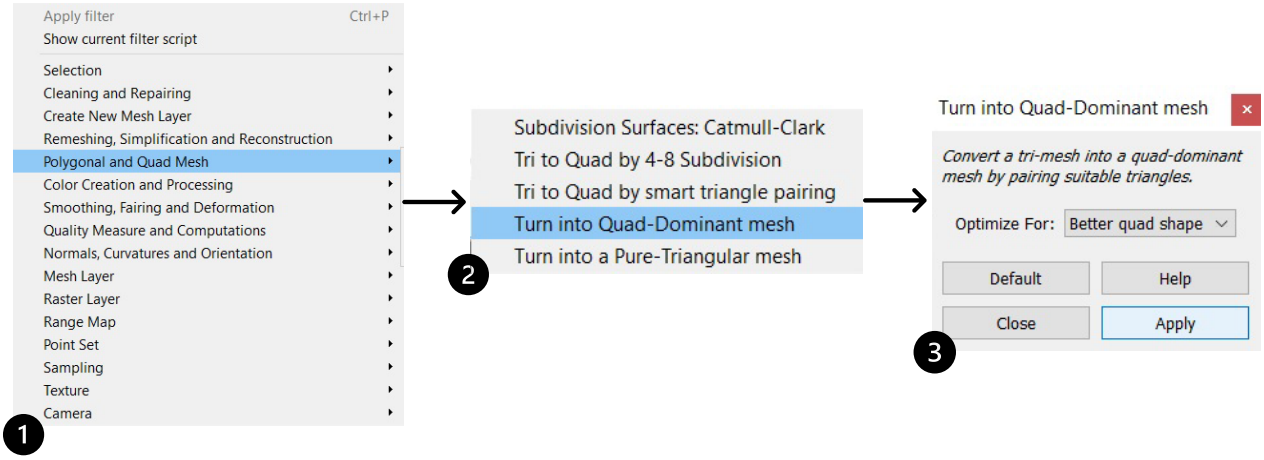


By halving the faces that make up the polygonal mesh, this way, as there are fewer polygons, it indicates that a large number of vertices of the point cloud that has generated the polygonal mesh will not be in use, so these are eliminated, so it is possible to see in the model values how both the mesh and the points are evenly reduced.

The second exercise: It consists of rearranging the polygons of the three-dimensional mesh, resizing them into quadratic shapes.

Once the software is installed and started, go to the top panel and select the view

Filters Once selected, the following panels will open correspondingly according to the options shown in the images.



1 First of all, after clicking on a general panel will be displayed with divisions that specify the feature or element of the 3D model that we want to transform, in this case we want to transform the triangular mesh into a Quad mesh, so we will choose the option "Polygonal and Quad Mes".

2 Subsequently, all the options that can help to redo the mesh or alter it quantitatively mainly, as well as mesh subdivision tools or mesh transformations, will be displayed, so we will select the option "Turn into Quad-Dominant mesh".

3 Once the tool has been chosen, the last panel will open where in the Optimise section we will select the option "Better quad Shape" to transform the whole mesh.

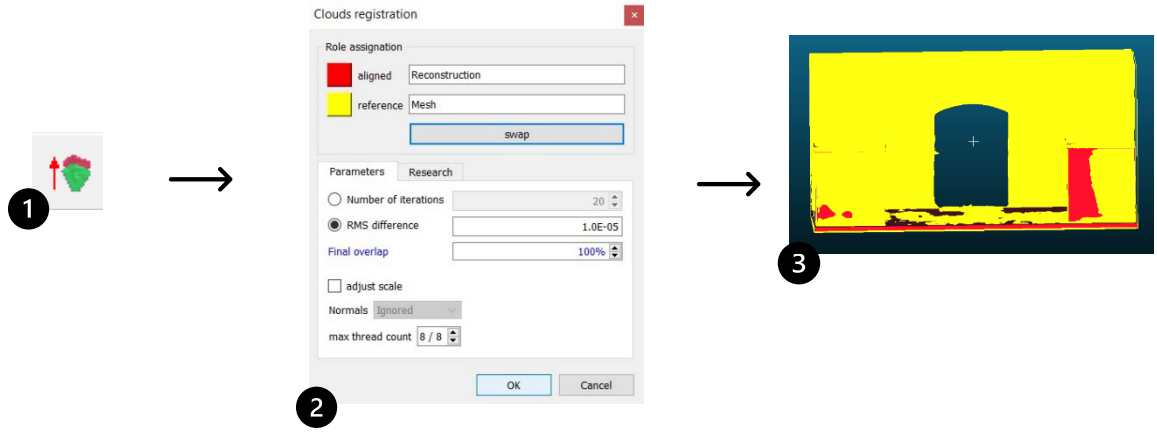
Quad meshes are lighter and optimise the file in good quality/weight ranges. Once this mesh is obtained, the texture should be remeshed if good texture results are desired with this configuration.

5.3 Cloud Compare

-Software installation: The Cloud Compare software is installed from its own web page http://www.cloudcompare.org/release/notes/20171026/ where you can find the download section, where you can download the file to the terminal from the browser itself, then unzip it and start a simple and quick automatic installation.

- Comparison: In this exercise, a comparison of 2 three-dimensional entities will be carried out, in order to observe existing divergences. For this practical case, it has been decided to compare the polygonal mesh of 500,000 polygons with a rough and inaccurate 3D reconstruction, in order to observe the existing divergences in a good way.

Once installed, we initialise the programme and import 2 three-dimensional elements that we want to compare, select them and click on the "Fine Registration" button.

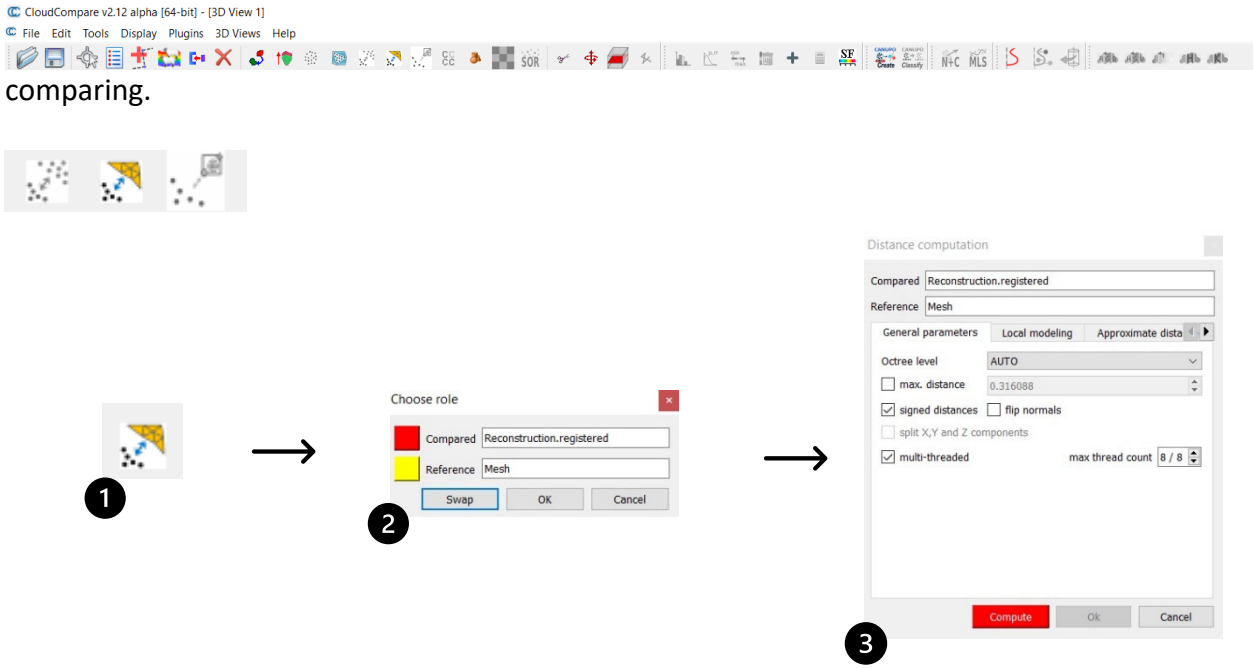


1 Select the "Fine Registration" option to align and register both entities.

2 In the next panel "reference" we should select the model with which we want to make the comparison, usually the one that is closest to reality. The "aligned" model should be the model that is less close to reality and that you want to compare.

3 Each three-dimensional entity is registered and aligned with a different colour, corresponding to the category assigned in the previous table.

Once both three-dimensional entities are registered and aligned, we proceed to calculate the distance between both entities, selecting the "compute" option according to the entities we are comparing.

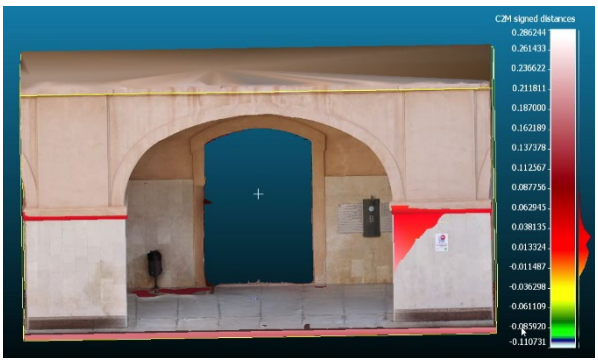


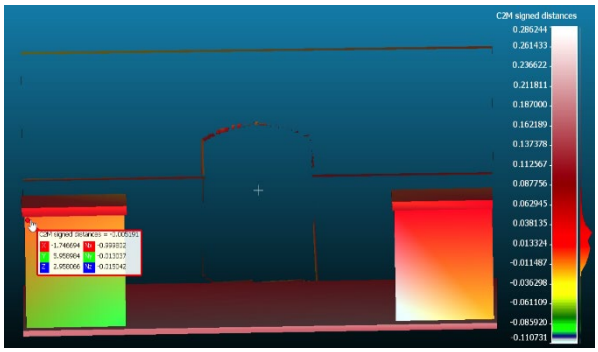
1 Select the option "compute cloud/mesh distance".

2 We select the reference, as previously done, by assigning it to the model closest to reality.

In the last box you can calibrate the accuracy and the maximum distance to be calculated.

3 As a result, we will obtain a "Scalar Field" in the mesh that is less similar to reality, indicating the divergences it has with respect to the model that is closer to reality.





The comparison work carried out using Cloudcompare provides us with valuable first-hand information, which can help us to improve our models or find divergences with reality. In the same way, we also propose that you develop Lowpoly models and compare them with their corresponding Highpoly model, in order to be able to observe in each case what the inflection point of information loss is, in each model this point will vary.

5.4- Video

https://www.youtube.com/watch?v=Q7NAHkcrFN0

6- Deliverables

In order for the teacher to be able to assess the students' progress, they will write a report of no more than 3 pages in length.

In this report, the student will explain the steps followed in practice, the difficulties encountered and the decisions taken. The report will be illustrated with photographs of the data capture and processing process, and the 3D file must also be submitted and uploaded to the Sketchfab platform.

7- What have we learned?

Manage 3D elements after processing is complete.

Decrease the size of the exported file.

Know and differentiate between triangular and quad polygonal meshes.

Knowledge of High Poly and Low Poly models and their differences.

Knowledge and handling of different editing and 3D element management software tools.

Obtain quantitative information from the 3D model useful for verification, transparency and reporting.

8- File to use in the tutorial

Project in RC (Reality Capture)

Geometric model in PLY format.

Meshlab, is a perfect programme to change the format of your 3D object, being able to export according to your needs: (nxs, nxz, 3ds, ply, stl, obj, off, wrl, dxf, dae, ctm, e57, xyz, json, u3d, idtf, x3d).

CloudCompare BIN project.