

3D MODELING USING FREEWARE

Maria – Roberta GRIDAN, Assist. PhD. Eng – Politehnica University Timișoara,

roberta.gridan@upt.ro

Carmen GRECEA, Prof. PhD. Eng – Politehnica University Timișoara,

carmen.grecea@upt.ro

Abstract: *In many cases, specialized 3D modeling software is very complicated to handle and also too expensive to buy if only basic modeling is needed. Because of this, free software can be a good alternative for people who need fair results in a short time. Of course, these programs cannot offer very high precision but the quality they offer is sufficient for presentation purposes. The opportunities for using this kind of software are various, from basic student projects, to museums (for animating exhibits), to archaeology, medicine etc. This paper presents a classical topographical instrument 3D modeling, Theo 020B, using the free 123D Catch software produced by Autodesk, aiming to use this software on further objects 3D modeling from Topo - Geodesic field.*

Keywords: *2D image, 3D model, freeware, Photogrammetry*

1. Introduction

In generally, Digital Photogrammetry is a well-established technique for acquiring dense 3D geometric information for real-world objects from stereoscopic image overlap and has been shown to have extensive applications in a variety of fields [1]. It implies one or two photos/photogramms analysis with specialized programs, for determining spatial relations.

Close Range Photogrammetry finds its application in various fields like medicine (plastic surgery), archaeology and historical and cultural heritage preservation because of its well known advantages: the measuring method is without direct contact with the studied object, the results are precise and reliable, the data collection is made in a short time with low costs and at any time the saved images can be remodeled [2].

This technique has become an efficient alternative at the classical façade topographical measurements, but an application accomplishment respects the steps of any Land Measurement project. So, for obtaining technical and scientific results it is necessary to plan and to recognize the field for the measuring campaign and to perform the measurement itself and also to process them.

2. Materials and Methods

The data acquisition principle using the photogrammetric method aims obtaining information referring to physical objects and to the environment, from distance, without physical contact through photographic images recording, measuring and processing.

Not all these projects are the same, but in general a Close Range Photogrammetry project has the following work flow:

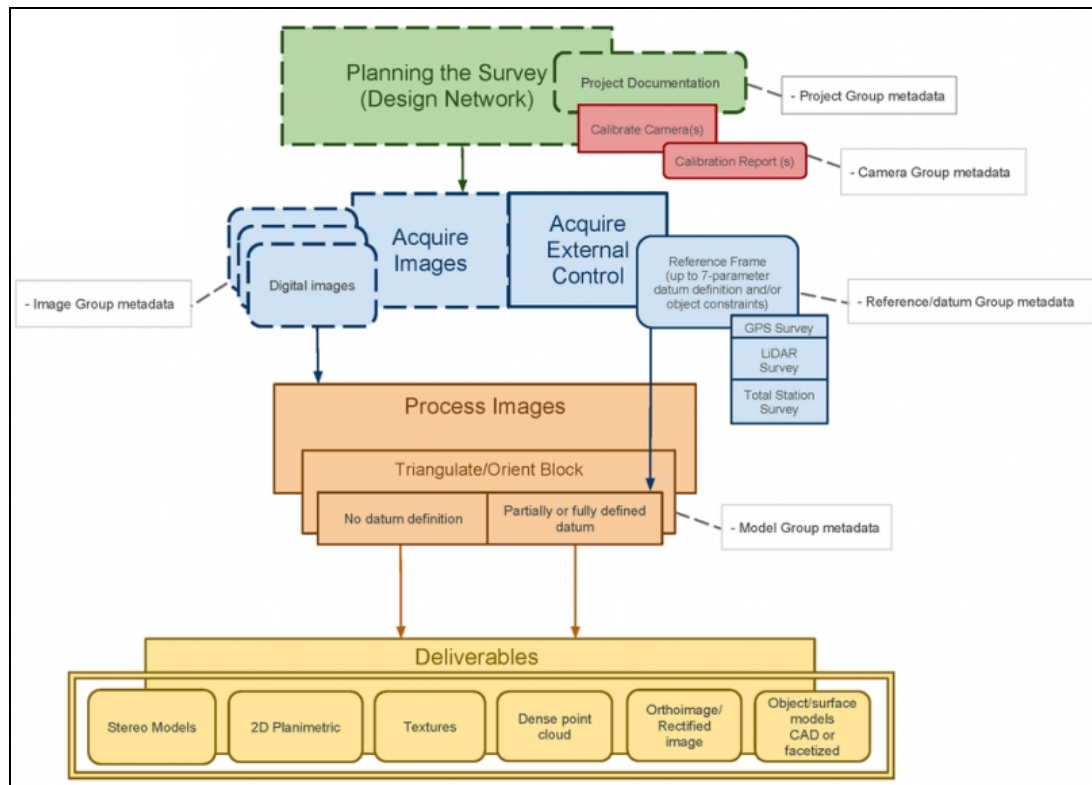


Fig. 1. Close range Photogrammetry workflow [3]

For this project the images were acquired with a Nikon D3100 and the processing software was 123D Catch from Autodesk. This software creates 3D models from series of photographs taken at various angles using Photogrammetry principles. 123D Catch is freeware software that can either be downloaded onto the PC or it can also be used online.

Next we will show how to create a 3D model using the downloaded software.

The start point for creating a 3D model from 2D images is to photograph the studied object from different angles (Fig.2). Our studied object is a classical topographic instrument, Theo 020B.

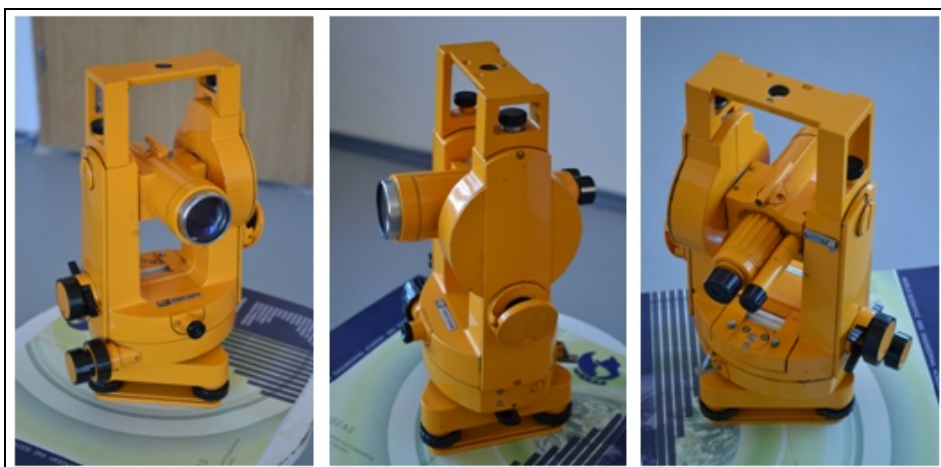


Fig. 2. Photographs of the studied object taken from different angles

We took about forty photographs of the studied object, from different angles and sides. The studied object was placed on a paper support with geometrical forms and text

drawn on it. This kind support makes the camera calibration easier and also it is very useful in obtaining the 3D model by helping the software to align the taken photographs.

The next step is downloading the photographs on the computer and creating our project in 123D Catch. After creating the project the photographs are uploaded into the application to create our capture (Fig. 3). The processing is made online on a memory cloud and when it is ready the result is sent via e-mail.

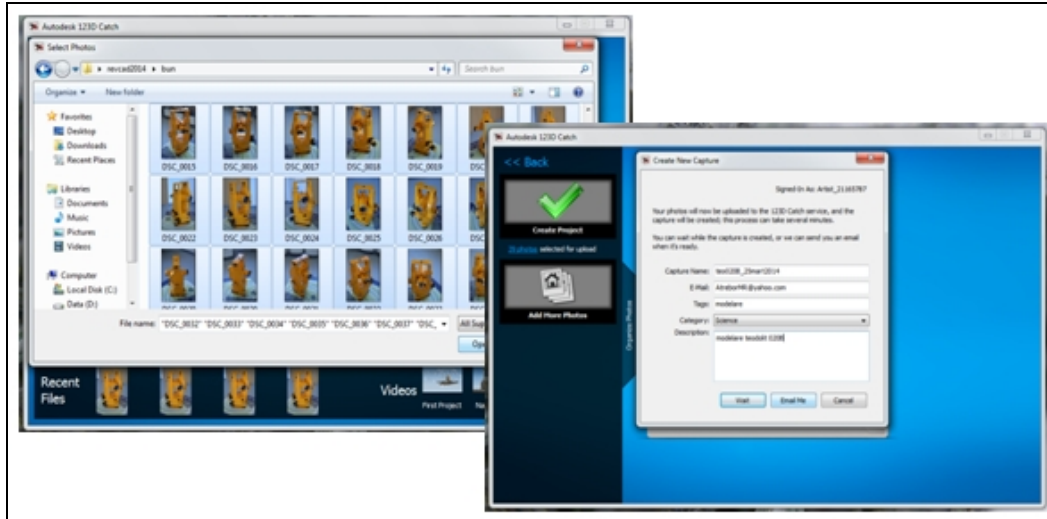


Fig. 3. Photographs loading

Bellow, in figure 4 we can see a raw 3D model of our object and the animation path with the camera position of our photographs.

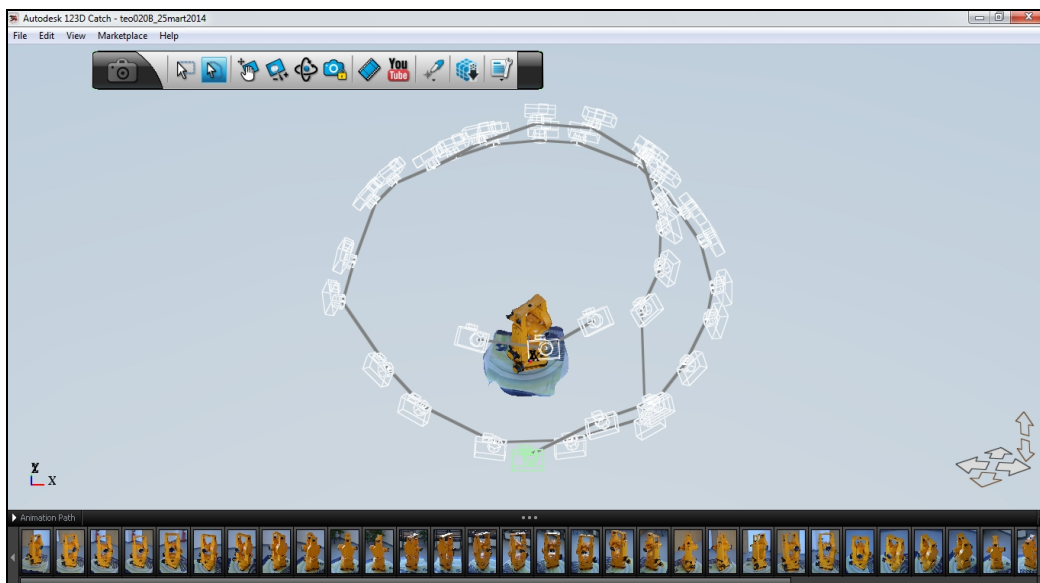


Fig. 4. 3D model

Before starting to clean the 3D model we must choose the mesh resolution and type. We have three mesh resolution options: mobile, standard and high (Fig 5) and three mesh types: wireframe, solid and combined. The mesh resolution is chosen depending on the required precision.

In our case we choose the standard mesh resolution because if we would chose the mobile mesh resolution some of the details would be lost and if we would chosen the high mesh resolution the details would be indeed very well defined, but a larger processing time would be required.

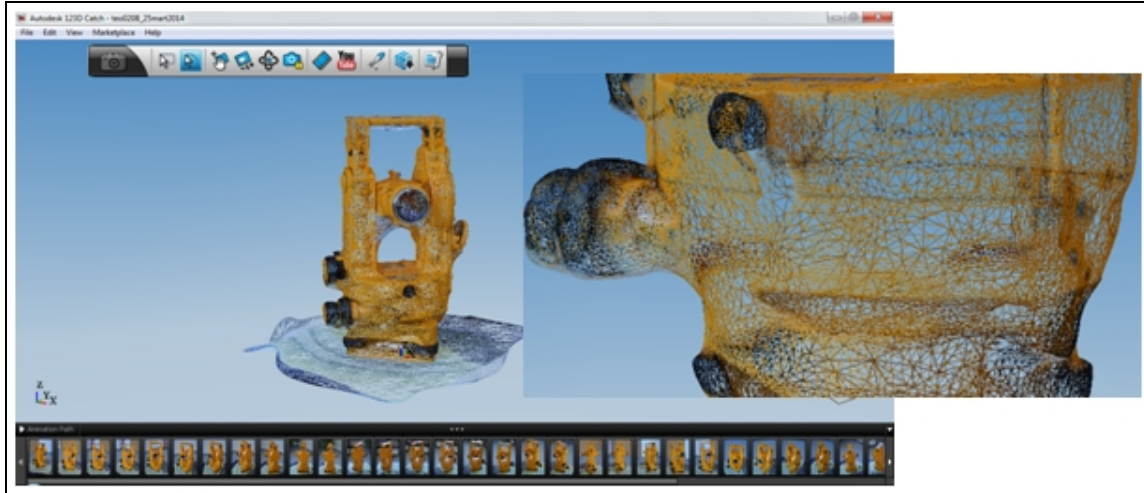


Fig. 5. Standard resolution mesh

The next step is cleaning the 3D object. For a precise cleaning it is better to use the wireframe mesh type (Fig. 6). When the cleaning is made we must be very careful and precise because this step has no undo option.

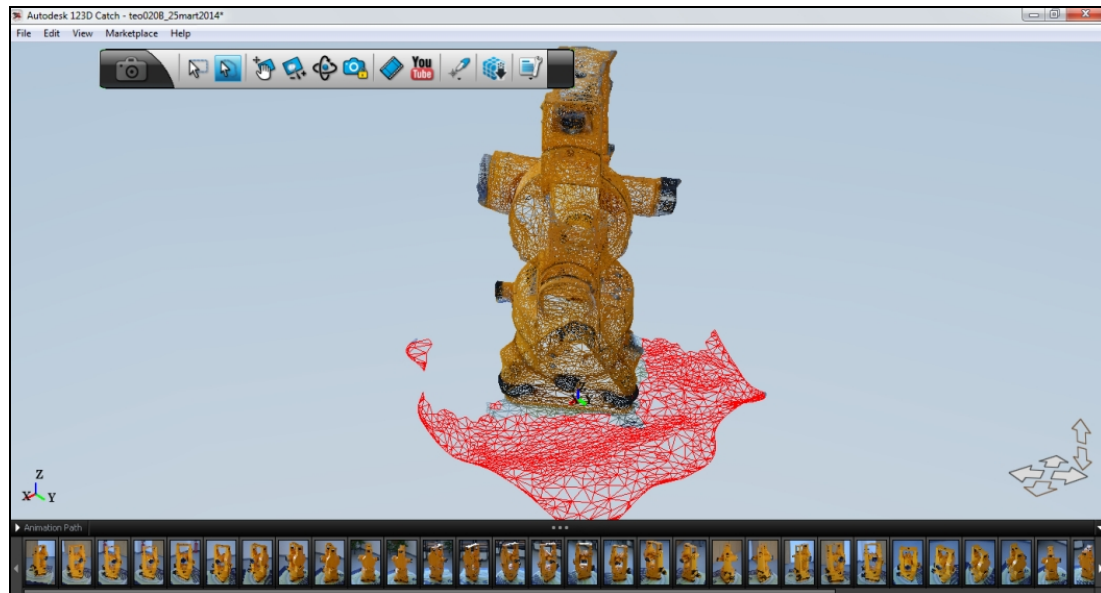


Fig. 6. 3D object cleaning

After cleaning and healing the mesh we obtain the final result presented in the figure bellow:



Fig. 7. The final result

The file with the final result can be exported as a file in dwg, fbx, obj, rzi, las or extensions which allow an accurate further processing in other programs (Fig. 8).

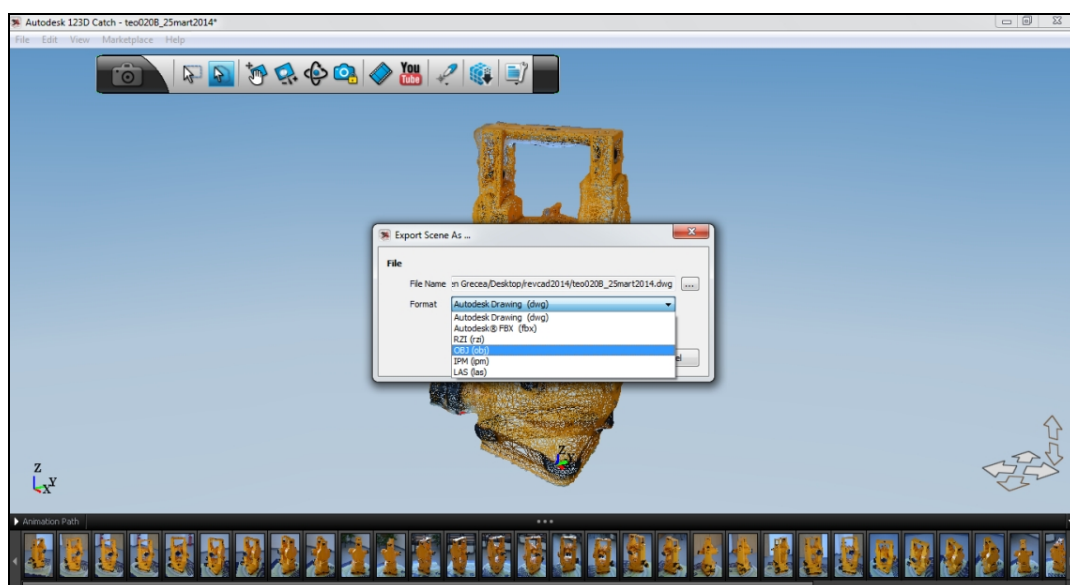


Fig. 8. Exporting different formats

123D Catch has the possibility to make animations with the 3D model. These animations can be made with different mesh types and the can be saved at different resolution, output and time framing (Fig. 9).

The animations and the whole project can either be visualized only by the beneficiary or they can be available for anyone by publishing them online.

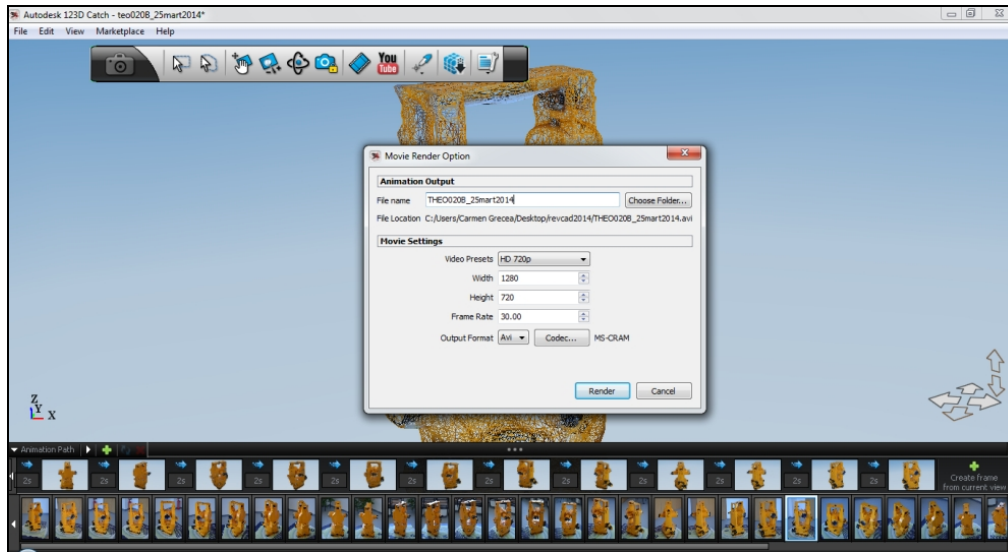


Fig. 6. Animation making

The same results are obtained when the online version is used.

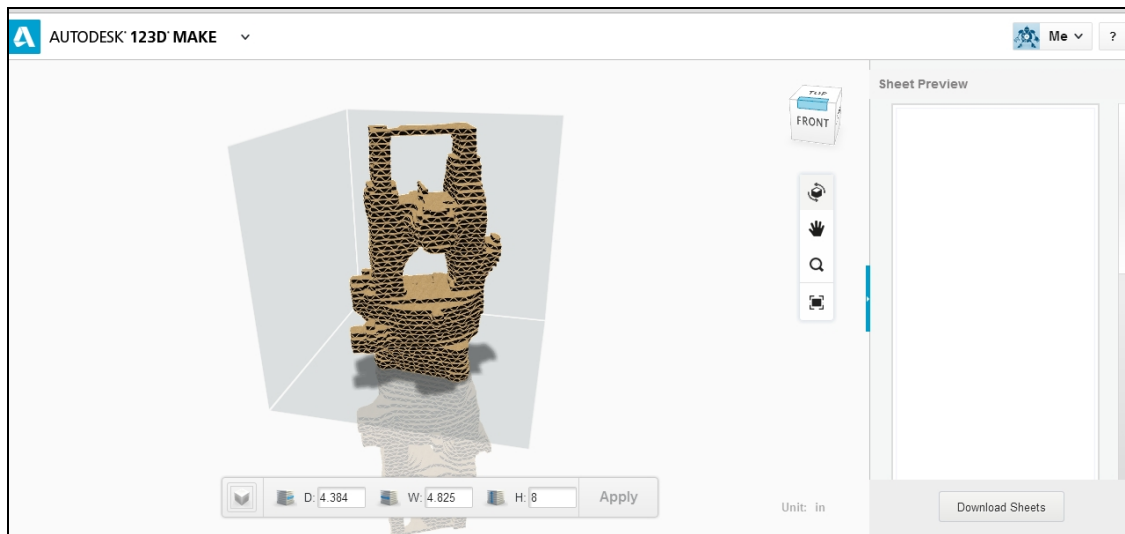


Fig. 10. Online modeling

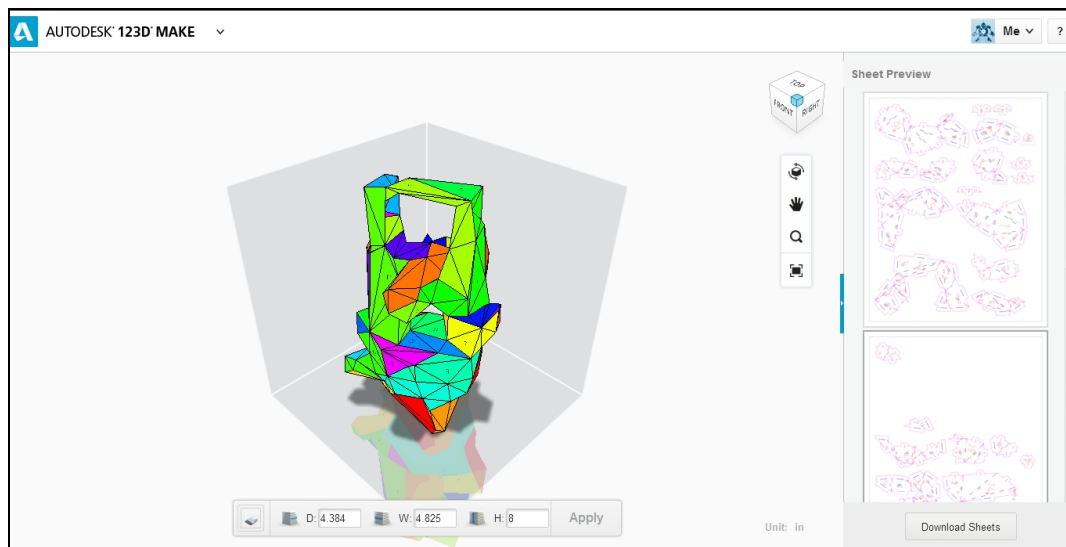
After creating the 3D model there are many possibilities to use it.

A very modern technique is 3D - printing. Although it is a very precise method to create 3D objects, it is still very expensive and not accessible to many people.

In order to obtain cost-effective 3D models, the 123D Catch software offers the possibility to create 3D cardboard or paper-cut models by aligning the slices as 2-D figures on printing sheets and numbering them. In the figures below it is shown how the models will look and the print-outs are displayed.



a)



b)

Fig. 11. 3D object construction technique
a) Stacked cardboard slices, b) Folded paper panels

3. Conclusions

3D modeling technique based on 2D images highlights the Digital Photogrammetry useful character of real life objects 3D visualization and modeling. The obtained 3D models have a precision that can make Close Range Photogrammetry an alternative to classical measuring techniques.

Close Range Photogrammetry as a research method has many advantages, like:

- it has low expenses on one area surface;
- the images can be processed for free online or on the downloaded application;
- image processing is made on a computer cloud;
- using it you can print a 3D model of the studied object at different scales;
- the final result can be exported as a file in dwg, fbx, obj extensions which allow an accurate further processing in other programs;

- the beneficiary can use the studied object animation;
- it is the fastest solution in case of a large data volume, creating the research possibility for vast and/or inaccessible areas.

As disadvantage we can note:

- the atmospheric conditions and the seasons can influence the photo acquisition on the field;
- in general, land measurements are made for a higher precision.

Our practical application highlights 3D model obtaining from 2D images through a specialized program using Photogrammetry, low cost equipment and freeware.

Still, in the end, we conclude that for many current applications from Topo - Geodesic field using this software is a real benefit.

4. References

1. <http://gmv.cast.uark.edu/photogrammetry/>
2. <http://www.ct.upt.ro/users/Clara-BeatriceVilceanu/Fotogrammetrie.pdf>
3. <http://gmv.cast.uark.edu/photogrammetry/four-basic-steps-of-a-close-range-photogrammetry-project-3/>
4. <http://www.123dapp.com/catch>
5. I.S. Herban, Carmen Grecea, Mihaela Sturza, Viorica David, Alina Bala, Floarea Brebu–Măsurători Terestre - Concepte - Volumul II, Editura Politehnica, Timișoara, 2012
6. A. Ahmad - Digital Photogrammetry: an experience of processing aerial photograph of UTM acquired using digital camera, <http://www.academia.edu/494079/>
7. K. Jacobsen - PC-based Digital Photogrammetry, http://www.ipi.uni-hannover.de/uploads/tx_tkpublikationen/jac_PC_DigPhot.pdf
8. Anestis Koutsoudis, Blaž Vidmar, George Ioannakis, Fotis Arnaoutoglou, George Pavlidis, Christodoulos Chamzas - Multi-image 3D reconstruction data evaluation, *Journal of Cultural Heritage*, Volume 15, Issue 1, pp 73-79