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# 3D MODELING OF A BUILDING FACADE

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***Abstract***

*This paper aims to present how 3D modeling technique based on digital images demonstrates usefulness of photogrammetry and accurate 3D visualization of real object that presents regular shapes (buildings, monuments, artifacts). The 3D model of a building facade has been obtained using Agisoft Photoscan software using two photos and the accuracy of this model is less than one pixel. We can also made a 3D analysing on the model. Totally automated workflow provides the ability to process images without advanced knowledge of modeling or processing thousands of aerial or terrestrial images. The importance of this aplication reflects the accesibility of this software that can process photos captured with a resonable camera using in fact a „low-cost" photogrametric technology, the photogrammetry becoming the best alternative of standard measuring techniques.*

***Key words:*** *3D modeling,"low-cost" photogrametric technology, stereomodel*

## INTRODUCTION

Photogrammetry is a measurment tehnologies of obtaining reliable information about physical objects and the environment through the process of recording, measuring and interpreting photographic radiant energy and other phenomena , in order to determine the three-dimensional coordinates of points on an object. This informations are achieved using stereoscopy, which is measurements made in two or more photographic images taken from different positions (different views). In principal, the 3D coordinates define the locations of object points in the 3D space. The image (photography) coordinates define the locations of the object points' images on the film or an electronic imaging device. The exterior orientation of a camera defines its location in space (translation) and its view direction (orientation). The inner orientation defines the geometric parameters of the imaging process. This is primarily the focal length of the lens, but can also include the description of lens distortions. Further additional observations play an important role in extracting this relations for 'solving' the images, such as: scale bars, basically a known distance of two points in space, and known fix points (anchor points), the connection to the basic measuring units is created (Neffra A. Matthews, 2008). In the beginning of photogrammetry and space records, normal photographic cameras (nonmetrics) had a particularly role for land registration (Popescu, 2013).

## MATERIALS AND METHODS

To create the 3D model of the Chemistry building façade I used the digital photogrammetry, a science that consist in using computers to create spatial-relation between photos/photograms and reality. This technique has become an effective alternative to classical facade surveying buildings, but achieving those applications specific to any project stages terrestrial measurements exactly necessary planning, recognition of land for measurement campaign organization, performance measurement and data processing itself to obtain results with technical and scientific value. To obvious the „low-cost" phtogrammetric tehniques used in recreating the 3D model, I used Agisoft Photoscan program. The principle of data

acquisition using photogrammetric method seeks to information about physical objects and the environment from a distance without physical contact them through recording, measuring and interpreting photographic images metric called frames. Before taking the photos we have to plan a shooting sesion (Figure 1.) which consists in a sketch that contains the locations of the object is photographed, so to respect both the transverse and longitudinal coverage (between 60-70 % for longitudinal coverage and 25-30 % for trasverse coverage). In order we have taken two photos in front of the building(VILCEANU B., 2013). For the georeferencing we have measured two distances (putting two levelling staffs on both corners of the building).

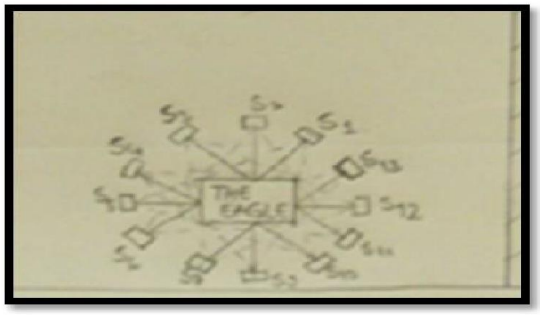

Figure 1. Shooting sesion (Vilceanu, 2013)

## RESULTS AND DISCUSSIONS

The first step is the phase field in which we have take this photos (Figure 2, Figure 3) with a Sony camera that has a focal length of 4.7 mm, 12 pixels. The size of each photos is 2048x1152. The only condition to use this program is that you can use a camera up to 5 pixels. Also if we have a smartphone that respect this condition and it have an internet connection we can make photos with the geographic coordinates (latitude, longitude). Also the photos have both longitudinal coverage.

For the georeferecing and to define the model scale I have measure two distances (in fact we have put two levelling of four meters staffs on both corners of the building and I have applied in the model this model).

Figure 2. First (left) picture

Figure 3. Second (right) picture

The second step consist in digital processing using the Agisoft Photoscan program. To succed in this operation I folow the workflow:

-first of all I have imported the photos using the sugestive comand:"Add photos"

-for better processing I have selected the interest area using the instruments on the toolbar ("Intelligent scissors"—select the interest area's points-"Invert selection"-"Add selection";

-then I have alingned the photos using the comand: "Align photos" (Figure 4.). Practical I have overlapp the photos to create the dens cloud using a the high accuracy setting;

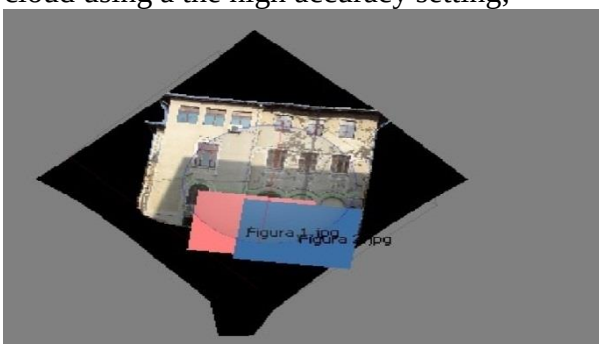

Figure 4. Perspective view (Agisoft program)

- the next step is building the geometry of the dense cloud using the comand: ”Build geometry”. In this moment we have a structure of the model but without a texture;
- the folow step is building texture using the comand: “Build texture”. In this moment we have a model similar with the photos but in a good perspective using the mirror effect. (Figure 5, Figure 6).

To georeference the model I have applied the measured distance on the model.

Figure 5. The building model(sharp texture)

Figure 6. The building model (smooth texture)

## CONCLUSIONS

The traditional photogrammetry is based on stereo or multi-image restitution of a block of overlapping images and collinearity equations allow us to determine the 3D model of the overlapped area. A sequence of overlapping images is acquired with calibrated digital cameras. Geo-referencing and block control is obtained, depending on hardware and processing facilities:

- measuring a set of ground control points by Total station or GPS;
- determining the camera position by a GPS tied to the camera and synchronized with the image acquisition.

Homologous image point coordinates are measured (manually or automatically by image correlation software) in every image. Bundle block adjustment provides image orientation. Object point coordinates are determined by triangulation or multiple intersections. (Curtaz M., 2012).

In conclusion, the low-cost photogrammetric technology have a lot of possibilities to process the images no matter how they are taken (with nonmetric cameras, with metric cameras or with a multi-spectral camera) if we account the conditions.

Agisoft program is capable to generate a quick raport of our work that contains the accuracy (in pixels) of model, the number of photos , how many points have been resulted from the model(the dense cloud).

From the survey data results that I have overlapped two images with an error of 0.46 x pixel size (Figure 7).

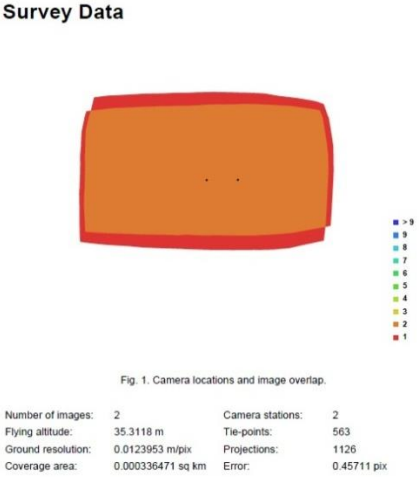


Figure 7. Survey data from Agisoft report

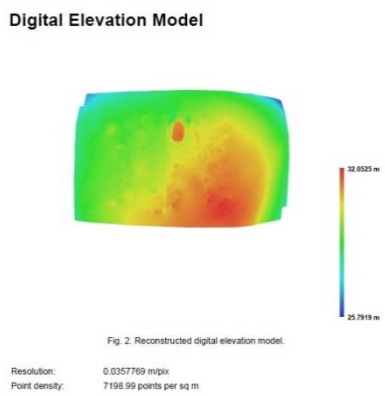


Figure 8. Digital elevation model from Agisoft raport

In this picture we can see how many points have been resulted from the model (in the dense cloud).
Nevertheless we can process images with a goood precision using a low-cost equipment.

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