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TRADITIONAL AND DIGITAL PHOTOGRAMMETRIC SYSTEMS

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Abstract

This appropriation is intended for the students of knowledge photogrammetric-related basic analog and digital: focal length,the inner and outer orientation ofphotogram, coordinate systems used in photogrammetry, useofspecializedprograms for processing.They are used in particular specialty programs, like VeCad, AgiSoft,PhotoScan and Pix4D, to bring out the advantages of using photogrammetric techniques "low-cost" digital as innovative practices in the process of education,with special effects in the fields of architectural and historical heritage. Digital stereoscopic measuring systems follow analytical stereoplotters well known as the more expensive systems. Many plottings are still done on analytical stereoplotters for metric documentation but as the performance and handle of digital systems increase and allow mass restitution. As textures are more and more required for 3D models, digital photographs and systems are getting more and more importance.

Key words*:photogrammetry, technology.*

INTRODUCTION

Photogrammetry- science and technology of obtaining reliable information, on objects from space, on the space around, trough registration processes, measuring, processing measurements made and interpreting photographic images and the results obtained, from a distance, without physical contact with the object, using this information as a support of the full spectrum of electromagnetic radiation and other forms of energy.

Digital photogrammetry is the science of using computers to obtain dimensions of objects photographed.Usually it involves analysis of one or more pictures / frames or existing video with specialized programs for photogrammetry to determine the spatial relationships. Digital photogrammetry from short range finds application in many areas such as medicine, archeology and conservation of historical and cultural heritage because of it’s advantages: measurement method is no direct contact with the object studied, the results are accurate and reliable.

Advantages and disadvantages of choosing photogrammetry as a research method are:

Advantages:Accuracy in showing leveling elements;If we need a voluminous amount of data, photogrammetry is by far the fastestsolution, enabling large areas of research and / or difficult to access;Costs per unit area are small;Satisfy all requests of precision;Terrestrial photogrammetry methods and those of the stereophotogrammetryhave the advantage that secures a fairly good accuracy the deformations constant and temporary;

Disadvantages: Working can be influenced by weather conditions and seasons; It is not appropriate shooting in summer, when vegetation is rich;

The hardware and the software required to work has very high price; Generally terrestrial geodetic measurements are needed to complement deficiencies.

MATERIALS AND METHODS

The principle of calibration is to achieve a set of 9 photos around the "chessboard", 4 pictures holding the camera right, other 4 with camera rotated 90 degrees and a photo above calibration sheet for the calculation of the parameters of indoor orientation. The case

described is the optimum and minimum number of photos for proper calibration is 6.

Figure 1.To the left „chessboard" used for calibration and to the right in the program interface CALIB

CALIB is a program that is used for calibrating digital cameras (Figure1).

VeCAD is a data processing 2D vector that can be used for practical applications such as CAD / GIS.VeCAD allows import / export file type DXF, HPGL, CNC and supports direct insertion Bitmap.Program options include good tools snap, control over the created layers, line types, colors, thicknesses, view-ports and types of text.

The camera is an optical device which can be obtained using real images of objects and was used in traditional photogrammetry. Appliances classic, setting the images was done on plates or films coated with photographic emulsion.

Parrot AR.Drone is a remote controlled flying quadcopter helicopter built by the French company Parrot. The drone is designed to be controlled by mobile or tablet operating systems such as the supported iOS or Androidwithin their respective apps or the unofficial software available for Windows Phone, Samsung BADA and Symbian devices (Figure2).

In digital photogrammetry, most of the measurements can be done automatically by correlation. The task is then to find the position of a geometric figure (called reference matrix) in a digital image. If the approximate position of the measured point is known in the image, then we can define a so-called search matrix. Correlation computations are used to determine the required position in the digital image. By correlation in the subpixel range the accuracy of positioning is roughly one order of magnitude better than the pixel size. Usually, the correlation process is very efficient on architectural objects, due to textured objects.

Correlation functions can be implemented in the different steps of the orientation : fiducial marks or reseau crosses can be measured automatically in the inner orientation; measurement of homologous points can be automated by the use of the correlation process both in the exterior orientation, and in the digital surface model and stereoplotting modules.

The correlation function is a real progress compared to manual measurements applied in analytical photogrammetry. The quality of the measurement is usually given by a correlation factor.

Figure 2. Unmanned aerial vehicle Parrot AR

RESULTS AND DISCUSSIONS

For realization the orthophotomosaic,shooting the front of the building, only 2 or 3 images will be needed in final, depending on the camera used so pictures to have a satisfactory longitudinal coverage and checkpoints to be visible in all photos (Figure 3).

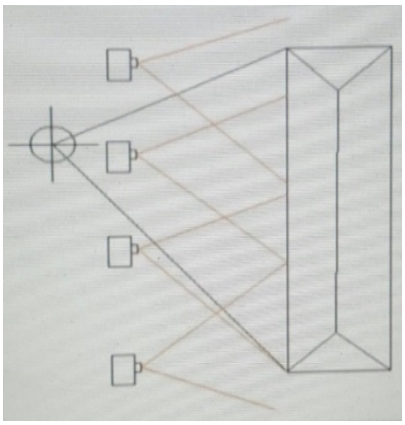

Figure 3. Operator position for shooting

These photographs shall be adjusted using the program CALIB, respecting the processdescribed and import VeCAD (Figures 4 and 5).

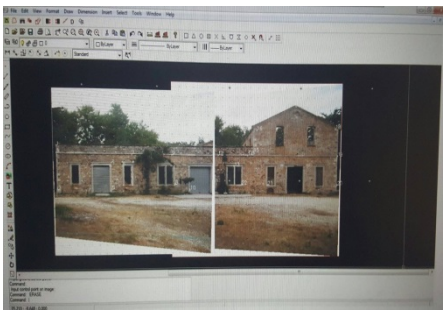

Figure 4. Creating theorthophotomosaic using 2 photos

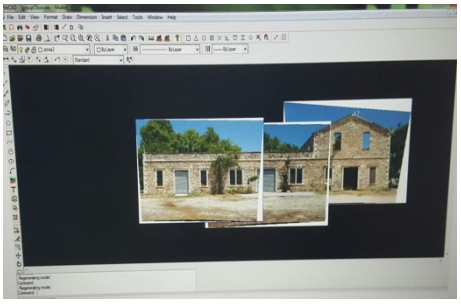

Figure 5.Creating the orthophotomosaic using 3 photos

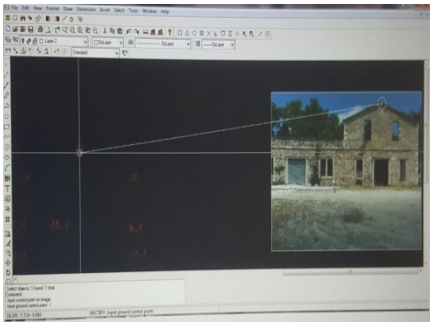

Figure 6. Linking checkpoints

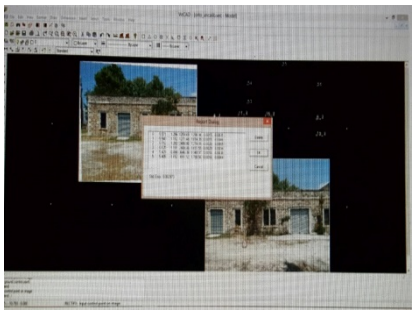

Figure 7. Dialog box with standard deviation error

The first step consists in making topographic measurements with the total station to determine the coordinates X, Y, Z control points.These checkpoints can be chosen from the material elements existing on the building area.Coordinates measured, after being discharged from the total station will be saved in a text file form X Y Z ID is then inserted in the program VeCAD.

The next step is inserting at a time, imaging to VeCAD. After finishing the marking checkpoints, they must be linked with those entered previously known coordinates to achieve georeferencing photos (Figure 5).

Finally, after selecting all control points press the right mouse button and a dialog box appears containing the error standard deviation calculated georeferencing program (Figure 6).

From the dialog box you can delete one or more points not corresponding to the desired accuracy. In the last two columns of errors georeferencing box displaying the planimetric coordinates (X, Y) Control Point. Corrected image processing can be done in AutoCad to highlights of important details such as doors, windows, bricks, building form.

Commercial CAD/CAM/CAE software packages often include image handling tools and allow also simple image transformation and rectification. But they seldom consider camera distortions, as opposed to photogrammetric software (Grussenmeyer et al., 2002).

In the case of a perspective rectification, radial image displacements in the computed image will occur for points outside the reference. The rectification obviously fails if the object isn't somewhat plane.

Some packages include functions for the photogrammetric determination of planes according to the multi-image process from two or three photographs that capture an object range from different viewpoints. Digital image maps can be produced by assuming the object surface and photo rectification. In the resulting orthophoto, the object model is represented by a digital terrain model. Image data of different planes can be combined into digital 3D-computer models for visualisation and animation with the help of photo editing or CAD software. ELSP from PMS (http://www.pms.co.at) and Photoplan (http://www.photoplan.net) are other examples of commercial systems particularly dedicated to rectification (Waldhaeusl et al., 1999).

CONCLUSIONS

Photogrammetry has been applied in numerous industrial fields and the potentially for further expansion and growth is seemingly limitless. Industrial photogrammetry has been described

as application of photogrammetry in building construction, civil engineering, mining, vehicle and machine construction, metallurgy, ship building and traffic, with their fundamentals and border subjects, including the phases of research, planning, production engineering, manufacture testing, monitoring, repair and reconstruction. Objects measured by photogrammetric techniques may be solid, liquid or gaseous bodies or physical phenomena, whether stationary or moving, that allow of being photographed (Popescu, 2016).
The main difference between a traditional photographic camera (Figure 8) and a digital camera (Figure 9) is in the different way of registering an image.

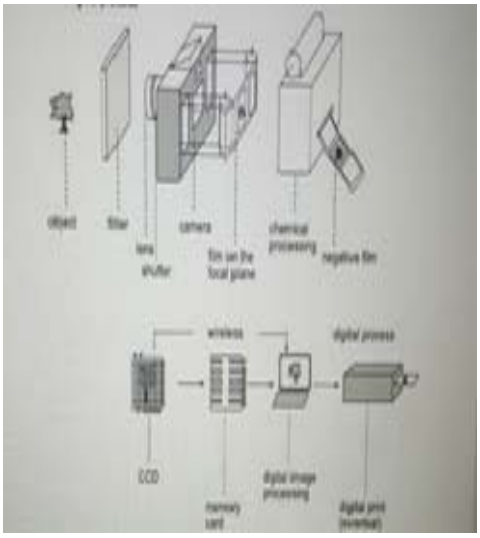

Figure 8. Traditional photographic camera

Photographic acquisition in the traditional process consists of: film, in analogical cameras; choice of photographic equipment: camera, lenses, film sensitivity; by means of the dispositive Charge-Coupled Device (CCD), conceptually like the sensors used for satellite acquisitions and in digital cameras; photochemical development and possible print; film scanning if the analogical acquisition is to be turned into digital; image digital processing.


Figure 9. Digital camera

The photographic process develops in subsequent operative and process steps,while with digital acquisition image availability and monitoring possibility are realtime with immediate feedback on the acquisition's quality. Except for the shot, or acquisition, processing and print operations take a longtime, are expensive and complex. Whereas, in the case of digital images, the operatorhas total and immediate control of the operative phases.

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