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HIGH-RESOLUTION TECHNOLOGIES AND IMAGES FOR TOPO-CADASTRAL ACTIVITIES

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Abstract: The present paper aims to present modern topographic measurement technologies and evolution towards a new method, that of measurements made with the help of Unmanned Aerial Vehicle (UAV). The photogrammetric measurements were carried out with the help of Dorna DJI Phantom 4 Pro, which made it possible to know a new way of working, much faster and more efficient, compared to traditional topographic measurements. The research presented in this paper was conducted in the western part of Romania, on the administrative territory of Timis County, on the campus of the "King Michael I" University of Life Sciences in Timisoara. The use of Dorna in the field of geodesy is currently in great demand due to its relatively easy operation and relatively affordable cost compared to satellite systems, especially high-resolution images. Over the past decade, the use of unmanned aerial vehicles as remote sensing platforms has become increasingly popular for a wide range of scientific disciplines and applications. Currently, many photogrammetric mapping methods use this technology to retrieve and record data on objects on earth. This is due to the fact that the use of a Dorne equipped with GNSS technology (Global Navigation Satellite System) for aerial measurements is very efficient and cheap and allows overflying hard-to-reach areas, significantly reducing the execution time of the work.

Key words: UAV, DJI Phantom 4 Pro, GNSS, AgiSoft, Pix4D

• Introduction

The technology of 3D scanning originated in the 60s of the last century, more precisely since 1968, based on the research between 1968 and 1978 of Dr. J. Riegl, at Vienna University of Technology, Austria. The first functional laser was developed in May 1960 by Theodore Maiman in the laboratories of Hughes Research Laboratories [Edl et al. 2018]. Lasers are commonly found in contemporary devices, especially optical storage devices such as compact disc drives or DVD players, in which the laser scans the surface of the disc to collect information. Other common applications of lasers are barcode readers and laser pointers. In industry, lasers are used to cut steel and other metals and to etch various patterns, such as letters on a computer keyboard. 3D laser scanning has applicability in the industrial field, civil engineering, mining, design, entertainment, event investigation-reconstruction, architecture, cultural heritage, real estate [Mita et al. 2020].

• Material and method

Smarter, more flexible, faster, stronger? These are the promises that the new DJI Phantom 4 Pro drone offers. The body of the drone is made of revolutionary materials and has an aerodynamic design that adds more precision to your controls, increases agility and respects coordinates even in strong wind conditions [Peppia et al. 2019].

The Phantom 4 is flexible enough to meet different flight requirements. Thus, sport mode adds extra agility and speed to the drone. The top speed increases by 25%, while all positioning systems are preserved for safer, better controlled flight.

High-efficiency engines and high-capacity battery specially designed for the DJI Phantom 4 (figure 1) give the drone a flight time of 28 minutes [Silva et al. 2018]. The DJI Phantom 4 is one of the few drones equipped with an obstacle detection sensor (TapFly and ActiveTrack function).



FIG. 1 DJI Phantom 4



A comparison between the two image processing solutions shows that an integrated application such as Agisoft Photoscan offers, first of all, convenience in use. The ability to handle large projects and the speed of data processing are very good, but the quality of the hardware platform is essential. The application makes heavy use not only of process and memory, but also of the graphics process/processors. For this reason, it is recommended to use the most powerful graphics stations available. To reduce costs, the use of platforms designed for gaming can be considered. Flexibility and parameterization possibilities can be considered good, covering most of the basic needs and numerous other exotic options. For example, the generated areas can be optimized by reducing ("decimation") and finally equalizing the number of nodes and faces. Even more, it is possible to export surfaces to be further finished and retouched in other computer graphics applications, with Agisoft Photoscan accepting the reimport of corrected surfaces and using them as a basis for texturing (and generating orthophotography).



Figure 12. Representation of the 3D model

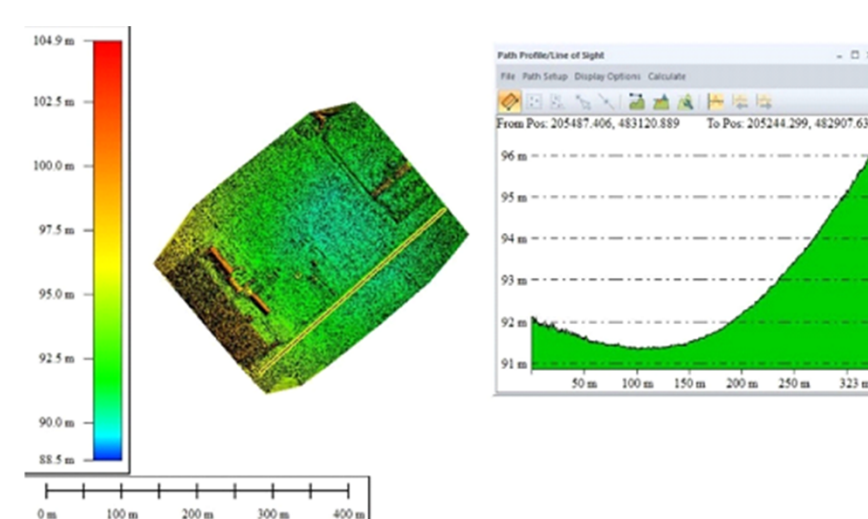


Figure 13. Longitudinal profile on DEM

• Results and discussions

1. Fieldwork

Following the exact determination of the objective to be measured, in the first stage a reconnaissance of the terrain was made and ground control points were established. These points were materialized in the field through targets with a size of 1m/1m (figure 3).



Figure 3. Targets with DJI drone



Figure 4. Leica Viva GS08 Plus



Figure 5. DJI Phantom 4 Pro

2. Preparation of the flight plan

The drone used was DJI Phantom 4 Pro (figure 5), whose composition includes the camera (with a 4K shooting capacity and images of 12 megapixels), the GNSS, GPS and GLONASS positioning system (which allows image acquisition in the WGS 1984 system), propellers, intelligent battery, obstacle detection system.

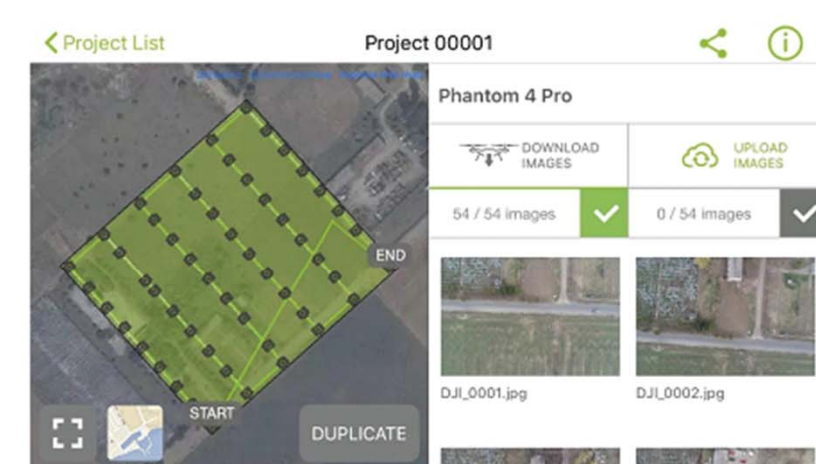


Figure 6. Making your flight plan with Pix4Dcapto

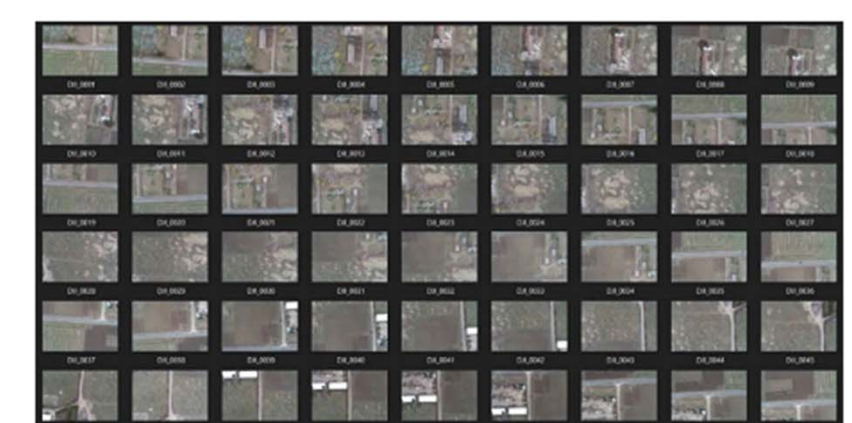


Figure 7. Pictures taken during the flight

3. Office work

The first office stage is the download of raw GPS data, namely the ASCII file with the coordinates of the three control points that we will use for georeferencing the ortho photo plane from the WGS '84 projection system to the '70 stereographic system.

In the second stage, data was processed with Agisoft PhotoScan Professional software (figure 8). This data processing is carried out by determining the flight path of the drone. Stereoscopic vision allows us to see an object from two different perspectives, such as aerial photography taken from different camera positions. That is why the result of mapping data by using this drone can produce images with a very high resolution, it also produces a three-dimensional image of the recorded surface

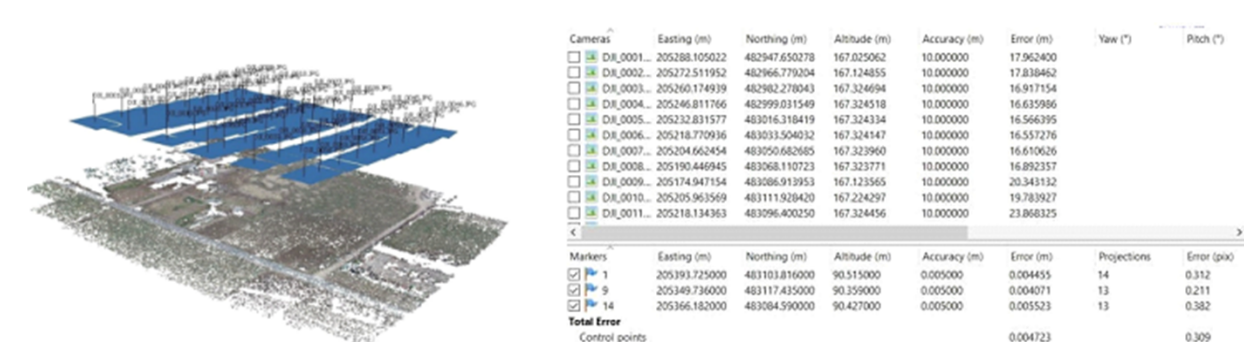


Figure 9. Align images

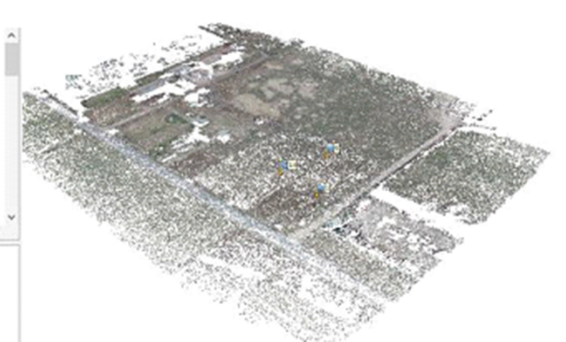


Figure 10. Entering CGP coordinates



Figure 15. Image from Google Earth and orthophoto overlay over Google Earth

• Conclusions

In conclusion, we can say that the use of drones is increasingly practiced both in foreign countries and in our country because it offers the user the possibility to enter inaccessible, difficult or dangerous areas for human operators. The project of photographing the entire campus with the help of modern technology (drone) resulted in situation plans that are used by students in the photogrammetry, GIS and remote sensing laboratory, also these plans, which resulted in the Stereographic 70 system, can be used to prepare topo cadastral documentation for notations in the land book of the land and buildings related to the campus. The accuracy of determining plans relative to classical topographic methods is on the order of centimetres.

Also, with the help of plans resulting from drone measurements, the number of levels of construction, the type of roof (terrace or roof structure), as well as the colour and texture of the facades can be established. For land intended for parks, the type of tree, soil vegetation and the application of a GIS for each type of soil can be established.