USE OF DRONE DJI PHANTOM 4 IN ENVIRONMENTAL PROTECTION

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***Abstract**: Considering the evolution of technology and the need to obtain the most accurate information, the present paperwork presents technologies and applications that can be used simultaneously both in topography and in environmental protection, the equipment used and the necessary steps in performing an aerial survey with the aim of protecting the environment we live in. For the precise spatial localization of the study area, the positioning in the national reference system is also important. The DJI Phantom 4 drone with fully integrated RTK module provides real-time centimeter position information. Photogrammetry represents the exact aerial image of the land surface with utility in topography, monitoring of protected areas, agriculture, architecture, forestry, environmental protection, etc. The use of photogrammetry is important in observing the land, for the optimal positioning of a photovoltaic park having implications in environmental protection and obtaining the advantages at the highest level, the working time being short, high precision and easily recording the areas that are more difficult to access.*

***Keywords:** aerial photogrammetry; orthophoto; environmental protection; GNSS technology; reference system*

1. Introduction

Photogrammetry, being a science in the field of terrestrial measurements, is used in the maps and topographical plans drawing up. With the help of photogrammetry, information about the environment is obtained by recording it from the distance.

By the use of photogrammetry, the following are ensured: orthophoto images in the local system but also in the national reference system, determining the spatial position of points defining objects, creating 3D models, accurately rendering leveling elements, etc. Triangulation is based on the forming triangles between points on the image captured by the drone, determining their exact coordinates in three-dimensional space, being accurate and constantly used in topography and cartography. [1], [2]

One of the main concerns of terrestrial measurements is the determination of the points position in a single reference system. Currently, three-dimensional positioning and the determination of coordinates in a global reference system is increasingly used, passing through the process of transforming coordinates into a national reference system (the Stereographic 1970 projection system and the Black Sea 1975 altitude system). Geodetic coordinates (B, L, H) are converted to Cartesian geodetic coordinates (x, y, z). When carrying out photogrammetric work using DJI Phantom 4 drones with fully integrated RTK mode,

centimetric position information can be obtained in real time, in this case it is not necessarily necessary to use geodetic control points of known coordinates. [3]

Determinations in the reference system and precise positioning by GNSS when carrying out an aerial photogrammetry work is important for the field spatial localization of the interested study area. The period when the aerial works are expected to be carried out must have a very good geometry dilution of precision. Considering the equipment used, the measurement is real-time through radio waves. [3], [4]

Each GNSS system (Global Navigation Satellite System) comprises three segments: the space segment with satellites, the control segment with monitoring and control stations and finally the user segment – Fig. 1. [4]

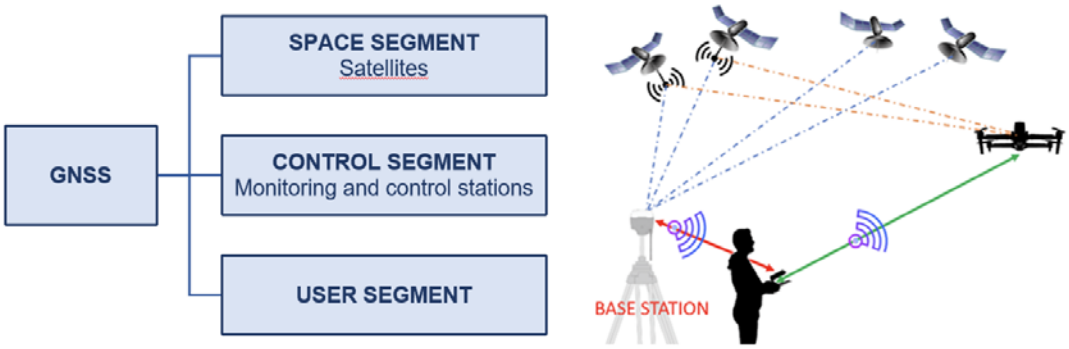

Fig. 1. RTK positioning mode of the drone [5]

Among the applications of aerial photogrammetry using drones, one can mention [2]:

- mapping – creating accurate maps of land, urban areas and obtaining accurate topographical information;
- constructions – for creating detailed 3D models of existing land and buildings;
- mining – creating detailed 3D models of mines and quarries, for planning mineral extraction and obtaining detailed information about the mining terrain;
- agriculture – obtaining information about existing crops and monitoring their condition, planning land management and improving agricultural production;
- environmental protection – identification of polluted or risk areas.

2. Materials and Methods

Conducting any photogrammetric project begins with establishing the stages that will have to be completed.

Depending on the objective nature and the project purpose, the tools to be used, the working methods and information processing are chosen. In order to carry out an aerial photography project used in research for environmental protection, in the present case the DJI Phantom 4 RTK drone was used, UAV (Unmanned Aerial Vehicle) equipment that allows obtaining information with high accuracy of the area of interest. Aerial imagery and collected data are processed and photogrammetric products, such as orthophoto and 3D terrain models, are obtained. [4]

The DJI Phantom 4 RTK drone (Fig. 2) includes a fully integrated RTK module that provides real-time centimeter spatial position information to achieve very high accuracy of image meta-information. [5], [6]

Fig. 2. DJI Phantom 4 RTK drone

In the first phase of designing the aerial photogrammetry session, the area of interest that will be flown over is determined from the office. In the field, as a rule, an area with high elevation is chosen, where it is stationed and from there the flight begins. From the controller, based on the images from Google Maps, the flight height is set to 110-120m altitude. In addition to taking images, the drone performs kinematic RTK measurements, being connected to the network of permanent SysCAD RTK stations, thus benefiting from RTK corrections. The flight parameters must comply with the legal norms in force. The weather conditions are checked beforehand, and it is verified if there are any other flights in the area. During the flight, the drone must remain in the VLOS area - visual line of site - to be able to be followed during the flight with the naked eye. In order to use the UAV equipment, it is necessary to have a flight permit. With this device, the collection of images is done very quickly, with a very good precision. The RTK system is used in conjunction with GNSS. RTK provides improved spatial positioning accuracy, making corrections in real-time, with fewer required ground control points. [6], [7]

After the flight, the images are uploaded into the Pix4D Mapper software for processing (Fig. 3), which assembles each image, resulting in the overall mosaic image.

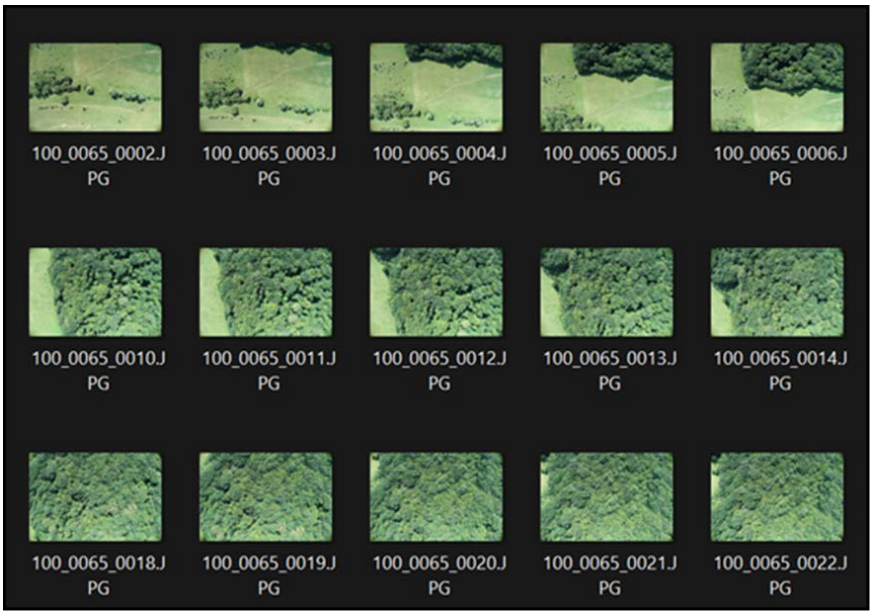

Fig. 3. Uploading images into Pix4D Mapper

Based on the images uploaded into the software, the 3D point cloud (Fig. 4) is generated for further classification, vectorization, assessment, analysis and measurements on the photogrammetric product, such as orthomosaic, DSM, 3D mesh or point cloud. The image

processing software is based on automatically finding the common points between the uploaded images with large overlap area. Paired key-points are called tie-points that are found on two different images in the image overlap area, and each set of tie-points generates a 3D point. 3D points can be determined more precisely when there are more tie-points. [7]

Vertical and horizontal accuracy is centimetric, with fewer ground control points required, providing improved image metadata accuracy. Ground control points are still needed to calibrate the final image. [7]

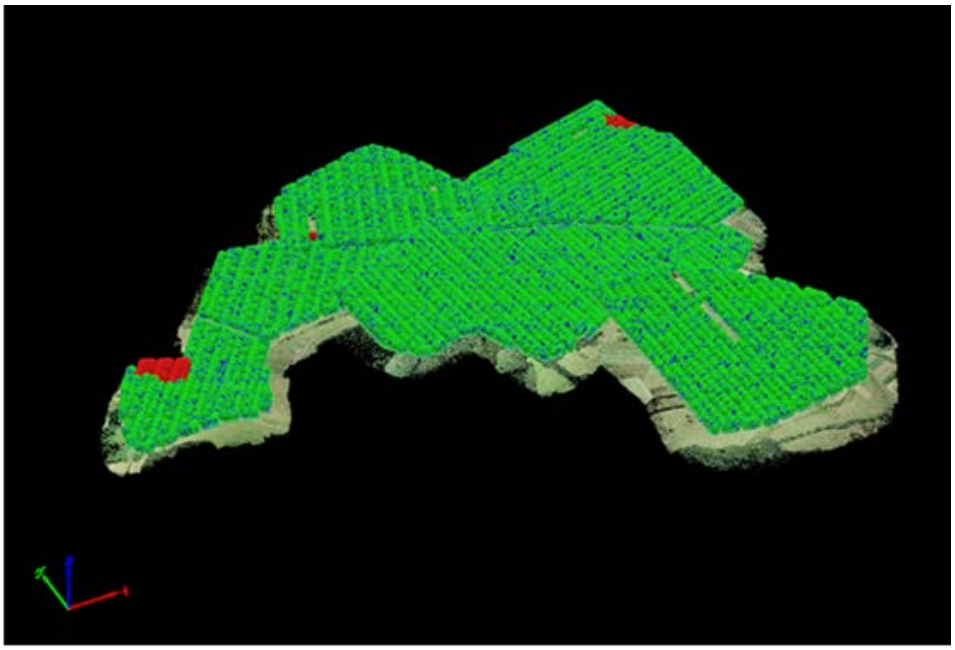

Fig. 4. The 3D point cloud of the studied area

3. Results and Discussion

The orthophoto (Fig. 5) is a composite aerial image, which in digital format is suitable for interpretation and vectorization and is also a real-time representation of a terrain surface that provides accurate aerial terrain information. The photogrammetric final products can be converted into different formats (Fig. 6) and have a wide range of usefulness in various fields, it can also be used to monitor a certain area in a certain period of time, suiting itself very well in the case of environmental protection. [6], [7]

The modern technology developed lately has an impact on both man and the environment, presenting both advantages regarding the ease of work in various branches of activity, travel, as well as disadvantages mainly on the environment and human health. Among the disadvantages there can be listed: stress, sedentary lifestyle and pollution. [5], [6]

By generating photogrammetric products such as orthophoto or 3D terrain model over the studied area, the optimal parameters (the orientation towards the cardinal points, land topography etc.) can be established in the creation of a photovoltaic park that presents benefits by increasing the production capacity of renewable electricity, improving air quality and implicitly improving the quality of life. [5], [6]

Fig. 5. The orthophoto of the studied area

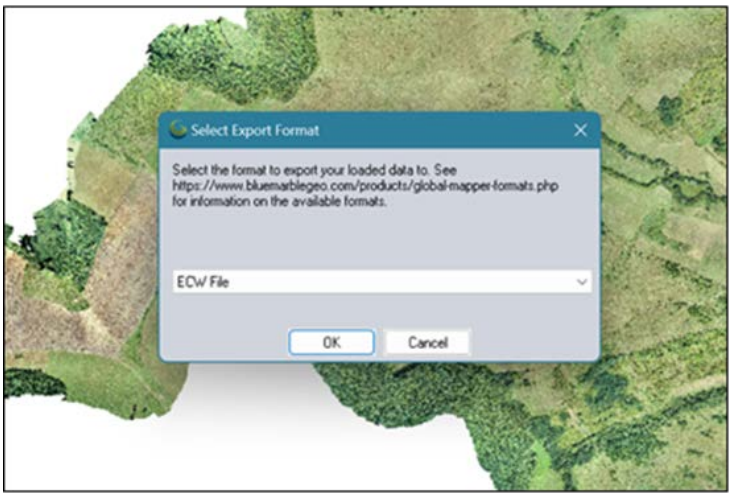

Fig. 6. Convertion into the proper format for applications

Photovoltaic parks present a major advantage in protecting the environment and combating climate change by the simple fact that they reduce greenhouse gas emissions in nature, for the generation of electricity using renewable sources, thus replacing fossil fuels, with a minimal impact on the environment.

4. Conclusions

Photogrammetry can be successfully used in terrestrial measurements, but it is also used in fields such as: agriculture, architecture - constructions, geology, meteorology, archaeology, land improvements but also in the field of environmental protection. [5], [2]

The drone is an important tool in environmental monitoring, as it is non-polluting, and it can be used for [5], [2]:

- territory monitoring: identification of illegal waste deposits, identification of desertification episodes, study of land use, identification of illegal constructions;
- soil and water monitoring;
- maintaining biodiversity, monitoring natural reserves;
- preventing and extinguishing fires;
- combating deforestation - forest monitoring.

Benefits of using DJI Phantom 4 RTK drone for the proposed case study:

- accurate survey lines (using RTK accuracy);
- fast data collection on any type of terrain;
- carrying out surveys on slopes and precarious terrain features;
- rapid evaluation of a larger area, from an economic point of view.

The necessary time to carry out an aerial photogrammetric project on a certain area of interest is relatively short, and the utility is of the utmost importance, representing a relief in the work carried out later.

For the optimal location of a photovoltaic park, it must be built on a sunny land (shaded areas should be avoided, so that the intensity of solar energy should not be reduced), oriented to the south, receiving the sunlight in an appropriate way, the land topography should be slightly inclined or even flat.

Considering the impact of technology development on the environment, each of us has an important role and through our actions we can turn a disadvantage into an advantage, an opportunity to do good to nature and the environment.

5. References

1. *Quirós Rosado, E. Introduction to Applied Photogrammetry and Cartography for Civil Engineering, Universidad de Extremadura, ISBN: 978-84-09-00910-7, 2018;*
2. *Dreghici, A., Fotogrammetrie, Course notes, "1 Decembrie 1918" University of Alba Iulia, Romania, 2023;*
3. *https://rompos.ro/index.php/informatii-tehnice/sisteme-gnss - accessed 29.09.2024*
4. *https://cartografie.ro/index.php/ro/domenii/sf - accessed 26.09.2024*
5. *https://dronelife.com/2022/03/20/rtk-and-drone-mapping-do-you-need-it-is-it-worth-it/ - accessed 20.09.2024*
6. *Taddia, Y., Stecchi, F., Pellegrinelli, A., Using DJI Phantom 4 RTK Drone for Topographic Mapping of Coastal Areas, The International Archives of the Photogrammetry, Remote Sensing and Spatial Information Sciences, Volume XLII-2/W13, 2019 ISPRS Geospatial Week 2019, Enschede, The Netherlands, https://doi.org/10.5194/isprs-archives-XLII-2-W13-625-2019, 2019, pp. 625-630*
7. *https://support.pix4d.com/hc/pix4dmapper - accessed 27.09.2024*