



## A survey from UAV in critical areas: the advantages of technology in areas with complex terrain



by Zaira Baglione

**The tale of two experiences in the geological and cultural heritage area through the use of fixed-wing drones. Innovation and high quality of the data returned from an aero-photogrammetric survey as support to the activities of the different professionals. From the survey phase to the post-production all the precautions to obtain images with a very good resolution and solve obstacles for the mapping of areas not easily accessible such as quarries.**

The aerial photography have had a great revolution with the advent of the UAV technology that actually has allowed to overcome the objective problems of the access to the information. Especially for the territories with a complex topography, the use of drones is an advantage in terms of speed, cost reduction and achievement of high quality results. The applications of the proximity remote sensing in critical areas are a lot and involve many areas: from geology to engineering, from surveillance to environmental monitoring, civil protection, archeology and more. In particular it is recommended, for several reasons, the use of fixed-wing models for the survey of medium-high extension surfaces. Meanwhile, this type of APR provides a greater flying range than the multi-

copter models (which generally have shorter range, considering also the take-off and landing operations), in fact with a single flight it is possible to cover areas of several kilometers and obtain uniform images, then with a very appreciable qualitative output; in addition the control of the flight parameters is efficient and it is possible to resist to the adverse environmental conditions, supporting wind gusts of up to 60 km/h. The fixed-wing aircraft, in general, are perfect for the applications in geology and archaeological surveys. Two interesting experiences, related respectively to the geological and cultural heritage area, are described below by Gabriele Santiccioli, FlyTop president and member of the Provincial Board of Surveyors and Surveyors Graduates of Rome. Certainly a very growing sector is the quarries monitoring

through precise mapping activities to accurately control the excavations, to know exactly the amount of material removed and prevent any movement of materials and the risk of landslides. A proof of the quality of the remote control systems for this type of professional application is given by Gabriele Santiccioli, president of FlyTop, through a project carried out in a mining quarry in the north of Italy. "We enthusiastically accepted the engagement by the responsible Authority for the exploitation of a quarry in Emilia Romagna - says the president Santiccioli - because it meant for us to win a challenge. This experimentation took place in an extremely mountainous area, undoubtedly challenging under the aeronautical profile. We used a fixed-wing aircraft, FlyGeo24Mpx, a unique drone in its category



equipped with technology to fly at a fixed altitude. Generally this type of critical reconnaissance is carried out with a multirotor drone, but the fixed wing flexibility allowed us to successfully conclude the mission. The conditions were not easy, considering the extension of the area to be analysed, about 95 hectares, and the difference in height of 360 meters between the top and the valley of the quarry. However, with a single flight, we have acquired in 25 minutes nearly five hundred pictures with a resolution of 2.5 cm per pixel ". With regard to the mining activity in the quarries it must be said that both private interests, relating to companies that hold the regional authorizations, both public are involved at the same time, considering that some of them represent a heritage that should

be used in an intelligent manner and preserve the environment. The UAV is a good instrument from many points of view: it allows to rationalize the excavation areas on the basis



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of what is known from the restitution of photos and the subsequent study and post-processing; they provide information relating to the amount of material removed and, finally, they are the only possible solution to reach critical areas that may only be known with the conventional aerial photogrammetry systems and with inevitable higher costs. "In order to plan the operation we referred to a regional technical map (CTR) - continues Santiccioli - and we decided to set a fixed altitude of 130 meters. Through some control points on the ground we made 12 strips with an overlap of 70 percent between each photo, acquiring one frame every 25 meters. We got a 3D model of the quarry, a cloud of points, the DTM and DSM from the restitution and we processed all the photogrammetric data with a special software characterized by a very high level of metric accuracy. We can say that this result satisfied the client and FlyTop, that realized the work." The application of the UAV technology has grown significantly also for the cultural heritage sector, not only for monitoring and documentation, but especially for the discovery activities. With the partnership started between the University of Salento and FlyTop an archaeological survey was carried out in the Veio Park area, a few kilometers from Rome, in an area between the towns of Formello and Isola Farnese. Gabriele Santiccioli together with Professor of ancient topography Giuseppe Ceraudo describes the survey done with the fixed wing UAV FlyGeo24Mpx that led to the identification of ancient Etruscan and Roman settlements, in particular the remains of structures of build-

ings and streets. The discovery comes from a research project that the University of Salento leads for over ten years and had a decisive result last year following the mission that led to the discovery of a city system of Etruscan and Roman eras. The area covered by the flight (about forty hectares) was overflowed with a fixed-wing drone equipped with a 24Mpx digital camera with single focal length lens. The operation involved the town of Archi di Pontecchio and was carried out in compliance with ENAC specifications. The flight has enabled to acquire images of the highest quality, almost two hundred pictures with a resolution of 1.7 cm per pixel, geo-referenced and complete of 3 parameters of translation and rotation. Through the captured frames there was a validation of what were until now only hypotheses; observing from the sky the differentiated growth of vegetation, in fact, it has been recognized part of the ancient Etruscan city of Veio. About the accuracy of aerial photogrammetric data Gabriele Santiccioli says: "Our company has always been committed to combine innovation and integration, so we have used all the instruments that the surveyor has, arriving until the production of maps of high technical quality in few hours. We have obtained a cloud of points, a 3D model, the DTM and DSM



from the elaborate digital images in order to know better the morphology of the land. Considering the future scenarios, I do not exclude that shortly the application of thermal and multispectral sensors will enter in the archaeological sector or at least one study focused on the result that could be achieved". The aero-photogrammetric proximity survey with the use of an APR represents an archaeological survey interesting landscape, as well as a real and accessible system for the study of preliminary research. Later, with subsequent investigations and excavations, it will be able to determine more accurately the reference period and other more detailed informations. The survey done in the quarry and the result of Veio demonstrate how the remote sensing of proximity through RPAS is advantageous in terms of time and costs, especially for particularly extended areas of inspection or not easily accessible.





The aero-photogrammetric proximity survey with the UAV use represents an interesting vision of the archaeological survey, as well as a concrete and accessible system for the study of preliminary researches. Later, with subsequent investigations and excavations, it will be able to determine more accurately the reference period and other more detailed information. Both the survey done in the quarry and the Veio result demonstrate how the remote sensing of proximity through the use of on UAV is useful in terms of time and costs, especially for particularly large areas of inspection or not easily accessible.

#### KEYWORDS

UAV; CULTURAL HERITAGE; SURVEY; AERO-PHOTOGRAMMETRY

#### ABSTRACT

The tale of two experiences in the geological and cultural heritage area through the use of fixed-wing drones. Innovation and high quality of the data returned from an aero-photogrammetric survey as support to the activities of the different professionals. From the survey phase to the post-production all the precautions to obtain images with a very good resolution and solve obstacles for the mapping of areas not easily accessible such as quarries.

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