

# Creation of a digital model of fields with application of DJI phantom 3 drone and the opportunities of its utilization in agriculture

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## ABSTRACT

Agriculture is one of the most important sectors of the economy of the Republic of Armenia. About 45% of people employed in Armenia are engaged in agriculture [1]. Innovative technologies, especially unmanned aerial vehicles (drones), can make a great contribution to the development and improvement of agriculture. The purpose of the research was to study the possibilities of application of unmanned aerial vehicles in agriculture. We have got digital models of 3 ha fields using DJI phantom 3, and this enables us to receive up-to-date information at any time and carry out a variety of analyzes and projections.

## Introduction

Farming is one of the oldest spheres of human activity. Throughout the centuries, people have been delivering technology to each other's cultivation improving their productivity. Along with the growth of population on the globe, a lot of challenges arise. One of the challenges is to provide the population with foodstuff. (see Figs. 1–7)

The use of traditional tillage techniques and technologies in agriculture are no longer effective. Agriculture becomes a big problem without high quality information. Often, pesticides given to crops are simply useless, as they are spent in large amounts, more than is needed or they are used in parts, where they are not needed at all. The consequences of such situations can be unpredictable. As soon as agriculture is able to control what is happening with the quality and mechanical composition of each plant and soil, the pesticides will be applied better [2–6].

Agriculture in the Republic of Armenia is one of the key branches of the economy of the country. Small scale and fragmentation of the agricultural farms hinder the development and extension of the agricultural farms in the Republic of Armenia. Innovative technologies can play a great role in unifying fragmented land plots and establishing new farming businesses [1].

Nowadays, in the era of innovative technology, the use of new technologies in agriculture is widespread [3].

The use of unmanned aerial vehicles in land management and in agriculture, in particular, is one of the most promising directions in the application of these technologies [4].

The application of unmanned aerial vehicles in agriculture is becoming more and more urgent day by day. Air photographs taken by drones are being performed in visible and thermal environments. They can streamline the image in real-time, which is much faster and more effective than supervising fields walking and being in the horizontal position.

Drones allow you to receive up-to-date and effective information when it's needed [7–10].

Drones give opportunity to create or update the field electronic maps as well as 3D models, realize soil, crop and irrigation monitoring systems, calculate vegetation indexes, forecast crop yields, detect erosive, dry or extruded plots and track product quality during harvesting.

Creating the mapping base of the fields with the exact coordinates of all objects will give an opportunity to carry out visual analyses, up to a few cents/pixels. Such bases can be applied to determine exact areas of the fields, distances, as well as carry out cadastral calculations [11–15].

## Materials and methods

We used the DJI phantom 3 drone in the Arzakany community of Kotayk Marz for the monitoring of agricultural lands.

In 2015 Chinese DJI Company introduced DJI phantom 3 drones.

Phantom 3 has a 12.4 MP camera, it works with GLONASS and GPS navigation systems, and the horizontal maximum speed can reach up to 16 m/s. The drone is not recommended to hover if the wind speed is 8–10 m/s or more.

Work consists of two parts:

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Fig. 1. Drone image at the height of 10 m.

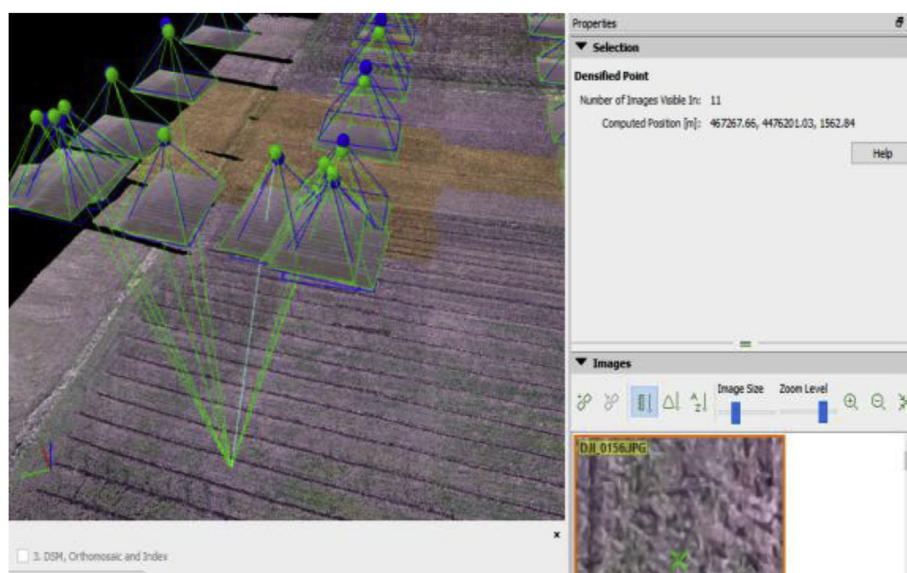


Fig. 2. Processing the drones pictures.

#### 1. Field and 2. Office

In the 1st stage the aeronautical photography of the space has been carried out.

Photographing was carried out in two stages on 3 ha of fields consisting of three parts. The 1st field was a fruit orchard, the second one was a free arable land, and the third one was a raspberry field. In the first stage, the drone was flying at the height of 50 m. The coefficient of the pictures combined to one another was maximum 80%.

In the 2nd round, the drone flipped 10 m high. We had a task to get higher quality photographs, which would enable us to get the 3D digital model of the raspberry field.

#### Results and analysis

We have got field heights, thermal and 3D digital models after working out data by the appropriate software, and the data were received as a result of aeronautical photography. The digital model allows to calculate the accurate areas of the fields, supervise the crops and

perform visual analyses.

The received pictures processing has been realized by us with the help of Pix4D software, and as a result, we got fields' heights digital and 3D models [16]. Having installed the digital model to ArcMap, we have performed the highest separation of colors from the heights. As seen from the picture, the slope of the field grows from green to blue.

And the 3D model of the field will enable us to have a high-precision mapping framework and use it to perform different analyses in the future.

We've installed the received digital model to Google Earth and Google Maps getting the high-precision mapping basis of the location in real-time.

#### Conclusion

The drones give an opportunity to get up-to-date and effective information when it is necessary. Moreover, the accumulated information at different times will enable us to realize the analyses of different processes.

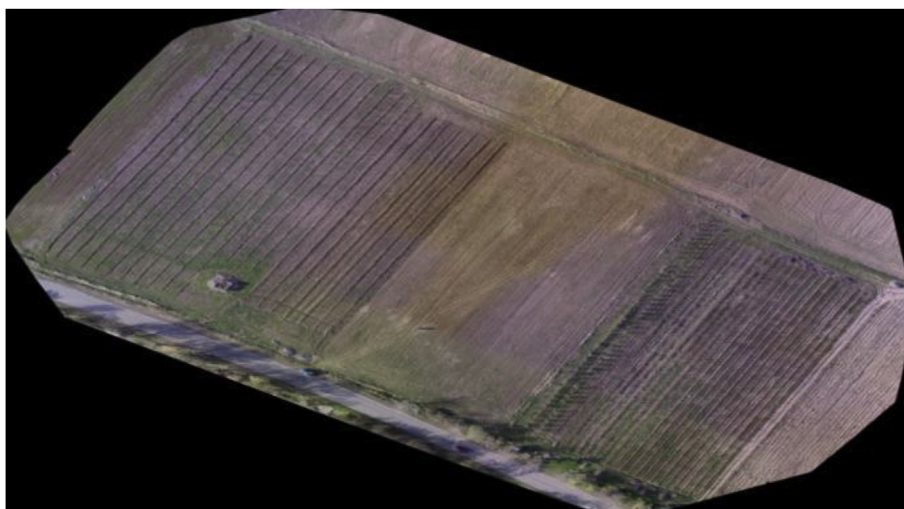


Fig. 3. Digital model of fields.

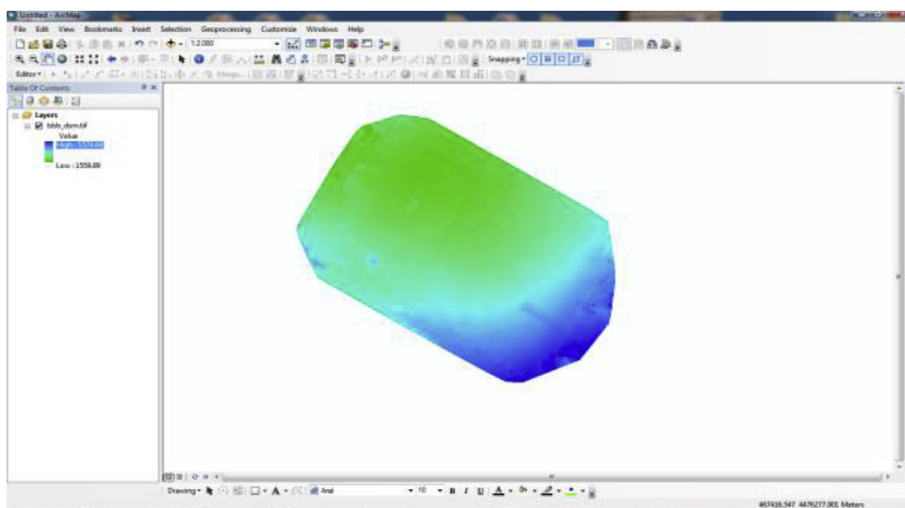


Fig. 4. The fields heights digital model.

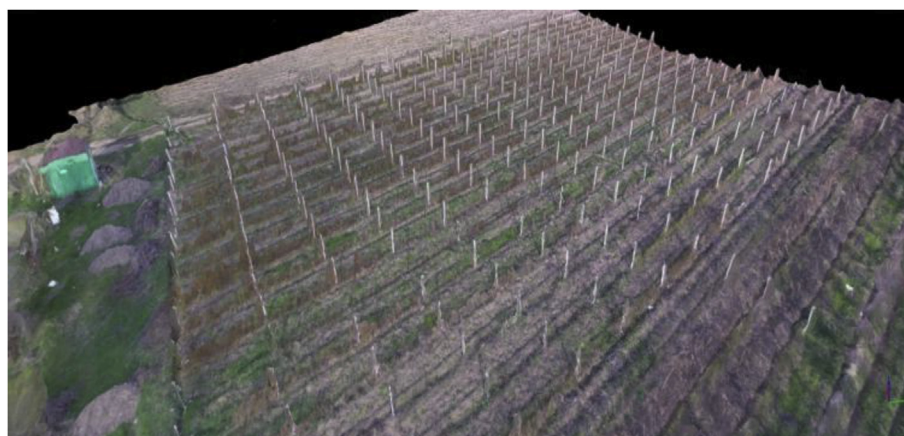


Fig. 5. The fields 3D model.

Placing the information, received as a result of an aeronautical photography, into the electronic topographic or cadastral maps, will give an opportunity to update the cartographic material in time and to solve the problems.

The use of drones is a new and rapidly developing industry in

agriculture that can play a pivotal role in the development of Armenian agricultural process.





Fig. 6. The fields' digital models installation to Google Earth.

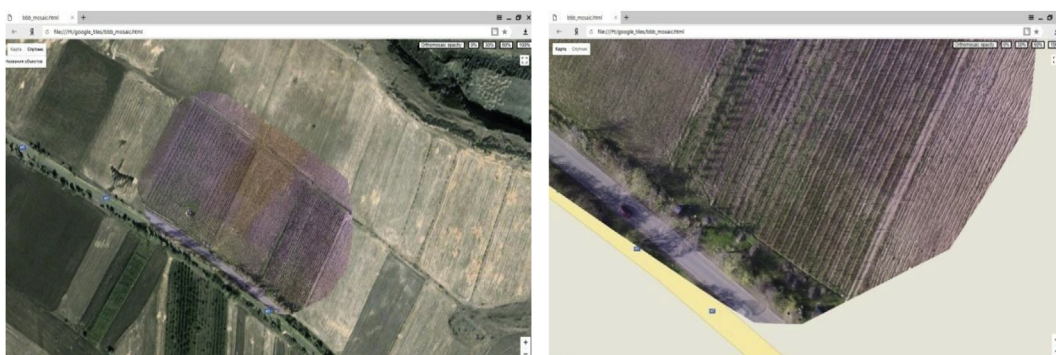


Fig. 7. The fields' digital models installation to Google Maps.

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