GENERATION AND ASSESSMENT OF HIGH RESOLUTION DIGITAL SURFACE MODEL BY USING UNMANNED AIR VEHICLE BASED MULTICOPTER

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ABSTRACT:

Unmanned air vehicle systems (UAVSs), which are presently defined as effective measuring instruments, can be used for measurements and evaluation studies in fields. Furthermore, UAVs are effective tools that can produce high-precision and resolution data for use in geographic information system-based work. This study examined a multicopter (hexacopter) as an air platform to seek opportunity in generating DSM with high resolution. Flights were performed in Kahramanmaras Sutcu Imam University Campus area in Turkey. Pre-assessment of field works, mission, tests and installation were prepared by using a Laptop with an adaptive ground control station. Hand remote controller unit was also linked and activated during flight to interfere with emergency situations. Canon model IXSUS 160 was preferred as sensor. As a result of this study, as mentioned previous studies, .The orthophotos can be produced by RGB (Red-green-blue) images obtained with UAV, herewith information on terrain topography, land cover and soil erosion can be evaluated.

1. INTRODUCTION

Generating digital surface models (DSMs) by unmanned air vehicles (UAV) and mountable systems become an appropriate and common method for scientific assessments and also for engineering related works. UAV classes, the specification of mounted sensors, flight height and speed may vary according to the aim and specific scope of the research(Watts et al., 2012; Wings et al., 2014; Gülci and Akay, 2016). The UAV-based studies that include before and after the flight stages, should be well designed for the quality of produced photogrammetric data and security (Akgül et al., 2016).

2. MATERIAL AND METHODS

2.1. Study area

The study was performed in Kahramanmaras Sutcu Imam University Campus area in Turkey. Land use type of the main study has been preferred to use as agricultural activity. The land, where has an erosion potential, has different slope classes (Figure 1).

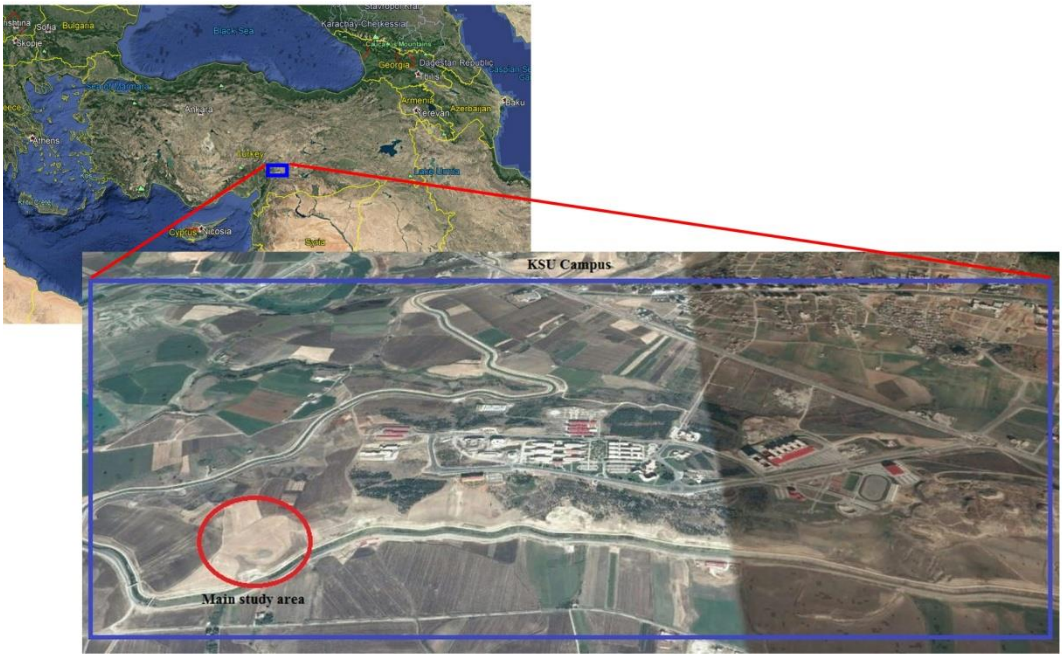

Figure1.Geographical location of the study area

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2.2. Field Study

This study examined a multicopter (hexacopter) as an air platform. Canon model IXSUS 160 which sensor mounted on hexacopter has a record ability on the secure digital (SD) Card inside the camera, was mounted on air platform (Figure 2;3) (Remondino et al., 2011; Chao et al., 2016). Total of 8 ground control points were surveyed by using Global navigation satellite system (GNSS), which has almost millimeter accuracy in spatial measurements, and these points were considered as reference point in geo-rectification.

Mission planner, which is an open-source interface software, provided flight mission to acquire block pattern. The flight altitude was defined 100 m, and the ratio of side and forward overlaps were planned as 80% (forward) and 60% (side).

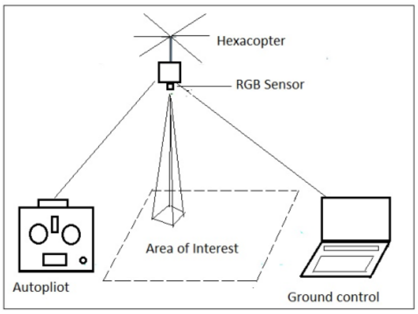


Figure 2. UAV system structure (after Chao et al., 2016)

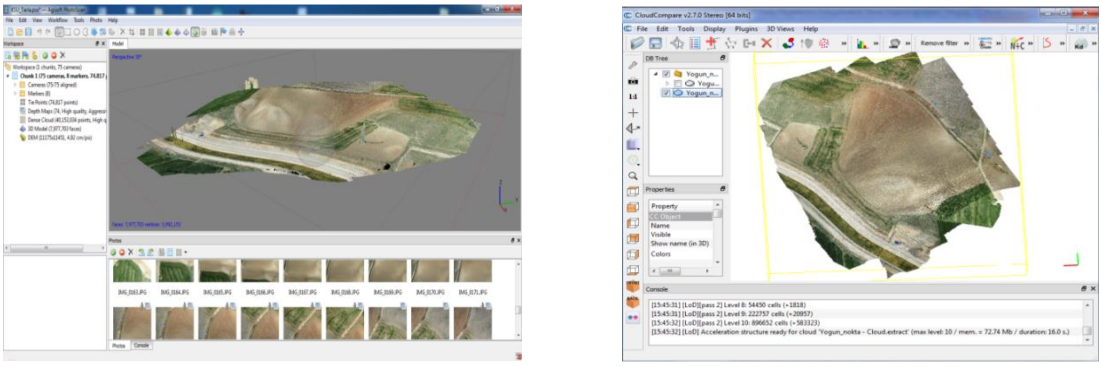
2.3. Image Process

Processing and analysis of images were performed with PhotoScan, which works under the base of SfM (Structure from motion) approaches, and CloudCompare, which is an open-source interface (Figure 4) (Westboy et al.,2012; Gülci et al., 2017; Cloud, 2017). Image processing steps by PhotoScan can be summarized as 1. identification of common points and creation of photo plane for block (alignment of photo), 2. point cloud generation, 3. image meshing, and 4. image texture (Agisoft, 2016). The initial options on image processing stages were implemented on PhotoScan as shown in Table 1.

Process	**Accuracy/Quality/Mode/Method**
Photo alignment	High
Point cloud	Ultra high
Mesh	High
Texture	Ortophoto

Table 1. Preferred work standards in image processing

Figure 3. Air platform (hexacopter) and preferred sensor (Canon IXSUS 160)



(a) (b)

Figure 4. Interface views of software used in image processing. (a) Agisoft PhotoScan, (b) CloudCompare

Figure 5. Air photo samples obtained by Hexacopter.

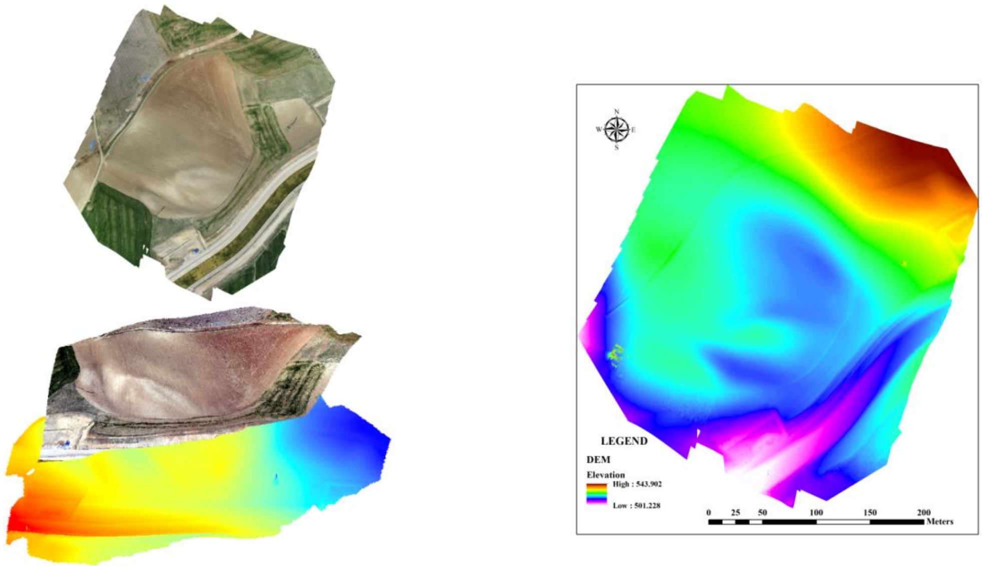


Figure 6. Generated DSM and ortophoto by using UAV

3. RESULTS AND FINDINGS

At the end of flight, total of 75 air photos were obtained from sensor (Figure 5). The alignment of photo was completed with considering 74817 tie points detected. Then, analysis of dense cloud point generation figured out, totally, as 40.153.034 points (413.129 points/m^2). Estimated image acquisition height was 111 m. The resultant resolution of the DSM and orthophoto were 4.92 cm and 2.46 cm/pix (Table 2; Figure 6).

Data type	Value
Total photo	75
Average flight altitude	111 m
Orthomosaic resolution	2.46 cm/pixel
Study area	96500 m^2
Camera stations	75
Tie points	74817
Projection	237911
Error	0.928 pixel

Table 2. Block adjustment results

Briefly, topographic maps with high resolution can be derived from the use of UAV systems. It provides convenience for researchers by removing time and area constraints (Akgül et al., 2016). The orthophotos can be produced by RGB (Red-green-blue) images obtained with UAV , herewith information on terrain topography, land cover and soil erosion can be evaluated (d'Oleire-Oltmanns et al., 2012; Bendinget al., 2014; Inan and Öztürk, 2016).

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