Generation of DSM of forest crown generated by vertical + oblique stereo pair images taken by small-sized UAV

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1. Introduction
Recently, the photographic surveying using a small-sized UAV (Unmanned Aerial Vehicle) has attracted attention. The SfM (Structure from Motion) method allows to create 3D point clouds and a 3D model from multiple 2D images (i.e., a large series of photographs of the same scene). Besides, an ortho-mosaic photograph and DSM (Digital Surface Model) can be generated from the 3D model. Obanawa et al. (2014) concluded that the points clouds derived from UAV-acquired imagery are as precise as LiDAR data. In contrast, Harwin and Lucieer (2012) reported that the precision of the point clouds becomes low when the targets are vegetations, due to an insufficient resolution of images, moving target vegetation with the wind, and parts of shadow areas in the images.
By considering these situations, this study performed to create a DSM of forest crown using vertical + oblique stereo pair images taken by small-sized UAV.
2. Methods
The study was performed in the larch forests at the foot of Mt. Yatsugatake, Nagano Prefecture in July 2015. The UAV flied over study site to acquire crown images of nadir and oblique directions using an autopilot system. The camera onboard the UAV was a RICOH GR. We first generated dense point clouds from the aerial images using PhotoScan (Agisoft). Then, we generated ortho-mosaic photographs and DSMs through point clouds according to the following three patterns.
(1) 70 nadir images at an altitude of 100m above the ground level
(2) (1) plus 54 nadir images at an altitude of 50m above the ground level
(3) (1) plus 54 oblique images at an altitude of 50m above the ground level
3. Results and discussion
We obtained DSMs which had 2.0~2.5 cm spatial resolution in all these patterns. Some parts of DSM in pattern (1) showed less surface roughness. In contrast, such parts decreased in patterns (2) and (3). In order to show how much percentage of these parts exist in each DSM, we calculated the percentage of the area that did not have point clouds. As for the pattern (1), 17.5% of the total areas did not have point clouds. Those of the patterns (2) and (3) were 12.8% and 9.7%, respectively. In other words, reproducibility was improved when oblique images were added (pattern 3) than nadir images were added (pattern 2).
4. Summary and future issues
The present study demonstrated the improvement of the reproducibility by adding the oblique images than the nadir images. Although the target was vegetation in this study, this method is applicable to other targets which has some parts of shade, such as structures or terrains.
As for future issues, we have to check an accuracy of created DSMs, to increase resolutions, and to consider the best angle and direction for creating DSMs.
5. References
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Keywords: UAV (Unmanned Aerial Vehicle), SfM (Structure from Motion), DSM (Digital Surface Model), oblique images, forest crown