Study on Accuracy of Slope Measurement using UAV

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1. Introduction

In order to grasp the situation of disasters caused by earthquake, heavy rain, etc. as quickly as possible and support prompt elimination of road obstacles, the NILIM has been studying utilization of technologies for early grasp of disasters including an airplane for the purpose of surveying damaged areas before starting activities for elimination of road obstacles and grasping the risk of failure or re-failure of slopes when working for elimination of road obstacles.

This paper introduces the results of study on the possible accuracy of measurement of slope conditions, including level difference and subsidence with focus on unmanned aerial vehicle (UAV) in order to avoid secondary disasters from failure or re-failure of slopes when surveying damaged areas or working for elimination of road obstacles. Measurement was conducted using a part of the drone airfield as test field (Fig. 1).

2. Examination of the conditions affecting measurement accuracy

Measurement accuracy is affected by slope conditions (slope angle, vegetation density, etc.) or measurement conditions (reference point arrangement, flight altitude, etc.). Then, we studied the effect of each condition on measurement accuracy using the UAV-loading type laser scanner expected to be used for grasping the situation of ground surface under vegetation. This paper introduces the effects of terrain clearance and vegetation density.

For examination, the measurement cross section of Fig. 1 (red line) was used from the results of measurement at the terrain clearance of 80 m and 140 m. Fig. 2 and Fig. 3 show the results of measuring the measurement cross section. Although topography is grasped even under vegetation regardless of terrain clearance, Fig. 2, in which terrain clearance is smaller, shows measurement of topography with better accuracy. Note that the number of points per unit area of the ground surface where laser beam reached was 1.7 to 2.5 times at the terrain clearance of 80 m as compared with the terrain clearance of 140 m.

In addition, the rate of laser beam reaching the ground (points of reaching ground / all the points) is different according to vegetation and was 26% for slender bamboos (Sasamorpha), 18% for broad-leaved forest, and 9% for coniferous forest at the terrain clearance of 80 m. This is attributable to changes in vegetation density. Note that similar trend was observed in changes in the rate of reaching ground according to vegetation density at the terrain clearance of both 80 m and 140 m.

3. Conclusion

We are going to study measurement conditions on which the risk of failure / re-failure of slopes can be determined through acquisition of topographic data using UAV images and laser on actual disaster sites, etc. and examine how UAV can be utilized before and after activity to eliminate road obstacles.

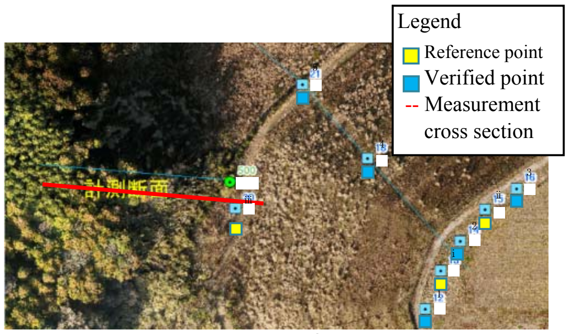

Fig. 1: Test field

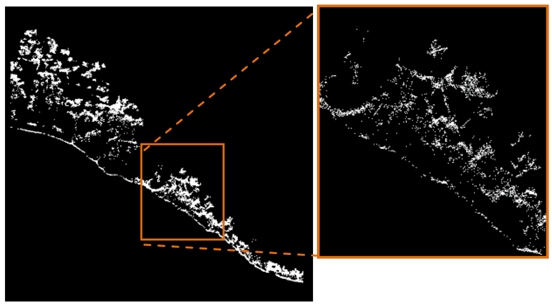

Fig.2 Measurement results (terrain clearance of 80 m)

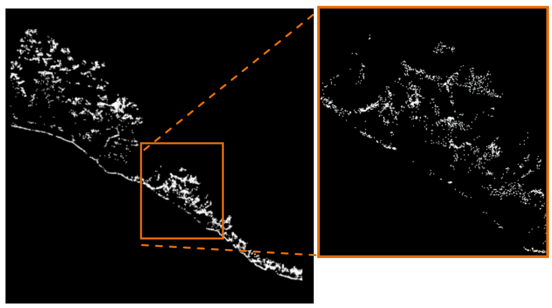

Fig.3 Measurement results (terrain clearance of 140 m)