A Study on Estimation of Areas Damaged by Landslide due to Heavy Rainfall

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Abstract: This study aimed to take a rapid detection and follow-up measures of Landslide using terrestrial LiDAR. HyangChon village, which is close to Uymeon mountain in Seoul, Korea, was heavily damaged by landslide last summer 2011 and we conducted laser scanning to obtain the 3D pointcloud data of damaged place. VRS GPS was also used for the geo-referencing of data acquisitions. Then, the 3D pointcloud data obtained by terrestrial LiDAR was co-registered with the airborne LiDAR data, which was obtained before landslide, and the damaged area was estimated. This result is expected to be used for rapid detection and fast recovery of disaster area.

INTRODUCTION

Korea Peninsular suffers from landslide problem due to heavy rainfall during rainy season every year. Recently, landslides occurred in urban area resulted in enormous sacrifices of life and property, thus the requirement of fast and reliable monitoring system has been increased. However, conventional field survey has many restrictions of time and man power for detecting damaged place. As an alternative, terrestrial LiDAR system can be a solution to satisfy such demands. In this study, we suggested the monitoring methods using high tech terrestrial LiDAR system to investigate and quantify the damaged area by landslide.

DATA ACQUISITION

HyangChon village, which is closely located to Uymeon mountain in Seoul, Korea, was seriously damaged by landslide in July 2011. To scanning the damaged area, Leica Scanstation 2 was used in this study. Additionally, Trimble R8GNSS GPS system was also used for the geo-referencing of 3D pointcloud data (Scaioni, 2005; Reshetyuk, 2009). The specifications of instruments are described in table 1.

Table 1: specification of terrestrial LiDAR and GPS system

Leica Scanstation 2	Trimble R8 GNSS
Accuracy of point positioning and distance measuring 6 mm / 4 mm	Accuracy of Static and Fast Static surveying Horizontal ±5mm + 0.5ppm RMS Vertical ±5mm + 1ppm RMS
Max scan rate 50,000 points / sec	
Field of view 360° by 270°	Accuracy of Kinematic surveying Horizontal ±10mm + 1ppm RMS Vertical ±20mm + 1 ppm RMS

DATA PROCESSING AND RESULTS

To calculate the volume of the damaged area, the dataset before landslide was obtained. It was acquired from the aerial LiDAR dataset taken over the mountain. Then, the damaged volume was calculated by the difference between the current volume and the fresh mountain topography (Shan, 2008). The amounts of cut and fill over the damaged area after the landslide were shown in Table 2. For the georeferencing and volume estimation, the commercial software Cyclone was used.

Table 2: The amount of cut and fill in the damaged area

Index	Areas of the damaged region (m^2)	Volumes of the damaged region (m^3)
Fill	1964.4	7927.3
Cut	6432.6	52486.6

CONCLUSION

In this study, we suggested that monitoring damaged area by terrestrial LiDAR system. HyangChon village, which was seriously damaged by landslide in 2011, was chosen as a study area and terrestrial laser scanning was performed to estimate the damaged area and volume change. Additionally, georeferencing of acquired pointcloud data was conducted by VRS GPS system. As a result, we could calculate the amount of cut and fill volume as 52486.6 and 7927.3 m^3 respectively. It is expected that this information can be used for rapid recovery of damaged area its management.

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REFERENCES:

Scaioni, M. 2005. Direct Georeferencing of TLS in surveying of complex sites, Isprs XXXVI/5-W17.

Shan, J., Charles K. Toth, 2008.Topographic laser ranging and scanning, United Kingdom, pp. 307-331.

Reshetyuk, Y., 2009. Self-calibration and direct georeferencing in terrestrial laser scanning. Stockholm, Sweden.