Approaches for Detecting Shallow Landslides with Standard Products of Airborne LiDAR Survey

Jin-King Liu [1], Wei-Cheng Hsu [2], Kuan-Tsung Chang [3], Peter Tian-Yuan Shih [4]

[1,2] *Civil Engineering Department, National Chiao-Tung University and LIDAR Technology Co., Ltd., Zhubei City 30264, Taiwan., Hsinchu 30264, Taiwan; {jkliu,ianhsu}@lidar.com.tw*
[3] *Dept. of Civil Eng. and Environmental Informatics, Ming Hsin University of Science and Technology, Xinfeng, Hsinchu 30401, Taiwan; ktchang1216@gmail.com*
[4] *Dept. of Civil Engineering, National Chiao-Tung University, Hsinchu City 30010, Taiwan; tyshih@mail.nctu.edu.tw*

Abstract: Landslide is a major natural hazard of Taiwan due to unfavorable geological conditions and severe rainfalls in summer season. LiDAR-derived data can be used to investigate many types of landslide including both shallow and deep-seated. Standard products of airborne LiDAR survey requested in the under-going national LiDAR mapping program include ground points, all points, DEM (digital elevation model), DSM (digital surface model), and Orthophoto. The purpose of this research is to review and develop method for recognizing shallow landslides with these standard products. Based on the data used, the options include, (1) with only discrete point clouds; (2) with only DEM and DSM; and (3) with all raster products. Four methods are proposed, namely, (a) Expert Method; (b) Method of Indices of Point Density; (c) Method of nDSM Slicing; and (d) a Hybrid OOA Method. Method a is a manual interpretation approach. Methods b and c are semi-automatic approaches whereas Method d is an automated classification approach.

The datasets for this study are in I-Lan County located in north Taiwan, collected after Typhoon Kalmaegi on 17 July 2008. For semi-automated approaches, the results show that a proper definition of the parameters for the indices is most critical for the detection of shallow landslides. For automated classification, landslide recognition approaches are tested by both pixel-based and object-oriented schemes with a Supported Vector Machine (SVM) classifier. The geomorphometric features applied in the automated classification include Slope, OHM, and Shaded Relief which are derived from LiDAR data, as well as features of RGB, Greenness, and NDVI which are derived from concurrent images. This case shows that object-oriented SVM method is better than a pixel-based SVM method in classification accuracy and the most important features include slope and OHM.

In conclusion, LiDAR data provides a good source for landslide investigation. The national LiDAR mapping program, spanning 2010 to 2015, was launched by the Central Geological Survey Taiwan. More datasets of multi-temporal and various physiographical settings are becoming available. Method for detecting deep-seated landslides in dense forest should be developed in priority.

Keyword : remote sensing, geohazard, high resolution, airborne LiDAR, geomorphommetry