

A Study on Landslides and Debris Flows Susceptibility Mapping Using Unmanned Aerial Vehicles

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The geology of Taiwan is generally vulnerable due to the natural adverse conditions such as younger strata, steep topography, active orogeny, frequent seismic activity, weathering and erosion, frequent typhoons, high rainfall, etc. Furthermore, the human factors like immature law and regulations, the weak execution, and improper land use and development also play an important role in reducing the slope stability. These factors to some degree worsen the slope conditions, lead to a more frequent natural disaster and cause the loss of life and property.

In order to effectively evaluate the landslide susceptibility and map the high risk areas, the Soil and Water Conservation Bureau of Taiwan Executive Yuan (SWCB) provides an assessment method for assessing the risk level of landslide susceptibility by selecting the combinations of impact factors that may trigger landslides. However, the accuracy and efficiency of data acquisitions, in a conventional way, for the assessment method are still limited.

With the advantages of UAVs, the digital image with high resolutions for a wider area without terrain restrictions can be obtained efficiently. Its applications have become more widespread, from battlefield detections and communications to forest management and mapping. This study utilizes the latest Dynamic Post-Processing Motion (PPK) positioning system to capture high-resolution image data from a chosen site in the northern part of Taiwan. The terrain information was extracted from aerial images using Pix4Dmapper with aerial triangulation techniques, thus the external direction of each image and the camera's internal direction parameters can be obtained, the point cloud data can be matched automatically, and a digital surface model can be established. Further, a three-dimensional model with topographic map and landslide susceptibility evaluations can be established and performed by comparing with historical data and monitoring the slope conditions. A modified assessment method is proposed using the three factors (slope, the volume of soil and rock accumulations, and rainfall) to assess the landslide susceptibility of the study area. The evaluations made by the proposed method are in agreement with the SWCB method. The results from this study can be used in slope management and precaution, and rescue and recovery.

Keywords: UAVs, landslides, debris flows, susceptibility evaluation