

臺灣中部區域之崩塌地動訊號觀測及延伸應用研究

摘要

在臺灣山區常因為強降雨導致大規模崩塌，而此種災害類型常造成居民與聚落財產上的危害，為此大規模崩塌的防減災策略已進入區域尺度或坡地尺度，針對高風險地區或邊坡持續加強各項的觀測工作，並制定雨量警戒基準。地震站紀錄可以獲得崩塌地動訊號並進行定位，有助於加速瞭解災害發生時間與地點等資訊，並運用於分析促崩雨量條件。

本年度計畫整理了中部區域(臺中、南投、彰化、雲林)一帶地震站，找出具有崩塌特徵之地動訊號資料集，再以卷積神經網路分類法建立地動訊號時頻圖的分類模型，其崩塌分類的召回率超過 97%。將時頻圖的分類模型應用於 2012 年至 2020 年的連續地動訊號紀錄，最終共有 36 個時間點可於至少 2 個以上的地震站紀錄中同時偵測到崩塌地動訊號。後續進行崩塌地動之振動源定位、檢查與配對，最終共 6 起崩塌事件之定位結果位於中部地區範圍內。計畫亦於梨山及清境架設地震站，並利用分類模型偵測 2022 年 10 月 16 日豪雨期間之地動紀錄。崩塌之降雨門檻分析顯示，以涵蓋 50% 資料的雨量門檻曲線

來看，研究區內大規模崩塌多數發生於累積降雨量大於 547 mm、降雨延時 79 小時以上的降雨條件之下，綜合各項降雨基準可做為制定大規模崩塌的警戒標準之基礎。同時，本計畫更新崩塌訊號自動辨識測試系統，新增崩塌面積與體積推估值，經由研究人員判讀後再發佈於展示網頁。

關鍵字：大規模崩塌；崩塌地動訊號；深度學習；機器學習

The study on observation and extended application of ground motions for landslides in Central Taiwan

Abstract

Disaster prevention and mitigation strategies for large-scale landslides have turned to focus on the regional scale or slope scale. Strengthening various observations for high-risk areas or slopes and revising the rainfall thresholds will be continued. The seismic records can provide landslide-induced ground motion signals and be used to locate the landslide, which helps to obtain the time and location of the disaster, and it is used to analyze the rainfall conditions. This project collated existing seismic stations in the central region and used continuous seismic records to find ground motion signals with landslide characteristics. A classification model for the ground motion spectrogram is built by the convolutional neural network, and its recall rate for landslide signals is over 90%. The classification model is applied to the seismic records from 2012 to 2020. Finally, 36 landslides were detected simultaneously at at least 2 seismic stations. A total of six landslide events were located in the central region. Two seismic stations were set up in Lishan and Qingjing, and the classification model were applied to detect the ground motion record during the heavy rainfall on October 16, 2022. The rainfall threshold about the large-scale landslides located in the study area reveals the critical rainfall for triggering large scale landslide which includes >547 mm of accumulative rainfall and >79 hours of rainfall duration. These basic

information about critical rainfall for large scale landslide will be useful for preparing the operation of disaster prevention. The project has updated the test system to provide the information of event area and volume after detecting the landslide signal, and automatically send a brief report, which will be read by the researcher before being released on the webpage.

Keywords: large-scale landslide, landslide quake, deep learning, machine learning

