自適性坡地崩塌評估模式於崩塌災害警戒管理之研究

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執行單位：逢甲大學
計畫主持人：逢甲大學土木工程學系　李秉乾教授
共同主持人：逢甲大學都市計畫與空間資訊學系　雷祖強教授
協同主持人：逢甲大學營建及防災研究中心　謝孟勳研究助理教授
協同主持人：逢甲大學地理資訊系統研究中心　黃亦敏研究助理教授
協同主持人：逢甲大學地理資訊系統研究中心　方耀民研究副教授
協同主持人：逢甲大學土地管理學系　周天穎教授

摘要

本團隊近期在農委會水土保持局(以下簡稱水保局)相關計畫中，針對陳有蘭溪、旗山溪、荖濃溪集水區等示範區進行相關資料蒐集彙整，透過人工智慧類神經網路建立的崩塌潛勢評估模式，針對不同類型之坡面導出不同雨量觸發因子(最大小時降雨和總有效累積雨量)及崩塌地文因子(地質、坡度、坡向、河道遠近、植生、歷史崩塌)之崩塌潛勢評估模型，並與降雨危害曲線整合為一套崩塌風險警戒機制模式。

本計畫今年將以擴增各年度衛星判釋全島崩塌地圖萃取各年度間新增之崩塌地圖以及蒐集對應年度之颱風豪雨事件雨量組體資料進行崩塌關聯資 料庫為主要目標，並探索及挖掘雨量時機點與實際發生崩塌之不確定性，透過更多時序的雨量特徵提取與過去年度崩塌進行關聯性模型訓練，使崩塌潛勢評估模型之準確性提高，進而提供更加精準之崩塌潛勢資訊，經過上述的人工智慧技術於崩塌潛勢評估模式精進後，後續亦將持續整合降雨危害曲線於本計畫過去所發展之崩塌風險警戒機制模式，同樣透過崩塌風險的三項因子(危害度、易損性以及暴露量)整合於崩塌風險警戒管理模式，其可有效掌握到個別因子的影響性，即降雨時序特徵對地面環境的影響性 (危害度)、地面環境對於降雨的承受能力 (易損性)以及保全對象所在的 位置(暴露度)，因此為了能夠有效地應用於災害應變管理，對於設定各指標之警戒門檻則亦是本計畫今年度之研究目標，然過去在崩塌警戒管理 上中本計畫僅透過歷史速報資料之最小機率作為最小致災門檻曲線，而其對於無速報資料之行政區無法有效之訂定警戒值，且因近年來受極端氣候常態化影響其不確定性增加，作為減災策略擬定之依據尚有許多不足之處；因此，對於本計畫後續針對多年度的崩塌雨量資料擴增，將嘗試利用 AI 技術的機器學習演運算，透過大數據崩塌雨量數據對警戒管理內容進行警戒值訂定模型之建置，並持續收蒐集崩塌事件進行模式驗證，以作為崩塌災害警戒值之訂定及管理應用之依據，有效達到協助防災應變決策之全面性以及提升國內坡地崩塌量化分析、警戒與風險評估之研究發展。

另一方面，如何有效提供民眾於崩塌災害前之重要潛勢風險資訊，亦是本計畫後續將崩塌災害警戒管理落實於自主防災之主要目的，所以本計畫將進行自主防災崩塌警戒發布管理流程設計，並挑選一處社區落實坡地崩塌評估模式於社區自主災害警戒應用，規劃相關避難路線及崩塌風險地圖等，進而達社區自主避災、防災及'減災的目標。

關鍵詞:崩塌、人工智慧、警戒模式、風險管理

Study of Adoptive Landslide Evaluation Model and Applications for the Landslide Disaster Response and Management

The research team have developed a system for Soil and Water Conservation Bureau (SWCB) about the subjects of landslide potential evaluation and landslide disaster warning model. The model was built based on the data from watersheds of Chen-Yo-Lan River, Qishan River, and Laonong River. The methods of artificial intelligent (AI) was used in the model to describe the influence of triggering factors of rainfall intensity and accumulation, as well as the environmental factors of geology, slope, aspect, distance to stream channel, vegetation, and historical landslides.

The program this year will be to expand the satellite interpretation images of each year's landslide map, and to collect the corresponding rainfall data of typhoons and heavy rainfalls in each year. The database will be used for exploring the correlation of landslide and environmental changes. Uncertainty about the timing of rainfall and actual landslide will be included in the model training. Through more time-series rainfall features in training, the model will be expected to be more accurate about the potential evaluation of landslide. After the above-mentioned artificial intelligence technology, the model is improved and integrated with previous fragility-curve model. The landslide risk, therefore, will be determined by considering hazard, vulnerability, and exposure factors in the model. The proposed model will be able to effectively capture the characteristics of landslide in terms of environmental susceptibility, withstand capability (fragility), and the object (exposure) to be protected. Therefore, in order to be effectively applied to disaster contingency management, setting the alert thresholds of various indicators is also the research goal of this plan this year. However, in the past, in regard to landslide alert management, the model only used the historical event notices to determine the minimum hazard threshold curve, and it cannot effectively set a warning value for regions without event notices. The uncertainty of landslide occurrence has increased due to the impact of extreme weather in recent years. There are still many deficiencies as a basis for the development of disaster reduction strategies. Therefore, an attempt will be made to use AI technology of machine learning algorithms to build a warning value model for landslide alert management. The proposed model and evaluation procedures will be effectively achieving the comprehensiveness of disaster prevention and response, and improve the understanding of landslide risk assessment.

On the other hand, how to effectively provide people with important potential risk information before the landslide disaster is also the main purpose of this study. Therefore, the program will conduct a procedure of landslide alert for autonomous disaster prevention communities. A community will be selected to implement the landslide alert assessment, including determining evacuation routes and making landslide risk maps. With the program, the community will achieve the goal of autonomous disaster prevention.

Keywords: Landslide, Artificial Intelligence, Warning Criteria, Risk Management