雷達衛星影像輔助林地災害偵測之研究

Research on Radar Satellite Images Assisted for Disaster Detection in Forest Land

主管單位：行政院農業委員會林務局農林航空測量所

邱俊穎 [1]　　胡植慶 [1]　　謝嘉聲 [2]

Chiu, Chun-Ying[1]　　Hu, Jyr-Ching[1]　　Hsieh, Chia-Shen[2]

[1] 國立臺灣大學地質科學系

[2] 國立高雄科技大學土木工程系

摘要

本計畫蒐集並整理目前常用的雷達衛星資訊，就其波長、解析度、穿透特性、偏極特性、再訪週期、影像取得、費用等，評估其於不同災害所需的影像，並對颱風豪雨後之洪水溢淹、堰塞湖與崩塌地，進行分析方法及自動判釋可行性之研究，同時亦探討多時期雷達影像對分析的影響，並將研究成果建置一套較為自動化的處理流程，以利防災應變的應用。

結果顯示，洪水溢淹或堰塞湖的地點及範圍可由雷達背向散射係數的差異進行分析與判釋，在影像偏極特性的選擇上，平行極化(HH 與 VV)會比交叉極化(VH 與 HV)有更好的分析結果；崩塌地區域的偵測，則以雷達植被指數 RVI 作進一步背向散射係數差異法分析，面積大於 0.06 平方公里的崩塌地有 90%能正確辨識，而面積小於 0.016 平方公里的崩塌地則有 90%判釋失敗，顯示雷達衛星影像對於大型崩塌地有比較好的辨識能力，卻無法解析較小的崩塌地；多時期濾波處理可以在保留原有影像解析力的情況下進行斑駁雜訊的濾除；多時期變遷偵測可以使用單一極化影像進行崩塌地偵測分析，相較於使用雷達植被指標 RVI 需要兩種極化影像，限制性較少；多時期變遷分析雖然有能力對林地火災跡地進行辨識，但農地栽種、灌溉、低植被灌木生長與地形差異等現象所造成的雷達訊號變異，會造成辨識的困難，降低辨識的精確性；偏移偵測法的結果顯示相當大的變形量與低相關性所發生的區域，可以指示山崩發生的概略位置。

為解決實際操作複雜性，計畫並建構以腳本操作來串接不同軟體的淹水與崩塌地緊急災害偵側標準流程，只需輸入事件前與事件後影像的檔名，處理的結果可產生由特定色系突顯可能災害區域的變遷偵測影像，影像帶有坐標系統，可匯入 GIS 軟體與相關地理資訊套疊，做為緊急應變的依據。

關鍵詞：遙測、合成孔徑雷達、淹水、崩塌地

Abstract

This project provides the information of radar images in terms of wavelength, spatial resolution, transmittance, polarization, revisit time, images sources, and purchase prices to facilitate the image processing and the feasibility in respond to different natural hazards induced by typhoon and heavy rainfall. Through the above-mentioned characteristics in radar images, the current project also attempts to build a series of processing methods and test their availabilies for flood area, landslide dammed lake and potential landslide zone. And we attempt to study the ability of multi-temporal radar images in detection of natural hazards after the typhoon and heavy rainfall. We also attempt to establish an automated platform for processing of radar images for quick response of governmental agency for detection of natural hazards.

The range and location of flood area and landslide dammed lake could be determined by calculating the difference of radar backscatter coefficients in the current project. In the application, parallel polarization (HH or VV) would lead clearer consequence than cross polarization (HV or VH). The range and location of landslide area could be determined by Backscattering Coefficient Difference algorithm with Radar Vegetation Index (RVI) and the analysis of HV polarimetric image as indexes in first stage. Among the detected landslide area, there were 90% of correct-discerned area are larger than 0.06 km^2, and 90% of wrong-discerned area are smaller than 0.016 km^2. This information indicates that the radar image represents better discernment for wide ranging landslide. The preliminary study of multi-temporal radar images suggests that the multi-temporal filtering could keep the spatial resolution to remove the speckle signals. In addition, the single polarized radar images could be used for the detection of the landslide area, which is much more feasible than the method of radar vegetation index (RVI) using two polarized radar images. Although the multi-temporal radar analysis could detect the forest fire area, however the cultivation, irrigation, lower dense of bush and difference of topography could change the backscatter of radar signals and reduce the ability for accurate detection. The pixel offset tracking could detect the landslide area with large displacement and low coherence area, which can approximately indicate the landslide. However, the predicted landslide area is much larger than the actual landslide area.

To resolve the operational difficulty and complexity for hazard detection, we already establish a standard flowchart by different scripts using in corresponding software for quick response in flood detection and landslide detection. The pre-event and post-event files are required to reproduce a specific color tuned hazard area image from change detection. This image has coordinate system that display with other geopraphic data in GIS software. It can be used for decision making of quick response after a hazardous event.

Keywords：Remote Sensing, SAR, Inundation, landslide