# 坡地土砂災害觀測資訊加值分析與應用

## Added-value analysis and application of monitoring data on slopeland disaster

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## 摘要

本研究計畫建立以地聲探測器與攝影機搭配的土石流監測預警系統。攝影畫面以創新的總灰階值變化率的方式，可以準確偵測土石流的到來，甚至在人類眼睛無法判別的暗度下，仍然可以偵測到。再利用修正顆粒光流法可以估算大石頭的移動與旋轉速度，另以畫面分析精度為要求，提供攝影機監測放置位置的條件。地聲探測器的資料以短時間傳立葉分析後,將主頻率(20-60Hz)總能量當作指標，先以能量時間變率與能量時間斜率變化兩者突然改變為依據，成功偵測土石流抵達時間，以土石流影片為標準來判斷,抵達時間誤差都在 10 秒以內，再以主頻率大小與河川流量建立流量經驗公式，相關度達 96%。

本研究計畫也已經建立了即時監測預警的網頁，網頁中包含目前所有監測站中監測儀器的訊號，同時也包含基本頻率分析與影像分析功能。利用影片與地聲訊號預警之功能，也已經整合到網頁中。未來這網頁也可成為一個公開的研究平台。

關鍵詞：土石流、地聲、影像分析

## Abstract

The research project established monitoring and warning system with combined data from CCD and geophone. CCD images are analyzed with a new total grey level temporal variation rate method. This method can detect the arrival of debris flows with error within 2 seconds. Even under dark environment where human eye cannot distinguish object, this method can still issue warning. Modified particle tracking method is used where rotation is considered. This method can produce the boulder velocity in the image with error less than 20%. Geophone signal is analyzed with short time Fast Fourier Transform. Then the integrated total energy between 20-60 Hz is used as the main index. The temporal variation of this index as well as its energy slope variation are used to detect debris flows. If the index changes rapidly, warning will be issued. This method can detect debris flow arrival accurate within 5s compared to CCD images. This index is also used to correlate to flowrate.

The monitoring and warning function is established in a website. All data is displayed and

warning function is built in. This website can be an open platform for debris flow research