

公路土壤邊坡崩塌監測系統維護及模組功能提升

Upgrading of wireless monitoring modules and maintaining of testing sites for highway slope failures

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摘要

為提升現有以降雨為指標之公路邊坡預警架構之準確性，交通部運研所持續進行客製化場址無線監測技術及預警系統研發，整合微機電(MEMS)感測元件與物聯網(IoT)通訊技術發展監測模組，並以水力力學耦合分析建立依時預警模式。本計畫針對前期建置之公路邊坡崩塌監測測試場址進行維護及資料處理，並對現有監測模組進行功能提升，本年度新增阿里山五彎仔路段監測場址，模組提升主要為廣域網路更新為 4G 網路，此外本年度新增公路邊坡擋土系統監測與預警值分析功能，以 PYWALL 軟體分析擋土牆破壞前變形，建立擋土支撐系統傾角及背填水位雙重指標預警值，另建構專屬整合雲端儲存與顯示功能之雲端平台，結合基於水力力學耦合分析之邊坡滑動與土壤結構互制分析之擋土牆體分析建議之預警值，進行預警顯示，後續可擴充主動通知警示功能，以期發展場址客製化具依時特性之公路邊坡淺層破壞與牆體穩定預警架構，用以互補現有以雨量監測為指標之經驗法預警模式，提高預警之準確與時效性，作為相關防災作為啟動之準據。

關鍵詞：公路邊坡破壞、無線監測模組、水力力學耦合分析、依時預警系統、物聯網

Abstract

To improve the limitations of rainfall-based slope warning system, a new framework that integrated the hydro-mechanical slope analysis and wireless sensing module for field key properties is under development in Institute of Transportation, MOTC. Wireless sensing modules adopting micro-electro-mechanical system (MEMS) sensors with wireless communication components are developed and deployed in the field. This project continues the on-going research to maintain the testing sites and upgrading the modules to 4G network. A new shallow failure site located in Highway 18 has been added in this study. A new module

for retaining wall inclination monitoring is deployed and a soil-structure interaction program PYWALL is adopted to predict the pre-failure deformation of the retaining wall. A cloud platform capable of data storage, display, and warning is also developed. Combining the real-time monitoring of ground hydraulic and mechanical responses and rigorous coupled hydro-mechanical analysis, a customized, time-dependent warning system might be feasible.