

應用希伯特黃轉換於表面波譜法之分析

林雨婷 馮正一*

摘要 表面波譜法 (spectral analysis of surface wave method, 簡稱 SASW 法) 是現今被廣為使用的非破壞性量測技術。其利用波傳原理量測表面波, 經由訊號處理後便可獲得地層剪力波速與深度之關係圖, 此技術可應用於推估土壩、堰塞壩等之材料性質。其試驗方法簡便且無需耗費大量資金, 但地層限制及雜訊卻是此方法的兩大難題。本研究利用 FLAC 模擬軸對稱水平地層受到一脈衝震源 (Impulsive source) 衝擊, 擷取土層表面等間距排列之速度訊號, 並以希伯特黃轉換 (Hilbert-Huang transform, 簡稱 HHT) 與低模態濾波法 (impulse response windowing filtering, 簡稱 IRF) 對其作處理, 分別針對原始訊號、使用低模態濾波之訊號以及低模態濾波搭配經驗模態分解法 (empirical mode decomposition method, 簡稱 EMD) 之訊號進行比較, 探討正向與反向土層之頻散曲線 (dispersive curve)。本研究結果顯示, 藉由兩者濾除訊號之技術相互搭配能改善頻散曲線分離的現象, 且距離震源較遠者的效果更加顯著。此外, 於反向土層方面, 此處理方法可大幅降低頻散曲線的誤差, 使其速度分布符合所模擬之地層速度, 因此表面波譜法應用於反向土層之困難可有明顯的改善。

關鍵詞：表面波譜法, 低模態濾波法, 希伯特黃轉換。

Applying Hilbert-Huang Transform to the Spectral Analysis of Surface Wave Method

Yu-ting Lin Zheng-yi Feng*

ABSTRACT The spectral analysis of surface wave method (SASW) has often been used as a non-invasive measurement process that can evaluate the material properties of earth structures. This method uses wave propagation theory to determine the shear wave velocity profile in soil layers. The limitations of the strata geometry and background noise are two major difficulties with this method. This study simulates SASW tests using FLAC for horizontal soil layers. An impulsive source will be generated for each SASW simulation, and the surface wave velocity data can be picked up by the equally-spaced sensors at the surface. The pre-procedure of the signal process includes Hilbert-Huang transform (HHT) and impulse response windowing filtering (IRF). The test results were compared with the dispersion curves by different filtering processes. This study shows the proposed filtering process can improve the separation phenomenon of dispersion curves, especially for sensors having large offsets from the source. Further, the pre-procedure can reduce erroneous signal processing in the case of 'inverse' soil layers. The difficulty of applying the SASW method to inverse soil layers is