AMBIENT NOISE RAYLEIGH WAVE TOMOGRAPHY ACROSS THE MILARD LANDSLIDE (TEHRAN-IRAN)

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As transport routes and population centers in mountainous and hazardous seismic areas expand, risks associated to landslide occurrence grow up at an alarming rate. Mitigation of this risk needs a suitable recognition of the geometry and internal characteristics of the landslides. Due to the rigorous topography and access difficulties, application of routine geophysical methods or geotechnical boring is not feasible in many areas. Therefore, finding the inexpensive and more feasible solutions for landslide investigation is a key point for risk mitigation in landslide prone areas.

Using ambient noise data recording has been proposed as one of the simple accessible and inexpensive technique by some researchers (Campillo and Paul, 2003).

The present paper shows the result of a case study on Milard landslide using the techniques based on ambient noise recording. This landslide is an old landslide located in North East of Tehran adjacent the Latian dam’s reservoir. The landslide was re-activated in Feb 2006 and damaged road facilities and some houses and some of displaced materials were entered into the reservoir. Locating in one of the most hazardous seismic zone of Iran can be result in sudden total failure of the mass during a probable future earthquake. This importance conducted us to study the geometry and internal structure (3-D shear wave velocity model) of this landslide using ambient noise recording. In this study we use the seismic ambient noise cross-correlation technique to retrieve a 3-D model of the shear wave velocity of this landslide. Seismic ambient noise was recorded during 26 days at 15 stations located on the landslide (figure 1). As previously experimented in several studies (Stehly et al., 2007; Renalier et al., 2010), all 24h segment of the recorded data were filtered between 0.5 and 20 Hz and their spectral amplitude were whitened in order to avoid dominance of strong spectral peaks in the noise. Moreover, only the sign of the signals was cross correlated and the amplitude was disregarded so as not to overweight the most energetic events (Campillo and Paul, 2003; Shapiro and Campillo, 2004). Cross correlations computed between the vertical components of all station pairs allow the retrieval of the Rayleigh wave Green’s functions. Next, all correlations of 24h records were stacked for each station pair (Figure 2). With use of the stacked Cross correlations, their group velocity dispersion curves in the frequency range higher than 1Hz were estimated. The analysis of the convergence of the cross correlations shows that the higher frequency range, the longer recording time is needed for the cross correlation to be stable. Therefore effect of recording time length on the quality of result (cross correlation) was investigated and it was determined how long time duration is sufficient to obtain stable and reliable result in this scale.

Figure 1. Bird view of Latian dam reservoir & land slide area and location of 15 recording stations

A tomographic inversion of the resulting Rayleigh wave group dispersion curves provides local group dispersion curves at each cell of the tomographic grid (figure 2). These are inverted with a neighborhood algorithm to retrieve the 3-D model of the landslide. Estimated velocities model and first- order features are in good agreement with previous geological and geotechnical investigations.

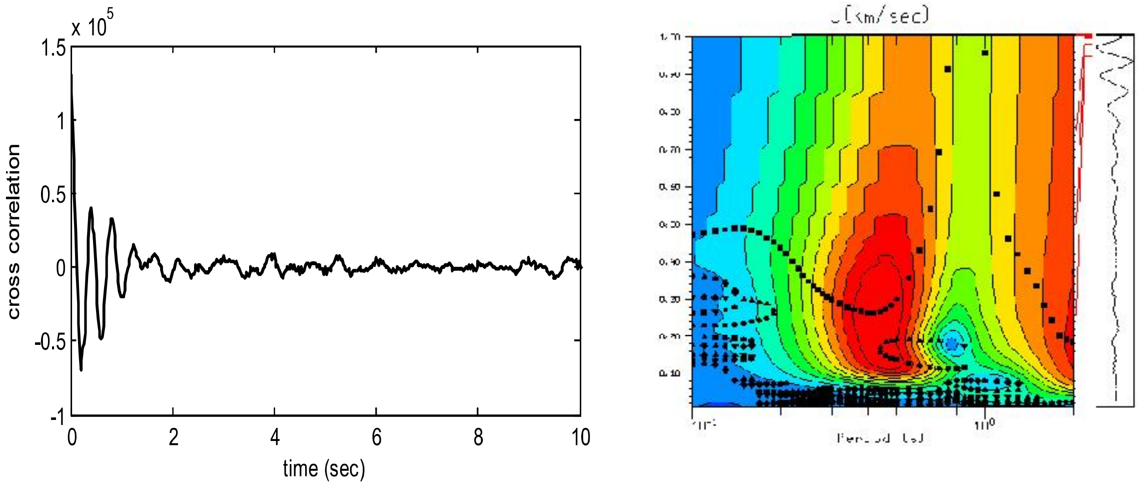

Figure 2. Stacked Cross-correlations at 26 day time-series lengths for one station pair band passed between 0.5 and 20Hz (left hand) and its respect dispersion curve (right hand)

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