Use of Microtremor Array Recordings for Estimating Surface-wave Group Velocities in Kathmandu Valley, Nepal

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The seismic interferometry technique is now widely applied to microtremor (ambient noise) data for extraction of interstation Green’s functions and estimation of surface-wave group velocities (Rayleigh and Love waves). Most existing studies have been focused on the estimation or validation of existing seismic velocity structures of upper crust or deep sedimentary basin, as well as the monitoring of temporal seismic velocity change before and after a large event (e.g. earthquake, volcanic eruption), using the continuous data recorded at selected two stations with interstation distances of at least several kilometers. On the other hand, there are a few examples of the application for estimating shallow shear wave velocity structure models using microtremor array recordings (interstation spacing of several hundreds meters to several kilometers) (e.g. Hayashida and Yoshimi, 2014; Tsuno et al., 2015). Previously we conducted microtremor surveys using the spatial-autocorrelation (SPAC) method with medium-to-large scale arrays (interstation distances: 137-1272 m) to estimate phase velocity dispersion characteristics of Rayleigh-wave at lower frequencies (< 1 Hz) in Kathmandu Valley, Nepal (Bhattarai et al., 2017SEGJ; 2017JAEE). In this study we use the long hours of microtremor data (at least 10 hours) to examine the effectiveness of the seismic interferometry technique for estimating group velocities of surface waves (Rayleigh and Love waves). The microtremor recordings were divided into segments of 655.36 s with 50 % overlap. The segments were one-bit normalized and then the spectral whitening and band-pass filter (0.8 –10 Hz) were applied. Finally, the interstation Green’s functions were extracted by stacking the obtained cross-correlation functions (CCFs) for sensor pairs whose distances are greater than 250 m. For each sensor pair, we derived nine-component CCFs (R-R, R-T, R-Z, T-R, T-T, T-Z, Z-R, Z-T, and Z-Z components). The stacked CCFs show distinct wave trains and the estimated group velocities using the multiple filtering (Dziewonski et al., 1969) show dispersive characteristics in the higher frequency range (> 1 Hz), indicating the effectiveness of the approach using actual field data. The comparisons between the estimated group velocities and predicted ones from existing structure models (Bhattarai et al., 2017) show reasonable agreements, suggesting that the combined use of SPAC method and seismic interferometry can be a useful tool to estimate velocity structure model more accurately, as well as to validate existing structure models.

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