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Phase-velocity dispersion curves and small-scale geophysics using surface waves extracted from noise correlation slant stack technique

P. Gouédard (1), C. Cornou (1,2), P. Roux (1) and M. Campillo (1)

(1) LGIT, CNRS, Université Joseph Fourier, Grenoble, France, (2) IRD, Institut de Recherche pour le Développement

Green's functions between receivers can be retrieved from the cross-correlation of ambient seismic noise or with an appropriate set of non synchronized sources. We demonstrate this principle in geophysics at small scales, using two datasets. First, we recorded user-generated noise in the bandwidth of 10 to 100 Hz, using 16 receiver arrays with different shapes. The noise sources are human steps. The time-domain correlation of the records yields Rayleigh waves propagating between each pair of receivers. We used a frequency-wavenumber Fourier transform to retrieve the phase velocity dispersion curves, first step toward an inversion. Such measurements of dispersion curves using noise correlation techniques are now more and more used in geophysics. However, very few numerical studies implying surface waves have been conducted to confirm the extraction of the true dispersion curves from noise correlation in a complicated soil structure. In a second experiment, we computed synthetic noise in a small-scale (< 1 km) numerical realistic model and applied classical processing techniques to retrieve the phase velocity dispersion curves. We compare results obtained from SPAC (Spatial Auto-Correlation method), HRFK (High-Resolution Frequency-Wavenumber method) and noise correlation slant stack techniques on a 10-sensor array. Two cases are presented in the [1 Hz - 20 Hz] frequency band that corresponds to an isotropic or a directional noise wavefield. Results show that noise correlation slant stack provides very accurate phase velocity estimates of Rayleigh waves within a wider frequency band than classical techniques and is also suitable for accurately retrieving Love waves dispersion curves.