Measuring the NCF dispersion without the long inter-station distance limitation –a new method based on hybrid peak time matching

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Over the past decade, the probing of Earth structures using seismic ambient noises has been widely used by seismologists and is now a well-developed technique. Based on an implicit high-frequency approximation, the consensus is that the noise cross-correlation function (NCF) of continuous seismic records resembles the Green’ s Function (GF) of the far-field surface wave between sensors. This perspective leads to the application of the long interstation distance criterion in the dispersion measurements, and, accordingly, much of the low-frequency content in the NCF is rejected. Herein we show that, for a far-field source, the NCF used in most surface wave studies should not be considered as representative of the empirical Green’ s Function (EGF); instead, it is simply the interference product between sensors. We present a theoretical derivation of an explicit definition for a “high-frequency approximation” and clarify the relationship between the NCF and the EGF. Furthermore, we propose a new method to measure the NCF dispersion, in which the phase velocity is estimated by matching the peak delay time observed in the time domain NCF to the one predicted by the theoretical complex NCF signals. In this hybrid peak time matching technique, the long interstation distance is no longer a required condition and phase velocities can be determined more precisely at lower frequencies. Therefore, this permits the investigation of deeper structures using noise data.

Keywords: phase velocity measurement, Empirical Green’ s Function, ambient noise

