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Improving dispersion measurement using weighted stacking based on polarization analysis

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Retrieving surface waves using linear arrays is becoming gradually popular in urban areas with abundant anthropogenic noise [Mi et al., 2020]. Dispersion measurements can be problematic due to the presence of off-line noise sources. We use the polarization analysis of three-component noise recordings to estimate the back-azimuth and intensity of sources for linear arrays. The noise segment where the source locates in the stationary-phase zones (SPZs) is retained and the noise cross-correlation function (NCF) is weighted according to the source intensity. In this way, we obtain accurate virtual shot gathers and dispersion images.

A single three-component seismic station can simultaneously record vertical, north, and east displacements. The back-azimuth and intensity of a noise source within a time segment can be estimated by the relationship between the vertical-horizontal cross-spectra [Takagi et al., 2018]. In practical applications, we remove the mean and trend of the raw three-component noise recordings and divide them into multiple segments. We use the polarization analysis for each segment to locate the orientations and intensities of the noise sources. We then average the results obtained at multiple stations in a linear array to obtain more robust results. We retain the noise segments where the noise sources are distributed in the SPZs and perform weighted stacking of their NCFs according to the intensities of the noise sources in these segments to obtain the final NCF and perform the subsequent dispersion measurement. We use a synthetic experiment and two field examples to demonstrate the superiority of our proposed method. After using the proposed method, the NCFs become more accurate with a higher signal-to-noise ratio, and the trend of the dispersion energy is more continuous.

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