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Multitaper dual-frequency coherence and Wigner-Ville spectrum for detecting dispersive signals

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Fourier analysis and the spectral characterization of time series have played an important role in modern seismological studies. The frequency contents of a stationary time series are generally expressed by the use of the power spectrum. In seismology, we deal with earthquake records that are non-stationary transient time sequences, where the usual spectral analysis fails to provide an acceptable estimate of the frequency contents of the signal with time, the temporal information is lost, and is thus unsuitable for earthquake records. We use a multitaper dual-frequency coherence estimate of teleseismic surface waves, which are highly dispersive, and construct a filter to extract the coherent frequencies associated with dispersion of the signal. We then can look at the Wigner-Ville spectrum by taking the 1-D Fourier transform of the dual-frequency spectra, rotated by 45 degrees. Improvements in the detection of the dispersive signals as well as reduction of interference terms are expected as a result. A narrow-band multitaper variant of the Wigner-Ville spectrum is also studied.