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extracting dispersion curves of acoustic data with continuous wavelet transform

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Group and phase velocity (i.e. dispersion) of acoustic data carry important information about the acoustic state of the rock and are important tools for interpretation and for quantitative inversion. In this paper we propose an approach to automatically extract the velocity dispersion (group and phase) of acoustic waves received by an array of receivers without the use of any physical model, user inputs or supervision. The first step consists in applying the continuous wavelet transform to the waveforms recorded by each receiver. Then, the peak on the modulus map is used to determine the time locus of the energy of each mode as a function of frequency. At each frequency, a method of data association is used to find the corresponding loci for all receivers. A straight line is fit to these loci and its slope is used as an estimate for the group velocity at that frequency. Moreover the rate of change of the phase of the complex wavelet coefficients at the locations corresponding to this best-fit straight line can be used to compute an estimate of the phase slowness at the same frequency. Repeating this for all frequencies and all separated modes of interest yields the desired dispersion curves for these modes.