Spectral Decomposition of Seismic Data with Wavelet-Packet-Like Transform

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Abstract

Standard spectral decomposition methods such as Short-time Fourier transform (STFT) and Continuous wavelet transform (CWT) have several limitations when resolving thin bed seismic events. The STFT method uses a fixed window length for all frequency analysis, while the CWT method enables window lengths of variable size. With the fixed window approach (STFT), a user can select a shorter window length to resolve high frequency events and to separate events with similar or closely-spaced dominant frequencies. However, the use of these shorter windows can overlook events at lower frequency. The variable window length approach (CWT) enables better frequency resolution at lower frequencies, but cannot adequately resolve low frequency events that are closely-spaced in the time domain.

This study presents a spectral decomposition approach based on the concept of wavelet packet that enables flexible implementation of spectral decomposition, called continuous-wavelet-packet-like transform (CWPLT). For example, spectral decomposition with the CWPLT method can reduce the window length (similar to STFT) but retains the same central frequency for high frequency event analysis. This aids in resolving high frequency events within the frequency domain, and improves resolution of low frequency events within the time domain. The CWPLT approach will be demonstrated and compared to standard spectral decomposition methods in VisualVoxAt seismic interpretation software.