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Semi-Automatic Method for Cepstral Depth Estimates for Sequences of Shallow Events

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In this study we describe an improved semi-automatic cepstral method for estimating the depth of very shallow earthquakes (depth < 3km) and explosions. To estimate yield and location, this method is crucial, especially for explosions, for which the depth phase (pP) is not easily discernable from the first arrival (P). Unlike previous cepstral studies, our novel procedure utilizes the Power and the Complex Cepstrums, and homomorphic deconvolution in performing these estimates. The analysis includes two steps: at first, an optimal window is chosen, using a reduced set of metrics; second, metrics related to homomorphic deconvolution are applied on the best data windows, and a statistically most probably signal-echo delay is chosen. The metrics quantify: scalloping and unwrapping, power and complex cepstrum similarity; liftering adequacy; and success of the homomorphic deconvolution, which includes delay lag recovery, and deconvolved waveform comparison to the initial signal. Weights applied to each metric are set empirically, or based on the adequacy of the minimum –phase signal approximation. The algorithms are tested on a ground-truth database, with well-known depth events and on synthetic waveforms.

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