

**Meeting:** 2022 IDC Virtual Expert Meeting

**Topic:** Advances in Waveform Processing and Special Studies

**Program:** GNDD

**Title:** Comparative Study of the Performance of Seismic Waveform Denoising Methods Using Local and Near-Regional Data

**Abstract:** Seismic waveform data are generally contaminated by noise from various sources, which interfere with the signals of interest. In this study, we implemented and applied several noise suppression methods using data recorded by the regional network of the University of Utah Seismograph Stations. The denoising methods, consisting of approaches based on nonlinear thresholding of continuous wavelet transforms (CWTs, e.g., Langston and Mousavi, 2019), convolutional neural network (CNN) denoising (Tibi et al., 2021), and frequency filtering, were all subjected to the same analyses and level of scrutiny. We found that for all the approaches the quality of the output waveform is dependent on the input signal-to-noise ratio (SNR). However, for frequency filtering, the output SNR decreases significantly faster with decreasing input SNR. For most of the input SNR range, the quality of the output waveform for CNN denoising in terms of output SNR and amplitudes is superior to other approaches. Results involving 4780 constructed waveforms suggest that in terms of degree of fidelity for the denoised waveforms with respect to the ground truth (GT) seismograms, CNN denoising outperforms both CWT denoising and frequency filtering. Depending on the purpose of the analyses for which the denoising task is performed, these finding have important implications. For instance, if the purpose of the analysis is to exploit the amplitude information of the seismograms for magnitude, yield, or moment tensor estimation, among the methods evaluated, CNN denoising would be the only suitable approach. This is because CWT thresholding and acausal filtering are associated with significant amplitude distortion, while causal filtering results not only in significant amplitude distortion, but also in considerable changes in waveform shape and phase.

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