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Study of the Performance of Seismic Waveform Denoising Methods

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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. The denoising methods, consisting of approaches based on nonlinear thresholding of continuous wavelet transforms (CWTs), convolutional neural network (CNN) denoising and frequency filtering, were all subjected to the same analyses and level of scrutiny. We found that 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. Our results suggest that in terms of degree of fidelity for the denoised waveforms with respect to the ground truth 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 findings 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 most suitable approach.

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Promotional text

This study aligns with the SnT2023 goal of identifying methods to improve nuclear-test-ban monitoring and inspection. In fact, the evaluated deep learning denoiser could provide a valuable addition to the existing data processing pipelines.

Oral preference format

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