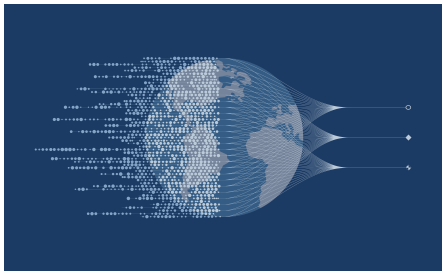

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Mathematical morphological filtering with a self-adaptive reconstruction technique and application to local seismic data

Thursday 11 September 2025 11:00 (1 hour)

Recorded seismic data are generally contaminated by noise from different sources, which masks the signals of interest. We implemented a noise suppression approach based on the mathematical morphology theorem. The method involves compound operations of dilation and erosion using structuring elements of varying lengths and decomposes an input noisy waveform into several time functions with differing characteristics. The filtered waveform is constructed from the time functions using a self-adaptive reconstruction technique. Application to a data set of >4700 local waveforms suggests that the implemented mathematical morphological filtering (MMF) approach is efficient for data with low SNR and significantly outperforms frequency filtering, the standard method for noise suppression, in that SNR range. For most of the dataset, frequency filtering results in higher SNR values compared with the MMF method. However, for ~42% of the waveforms, MMF outperforms frequency filtering. The SNR gain achieved with MMF is as large as 23 db. Our results suggest that in an operational setting, MMF cannot replace frequency filtering; however, signal detection can be improved if MMF is used to supplement frequency filtering. MMF could help detect signals in problematic low-SNR data, which are currently being missed when using frequency filtering alone.

E-mail

rtibi@sandia.gov

In-person or online preference

Primary author: Dr TIBI, Rigobert (Sandia National Laboratories (SNL))

Presenter: Dr TIBI, Rigobert (Sandia National Laboratories (SNL))

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