Neural Network Interpretation as a Denoising Tool for Automated Tremor Location

We present a new methodology for tremor location, aiming at improving the identification of events close to or below the noise level. This methodology relies on neural networks to denoise tremor waveforms, resulting in cleaner signals with more structure and impulsivity. We find that these denoised waveforms can be used for event location with standard array-based techniques.

Our approach consists in two main, consecutive steps. First, we feed waveform spectrograms to a neural network that has been trained to identify tremor, and we rely on neural network interpretation to denoise the raw waveforms. Second, these cleaned waveforms are used as input in an array-based location phase, that relies on the cross-correlation of seismic envelopes to locate tremor events.

As proof of concept, we apply this approach in the Cascadia subduction zone. We attempt to locate tremor events during the 2018 slow slip underneath Vancouver Island, Canada. Analyzing a well-studied area allows us to validate our methodology by comparing our results with existing catalogs. We identify tremor patches coherent with existing literature, which validates the assumption that our denoising procedure preserves the events' move-out patterns. Our approach allows us to extract events below the noise level and to identify more events than in existing catalogs.

Keywords : seismology, tectonics