

T3.3-O7. Signal-based Bayesian Monitoring

We present SIG-VISA (SIGnal-based Vertically Integrated Seismic Analysis), a next-generation approach to Bayesian seismic monitoring. This work builds upon the success of NET-VISA, recently recommended for production deployment at the IDC. While NET-VISA focuses on network processing, SIG-VISA subsumes station and network processing using a probabilistic model of continuous seismic waveforms. Inference in this model yields a new algorithm for simultaneous detection and location of seismic events, unifying signal-based techniques such as waveform matching and double-differencing with traditional detection-based monitoring in a single framework with principled handling of uncertainty. SIG-VISA represents a seismic phase arrival as a parametric envelope perturbed by a random modulation given by a location-dependent Gaussian process (kriging) distribution on wavelet coefficients. Model parameters are learned from historical data, so that the signal from an event with a nearby historical doublet will tend to match the previous observation, with uncertainty increasing as distance. When no historical events are nearby, the predictions smoothly degrade to parametric envelopes. We show preliminary results demonstrating detection and localization with waveform matching on synthetic and real data, and discuss progress in scaling up our system for computation on a global network.

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