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Detection of Low-SNR Seismic Events by Pattern Matching with Automatically Generated Prototypes in an OSI Scenario

The reliable, automatic detection of low-SNR seismic events is not yet feasible without a large amount of false-positive detections, i.e., false alarms. This applies especially to temporal local networks with exposed seismic stations and a-priori unknown noise conditions and event signatures, as in an OSI seismic aftershock monitoring. To overcome this problem, we use a multi-path approach. As a first step, high-SNR events from noise bursts and seismic signals are detected by conventional STA/LTA triggering and coincidence analysis. These events are grouped for similarity to define a set of master events. Thus in step two the events are transformed into noise-adapted sonograms, and further reduced in dimension by principal component analysis (PCA). A self-organizing map (SOM) is used then to create event prototypes by event alignment on a two-dimensional grid based on similarity. Prototypes which are based on noise signals will positively identify repetitive noise sources, while the remaining signal prototypes are used to detect any low-SNR events in the full data set through adapted pattern matching. This method allows to lower the automatic detection threshold significantly with only a small increase in false-positives.

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