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Automatic classification of seismic events within a regional seismograph network

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A fully automatic method for seismic event classification within a sparse regional seismograph network is presented. The tool is based on a supervised pattern recognition technique, Support Vector Machine (SVM), trained here to distinguish weak local earthquakes from a bulk of human-made or spurious seismic events. The classification rules rely on differences in signal energy distribution between natural and artificial seismic sources. Seismic records are divided into four windows, P, P coda, S, and S coda. For each signal window STA is computed in 20 narrow frequency bands between 1 and 41 Hz. The 80 discrimination parameters are used as a training data for the SVM.

The SVM models are calculated for 19 on-line seismic stations in Finland. The event data are compiled mainly from fully automatic event solutions that are manually classified after automatic location process. The station-specific SVM training events include 11-302 positive (earthquake) and 227-1048 negative (non-earthquake) examples. The best voting rules for combining results from different stations are determined during an independent testing period. Finally, the network processing rules are applied to an independent evaluation period comprising 4681 fully automatic event determinations, of which 98 % have been manually identified as explosions or noise and 2 % as earthquakes. The SVM method correctly identifies 94 % of the non-earthquakes and all the earthquakes. The results imply that the SVM tool can identify and filter out blasts and spurious events from fully automatic event solutions with a high level of confidence. The tool helps to reduce work-load in manual seismic analysis by leaving only $\sim$5 % of the automatic event determinations, i.e. the probable earthquakes for more detailed seismological analysis. The approach presented is easy to adjust to requirements of a denser or wider high-frequency network, once enough training examples for building a station-specific data set are available.