Automatic event detection based on artificial neural networks

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The proposed algorithm was developed to be used for Webnet, a local seismic network in West Bohemia. The Webnet network was built to monitor West Bohemia/Vogtland swarm area. During the earthquake swarms there is a large number of events which must be evaluated automatically to get a quick estimate of the current earthquake activity. Our focus is to get good automatic results prior to precise manual processing. With automatic data processing we may also reach a lower completeness magnitude.

The first step of automatic seismic data processing is the detection of events. To get a good detection performance we require low number of false detections as well as high number of correctly detected events.

We used a single layer recurrent neural network (SLRNN) trained by manual detections from swarms in West Bohemia in the past years. As inputs of the SLRNN we use STA/LTA of half-octave filter bank fed by vertical and horizontal components of seismograms. All stations were trained together to obtain the same network with the same neuron weights. We tried several architectures - different number of neurons - and different starting points for training. Networks giving the best results for training set must not be the optimal ones for unknown waveforms. Therefore we test each network on test set from different swarm (but still with similar characteristics, i.e. location, focal mechanisms, magnitude range). We also apply a coincidence verification for each event. It means that we can lower the number of false detections by rejecting events on one station only and force to declare an event on all stations in the network by coincidence on two or more stations.

In further work we would like to retrain the network for each station individually so each station will have its own coefficients (neural weights) set. We would also like to apply this method to data from Reykjanet network located in Reykjanes peninsula, Iceland. As soon as we have a reliable detection, we can proceed to phase picking and location.