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# Unsupervised feature selection for seismic phase detection and event classification using self-organizing maps and significance testing

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We suggest an automatic unsupervised feature selection procedure for the discovery of significant patterns in seismic single-station or network recordings. For this purpose, the data is parameterized by adaptive feature vectors for short time windows using standard analysis tools for seismic data such as Frequency Wavenumber, polarization and spectral analysis. Depending on the number of receivers and available components, we can compute a set of 100-200 different features. The feature selection procedure itself is based on correlation hunting with Self-Organizing Maps (SOMs) and significance testing using the Wald-Wolfowitz Runs-Test. The SOM technique is an unsupervised data investigation tool that is commonly used for data visualization and clustering. We demonstrate the improved discriminative power of our approach with respect to manual feature subset selection by cross-validating clusterings of a simple synthetic data set composed of Rayleigh and Love Waves. Furthermore, we apply the procedure on a set of regional single station earthquake recordings in order to find suitable and significant features that may be used for seismic phase detection or event classification. With the goal to discriminate between different seismic phases and noise of single events and, in a second step, to distinguish P-waves of different event types, the feature sets are reduced to a number of about 15-25 features. We intuitively visualize our results using SOMs. Our technique can e.g. be applied as a supporting tool for developing advanced, supervised classification algorithms.