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# Clustering of seismic signals in wavefields of complex composition using self-organizing maps

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For single seismic events in a low-noise environment, a few characteristic parameters such as e.g. the time-frequency amplitudes are mostly sufficient to identify automatically or visually the onset or type of an incoming wave. However, in the case of waves which arrive simultaneously or shortly after another from one or multiple azimuths, superposition of the signals, a low signal to noise ratio and a broad spectrum of signal shapes from transients to emergent tremor-like waves require more sophisticated techniques. For this purpose, as much information as possible contained in the wavefield has to be utilized. This study presents first results of a pattern recognition approach for signals in wavefields of complex composition. Due to the difficulty to define a reference data set in such situations, we employ unsupervised pattern recognition based on the self-organizing map (SOM) algorithm. The SOM techniques allow to identify clusters in a high-dimensional data space which represents a decomposition of the wavefield into similar signals. SOM allows the visual identification of clusters or the evaluation of automatic clustering algorithms such as e.g. K-means by a 2D visualization of the data space topology. For the clustering we define a parametrization vector calculated from three component array-network recordings. The parametrization includes attributes from time-frequency analysis, polarization, frequency-wavenumber analysis, the analytic trace, autoregressive modelling and spatial coherency. Primary results for synthetic waveforms show that this approach is suitable well to distinguish between uncorrelated noise, Rayleigh waves and Love waves in the case of complexly composed wavefields and high-noise environments. Furthermore, we apply the clustering to recordings of the seismic wavefield at the volcano Merapi in Indonesia. We are able to identify the characteristic impulsive volcano-seismic signals as well as other correlated waves of low signal to noise ratios. We plan to apply this approach to urban ambient vibration wavefields (mircotremors). The motivation behind is to

choose time windows suitable for the subsurface velocity structure investigation which is expected to reduce the recording time and to improve the final results.