Shear wave velocity from inter-source interferometry

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Ambient noise correlation uses the recordings of multiple, statistically distributed seismic sources (the noise sources) at two seismometers. By cross-correlating this signal, one obtains a wave traveling between two seismometers. Due to the principle of reciprocity it is possible to interchange the role of sources and receivers. This cannot be done with ambient noise, but another stochastic signal, the seismic coda is used. Using a cross-correlation of the seismic coda of two earthquakes recorded at multiple seismometers, it is possible to construct a seismic wave traveling between the two earthquakes in depth (inter-source interferometry). Here, I use the the time lag of the maxima in the cross-correlation of the coda wave field to measure the shear wave velocity in the source volume of swarm earthquakes. This technique is different from previous studies analyzing the decorrelation of the coda wave field of nearby events or using the cross-correlation for relocation purposes.

The technique is applied to five event clusters of the 2018 West Bohemia earthquake swarm. With the help of a high quality earthquake catalog, I was able to determine the shear wave velocity in the region of the five clusters separately. The shear wave velocities range between 3.5 km/s and 4.2 km/s. The resolution of this novel method is given by the extent of the clusters and better than for a comparable classical tomography. The method can be incorporated into a tomographic inversion to map the shear wave velocity in the source region with unprecedented resolution. The influence of focal mechanisms and the attenuation properties on the polarity and location of the maxima in the cross-correlation functions is discussed.