Geophysical Research Abstracts
Vol. 20, EGU2018-13594, 2018
EGU General Assembly 2018

Well-founded parameters for CLEAN and MUSIC beamforming

Olivier den Ouden (1), Jelle Assink (1), Pieter Smets (1,2), Laslo Evers (1,2)

(1) Royal Netherlands Meteorological Institute, R&D Seismology and Acoustics, Netherlands (olivier.den.ouden@knmi.nl),
(2) Delft University of Technology, Applied Geophysics & Petrophysics, Netherlands

Ambient noise varies in both space and time, resulting in multiple source locations with varying strength. Classical beamforming can have problems when dealing with these interfering sources. Previous studies proposed two alternative beamforming methods to better discriminate multiple continuous sources, beside the dominant one, in the f-k spectrum. The CLEAN method iteratively select the maximum of the f-k spectrum, removes it and stores it in a new spectrum. MUSIC is based on eigenvalues and its eigenvectors of the cross spectral density matrix. It creates a signal and noise subspace that will be used to calculate a f-k spectrum.

Nonlinear ocean wave interaction generates signals that radiate in the ocean, atmosphere and solid earth. These low frequency signals dominate the ambient noise field, around 0.2Hz (microbaroms in the atmosphere and microseisms in the solid earth). To detect and characterise these continuous signals, infrasound and seismic arrays of the International Monitoring System (IMS) are used. Those arrays are build to monitor nuclear test, for the verification of the Comprehensive Nuclear Test Ban Treaty (CTBT), and also measure continuously the ambient noise field.

In this research, both methods are compared elaborately. Furthermore, a practical implementation is given based on coherence and array configurations. For example, transparent stopping criteria related to Fisher coherence estimate (CLEAN) and a noise eigenvalue threshold (MUSIC). These results are obtained by applying the methods on synthetic data and on real IMS data.

It is shown that MUSIC is computationally most beneficial but still has a problem of discriminating low frequency low coherence interfering sources. CLEAN performs best, although it is computationally most expensive even after applying the Fisher threshold.