Geophysical Research Abstracts
Vol. 17, EGU2015-7382, 2015
EGU General Assembly 2015

Extraction of the local phase velocity and the group velocity from surface noise source in microseismic monitoring.

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The aim of this work is to demonstrate the extraction of the local phase velocity and the group velocity from surface noise source in microseismic monitoring.
One of the biggest challenges in microseismic monitoring is surface seismic noise. Microseismic surface studies are often contaminated with instrumental and ambient seismic noise, originating from both natural (wind, rain) and anthropogenic sources (injection, pumps, infrastructure, traffic).
The two primary ways to attenuate the undesired surface noise sources are via processing and acquisition strategies. At the acquisition stage, one solution is through the use of patch array. One patch is a group of 48 vertical sensors densely distributed on the area of∼150m*150m, and one trace is the array of 12 vertical geophones. In the present work, 44 patches were sparsely distributed on a 41 square kilometer area. Benefitting from continuous recording, we used Matched Field Processing (MFP) methods to extract local phase and group velocities over the whole area.
The aim of this technique is to detect and locate uncoherent noise sources while using array-processing methods. The method is based on the comparison between a recorded wave field per patch (the data vector) and a theoretical (or modeled) wave-field (the replica vector) in the frequency domain.
The replica vector is a Green's function at a given frequency, which depends on the following parameters: position (x,y) in 2D-grid and a phase velocity. The noise source location is obtained by matching the data vector with the replica vector using a linear "low-resolution" algorithm or a nonlinear "high-resolution" adaptive processor. These algorithms are defined for each point in the 2D – grid and for each phase velocity. The phase velocity per patch is optimal if it maximizes the processor output. As a result, an ambiguity surface is produced which shows the probability of presence of primary noise sources per patch. The combination of all the maps per patch reveals the position of the strongest surface noise source.
When properly identified and localized, the surface noise source provides information about a group velocity between each patch in the propagation medium. To do so, the data are cross-correlated between patches and a move-out is applied to cross-correlation functions using the phase velocity per patch. The remaining time shift between the envelopes of the cross-correlation functions gives a value of the group velocities between the patches. The technique can be generalized to every pair of patches depending on the number of surface noise source identified at the surface.