Retrieving of surface and body waves from ambient seismic noise, recorded during XSodEX experiment

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In this article, we describe the first results of passive seismic data analysis, collected during XSodEX seismic experiment. Application of advanced technique of retrieving Empirical Greens Functions allowed to extract both surface and body waves from ambient seismic noise.

Keywords: ambient seismic noise, passive seismic interferometry, surface and body waves retrieving

1. Introduction

At present, passive seismic methods of applied geophysics are rapidly developing. These methods are very good tool for solution of many applied tasks, where information about elastic properties of the rocks in near-surface layers is needed (microseismic zonation, groundwater and microearthquakes sources study etc.). In some situations, such as measuring near active industrial object or other areas with high level of seismic noise, application of passive seismic techniques is the only option (Place and Malemhir, 2015, Cheng et al., 2015; Shirzad and Shomali, 2014; Vidal et al., 2014, Panea et al., 2014, etc.). In this study, we described the first results of analysis of ambient noise recorded during XSodEx seismic experiment. Retrieving surface and body waves from the noise is based on splitting of all records to time windows with surface or body waves only and calculation of crosscorrelation function separately for these parts. The main idea of data processing has been taken from works by Vidal et al. (2014) and Panea et al. (2014).

2. Description of the passive seismic experiment

For extraction of surface and body waves from ambient seismic noise, we used continuous passive seismic data recorded since 21.08.2017 to 23.08.2017 with the sampling frequency of 500 Hz along the profile of total length of about 950 m with intersensor spaces about 10-15 m. The equipment consisted of 38 DSU-SA 3C MEMS and 60 1C SG-5 seismic sensors with the autonomous RAUD eX data acquisition units produced by Sercel Ltd. The profile was located near roads and river, which may be sources of continuous seismic noise.

For evaluation of surface and body wave parts of empirical Greens functions, we particularly used the procedure, described on Panea et al. (2014). The algorithm of the data processing includes spectral whitening of seismic noise records, splitting of all records to time windows of 1 minute length, calculation of crosscorrelation functions. After this visual inspection of calculated crosscorrelation functions had been applied. The main criteria of separation were apparent velocity, which must be higher for body waves.

After visual inspection, time windows have been merged into two new records contained only body waves or both surface and body waves. After this, we calculated crosscorrelation...
functions separately for these records and stacked correspondent functions for different locations of a virtual source (figure 1).

Figure 1. Empirical Greens functions with both surface and body waves parts, calculated for different positions of virtual sources (marked by the red stars).

As one can see on figure 1, application of this procedure, allowed to get signals as generated by active sources, located on positions of virtual sources (red starts on figure 3). On these correlograms, there are refracted and reflected body waves and surface waves.

3. Conclusions
In present study, we showed the first results of application advanced technique of passive data processing. This procedure includes visual inspection of crosscorrelation functions, calculated for short time records of seismic noise. It makes it possible to extract both surface and body waves parts of empirical Greens functions. From our results we can conclude that sources of seismic noise have inhomogeneous distribution and were located near one side of profile, in general. But principles of seismic interferometry and virtual source method make it possible to change position of virtual source and, therefore get signal as in active seismic experiments.

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