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Estimation of application conditions for seismic interferometry based on numerical simulation

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The seismic interferometry reconstructs the pseudo shot record (Response function) from observed seismic data simultaneously by auto-correlation or cross-correlation function. The Response function provides us with useful information for imaging the subsurface structure. However, it is important to evaluate the applicability of this technique. One of the conditions of response functions is characterized by filtering or source characteristics of the observed seismic data. In this study, we examined the application conditions for the seismic interferometry estimated from auto-correlation by using theoretical waves. Next we also applied it to the observed strong motion records in the Osaka basin.

First, we examined the appropriate frequency range of the response function corresponded with the depth of the basement structure. Assuming the basement structure model beneath a receiver, we calculated theoretical waveforms with a variety of rise times and filtering. The Green's function is calculated by using discrete wavenumber method (Bouchon, 1981) with the reflection and transmission matrix (Kennett and Kerry, 1979). We obtained a sufficient database for various frequency range and rise time for imaging an assuming depth of the basement. The appropriate rise time is less than 0.5s to estimate basement depth from 100 m to 1000 m. we also found that low-cut filtered waveforms by 1.0 Hz are relatively available to estimate basement depth shallower than 500 m.

Second, we compared the SN ratio of the response function with number of stacked records using above database. Signals of the response function have sufficient SN ratio with stacked records up to 50. Using the observed seismic data, however, more stacked records will be required for sufficient SN ratio because of various noises exist in the seismograms.

Finally, we applied the seismic interferometry to estimate seismic basement structure in the Osaka basin using observed strong motion records. The basement depth estimated from the seismic interferometry agrees with the basin model in the Osaka area (e.g. Kagawa *et al*., 2004). At some station, however, especially near the edges of the Osaka basin, the depth estimated from the response functions did not agree with the Osaka basin model.

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Keywords: seismic interferometry, auto-correlation function, numerical simulation, application conditions, Osaka basin