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Detection of Rayleigh wave and Love wave detection from microtremor array measurements

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Microtremor array measurements are considered to be one of the most practical ways to explore the S-wave velocity structures for the seismic hazard evaluation. As seen in many articles (e.g. Horike, 1985), the Rayleigh-wave dispersive characteristics have been derived from vertical components to model the S-wave velocity structures. On the other hand, the detection of Love-waves from horizontal components seems to be limited in very few literatures (e.g. Yamamoto, 2000), because horizontal components of microtremors are composed of the Love-waves and the Rayleigh-waves and the separation of two different kinds of surface waves is usually considered to be difficult.

As representative methods to analyze the microtremoer array records, the FK spectral method proposed by Capon (1969) and the spatial autocorrelation (SPAC) method by Aki (1957) have been used. Both methods have been extended to treat three-component data and detect the Love-wave as well as the Rayleigh-wave: the FK spectral method by Saito (2007) and the SPAC method by Okada and Matsushima (1990) and Yamamoto (2000), respectively. It is considered to be significant to apply these extended methods to observed data in various test fields. In our previous study, we carried out microtremor array measurements at Takasu area in Kochi city, south-west Japan on November 2010. We used two circular arrays with radii of 50 m and 100 m simultaneously, and successfully detected dispersive characteristics of both Rayleigh-waves and Love-waves in a frequency range between 1.2 to 3.8 Hz (Ohori et al. 2013). In analyses of observed array records, we used two kinds of the FK spectral methods: Capon's technique (1969) applied to vertical component and Saito's one (2007) to horizontal components.

To make a better understanding about characteristics of microtremors for the targeted area and obtain surface wave dispersive characteristics in more higher frequency range (up to 6Hz), we additionally conducted a few smaller array measurements on March 2013, using 4 sets of three-component portable seismometers which compose a circular array with a radius varying step-by-step from 50 m to 25 m and 12.5 m. In our study, results from newly observed data are reported and discussed. Phase velocity results were obtained from FK spectral method for vertical and transverse components. We also applied the SPAC method (Yamamoto, 2000) and compared the estimated phase velocity results from the SPAC method with those from the FK spectral method. The SPAC method provided that the energy power ratio of Love-waves in horizontal components distributed within 40-70% in a frequency range between 1.4 to 6 Hz.

Keywords: microtremor array measurements, FK spectral method, SPAC method, Rayleigh-wave, Love-wave