

A new method to determine phase velocities of Love waves using microtremor records from a double-circular seismic array (Part 2)

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Cho, Tada and Shinozaki (2005) propose, in a different speech given at the present meeting, a new algorithm of microtremor exploration that enables to estimate phase velocities of Love waves directly by using horizontal-motion records of microtremors alone, by way of an intermediary quantity called a 'spectral ratio.' Their method requires horizontal-motion seismograms of microtremors, obtained with seismic sensors placed around two circumferences of different radii but, unlike traditional spatial auto-correlation (SPAC) methods (e.g., Yamamoto, 2000), does not in principle require seismograms obtained at the center of the circles.

With a view to verifying the practicability of their new method, we have conducted field measurements of microtremors, with double-circular arrays of seismic sensors, at two locations where the shallow underground seismic velocity structure is known from PS logging data, one of them in Kasukabe City, Saitama Prefecture, and the other in Koto-ku, Tokyo Prefecture. We have then attempted to evaluate the phase velocity dispersion curve of Love waves under the assumption that their fundamental mode is dominant. We have deployed a ten-sensor array, in the shape of two circles of different radii with five sensors placed equidistantly around each of them, and repeated simultaneous thirty-minute-long measurement of microtremors for different combinations of the two array radii. As a result, we have been able, in most cases, to evaluate the phase velocities of the fundamental-mode Love waves with sufficient precision within certain frequency ranges, and this confirmed the practicability of the new method.

Outside such frequency ranges, the 'spectral ratio,' the intermediary quantity calculated from measurement records prior to the evaluation of the phase velocities of Love waves, showed discrepancies with the spectral ratio curves that are theoretically expected under the assumption that their fundamental mode dominates. It turned out, however, that the causes of the discrepancies could be mostly accounted for by theoretically considering the following three factors: the presence of higher modes, directional aliasing related to the finite number of sensors constituting the seismic array, and the presence of incoherent noise.

The microtremor field at our field site in Tokyo Prefecture was subject to periodic fluctuations in intensity reflecting alternations in traffic signals. The time intervals where the seismograms can be regarded as mostly stationary are thus composed of intervals where the amplitudes are relatively large (strong intervals) and intervals where they are relatively small (weak intervals). We have been able to evaluate phase velocities of Love waves with good precision in most cases when we put to analysis both the strong and weak intervals simultaneously with no distinction, but in some cases where we analyzed strong and weak intervals separately, the estimated phase velocities appeared to have approached the theoretically expected values in either of the two categories. This may possibly reflect the fact that the assumption of stationarity, on which Cho et al.'s (2005) analysis theory is based, was satisfied with higher fidelity when we separated the strong intervals from the weak intervals. However, the paucity of examples precludes any definite interpretations.