Estimation of the shallow structure around Kurikoma, Miyagi, Japan, using the microtremor array survey

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The 2008 Iwate-Miyagi Nairiku earthquake brought severe damage to a limited area of Kurikoma, Miyagi, Japan. To know the characteristics of the earthquake ground motions, we may use sometime the responses of tombstone. However, it is found that their responses vary in limited area. In such case, it must be difficult to estimate the ground motions durig the earthquake.

After the Iwate-Miyagi Nairiku earthquake, the authors surveyed many cemeteries and checked the performance of the tombstones. At a few cemeteries, an uniform responses of the tombstones are observed. To obtain the reason of such the responses, we tried to survey the ground structure at some sites as a first step of our interest.

The observations are carried out at three sites in Kurikoma, Miyagi, Japan: at KGJ, where there was no uniform responses of tombstone, at HZJ, where uniform responses were found, and JMA, where is the observation site of Japan Meteorlogical Agency and strong motion record is available. We used a small arrays with 5-m radii for the microtremor observation and the data is observed at 4 sites simultaneously. The sensors are moving-coil-type velocity sensor with 2-second natural period and we use data loggers with 24-bit A/D converter and 800 Hz sampling frequency, which inculde analogue amplifier with low pass filter of 10-Hz cut off frequency.

Before the observation, the step response of the pendulum is recorded and the natural period and damping factor are estimated from the response. Using these data, the instrumental corrections are carried out. To estimate the phase velocities, the spatial auto-correlation (SPAC) method is applied and the horizontal and vertical spectral ratio (H/V) is also calculated. Under the assumptions that the microtremors consists of Rayleigh wave, we serach an optimal velocity structure to sutisfy the observed phase velocities and H/V using a forward technique.

From the analyses, five layers are found: shear wave velocities are 100 m/s, 250 m/s, 700 m/s, and 1 km/s as basement in this model. Althoguh five layers are found at JMA, KGJ lacks 700-m/s layer and HZJ lacks 250-m/s layer. From this results, the response of earthquake ground motions at the surface must be different each other. Especially, the difference between KGJ and HZJ may bring the difference of the level of non-linearity and it may cause the difference of the responses of the tombstone.

On the other hand, for the tombstones to respond uniformly, a global circumstance may also play an important role. Thus, we have to survey the deep structure of the ground and to consider the source effects and so on, in the future developments.