Seismic interference experiment using an array of acoustic ACROSS sources

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We are developing a seismic Accurately Controlled Routinely Operated Signal System (acoustic ACROSS), which continuously generates seismic signal and receive it to monitor the crustal elastic and unelastic properties. We deployed a couple of acoustic ACROSS sources at Toyohashi city, Aichi prefecture. One of the aims of this arrangement is to conduct an interference experiment by multi-sources. We will report the principle of the multi-source interference and the preliminary results of an experiment being conducted in this March.

Generally we use receiver array to search the arrival directions of seismic waves. In addition, source array enable us to concentrate wave energy in aimed direction and we can detect reflected and scattered wave effectively. In this study, we conduct an interference experiment using a couple of acoustic ACROSS sources and receiver array. We search spatial energy distribution in the receiver array with various combination of vibration phase of the sources.

As the feature of ACROSS source, they continuously generate sinusoidal waves by Frequency modulation. The signal from each source cannot be identified by arrival time. In the interference experiment using ACROSS, we use a frequency-shift technique. We operate each ACROSS sources by slightly different carrier frequency and after obtaining the data, we shift the frequency to be same with each other. In the procedure, we can identify the signal from each source and can shift the relative phases arbitrarily.

We conducted a numerical test of this interference experiment in advance of the experiment scheduled in coming March. As a result of the test, we retrieved the spatial interference pattern with variation amplitude of about 5 %, which has larger contrast on the circumference and smaller contrast on the radial line. The small amplitude of 5 % is due to the shortness of the distance 35 m between the sources relative to the wave length of about 400 m.

In the experiment in March, we will compare the generated interference pattern with the predicted one. We will develop a method to search scattering bodies by concentrating the wave energy at the arbitrarily point in the crust.