Japan Geoscience Union Meeting 2012
(May 20-25 2012 at Makuhari, Chiba, Japan)

SSS27-06 Room:103 Time:May 23 10:15-10:30

Time reversal analysis of seismic waves in Suruga Bay

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We have examined the application of time reversal in the field of the ocean acoustics. A sound pulse is radiated from a sound source set up in the sea, and the sound pulse is received by a hydrophone array set up at the remote position. The sound pulse that converges in the original source location is formed when re-emitting it from the array after time reversal processing is given to the received signal. The waveform of the sound pulse that converges in the source location becomes the same as the waveform of the sound pulse radiated there. The vibration of the hypocenter is obtained by applying this principle.

We pay attention to the earthquake of magnitude 6.5 that occurred in the Suruga Bay central part on August 11, 2009 to examine it more widely.

To obtain the propagating environment that is the most important factor for the application of the time reversal, we proposed the inverse problem method using the robustness of the time reversal.

P wave component is cut out from the received signal by the seismometer, and the time reversal processing is given to it. And, the inverted signal is transmitted in the propagating environment on the propagating simulation. And, the pulse formed in the vicinity of the hypocenter, that is, time reversal pulse is obtained.

As a result, the pulses ware greatly different according to the observation station.

We paid attention to the azimuth, and the time reversal pulse was arranged in an azimuthal order. Even if the range and depth are greatly different it, the time reversal pulse of the observation station which the azimuth is near becomes a similar waveform. However, the waveform of the time reversal pulse has changed greatly when the azimuth is changed. Then, the Fourier transform was performed to the time reversal pulse, and frequency spectrum was obtained. As a result, frequency spectrum of the observation station which the azimuth was near was similar. However, the azimuthal dependence of frequency spectrum appeared greatly. Then, the peak frequency of frequency spectrum to the azimuth was obtained.

When this result is examined from an acoustics standpoint, it is clear that the hypocenter corresponds to not a fixed sound source but the maneuvability sound source.

Keywords: Time reversal,, Phase conjugation, hypocenter vibration, Seismic wave propagation, underwater acoustics