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Preliminary Result of Biological Transient Noise Observation Using 2 Sets of 4-Element Hydrophone Array

2組の4素子ハイドロフォンアレイを用いた生物突発性雑音観測の一例

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1. Introduction

Biological transient noise produced by snapping shrimp was used for Ambient Noise Imaging (ANI) in some sea trials [1),2)]. Mori *et. al.* proposed an ANI system with acoustic lens [3),4)]. The investigation of biological transient noise as a sound source for ANI system is indispensable to design a practical system.

On the other hand, it is useful to estimate source position in order to comprehend the characteristic of biological transient noise. A snapping shrimp has one enlarged claw that produces a short acoustic transient signal when snapped closed. A typical waveform of snap has a low intensity positive excursion (precursor) and a short time pulse with high intensity (main pulse) [5)]. In some previous studies, it had been estimated that the principal habitat of snapping shrimp population is the subsurface structure of wharf [6), 7)].

We had observed the snapping noises in Hashirimizu port, Yokosuka on August 2007. Then, the single hydrophone was used and the two minutes recording was conducted every 30 minutes. These observations are continued at 2 weeks. We found that the number of snapping pulses rapidly increase at sunset time. And the pulse number of night time was greater than that of daytime at every day. When the water temperature was relatively warm, the number of snapping pulses increased. [8), 9)]

In this study, we observed biological transient noises with 2 sets of 4-element hydrophone array in August 2009. Our aim was to estimate the positions of those noise sources. The observation site was Hashirimizu port in Yokosuka again. This article reports the observation setups and several examples of the observed signals.

2. Methods and Result

The observation place was the maritime training harbor of National Defense Academy in Hashirimizu (**Fig. 1**). This harbor faces Tokyo bay, the wharf suppresses the surface wave in the harbor. The ship sounds of the marine traffic from Uraga water course are shut out. Therefore this site was suitable to observe only snapping noises. The observation was conducted on August 3-6, 2009.

Fig. 2 shows the arrangement of 2 sets of 4-element hydrophone array. The distance of both sets was about 20 m. The hydrophones were arranged on the part of vertexes of a 1 meter cube. This hydrophone (B&K, Type 8105) makes absolute sound measurements over the frequency range 0.1 Hz to 160 kHz with a receiving sensitivity of -205 dB re 1 V/μPa. It is omni-directional over 360° in the x-y (radial) plane and 270° in the x-z (axial) plane. The received signals were amplified with the gain of 40 dB and those bands are limited from 200 Hz to 200 kHz (System Intech, Aquafeeler SEQ-1001C). Finally, they are digitized by the A/D converter (National Instruments, PXI-1036, PXI-6133, PXI-8360). Its sampling frequency is 1MHz and its quantization bit rate is 14 bits.

Fig. 3 shows the preliminary result of this observation. Each signal has precursor and main pulse. These waveforms agree with those of the sound radiated by snapping shrimp[5)]. We can see the similar waveform sifted on time axis. It is possible to obtain the relative time of arrival snapping noise at each hydrophone.

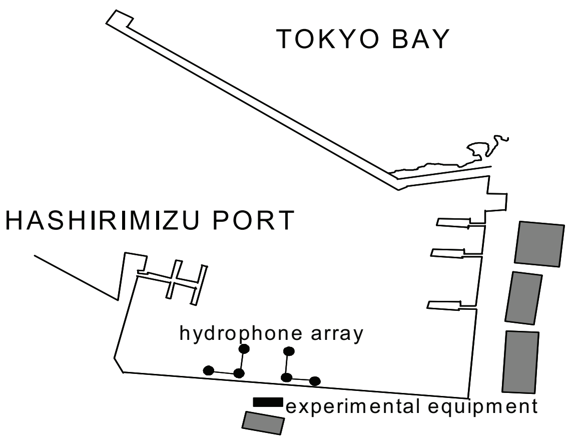

Fig. 1 Maritime training harbor of National Defense Academy in Hashirimizu.

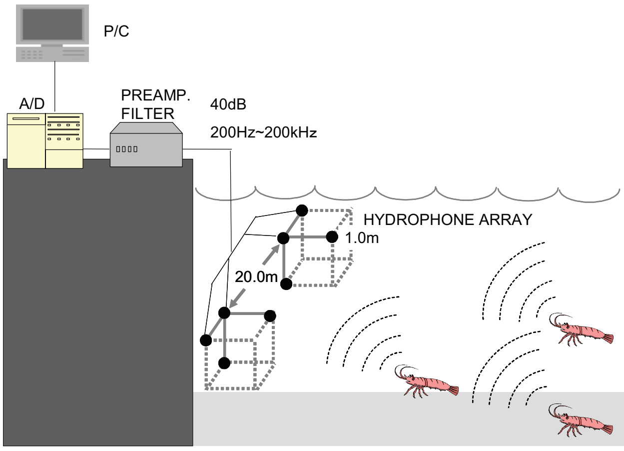

Fig. 2 Block diagram of the experimental equipment for recoding of biological transient noise.

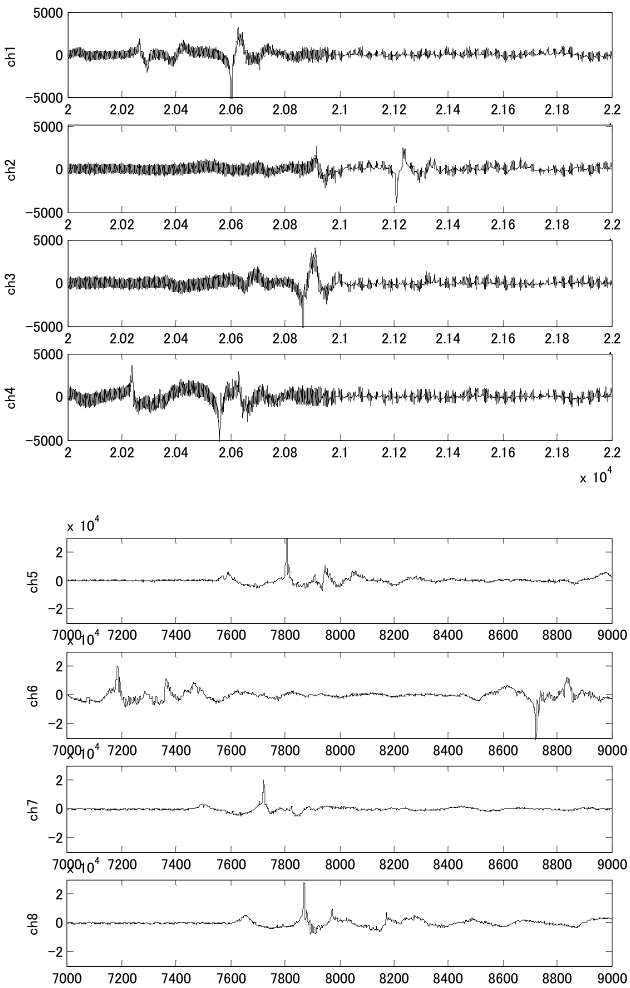
Fig. 3 Examples of observation signals of snapping sound.

3. Conclusion

Measuring the relative times of arrival of the acoustic transient's wavefront at each hydrophone enables to estimate the range and bearing of the source position of the transient. Before estimating the source position of biological transient noise, we tested the measurement accuracy using an artificial sound source. It radiated a burst pulse of the frequency of 80 kHz.

In near future, we will confirm the measurement accuracy estimating the range and bearing of the artificial sound source. Next, the source position of the biological transient noise will be also estimated by this observation data including many snapping pluses.

Finally, it will be possible to estimate the habitat of snapping shrimp in Hashirimizu port. Additionally, the source level of snapping noise will be estimated by the amplitude of received signal and the range of source. These data will be useful for designing ANI system.

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