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# A Basic Study of Movie Shooting of Snapping Shrimp Sound Radiation by Schlieren Method

テッポウエビ発音のシュリーレン動画撮影に関する基礎研究


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## 1. Introduction

Buckingham *et al.* developed a revolutionary idea, which views ambient noise as a sound source rather than a hindrance, and which is neither a passive nor an active sonar. [1] This method is often called ambient noise imaging (ANI), and an acoustic lens system would be a suitable choice for realizing ANI. We already designed and made an aspherical lens with an aperture diameter of 1.0 m for ANI. It was verified that this acoustic lens realizes directional resolution, which is a beam width of 1° at the center frequency of 120 kHz over the field of view from -7 to +7°. [2] In the 1st and 2nd sea trials, the silent targets were successfully imaged under only ocean natural ambient noise, which is mainly generated by snapping shrimps. [3-5] In the 3rd sea trial, the frequency-dependent targets were effectively imaged by RGB additive color mixing. [6] By the way, it is important to survey biological transient noises produced by snapping shrimps, which may be the main noise sources in ANI applications in coastal waters. Versluis *et al.* firstly observed the claw motion of snapping shrimp, and generation and collapse of cavitation bubble at the impulsive sound radiation using the high-speed video camcorder. [7] In this study, we tried to visualize the impulsive sound radiation of snapping shrimp using by Schlieren Method. The way to movie shooting of the sound radiation and several examples of the recorded frames are described in this report.

## 2. Movie Shooting and Results

The samples of snapping shrimps were captured in Hashirimizu Port at Yokosuka and Uchiura Bay at Numazu. The three samples which may be subspecies of Alpheus were used in the movie shootings. Each sample was fixed in the glass water tank filled with the artificial sea water. Its size is 17 cm (width), 25 cm (height), and 30 cm (depth). The Schlieren measurement system is SS100 (Kato Koken) using "W-Pass Method" in which the parallel lights pass the measurement space twice. The light radiated from the point light source is converged to the parallel beam by the optical system, the beam is converged again after passing the measurement space. Finally, the converged light is interrupted by the knife edge in the Schlieren measurement system. As shown in Fig. 1, the movie shootings were performed when the water tank was arranged in the measurement space. The high-speed video camcorder was PHANTOM v2512 (Vision Research). Here, the light source was the Xenon lamp of 75 W. The output image of SS100 was recorded with 128×128 pixels and 200,000 fps. The frame interval was 5 μs, the exposure time was 1 μs every a frame. The movie data were stored as the AVI files at the frame rate of 30 fps, thus the time scale is 6666 times.

Several examples of frames in the movie obtained by Schlieren method are shown in Fig. 2. Frame 1 shows that the craw is fully opened, and Frame 48 shows that the craw is fully closed. The cavitation bubble is maximum generated after the claw close in Frame 122, and the tips are torn then. The bubble is collapsed in Frame 141, the spherical pulse sound is immediately radiated in Frame 142. The sound is spreading in Frame 143 still wider. The rebounded bubble is maximum generated in Frame 164, and is collapsed in Frame 190. Then, the 2nd spherical pulse sound is radiated in Frame 191. The movie shooting was succeeded, as shown in these examples.

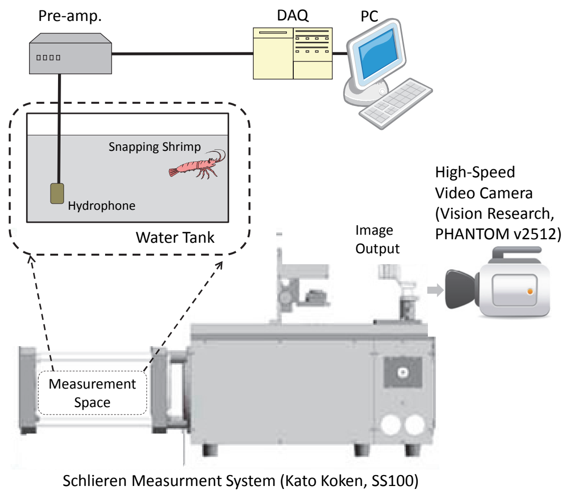


Fig. 1　Measurement Setups.

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**References**

1. M. J. Buckingham, B. V. Verkhout and S. A. L. Glegg: Nature, **356** (1992) 327.
2. K. Mori, H. Ogasawara, T. Nakamura, T. Tsuchiya, N. Endoh: Jpn. J. Appl. Phys., **50** (2011) 07HG09.
3. K. Mori, H. Ogasawara, T. Nakamura, T. Tsuchiya, N. Endoh: Jpn. J. Appl. Phys., **51** (2012) 07GG10.
4. K. Mori, H. Ogasawara, T. Nakamura, T. Tsuchiya, N. Endoh: Jpn. J. Appl. Phys., **52** (2013) 07HG02.
5. K. Mori, H. Ogasawara, T. Tsuchiya, and N. Endoh, J. Appl. Phys., **55** (2016) 07KG07.
6. K. Mori, H. Kawahara, H. Ogasawara, and T. Tsuchiya, J. Appl. Phys., **57** (2018) 07LG05.
7. M. Versluis, B. Schmitz, A. von der Heydt, D. Lohse, Science, **289** (2000) 2114.

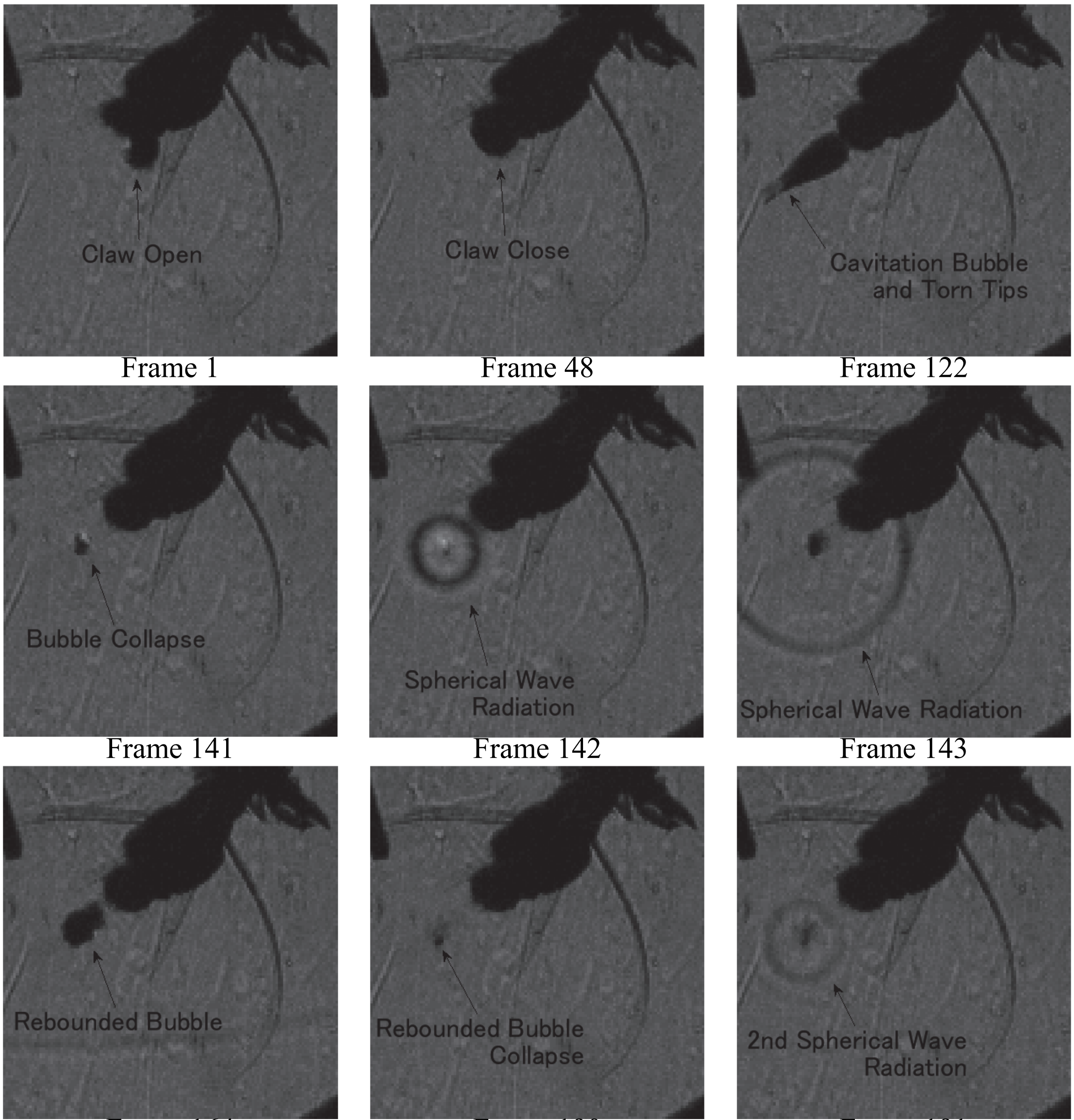


Fig. 2 Examples of Visualization of Snapping Shrimp Sound Generation Using Schlieren Method.