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P07

音波浮遊法における浮遊液滴近傍の波の解析

Analysis of Waves Near Floating Droplets by the Acoustic Levitation Method

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1. Introduction

The acoustic levitation method is the way to control the location of the levitated sample by the acoustic pressure[1)]. A stabilization point is made with a standing wave from a couple of transducers. The traditional methods of acoustic levitation, high power transducers, such as Langevin oscillators, must be used. Recently, the array of small speakers can be used for this method and the sound field can be controlled by the controlling the phase of each speaker, which is called as a phased array method. In the last year, we accomplished the levitation of water droplet whose diameter was 2mm by using the arrays of small speaker.

In this study, we try to reveal the sound field around the levitated sample by using the acoustic levitation. Then, we use Schlieren photography technique to acquire the image of standing waves near the floating droplet. The obtained images will be contributed to the development feedback control system of sample position in the near future.

2. Experimental Method

2.1 The acoustic levitation device

We have developed the acoustic levitation device of speaker arrays. Around 40 speakers arranged on a concave surface (concave array) which was made by 3D printer. A pair of concave array was used. The one was placed at lower and others was placed upper facing each other. The distance between concave arrays was around 200 mm. Each speaker was driven by using a push-pull circuit with a function generator whose frequency was 40 kHz. For the purpose, we used acoustic transducer MA404S made by MURATA MFG. By using this device, the water droplet whose diameter was 2mm can be floated.

2.2 Schlieren photography technique

We used a usual Schlieren optics. The configuration of optics is shown in **Fig.1**.
The light source was halogen lamp. The acoustic levitation device was installed at the center of concave mirrors. The image was captured by CCD camera (KP-D20B manufactured by Hitachi Kokusai Electric Inc.) with a macro zoom lens.

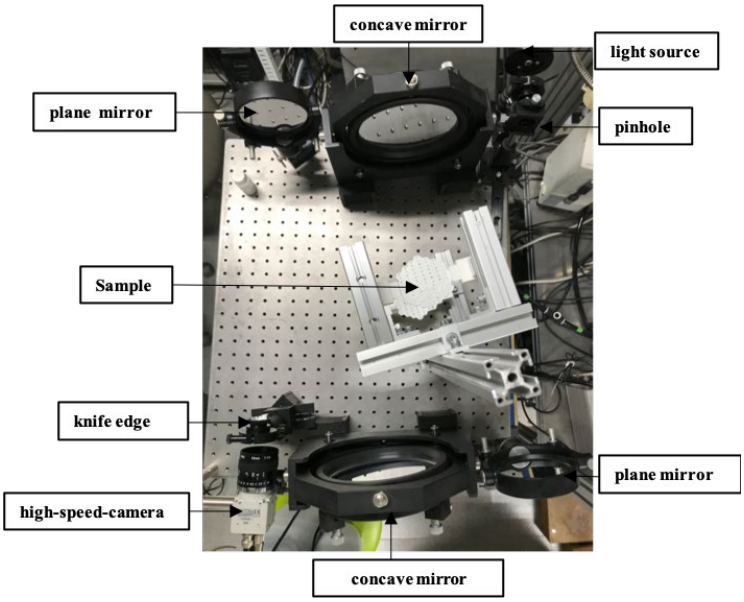

Fig.1 the Schlieren optics

2.3 Image processing and analysis

By using Schlieren optics, the density difference of air can be observed as light and shade of image. In order to eliminate obstacle fringes and noises, we made a software for the image analysis via python. Specifically, we eliminated the obstacle noise by the median filter and the obstacle fringe by subtracting **b** from a in **Fig.2.** We analyzed the wave length of standing wave, distribution of sound field around the sample.

3 Results

The image acquired by the **S**chlieren photography technique is shown in **Fig.2**.

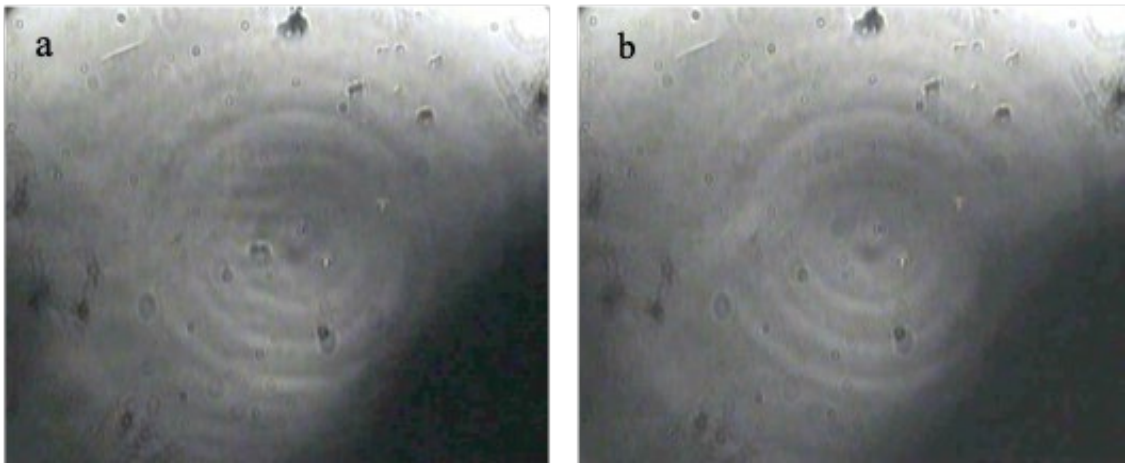

Fig.2 Observation results by Schlieren photography technique (a: sound on, b : sound off)

The standing wave can be seen as slightly difference of light and shade around the center of the image. In order to emphasize it, we carried out the subtraction of image. The image of standing waves extracted by image processing is shown in **Fig.3.** The standing wave and levitated sample was clearly observed.

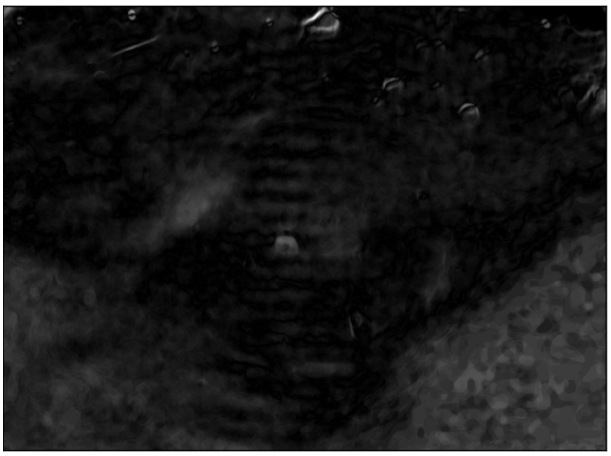

Fig.3 Result of image processing

4 Conclusion

By Using the Schlieren method, we can acquire the image of standing waves around the levitated droplets. We try to make clear about control parameters of the stability of levitating droplet.

References

1) T. Ishikawa, a doctoral thesis, (2001), Tokyo Institute of Technology.