

## Ultrasonic Stimulation Equipment for Aquaculture

### 魚養殖用超音波刺激装置

Yohachi (John) Yamashita<sup>†</sup>, Hiroki Sugiura, Hayato Sasaki, and Tomoaki Karaki  
(Dep. of Intelligent Systems Design Engineering, Toyama Prefectural Univ.)

山下 洋八<sup>†</sup>, 杉浦 弘樹, 佐々木 勇翔、唐木 智明 (富山県立大学 工学部 知能デザイン工学科)

#### 1. Introduction

Aquaculture, also known as aquafarming, is the farming of aquatic organisms such as fishes, crustaceans, molluscs and aquatic plants. According to the United Nation (UN) Food and Agriculture Organization (FAO) aquaculture is the fastest growing food-producing sector and in 2014 accounts for almost 50% of the world fish being used for food in both developing and developed economies.

Due to a steady increase of world population to 7.2 billion in 2014, and continuing shortages of food worldwide, the mapping of research and development's innovative aquaculture methods are, according to the UN agencies going to be among priority tasks for aquaculture researchers worldwide.

However, regardless these urgent global needs, many of conventional aquaculture methods have frequently been limited to feeding, water temperature and stream control. Subsequently, our research team proposes a use of ultrasound to increase the growth and survival rate of fish in aquafarming conditions.

Ultrasound is an oscillating sound pressure wave with a frequency greater than the upper limit of the human hearing range, 20 kHz. Ultrasound has been used in many different applications, such as sonar, fish finder, cleaning, and medical imaging. However, ultrasound application for aquaculture field is a little known except fish finder. Only a few reports<sup>1)</sup> published by researchers in India in 2006 could be found. While it is relatively easy to install the ultrasonic stimulation equipment and immerse it into the water of aquaculture tank, two practical problems have to be dealt with: 1) A difficulty to directly eject uniform ultrasound power to the fishes in the aquaculture tanks. 2) In addition, it is difficult to change ultrasonic direction and to maintain the equipment.

In this report, to solve the above outlined practical problems, we developed a new floating type of ultrasonic stimulation equipment for aquaculture application. This innovative solution could be easily replicable and readjusted to the local field conditions, as well as to regional climatic changes and the changing socio-economic needs of fish suppliers and fish consumers in developing and developed economies.

#### 2. Experimental and results

Figure 1 illustrates a schematic image of the floating type ultrasonic stimulation equipment for aquaculture. The equipment has several ultrasonic transducers with different ultrasonic power directions. In addition, the equipment can flow on the surface of the tank, the ultrasonic power for fishes in the tank become uniform as shown in Fig.1

Figure 2 shows main parts of the equipment. The equipment has four important parts, aluminum metal pan, 1.0 MHz ultrasonic device, 100 Hz sonic device, and its control circuit as shown in Fig. 2.

Figure 3 shows top and bottom views of the floating equipment. The equipment has four 40 mm in diameter of 1.0 MHz ultrasonic devices, one sonic device, and a power supply as shown in Fig. 3.

Figure 4 shows aquaculture sea-water tanks and the floating ultrasonic stimulation equipment. The dimension of a big tank is 1.6 x 1.0 x 0.6 m, and its capacity is about 0.4 m<sup>3</sup> when the water depth is 0.26 m. A small tank, 0.8 x 0.55 x 0.48 m<sup>3</sup> was placed in the large tank. Air flow of 7 m<sup>3</sup>/day was supplied from air pump during all stage of experiment.

Figure 5 shows ultrasonic stimulation for aquaculture fishes in sea-water tanks and the floating ultrasonic stimulation equipment. The equipment can eject a uniform ultrasonic power to fishes in the tank utilizing reflection of ultrasound

from bottom, side and water-surface of the aquaculture tank as shown in Fig. 1 and 5. The ultrasonic stimulation experiments for several fishes have been carried out using the equipment, and optimistic results were obtained.

### 3. Conclusion

Floating type ultrasonic stimulation equipment for aquaculture application was designed and manufactured. The equipment ejects a uniform ultrasonic power to fishes in the tank utilizing reflection of ultrasound from bottom, side and water-surface of the aquaculture tank. As both the manufacturing of basic equipment and the acceleration of fish growth process require a low initial investment, and could be relatively quickly expanded into a mass production of fish, our innovative solution may contribute to solving the world food shortages in the near future.

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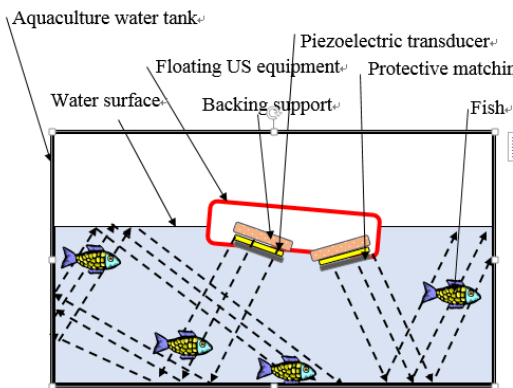


Fig.1 Schematic image of the floating ultrasonic stimulation equipment.

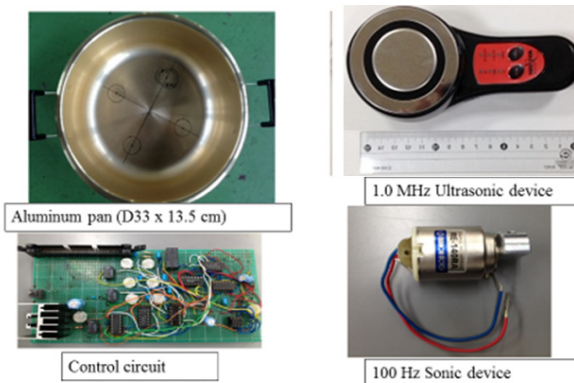


Fig. 2 Main parts of the floating ultrasonic stimulation equipment.

### References

1. <http://www.fishgrower.com/>

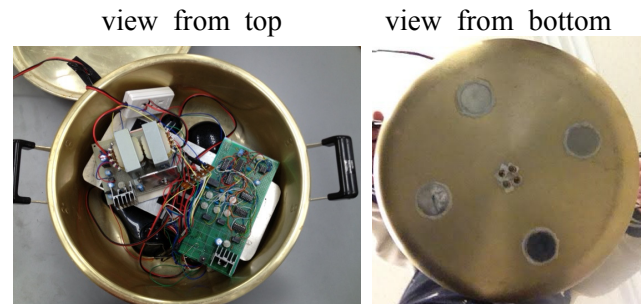


Fig. 3 Top and bottom view of the floating ultrasonic stimulation equipment.

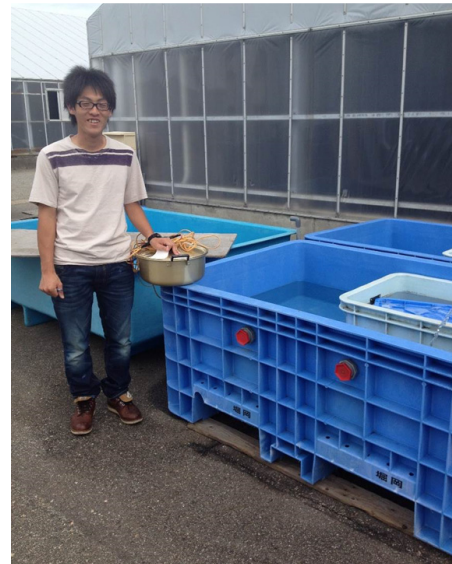


Fig. 4 Aquaculture sea-water tanks and the floating ultrasonic stimulation equipment.

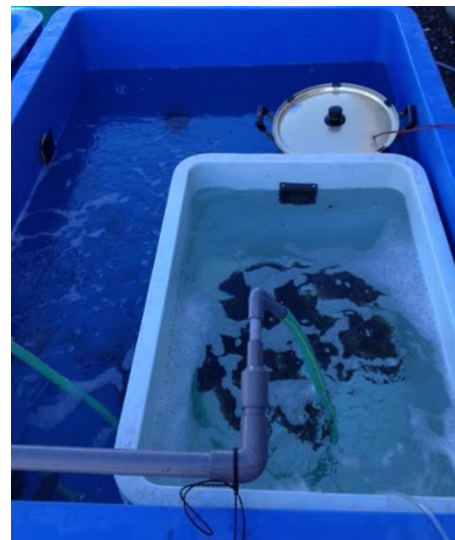


Fig. 5 Ultrasonic stimulation for aquaculture fishes in sea-water tanks and the floating ultrasonic stimulation equipment.