*The 2022 World Congress on*
***The 2022 Structures Congress (Structures22)***
*16-19, August, 2022, GECE, Seoul, Korea*

# Kinematic of a flexible foil near an air-water interface

Min Sik Kang[2] and *Sung Goon Park[1]

[2] *Department of Mechanical Engineering, Seoul National University of Science and Technology, Seoul 01811, Korea*
[1] *Department of Mechanical and Automotive Engineering, Seoul National University of Science and Technology, Seoul 01811, Korea*

[2] *kams1302@seoultech.ac.kr*
[1] *psg@seoultech.ac.kr*

## ABSTRACT

Two-dimensional simulations are performed to investigate the hydrodynamic effect of an air-water interface on the flapping kinematics of a flexible fin. An immersed boundary method is adopted to consider the interaction between the flexible fin and the surrounding fluid. Coupled level-set and volume of fluid (CLSVOF) method is used to capture the air-water interface. The leading edge of the flexible fin is imposed by the heaving motion, the trailing edge, on the other hands, are set to freely move due to the fluid-flexible body interaction. The effects of the submergence depth and heaving frequency of the flexible fin on its flapping dynamics are mainly analyzed. The submergence depth ranges from 0.5*L* to 8*L*, where *L* is the length of the fin. The boundary condition is imposed on the leading edge to induce the heaving motion, and its frequency is determined to be 0.5, 1, and 1.5 times the wave frequency. The flexible fin shows the single flapping mode if the heaving frequency is the same to that of the oncoming wave, otherwise it shows multiple flapping modes. As the submergence depth increases, the flapping amplitude of the fin tends to increase when the heaving frequency is synchronized to be the oncoming wave frequency. The input power, thrust force and efficiency gradually increase with the increment of the depth, and then tend to converge beyond a certain level. This implies that the flexible fin takes disadvantage from flapping near the air-water interface when its motion is synchronized with the wave motions. It is observed that the advantage from flapping near the air-water interface largely depends on not only the submergence depth but also the phase difference between the fin motion and the oncoming wave. The present study could improve the understating of the underlying mechanism at which the foil gets benefit from flapping near the air-water interface.

---

[1] Professor
[2] Graduate Student