Park, Sung Goon; **Sung, Hyung Jin**

Vortex interaction between two tandem flexible propulsors with a paddling-based locomotion. (English) Zbl 1382.76312

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Summary: Schooling behaviours among self-propelled animals can benefit propulsion. Inspired by the schooling behaviours of swimming jellyfish, flexible bodies that self-propel through a paddling-based motion were modelled in a tandem configuration. This present study explored the hydrodynamic patterns generated by the interactions between two flexible bodies and the surrounding fluid in the framework of the penalty immersed boundary method. The hydrodynamic patterns produced in the wake revealed flow-mediated interactions between two tandem propulsors, including vortex–vortex and vortex–body interactions. Two tandem flexible propulsors paddling with identical amplitude and frequency produced stable configurations as a result of the flow-mediated interactions. Both the upstream and downstream propulsors benefited from the tandem configuration in terms of the locomotion velocity and the cost, compared with an isolated propulsion system. The interactions were examined as a function of the initial gap distance and the phase difference in the paddling frequency. The equilibrium gap distance between two propulsors remained constant, regardless of the initial gap distance, although it did depend on the phase difference in the paddling frequency.

MSC:

76Z10 Biopropulsion in water and in air
74F10 Fluid-solid interactions (including aero- and hydro-elasticity, porosity, etc.)
76D17 Viscous vortex flows
92C05 Biophysics

Cited in **2** Documents

Keywords:

flow–structure interactions; swimming/flying; vortex dynamics

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