

Abstract Submitted
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Flapping modes of three filaments placed side by side in a free stream¹ FANG-BAO TIAN, University of Science and Technology of China, HAOXIANG LUO, Vanderbilt University, LUODING ZHU, Indiana University–Purdue University Indianapolis, XI-YUN LU, University of Science and Technology of China — Flexible filaments flapping in a surrounding flow are useful models for understanding the flow-induced vibration and mimicking the schooling behavior of fish. In the present work, the coupled modes of three identical filaments in a side-by-side arrangement are studied using the linear stability analysis and also an immersed boundary–lattice Boltzmann method for low Reynolds numbers (Re on order of 100). The numerical simulations show that the system dynamics exhibits several patterns that depend on the spacing between the filaments. Among these patterns, three can be predicted by the linear analysis and have been reported before. These modes are: (1) the three filaments all flap in phase; (2) the two outer filaments are out of phase while the middle one is stable; (3) the two outer filaments are in phase while the middle one is out of phase. The simulations also identified two additional modes: (1) the outer two filaments are out of phase while the middle one flaps at a frequency reduced by half; (2) the outer two filaments are out of phase while the middle one flaps at a slightly different frequency. In addition to the vibratory modes, the drag force and the flapping amplitude are also computed, and the implication of the result will be discussed.

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