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Numerical simulation of self-propulsion of flapping flexible plates
XI-YUN LU, RU-NAN HUA, University of Science and Technology of China, FLUID MECHANICS TEAM — Self-propulsion of flapping flexible plates has been studied numerically by means of an immersed boundary-lattice Boltzmann method for the fluid dynamics around the plate and a finite element method for the deformable flapping motion of the plate. Both the two- and three-dimensional flexible plates are investigated to reveal the propulsion properties and their differences. As a result of the fluid-plate interaction, three typical movement regimes have been identified and can be briefly described as forward, backward, and irregular movements which mainly depend on the flapping amplitude and bending rigidity. It is found that there exists an optimal range of the bending rigidity for large propulsive speed or high efficiency in the forward movement regime, consistent with the observation and measurement of swimming and flying animals. The results obtained in this study provide physical insights into understanding of the propulsive mechanisms of the flapping fin or wing of animals.

Xi-Yun Lu
University of Science and Technology of China

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