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Efficient swimming of a plunging elastic plate in a viscous fluid

PETER YEH, ALEXANDER ALEXEEV, Georgia Institute of Technology — We use three dimensional computer simulations to examine the combined hydrodynamics and structural response of a plunging elastic plate submerged in a viscous fluid with Reynolds number of 250. The plate is actuated at the root with a prescribed vertical sinusoidal displacement and a zero slope (clamped) boundary condition. We explore the steady state swimming velocity and the associated input power as a function of driving frequency, added mass, and aspect ratio. We find a universal bending pattern independent of geometry and added mass that maximizes the distance traveled per unit applied work. This bending pattern is associated with minimizing center of mass oscillations normal to the direction of travel. Subsequently, the flow around the sides of the swimmer, which does not aid in propulsion, is minimized, thereby reducing viscous losses.

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