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An autonomous sperm-like propulsor in a quiescent flow BOYOUNG KIM, SUNG GOON PARK, HYUNG JIN SUNG, KAIST — Flapping motions of flexible fins are widespread in nature. Birds, fish, and insects use their wings, fins, or bodies to stay afloat and to advance forward in the surrounding fluids. It is important to understand the physics of the flapping motions to utilize them for the biomimetic machines. In the present study, we introduce a sperm-like propulsor that consists of a rigid head containing genetic information and a flapping flexible tail for propulsion. The head gives a sinusoidal torque to the leading edge of the tail, and the flexible tail flaps along the leading edge. In other words, the sperm-like propulsor is moved by an oscillating relative angle between the head and the leading edge of the tail. Unlike self-propelled heaving and pitching fins, the 'autonomous' sperm-like propulsor has no prescribed motion or constraint referenced from outside coordinates. The penalty method and the immersed boundary method are used to solve the autonomous sperm-like propulsor in a quiescent flow. The cruising speed and the propulsive efficiency of the propulsor are explored as a function of the head size (D/L), the pitching angle (θ_0), the pitching frequency (f), and the distance from the wall (G/L).

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