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Thickness-varying flexible plunging fins swim more efficiently YUANDA LI, Massachusetts Institute of Technology, PETER YEH, ALEXANDER ALEXEEV, Georgia Institute of Technology — We use three dimensional computer simulations to probe the hydrodynamics of oscillating flexible fins with varying thickness. The fin is modeled as an elastic rectangular plate with the thickest section at the leading edge, decreasing linearly until the trailing edge. The plate is modeled as infinitely thin, and we assume that the thickest part of the fin is much smaller compared to its other length scales. Therefore, we simulate the swimmer as two dimensional plate and introduce the effect of the thickness gradient by including an appropriate mass gradient and stiffness gradient along the length of the plate. The flexible fin is actuated by a plunging motion at its leading edge. We evaluate the performance of the swimmer by measuring the steady state thrust, free swimming velocity, input power, and swimming economy as a function of driving frequency and the magnitude of the thickness gradient. We find a wideband frequency range in which the swimming economy is increased as compared to a uniformly thick swimmer. These findings may shed insight into some of the physical mechanisms that allow fish to have high swimming efficiency.

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