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Fish robotics and hydrodynamics

GEORGE LAUDER, Harvard University

Studying the fluid dynamics of locomotion in freely-swimming fishes is challenging due to difficulties in controlling fish behavior. To provide better control over fish-like propulsive systems we have constructed a variety of fish-like robotic test platforms that range from highly biomimetic models of fins, to simple physical models of body movements during aquatic locomotion. First, we have constructed a series of biorobotic models of fish pectoral fins with 5 fin rays that allow detailed study of fin motion, forces, and fluid dynamics associated with fin-based locomotion. We find that by tuning fin ray stiffness and the imposed motion program we can produce thrust both on the fin outstroke and instroke. Second, we are using a robotic flapping foil system to study the self-propulsion of flexible plastic foils of varying stiffness, length, and trailing edge shape as a means of investigating the fluid dynamic effect of simple changes in the properties of undulating bodies moving through water. We find unexpected non-linear stiffness-dependent effects of changing foil length on self-propelled speed, and as well as significant effects of trailing edge shape on foil swimming speed.