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Hydroelastic Tuning in Fish Swimming BENJAMIN CONNELL, Applied Physical Sciences Corp — Recent studies have indicated the importance of structural properties to the hydroelastic response of passive flexible bodies in uniform flow. One response regime includes a structural traveling wave of increasing amplitude from leading to trailing edge with alternating vortex shedding in the wake. This modal response exhibits the same characteristics as fish swimming, suggesting the importance of the natural hydroelastic response in fish swimming actuation. We explore the concept of underactuation in fish swimming by examining the ability to achieve swimming kinematics through single point forcing of a flexible body. The phenomenon is first studied through simulation of the Navier-Stokes equations coupled to a nonlinear structural solver. This indicates the relationship between passive and active modal response, and the ability to alter the vortex wake and associated hydrodynamic loading through underactuation. A reduced-fidelity model for the fluid-structural dynamics is employed to optimize the properties of a fish body for the desired underactuated modal response. The optimized design is then tested in a captive-swimming experiment to examine the response modes and swimming performance.

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