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Vortex Ring Formation in the Wake of Biologically Inspired Flapping Foils M.B. READ, M.J. KRUEGER, A.H. TECHET, MIT Department of Mechanical Engineering — The design of biologically inspired propulsion mechanisms for underwater vehicles continues to generate significant interest in the hydrodynamics of fish swimming. Flapping foils, mimicking fish fins, have been shown to produce significant thrust and have been implemented on prototype underwater vehicles. Here, the three-dimensional vortical structures in the wake of a finite aspect ratio flapping foil are investigated in order to model the three dimensional propulsive signature of swimming fish and flapping foils. The vortical patterns in the wake of a flapping foil are visualized using qualitative fluorescent dye methods, imaged in three views: planform, wing-tip and isometric. Reynolds number based on foil chord length is 165. The foil is forced to heave and pitch with a prescribed motion mimicking that of a swimming fish tail. The visualizations reveal the formation of a pair of coherent, curved, and interconnected ring-like vortices for each full flapping cycle. The wake evolution shows a dependence on Strouhal number and foil motion kinematics; Strouhal number was varied between 0.1 and 0.4. Experimental visualization results compare well with recent numerical simulations using the same parameters. An analogy the model of the wake of a swimming fish is also explored.

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