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Tuna Swimming: An Enhanced Hydrodynamic Performance by Finlets[1] JUNSHI WANG, University of Virginia, DYLAN WAINWRIGHT, Yale University, GEORGE LAUDER, Harvard University, HAIBO DONG, University of Virginia — Finlets are commonly equipped by scombrid fishes (mackerels, bonitos, and tunas) which are known for their high swimming speed. The finlets are a series of small non-retractable fins located on the dorsal and ventral margins of the fish body. It is thought these small fins would potentially affect the propulsive performance of fish swimming. In this work, a combined experimental and computational approach is used to investigate the hydrodynamics of a live tuna undergoing steady swimming. High-resolution videos of the swimming fish are obtained and used as a basis for developing high-fidelity models of tuna locomotion with independently mobile finlets. Simulations are carried out using a Cartesian-grid based immersed boundary flow solver to examine the hydrodynamic performance and vortex dynamics of tuna swimming. An adaptive mesh refinement (AMR) method is used to gain a higher resolution of the finlet flow. It is found that the hydrodynamic interactions between finlets, trunk, and caudal fin play an important role in the thrust generation and propulsion efficiency of tuna swimming. Results from this study help to bring novel insights into the design of high-performance underwater vehicles from a vortex dynamics perspective.

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