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Fin-Body Interaction and its Hydrodynamic Benefits in Fish's Steady Swimming[1] GENG LIU, YAN REN, HAIBO DONG, University of Virginia, GEORGE LAUDER, Harvard University — In many past studies on fish swimming, the hydrodynamics of fish caudal fins were investigated separately. However, fish body inevitably interacts with the caudal fin since the fin flaps in the wake of the body during swimming. In this work, an integrated experimental and computational approach has been used to investigate hydrodynamic performance improvement and the vortex dynamics associated with the fin-body interactions of a jack fish in steady swimming. Realistic 3D jack fish geometry and the undulatory kinematics are reconstructed based on the output of a high-speed photogrammetry system. Hydrodynamic performance and wake structures are simulated by an in-house immersed-boundary-method flow solver. It is found that the body-fin interactions enhance the thrust production of the caudal fin by more than 30% compared to that produced by an isolated caudal fin. Further analysis on the vortex dynamics has shown that the vortices shed from the posterior part of the fish body are captured by the leading edge portion of the caudal fin. This further enhances the strength of the leading-edge vortex attaching to the caudal fin and results in larger thrust production. This work reveals a potential performance enhancement mechanism in fish's steady swimming.

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