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Flow-structure Interaction Modeling of a Fish Caudal Fin during Steady Swimming GENG LIU, BIAO GENG, XUDONG ZHENG, QIAN XUE, University of Maine, HAIBO DONG, University of Virginia — It's widely thought that the flexibilities of fish fins play critical roles in propulsive performance enhancement (such as thrust augment and efficiency improvement) in nature. In order to explore the formation mechanisms of the fish fin's flexible morphing and its hydrodynamic benefits as well, a high-fidelity flow-structure/membrane interaction modeling of the fish caudal fin is conducted in this work. Following the realistic configuration of the fish caudal fin, a thin membrane supported by a series of beams is constructed. The material properties of the membrane and the beams are reversely determined by the realistic fin morphing obtained from the high-speed videos and the high fidelity flow-structure interaction simulations. With the accurate material property, we investigate the interplay between structure, kinematics and fluid flow in caudal fin propulsion. Detailed analyses on the relationship between the flexural stiffness, fin morphing patterns, hydrodynamic forces and vortex dynamics are then conducted.

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