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On the efficient swimming of a ray-inspired underwater vehicle. Part II: Computational analysis of fin hydrodynamics[1] GENG LIU, YAN REN, JIANZHOU ZHU, HILARY BART-SMITH, HAIBO DONG, Department of Mechanical and Aerospace Engineering, University of Virginia — High-fidelity numerical simulations are being used to examine the key hydrodynamic features and thrust performance of the fin of a manta ray-inspired underwater vehicle (MantaBot) which is moving at a constant forward velocity. The numerical modeling approach employs a parallelized DNS immersed boundary solver for low-Reynolds number flows past highly deformable bodies such as fish pectoral fins and insect wings. The three-dimensional, time-dependent fin kinematics is obtained via a stereo-videographic technique. The primary objectives of the CFD effort are to quantify the thrust performance of the MantaBot fin with different bending stiffness as well as to establish the mechanisms responsible for thrust production. Simulations show that the bending angle and bending rate of the fin play important roles in thrust producing. A distinct system of connected vortices produced by the deformable fins is also examined in detail for understanding the thrust producing mechanisms.

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