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Flow-Induced Vibration of Flexible Hydrofoils in Incompressible, Turbulent Flows EUN JUNG CHAE, DENIZ TOLGA AKCABAY, YIN LU YOUNG, University of Michigan — Flexible lifting bodies can be used to enhance the energy-efficiency and maneuverability of propulsion devices compared to their rigid counterparts. To take advantage of advances in materials and active/passive control techniques, an improved understanding of the fluid-structure interaction physics is needed. This numerical study focuses on flexible hydrofoil in incompressible, turbulent flows. The spanwise bending and twisting of a rectangular, cantilevered hydrofoil was modeled as 2DOF equations of motion coupled with the unsteady RANS equation. The results, which have been validated with experimental measurements, showed that the natural frequencies are lower in water compared to those in air due to the added mass effect, and the natural frequencies vary slightly with speed and angle of attack due to hydrodynamic bend-twist coupling and viscous effects. Lock-in of the vortex shedding frequencies with the natural frequencies was observed, along with modification of the wake patterns due to hydrodynamic bend-twist coupling. The hydrodynamic damping was found to be much greater than structural damping, and depends on the relative velocity, angle of attack, as well as structural stiffness and density, and can lead to destabilizing condition of structure in particular cases.

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