Abstract Submitted
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The fluid dynamics of mayfly naiads[1] K. ABDELAZIZ, E. BALARAS, K. KIGER, University of Maryland — The present work is focused on the study of mayfly naiads (nymphs) as a possible biological model for the efficient generation of external circulation currents in low to intermediate Reynolds number flows. Our primary objective is to validate a series of high-fidelity simulations we conducted by comparisons to experimental results obtained at an earlier stage of the project. For this purpose a realistic 3D model of the mayfly is constructed. It includes the abdomen, thorax, head, and six pairs of gills. Each gill is represented by two, zero-thickness rigid plates, which are hinged to at the location of the primary flexion line. The kinematics for all gills are prescribed and derived from the experiments. In particular, the trajectory of a set of points recorded in the experiments is translated into a sequence of Euler angles, which are then fed to a three-level kinematic chain enabling the derivation of all rigid body kinematics in the inertial frame. A Navier-Stokes solver in Cartesian coordinates is used and boundary conditions on the complex moving bodies are imposed with an embedded-boundary, direct forcing approach. The phase averaged numerical results are in good agreement with the corresponding particle image velocimetry (PIV) data from the experiment. The effects of gill kinematics and Reynolds number will also be discussed.

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