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Numerical and Experimental Investigation of Flow Structures During Insect Flight[1] CAMLI BADRYA[2], JAMES D. BAEDER[3], University of Maryland, Aerospace department, College Park — Insect flight kinematics involves complex interplay between aerodynamics structural response and insect body control. Features such as cross-coupling kinematics, high flapping frequencies and geometrical small-scales, result in experiments being challenging to perform. In this study OVERTURNS, an in-house 3D compressible NavierStokes solver is utilized to simulate the simplified kinematics of an insect wing in hover and forward flight. The flapping wings simulate the full cycle of wing motion, i.e., the upstroke, downstroke, pronation and supination.The numerical results show good agreement against experimental data in predicting the lift and drag over the flapping cycle. The flow structures around the flapping wing are found to be highly unsteady and vortical. Aside from the tip vortex on the wings, the formation of a prominent leading edge vortex (LEV) during the up/down stroke portions, and the shedding of a trailing edge vortex (TEV) at end of each stroke were observed. Differences in the insect dynamics and the flow features of the LEV are observed between hover and forward flight. In hover the up and downstroke cycles are symmetric, whereas in forward flight, these up and downstroke are asymmetric and LEV strength varies as a function of the kinematics and advance ratio.

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