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Wing kinematics and unsteady aerodynamics of hawkmoth in hovering and forward flight SETH LIONETTI, Villanova University, TYSON L. HEDRICK, University of North Carolina at Chapel Hill, CHENGYU LI, Villanova University — The hawkmoth (Manduca sexta) is able to control its flight speed by modifying the flapping motion of its wings. As a result, the hawkmoth's wing kinematics, lift/drag force generation, and power requirements vary across different flight speeds. The goal of this work aims to compare the aerodynamics involved in hawkmoth hovering to those in forward flight. High-speed video recordings and 3D surface reconstruction were used to capture a hawkmoth's wing kinematics when hovering at 0m/s and at forward flight speeds of 2m/s, 3m/s, and 4m/s. Following reconstruction, the insect model was imposed in an in-house immersed-boundary-method based computational fluid dynamics (CFD) solver. The CFD solver provided a quantitative measure of the force generation, power requirements, and complex vortex structures generated during sustained flight. These results enable the analysis of certain trends in how hawkmoths adjust flapping kinematics and its associated unsteady aerodynamics across different flight speeds.

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