Abstract

In recent years, robotics has advanced, yielding aerial vehicles mimicking the flight of insects and birds. This thesis presents an open-source simulation for the Cooper Union Bio-Inspired Robotics Design (CUBIRD) Flapping Wing Micro Air Vehicle (FWMAV) project, aiming to create a lightweight, accessible FWMAV. Despite abundant resources for rotary or fixed-wing drones, FWMAV development lacks accessible tools due to complex design requirements and the need for more advanced controllers. This simulation bridges this gap, enabling users to test the effects of various changes in their design choices. The adaptable simulation accommodates various FWMAV sizes and configurations, allowing adjustments to critical dimensions like wing shapes and the center of mass position. A modified quasi-steady aerodynamic model, based on blade element theory, accurately computes forces and moments during flapping motion, considering factors like unsteady leading edge vortex effects, rotational effects, and added mass effects. The simulation was verified by comparing a purchased FWMAV’s movement to a simulated counterpart under identical conditions. The simulation displayed similar flight patterns with small oscillations appearing and possessed similar trends in the overall trajectory and rotation of the FWMAV. Minor discrepancies suggest room for improvement in the body and tail aerodynamic models and the necessity
of more precise wing shape equations. Nevertheless, the simulation serves as a valuable design tool, allowing users to explore the impact of different designs on FWMAV performance. In summary, this thesis contributes an accessible and versatile simulation platform, fostering future innovations in FWMAV research and development.