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Optimization of Kinematics of a Flapping Wing Mechanism[1]
RYAN GEORGE, SCOTT THOMSON, CHRISTOPHER MATTSON, MARK COLTON, MIKE TREE, Brigham Young University — Flapping flight offers several potential advantages over conventional fixed wing flight, such as agility and maneuverability in confined spaces, potentially decreased noise and detectability, and hovering capability. In this presentation, a water tunnel-based flapping wing apparatus is introduced that allows for arbitrary wing trajectories in three rotational degrees of freedom and simultaneous measurements of lift and thrust production. An optimal flapping trajectory for takeoff is found using hardware-in-the-loop optimization methodology. Wing motion derived from high-speed imaging of a ladybug during takeoff is used as a first iteration of the hardware-in-the-loop optimization. Using real-time force measurements and a gradient-based optimization approach, the algorithm searches for the optimal trajectory for a variety of parameters such as lift or efficiency. Hardware performance is assessed. Results from the optimization routine, including the final flapping trajectory are reported for both rigid and compliant wings.

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