Abstract Submitted
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An Adjoint-Based Approach to Study a Flexible Flapping Wing in Pitching-Rolling Motion[1] KUN JIA, MINGJUN WEI, Kansas State University, MIN XU, New Mexico State University, CHENGYU LI, HAIBO DONG, University of Virginia — Flapping-wing aerodynamics, with advantages in agility, efficiency, and hovering capability, has been the choice of many flyers in nature. However, the study of bio-inspired flapping-wing propulsion is often hindered by the problems large control space with different wing kinematics and deformation. The adjoint-based approach reduces largely the computational cost to a feasible level by solving an inverse problem. Facing the complication from moving boundaries, non-cylindrical calculus provides an easy extension of traditional adjoint-based approach to handle the optimization involving moving boundaries. The improved adjoint method with non-cylindrical calculus for boundary treatment is first applied on a rigid pitching-rolling plate, then extended to a flexible one with active deformation to further increase its propulsion efficiency. The comparison of flow dynamics with the initial and optimal kinematics and deformation provides a unique opportunity to understand the flapping-wing mechanism.

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Mingjun Wei
Kansas State University

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