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Kinematics, forces, flexion, and wake dynamics in a flapping wing with low-order flexibility JONATHAN TOOMEY, JEFF ELDREDGE, UCLA Mechanical & Aerospace Engineering — Insects display a high degree of flexibility in their wing structure during aerodynamic loading. The degree to which this flexibility is an unavoidable consequence of the wing structure or an aid to the flight mechanism is not fully understood. Numerical and experimental investigations are performed using a reduced order model of a flexible wing undergoing hovering kinematics. Computations are carried out using a structurally coupled viscous vortex particle method; dynamically-scaled experiments use a set of high aspect ratio bodies attached to a two-axis motion stage. A comparison across a broad kinematic range between numerical and experimental data demonstrates excellent agreement between these complementary tools. Particular effort is devoted to studying the relationship between wake dynamics, force generation, and wing flexion. The Reynolds number influence in deflection and lift is also studied. The power consumption and lift generation are explored across a broader kinematic spectrum from previous work. The role of flexibility in auto-rotation, and general opportunities for a reduction in power consumption, are also explored.

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