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Wake vortex properties and thrust production of a harmonically-pitching flexible airfoil at low Reynolds number[1] DAVID OLSON, AHMED NAGUIB, MANOOCHEHR KOOCHESFAHANI, Michigan State University — Many of the natural flyers have deformable wing structures and exhibit complex kinematics in order to produce lift and thrust. Replicating all of these conditions in the laboratory (or in simulations) is extremely difficult, and drawing explicit connections to basic unsteady aerodynamics models and theories is even more complicated. Therefore, simplified wing structure and kinematics are typically used to facilitate drawing out these connections. In this work, measurements are conducted using a rigid and a chordwise-flexible NACA0009 airfoils when harmonically pitched about the quarter chord point. Molecular tagging velocimetry is used to characterize the wake and estimate the thrust based on the momentum integral equation as function of the reduced frequency and the pitching amplitude. The results obtained using the two different airfoils are compared in order to examine the influence of structural flexibility. Consistent with the literature, chordwise flexibility is found to enhance thrust production and the circulation of the vortices shed into the wake, for a certain range of frequencies and amplitudes. Additional characterizations are undertaken of the wake vortex structure and its scaling.

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