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The Effect of Wing Kinematics on Performance and Wake Structure Produced by a Finite-Span Hovering Wing HAIBO DONG, MIKE HARFF, Wright State University, RAJAT MITTAL, The George Washington University — High-fidelity numerical simulations are being used to examine the effect of different type of wing kinematics on aerodynamic features and lift performance of low-aspect-ratio foils undergoing hovering motion. The numerical modeling approach employs a finite-difference-based-immersed-boundary solver which can perform direct numerical simulation (DNS) of 3-D flapping foils in both quasi-steady and unsteady flow. The primary objectives of the CFD effort are to establish the mechanisms responsible for different lift performance produced by different wing kinematics. Simulations show that the wake topology of these relatively low-aspect-ratio wings is significantly different from that observed for infinite-/large-aspect-ratio wings. The motion of the wing produces a distinct system of connected vortices which are examined in detail in order to gain insight into the lift producing mechanisms. The simulations also allow us to investigate the effect of different motion types, thickness of flapping wings, Strouhal numbers, and foil aspect-ratio on the wake topology and wing performance.

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