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Effects of Wing Platform on the Aerodynamic Performance of Finite-Span Flapping Wings MEILIN YU, Z.J. WANG, HUI HU, Iowa State University — A numerical study is conducted to investigate the effects of wing platform on the aerodynamics performance of finite-span flapping wings. A three-dimensional high-order Navier-Stokes compressible flow solver was developed using the spectral difference method and dynamic grids. An AUSM$^+$-up Riemann solver was implemented to simulate the unsteady low Mach number flows over finite-span flapping wings with explicit third order Runge-Kutta time integration. The studied finite-span flapping wings, which include a rectangular flapping wing, an elliptic flapping wing and a bio-inspired flapping wing, have the same wing span, aspect ratio of the platform and the characteristics of the flapping motion (i.e., sinusoidal trajectory of the flapping wing tip, Strouhal number and reduced frequency). In the present study, the Strouhul number (Str) of the finite-span flapping wings was selected to be well within the optimal range usually used by flying insects and birds and swimming fishes (i.e., $0.2 < Str < 0.4$). The effects of the wing platform on the aerodynamics performance of the finite-span flapping wings were elucidated in the terms of the evolutions and dynamic interaction between the leading edge vortices (LEV) and the wing tip vortices as well as the resultant aerodynamic forces (both lift and thrust) generated by the flapping wings.

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