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Parametric Dependencies in Aero-Elastic, Articulated, Flapping Flight D.J. WILLIS, Brown University & MIT, P. PERSSON, J. PERAIRE, Massachusetts Institute of Technology, K.S. BREUER, Brown University — Aero-elastic coupling and wing articulation both play a vital role in the generation of lift and propulsion in birds, bats and fish. We present results from a computational study that employs several tools of varying fidelity to explore the role of flexible structures on the performance and efficiency of bird and bat flight mechanics. The tools (both 2-D and 3-D) include a Wake only "Betz" analysis following the work of Hall, Pigott and Hall (*J. Aircaft*, 1998), a potential flow model coupled to a free-vortex wake (Willis, Peraire & White, *AIAA 2005-0854*), and lastly, a discontinuous Galerkin solver (Persson & Peraire, *AIAA 2006-0113*) for the full Navier-Stokes equations. Structural models include springs, beams and membranes to represent compliant biological structures. The results demonstrate the changes in efficiency that can be achieved by different parametric variations in the flight behavior, including the effects of increasing kinematic degrees of freedom (e.g. articulated wings) and the effect of compliance in wing and skeletal structures.

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