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Simulation of a Plunging Airfoil with a Flexible Tail ALAN LAI, FENG LIU, University of California, Irvine — The fluid motion of an airfoil with a flexible tail is simulated using an unsteady panel method with diffusive wake modeling. The fluid simulation is coupled with a CSD solver to simulate the deflection of the flexible tail due to both inertial and aerodynamic forces. The modal equations were used to calculate the structural deformation under an aerodynamic load. Computations with varying stiffness coefficient and reduced frequencies were performed to produce a performance map of a plunging airfoil with a flexible tail. The results showed a range of reduced frequencies and tail stiffness that increased the thrust produced by the plunging motion by as much as 45% when compared with the same airfoil that has a rigid tail. The propulsive efficiency with a flexible tail increased slightly as well. The upper limit of the thrust enhancement is bounded by the first natural frequency of the flexible tail. A stiffer tail is shown to be most beneficial, but the minimum reduced frequency where thrust is improved increases with increasing stiffness. Spectral analysis of the unsteady forces and wake velocities showed that the increase in thrust can be directly attributed to the effect the flexible tail has on the wake vorticies.

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