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Aerodynamic Flow Control of a Maneuvering Airfoil DANIEL P. BRZOZOWSKI, JOHN CULP, ARI GLEZER, Georgia Institute of Technology — The unsteady aerodynamic forces and moments on a maneuvering, free-moving airfoil are varied in wind tunnel experiments by controlling vorticity generation/accumulation near the surface using hybrid synthetic jet actuators. The dynamic characteristics of the airfoil that is mounted on a 2-DOF traverse are controlled using position and attitude feedback loops that are actuated by servo motors. Bi-directional changes in the pitching moment are induced using controllable trapped vorticity concentrations on the suction and pressure surfaces near the trailing edge. The dynamic coupling between the actuation and the time-dependent flow field is characterized using simultaneous force and velocity measurements that are taken phase-locked to the commanded actuation waveform. The time scales associated with the actuation process is determined from PIV measurements of vorticity flux downstream of the trailing edge. Circulation time history shows that the entire flow over the airfoil readjusts within about 1.5 T_{CONV}, which is about two orders of magnitude shorter than the characteristic time associated with the controlled maneuver of the wind tunnel model. This illustrates that flow-control actuation can be typically effected on time scales commensurate with the flow's convective time scale, and that the maneuver response is only limited by the inertia of the platform. Supported by AFSOR.

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