Abstract Submitted
for the DFD11 Meeting of
The American Physical Society

Closed-Loop Aerodynamic Flow Control of a Maneuvering Airfoil DANIEL P. BRZOZOWSKI, JOHN R. CULP, ARI GLEZER, Georgia Institute of Technology — The unsteady interaction between trailing edge aerodynamic flow control and airfoil motion in pitch and plunge is investigated in wind tunnel experiments using a 2-DOF traverse which enables application of time-dependent external torque and forces by servo motors. The global aerodynamic forces and moments are regulated by controlling vorticity generation and accumulation near the surface using hybrid synthetic jet actuators. 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 effect of the unsteady motion on the model-embedded flow control is assessed in unsteady several maneuvers. Circulation time history that is estimated from a PIV wake survey shows that the entire flow over the airfoil readjusts within about 1.5 TCONV, 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 that are commensurate with the flow's convective time scale, and that the maneuver response is primarily limited by the inertia of the platform.

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Date submitted: 05 Aug 2011 Electronic form version 1.4