Abstract Submitted
for the DFD16 Meeting of
The American Physical Society

Closed-Loop Flow Control of the Coupled Wake Dynamics and Aerodynamic Loads of a Freely-Pivoting 3-DOF Bluff Body[1] T. LAMBERT, B. VUKASINOVIC, A. GLEZER, Georgia Institute of Technology — The motion of an axisymmetric bluff body model that is free to pivot in pitch, yaw, and roll in a uniform stream in response to flow-induced aerodynamic loads is controlled in wind tunnel experiments using fluidic actuation. The model is attached to an upstream, wire-supported short streamwise sting through a low-friction hinge, and each of the support wires is individually-controlled by a servo actuator through an in-line load cell. The aerodynamic loads on the body, and thereby its motion, are controlled through fluidic modification of its aerodynamic coupling to its near wake using four independent aft mounted synthetic jet actuators that effect azimuthally-segmented flow attachment over the model's tail end. The effects of actuation-induced, transitory changes in the model's aerodynamic loads are measured by its motion response using motion tracking, while the coupled evolution of the near-wake is captured by high-speed stereo PIV. Flow control authority is demonstrated by feedback-controlled manipulation of the model's dynamic response, and dynamic mode decomposition (DMD) of the wake is used to characterize changes in the wake structure and stability. It is shown that this flow control approach can modify the stability and damping of the model's motion (e.g., suppression or amplification of its natural oscillations), and impose desired directional attitude.

[1]Supported by the ARO.

Ari Glezer
Georgia Tech

Date submitted: 28 Sep 2016 Electronic form version 1.4