Abstract Submitted
for the DFD13 Meeting of
The American Physical Society

Real-time control of the boundary layer disturbance induced by a dynamic isolated roughness element using plasma actuators[1] KYLE BADE, AHMED NAGUIB, Michigan State University, RONALD HANSON, PHILIPPE LAVOIE, University of Toronto Institute for Aerospace Studies, BRANDT BELSON, CLARENCE ROWLEY, Princeton University — It is well established that bypass boundary layer transition is initiated by the formation and growth of unsteady streaks. Motivated by the delay/prevention of transition, this study examines the ability to sense unsteady streaks in a Blasius boundary layer and to attenuate their transient growth. The unsteady streaks are introduced into the boundary layer using an isolated roughness element that is dynamically actuated from flush with the wall to a specified height; resulting in a time varying disturbance. A real-time, closed-loop, feedforward-feedback control system is designed to apply an appropriate voltage to a plasma actuator in order to reduce the roughness induced disturbance. The control system inputs come from two in-wall hot-wire shear stress sensors located within a high-speed streak disturbance, one upstream and one downstream of the plasma actuator. The controller is shown to effectively drive the shear stress at the feedback sensor toward the Blasius level. The flow state is later examined over a cross-flow plane above the feedback sensor to assess the effectiveness of the control in reducing the total disturbance energy. In addition, the effects of the control parameters on the controller's effectiveness and robustness are investigated.

[1]NSF Grant: CMMI 0932546

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Date submitted: 02 Aug 2013 Electronic form version 1.4