Abstract Submitted
for the DFD10 Meeting of
The American Physical Society

Towards Feedback Control of Bypass Transition: Experiments on Laminar Boundary Layer Response to a Pulsed Plasma Actuator[1]
PHILIPPE LAVOIE, RONALD HANSON, University of Toronto, Institute for Aerospace Studies, AHMED NAGUIB, Michigan State University, Mechanical Engineering — Plasma actuators have recently been shown to negate the effect of the transient growth instability occurring in a Blasius boundary layer for the purpose of delaying bypass transition. Specifically, a spanwise array of symmetric plasma actuators generate a counter disturbance of spanwise periodic counter-rotating vortices. During steady operation, the total disturbance energy, introduced via an array of static cylindrical roughness elements, was reduced by up to 68%, as shown by Hanson et al (Exp. Fluids, 2010). The objective of this work is to elucidate the dynamic response of a laminar boundary layer to pulsed excitation by the actuators used in the aforementioned study. The temporal evolution and decay of the disturbance is studied using phase-averaged hotwire measurements at a single plane located downstream of the actuator. The data provide insight into the spatio-temporal character of the modes excited by pulsed plasma actuation. Results are discussed with respect to eventual integration with a feedback control system in collaboration with Princeton University in a multi-university research program aimed at transition control.

[1]NSERC and NSF grant number: CMMI 0932546

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Date submitted: 04 Aug 2010 Electronic form version 1.4