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Closed-Loop Control of Unsteady Transient Growth Disturbances in a Blasius Boundary Layer using DBD Plasma Actuators[1] PHILIPPE LAVOIE, RONALD HANSON, University of Toronto, Institute for Aerospace Studies, KYLE BADE, AHMED NAGUIB, Michigan State University, Dept. of Mechanical Engineering, BRANDT BELSON, CLARENCE ROWLEY, Princeton University, Dept. of Mechanical and Aerospace 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, during steady operation, the energy of a disturbance introduced via an array of static cylindrical roughness elements was reduced by up to 68%, as shown by Hanson et al (Exp. Fluids, 2010). In the present work, the actuators used in the aforementioned study were integrated into a complete closed-loop control system capable of negating unsteady transient growth disturbances induced in a Blasius boundary layer established in a wind tunnel. Shear stress measurements from an array of hot-wires mounted just above the surface of the boundary-layer plate downstream of the actuators are used to provide feedback information about the state of the boundary layer. The effectiveness and robustness of the closed-loop controller are rigorously established based on both control-model simulations and experiments.

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