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Active Control of Natural Tollmien-Schlichting Waves using Plasma Actuators MARIOS KOTSONIS, RAM KRISHAN SHUKLA, STEFAN PROBSTING, Delft University of Technology — An experimental study is performed on active control of boundary layer instabilities developing on a NACA 0012 airfoil. A closed-loop control system has been implemented using the filtered-x Least Mean Squares adaptive algorithm based on Finite Impulse Response filters. Surface mounted microphones are used as sensors. The controller drives a Dielectric Barrier Discharge plasma actuator placed along the span of the airfoil. In contrast to the conventional sinusoidal signal, the actuator is powered using a continuously adapted signal selected by the controller in order to damp the incoming wavetrain of TS waves. High speed 2-component Particle Image Velocimetry is used to characterize the flow in the vicinity of the actuator. Several cases are tested using both open-loop and closed-loop actuation. Tested freestream velocities range from 17 to 25 m/s at chord Reynolds of 0.22 to 0.33 million respectively. Results indicate the suppression of the tonal component of unstable TS waves with closed-loop actuation. Amplitude reduction of approximately 50 % is achieved for freestream velocity of 17 m/s while significant suppression is maintained for higher velocities. In the case of open-loop control, the actuator is operated using non-adapted single-frequency sinusoidal signal.

Marios Kotsonis
Delft University of Technology

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