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Reactive Control of Boundary Layer Streaks Induced by Freestream Turbulence Using Plasma Actuators KEVIN GOUDER, Imperial College, AHMED NAGUIB, Michigan State University, PHILIPPE LAVOIE, University of Toronto, JONATHAN MORRISON, Imperial College — Over the past few years we have carried out a systematic series of investigations aimed at evaluating the capability of a plasma-actuator-based feedforward-feedback control system to weaken streaks induced "synthetically" in a Blasius boundary layer via dynamic roughness elements. This work has been motivated by the delay of bypass boundary layer transition in which the streaks form stochastically beneath a freestream with turbulence of intensity of more than approximately 1%. In the present work, we carry forward the knowhow from our previous research in a first attempt to control such naturally occurring streaks. The experimental setup consists of a turbulence-generating grid upstream of a flat plate with a sharp leading edge. At the freestream velocity of the experiment, turbulent spot formation is observed to start at a streamwise location of $x \approx 350$ mm from the leading edge. The control system is implemented within a streamwise domain stretching from $x = 150$ mm to 300mm, where the streaks exhibit linear growth. At the upstream and downstream end of the domain a feedforward and a feedback wall-shear-stress sensors are utilized. The output from the sensors is fed to appropriately designed controllers which drive two plasma actuators providing positive and negative wall-normal forcing to oppose naturally occurring high- and low-speed streaks respectively. The results provide an assessment of the viability of the control approach to weaken the boundary layer streaks and to delay transition.

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