Abstract Submitted
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Turbulent Boundary Layer Drag Reduction by Active Control of Streak Transient Growth[1] FLINT THOMAS, THOMAS CORKE, University of Notre Dame, FAZLE HUSSAIN, Texas Tech University , ALAN DUONG, RYAN MCGOWAN, CHRISOTPHER JASINSKI, DANIEL SIMMONS, University of Notre Dame — Experiments are reported employing a novel method of large-scale active flow control that was designed to intervene in Streak Transient Growth (STG) which was first postulated by Schoppa and Hussain (Phys. Fluids 1998, JFM 2002) as the primary mechanism in the production of streamwise vorticity in wall-bounded turbulence. We term the actuator SLIPPS ("Smart Longitudinal Instability Prevention via Plasma Surface). It consists of a new pulsed-DC plasma actuator array that is mounted flush with the wall in a zero pressure gradient, high Reynolds number turbulent boundary layer. The array induces a near-wall spanwise mean velocity component that is comparable in magnitude to the local friction velocity. This prevents the lift-up of low-speed streaks, thereby limiting their flanking wall-normal vorticity, which has been shown to be a critical parameter is STG. Experiments demonstrate friction drag reduction of up to 68%. Measured drag reduction is found to scale with the actuator array spanwise inter-electrode spacing, with the maximum drag reduction corresponding to the simultaneous control of approximately 8-10 low-speed streaks. Due to the unique voltage-current characteristics of the pulsed-DC actuator, the drag reduction is obtained with net power savings.

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