Abstract Submitted
for the DFD16 Meeting of
The American Physical Society

A Nonlinear System Model of Wall Turbulence Generation Under Active Suppression and Enhancement of Streak Transient Growth Instability[1] SAMARESH MIDYA, ALAN DUONG, FLINT THOMAS, THOMAS CORKE, University of Notre Dame — Schoppa and Hussain (1998, 2002) demonstrated streak transient growth (STG) as the dominant streamwise coherent structure generation mechanism required for wall turbulence production. A novel, flush surface-mounted pulsed-DC plasma actuator was recently developed at the University of Notre Dame to actively intervene in STG. In recent high Reynolds number, zero pressure gradient turbulent boundary layer experiments, drag reduction of up to 68% was achieved. This is due to a plasma-induced near-wall, spanwise mean flow sufficient in magnitude to prevent the lift-up of low-speed streaks. This limits their flanking wall-normal component vorticity-a critical parameter in STG. Experiments also show that sufficiently large plasma-induced spanwise flow can exacerbate STG and increase drag by 80%. The ability to significantly increase or decrease drag by near-wall actuation provides an unprecedented new tool for clarifying the open questions regarding the interaction between near-wall coherent structures and those in the logarithmic region. In the reported experiments this interaction is experimentally characterized by a second-order Volterra nonlinear system model under both active suppression and enhancement of STG.

[1]Supported by NASA Langley under NNX16CL27C

Flint Thomas
University of Notre Dame

Date submitted: 27 Jul 2016 Electronic form version 1.4