Abstract Submitted
for the DFD19 Meeting of
The American Physical Society

Turbulent boundary layer drag recovery downstream of spanwise wall oscillation CHRISTOPHER BRYSON, FAZLE HUSSAIN, Texas Tech University — Spanwise wall oscillation (SWO) has been well researched for producing significant drag reduction. While the dynamics within the control region has been studied, the flow recovery downstream of the control region is poorly understood. Direct numerical simulation of a TBL with SWO is performed for a range of control velocity oscillation amplitudes $A^+ = \{10, 20, 30\}$ and oscillation periods $T^+ = \{50, 100, 200\}$. It has been found that stronger drag reduction within the control region correlates with faster recovery to higher saturation levels of drag, which are also higher than an uncontrolled TBL. Compared with the uncontrolled case, visualization of control cases reveal that streak spacing is higher in the saturation region with increased wall normal velocity gradients in between, thus increased drag. The flow near the wall accelerates during the recovery phase producing a mean wall normal velocity that pulls streak transient growth (STG) vortices closer to the wall. The vortices then strengthen the streaks which spawn additional streamwise λ_2 vortices by STG, contributing to the increased drag. Further details in terms of the connection between vortical structures and wall shear stress will be discussed.

Christopher Bryson
Texas Tech University

Date submitted: 01 Aug 2019 Electronic form version 1.4