Abstract Submitted
for the DFD17 Meeting of
The American Physical Society

Downstream development of a turbulent boundary layer following a step change in roughness height: influence of virtual origin M. LI, C. M. DE SILVA, R. BAIDYA, D. CHUNG, I. MARUSIC, N. HUTCHINS, University of Melbourne — In this study we examine a streamwise heterogeneous roughness where a step change in wall condition occurs from a rough to a smooth wall along the flow direction. Our work focuses on the impact of the height difference between the virtual origins of the rough- and smooth-walled surfaces. Accordingly, a set of particle tracking velocimetry experiments are conducted where the smooth wall is located (1) above the roughness peak, (2) below the roughness valley and (3) in between the roughness canopy. These data are used to provide direct measurements of the wall shear stress from the viscous sublayer over the smooth wall, and are compared against estimates from oil film interferometry and through empirical fits to hotwire databases, as well as large-eddy simulation results at matching Reynolds number obtained at California Institute of Technology. Differences in virtual origin between the two surfaces of less than 5% of the boundary layer thickness lead to significant changes in the evolution of the shear stress after a change in surface conditions. These observations may explain the large scatter reported in past studies on the evolution of a turbulent boundary layer and associated internal layer after a sudden change in surface conditions.

M. Li
University of Melbourne

Date submitted: 01 Aug 2017 Electronic form version 1.4