Abstract Submitted
for the DFD17 Meeting of
The American Physical Society

Characteristics of turbulent boundary layers over smooth surfaces with spanwise heterogeneities. TAKFARINAS MEDJNOUN, CHRISTINA VANDERWEL, BHARATHRAM GANAPATHISUBRAMANI, Univ of Southampton, AERODYNAMIC AND FLIGHT MECHANICS RESEARCH GROUP TEAM — An experimental investigation of a turbulent boundary layer flow over an idealized rough surface is performed to examine the mean and turbulent flow characteristics, but also to document the variation of skin-friction that might affect the applicability of traditional scaling and similarity laws. These spanwise heterogeneous surfaces whose length-scale is comparable to the boundary layer thickness are known to create large-scale secondary motions. Single-point velocity measurements combined with direct skin-friction measurements are used to examine Townsend's hypothesis. The results reveal a drag increase of 35% relative to the smooth wall. Additionally, they show the existence of a log-layer in the mean velocity profile with a zero-plane displacement and a roughness function that vary across the span. Lack of collapse in the outer region of the mean velocity and variance profiles is attributed to the secondary flows induced by the heterogeneous surfaces. The lack of similarity also extends to the spectra across all scales in the near-wall region with a gradual collapse at low wavelengths for increasing spacing. This suggests that the effect of secondary flows is not necessarily felt at the smaller scales other than to reorganize their presence through turbulent transport.

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Date submitted: 01 Aug 2017 Electronic form version 1.4