

Abstract Submitted
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Comparison of spatial and temporal characteristics of a turbulent boundary layer in the presence of free-stream turbulence¹ EDA DOGAN, R. JASON HEARST, University of Southampton, RONALD E. HANSON, University of Toronto, BHARATHRAM GANAPATHISUBRAMANI, University of Southampton — Free-stream turbulence (FST) has previously been shown to enhance the scale interactions occurring within a turbulent boundary layer (TBL). This is investigated further by generating FST with an active grid over a zero-pressure gradient TBL that developed on a smooth flat plate. Simultaneous measurements were performed using four hot-wires mounted to a rake that traversed the boundary layer height. Planar PIV measurements were also performed. Hot-wire measurements indicate that on average large-scale structures occurring in the free-stream penetrate the boundary layer and increase the streamwise velocity fluctuations throughout. Two-point correlations of the streamwise velocity fluctuations from the hot-wires enable determination of the inclination angle of the wall-structures in the boundary layer using Taylor's hypothesis. This angle is observed to be invariant around 11-15 degrees in the near-wall region in agreement with the literature for canonical TBLs. This presentation will compare the planar PIV data to these hot-wire measurements to determine if these phenomena that appear in the statistics using Taylor's hypothesis can be tracked to instantaneous spatial features in the TBL subjected to FST.

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