Statistical structure of spanwise vorticity in high Reynolds number rough-wall turbulent boundary layers

CALEB MORRILL-WINTER, University of Melbourne, JOSEPH KLEWICKI, University of Melbourne, University of New Hampshire, IVAN MARUSIC, University of Melbourne — A defining characteristic of boundary layers is the presence of vorticity. Within the 2-D turbulent boundary layer the only component of vorticity to have a non-negligible mean value is the spanwise component, \( \omega_z \). In the present experiments, a compact four element (“Foss-style”) hotwire probe was used to acquire well-resolved \( \omega_z \) fluctuations over the range, \( 3,000 \leq \delta^+ = \delta u_r / \nu \leq 20,000 \) for 36 grit sandpaper roughness. Over the entire Reynolds number range good spatial resolution was maintained by utilizing the low speed, large scale attributes of the HRNBLWT at the University of Melbourne. The present talk addresses the statistical structure of \( \omega_z \) above a rough wall including comparisons with its smooth wall counterpart. The observed low Reynolds number smooth wall self-similarity between the mean and the rms profiles of \( \omega_z \) is clarified for the rough-wall case. The rough wall \( \omega_z \) behavior is described in a context consistent with the mean momentum equation.

\(^1\)The support of the Australian Research Council is gratefully acknowledged.

Caleb Morrill-Winter
University of Melbourne

Date submitted: 01 Aug 2014

Electronic form version 1.4