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Altered large-scale structures in turbulent boundary layers formed over drag-increasing riblets RYAN NEWTON, DANIEL CHUNG, NICHOLAS HUTCHINS, University of Melbourne — Riblet drag reduction only occurs within a small, viscous-scaled riblet spacing envelope, outside of which drag is significantly increased. In this study, non-optimal, drag-increasing trapezoidal riblet surfaces, with a 30° tip angle and height of $0.5s$ are experimentally investigated in the regime where the viscous-scaled riblet spacing is large ($40 < s^+ < 250$). The motivation behind this is to understand the cause of the drag increase in this regime. Results indicate that riblets with a large s^+ provide a considerable drag penalty, which appears to asymptote to fully rough behavior as s^+ increases. An analysis of the turbulence close to the surface reveals that there is little evidence of either lodgment of near-wall turbulence in the riblet grooves, or of a Kelvin–Helmholtz instability above the riblet crests. This suggests that the two previously hypothesized mechanisms for the breakdown in drag reduction at $s^+ \approx 20$, do not play a role at large s^+. In addition, energy spectra show that the riblets greatly diminish the footprint of large-scale turbulent motions in the near-wall and logarithmic regions, questioning the presence of a typical log layer and the validity of outer-layer similarity for these cases.

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