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Effects of roughness on accelerating boundary layer JUNLIN YUAN, UGO PIOMELLI, Queen's University — Large-eddy simulation is carried out on a rough-wall boundary layer with favourable pressure gradient (FPG) to study the combined effects of FPG and roughness. The acceleration is strong enough to start relaminarization on a smooth wall; the fully rough regime is achieved in the FPG region. Unlike the flow over a smooth wall, where FPG causes significant Reynolds-stress anisotropy and decoupling between the inner and outer layers, on the rough wall, the interaction between inner and outer layers is amplified near the roughness crest by FPG, due to the increased Reynolds shear stress associated with strong sweeping events, which cause large fluxes of turbulent kinetic energy towards the wall. Spatial variations of time-averaged velocities in the roughness sublayer are observed. They scale with friction velocity and the roughness length scale and, in the FPG region, they increase in magnitude due to the work of the mean flow against the form drag. The spatial disturbances of time-averaged Reynolds stresses play an important role, by sustaining the vertical turbulent motions through a production mechanism, and subsequently lead to the increase in Reynolds shear stress. As a result, relaminarization is not achieved on the rough wall.

Junlin Yuan
Queen's University

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