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Large eddy simulation of accelerating turbulent boundary layers over rough surfaces JUNLIN YUAN, UGO PIOMELLI, Queen's University — Rough-wall turbulent boundary layers subject to favourable pressure gradients (FPGs) and freestream acceleration are found in many engineering applications. On a smooth wall with a strong FPG the flow may revert to a quasi-laminar state. Roughness, on the other hand, enhances turbulent fluctuations near the wall. We investigate strongly accelerating turbulent boundary layers over rough surfaces by large eddy simulation. We use an immersed-boundary method to model random sandgrain-type roughness. Flow statistics show that the extent of relaminarization depends on the degree of acceleration, on the roughness height, and on the flow Reynolds number. The stabilizing effect of the FPG (laminar-like mean velocity, decreased Reynolds stresses, increased anisotropy) is only found outside the roughness sublayer: close to the wall, roughness results in an increase of all components of the Reynolds stress and decreases Reynolds-stress anisotropy. An increase in the Reynolds number intensifies the roughness effect. Small eddies are generated in the wake of the roughness elements; they tend to disrupt the streak stabilization observed in FPG boundary layers, and increase bursting. This study confirms previous findings which indicate that roughness competes with the FPG stabilizing effect near the wall, and might deactivate acceleration effect in the outer layer.

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