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Simulations of equilibrium accelerating turbulent boundary layers over rough walls JUNLIN YUAN, UGO PIOMELLI, Queen's University — Studies of favorable-pressure-gradient (FPG) turbulent boundary layer are important both for engineering and geophysical applications, and for the fundamental understanding of the inner-outer layer interactions in turbulent wall-bounded flows. The sink flow, a FPG flow that is statistically self-similar in the streamwise direction, removes the history-dependence of a developing flow and is a good test bed to perform quantitative comparison between roughness and FPG effects. We carry out direct and large-eddy simulations of rough-wall sink flows in the transitionally- and fully-rough regimes, with mild to medium acceleration. The results show that the Reynolds number and the friction coefficient are generally affected by FPG and the physical roughness height (blockage ratio), respectively. The mean flow and the roughness function weakly depend on the pressure gradient. Flow statistics show that center-line velocity and friction velocity absorb the effects of acceleration and roughness respectively; close to the wall, the roughness-FPG combined effects are mostly reflected in the total drag, with the wall-normal location of strong turbulence production noticeably affected by the roughness. Explanations are provided by an exam of the turbulence structures.

Junlin Yuan
Queen's University

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