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Numerical simulation of adverse-pressure-gradient boundary layer with or without roughness POUYA MOTTAGHIAN, JUNLIN YUAN, UGO PIOMELLI, Queen's University — Large-eddy and direct numerical simulations are carried out on flat-plate boundary layer over smooth and rough surfaces, with adverse pressure gradient.The deceleration is achieved by imposing a wall-normal freestream velocity profile, and is strong enough to cause separation at the wall. The Reynolds number based on momentum thickness and freestream velocity at inlet is 600. Numerical sandgrain roughness is applied based on an immersed boundary method, yielding a flow that is transitionally rough. The turbulence intensity increases before separation, and reaches a higher value for the rough case, indicating stronger mixing. Roughness also causes higher momentum deficit near the wall, leading to earlier separation. This is consistent with previous observation made on rough-wall flow separation over a ramp. In both cases, the turbulent kinetic energy peaks inside the shear layer above the detachment region, with higher values in the rough case; it then decreases approaching the reattachment region. Near the wall inside the separation bubble, the near-zero turbulent intensity indicates that the turbulent structures are lifted up in the separation region. Compared with the smooth case, the shear layer is farther from the wall and the reattachment length is longer on the rough wall.

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