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Large-eddy simulations of impinging jet with embedded vortices on rough surface WEN WU, RAYHANEH BANYASSADY, UGO PIOMELLI, Queens Univ — Large-eddy simulations (LES) are used to study round jets impinging on rough surface at nozzle-to-plate distance $H/D = 1$ (D is the nozzle exit diameter) and Reynolds numbers $Re = U_o D/\nu = 6.6 \times 10^4$ (U_o is the mean jet velocity). Our aim is to explore the effect of roughness on the evolution of vortices in the analysis of impinging jet. Two cases, one with turbulent, the other with laminar inflow, are performed. Roughness is represented by uniformly distributed but randomly oriented ellipsoids of equivalent sand-grain height $k_s/D = 0.02$, modelled by immersed boundary method. Results are compared to our previous LES simulations of jets impinging on a smooth surface. A wider and weaker wall jet is observed in the rough surface turbulent jet, compared to the reference turbulent one with smooth surface. The vortices and the peak of wall jet velocity shift away from the surface. Secondary vorticity is formed and lifted up, as in the smooth-surface case.The wall shear stress increases significantly; the separated vorticity, however, has the same strength as the one in the smooth case. The roughness causes higher turbulent fluctuations, and leads to the transition to turbulent wall jet even when the inflow is laminar, changing the vortex dynamics during vortex interaction.

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