Abstract Submitted
for the DFD15 Meeting of
The American Physical Society

Surface roughness effects on vortex dynamics in turbulent impinging jet WEN WU, RAYHANEH BANYASSADY, UGO PIOMELLI, Queen's University — Large-eddy simulations (LES) are used to study forced round jets impinging on rough surfaces 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 roughness effects on the evolution of the vortices generated in the jet shear layer. Roughness is represented by uniformly distributed but randomly oriented ellipsoids which result in sand-grain-like surfaces with equivalent sand-grain heights $k_s/D = 0.02$ and 0.013. An immersed boundary method is used. Results are compared to our previous LES simulations of jets impinging on a smooth surface. More rapid decay of the vortices is observed in the rough cases compared to the smooth one. The momentum deficit due to the roughness displacement effect plays a key role during this process. Secondary vorticity is amplified in magnitude and associated with larger dissipation. The turbulent statistics and structures near the wall are altered by the roughness. The extent of roughness effects is initially limited to the "roughness sublayer". The modified near-wall flow, however, is advected outward by the secondary vorticity, and affects the evolution of the primary vortex in the outer shear layer of the wall jet.

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Date submitted: 27 Jul 2015 Electronic form version 1.4