Abstract Submitted
for the DFD13 Meeting of
The American Physical Society

LES of radial wall jets over smooth and rough surfaces RAYHANEH BANYASSADY, UGO PIOMELLI, Queen's University — Large-eddy simulations of turbulent radial wall jets were conducted over both smooth and rough surfaces ($5 < k_s^+ < 70$) at the Reynolds number of $40,000$ (based on the bulk velocity and diameter of the impinging jet). The roughness elements are represented using a virtual sandpaper model and an immersed-boundary method (IBM). The results of the simulation are validated with available experimental data and also compared to our previous plane wall-jet simulations. The radial wall jets spread faster compared to the plane ones due to expansion in two directions. However, the effects of roughness are similar and mostly confined to the inner layer of the wall jet. Roughness enhances isotropy in this region. The damping of wall normal velocity fluctuations by the wall decreases over the rough wall which increases the penetration height of the wall jet. In the outer layer, normalizing with maximum velocity and wall jet half-height, $y_{1/2}$, can collapse mean velocity and Reynolds stresses profiles. There is no significant structural difference at the same non-dimensional height from the wall ($y/y_{1/2}$) over the smooth and the rough wall. An analysis of the effect of surface roughness on the instantaneous flow structures is also presented.

Rayhaneh Banyassady
Queen's University

Date submitted: 29 Jul 2013 Electronic form version 1.4