Abstract Submitted
for the DFD07 Meeting of
The American Physical Society

A Numerical Study of a Scaling Parameter for Turbulent Boundary Layer with Large Roughness ERIKA JOHNSON, CHELAKARA SUBRAMANIAN, Florida Institute of Technology — Several investigations have shown that when a turbulent boundary layer is subjected to large surface roughness (on the order of the inner layer thickness), the friction velocity, u_τ, is not a suitable scaling parameter for the mean and turbulent velocities. Experimental studies concerning large surface roughness have consistently shown a dramatic effect on the mean and turbulent velocities, with the effect being particularly strong on the wall normal velocity fluctuation, $\overline{v'^2}$. Additionally, Lebrun (2004) showed a concomitant pressure gradient normal to the rough surface, even when no external pressure gradient exists. In this investigation, we perform a numerical simulation of a boundary layer over a surface with large roughness (k/δ = 0.07 - 0.3) to gain more insight on the correlation between the wall normal pressure gradient and the wall normal velocity fluctuation, $\overline{v'^2}$. Four different size regular roughness elements are considered and the pressure gradient velocity scale, u_P, is applied to each case. It is believed that the pressure gradient velocity scale, u_P, is a better alternative for capturing the effects of the roughness induced pressure gradient. While a perfect similarity is not achieved, the results scaled by u_P are encouraging.

Erika Johnson
Florida Institute of Technology

Date submitted: 06 Aug 2007 Electronic form version 1.4