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Simulation of Turbulent Boundary Layer Flow with Large Roughness ERIKA JOHNSON, CHELAKARA SUBRAMANIAN, Florida Institute of Technology — Several studies indicate that in situations where surface roughness is very strong, the friction velocity scaling for the mean and turbulent velocities are not satisfactory. Subramanian et al showed a dramatic effect of a strong irregular roughened surface on the turbulent properties. The log-law relation in the overlap region was distorted. A significant pressure gradient normal to the surface was observed with a concomitant increase in normal turbulent stress, $\overline{v'^2}$. The pressure gradient velocity scale, u_P, was suggested as a better alternative for capturing the effects of this roughness induced pressure gradient. Here, we performed a numerical simulation of a roughened boundary layer to gain more insight on the correlation between the wall normal pressure gradient and normal turbulent stress, $\overline{v'^2}$ and further validate this new pressure gradient velocity scale, $u_P$for different types of roughness. A two-dimensional flat plate computational model with strong regular (k-type) roughness, was constructed in GAMBIT and a CFD analysis performed using FLUENT, version 6.2. The roughness elements cause the pressure near the wall to increase suddenly at the first element and then decrease gradually similar to experiments. The variation of this normal pressure gradient is well correlated with the normal turbulent stress $\overline{v'^2}$ variation. Application of the u_P as scaling parameter for other non-equilibrium flows such as with suction and blowing is also investigated.

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