Abstract Submitted
for the DFD06 Meeting of
The American Physical Society

Numerical Study of Rough and Smooth Turbulent Boundary Layers at Zero Pressure Gradient.[1] JORGE BAILON-CUBA, LUCIANO CASTILLO, Rensselaer Polytechnic Institute — The present study proposes an accurate numerical technique for determining the flow parameters of a rough turbulent boundary layer, based on the theory by George & Castillo (GC-97). Moreover, an improvement in the Large Eddy Simulation (LES) of Bohr (2005) over a smooth flat plate, has been performed through a grid refinement and increase in the Reynolds number (δ^+) range. This LES emphasizes a Rescaling-Recycling technique based on the Equilibrium Similarity Theory of GC-97, when it is implemented in the method originally proposed by Lund et al. (1998). The results, after comparing with the LES for smooth surfaces, and testing with experimental rough & smooth data available, show that the ranges of the turbulent Reynolds number, δ^+, and the blockage ratio, $k/\delta \geq 0.030$, at which similarity laws are expected to be valid are in consistency with the predictions by Jimenez (2005). The theoretical behavior of flow parameters such as u_τ, Re_x, Re_{δ^*}, vs Re_θ indicate that for the rough surfaces tested, the GC-97 theory can be validated for hydraulically smooth, and transitionally rough surfaces until: $k^+ \leq 35$. In addition, the analytical profiles of velocity (U/U_∞), Reynolds shear stresses ($-\langle uv \rangle$), and Eddy viscosity ($\langle \nu_T \rangle$), are compared with the LES and experiments, showing good agreement (especially at high δ^+'s values) in the inner and outer regions.

[1]Supported by the Office of Naval Research.

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Date submitted: 06 Aug 2006 Electronic form version 1.4