Abstract Submitted
for the DFD10 Meeting of
The American Physical Society

DNS of a Turbulent Boundary Layer with Surface Roughness[1]
YI CHEN, JAMES CARDILLO, Rensselaer Polytechnic Institute, GUILLERMO ARAYA, Swansea University, LUCIANO CASTILLO, Rensselaer Polytechnic Institute, KENNETH JANSEN, University of Colorado Boulder — A Direct numerical simulation (DNS) of a high Reynolds number, zero pressure gradient, turbulent boundary layer (Re_θ= 2400) subjected to sandpaper surface roughness is performed. The surface roughness is modeled with a roughness parameter $k^+ \sim 25$ to match the experiments at similar Reynolds number and roughness distribution. The employed computational method involves a synergy of the multi-scale dynamic approach devised by Araya et al. (2010) and a new method for mapping high-resolution topographical data onto a computational domain. When dealing with rough surfaces, where calculation of the wall shear stress is very challenging the multi-scale dynamic method provides a major advantage. Contrary to traditional thought, it has been shown that the different types of surface roughness yield different types of flow fields. In light of these challenges the current roughness methodology aims to provide the community with the tools to use real topographical data to simulate surface roughness. The present simulations may shed light on our understanding of the interaction of the outer and inner layers at various scales.

[1]Funding from NSF (CBET- 0829020) and ONR (Dr. R. Joslin).

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Date submitted: 09 Aug 2010 Electronic form version 1.4