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DNS of Rough Surface Turbulent Boundary Layer[1] JAMES CARDILLO, RPI, GUILLERMO ARAYA, Texas Tech University, YI CHEN, RPI, KENNETH JANSEN, University of Colorado-Boulder, ONKAR SAHNI, RPI, LUCIANO CASTILLO, Texas Tech University — A dynamic method for prescribing realistic inflow boundary conditions is presented for simulations of spatially developing turbulent boundary layers subject to surface roughness. Direct Numerical Simulation (DNS) of a moderate Reynolds number, zero pressure gradient (ZPG) turbulent boundary layer was performed. The boundary layer was subjected to transitional, 24−grit sand grain surface roughness, modeled with a roughness parameter of $k^+ \sim 12$ and a Reynolds number of $R_\theta = 2400$. The computational method involves a synergy of the multi-scale dynamic approach and a new methodology for mapping high-resolution topographical surface data into a computational fluid dynamics environment. It is shown here that the multi-scale dynamic approach can be successfully extended to simulations, which incorporate surface roughness. In terms of the mean velocity and Reynolds stresses, the DNS results are encouraging as they demonstrate good agreement with the LDA measurements performed under similar conditions.

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