Turbulence production and shear stress partitioning in rough-walled channel flow DNS RICHARD LEIGHTON — The effects of roughness in an incompressible turbulent boundary layer include the increased production of turbulence kinetic energy (TKE) and altered the nature of the skin drag. By formulating the exact Reynolds-averaged Navier-Stokes turbulence kinetic energy equations in a manner that includes an arbitrary roughness, the averaged terms representing the roughness production of TKE and the roughness drag can be written explicitly. Similar transport equations for TKE can be formulated wherein the roughness geometry is represented using the immersed boundary methodology. These terms are calculated from a collection of direct numerical simulations (DNS). The roughness geometry is limited to a simple array of vertically oriented cylinders with roughness heights range from $2l^+$ to $50l^+$. The primary results include an examination of the partitioning of the production of TKE into canonical shear production and into production by roughness, and the partitioning of drag into form drag and viscous shear drag. The relevance of the partitioning will be discussed in the context of turbulence modeling.

Richard Leighton

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