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Analysis of turbulent heat and momentum transfer in a transitionally rough turbulent boundary layer ALI DOOSTTALAB, SURANGA DHARMARATHNE, Texas Tech University, MURAT TUTKUN, IFE, Department of Process and Fluid Flow Technology, Norway, RONALD ADRIAN, Arizona State University, LUCIANO CASTILLO, Texas Tech University — A zero-pressure-gradient (ZPG) turbulent boundary layer over a transitionally rough surface is studied using direct numerical simulation (DNS). The rough surface is modeled as 24-grit sandpaper which corresponds to $k^+ \approx 11$, where k^+ is roughness height. Reynolds number based on momentum thickness is approximately 2400. The walls are isothermal and turbulent flow Prandtl number is 0.71. We simulate temperature as passive scalar. We compute the inner product of net turbulent force ($d(u_1 u_i)/dx_i$) and net turbulent heat flux ($d(u_i\theta/dx_i)$) in order to investigate (i) the correlation between these vectorial quantities, (II) size of the projection of these fields on each other and (IIi) alignment of momentum and hear flux. The inner product in rough case results in larger projection and better alignment. In addition, our study on the vortices shows that surface roughness promotes production of vortical structures which affects the thermal transport near the wall.

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