Abstract Submitted
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Turbulent flow over 'hydrodynamically smooth' longitudinal grooves[1] YIXUAN LI, KRISHNAN MAHESH, University of Minnesota, Twin Cities — Direct numerical simulations (DNS) are used to study turbulent channel flow at $Re_\tau = 400$ over longitudinal grooves whose size is within the hydrodynamically smooth regime. Simulations are performed for flat-wall channel and three different groove geometries. It is found that despite identical bulk velocity when the size of the groove is comparable to the viscous sublayer thickness, the slip effect of the longitudinal grooves causes some differences within the viscous sublayer. The spectra of the velocity and pressure fluctuations inside and outside the grooves are presented. It is found that the grooves suppress the energy at low frequencies. The filtering effect of the grooves is investigated using an analytical approach and a set of numerical experiments. The local effect of the grooves is associated to the turbulent channel flow by a non-dimensional parameter $\omega L^2/\nu$, where ω is the frequency of outside turbulent signal, L is half size the groove and ν is the kinematic viscosity. The analytical solution shows good agreement with the DNS data and helps explain the filtering mechanism of the grooved surfaces.

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