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Superhydrophobic surfaces in turbulent channel flow[1] YIXUAN LI, KARIM ALAME, KRISHNAN MAHESH, University of Minnesota, Twin Cities —
The drag reduction effect of superhydrophobic surfaces in turbulent channel flow is studied using direct numerical simulation. The volume of fluid (VOF) methodology is used to resolve the dynamics of the interface. Laminar flow simulations show good agreement with experiment, and illustrate the relative importance of geometry and interface boundary condition. An analytical solution for the multi-phase problem is obtained that shows good agreement with simulation. Turbulent simulations over a longitudinally grooved surface show drag reduction even in the fully wetted regime. The statistics show that geometry alone can cause an apparent slip to the external flow. Instantaneous plots indicate that the grooves prevent the penetration of near wall vorticity, yielding overall drag reduction. Results for spectra, wall pressure fluctuations and correlations will be presented. Unsteady effects on the air-vapor interface will be discussed. Results for random roughness surfaces will be presented.

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