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Lattice Boltzmann Simulations of Skin-Friction Drag Reduction in Turbulent Channel Flow with Slip/No Slip Wall Ridges AMIRREZA RASTEGARI, RAYHANEH AKHAVAN, University of Michigan — To gain a better understanding of the mechanisms at work in skin friction drag reduction with superhydrophobic surfaces, Lattice Boltzmann simulations were performed in turbulent channels with alternating slip/no slip ridges on the walls. Simulations were performed in turbulent channels of size $5h \times 2.5 \times 2h$ and $10h \times 5h \times 2h$ at a base Reynolds number of $Re_\tau \sim 230$. Alternating slip/no slip ridges of width $4 \leq w+ \leq 140$, aligned in the streamwise direction, all with the same fractional area of slip boundary, were studied. Drag reductions of 4%, 8%, 21%, 33% and 47%, corresponding to slip velocities of $U_{slip}/U_{bulk} = 0.05$, 0.1, 0.26, 0.31 and 0.36 were observed for $w+ = g+ = 4$, 8, 40, 70 and 140, respectively. The mean velocity profiles display the characteristics of combined slip described by Min and Kim [Min et al. 2004]. The streamwise and spanwise turbulence intensities show large slips at the wall, the magnitude of which increases with increasing drag reduction. Examination of the anisotropy invariant maps shows a shift of turbulence structure towards the one-dimensional turbulence limit near the wall with increasing drag reduction. For $z^+ > 25$, the turbulence structure returns to the isotropic limit.

Rayhaneh Akhavan
University of Michigan

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