Abstract Submitted
for the DFD17 Meeting of
The American Physical Society

Degradation of turbulent skin-friction drag reduction with superhydrophobic, liquid-infused and riblet surfaces with increasing Reynolds number RAYHANEH AKHAVAN, AMIRREZA RASTEGARI, The University of Michigan, Ann Arbor — It is shown that the magnitude of Drag Reduction (DR) with Super-Hydrophobic (SH), liquid-infused, or riblet surfaces can be parameterized in terms of the shift, ΔB, in the intercept of a log-law representation of the mean velocity profile and the friction coefficient of the base flow. Available DNS data shows ΔB to be Reynolds number independent and only a function of the geometrical parameters of the surface micro-texture in viscous wall units. This allows the DR results from DNS to be extrapolated to higher Reynolds numbers. It is shown that for a given geometry and size of the wall micro-texture in viscous wall units, the magnitude of DR degrades by factors of $\sim 2-3$ as the friction Reynolds number of the base flow increases from $Re_{\tau_0} \sim 200$ of DNS to $Re_{\tau_0} \sim 10^5 - 10^6$ of practical applications. Extrapolation of DNS results in turbulent channel flow at $Re_{\tau_0} \approx 222$ and 442 with SH longitudinal microgrooves of width $15 \leq g^{+0} \leq 60$ and shear-free-fractions of $0.875 - 0.985$ shows that the maximum DRs which can be sustained with SH longitudinal micro-grooves of size $g^{+0} \leq 20 - 30$ in practical applications is limited to DRs of $25-35\%$ at $Re_{\tau_0} \sim 10^5$ and $20-25\%$ at $Re_{\tau_0} \sim 10^6$.

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Date submitted: 25 Jul 2017 Electronic form version 1.4