Abstract Submitted
for the DFD14 Meeting of
The American Physical Society

The Effects of Superhydrophobic Surface on Near-wall Turbulence Structures and Drag Reduction[1] HYUNWOOK PARK, JOHN KIM, University of California, Los Angeles — Direct numerical simulations of a turbulent boundary layer (TBL) developing over a superhydrophobic surface (SHS) were performed. SHS was modeled through the shear-free boundary condition, assuming the air-water interface remained as a flat surface. It was found that SHS led to substantial drag reduction by weakening near-wall turbulence due to the lack of the shear over SHS. For the considered Reynolds number ranges and SHS geometries, it was found that the effective slip length normalized by viscous wall units was the key parameter and the effective slip length should be on the order of the buffer layer in order to have the maximum benefit of drag reduction. It was also found that the width of SHS, relative to the spanwise width of near-wall turbulence structures, was also a key parameter to the total amount of drag reduction. Similarities and differences between the present TBL and turbulent channel flows with SHS were also examined. In contrast to fully developed channel flows, the effective slip velocity and hence the effective slip length varied in the streamwise direction, implying that total drag reduction would depend on the streamwise length of a given SHS. This observation will be compared with recent experimental results.[2]

[1]Supported by ONR grant, N000141110503.
[2]Park et al., JFM 747 (2014) 722-734

Hyunwook Park
University of California, Los Angeles

Date submitted: 29 Jul 2014 Electronic form version 1.4