Abstract Submitted
for the DFD20 Meeting of
The American Physical Society

Roughness height effects on turbulent boundary layers over rod- and cuboid-roughened walls[1] YUN KYUNG CHOI, HYEON GYU HWANG, YOUNG MO LEE, JAE HWA LEE, Department of Mechanical Engineering, UNIST — Direct numerical simulations (DNSs) of spatially developing turbulent boundary layers (TBLs) over rod- and cuboid-roughened walls are conducted to investigate the effects of the roughness height on the flow characteristics in the outer layer. The rod and cuboid roughness height (k) is varied in the range of $0.1 \leq k/\theta_{in} \leq 1.8$ ($13 \leq \delta/k \leq 285$). As the roughness height increases, the roughness function (ΔU^+) increases and the magnitude of the Reynolds stresses in the outer layer also increases. The outer layer similarity between the flows over the rough and smooth-walls is established when $\delta/k \geq 250$ and 100 for the 2D rod and 3D cuboid, respectively. The continuous increase of the Reynolds stresses in the outer layer with an increase of $k/\delta$is explained by a large population of very long structures over the rough-wall flows. Moreover, as k/δ increases, the wider characteristic width of the structure leads to frequent spanwise merging between adjacent structures. The active spanwise merging events between the spanwise-offset LSMs increase the appearance of meandering significantly as k/δ increases.

[1]This research was supported by the National Research Foundation of Korea (NRF) funded by the Ministry of Education (NRF-2019R1A2C1083858) and partially by the National Supercomputing Center with supercomputing resources including technical support (KSC-2019-CRE-0170).

Yun Kyung Choi
Department of Mechanical Engineering, UNIST

Date submitted: 30 Jul 2020 Electronic form version 1.4