Abstract Submitted
for the DFD17 Meeting of
The American Physical Society

The flow field around a pair of cubic roughness elements with different spacings immersed in turbulent boundary layer[1] KARUNA AGARWAL, JIAN GAO, JOSEPH KATZ, Johns Hopkins University — The shape, size, and spacing between roughness elements in turbulent boundary layers affect the associated drag and noise. Understanding them require data on the flow structure around these elements. Dual-view tomographic holography is used to study the 3D 3-component velocity field around a pair of cubic roughness elements immersed in a turbulent boundary layer at $\mathrm{Re}_\tau = 2500$. These a =1 mm high cubes correspond to 4% of the half channel height and 90 wall units (δ_ν =11 μm). Tests are performed for spanwise spacings of a, $1.5a$ and $2.5a$. The sample volume is $385\delta_\nu \times 250\delta_\nu \times 190\delta_\nu$ and the vector spacing is $5.4\delta_\nu$. Conversed statistics is obtained by recording 1500 realizations in volumes centered upstream, downstream and around a cube. The boundary layer separating upstream of the cube does not reattach until the wake region, resulting in formation of a vortical "canopy" that engulfs each cube. It is dominated by spanwise vorticity above the cube and separated region, bounded by vertical vorticity on the sides. Flow channeling in the space between cubes causes asymmetry in the vorticity distributions along the inner and outer walls. The legs of horseshoe vortices remain near the wall between cubes, but grow and expand in the wake region.

[1]Funded by NSF and ONR

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Date submitted: 28 Jul 2017 Electronic form version 1.4