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Time Resolved Tomographic PIV Measurements of Rough-Wall Turbulent Channel Flow[1] RINALDO MIORINI, CAO ZHANG, PATRICK LUCKETT, DEV PATEL, JOSEPH KATZ, Johns Hopkins University — Turbulent channel flow is investigated via time-resolved tomographic particle image velocimetry. The optical refractive index of the transparent channel rough wall is matched with that of the fluid, allowing measurements very close to its surface. A thick, high-speed laser sheet illuminates tracers whose scattered light is recorded by four high-speed cameras. The roughness consists of staggered pyramidal elements whose aspect ratio satisfies the "well-characterized" flow conditions, with h/k close to 50 and k+=60-100 (h and k are the channel half-height and roughness height, respectively). The measurements are performed at Re(h) in the 40000-60000 range. Following the work of Hong et al. (JFM, 2011, 2012), data analysis is aimed at understanding the interaction between outer layer large-scale structures and the roughness elements. We examine the processes involved with vortex generation at the pyramid front ridge, vortex evolution in the non-uniform flow in the roughness sub-layer, its rise as neighboring structures interact, and its subsequent development under the influence of outer layer structures. Associated trends of Reynolds stresses and TKE are also explored, taking advantage of the available three-dimensional velocity gradients.

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