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High spatial resolution measurements of large-scale three-dimensional structures in a turbulent boundary layer[1] CALLUM ATKINSON, NICOLAS BUCHMANN, MATTHIAS KUEHN, JULIO SORIA, Monash University — Large-scale three-dimensional (3D) structures in a turbulent boundary layer at $\mathrm{Re}_\theta = 2000$ are examined via the streamwise extrapolation of time-resolved stereo particle image velocimetry (SPIV) measurements in a wall-normal spanwise plane using Taylor's hypothesis. Two overlapping SPIV systems are used to provide a field of view similar to that of direct numerical simulations (DNS) on the order of $50\delta \times 1.5\delta \times 3.0\delta$ in the streamwise, wall-normal and spanwise directions, respectively, with an interrogation window size of $40^+ \times 20^+ \times 60^+$ wall units. Velocity power spectra are compared with DNS to examine the effective resolution of these measurements and two-point correlations are performed to investigate the integral length scales associated with coherent velocity and vorticity fluctuations. Individual coherent structures are detected to provide statistics on the 3D size, spacing, and angular orientation of large-scale structures, as well as their contribution to the total turbulent kinetic energy and Reynolds shear stress.

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