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Simultaneous wall-shear-stress and wide-field PIV measurements in a turbulent boundary layer[1] GUILLAUME GOMIT, University of Southampton, GREGOIRE FOURRIE, Universite internationale de Rabat, ROELAND DE KAT, BHARATHRAM GANAPATHISUBRAMANI, University of Southampton —
Simultaneous particle image velocimetry (PIV) and hot-film shear stress sensor measurements were performed to study the large-scale structures associated with shear stress events in a flat plate turbulent boundary layer at a high Reynolds number ($Re_\tau \approx 4000$). The PIV measurement was performed in a streamwise-wall normal plane using an array of six high resolution cameras (4×16MP and 2×29MP). The resulting field of view covers 8δ (where δ is the boundary layer thickness) in the streamwise direction and captures the entire boundary layer in the wall-normal direction. The spatial resolution of the measurement is approximately is approximately 70 wall units (1.8 mm) and sampled each 35 wall units (0.9 mm). In association with the PIV setup, a spanwise array of 10 skin-friction sensors (spanning one δ) was used to capture the footprint of the large-scale structures. This combination of measurements allowed the analysis of the three-dimensional conditional structures in the boundary layer. Particularly, from conditional averages, the 3D organisation of the wall normal and streamwise velocity components (u and v) and the Reynolds shear stress ($-u'v'$) related to a low and high shear stress events can be extracted.

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