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Time-resolved PIV measurement of a developing turbulent boundary layer on a towed plate JUNGHOON LEE, YONGSEOK KWON, JASON MONTY, NICHOLAS HUTCHINS, The University of Melbourne — Time-resolved particle image velocimetry (TRPIV) is used to investigate the development of a zero-pressure-gradient turbulent boundary layer from trip to a high Reynolds number state. The unique experimental facility consists of a 5m long flat plate towed through a 60 x 2 x 2 m tow tank at speeds of up to 1 m/s. Windows in the side of the tank enable the evolution of the turbulent boundary layer along the towed plate to be captured using a stationary TRPIV system. This provides a unique view of a spatially and temporally evolving turbulent boundary layer from inception at the trip up to $Re_\tau = 3000$ (near the trailing edge of the plate). Here $Re_\tau = \delta U_\tau/\nu$ is the Kármán number where δ is boundary layer thickness, U_τ is wall-shear velocity, and ν is kinematic viscosity. In this frame of reference, evolving large-scale features with convection velocities close to the freestream appear nominally stationary within the field of view, enabling us to document the origins and evolution of these features. An analysis of instantaneous convection velocity associated with low- and high-speed structures reveals differences in the trajectory and local convection velocity of these features as the turbulent boundary layer develops along the flat plate.

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