Experimental investigation of turbulent superstructures in canonical boundary layers along flat plates with zero pressure gradient

The analysis of coherent flow structures in turbulent boundary layers along flat plates with zero pressure gradient is intensely studied due to the vast scientific and technological interest for this type of canonical flow. In particular, the discovery of highly ordered coherent fluid motions is very important as the complex turbulent exchange phenomena can be explained qualitatively taking the presence and interaction of these structures into account. In the literature, the presence of superstructures in turbulent boundary layers along flat plates with a zero pressure gradient is considered as universal. However several questions arise, namely, if a family of turbulent superstructures exists or if the turbulent superstructures observed in experiments are a superposition of individual large scale structures or if different superstructures exist depending on the intensity of the structures. Therefore, within this research project, superstructures in a canonical incompressible turbulent boundary layer flow along a flat plate with zero pressure gradient will be investigated at Reynolds numbers up to Re_Θ = 80000 in the Atmospheric Windtunnel Munich (AWM). Using high resolution 2D and 3D PIV / PTV measurement techniques the size, shape and organisation of the turbulent superstructures, their dynamics and mutual interaction and near their interaction with low-speed streaks near the wall and the surrounding flow field will be examined.

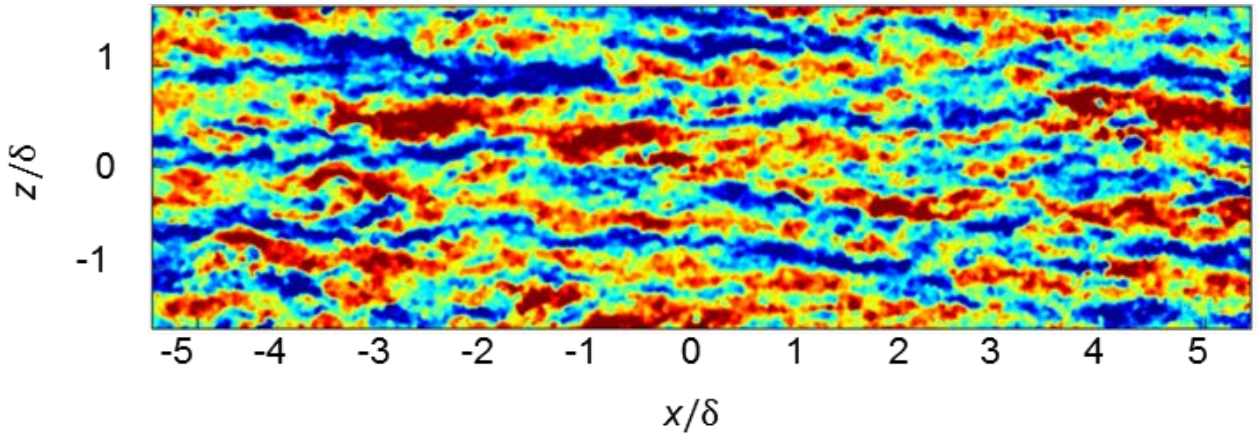

Figure: Large field of view (1.7 m × 0.5 m) measurement of turbulent superstructures showing the distribution of the elongated coherent structures in a wall parallel plane at y / δ = 0.065. Blue: $u' < 0$. Red: $u' > 0$.