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Mach Number effects on turbulent superstructures in wall bounded flows[1] CHRISTIAN J. KAEHLER, MATTHEW BROSS, SVEN SCHARNOWSKI, Univ. Bundeswehr — Planer and three-dimensional flow field measurements along a flat plat boundary layer in the Trisonic Wind Tunnel Munich (TWM) are examined with the aim to characterize the scaling, spatial organization, and topology of large scale turbulent superstructures in compressible flow. This facility is ideal for this investigation as the ratio of boundary layer thickness to test section spanwise extent ratio is around 1/25, ensuring minimal sidewall and corner effects on turbulent structures in the center of the test section. A major difficulty in the experimental investigation of large scale features is the mutual size of the superstructures which can extend over many boundary layer thicknesses. Using multiple PIV systems, it was possible to capture the full spatial extent of large-scale structures over a range of Mach numbers from Ma = 0.3 - 3. To calculate the average large-scale structure length and spacing, the acquired vector fields were analyzed by statistical multi-point methods that show large scale structures with a correlation length of around 10 boundary layer thicknesses over the range of Mach numbers investigated. Furthermore, the average spacing between high and low momentum structures is on the order of a boundary layer thicknesses.

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