COMPARISONS OF WALL SHEAR STRESS CORRELATIONS IN BOUNDARY LAYERS OVER A LARGE REYNOLDS NUMBER RANGE

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An important aspect of wall turbulence is understanding the relationship between the fluctating velocity field, throughout the boundary layer, and the wall shear stress distribution at the surface. Here we compare results from different experiments that span over three orders of magnitude of Reynolds number.

Experiments were conducted in a laboratory wind tunnel and also in the atmospheric surface layer on salt-flats in Utah (SLTEST). The wind tunnel experiments involved using an array of hot-wires and wall-flush mounted hot-films for $Re_\tau = 1350$. These data were originally used for the evaluation of near-wall models for LES [1]. The salt-flat experiments were conducted under neutrally buoyant conditions with a nominal Reynolds number of $Re_\tau = 660,000$. The experiments involved using an array of sonic anemometers and a new lightweight, high frequency response, floating element sensor to measure wall shear stress fluctuations in an atmospheric surface layer. The sensor is described by Heuer & Marusic [2] and uses a laser position measurement system to track the motion of the floating element.

Cross-correlations of shear stress and streamwise velocity fluctuations are analysed in an attempt to identify structure angles in the flow, amongst other things. The structure angles between the atmospheric and laboratory flows are found to agree very well, indicating that the such structural features of wall turbulence are universal and independent of Reynolds number.

References

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