

Paper 27.1

Near-wall investigation of a streamwise vortex pair

by

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ABSTRACT

Simultaneous three-orthogonal component LDV measurements with a measurement volume on the order of 50 μm in size were made in a turbulent boundary layer downstream of a pair of half delta-wing vortex generators. Coincident instantaneous U, V, W components of the velocity were used to determine the mean flow, Reynolds stresses, and triple products. Measurements below $y^+ = 5$ were made and used to deduce the wall skin friction. Careful considerations were given to the evaluation of bias and broadening effects on the data. Data for a 2-D turbulent boundary layer closely agree with direct numerical simulation (DNS) results. All turbulence data satisfy the realizability conditions. This is the first time that detailed near-wall measurements have been made in this type of flow. While large streamwise vorticity is generated away from the wall, significant opposite sign vorticity is generated by the viscous interaction of the vortex and the wall. Further analysis of this data set is found in Kuhl (2000).

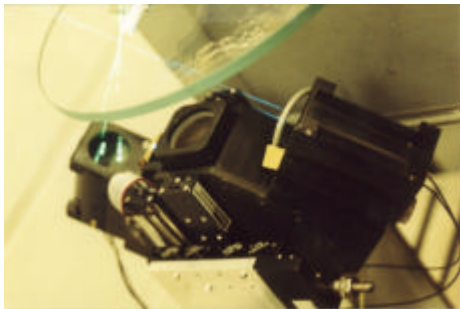


Figure 1: 3-orthogonal-velocity-component fiber-optic LDV head

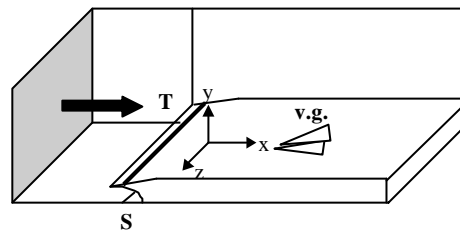


Figure 2: Experimental test set-up showing suction slot S; boundary layer trip T and vortex generator pair v.g.

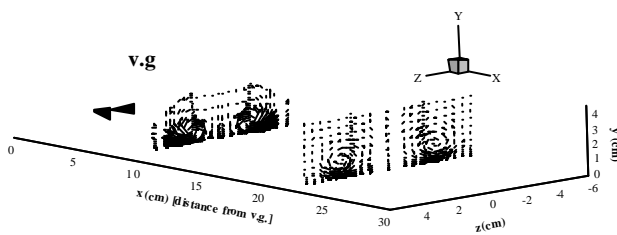


Figure 3: VW mean secondary flow vectors in 2 measurement planes

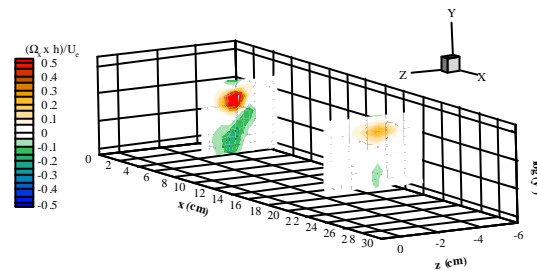


Figure 4: Mean streamwise vorticity for a semi-span in $\log(y^+)$ and z planes

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