

Experimental study of localized disturbances at straight and swept wing boundary layer

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Abstract

Turbulence production processes in gradient boundary layer at enhanced level of free-stream turbulence have been studied experimentally. The longitudinal localized disturbances arising in the boundary layer under the action of free-stream turbulence were artificially modelled from the incoming flow or model surface using a blowing-suction technique. Wave packets, or forerunners, produced in the boundary layer, in the region preceding the abrupt local change of flow velocity near the longitudinal disturbance fronts, were examined.

The investigations were carried out in the subsonic low-turbulent wind tunnels T-324 and MT-324 ITAM SB RAS. Free stream velocity was in the range $4 \leq U_\infty \leq 8$ m/s at the turbulence level at varied from 0.04 to 2.31 %. Test models were straight or swept wings (with sweep angle 45°). Measurements of the flow fields were carried out using a single-wire probe of a constant-temperature hot-wire anemometer.

The results of the study make reason to consider the forerunners as wave packets of 3D instability (T-S) waves. It was observed that the forerunners are strongly amplified in the adverse pressure gradient flow being much influenced by local velocity gradients. It was found that at downstream development of the forerunners they transform into so - called Lambda-structures.