

Application of FR/CPR Method on Boundary Layer Transition

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In this paper, both the whole transition process on a flat plate and the flow passing a single forward-facing step in a boundary layer are investigated with a developed FR/CPR method^[1,2], which can obtain a relatively high accuracy considering efficiency. For the flat plate transition, a Blasius laminar similarity solution is included at the inlet. The free stream Mach number is $M = U_\infty/c = 0.2$ and the Reynolds number based on the distance from the leading edge is $Re_x = 10^5$. One disturbance strip is adopted to trigger a K-type transition with a shape like TS wave.^[3] Typical transition processes including the TS wave, λ vortex, and the vortex ring are observed. The process of breaking down and the development of the turbulent spot are also investigated. In contrast, if a forward-facing step exists during the developing process of the disturbances, the streamwise vorticity is amplified rapidly after the step and induces an earlier transition compared with the flow on a flat plate.

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