FM13L_12372

XXI International Congress of Theoretical and Applied Mechanics
Warsaw, Poland, August 15–21, 2004

On Instability Mechanisms in a Separating Boundary-layer Flow

Matthieu Marquillie, **Uwe Ehrenstein**, François Gallaire

Lab. J.A. Dieudonné, Université de Nice-Sophia Antipolis, France

The stability of separating boundary-layer flow at the rear of a bump mounted on a flat plate is numerically investigated. It is shown that a geometrically controlled, short separation bubble exhibits a global instability consisting of self-sustained two-dimensional saturated perturbations oscillating at a well defined frequency. Local stability analyses confirm that this instability is triggered by a transition from local convective to local absolute instability in the separation bubble. Solving the three-dimensional Navier–Stokes equations, the flow field is shown to exhibit a three-dimensional steady structure well below the critical Reynolds number for the onset of two-dimensional self-sustained oscillations. Regions subject to centrifugal instability due to streamline curvature are detected, considering the Rayleigh discriminant: some evidence is given that the counter-rotating three-dimensional streamwise vortex structure originates from a potentially unstable region nearby the bump-summit.

View the extended summary