THE EFFECT OF CROSSFLOW ON GÖRTLER VORTICES

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ABSTRACT

It is well known that the boundary layer flow over a surface with a region of concave curvature is susceptible to centrifugal instabilities in the form of Görtler vortices. In the limit of large Görtler number (a parameter which is a measure of the curvature of the surface) the effect of a crossflow component in the underlying basic flow has been shown to stabilises these modes and thus render the Görtler vortex mechanism inoperable in these situations. Here we consider the effect of crossflow when the Görtler number (and the scaled spanwise wavenumber of the vortex) are both order one quantities. The parabolic partial differential equations governing the linear evolution of a Görtler vortex in a three-dimensional boundary layer are solved numerically. Our results suggest that, at least for small magnitude crossflows, the Görtler vortex instability mechanism is still operable. In addition we consider the effect of an applied pressure gradient within the boundary layer on the instability mechanism and demonstrate that a favourable pressure gradient renders the boundary layer more susceptible to the Görtler vortex instability; this is in stark contrast to the case of Tollmien-Schlichting waves where a favourable pressure gradient stabilises the flow.

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