A new mode of instability in compressible boundary-layer flows

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Abstract:

In low disturbance environments such as aerodynamic flight, the initial growth of disturbances that cause the laminar-turbulent transition process in a boundary layer can be investigated with linear stability theory (LST). A large collection of results using LST are available in the literature, however excluded are the class of boundary-layer flows with region of velocity overshoot. Using a compressible, heated-wall flat-plate boundary layer with a favourable pressure gradient as a prototype, the linear stability of this class of boundary layers is investigated numerically and analytically using LST. Along with the traditional Mack modes, a new mode of inviscid instability is found that is localised within the region of velocity overshoot. The interaction between the new mode and the Mack modes is investigated through viscous stability analysis.