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EFFECT OF HUMPS AND INDENTATIONS ON BOUNDARY-LAYER TRANSITION OF COMPRESSIBLE FLOWS USING THE AHLNS METHODOLOGY

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The presence of surface irregularities like humps or indentations can cause regions of localized strong streamwise gradients in the base flow quantities. These large gradients can enhance the linear mechanisms that lead to laminar-turbulent transition in wall-bounded flows (e.g. Tollmien-Schlichting waves) [1]. Standard methodologies like LST (Local Stability Theory) or PSE (Parabolized Stability Equations) can still be applied in regions far from the surface irregularities, where the streamwise variations are small. However, their formulations are not suited for handling the presence of such large streamwise gradients.

The Adaptive Harmonic Linearized Navier-Stokes (AHLNS) equations [2] can handle these large streamwise gradients by using a DNS-like formulation. Moreover, as in PSE a wave-like character of the instabilities is assumed, leading to a significant reduction in the number of streamwise points required compared with DNS computations.

In the present study, rectangular and smooth humps/indentations with height/depth comparable with the local boundary-layer thickness will be investigated. Different shapes of the surface irregularities will be analyzed. The effect of the hump/indentation on the spatial evolution of convective instabilities, in terms on growth rates, wavenumbers and N-factors, will be discussed.

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