Crossflow Instability in Three-Dimensional Hypersonic Boundary Layers

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Motivation

The general problem is stability of disturbances in a high-speed (compressible) three-dimensional boundary layer, such as hypersonic flow over a swept wing.

DARPA
Lockheed-Martin SR-72
“Son of Blackbird”

Overview

The mean flow is solved in a coordinate system fitted to the wing; flow velocity variables are then rotated to local-streamline-aligned coordinates for linear stability calculations.

This figure depicts the coordinate systems used in mean flow and linear stability calculations. Incoming flow approaches the swept wing leading edge from the top.

Future Work: Nonlinear Simulations

Overall, increasing Mach number has a stabilizing effect.

References


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