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**Rayleigh Instability in Supersonic Compression Ramp Flow**
KEVIN CASSEL, DANNY BOCKENFELD, Illinois Institute of Technology — The supersonic flow past a compression ramp with ramp angle of $O(Re^{-1/4})$ is governed by the supersonic triple-deck formulation. For scaled ramp angles $\alpha \geq 3.9$ Cassel, Ruban & Walker (1995)[1] have found that the triple-deck flow is unstable to long-wave Rayleigh (LWR) modes, which have wavelengths shorter than the $O(Re^{-3/8})$ streamwise length scale of the triple-deck region, but larger than the $O(Re^{-5/8})$ vertical extent of the lower deck. The LWR instability is manifest in the unsteady triple-deck calculations as an absolute instability in the form of a wave packet. In the present investigation, the possible presence of a Rayleigh instability is investigated in the supersonic compression ramp flow. Rayleigh modes, which are of the same order as the $O(Re^{-5/8})$ viscous lower deck, are not admitted in the triple-deck formulation due to the additional physics that is required in the $O(Re^{-5/8}) \times O(Re^{-5/8})$ Rayleigh region. However, the Rayleigh instability has a faster growth rate than the LWR instability and would be expected to dominate in solutions of the full Navier-Stokes equations for the compression ramp flow. The stability problem consists of solving the triple-deck formulation for the base flow and the Rayleigh equation for the perturbations to this base flow. Results for ramp angles up to $\alpha = 5.5$ show that for all cases that are unstable to LWR modes, i.e. that contain inflectional velocity profiles, the flow is also unstable to Rayleigh modes.

[1]Cassel, Ruban & Walker, *J. Fluid Mech.* **300**, 265–286 (1995).

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