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Simulation and Global Stability Analysis of a 35^o compression ramp in a uniform Mach 6 flow[1] FABIAN DETTENRIEDER, DANIEL BODONY, University of Illinois at Urbana-Champaign — Aerothermal and structural loads of flows relevant to hypersonic vehicles pose a multi-disciplinary design problem. Of particular interest is the fluid-structure interaction associated with a deflected control surface at sufficiently high Mach number such that the compression shock sits on the control surface downstream of the corner, leading to large localized pressure and thermal loads. As a baseline for subsequent compliant analyses, we investigate the Mach 6 flow past a rigid 35 degree compression ramp attached to a finite-length flat plate, which together model the control surface geometry, by means of direct numerical simulation (DNS). The three-dimensional DNS results include the boundary layer development from the plate's leading edge, through transition, and ultimate transition to turbulence. The unsteadiness of the separation bubble and observed ejection of mass and shocklets from the separation bubble are quantified and compared to experimental data. We use global stability analyses of the time-averaged flow to discuss the observed unsteadiness in terms of global modes.

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