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Effect of Surface Thermal Perturbations on Compressible Boundary Layer Stability[1] CHRISTOPHER ALBA, DATTA GAITONDE, Air Force Research Laboratory — High-speed laminar-turbulent boundary layer transition is a critical issue for re-entry and sustained hypersonic cruise vehicles. Turbulent wall heating rates can increase several orders of magnitude compared to laminar rates and skin friction drag can become a major component of the overall drag. We analyze approaches to modulate transition by altering the stability features of the boundary layer through the use of thermal perturbations. To this end, high-fidelity numerical simulations to generate basic states for Mach 1.5 and Mach 5.6 flat plate boundary layers with and without thermal bumps. Linear Parabolized Stability Equations (PSE) are solved using the STABL software suite to establish the flow stability characteristics under baseline (no excitation), constant and pulsed bump cases for each freestream Mach number. The effects are described in terms of neutral curves showing amplification for various frequencies versus Reynolds number. The three-dimensional flow structure is also examined near the breakdown to turbulence flow region to gain insight into the final stages of transition.

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