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Growth of nonlinear streaky structures and the associated streamwise vortices in high-speed boundary layers ADRIAN SESCU, Mississippi State University, USA, MOHAMMED AFSAR, University of Strathclyde, UK, YUJI HATTORI, Tohoku University, Japan — High-speed boundary layer transition has recently seen a resurgence of interest and reinvigoration, motivated by the need to improve the design and optimization of future hypersonic transport aircraft or reentry vehicles, increase the efficiency of high-speed engines, improve the flow in natural gas pipelines, or to quieten high-speed wind tunnels. In the pre-transitional stage, streamwise vortices and the associated streaks experience transient growth in boundary layer flows over flat or concave surfaces as a result of various disturbances initiated in the upstream region or from the wall. Here, we study the nonlinear progression of streaky structures in supersonic and hypersonic boundary layers via the full nonlinear compressible boundary region equations, which is the high Reynolds number asymptotic extension of the Navier-Stokes equations under the assumption that the streamwise wavenumber of the disturbances is much smaller than both wall-normal and spanwise wavenumbers. The base flow is excited either by freestream disturbances imposed at the upstream boundary or by disturbances from the wall in the form of wall transpiration. An extensive parametric study is performed in different flow conditions to assess the development of these streaky structures.

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