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Global eigenfunctions of a hypersonic blunt cone[1] TIM FLINT, PARVIZ MOIN, M. J. PHILIPP HACK, Center for Turbulence Research, Stanford University — Transition to turbulence in external high-speed flows is sensitive to free-stream disturbances. Current methods for predicting boundary-layer transition are unable to account for the physics of the receptivity process. We address the receptivity of hypersonic flows by solving the global eigenvalue problem in the linearized and adjoint linearized compressible Navier-Stokes equations (CNSE) without a priori assumptions. The effects of shocks and complex geometry are directly captured in the analysis. Eigenfunctions of the linearized CNSE identify the structure of instabilities while eigenfunctions of the adjoint linearized CNSE connect the free-stream disturbances to perturbations within the boundary layer. We present results for a cone with a blunt nose and geometry comparable to experimental studies at hypersonic conditions. The direct eigenfunctions describe short-scale waves that are concentrated within the lower half of the boundary layer and amplify as they travel downstream. The corresponding adjoint eigenfunctions identify the region of highest receptivity as the location immediately upstream of the normal portion of the bow shock.

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