Abstract Submitted
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Separation control in a hypersonic shock wave / turbulent boundary-layer interaction[1] ANNE-MARIE SCHREYER, Institute of Fluid Mechanics, TU Braunschweig, Germany, IVAN BERMEJO-MORENO, Aerospace and Mechanical Engineering, University of Southern California, JEONGLAE KIM, JAVIER URZAY, Center for Turbulence Research, Stanford University — Hypersonic vehicles play a key role for affordable access to space. The associated flow fields are strongly affected by shock wave/turbulent boundary-layer interactions, and the inherent separation causes flow distortion and low-frequency unsteadiness. Microramp sub-boundary layer vortex generators are a promising means to control separation and diminish associated detrimental effects. We investigate the effect of a microramp on the low-frequency unsteadiness in a fully separated interaction. A large eddy simulation of a 33○-compression-ramp interaction was performed for an inflow Mach number of 7.2 and a Reynolds number based on momentum thickness of $Re_\theta = 3500$, matching the experiment of Schreyer et al.(2011). For the control case, we introduced a counter-rotating vortex pair, as induced by a single microramp, into the boundary layer through the inflow conditions. We applied a dynamic mode decomposition (DMD) on both cases to identify coherent structures that are responsible for the dynamic behavior. Based on the DMD, we discuss the reduction of the separation zone and the stabilization of the shock motion achieved by the microramp, and contribute to the description of the governing mechanisms.

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