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On the Mechanisms of Shear Layer High-Frequency Control. Part II: Stability Studies Z. RUSAK, RPI, J.J. CHOI, R.P.I. — Linear temporal and spatial stability analyses and nonlinear parabolic stability equations are used to describe the effect of upstream low- and high-frequency (HF) fluidic actuation on the dynamics of small- and large-scale motions in a base shear layer. The stability analyses show that at low forcing frequencies, the periodic vortical perturbations first grow over a distance related to position where the imposed perturbations' frequency matches twice the local natural frequency. Beyond this distance, perturbations decay exponentially. At high forcing frequencies, above twice the layer's maximum natural frequency, the perturbations always decay with distance. The nonlinear parabolic stability computations demonstrate that the nonlinear interaction between the various modes generates a zero mode change which in turn modifies the perturbations' kinetic energy (PKE) distribution in each mode. HF actuation causes in an initial domain along the layer a significant increase in layer thickness, a reduction in local natural frequency and a production of PKE. This is followed by a region, which depends on the actuation amplitude, where shear layer thickness is moderately increased and PKE is more spread and lower in magnitude. Beyond this region, the effect of HF forcing decays and large-scale, low-frequency modes reappear and dominate the flow. Results support the experimental finding of Vukasinovic & Glezer (2007). The research was supported by The Boeing Company and AFRL, the FLOWCAD program, and by the NSF, Award No. ECS-0523957.

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