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Supersonic cavity flow control using resolvent analysis[1] QIONG LIU, University of California. Los Angeles, YIYANG SUN, University of Minnesota, Minneapolis, CHI-AN YEH, KUNIHIKO TAIRA, University of California. Los Angeles — We examine supersonic flows over a 3D cavity at Mach number of 1.4 with cavity-depth-based Reynolds number of 10,000 using LES and propose a resolvent analysis based flow control technique to suppress the pressure fluctuations over the cavity. The resolvent analysis identifies the range of the forcing frequency and spanwise wavenumber for the turbulent cavity flow where energy amplifies significantly. Given these insights from resolvent analysis, we perform a series of controlled flow simulations by prescribing the unsteady actuation with various combinations of the spanwise wavelength and actuation frequency over the supersonic turbulent cavity flow. The controlled achieves over 28% of reduction in pressure fluctuations. By combining the insights from resolvent analysis with DMD of the 3D cavity flows, we uncover two main mechanisms responsible for effective suppression: (1) the unsteady actuation thickens the shear layer near the leading edge and modifies its spreading rate to reduce the receptivity to acoustic disturbances; (2) the actuation disrupts the formation of large-scale spanwise vortices which mitigates the obstruction of incoming flow and alleviates the trailing-edge impingement.

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