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Stability Analysis of High-Speed Cavity Flow[1] YIYANG SUN, KUNIHIKO TAIRA, LOUIS CATTAFESTA, Florida State University, GUILLAUME BRES, Cascade Technologies, LAWRENCE UKEILEY, University of Florida — Stability analysis is conducted to uncover the inherent instabilities in subsonic to supersonic open cavity flows. Two- and three-dimensional direct numerical simulations of spanwise periodic cavity flows are performed with the high-fidelity compressible flow solver "Charles" developed at Cascade Technologies. Two-dimensional nonlinear computations are carried out to characterize the flow stability over a wide range of Mach numbers and Reynolds numbers, and to extract a base flow for three-dimensional linear stability analysis. Selective frequency damping method is used to solve for the steady state for cases where the flow is found to be unstable. Both stable and unstable two-dimensional steady state can then be used as base state to examine, in the linear limit, how instabilities grow in space and over time. The present study forms a foundation to pursue three-dimensional flow control in which the spanwise instability will be exploited to redistribute kinetic energy from large spanwise vortices to reduce load fluctuations within the cavity.

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