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Reduced-order Model Based Feedback Control of Cavity Flows – Changes in the Flow Characteristics[1] MO SAMIMY, JESSE LITTLE, MARCO DEBIASI, EDGAR CARABALLO, ANDREA SERRANI, XIN YUAN, Gas Dynamics and Turbulence Laboratory; Collaborative Center of Control Science; The Ohio State University — We have developed and experimentally implemented reduced-order model based feedback control of subsonic cavity flows. Reduced-order models were developed via Proper Orthogonal Decomposition (POD) using particle imaging velocimetry (PIV) in conjunction with the Galerkin projection of the governing Navier-Stokes equations onto the resulting spatial eigenfunctions. The stochastic estimation technique using simultaneous PIV and surface pressure measurements was used to establish correlation between the flow field and surface pressure. For the implementation of the controller, dynamic surface pressure measurements were used for the estimation of the POD modal coefficients. The reduced-order model was linearized around the equilibrium point and a linear-quadratic optimal controller was designed and implemented in the experiments. The actuator was a compression driver type and its output was channeled through a one millimeter slit spanning the entire width of the cavity leading edge. Models based on one or more flow conditions for a Mach 0.3 cavity flow were developed and used, which suppressed the cavity resonant modes. We will compare and contrast the flow characteristics for the open- and closed-loop controlled flows.

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