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Control of instabilities in a cavity-driven separated boundary-layer flow JEROME HOEPFFNER, ESPEN ÅKERVIK, KTH Mechanics, Stockholm, UWE EHRENSTEIN, Laboratoire J.A. Dieudonné, Nice, DAN HENNINGSON, KTH Mechanics, Stockholm — A two-dimensional incompressible boundary-layer flow along a smooth-edged cavity is considered. Unstable global modes appear above a critical inflow Reynolds number of approximatively 500. We aim at stabilizing the flow using feedback control. Sensors measure shear stress at the downstream lip of the cavity, where the unstable modes are most energetic, and actuators apply blowing and suction upstream, where sensitivity is highest. The optimal control loop, in the form of control and estimation feedback gains, is computed through the solution of two Riccati equations. The high dimentionality of this strongly nonparallel flow, once discretized, challenges the design of an optimal feedback controller. A reduced dynamic model is thus constructed for small perturbations to the basic flow by selecting the least stable eigenmodes of the linearized Navier-Stokes equations for this geometry. The flow system is discretized using Chebyshev collocation in both the streamwise and wall-normal direction and the global eigenmodes are computed by means of the Krylov-Arnoldi method. Flow stabilization is demonstrated using a model reduced to 50 states, provided the actuators are smooth, with slow time scales.

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