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Feedback Control of Unsteady Flow and Vortex-Induced Vibration RAJEEV JAIMAN, WEIGANG YAO, National University of Singapore — We present an active feedback blowing and suction (AFBS) procedure via model reduction for unsteady wake flow and the vortex-induced vibration (VIV) of circular cylinders. The reduced-order model (ROM) for the AFBS procedure is developed by the eigensystem realization (ERA) algorithm, which provides a low-order representation of the unsteady flow dynamics in the neighbourhood of the equilibrium steady state. The actuation is considered via vertical suction and blowing jet at the porous surface of a circular cylinder with a body mounted force sensor. The resulting controller designed by linear low-order approximation is able to suppress the nonlinear saturated state. A systematic linear ROM-based stability analysis is performed to understand the eigenvalue distributions of elastically mounted circular cylinders. The results from the ROM analysis are consistent with those obtained from full nonlinear fluid-structure interaction simulations. A sensitivity study on the number of suction/blowing actuators, the angular arrangement of actuators, and the combined versus independent control architectures has been performed. Overall, the proposed control is found to be effective in suppressing the vortex street and the VIV for a range of reduced velocities and mass ratios.

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