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A reduced order interaction model for flow control via a poroelastic carpet of compliant actuators DIVYA VENKATARAMAN, ALESSANDRO BOTTARO, University of Genoa, Italy, RAMA GOVINDARAJAN, Jawaharlal Nehru Centre for Advanced Scientific Research, Bangalore, India — A passive actuation technique that consists of covering the suction side of an airfoil with a coating of porous, compliant actuators (analogous to a class of flight feathers known as "coverts"), has in the recent past been shown to be effective in controlling its wake. A feature in the case of an airfoil (as opposed to the case of a cylinder) is that two flow frequencies are observed under many conditions. Such wake control is highly sensitive to whether or not the frequency of the structure's dynamics synchronizes with one of these frequencies. Possible transitions from non-chaotic to chaotic vortex shedding regimes have also been observed. To determine the physics governing this complex fluid-structure interaction problem, a reduced order model is developed, by coupling an oscillator model for the structure with a van der Pol-like nonlinear oscillator model for the vortex shedding of the airfoil (a form with which the vortex-shedding from many canonical structures has been represented). In the case of a cylinder, the limit cycle of the unsteady lift coefficient for the coupled system is seen to lie within that of the plain vortex-shedding oscillator, indicating that the poroelastic coating is capable of yielding drag reduction, arising from a stabilization of the wake.

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