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A Hybrid Low-order Model of Dynamic Lift Response to Time-varying Actuation[1] XUANHONG AN[2], Princeton University, DAVID WILLAMS[3], Illinois Institute of Technology — Time-varying actuation from a synthetic jet actuator has previously been shown to be an effective way of controlling unsteady flow separation. In order to integrate this type of actuation into a real-time control system, a low-order model of the lift response to the actuation is desired. The current work proposes a low-order approach to modeling the lift response to time-varying leading edge actuation on a stalled airfoil. Dynamic Mode Decomposition (DMD) is employed to extract from the flowfield the critical dynamical information, which is connected to the lift variation. It is shown that there are two sets of DMD modes associated with two different frequencies. These two frequencies are contained in both the actuation signal and the lift response. Based on the information provided by the critical DMD modes, we propose a hybrid low-order model which consists of a time delay decay model and a convolution integral model. This hybrid model is capable of accurately predicting the lift response of an airfoil to the time-varying actuation.

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