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Towards DMD-Based Estimation and Control of Flow Separation using an Array of Surface Pressure Sensors[1] ERIC DEEM, LOUIS CATTAFESTA, Florida State University, HAO ZHANG, CLANCY ROWLEY, Princeton University — Closed-loop control of flow separation requires the spatio-temporal states of the flow to be fed back through the controller in real time. Previously, static and dynamic estimation methods have been employed that provide reduced-order model estimates of the POD-coefficients of the flow velocity using surface pressure measurements. However, this requires a learning dataset a priori. This approach is effective as long as the dynamics during control do not stray from the learning dataset. Since only a few dynamical features are required for feedback control of flow separation, many of the details provided by full-field snapshots are superfluous. This motivates a state-observation technique that extracts key dynamical features directly from surface pressure, without requiring PIV snapshots. The results of identifying DMD modes of separated flow through an array of surface pressure sensors in real-time are presented. This is accomplished by employing streaming DMD on the fly to surface pressure snapshots. These modal characteristics exhibit striking similarities to those extracted from PIV data and the pressure field obtained via solving Poissons equation. Progress towards closed-loop separation control based on the dynamic modes of surface pressure will be discussed.

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