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Snapshot Selection for State Estimation of Wake Flows using Proper Orthogonal Decomposition STEFAN SIEGEL, KELLY COHEN, JUERGEN SEIDEL, THOMAS MCLAUGHLIN, US Air Force Academy — Proper Orthogonal Decomposition (POD) has been used extensively in the past for estimation and low dimensional modeling of both steady and time periodic flow fields. If the intended use of the low dimensional POD model is in the area of feedback flow control, the low dimensional state of a flow field needs to be accurately estimated as input for a controller. We investigate POD bases derived from steady state, transient startup and open loop forced data sets for the two dimensional wake of a D-shaped cylinder at Re = 300. We find that only a POD basis derived from a composite snapshot set consisting of both transient startup as well as open loop forced data accurately models the features of the feedback controlled flow. For similar numbers of modes, this POD basis, which can be derived a priori, represents the feedback controlled flow as well as a POD model developed from the feedback controlled data a posteriori. Conclusions: Firstly, an accurate POD basis can be developed without iteration from unforced and open loop data. Secondly, it appears that the feedback controlled flow does not leave the subspace spanned by open loop and unforced startup data, which may have important implications for the performance limits of feedback flow control.

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