4D-Var identification of DMD Reduced-Order Models[1] GILLES
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reduced-order modelling (ROM) strategy is crucial to achieve model-based control
in a wide class of flow configurations. In turbulence, ROMs are mostly derived by
Galerkin projection of first principles equations onto the proper orthogonal decom-
position (POD) modes. POD is widely used since it extracts from a sequence of
data an orthonormal basis which captures optimally the flow energy. Unfortunately,
energy level is not necessarily the correct criterion in terms of dynamical modelling
and deriving a dynamical system based on POD modes leads sometimes to irrele-
vant models. In this communication, the Dynamic Mode Decomposition (DMD) as
recently proposed by Schmid (JFM 2010) is used to determine the DMD modes. A
DMD ROM is then derived by Galerkin projection of the Navier-Stokes equations
onto a selected set of optimized-DMD modes. Finally, a four-dimensional variational
assimilation approach (4D-Var) is employed to identify the coefficients of the DMD
ROM. Essentially, 4D-Var combines imperfect observations, a background solution
and the underlying dynamical principles governing the system under observation to
determine an optimal estimation of the true state of the system. The methodology
is illustrated for a DNS cylinder wake flow at Re=200 and PIV measurements at
Re=13000.

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