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Model reduction using snapshot-based realizations DIRK M. LUCHTENBURG, CLARENCE W. ROWLEY, Princeton University — A number of methods can be used to develop reduced-order models (ROM) for flow control, including proper orthogonal decomposition (POD), approximate snapshot-based balanced truncation (balanced POD), and the eigenvalue realization algorithm (ERA). We present a new method for obtaining a ROM from snapshots of the impulse response of a linear system. The idea is to use snapshots to identify a dynamical system that exactly reconstructs the impulse response. The dimension of this dynamical system is given by the rank of the controllable subspace (the number of states that respond to inputs). This system can be reduced even further by projecting out the unobservable subspace (the subspace that cannot be inferred from the output history), leading to a minimal realization. If the dimension of this realization is sufficiently small, balanced truncation can be readily performed. This is usually the case for active flow control applications, where the dimension of the flow field is large compared to the number of controllable / observable states. One advantage of the proposed method is that it avoids the construction of (large) Hankel matrices, as is necessary for methods like ERA or BPOD. Moreover, in general fewer snapshots are required for a more accurate balanced model. The findings are illustrated using several numerical examples.

Dirk M. Luchtenburg
Princeton University

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