Balancing and the reduction of dynamical systems based on data

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Balanced truncation is a classical approach to model reduction that has long been the "gold standard" for high fidelity reduced order modeling for large scale linear dynamical systems. I will discuss a novel data-driven reformulation of this approach that does not require intrusive access to internal system dynamics, that is, knowledge of an original system realization is unnecessary. Instead, observations are accumulated of the system response - either sampling the transfer function evaluated at complex driving frequencies, or sampling (in time) the system's impulse response. Notably, we do not require access to state-space trajectory snapshots as would be found in POD-type methods, nor do we approximate any system Grammians. A variety of numerical experiments are provided that verify the effectiveness of this approach.

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