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Approximate Balanced Truncation for Large Unstable Systems
THIBAULT FLINOIS, AIMEE S. MORGANS, PETER J. SCHMID, Imperial College London — A new snapshot-based extension of approximate balanced truncation to unstable systems that does not rely on the computation of global modes is presented. Applying feedback control to fluid flows often allows reaching the desired goal – e.g. drag minimisation, suppression of instabilities – more efficiently than passive and open-loop control, or where these approaches are ineffective. However a low-order approximation of the system's input-output dynamics is often required in order to make controller design and online implementation tractable. Several system identification and model reduction procedures have been developed to this end: one such method that has received much attention is approximate balanced truncation, or balanced POD. It is applicable to stable systems and has recently been extended to unstable systems. This extension is based on the projection of the system onto its stable subspace, but this procedure can become computationally expensive for large systems. Here we show how balanced POD can be applied to unstable systems in a way that scales well even for very large systems, as it is projection-free and does not require computing global modes. We show that this method can be easily implemented by applying it to model systems and other selected flow configurations.

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