Abstract Submitted
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Efficient randomized methods for stability analysis of fluids systems[1] SCOTT DAWSON, CLARENCE ROWLEY, Princeton University — We show that probabilistic algorithms that have recently been developed for the approximation of large matrices can be utilized to numerically evaluate the properties of linear operators in fluids systems. In particular, we present an algorithm that is well suited for optimal transient growth (i.e., nonmodal stability) analysis. For non-normal systems, such analysis can be important for analyzing local regions of convective instability, and in identifying high-amplitude transients that can trigger nonlinear instabilities. Our proposed algorithms are easy to wrap around pre-existing timesteppers for linearized forward and adjoint equations, are highly parallelizable, and come with known error bounds. Furthermore, they allow for efficient computation of optimal growth modes for numerous time horizons simultaneously. We compare the proposed algorithm to both direct matrix-forming and Krylov subspace approaches on a number of test problems. We will additionally discuss the potential for randomized methods to assist more broadly in the speed-up of algorithms for analyzing both fluids data and operators.

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