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Towards Scalable Parallel-in-Time Turbulent Flow Simulations
QIQI WANG, STEVEN GOMEZ, PATRICK BLONIGAN, MIT, ALASTAIR GREGORY, Cambridge University, ELIZABETH QIAN, MIT — We present a reformulation of unsteady turbulent flow simulations that exhibits chaotic dynamics. Examples include many DNS and LES. This reformulation uses the concept of least squares shadowing. The flow field is assumed to be ergodic, and only long time averaged statistical quantities are considered as quantities of interest. The initial condition is relaxed in the least squares shadowing formulation, and information is allowed to propagate both forward and backward in time. Simulations of chaotic dynamical systems with this reformulation can be proven to be well-conditioned time domain boundary value problems. We analyze how this reformulation can enable scalable parallel-in-time simulation of turbulent flows.

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