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Bridging the Gap Toward Multiple Timescale Simulation: A Data-Driven Approach for Projective Integration[1] SEBASTIAN DE PASCUALE, DAVID GREEN, JEREMY LORE, Oak Ridge National Lab — The physics of fusion plasmas includes multiscale phenomena that can be prohibitively expensive to simulate. Projective integration offers a computational framework for bridging divided timescales. Toward this end, we demonstrate the data-driven construction of linear time advance operators, which are devised to be separable into the fast and slow components of simulated dynamics. Our work is based on a least-squares approximation obtained via singular value and dynamic mode decomposition. We filter the components of these procedures to specifically enable large timesteps, resulting in a spatially reduced rank and temporally partitioned operator for use in standard integration schemes. We verify the capability of these operators to reconstruct dynamics extracted from simulated data. In addition, we test their stability characteristics for first order methods. Our results are detailed for linear cases of 1d diffusion and advection. We then investigate modeling scenarios relevant to fusion plasma physics by applying this approach to 2D SOLPS steady-state simulations. From these benchmarks, we conclude by extending the developed data-driven algorithm to a projective integration framework for multiscale simulation.

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