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Forecast-Enhanced Multiscale Modeling for High Energy-Density Matter[1] AUSTIN GILBERT, MICHAEL MURILLO, Michigan State University, JEFFREY HAACK, Los Alamos National Lab — Microscopic data in the form of collision times, transport coefficients, reaction rates, and equations of state are needed to provide crucial material properties to macroscopic models. In many cases, this data can be precomputed and stored in tables or fits. In some cases, however, this is inconvenient because of the required span and dimensionality of the table. In such cases, it is more efficient and accurate to compute the closure data on the fly, alternating between microscopic and macroscopic model solvers. This scheme, known as the Heterogenous Multiscale Method (HMM), suffers from (1) the data becoming stale at an unknown time during the macroscale evolution and (2) reinitializing the microscale model requires more data than the macroscale model contains. Here, we propose the use of machine learning, specifically vector auto-regression (VAR), to solve the HMM problem by recasting it as a Bayesian forecasting problem. That is, we learn the microscopic behavior with VAR and evolve it alongside the macroscopic solver such that we can assess its uncertainty before we reinitialize the microscale model. We numerically explore this idea using a hydrodynamic model with various numbers of moments.

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