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Sub-grid scale models for discontinuous Galerkin methods based on the Mori-Zwanzig formalism[1] ERIC PARISH, KARTHK DURAISAMY, University of Michigan — The optimal prediction framework of Chorin et. al., which is a reformulation of the Mori-Zwanzig (M-Z) formalism of non-equilibrium statistical mechanics, provides a framework for the development of mathematically-derived closure models. The M-Z formalism provides a methodology to reformulate a high-dimensional Markovian dynamical system as a lower-dimensional, non-Markovian (non-local) system. In this lower-dimensional system, the effects of the unresolved scales on the resolved scales are non-local and appear as a convolution integral. The non-Markovian system is an exact statement of the original dynamics and is used as a starting point for model development. In this work, we investigate the development of M-Z-based closures model within the context of the Variational Multiscale Method (VMS). The method relies on a decomposition of the solution space into two orthogonal subspaces. The impact of the unresolved subspace on the resolved subspace is shown to be non-local in time and is modeled through the M-Z-formalism. The models are applied to hierarchical discontinuous Galerkin discretizations. Commonalities between the M-Z closures and conventional flux schemes are explored.

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