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**Machine Learning-based discovery of closures for reduced models of dynamical systems**[1] SHAOWU PAN, University of Michigan Ann arbor, KARTHIK DURAISAMY, Univesity of Michigan Ann arbor — Despite the successful application of machine learning (ML) in fields such as image processing and speech recognition, only a few attempts has been made toward employing ML to represent the dynamics of complex physical systems. Previous attempts mostly focus on parameter calibration or data-driven augmentation of existing models. In this work we present a ML framework to discover closure terms in reduced models of dynamical systems and provide insights into potential problems associated with data-driven modeling. Based on exact closure models for linear system, we propose a general linear closure framework from viewpoint of optimization. The framework is based on trapezoidal approximation of convolution term. Hyperparameters that need to be determined include temporal length of memory effect, number of sampling points, and dimensions of hidden states. To circumvent the explicit specification of memory effect, a general framework inspired from neural networks is also proposed. We conduct both a priori and posteriori evaluations of the resulting model on a number of non-linear dynamical systems.

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