

Challenges and progress in learning physics-based reduced models for combustion processes

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Abstract

The computational science and engineering community is awash with excitement over the prospect of using machine learning to learn low-dimensional models from data. Indeed, the field of model reduction has long sought to derive approximate low-dimensional representations of an underlying high-fidelity model. Model reduction has clear connections to machine learning, yet with a large difference in perspective: model reduction methods have grown from the computational science and engineering (CSE) community, with a focus on reducing high-dimensional models that arise from physics-based modeling, whereas machine learning has grown from the computer science community, with a focus on creating low-dimensional models from black-box data streams. This talk will discuss the importance of blending the two perspectives, especially in the context of transport systems governed by complex multi-scale multi-physics dynamics, high-dimensional uncertain parameters that cannot be observed directly, and a need to issue predictions that go beyond the specific conditions where data may be available.