Reduced models you can believe in

Jan S Hesthaven
Division of Applied Mathematics
Brown University
Providence
RI 02912
Jan.Hesthaven@Brown.edu

Abstract

The development and application of models of reduced computational complexity is used extensively throughout science and engineering to enable the fast/real-time/subscale modeling of complex systems for control, design, or prediction purposes of multiscale problems. Such models, while often successful and of undisputed value, are, however, often heuristic in nature and the validity and accuracy of the output is often unknown. This limits the predictive value of such models.

In this talk we will discuss recent and ongoing efforts to develop reduced basis methods for which one can develop a rigorous a posteriori theory. The approach aims at formulating reduced models for parameterized linear partial differential equations such as Maxwell's equations. We will outline the theoretical developments of certified reduced basis methods, discuss an offline-online approach to ensure computational efficiency, and emphasize how an error estimator can be exploited to construct an efficient basis at minimal computational off-line cost. The discussion will draw on examples based both on differential and integral equations formulations.

The performance of the certified reduced basis model will be illustrated through several examples to highlight the major advantages of the proposed approach as well as key open challenges in the current approach.

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