Multidisciplinary Simulation, Estimation, and Assimilation Systems

Seminar Series

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The Certified Reduced Basis Method for High-Fidelity Simulation in Many Query and Real-Time Applications

Abstract: We employ the certified Reduced Basis (RB) method to accelerate high-fidelity numerical approximation of parameterized partial differential equations. The approach is divided into a computationally intensive Offline stage (performed on a supercomputer, for example) in which the reduced order model is generated, and a very inexpensive Online stage in which quantities of interest and rigorous error bounds are evaluated in real-time. We discuss theoretical elements of the framework, including a Greedy algorithm for basis function selection, a posteriori error bound theory for elliptic and parabolic problems, and primal-dual RB approximation for output superconvergence. We demonstrate the methodology through a number of examples drawn from fluid mechanics, solid mechanics, acoustics and heat transfer. In particular, we demonstrate the potential of the RB method to provide accurate, robust and efficient reduced order models for many-query (sensitivity analysis, multiscale analysis) and real-time/deployed (in situ parameter estimation and model calibration) contexts.

Friday, Jan. 7, 2011

4:00PM; Rm. 5-314

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