Department of Mathematics

University of Houston

Scientific Computing Seminar

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Sandia National Laboratories

Perspectives on preservation of physical properties through optimization

Wednesday, Feb. 18, 2015*
3:00 PM- 4:00 PM
Room 646 PGH

***Note Special Day and Time**

Abstract: Predictive simulations of science and engineering applications require numerical methods which produce physically meaningful solutions. Yet, many formally stable and accurate methods fail to preserve critical properties such as global and/or local solution bounds, discrete maximum principle, symmetries, or monotonicity. As a result, the state of property preserving discretizations lags significantly behind the formal understanding of structure preserving, or compatible discretizations, which reproduce, e.g., a discrete DeRham sequence.

Optimization-based modeling (OBM) is a “divide-and-conquer” strategy that decomposes mutiphysics, multiscale operators into simpler constituent components and separates preservation of physical properties such as a discrete maximum principle, local bounds, or monotonicity from the discretization process. In so doing OBM relieves discretization from tasks that impose severe geometric constraints on the mesh, or tangle accuracy and resolution with the preservation of physical properties.

In a nutshell, our approach reformulates a given mathematical model into an equivalent multiobjective constrained optimization problem. The optimization objective is to minimize the discrepancy between a target approximate solution and a state, subject to constraints derived from the component physics operators and the condition that physical properties are preserved in the optimal solution.

To illustrate the approach we discuss applications of OBM to conservative data transfer (remap) and formulation of conservative and monotone semi-Lagrangian transport schemes. This talk is based on joint work with Scott Moe, Denis Ridzal, Kara Peterson, and Misha Shashkov.

This seminar is easily accessible to persons with disabilities. For more information or for assistance, please contact the Mathematics Department at 743-3500.