Department of Mathematical Sciences Colloquium

Candidate for Tenure-Track Applied Math Position, Dept. of Mathematical Sciences

Dr. Jehanzeb Hameed Chaudhry
Department of Mathematics
Colorado State University

A *posteriori* analysis of multi-scale, multi-physics systems

Numerical simulation of a multi-scale system inevitably involves significant discretization error. Quantification of this error is an important facet of predictive science. In particular, science and engineering applications are primarily interested in quantifying the error in particular low-dimensional quantities of interest (QoI) computed from a solution corresponding to observable data. Some examples include computing the lift on a wing, conservation of mass or energy, or a spatial average of the solution. Adjoint based a posteriori techniques have been applied successfully to estimating errors in quantities of interest for a wide variety of applications.

This talk is concerned with the accurate computational error estimation of numerical solutions of multi-scale, multi-physics systems of reaction-diffusion equations. Such systems present significantly different temporal and spatial scales within the components of the model. Hence it is impractical to solve the system at the finest resolution. The choice of numerical method is often dictated by high performance computing issues, indicating the use of independent discretizations for different components as well as iterative and implicit/explicit (IMEX) schemes for time integration. However, multi-discretization has significant effects on accuracy and stability, and traditional adjoint based analysis does not apply to such systems. In this talk, we extend adjoint-based analysis to derive accurate a posteriori error estimates for user-defined quantities of interest. These estimates account for leading order contributions to the error arising from the numerical solution of each component as well as errors due to incomplete iteration, linearization, projection of solution components between different spatial meshes and implicit/explicit time integration. Several numerical examples with various settings are given to demonstrate the performance of the error estimators.

Friday, March 28, 2014 at 3 pm
In Bell Hall 143
The University of Texas at El Paso

Refreshments will be served 15 minutes prior to start of the colloquium
For further information, please contact Dr. Ming-Ying Leung, 915-747-6836
email: mleung@utep.edu,