SUBJECT: Ph.D. Proposal Presentation

BY: Hyeong-Kae Park

TIME: Monday, April 24, 2006, 10:00 a.m.

LOCATION: Neely Building, Room 118

TITLE: Coupled Space-Angle Adaptivity and a Goal Oriented Error Control for Radiation Transport Calculations

COMMITTEE: Dr. Cassiano de Oliveira, Chair (ME)
Dr. Farzad Rahnema (ME)
Dr. Weston Stacey (ME)
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SUMMARY

This research is concerned with the self-adaptive numerical solution of the neutral particle radiation transport problem. Radiation transport is an extremely challenging computational problem since the governing equation is seven-dimensional (3 in space, 2 in direction, 1 in energy, and 1 in time) with a high degree of coupling between these variables. If not careful, this relatively large number of independent variables when discretized can potentially lead to sets of linear equations of intractable size. Though parallel computing has allowed the solution of very large problems, available computational resources will always be finite due to the fact that ever more sophisticated multiphysics models are being demanded by industry. There is thus the pressing requirement to optimize the discretizations so as to minimize the effort and maximize the accuracy. One way to achieve this goal is through adaptive phase-space refinement. Unfortunately, the quality of discretization (and its solution) is, in general, not known a priori; accurate error estimates can only be attained via the a posteriori error analysis. In particular, in the context of the finite element method, the a posteriori error analysis provides a rigorous error bound. The main difficulty in applying a well-established a posteriori error analysis and subsequent adaptive refinement in the context of radiation transport is the strong coupling between spatial and angular variables. This research attempts to address this issue within the context of the second-order, even-parity form of the transport equation discretized with the finite-element spherical harmonics method. The objective is to develop an a posteriori error analysis in a coupled space-angle framework and to develop an efficient adaptive algorithm. The error will be measured in terms of global energy and/or the L2 norm error as well as some engineering output (functional).