PEOPLE

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Women in NSE
Meet Our Students

Kord Smith

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Education

B.S., Nuclear Engineering, Kansas State University 1976
M.S. and N.E., Nuclear Engineering, Massachusetts Institute of Technology, 1979
PhD., Nuclear Engineering, Massachusetts Institute of Technology, 1980

Research Interests

Development and application of computational physics methods for modeling and simulation of nuclear reactor cores: reactor physics analysis methods, fuel/core loading design and optimization, transient safety analysis, real-time operator training, and on-line plant monitoring.

Reactor Analysis Methods

Modern computing has made possible vast improvements in physics models used for reactor analysis, and many approximations in current-generation tools are being systematically improved or eliminated. Significant verification and validation (V&V) challenges are being addressed as new methods are prepared for deployment in production tools. Our group is engaged in an effort to use data from operating LWRs for qualification of new methods. As data is analyzed, open-literature benchmarks are being prepared for use in V&V efforts within the broader nuclear industry. Students have opportunities to develop not only improved analysis methods, but also new techniques for V&V. Students also help support nuclear utilities and fuel vendors by solving practical reactor analysis problems.

Computational Methods

The implementation of reactor physics methods into efficient simulation tools requires effective computational methods and numerical algorithms. Students are engaged in extending a class of non-linear acceleration techniques recently developed for deterministic applications (physics-based multi-grid methods) to stochastic Monte Carlo neutral particle transport. Multi-physics coupling of neutron transport, fluid flow, and fuel modeling with Krylov solvers is being pursued for large-scale reactor simulations. These methods hold promise for not only providing efficient acceleration for Monte Carlo calculations, but also for extending Monte Carlo applications to the time domain.

High Performance Computing (HPC)s

As DOE's Office of Science pushes the frontiers of advanced computing to the Exascale (10^{18} FLOPS), significant challenges are being encounter in the design and utilization of these massively-parallel machines - which will have hundreds of millions or billions of compute cores. DOE is sponsoring three interdisciplinary "co-design centers" that are tasked with simultaneously designing hardware and software for deployment on machines in 2019. Our group is an integral part of one center, CESAR, the ANL-led Center for Exascale Simulation of Advanced Reactors, working together with industrial partner IBM. Fundamental research on basic reactor modeling methods, massively-parallel algorithms, software architecture, and computer hardware design are underway. CESAR provides unique opportunities for students to be involved in large interdisciplinary HPC projects, and students will be exploring parallel communication bottlenecks, developing new algorithmic

Research profile:
Kord Smith brings 30 years of simulation insight to NSE

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approaches, and testing large-scale GPGPU utilizations.

Recent Publications

1. A. Siegel, K. Smith, P. Fischer, V. Mahadevan, “Analysis of Communication Costs for Domain Decomposed Monte Carlo Methods in Nuclear Reactor Analysis,” submitted for publication to the *Journal of Computational Physics,* July, 2011.
2. K. Smith, et al., ‘Experimental Benchmarks for Quantifying Fuel Reactivity Depletion Uncertainty,” *9th International Conference on Nuclear Criticality Safety,* Edinburgh, Scotland, September, 2011.
3. D.A. Knoll, H. Park, K. Smith, “Application of the Jacobian-Free Newton-Krylov Method in Nonlinear Transport Acceleration,” *Nuclear Science and Engineering,* Vol. 87, p 122-132, February, 2011.
4. D. J. Lee, K. Smith, and J. Rhodes, “The Impact of 238U Resonance Elastic Scattering Approximations on Thermal Reactor Doppler Reactivity,” *Annals of Nuclear Energy*, p 274-280, January 2009.
5. K. Smith, “Full-Core, 2-D LWR Core Calculations with CASMO-4E,” *Proceedings of the PHYSOR 2002 International Conference on the New Frontiers of Nuclear Technology Reactor Physics, Safety and High-Performance Computing*, Seoul, Korea, October 7-10, 2002.
6. K. Smith, “S3K: Enhancements and Application to Boiling Water Reactor Transients, *Transactions of the American Nuclear Society Summer Meeting ,* Vol. 84, p 64, Milwaukee, WI, June 17-21, 2001.
7. D. Kropaczek and K. Smith, “A Fully-Implicit, Five Equation Channel Hydraulics Model for SIMULATE-3K,” *Proceedings of the 1997 Joint International Conference on Mathematical Methods and Supercomputing for Nuclear Applications,* Vol. 2, p 1401, Saratoga Springs, NY, October 6-10, 1997.

Teaching

22.251: Nuclear Fuel Cycle

22.211: Nuclear Reactor Physics I

22.212: Nuclear Reactor Analysis II

Awards

- Fellow of the American Nuclear Society (ANS) 2010
- ANS Young Member Engineering Achievement Award 1986