PEOPLE

Faculty
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Women in NSE
Meet Our Students

Benoit Forget

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Education

PhD, Georgia Institute of Technology, 2006
MS, École Polytechnique de Montréal, 2003
B.S., École Polytechnique de Montréal, 2003

Research

Monte Carlo methods

One forthcoming challenge in the area of high-performance computing is having the ability to run large-scale problems while coping with less memory per compute node. Through the development of an open source Monte Carlo code (openMC), we are investigating novel data decomposition method that would allow Monte Carlo transport calculations to be performed on systems with limited memory per compute node. Initial developments have led to modifications to the fission bank algorithm for criticality calculations.

1. P.Romano and B.Forget, "Fission Bank Algorithms in Monte Carlo Criticality Calculations," Nuclear Science and Engineering accepted March (2011).
2. P.Romano, B.Forget and F.Brown, "Towards Scalable Parallelism in Monte Carlo Particle Transport Codes Using Remote Memory Access" Progress in Nuclear Science and Technology, invited October (2010).

Advanced Response Matrix Methods **ent**

Historically, full core analyses have been performed using relatively low fidelity techniques based on various homogenizations of phase-space. For new, highly heterogeneous reactor designs, the legacy methods currently available are likely not applicable. Consequently, a move toward full core analysis techniques that can leverage the high fidelity methods typically used for smaller problems is desired. This research program focuses on reformulating the response matrix system as a nonlinear system of equations and using high performance nonlinear solvers.

1. J.Roberts and B.Forget, "Solving Eigenvalue Response Matrix Equations with Jacobian Free Newton Krylov Methods," International Conference on Mathematics and Computational Methods Applied to Nuclear Science and Engineering, M&C 2011, Rio de Janeiro, Brazil, May 8-12 (2011).
2. J.Roberts and B.Forget, "Nonlinear Coarse Mesh Transport Using the Jacobian-Free Newton-Krylov Method," Transactions of the American Nuclear Society, 102, 1, 533-535 (2010).

Energy expansion

The energy variable is by far the most complex of the variables treated in deterministic simulations due to the resonant nature of the interaction probability with matter. A new approach called the discrete generalized multigroup method was developed at MIT that alleviates many of the previous approximations and allows the efficient treatment of many spectral effects arising in advanced fuels and proposed reactor designs.

Research profile:

Forget helps advance computational capabilities, expand student research options in NSE's CRPG

Better Models for Better Reactors

Labs + Groups

MIT Computational Reactor Physics Group

OpenMC

Consortium for Advanced Simulation of Light Water Reactors (CASL)

Recent News

Forget wins Landis Engineering Achievement Award from the ANS

New NSE Faculty Drive Curriculum Expansion Into Computational Science and Engineering

Learning the lessons of Fukushima

NSE publishes report on lessons learned from Fukushima-Daiichi accident

1. B.Forget and L.Zhu, "Mixed Energy Reactor Simulations using the Discrete Generalized Multigroup Method," Nuclear Science and Engineering, invited March (2011).
2. L.Zhu and B.Forget, "An Energy Recondensation Method Using the Discrete Generalized Multigroup Energy Expansion Theory," Annals of Nuclear Energy, accepted April (2011).
3. L.Zhu and B.Forget, "A Discrete Generalized Multigroup Energy Expansion Theory," Nucl. Sci. Eng., 166 (2010).

Reactor design and optimization

Optimization techniques for reactor design and fuel cycle performance are continuously being studied by our group. Additionally, innovative reactor concepts such as reduced moderation boiling water reactors, molten salt reactors and travelling wave reactors are being evaluated.

1. R.Petroski, B.Forget and C.Forsberg, "Characterizing Limited Separations Fuel Cycles Using Breed-and-Burn Reactors", submitted Nuclear Technology March (2011).
2. B.Feng, E.Shwageraus, B.Forget, and M.S.Kazimi, "Light Water Breeding with Nitride Fuel," Progress in Nuclear Energy, submitted October (2010).
3. R.Petroski, B.Forget and C.Forsberg, "Using the Neutron Excess Concept to Determine Starting Fuel Requirements for Minimum-Burnup Breed-and-Burn Reactors", accepted Nuclear Technology November (2010).
4. N.Stauff, M.J.Driscoll, B.Forget, P.Hejzlar, "Resolution of Proliferation Issues for a Sodium Fast Reactor Blanket," Nucl. Tech., 170 (2010).
5. B.Herman, E.Shwageraus, J.Leppanen and B.Forget, "Cross Section Generation Strategy for Advanced LWRs," Proceedings of ICAPP, Nice, France, May 2-5 (2011).
6. M.Massie and B.Forget, "Quantitative Optimization of Target Assembly Material Compositions for Isotope Management," Transactions of the American Nuclear Society, 103, 1, 746-747 (2010).
7. R.Petroski, B.Forget and C.Forsberg, "Neutronic Evaluation of Breed-and -Burn Reactor Fuel Types Using an Infinite-Medium Depletion Approximation," PHYSOR 2010, Pittsburgh, May (2010).

MIT Reactor Conversion

The MIT Reactor (MITR-II) is scheduled to convert from highly enriched uranium (HEU) fuel to low-enriched uranium (LEU) fuel by 2015 under the Reduced Enrichment for Research and Test Reactors (RERTR) Program managed by the Office of Nuclear Material Threat Reduction in the National Nuclear Security Administration (NNSA). To meet that goal, a high-density monolithic U-Mo LEU fuel has been proposed to replace the current HEU fuel while maintaining the flux levels necessary for continued operation. Our group provides support for neutronic analysis for the LEU and transition cores.

1. T.H.Newton, H.Horelik, P.Romano, B.Forget, E.Pilat, E.H.Wilson, B.Dionne, A.Bergeron and J.Stevens, "LEU Conversion Activities at the MIT Research Reactor: Use of Neutronic Models for Safety Analsyses," RERTR 2010 – 32nd International Meeting on Reduced Enrichement for Research and Test Reactors, Lisbon, Portugal, October 10-14 (2010).
2. T.H. Newton, Jr., L-W Hu, G. E. Kohse, E. E. Pilat, B. Forget, P. K. Romano, Y-C Ko, S. Wong, Y. Wang, B.Dionne, J. Thomas and A. Olson, "Completion of Feasibility Studies on using LEU fuel in the MIT Reactor," International Meeting on Reduced Enrichment for Research and Test Reactors, RERTR 2009, Beijing (2009).
3. P.Romano, B.Forget and T.Newton, "Development of a Graphical User Interface for In-core Fuel Management using MCODE," Advances in Nuclear Fuel Management IV, Hilton Head Island, South Carolina, USA, April 12-15 (2009).

Patents

B. Forget and F. Rahnema, "Boundary Adjusted Critical Spectrum Methodology for Reactor Lattice Depletion", US Patent 7676015 Issued on March 9th, 2010.

Teaching

22.05 Neutron Science and Reactor Physics

22.106 Neutron Interactions and Applications

Awards

- Landis Young Member Engineering Achievement Award, American Nuclear Society, 2013
- Ruth and Joel Spira Award for Distinguished Teaching
- ANS Faculty/PIA Teaching Award