

# Ahmad Ibrahim

ibrahimam@ornl.gov (865) 576-0153

1 Bethel Valley Rd, Oak Ridge, TN 37831

## Summary

Nuclear Engineer (PhD) with experience in development and application of advanced computational methods and tools for radiation transport analysis of a wide range of applications including fission and fusion energy systems; particular expertise in Monte Carlo and deterministic radiation transport modeling, Monte Carlo variance reduction techniques, hybrid Monte Carlo/deterministic methods, processing nuclear data libraries, and geometric modeling of complex systems using computer-aided design (CAD); experience in documenting and reviewing complex analyses; experience in developing and implementing new methods in production-level simulation codes; experience in developing and procuring funding proposals; and special interests in automation and optimization of simulation methods for full-scale modeling of large and geometrically complex systems.

## Education

### **Ph.D. Nuclear Engineering**, July 2012

University of Wisconsin-Madison

- Thesis: [Automatic Mesh Adaptivity for the Hybrid Monte Carlo/Deterministic Neutronics Modeling of Difficult Shielding Problems](#)
- Advisor: Prof. Paul Wilson
- Major: Nuclear Engineering, Neutronics Design, Radiation Transport
- Minor: Distributed between Computer Science, Mathematics, and Mechanical Engineering with emphasis on scientific computing and numerical analysis

### **M.S. Nuclear Engineering**, May 2010

University of Wisconsin-Madison

### **B.S. Nuclear Engineering**, May 2003

University of Alexandria, Egypt

- Grade: Distinction with First Degree of Honor

## Experience

### **Research and Development Staff, Radiation Transport (RT) Group, Reactor and Nuclear Systems Division (RNSD), Oak Ridge National Laboratory (ORNL) – June 2014-present**

- Expansion of the ORNL's participation in fusion neutronics
  - Performed and demonstrated a variety of ITER neutronics analyses that led to procure two funding grants from the ITER International Organization (ITER IO) and the US ITER domestic agency (US ITER).
  - Conceptualized novel hybrid Monte Carlo/deterministic methods for shutdown dose rate simulations. The Laboratory Directed Research and Development funding proposal “transformational integrated fusion neutronics modeling and simulation” will fund the production-level implementation of these methods.

### **Post-Doctoral Research Associate, RT Group, RNSD, ORNL – July 2012- June 2014**

- Expansion of the ORNL's participation in fusion neutronics
  - Led the ORNL efforts in submitting a proposal to support the neutronics analysis of the ITER International Organization that guided the procurement of the TA between the ITER IO and US ITER.
  - Led the ORNL and US ITER efforts in reviewing the Princeton Plasma Physics Laboratory report “Survey of Interspace Dose Rates for US-ITER Equatorial Port Diagnostics” for a DOE Performance Plan Milestone.
- Development of the Multi-Step CADIS hybrid Monte Carlo/deterministic technique
  - Developed the novel Multi-Step CADIS (MS-CADIS) hybrid Monte Carlo (MC)/deterministic technique that uses the Consistent Adjoint Driven Importance Sampling (CADIS) method but focuses on multi-step shielding analyses.
  - Successfully demonstrated the ability of the MS-CADIS method to accurately perform the traditionally impractical shutdown dose analyses using full-scale 3-D Monte Carlo simulations.
- Development and support of the Automated VARIance reduction Generator (ADVANTG) code
  - Added the unfolding capability to the ADVANTG 3.0 geometric mapping routines to enable ADVANTG to analyze Monte Carlo models with reflecting boundaries.
  - Adding the the weight-window coarsening mesh adaptivity algorithm to ADVANTG 3.0.
- Fission source convergence for used nuclear fuel criticality safety analysis
  - Contributed to adding some fission source convergence diagnostics to the SCALE code system.
  - Contributed to leading the development of the Sourcerer sequence which deterministically calculates an appropriate, problem-dependent fission distribution to be used as the starting source in Monte Carlo eigenvalue calculations.
  - Demonstrated the necessity of the Sourcerer approach to criticality safety analysis of canister-specific (as-loaded) used nuclear fuel problems.

### **Research Assistant, University of Wisconsin – Madison (UW-Madison) 2006-2012**

- Dissertation
  - Developed the macromaterials, the deterministic mesh refinement algorithms, and the weight-window coarsening algorithm to enhance the reliability and efficiency of the CADIS and FW-CADIS hybrid techniques to enable the accurate full-scale shielding simulations of very large and geometrically complex problems.
  - Demonstrated the ability of accurately calculating the prompt dose rate throughout the entire ITER experimental facility using an FW-CADIS simulation that uses the three algorithms. This eliminated the need for a world-class super computer in performing such an extremely difficult simulation.
- Other research at the UW-Madison Fusion Technology Institute
  - Fusion Development Facility (FDF) neutronics analysis:
    - Assessed the breeding ratio and the damage to the magnets in the baseline design of the FDF. The three-dimensional (3-D) neutronics analyses used the UW-Madison CAD-based Monte Carlo code, DAG-MCNP.
  - High Average Power Laser (HAPL) final optics and shielding configuration:

Assessed the impact of different design options of the Grazing Incidence Metallic Mirror (GIMM) and different biological shielding configurations on the nuclear environment at the dielectric focusing and turning mirrors of the HAPL system. The three-dimensional (3-D) neutronics analyses used the UW-Madison CAD-based Monte Carlo code, DAG-MCNP.

- Radiation streaming through cooling pipes in ARIES compact stellarator: Analyzed the effects of radiation damage on the shielding performance of the ARIES compact stellarator fusion power plant because of neutron streaming through the divertor He-access pipes. The 3-D neutronics analysis used DAG-MCNP and the deterministic transport code Attila.

### **Summer Intern, ORNL – RNSD, 2008, 2009, 2010, 2011**

- Development and support of the SCALE package
  - Added the macromaterials capability, which enhances the geometry representation of the deterministic models, to SCALE/MAVRIC.
  - Extended the macromaterials approach to automatically define the adjoint sources for space-dependent responses in SCALE/MAVRIC.
  - Added the capability of calculating the Shannon entropy to SCALE/KENO for Monte Carlo eigenvalue calculations.
  - Demonstrated the significant increase in the reliability and the efficiency of eigenvalue Monte Carlo calculations using deterministic-based starting sources.
  - Evaluated candidate hybrid methods for optimizing the calculation of space- and energy-dependent reaction rates in eigenvalue Monte Carlo calculations.
  - Created a specialized development tool to SCALE for writing the variance reduction parameters created by SCALE/MAVRIC in MCNP format
- Development and support of the ADVANTG code
  - Added several new features to ADVANTG 2.0 such as response weighting, the Macromaterials approach, cell-based sources and cell-based adjoint sources, and adjoint flux collapsing.
  - Created a 46 neutron/21 gamma group FENDL2.1 library for the Denovo code in ANISN format, which is used by ADVANTG.
- Global neutronics modeling of ITER:
  - Demonstrated the applicability of coupling the CADIS and FW-CADIS hybrid Monte Carlo/deterministic techniques with CAD based Monte Carlo methods by applying ADVANTG and DAG-MCNP for calculating the nuclear heating at the ITER magnet using the UW-Madison CAD model of ITER.
  - Assessed the prompt dose rates throughout the entire ITER plant using ADVANTG.

### **Demonstrator, University of Alexandria, Egypt 2004-2006**

- Assisted in teaching classes in the Nuclear Engineering, Chemical Engineering, and Electrical Engineering departments
  - Physical Reactor Design
  - Radiation shielding
  - Reactor Physics
  - Reactor Kinetics
  - Neutron Physics
  - Heat Transfer
  - Thermodynamics
  - Thermal Power Stations
  - Materials Science
  - Nuclear Materials
  - Reactor Engineering
  - Atomic Physics

## Professional Development Activities

### American Nuclear Society (ANS)-National

- Publication Chair for the 2015 International Conference on Mathematics and Computational Methods Applied to Nuclear Science and Engineering (M&C2015).
- Publication Chair for the 2014 Radiation Protection and Shielding topical meeting (RPSD2014).
- Member of the working group in charge of writing “ANSI/ANS-6.4.2: Specification for Radiation Shielding Materials.”
- ANS Young Member Group liaison for the ANS Radiation Protection and Shielding Division and the ANS Fusion Energy Division.
- Appointed member in the national American Nuclear Society Student Section Committee (SSC), 2009-2012.
- SSC commendation chair, 2011.

### American Nuclear Society-Wisconsin Student Section

- President of Wisconsin Alpha chapter of Alpha Nu Sigma, 2009-2010.

## Other Relevant Skills

### Programming languages

- Expert programming abilities in C++, C, and FORTRAN.
- Advanced user of multiple scripting and extension languages including PYTHON and BASH.
- Extensive experience in mathematical simulation programming using MatLab.

### Neutronics modeling and simulation tools

- Extensive experience in developing and using neutronics modeling and activation codes such as MCNP, Attila, PARTISN/DANTSYS, Denovo, SCALE, ORIGEN, and ADVANTG.
- Acquired MCNP5.1.X and MCNP6 “source” code licenses.
- Implemented and modified codes that have been permanently added to production-level codes such as SCALE and ADVANTG.

## Honors and Awards

- ANS Radiation Protection and Shielding Division Best Student Paper Award, 2012 ANS Winter Meeting, San Diego, CA: “Automatic Mesh Adaptivity for Hybrid Monte Carlo/Deterministic Neutronics Modeling of Difficult Shielding Problems.”
- Best Paper/Presentation Award, 2011 ANS Student Conference, GA: “Global Evaluation of Prompt Dose Rates in ITER Using FW-CADIS.”
- Inducted into Alpha-Nu-Sigma, 2006-present.
- Certificate of Distinction from Engineering Dean and Young Scientists of America for community service-2006/2009, University of Wisconsin-Madison.
- The Shield of Engineering Syndicates awarded in the graduation ceremony to the top student of each department in the Faculty of Engineering, University of Alexandria, Egypt.
- Mohamed Sawan prize for the top nuclear engineering student with accumulated grade of “Distinction with First Degree of Honor”.
- Top of Batch Award in the Department of Nuclear Engineering, University of Alexandria, Egypt for the academic years 2000, 2001, 2002, and 2003
- The Distinction Award in The University of Alexandria, Egypt for the academic years 2000, 2001, 2002, and 2003

## Selected Publications

### Journal Papers

- **A. Ibrahim**, Paul P.H. Wilson, Mohamed E. Sawan, Scott W. Mosher, Douglas E. Peplow, John C. Wagner, Thomas M. Evans, and Robert E. Grove, "Automatic Mesh Adaptivity for Hybrid Monte Carlo/Deterministic Neutronics Modeling of Difficult Shielding Problems," in submission to *Nuclear Science and Engineering* (2013).
- **A. Ibrahim**, D. Peplow, and R. Grove, and P. Wilson, "[Novel Hybrid Monte Carlo/Deterministic Technique for Shutdown Dose Rate Analyses](#)," *Fusion Engineering and Design*, In Press
- **A. Ibrahim**, P. Wilson, M. Sawan, S. Mosher, D. Peplow, and R. Grove, "[Assessment of Fusion Facility Dose Rate Map Using Mesh Adaptivity Enhancements of Hybrid Monte Carlo/Deterministic Techniques](#)," *Fusion Engineering and Design*, In Press.
- **Ahmad M. Ibrahim**, Mohamed E. Sawan, Scott W. Mosher, Thomas M. Evans, Douglas E. Peplow, Paul P. H. Wilson, and John C. Wagner, "[Global Evaluation of Prompt Dose Rates in ITER Using Hybrid Monte Carlo/Deterministic Techniques](#)," *Fusion Science and Technology*, **60**, 676-682 (2011).
- **Ahmad M. Ibrahim**, Scott W. Mosher, Thomas M. Evans, Douglas E. Peplow, Mohamed E. Sawan, Paul P. H. Wilson, and John C. Wagner, "[ITER Neutronics Modeling Using Hybrid Monte Carlo/S<sub>N</sub> and CAD-based Monte Carlo Methods](#)," *Nuclear Technology*, **175**, 251-258 (2011).
- **Ahmad M. Ibrahim**, D. L. Henderson, L. A. El-Guebally, P. P. H. Wilson, M. E. Sawan, "[Three Dimensional Analysis of Radiation Streaming Through ARIES-CS He-Access Pipes](#)," *Fusion Science and Technology*, **56**, 726-730 (2009).
- M.E. Sawan, **A. M. Ibrahim**, P.P.H. Wilson, E.P. Marriott, R.D. Stambaugh, C.P.C. Wong, "[Neutronics Analysis in Support of The Fusion Development Facility Design Evolution](#)," *Fusion Science and Technology*, **60**, 671-675 (2011).
- M. E. Sawan, **A. M. Ibrahim**, T. D. Bohm, and P. P. Wilson, "[Nuclear Assessment of Shielding Configuration Options for Final Optics of HAPL Fusion Power Plant](#)," *Fusion Science and Technology*, **56**, 756-760 (2009)
- M. Sawan, **A. Ibrahim**, T. Bohm, and P. Wilson, "[Three-dimensional nuclear analysis of the final optics of a laser driven power plant](#)," *Fusion Engineering and Design*, **83**, 1879-1883 (2008).
- M. E. Sawan, M. W. Mcgeoch, **A. M. Ibrahim**, P. P. Wilson, "[Nuclear Assessment of Final Optics of a KrF Laser Driven Fusion Power Plant](#)," *Fusion Science and Technology*, **52**, 938-942 (2007).
- L. El-Guebaly, P. Wilson, D. Henderson, M. Sawan, G. Sviatoslavsky, T. Tautges, R. Slaybaugh, B. Kiedrowski, **A. Ibrahim**, C. Martin, R. Raffray, S. Malang, J. Lyon, L. P. Ku, X. Wang, L. Bromberg, B. Merrill, L. Waganer, F. Najmabadi, and ARIES-CS Team, "[Designing ARIES-CS Compact Radial Build and Nuclear System: Neutronics, Shielding, and Activation](#)," *Fusion Science and Technology* **54**, 747-770 (2008).
- F. Najmabadi, A. R. Raffray, ARIES-CS Team: S. I. Abdel-Khalik, L. Bromberg, L. Crosatti, L. El-Guebaly, P. R. Garabedian, A. A. Grossman, D. Henderson, **A. Ibrahim**, T. Ihli, T. B. Kaiser, B. Kiedrowski, L. P. Ku, J. F. Lyon, R. Maingi, S. Malang, C. Martin, T. K. Mau, B. Merrill, R. L. Moore, R. J. Peipert, Jr., D. A. Petti, D. L. Sadowski, M. Sawan, J. H. Schultz, R. Slaybaugh, K. T. Slattery, G. Sviatoslavsky, A. Turnbull, L. M. Waganer, X. R. Wang, J. B. Weathers, P. Wilson, J. C. Waldrop III, M. Yoda, M. Zarnstorff, "[The ARIES-CS Compact Stellarator Fusion Power Plant](#)," *Fusion Science and Technology*, **54**, 655-672 (2008).

### Conference Papers

- **A. M. Ibrahim**, D. E. Peplow, K. B. Bekar, C. Celik, D. Ilas, J. M. Scaglione, J. C. Wagner, "[Hybrid Technique in SCALE for Fission Source Convergence Applied To Used Nuclear Fuel Analysis](#)," 2013 Topical Meeting on Nuclear Criticality Safety (NCS 2013), Wilmington, NC, September 29– October 3, 2013.
- **A. M. Ibrahim**, Paul P. H. Wilson, Mohamed E. Sawan, Douglas E. Peplow, Scott W. Mosher, John C. Wagner, and Thomas M. Evans, "[Automatic Mesh Adaptivity for CADIS and FW-CADIS Neutronics Modeling of Difficult Shielding Problems](#)," Proc. 2013 Int. Conf. on Advances in Mathematics, Computational Methods, and Reactor Physics, Sun Valley, ID, May 5–9, 2013, American Nuclear Society 1411-1428 (2013).
- **A. M. Ibrahim**, D. E. Peplow, and Robert E. Grove "[Novel Hybrid Monte Carlo/Deterministic Technique for Shutdown Dose Rate Calculations](#)," *Trans. Am. Nucl. Soc.*, **108**, 647-650 (2013).
- **A. M. Ibrahim**, Paul P. H. Wilson, Mohamed E. Sawan, Douglas E. Peplow, John C. Wagner, Scott W. Mosher, and Thomas M. Evans, "[Automatic Mesh Adaptivity for Hybrid Monte Carlo/Deterministic Neutronics Modeling of Difficult Shielding Problems](#)," *Trans. Am. Nucl. Soc.*, **107**, 934-937 (2012).
- **A. M. Ibrahim**, D. E. Peplow, J. C. Wagner, S. W. Mosher, T. E. Evans, "[Acceleration of Monte Carlo Criticality Calculations Using Deterministic-Based Starting Sources](#)," Proc. PHYSOR 2012, Advances in Reactor Physics, Knoxville, TN, April 15-20 (2012).
- **A. M. Ibrahim**, D. E. Peplow, J. C. Wagner, S. W. Mosher, T. E. Evans, "[Acceleration of Monte Carlo Criticality Calculations Using Deterministic-Based Starting Sources](#)," *Trans. Am. Nucl. Soc.*, **105**, 539-541 (2011).
- **A. M. Ibrahim**, D. E. Peplow, T. M. Evans, P. P. H. Wilson, and J. C. Wagner, "[Improving the  \$S\_N\$  Adjoint Source and Geometry Representation Capabilities in the SCALE Hybrid Shielding Analysis Sequence](#)," American Nuclear Society Radiation Protection and Shielding Division 2010 Topical Meeting, Las Vegas, NV, April 18–23 (2010).
- **A. M. Ibrahim**, S. W. Mosher, T. M. Evans, D. E. Peplow, M. E. Sawan, P. P. H. Wilson, J. C. Wagner, "[ITER Neutronics Modeling Using Hybrid Monte Carlo/ \$S\_N\$  and CAD-Based Monte Carlo Methods](#)," American Nuclear Society Radiation Protection and Shielding Division 2010 Topical Meeting, Las Vegas, NV, April 18–23 (2010).
- **A. M. Ibrahim**, D. E. Peplow, T. E. Evans, J. C. Wagner, P. P. H. Wilson, "[Improving the Mesh Generation Capabilities in the SCALE Hybrid Shielding Analysis Sequence](#)," *Trans. Am. Nucl. Soc.*, **100**, 302-304 (2009).
- B. T. Rearden, L. M. Petrie, D. E. Peplow, K. B. Bekar, D. Wiarda, C. Celik, C. M. Perfetti, **A. M. Ibrahim**, S. W. D. Hart, and M. E. Dunn, "Monte Carlo Capabilities of the SCALE Code System," Joint International Conference on Supercomputing in Nuclear Applications and Monte Carlo 2013 (SNA + MC 2013), La Cité des Sciences et de l'Industrie, Paris, France, October 27-31 (2013).
- D. E. Peplow, **A. M. Ibrahim**, and Robert E. Grove "[Propagation of Uncertainty from a Source Computed with Monte Carlo](#)," *Trans. Am. Nucl. Soc.*, **108**, 643-646 (2013).
- Brian C. Kiedrowski, **Ahmad Ibrahim**, "[Evaluating the Efficiency of Estimating Numerous Monte Carlo Tallies](#)", *Trans. Am. Nucl. Soc.*, **104**, 325-328 (2011).
- M. E. Sawan, P. P. Wilson, T. Tautges, L. A. El-guebally, D. L. Henderson, T. D. Bohm, B. Kiedrowski, B. Smith, **A. Ibrahim**, R. Slaybaugh, E. Marriot, "[Application of CAD-Neutronics Coupling to Geometrically Complex Fusion Systems](#)", 23rd Symposium on Fusion Engineering (SOFE), San Diego, CA, May 31-June 5 (2009).
- L.A. El-Guebaly, P. Wilson, D. Henderson, M. Sawan, G. Sviatoslavsky, T. Tautges, R. Slaybaugh, B. Kiedrowski, **A. Ibrahim**, C. Martin, and the ARIES-CS Team, "[Overview of ARIES-CS In-Vessel Components: Integration of Nuclear, Economics, and Safety](#)

[Constraints in Compact Stellarator](#),” IAEA-TM-32812, Proceedings of 2nd IAEA Technical Meeting on First Generation of Fusion Power Plants: Design and Technology, Vienna, Austria June 20-22 (2007).

### Technical Reports

- S. W. Mosher, A. M. Bevill, S. R. Johnson, **A. M. Ibrahim**, C. R. Daily, T. M. Evans, J. C. Wagner, J. O. Johnson, and R. E. Grove, “[ADVANTG—An Automated Variance Reduction Parameter Generator](#),” ORNL/TM-2103/416, Oak Ridge National Laboratory, Oak Ridge, TN (2013).
- Douglas E. Peplow, **Ahmad M. Ibrahim**, Kursat B. Bekar, Cihangir Celik, and Bradley T. Rearden, “Sourcerer: Deterministic Starting Source for Criticality Calculations,” Oak Ridge National Laboratory report will be released with SCALE 6.2.
- **A. Ibrahim**, D. L. Henderson, L. A. El-Guebaly, P. P.H. Wilson, M. E. Sawan, “[Assessment of Radiation Streaming Through ARIES-CS HE-Access Pipes using Two- and Three-Dimensional Analyses](#)”, University of Wisconsin-Madison Fusion Technology Institute report, UWFD-1331, Madison, WI (2007).