

# Brian Michael Adams

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Optimization and Uncertainty Estimation  
Sandia National Laboratories  
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## Research Interests

- Scientific computation and software development, including modeling, simulation, optimization, and parallel computing.
- Close collaboration with mathematicians, statisticians, engineers, and other disciplinary scientists to model systems and analyze data.
- Inverse problems and sensitivity analysis with engineering and biological models using simulated and/or experimental data. Model calibration and extrapolation under uncertainty.
- Algorithms combining optimization and uncertainty quantification. Non-intrusive methods for efficient uncertainty quantification.
- Modeling and control theory, especially with biological applications, including population dynamics, in-host infection dynamics and optimal treatment interruption strategies.

## Education

- Ph.D., Computational and Applied Mathematics, North Carolina State University, Raleigh, NC, 2005.  
*Advisor:* Dr. H.T. Banks; 4.0 GPA.
- M.S., Computational and Applied Mathematics, North Carolina State Univ., Raleigh, NC, 2002; 4.0 GPA.
- B.S., Mathematics, Saint Michael's College, Colchester, VT, 1999.  
Computer science and music minors; VT Teaching License in Secondary Mathematics; 4.0 GPA.

## Publications

Rodriguez, J., Cheng, K.E., McClellan, G., Crary, D.J., Oldson, D., Adams, B., and Ray, J., Contagious disease module for the Joint Effects Model, *Proc. DTRA Chemical and Biological Technologies Conference*, New Orleans, November 17—21, 2008.

Ray, J., Adams, B.M., Devine, K.D., Marzouk, Y.M., Wolf, M.M., and Najm, H.N., Distributed micro-releases of bioterror pathogens: Threat characterizations and epidemiology from uncertain patient observables, *Sandia Technical Report SAND2008-6044*, October 2008.

Swiler, L.P., Adams, B.M., and Eldred, M.S., Model Calibration under Uncertainty: Matching Distribution Information, AIAA-2008-5944 in *Proc. 12th AIAA/ISSMO Multidisciplinary Analysis and Optimization Conference*, Victoria, British Columbia, September 10—12, 2008.

Eldred, M.S., Bichon, B.J., Adams, B.M., and Mahadevan, S., Overview of Reliability Analysis and Design Capabilities in DAKOTA with Application to Shape Optimization of MEMS, in *Structural Design Optimization Considering Uncertainties*, Tsompanakis, Lagaros, and Papadrakakis, eds. February 2008.

Eldred, M.S., Adams, B.M., Copps, K.D., et al., Solution-Verified Reliability Analysis and Design of Compliant Micro-Electro-Mechanical Systems, AIAA-2007-1934 *Proc. 48<sup>th</sup> AIAA/ASME/ASCE/AHS/ASC Structures, Structural Dynamics, and Materials Conference (9th AIAA Non-Deterministic Approaches Conference)*, Honolulu, HI, April 23—26, 2007.

Adams, B.M., Devine, K.D., Ray, J., and Wolf, M.M., Efficient Large-scale Network-based Simulation of Disease Outbreaks, abstract for *Fifth Annual Syndromic Surveillance Conference*, Baltimore, MD, October 18—20, 2006.

Adams, B.M., Bichon, B.J., Carnes, B., et al., Solution-Verified Reliability Analysis and Design of Bistable MEMS Using Error Estimation and Adaptivity, *Sandia Technical Report SAND2006-6286*, September 2006.

Eldred, M.S., Brown, S.L., Adams, B.M., et al., DAKOTA, A Multilevel Parallel Object-Oriented Framework for Design Optimization, Parameter Estimation, Uncertainty Quantification, and Sensitivity Analysis: Version 4.0 Users Manual, Sandia Technical Report SAND2006-6337, September 2006. (Also Ver. 4.0 Reference Manual, SAND2006-4055 and Ver. 4.0 Developers Manual, SAND2006-4056.)

Adams, B.M., Eldred, M.S., and Wittwer, J.W., Reliability-Based Design Optimization for Shape Design of Compliant Micro-Electro-Mechanical Systems, AIAA-2006-7000 in *Proc. 11th AIAA/ISSMO Multidisciplinary Analysis and Optimization Conference*, Portsmouth, VA, Sep. 6—8, 2006.

Eldred, M.S., Bichon, B.J., and Adams, B.M., Overview of Reliability Analysis and Design Capabilities in DAKOTA, *Conference Paper, NSF Workshop on Reliable Engineering Computing (REC 2006)*, Savannah, GA, February 2006.

Adams, B.M., Banks, H.T., Davidian, M., and Rosenberg, E.S., Model fitting and prediction with HIV treatment interruption data, *CRSC Tech. Rpt.* CRSC-TR05-40, NC State University, October 2005; *Bull. Math. Biol.*, **69** (2007), 563—584.

Adams, B.M., Non-parametric parameter estimation and clinical data fitting with a model of HIV infection, Ph.D. dissertation, NC State University, July 2005.

Adams, B.M., Banks, H.T., Tran, H.T., and Kwon, H., Dynamic Multidrug Therapies for HIV: Optimal and STI Control Approaches, *CRSC Tech. Rpt.* CRSC-TR04-18, NC State University, April 2004; *Mathematical Biosciences and Engineering* **1** (2004), 223—241.

Adams, B.M., Banks, H.T., Davidian, M., et al., HIV Dynamics: Modeling, Data Analysis, and Optimal Treatment Protocols, *CRSC Tech. Rpt.* CRSC-TR04-05, NC State University, February 2004; *Journal of Computational and Applied Mathematics* **184** (2005), 10—49.

Adams, B.M., Banks, H.T., Banks, J.E., and Stark, J.D., Population Dynamics Models in Plant – Insect Herbivore – Pesticide Interactions, *CRSC Tech. Rpt.* CRSC-TR03-12, NC State University, March 2003; *Mathematical Biosciences*, **196** (2005), 39—64.

Adams, B., et al., “Modeling Cash Flows in Bond Structures” in Proc. 2000 Industrial Mathematics Modeling Workshop for Graduate Students, *CRSC Tech. Rpt.* CRSC-TR00-24, NC State University, October 2000.

## **Professional Experience**

### Senior Member of Technical Staff, *Sandia National Laboratories*

Researching and implementing algorithms for optimization and uncertainty quantification of engineering models, including model calibration and extrapolation. DAKOTA software Product Manager. Solving engineering and biology-related optimization problems in collaboration with disciplinary scientists. Developing large-scale network-based disease spread models for use in detecting bioterror incidents. *Fall 2007 to Present (Limited Term Member of Technical Staff, Fall 2005—Fall 2007)*.

Graduate Research Assistant, *Center for Research in Scientific Computation, NC State University*

Conducted research in population biology and infectious disease modeling, control, and nonparametric parameter estimation under the direction of Dr. H.T. Banks in preparation for Ph.D. dissertation. Collaborated with statisticians and clinicians to fit patient data. *Fall 2000 to Fall 2005.*

Systems Administrator, *Center for Research in Scientific Computation, NC State University*

Supported numerical mathematics research group in a mixed Linux/Solaris/Windows environment, including deployment and administration of operating system and software on Linux-based workstations. Consulted on hardware acquisitions and served as liaison between users and university computing staff. *Fall 2001 to Fall 2005.*

Preparing the Professoriate Program, *NC State University*

Participated in yearlong mentored teaching program to train graduate students for university teaching. Observed my mentor teaching one semester and then prepared for and taught my own section the next. Attended seminars and discussion sessions on educational issues. *2002—2003.*

Research Assistant, *SCHARP/Fred Hutchinson Cancer Research Center, Seattle, WA*

Researched optimal scheduling for structured treatment interruptions (STIs) for HIV treatment. Investigated several differential equation models for HIV infection dynamics and developed potential cost function criteria for the optimal control problem. Collaborated with two mathematicians to run simulations and understand results. *Summer 2001.*

Volunteer Technology Administrator and Teacher, *Bishop Perry Middle School, New Orleans, LA*

Installed a school-wide data, voice, and video network, contracted for services, and set up servers. Instructed students in computer and religion classes. *August 1999 to August 2000.*  
(Continued to maintain hardware and software through August 2004.)

Student Teacher, *Mathematics Department, Essex High School, Essex Junction, VT*

Taught high school pre-algebra, geometry, and computer programming. *Fall 2000.*

Systems and Network Support Specialist, *Saint Michael's College, Colchester, VT*

Installed and maintained computer and network hardware and software on a Windows NT network with 2500 users. Managed a team of five employees. *April 1996 to July 1999.*

Sound Engineer, *Kevin Healy Productions (and self-employed), Burlington, VT*

Transported, connected, and operated sound systems for events throughout Vermont in venues of all sizes. Responsible for operations, troubleshooting, and client relations. *May 1996 to December 2000.*

Electronic Systems Analyst Intern, *National Weather Service, South Burlington, VT*

Maintained computer and network hardware and developed desktop software solutions in a 30 employee office. *April to August 1998.*

College Mathematics Tutor, *Saint Michael's College, Colchester, VT*

Tutored individual students and small groups in Calculus, Finite Math, and Statistics. *September 1996 to December 1997.*

## **Computer Skills**

❖ Scientific Computing and Software Development

- C and C++, including MPI and GSL; Python; some Java and Fortran
- Matlab; Maple
- Parallel development / usage on workstation-based and large-scale cluster computers
- Familiarity with shell and other scripting languages (BASH, CSH, Perl)

❖ User Environments

- Experience with Sun Ultra, Intel, and AMD workstations
- Comfort working with all Windows variants through XP, Linux variants (especially Redhat Enterprise and Fedora Core), and SunOS/Solaris

- LaTeX, Microsoft Office applications
- ❖ Administration
  - Substantial experience performing comprehensive systems and network administration including workstation, network, and server solutions
  - All Windows variants through XP, including server and workstation administration
  - Redhat Linux variants through RHEL4 and FC4, including servers and workstations
  - Network services and hardware, including devices and wiring

## Honors and Awards

- ❖ Sandia National Laboratories
  - Individual Performance Award for DAKOTA software training classes, Summer 2008
  - Employee Recognition Award Nomination for Individual Exceptional Service, Spring 2008
  - Employee Recognition Award Nomination for NuGET QMU Methodology Team, Spring 2008
  - Individual Performance Award for DAKOTA 4.1 software release, Fall 2007
  - Individual Performance Award for cross-center collaboration, Spring 2007
  - Individual Performance Award for technical initiative on ASC Level 2 Milestone, Fall 2006
- ❖ North Carolina State University
  - Winton-Rose Scholarship; awarded for excellence in research and service, 2004
  - Statistical and Applied Mathematical Sciences Institute Graduate Associate, 2002-2003
  - U.S. Department of Education GAANN Computational Science Fellow, 2000-2003
  - Nominated, Phi Kappa Phi Honor Society and Pi Mu Epsilon Honor Society
  - Recipient, Alumni Association Fellowship, 2000-2001
  - SIAM Student Travel Awards to attend conferences in 2002, 2003, and 2004
- ❖ Saint Michael's College
  - Valedictorian, Class of 1999
  - NASA/Vermont Space Grant Consortium Scholar and grant recipient
  - Scored 19 points on 1998 Putnam Prize Examination in Mathematics (top third in nation)
  - Delta Epsilon Sigma National Catholic and Phi Delta Kappa Educational Honor Societies
- ❖ Boy Scouts of America – Eagle Scout Award

## Presentations

*Uncertainty Quantification Algorithms and Software Enabling V&V*, Verification & Validation for Nuclear Systems Analysis Workshop, July 20—25, 2008, Idaho Falls, ID.

*Validation & Verification and Uncertainty Quantification at Sandia*, Research Consortium for Multidisciplinary System Design Workshop, 2008, July 17—18, 2008, MIT, Cambridge, MA.

*From Uncertainty to Credibility: UQ Algorithms and Research Challenges*, 2008 CSRI Summer Lecture Series, July 2, 2008, Albuquerque, NM.

*The DAKOTA Toolkit for Parallel Optimization and Uncertainty Analysis*, SIAM Conference on Optimization (OP08) May 10—13, 2008, Boston, MA. (mini-symposium co-organizer)

(Invited) *A Multi-fidelity Approach for Efficient Network-based Simulation of Disease Outbreaks*, Atlantic Coast Symposium on the Mathematical Sciences in Biology and Biomedicine, April 24—26, 2008, Raleigh, NC.

(Invited) *Opportunities in Computational Applied Mathematics at Sandia National Laboratories*, NC State SIAM Student Chapter Invited Lecture, April 24, 2008, Raleigh, NC.

*Uncertainty-Aware Design Optimization with the DAKOTA Toolkit*, INFORMS Annual Meeting 2007, Seattle, WA, November 7, 2007.

*Derivative-free Optimization Methods in DAKOTA with Applications*, Second International Conference on Continuous Optimization (ICCOPT II), Hamilton, Ontario, Canada, August 13—16, 2007.

*Efficient Large-scale Network-based Simulation of Disease Outbreaks*, Fifth Annual Syndromic Surveillance Conference, Baltimore, MD, October 20, 2006.

*Reliability-Based Design Optimization for Shape Design of Compliant Micro-Electro-Mechanical Systems*, 11th AIAA/ISSMO Multidisciplinary Analysis and Optimization Conference, Portsmouth, VA, September 7, 2006.

(Invited) *Predictive Capability of an HIV Model Calibrated with Treatment Interruption Data*, SIAM Annual Meeting, Boston, MA, July 12, 2006.

*Uncertainty quantification for credible simulation and risk analysis: methods, software tools, and research needs*, Workshop on Assessment of Sensitivity/Uncertainty Analysis Capabilities Applicable for the Nuclear Fuel Cycle, NC State University, Raleigh, NC, May 31, 2006

(Invited) *Predictive Capability of an HIV Model Calibrated with Treatment Interruption Data*, Mathematical Biosciences Institute, The Ohio State University, Columbus, OH, April 20, 2006.

*Uncertainty Quantification and Reliability Analysis-Based Design Optimization Capabilities in DAKOTA*, Ninth Copper Mountain Conference on Iterative Methods, Copper Mountain, CO, April 7, 2006.

*Parameter Estimation for a Nonlinear HIV Dynamics Model*, Applied Mathematics Graduate Student Seminar, North Carolina State University, Raleigh, NC, April 5, 2005.

*Applied Math: Cleans up spills! Kills bugs! Gives good vibrations!?* Middle Creek High School, Apex, NC, December 7, 2004.

(Invited) *Applied Math: Cleans up spills! Kills bugs! Gives good vibrations!?* Saint Michael's College Mathematics Department Centennial Celebration and Pi Mu Epsilon induction, Colchester, VT, September 25, 2004.

*Non-parametric Parameter Estimation in HIV Infection Dynamics*, 2004 SIAM Conference on the Life Sciences, Portland, OR, July 11, 2004. (mini-symposium co-organizer)

*Modeling and Parameter Estimation in HIV Infection Dynamics*, Journées Jeunes, Laboratoire Jacques-Louis Lions / Paris VI, Paris, France, March 9, 2004.

*Modeling and Parameter Estimation in HIV Infection Dynamics*, Mathematics Department Recruiting Weekend Retreat, North Carolina State University, Raleigh, NC, February 28, 2004.

*Models for Control of HIV Infection: Context: Structured Treatment Interruptions*, Applied Mathematics Graduate Student Seminar, North Carolina State University, Raleigh, NC, October 1, 2003.

(Invited) *Models for Control of HIV Infection: Context: Structured Treatment Interruptions*, Computation, Control, and Biological Systems VIII, Montana State University, Bozeman, MT, August 1, 2003.

(Invited) *Models for Control of HIV Infection: Context: Structured Treatment Interruptions*, Mathematical Modeling in the Health Sciences mini-symposium, 2003 SIAM Annual Meeting, Montreal, QC, Canada, June 20, 2003.

*Population Dynamics Models in Plant—Insect Herbivore—Pesticide Interactions*, Université Pierre et Marie Curie – Paris VI, Paris, France, April 22, 2003.

*Population Dynamics Models in Plant--Insect Herbivore—Pesticide Interactions*, Applied Mathematics Graduate Student Seminar, NC State University, Raleigh, NC, April 7, 2003.

*Controlling HIV Infection by Interrupting Treatment*, Mathematics Department Recruiting Weekend Retreat, NC State University, Raleigh, NC, March 1, 2003.

*Structured Treatment Interruptions for HIV Therapy: Modeling and Control*, Statistical and Applied Mathematical Sciences Institute, Research Triangle Park, NC, October 8, 2002.

*Structured Treatment Interruptions for HIV Therapy: Modeling and Control*, Applied Mathematics Graduate Student Seminar, NC State University, Raleigh, NC, September 9, 2002.

Graduate Student Discussion Panel, *Surviving Graduate School*, sponsored by NC State University Graduate School / NC Alliance to Create Opportunity through Education, Raleigh, NC, July 9, 2002.

(Invited) *Structured Treatment Interruption Control of HIV Infection*, First Annual SIAM Conference on Life Sciences, Boston, MA, March 6, 2002.

*Structured Treatment Interruption Control of HIV Infection*, Applied Mathematics Graduate Student Seminar, NC State University, Raleigh, NC, February 27, 2002.

*A Graduate Student Perspective: Application of Mathematics to HIV and Comments on Graduate School*, Saint Michael's College, Colchester, VT, October 4, 2001. Presented results of research with FHCRC and delivered recruiting talk on behalf of NCSU.

*Clap to It! An Examination of Steve Reich's 'Clapping Music,'* Mathematical Association of America MathFest99, Providence, RI, July 31 to August 2, 1999. Cited "Best in Session."

### **Other Conferences, Workshops, and Professional Development**

*2nd Annual QMU Workshop*, Sandia National Laboratories, Albuquerque, NM, September 24—25, 2008.

*Agent-based, Discrete Event, and Game-based Modeling and Simulation Workshop: Defining the State of the Art and Future Directions*, Sandia National Laboratories, Albuquerque, NM, May 2007.

*Seventh Biennial Tri-Laboratory Engineering Conference*, Sandia National Laboratories, Albuquerque, NM, May 7—10, 2007.

*Intermediate C++ programming course*, Sandia National Laboratories, Albuquerque, NM, Spring 2008.

*SIAM Conference on Computational Science and Engineering*, Costa Mesa, CA, February 19—23, 2007.

Short course "Micro Electro Mechanical System Design" (instructor: Jim Allen), Spring 2006.

Completed Sandia's New Hire Orientation Program and Nuclear Weapons (NW101) courses in 2006.

Marcus Feldman Lecture and Reception, Santa Fe Institute, Santa Fe, NM, September 10, 2005.

*SAMSI Workshop on Modeling Infectious Diseases*, Statistical and Applied Mathematical Sciences Institute, Research Triangle Park, NC, January 31 – February 2, 2005.

*Opening Workshop of the SAMSI Program Genomes To Global Health: Computational Biology Of Infectious Disease*, Statistical and Applied Mathematical Sciences Institute, Research Triangle Park, NC, September 19-22, 2004.

Organizer, *SAMSI/CRSC Undergrad Workshop*, NC State University, Raleigh, NC, June 9-13, 2003.

*Inverse Problem Methodology In Complex Stochastic Models: Final Workshop*, Statistical and Applied Mathematical Science Institute, Research Triangle Park, NC, May 14-15, 2003

*Large-Scale Computer Models for Environmental Systems: Simulation and Optimization Workshop*, Statistical and Applied Mathematical Sciences Institute, Research Triangle Park, NC, April 28-30, 2003.

*Jump-Starting Innovation: Government, Universities and Entrepreneurs: 2003 Emerging Issues Forum*, North Carolina State University, Raleigh, NC, February 10-11, 2003.

*Inverse Problem Methodology in Complex Stochastic Models*, Statistical and Applied Mathematical Sciences Institute, Research Triangle Park, NC, September 21-24, 2002.

*Nonlinear Differential Equations, Mechanics and Bifurcation*, Duke University, Durham, NC, May 20-22, 2002.

Participant, *Workshop on Making Effective Scientific Poster Presentations*, NC State University, Raleigh, NC, April 4, 2002.

*Finite Element Circus*, Center for Research in Scientific Computation, North Carolina State University, Raleigh, NC, November 2-3, 2001.

Student Advisor, *2001 Industrial Mathematics Modeling Workshop for Graduate Students*, Center for Research in Scientific Computation, NC State University, Raleigh, NC, July 23-31, 2001.

*Fifth SIAM Conference on Control and Its Applications*, San Diego, CA, July 11-14, 2001.

*2001 SIAM Annual Meeting*, San Diego, CA, July 10-13, 2001.

*Seventh SIAM Conference on Applied Linear Algebra*, North Carolina State University, Raleigh, NC, October 23-26, 2000.

*Conference on Future Directions in Distributed Parameter Systems*, Center for Research in Scientific Computation, North Carolina State University, Raleigh, NC, October 5-7, 2000.

Participant, *Mathematics Department Graduate Student Teacher Training*, NC State University, Raleigh, NC, August 2000. Completed one-week training course to facilitate more effective teaching.

Participant, *2000 Industrial Mathematics Modeling Workshop for Graduate Students*, Center for Research in Scientific Computation, NC State University, Raleigh, NC, July 24 – August 1, 2000.

## **Professional Societies and Service**

- Member, Society for Industrial and Applied Mathematics (since 2000), Life Sciences Activity Group
- Member, Mathematical Programming Society (2007—2008)

- Member, American Institute for Aeronautics and Astronautics (2006—2007)

### **Interests and Activities**

- Habitat for Humanity construction volunteer
- Multi-instrument musician; bass player with Church of Swing (jazz quintet), Somewhat Superstitious (rock cover band), and various small jazz combos
- Recreational runner; regularly play volleyball, soccer, and racquetball; swing dancer