

# Brian W Bush – Curriculum Vitae

Energy Modeling & Forecasting Group  
National Renewable Energy Laboratory  
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[http://www.nrel.gov/analysis/staff\\_efm.html](http://www.nrel.gov/analysis/staff_efm.html)

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## Mission

To research and develop high-quality, integrated analyses and analysis techniques for problems important to society through scientific computing, computational physics, data analysis/mining, and the modeling & simulation of complex systems.

## Vision

To be a member of a quality- and productivity-oriented team performing innovative, ground-breaking research and development in scientific computation for complex systems.

## Biographical Sketch

Brian W. Bush is a Principal Engineer in the [Energy Forecasting & Modeling Group](#) of the [Strategic Energy Analysis Center](#) at the [National Renewable Energy Laboratory \[NREL\]](#). He currently leads NREL's [Biomass Scenario Model \[BSM\] project](#), a system-dynamics simulation of the cellulosic biomass-to-biofuels supply chain, and its [Scenario Evaluation and Regionalization Analysis \[SERA\] project](#), an optimization tool for regional hydrogen infrastructure. He has also led and collaborated on projects focused on numerous data-science and data-engineering projects such as the geostatistical modeling and analysis of the spatial and temporal correlations in renewable energy resources, automated anomaly detection and correction in energy datasets, and logical reasoning on qualitative semi-structured databases. He is a member of NREL's Research Council.

For more than seventeen years prior to his arrival at NREL, he was a technical staff member in the Energy and Infrastructure Analysis Group at Los Alamos National Laboratory [LANL]. His work on [TRANSIMS \[the Transportation Analysis Simulation System\]](#) from 1994 to 2000 there focused on leading

research on software architecture, the representation of road networks, microsimulation output collection, and data compression. More recently, he developed computer simulations for complex phenomena such as [interacting critical infrastructures](#) and [supercomputer hardware architectures](#). He formerly directed the [Interdependent Energy Infrastructure Simulation System \[IEISS\]](#) and [Critical Infrastructure Protection Decision Support System \[CIPDSS\]](#) projects, leading teams of approximately one dozen people, and held the position of Thrust Area Leader for the U.S. Dept. of Homeland Security's Critical Infrastructure Protection Portfolio in its Science & Technology Directorate. At LANL he was a member of its Patent Committee and its Institutional Computing Technical Committee. As a visiting scientist at the National Center for Atmospheric Research (NCAR), he initiated efforts to [connect simulations of weather and climate to impact models for energy and infrastructure networks](#).

Brian received a B.S. in physics at the California Institute of Technology in 1985 and a Ph.D. in theoretical physics at Yale University in 1990, where he was a National Science Foundation graduate fellow. He extensively performed and published [physics research on ultrarelativistic heavy-ion collisions and nuclear shape fluctuations](#). His research interests include statistical physics, symbolic dynamics, information theory, data mining, approximate reasoning, theory of simulation, and visualization.

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## **Skills**

### **Project Leadership**

Successfully led complex software- and data-intensive research & development teams of a dozen people.

Experience writing proposals for the NSF, DOE, DOD, and DHS.

### **Research**

Broad and innovative research, analysis, modeling, and simulation experience with complex systems and in disciplines ranging from transportation research to graph theory.

Data mining, statistical learning, approximate reasoning, and visualization expertise with massive data.

Strong theoretical physics basic research background, involving both analytic and numerical work.

## Computing

Extensive scientific computing abilities (particularly simulation architecture, design, and implementation) and numerical methods/algorithms knowledge.

Comprehensive experience with object-oriented software engineering: analysis, architecture, design, coding, testing; Booch methodology and UML.

Design and development expertise with system architectures, frameworks/patterns/libraries/wrappers, data structures, and algorithms.

*Languages:* active use of C++ (1991–present), Haskell (2002–present), Java (1996–present), SQL (1992–present), XML/XSL (1998–present); familiarity with Prolog (1993–present); past use of Eiffel (1994–1997), FORTRAN (1979–1991), Pascal (1980–1985), PL/I (1982), POSTSCRIPT (1990–1992), SGML/DSSSL (1996–2001), Smalltalk (1993–1996), VRML (1996–2001).

*Operating Systems:* UNIX (1990–present), Linux clusters (1998–present), Windows (1992–present).

*Software:* databases—MySQL, Oracle, PostgreSQL, Derby; services—Globus, WSDL, WS-\*, SOAP; geographic information systems—ArcGIS, GeoTools, WFS/WMS/GML; class libraries—STL, MPI, OpenMap, Boost, Eclipse RCP/EMF/Ecore; mathematics/statistics/visualization—Mathematica, R, GGobi; software engineering—SourceForge, Rational Rose, Together, Eclipse; configuration management—ClearCase, CVS, TeamWare, Subversion, GIT, Mercurial; simulation—DaSSF, Vensim, STELLA; ontology—OWL, RDF, Protégé, TopBraid Composer.

*Application Areas:* discrete-event and continuous simulation; graph and network analysis; mathematical and statistical modeling; data analysis, mining, and visualization; productivity tools.

## Languages

Ability to read modern Italian, classical Latin, classical Greek, and Pāli.

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## Education

### Ph.D. in Theoretical Physics, December 1990 [GPA 3.8]

Yale University, New Haven, CT

*Curriculum:* atomic, nuclear, and high energy physics; field theory, including the standard model; scattering theory; group theory and mathematical methods.

*Dissertation Title:* Shape Fluctuations in Hot Rotating Nuclei.

## **B.S. in Physics (with honor), June 1985 [GPA 4.0]**

California Institute of Technology, Pasadena, CA

*Curriculum:* classical, quantum, and statistical physics; mathematical methods, including abstract algebra, complex analysis, asymptotics, and spectral theory; probability and statistics.

*Senior Thesis:* set upper limits on proton lifetime in several decay modes using IMB collaboration experimental data.

## **Continuing Education**

*Subject Areas:* statistics, graph theory, fuzzy logic, information theory, genetic algorithms, neural networks, data mining, approximate reasoning, simulation; visualization; object-oriented analysis and design, data structures, algorithms, patterns, ontologies, effective user interface design, software testing and quality assurance, software engineering process; project leadership & facilitation.

“Learning from Data,” California Institute of Technology, Spring 2012.

“Proposing to Win,” Korn/Ferry International, 10–11 January 2012.

“Intermediate Dynamic Modeling with STELLA and iThink,” ISEE Systems, 10–12 December 2008.

“Software Inspections and Peer Reviews,” Los Alamos National Laboratory, 28 February 2006.

“Presenting Data and Information,” Yale University, 28 July 2003.

“Statistical Learning and Data Mining: from Supervised to Unsupervised Learning,” Stanford University, 6–7 September 2001.

“Modern Regression and Classification,” Stanford University, 31 January–1 February 2000.

“Mastering Projects,” True North pgs, 8–10 June 1999.

“Data Mining: Principles and Practice,” Gordian Institute, 4–6 November 1998.

“Substation Communications and Automation,” University of Wisconsin – Madison, College of Engineering, 26–28 June 1996.

“Engineering Simulation using SimSmart,” Advance High Technology Corporation, 11–15 December 1995.

“Software Testing and Quality Assurance,” University of California, Berkeley, University Extension, 18–20 October 1995.

“Effective GUI Design,” Corporate Computing International, 23–24 May 1995.

“Object-Oriented Analysis and Design with C++,” Catalyst Solutions, 30 August–2 September 1994.

## Standardized Tests

*SAT (1981)*: combined – 1470 (99th percentile); math – 750 (99th percentile); verbal – 720 (99th percentile).

*GRE (1984)*: quantitative – 800 (99th percentile); analytical – 660; verbal – 720 (96th percentile); physics – 950 (97th percentile).

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## Work Experience

### Principal Engineer, 2008–present

National Renewable Energy Laboratory, Golden, CO

Led the Biomass Scenario Model (BSM) project, a system-dynamics simulation of the cellulosic biomass-to-biofuels supply chain. Developed an enhanced version of the Scenario Evaluation and Regionalization Analysis (SERA), an optimization tool for regional hydrogen infrastructure. Also collaborated on statistical and geospatial analyses of renewable energy systems (photovoltaics and wind-turbine farms) from technical, financial, and economic perspectives. Researched issues around supporting community decisions in their transition to more efficient and renewable energy use. Led a data-mining and analysis-automation project that is developing new statistical and machine learning methods for application to renewable energy information.

### Technical Staff Member, 1993–2008

Los Alamos National Laboratory, Los Alamos, NM

Led numerous innovative research-oriented simulation projects (often several simultaneously) with teams of approximately one dozen people and with an emphasis on robust architecture and software quality. Collaborated as a software architect, designer, and programmer on TRANSIMS, a multiyear, multimillion-dollar project to develop a transportation simulation system; led team for information and data handling research and development. Performed groundbreaking research on information theory, graph theory, and infrastructure (electric power, control communications, interdependence) assurance; architected, designed, and developed simulation software, analysis software applications, geographic information systems, and relational databases. As a Visiting Scientist at the National Center for Atmospheric Research (NCAR), recently began efforts to connect simulations of weather and climate to impact models for energy and infrastructure networks.

**Director-Funded Postdoctoral Fellow, 1990–1992**

Los Alamos National Laboratory, Los Alamos, NM

Developed theory and computer simulations of ultrarelativistic heavy-ion collisions, nuclear dissipation, shape diffusion, and level densities, and solvable nuclear models.

**Research Associate, 1987–1992 (consultant), and Research Assistant, 1984–1987**

Pacific-Sierra Research Corporation, W. Los Angeles, CA

Analyzed and developed computer simulations of large area urban fires, wildland fires, ignition phenomena; studied atmospheric and environmental impacts of nuclear weapons.

**Research Assistant, 1988–1990, and National Science Foundation Graduate Fellow, 1985–1988**

Yale University, New Haven, CT

Researched nuclear shape fluctuations, phase transitions, giant resonances, and Landau theory in hot rotating nuclei, comparing numerically computed predictions to available experimental data; investigated the shell model, level densities, nuclear damping, and pion-proton scattering.

**Teaching Assistant, 1985–1987**

Yale University, New Haven, CT

Assisted teaching laboratory courses for science majors, physics majors, and physics graduate students.

**Research Assistant, 1984**

California Institute of Technology, Pasadena, CA

Assisted development of Monte-Carlo computer simulations for muon-decay parity-violation experiment.

**Materiel Assistant, 1982**

Hughes Aircraft Company, Electro-Optical and Data Systems Group, El Segundo, CA

Developed computer programs for business applications related to procurement.

### **Assistant to Accounts Receivable, 1981**

Bel-Air Bay Club, Pacific Palisades, CA

Performed various clerical tasks for accounts receivable and payroll.

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## **Other Experience**

### **Professional Society Membership**

American Physical Society, 1982–1985, 1995–present.

Association for Computing Machinery, 1996–present.

Institute of Electrical and Electronics Engineers (including Computer Society), 1995–present.

Society for Industrial and Applied Mathematics, 1995–2008.

Society for Risk Analysis, 2004–2005.

### **Honors**

National Renewable Energy Laboratory President’s Award, 2013.

National Renewable Energy Laboratory FY2010 Outstanding Achievement Award, 2011.

Los Alamos Achievement Award, 2004.

Los Alamos Achievement Award, 2001.

University of California and U.S. Department of Energy Distinguished Copyright Award, 2000.

Los Alamos Achievement Award, 1996 (twice).

Sterling Prize Fellowship, 1988.

National Science Foundation Graduate Fellow, 1985–88.

J. W. Gibbs Fellowship, 1985.

National Merit Scholar finalist, 1981.

Bank of America Achievement Award, 1981.

California Junior Classical League Competition, first place in 3rd year Latin Grammar, 1981.

Bay Area Math League Competition, fourth place, 1981.

California Scholastic Federation member, 1979–81.

Rensselaer Polytechnic Institute medallist, 1980.

California Junior Classical League Competition, first place in 2nd year Latin Grammar, 1980.

Occidental College Math Field Day, finalist, 1980.

California High School Cooperative Chemistry Exam, first place, 1980.

California Junior Classical League Competition, first place in 1st year Latin Grammar, 1979.

### **Collaboration**

Collaborator with scientists at Argonne National Laboratory, Brookhaven National Laboratory, Idaho National Engineering Laboratory, Los Alamos National Laboratory, Michigan State University, National Center for Atmospheric Research, Pacific Northwest National Laboratory, Sandia National Laboratories, University of Colorado, University of Denver, University of Washington, Washington State University, Weizmann Institute, and Yale University.

### **Teaching**

Frequently mentored graduate students and post-docs.

Supervised graduate research assistants.

Occasionally taught or assisted teaching university courses up to graduate level.

### **Software Authorship Metrics**

C++: 173,127 lines of code.

Java: 182,342 lines of code.

Smalltalk: 30,664 lines of code.

FORTTRAN: 17,868 lines of code.

### **Beta Testing**

Tested pre-release versions of software for a major commercial database and programming language product firm, 1994–1996.



### **Committee Membership**

Research Council, National Renewable Energy Laboratory, 2014–present.

Patent Committee at Los Alamos National Laboratory, 2002–2005.

Institutional Computing Technical Committee at Los Alamos National Laboratory, 2002–2003.