Jennifer B. Webster

Curriculum Vitae

CONTACT INFORMATION

Pacific Northwest National Laboratory
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RESEARCH INTERESTS

Inverse Problems, Machine Learning, Classification, Optimization, Radiation Transport

EDUCATION

Texas A&M University, College Station, Texas *Aug. 2008 – Aug. 2013*

PhD, Mathematics

- Dissertation Topic: Cost-Sensitive Classification Methods for Detection of Smuggled Nuclear Material in Cargo Containers
- Advisor: Dr. Wolfgang Bangerth

University of California – San Diego, San Diego, California *Aug. 2004 – June 2008*

B.A. in Applied Mathematics - Departmental Honors with Distinction, June 2008
B.A. in History - War, Revolution and Social Change, June 2008

- Cum Laude

COMPUTER SKILLS

- Languages: C family languages including C/C++/C# and Python
- Applications: MCNP, Mathematica, MATLAB, Subversion
- Visualization Software: PyQT GUI development, Gnuplot, Xmgrace, VisIt
- Optimization Software: Opt++, TAO (PETSc based), Matlab packages

LANGUAGES

Native English speaker, functional knowledge of German and Spanish

EMPLOYMENT

Pacific Northwest National Laboratory, Richland, WA
Applied Statistics and Computational Modeling Group *May 2013 – present*

Instructor: Signature Discovery Initiative Workshop

July 2016 – present

- Developing course materials to teach principles of data mining and machine learning to non-expert users

Instructor: Evaluation of Detectors via ROC curves

March 2016 – present

- Developing course materials to teach principles of detector performance verification to nuclear engineers with DHS DNDO

Principle Investigator: Fundamental Mathematical Models for Human Interaction

Oct. 2015 – present

- NSD LDRD involving a team of 4 staff members and 2 students; $250k/year for 2 years
- Investigating 3 tasks:
  - Design and improve mathematical models for community detection

- Develop methods for incorporating uncertainty analysis and sampling bias into existing community detection algorithms
- Re-purpose data from multiple sources to form a holistic, evidence-based description of an individuals behavior

Technical Team Lead: Uncertainty Quantification Software

Oct. 2015 – present

- Utilize Stochastic Collocation Principles to develop a generalized software package for uncertainty quantification and inverse problems application

Technical Team Member: Unattended Cylinder Verification Services Project

Jan. 2014 – May 2016

- In charge of developing and maintaining software in python for the characterization of fuel enrichment levels based on spectral information

Technical Team Member: DTRA Nuclear Loss of Custody Detection via Proxies Oct. 2013 – Jan. 2016

- Technical team member on the graph analytics and modeling teams
- Analyze community behavior from a variety of data sources to determine purpose

PI and Technical Team Member: Signatures of Illicit Nuclear Trafficking Challenge Project Sept. 2013 – Sept. 2015

- Co-PI (Jan. 2014 – Sept. 2015) under the Signature Discovery Initiative
- Investigate business intelligence signatures to identify illicit behavior in shipping networks
- Utilized a variety of statistical, classification, and graph analysis techniques

Technical Team Member: Microwave Imaging for Detecting Concealed Targets

Oct. 2013 – May 2015

- Implemented machine learning and anomaly detection methods for the processing of alternatively generated images as part of the Automated Target Recognition Task Team.

PI and Technical Team Member: Strategic Goods Testbed *Sept. 2013 – Oct. 2015*

- Co-PI (Mar. 2014 – Oct. 2015) and team member of the Strategic Goods Testbed Team – a laboratory wide data service for the Disruption of Illicit Nuclear Trafficking Laboratory Objective (May 2013 – Oct. 2015)

Technical Team Member: ARES Localization Project *Sept. 2013 – Summer 2014*

- Developed analytical methods for locating a radiation source based on helicopter mounted detectors

Technical Team Member: Small Vessel Standoff Detection Project *May. 2013 – March 2014*

- Designed test plans and performed mathematical analysis of collected data to confirm radiation detector accuracy under maritime environmental conditions. Contributed key sections to the final report. (DHS DNDO)

Texas A&M University, Department of Mathematics

Teaching Assistant and Grader *Aug. 2008 – May. 2013*

- Math 642: Analysis for Applications (Spring 2013) – Grader
- Math 152: Engineering Mathematics II (Summer 2012) – TA with computer lab
- Math 442: Mathematical Modeling (Fall 2008) – Grader

Instructor of Record *Aug. – Dec. 2012*

- Instructor for Math 131: Mathematical Concepts – Calculus (110 students)
- Course website: http://www.math.tamu.edu/~jwebster/courses/math131.html

Research Assistant to Dr. Wolfgang Bangerth *Aug. 2008 – May 2012*

- Developed cost-sensitive classification algorithms for determining optimal detector thresholds and locating radioactive sources
- Worked on the DHS–DNDO ARI Project SHIELD –http://shield.tamu.edu/
- Utilized MCNP, classical statistics, machine learning and feature selection methods in the development of such algorithms

Blinn College, Learning Center

Tutor at Blinn Learning Center *Jan. 2011 – Aug. 2011*

- Tutored individuals and small groups in Math, Physics, Chemistry and Philosophy
- Provided computer support for students and proctored exams

Los Alamos National Laboratory, Los Alamos, New Mexico

Student Intern, X-Computational Physics, XCP-4 & XCP-8 *May – July 2010 & 2011*
Nuclear NonProliferation Division, N-2 *May – Aug. 2009*

- Developed infrastructure for the Python Radiograph Analysis Toolkit (PyRAT) Software to determine edge positions and estimate densities of concentric layers in a radiograph
- Designed a GUI for PyRAT using PyQT software

Student Intern, Computer, Computational and Statistical Sciences Division, CCS-2
June 2007 – Sept. 2008

- Developed C++ codes to model diffusion of radiation and ion-ion collisions
- Organized and attended a class on Introductory Radiation Transport taught by Dr. Dimitiri Mihalas – July and August 2007

Student Intern, Applied Physics Division, X-DO-IAT *June – Sept. 2006*

- Created a program to remotely gather status information about computers on the X-Division network for multiple operating systems, making use of C, C#, shell scripting and Python
- Developed a program in python to detect login patterns and watch for anomalies

Student Intern, Applied Physics Division, X-8 *June – Sept. 2005*

- Developed a hash table to deal with vertex multiplicity in geometric models for Oso
- Designed simple problems to test for mesh entanglement

Student Intern, Material Science & Technology Division, MST-6 *May – Aug. 2004*

- Obtained technical documents and set up a searchable, electronic library
- Assisted in the preparation of metal samples for testing and optically recorded the results

PUBLICATIONS

[1] L. E. SMITH, K. A. MILLER, J. R. GARNER, S. BRANNEY, B. S. MCDONALD, J. B. WEBSTER, M. A. ZALAVADIA, L. C. TODD, J. A. KULISEK, H. NORDQUIST, N. S. DESHMUKH, AND S. STEWART, *Viability study for an unattended uf6 cylinder verification station: Phase i final report*, Tech. Report PNNL-25395, Pacific Northwest National Laboratory, 2016.

[2] E. MILLER, S. ROBINSON, K. ANDERSON, J. MCCALL, A. PRINKE, J. WEBSTER, AND C. SEIFERT, *Adaptively reevaluated bayesian localization (arbl): A novel technique for radiological source localization*, Nuclear Instruments and Methods in Physics Research. Section A, Accelerators, Spectrometers, Detectors and Associated Equipment, 487 (2015), pp. 332 –338.

[3] A. M. B. PEDDICORD, D. W. ENGEL, Z. N. GASTELUM, A. HEREDIA-LANGNER, E. A. HOGAN, V. A. LEWIS, K. E. MCNEIL, L. R. RODRIGUEZ, AND J. B. WEBSTER, *Signature discovery for procurement networks in business intelligence applications*, Tech. Report PNNL-24554, Pacific Northwest National Laboratory, 2015.

[4] J. B. WEBSTER, *Cost-sensitive classification methods for the detection of smuggled nuclear material in cargo containers*, in Information Analysis Technologies, Techniques, and Methods for Safeguards, Nonproliferation and Arms Control Verification Workshop, INMM, May 2014, pp. 184–199.

[5] J. B. WEBSTER, L. E. ERIKSON, Z. N. GASTELUM, V. A. LEWIS, D. M. BEST, E. A. HOGAN, AND S. CHIKKAGOUDAR, *Signatures of illicit nuclear procurement networks: An overview of preliminary approaches and results*, in Information Analysis Technologies, Techniques, and Methods for Safeguards, Nonproliferation and Arms Control Verification Workshop, no. PNNL-SA-102655, INMM, May 2014, pp. 157–167.

[6] J. B. WEBSTER, L. E. ERIKSON, C. TOOMEY, AND V. A. LEWIS, *PNNL strategic goods testbed: A data library for illicit nuclear trafficking*, in Information Analysis Technologies, Techniques, and Methods for Safeguards, Nonproliferation and Arms Control Verification Workshop, no. PNNL-SA-102636, INMM, May 2014, pp. 168–172.

[7] M. ALLMARAS, W. BANGERTH, J. M. LINHART, J. POLANCO, F. WANG, K. WANG, J. WEBSTER, AND S. ZEDLER, *Estimating parameters in physical models through bayesian inversion: A complete example*, SIAM Review, 55 (2013).

[8] J. WEBSTER, *Cost-Sensitive Methods for the Classification of Nuclear Material in Cargo Containers*, PhD thesis, Texas A&M University, 2013.

[9] J. WEBSTER, *Help documentation and explanation for PyRAT - version 1.0.0*, Tech. Report LA-UR-09-05048, Los Alamos National Laboratory, August 2009.

[10] J. WEBSTER, *A Comparison of Two Methods for Modeling Electron-Radiation Interactions*, undergraduate honors thesis, University of California - San Diego, 2008.

Papers in Preparation

[1] A. M. Boek-Peddicord, D. W. Engel, Z. N. Gastelum, A. Heredia-Langner, E. A. Hogan, V. A. Lewis, K. E. McNeil, L. R. Rodriguez, and J. B. Webster, *Signature discovery for procurement networks in business intelligence applications*, in preparation, (2016).

[2] J. A. Kulisek, B. S. McDonald, L. E. Smith, M. A. Zalavadia, and J. B. Webster, *Analysis of an indirect neutron signature for enhanced uf6 cylinder verification*, Nuclear Instruments and Methods in Physics Research. Section A, Accelerators, Spectrometers, Detectors and Associated Equipment, (2016).

Conference Presentations and Posters

[1] P. S. Mackey and J. B. Webster, *A multi-network analysis of scientists on social media and their scientific co-authorship graphs*, in SIAM Workshop on Network Science (NS16), Boston, MA, 2016.

[2] J. B. Webster, *Fundamental mathematical models for human interactions*, Tech. Report PNNL-SA-118712, Pacific Northwest National Laboratory, 2016.

[3] J. B. Webster, *Understanding data: Graphs and their uses*, in SIAM Annual Meeting, Boston, MA, 2016.

[4] J. B. Webster and Z. N. Gastelum, *Mathematical formulation of "fuzzy" problems for signature discovery*, in Joint Mathematics Meetings, no. PNNL-SA-107483, San Antonio, TX, January 2015.

[5] J. B. Webster, *Cost-sensitive classification methods for the detection of smuggled nuclear material in cargo containers*, in Information Analysis Technologies, Techniques, and Methods for Safeguards, Nonproliferation and Arms Control Verification Workshop, INMM, May 2014, pp. 184–199.

[6] J. B. Webster, L. E. Erikson, Z. N. Gastelum, V. A. Lewis, D. M. Best, E. A. Hogan, and S. Chikkagoudar, *Signatures of illicit nuclear procurement networks: An overview of preliminary approaches and results*, in Information Analysis Technologies, Techniques, and Methods for Safeguards, Nonproliferation and Arms Control Verification Workshop, no. PNNL-SA-102655, INMM, May 2014, pp. 157–167.

[7] J. B. Webster, L. E. Erikson, C. Toomey, and V. A. Lewis, *PNNL strategic goods testbed: A data library for illicit nuclear trafficking*, in Information Analysis Technologies, Techniques, and Methods for Safeguards, Nonproliferation and Arms Control Verification Workshop, no. PNNL-SA-102636, INMM, May 2014, pp. 168–172.

[8] J. Webster, W. Bangerth, M. Adams, N. Amato, S. Chirayath, J.-L. Guermond, G. Kanschat, P. Kuchment, J. Morel, J. Ragusa, and L. Rauchwerger, *A classification framerwork for detection of sources in cargo containers*. Poster at the 5th Annual DHS DNDO Academic Research Initiative (ARI) Grantees Conference, July 2012.

[9] J. Webster, *The curse of dimensionality and feature selection in classification problems*, in 1st Annual Probability and Statistics Day, Texas A&M University, March 24 2012.

[10] J. Webster, *Two approaches to binary classification*, in Graduate Student Organization Talk, Dept. of Mathematics, Texas A&M University, December 1 2011.

[11] M. Adams, N. Amato, M. Allmaras, W. Bangerth, S. Chirayath, J.-L. Guermond, G. Kanschat, P. Kuchment, J. Morel, J. Ragusa, L. Rauchwerger, and J. Webster, *Detecting small low emission radiating sources.* Poster at the 4th Annual DHS DNDO Academic Research Initiative (ARI) Grantees Conference, April 2011.

[12] J. Webster, W. Bangerth, M. Adams, N. Amato, S. Chirayath, J.-L. Guermond, G. Kanschat, P. Kuchment, J. Morel, J. Ragusa, and L. Rauchwerger, *Using statistics to set detector threshold curves.* Poster at the 3rd Annual DHS DNDO Academic Research Initiative (ARI) Grantees Conference, April 2010.

[13] J. Webster, *Reconstruction of spherically symmetric objects from 2d radiographic data*, Tech. Report LA-UR-09-04735, Los Alamos National Laboratory, August 2009.

[14] W. Bangerth, M. Adams, N. Amato, S. Chirayath, J.-L. Guermond, J. Ragusa, and L. Rauchwerger, *Forward and inverse capabilities for detection and imaging.* Poster at the 2nd Annual DHS DNDO Academic Research Initiative (ARI) Grantees Conference, April 2009. J. Webster provided images for this poster.

Professional Memberships

- IEEE, Jan. 2015 to present (Chair of the Richland Section Women in Engineering Interest Group, 2015)
- Phi Beta Kappa Member, inducted to UCSD, California Sigma Chapter, June 2008
- Society for Industrial and Applied Mathematics (SIAM), Fall 2006 to present
- American Mathematical Society (AMS), Fall 2006 to present

Professional Service

- Coach for the Hanford High School FIRST Technology Challenge Team and Engineering Club (Sept. 2013 – Dec. 2015)
- Organized a Machine Learning Journal Club at PNNL (Spring 2014 – Fall 2014)
- Volunteered at the Math MiniFair at Texas A&M University as part of Math Awareness Month for K-12 (Math related games and puzzles) – April 2011 & April 2012
- Graded for a local High School math competition, TAMU – Sept. 2010
- UCSD Math Club, Member – Sept. 2004 to June 2008 (Vice President 2007 – 2008)
- Volunteer Tutor at UCSD Preuss School – Jan. to June 2005

Honors and Awards

- PNNL:
  - Outstanding Performance Awards for aiding the development of a laboratory directorate and performing a large analysis effort on short notice (2 - Sept. 2014)
  - Letter of Appreciation from DHS-DNDO Assistant Director for efforts on the Small Vessel Standoff Detection Project (June 2, 2014)
  - National Security Directorate "Of The Year" Project Award for the Small Vessel Standoff Detection Project (2013)
- TAMU: 4 year Research Assistantship with Dr. Wolfgang Bangerth under Department of Homeland Security – Domestic Nuclear Detection Office, Academic Research Initiative Grant # 2008-DN-077-ARI018-05 – Fall 2008 to Spring 2012
- UC San Diego:
  - Provost's Honors Fall 2004 to Spring 2008
  - Dean's Award for Excellence, Dept. of Physical Sciences, Nov. 2007