

Shuhua Hu

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EDUCATION

- Doctor of Philosophy in Applied Mathematics December 2004
University of Louisiana at Lafayette, Lafayette, LA
Co-advisors: Dr. Azmy S. Ackleh and Dr. Keng Deng
Dissertation: *Structured population models: well-posedness, approximation and parameter estimation*
- Master of Science in Computational Mathematics March 2001
Nanjing University of Aeronautics and Astronautics, Nanjing, Jiangsu, P. R. China
Advisor: Dr. Qin Ni
Thesis: *Direct search methods for nonlinear programming*
- Bachelor of Science in Mathematics Education July 1998
Qingdao University, Qingdao, Shandong, P. R. China

CURRENT RESEARCH INTERESTS

- Population Dynamics, Infectious Disease Dynamics, Elasticity and Viscoelasticity, EM
- Uncertainty Propagation and Quantification
- Sensitivity Analysis, Parameter Estimation Methods
- Optimal Control, Dynamic Game

RESEARCH EXPERIENCE

- Senior Research Scientist July 2011 - present
Center for Research in Scientific Computation, North Carolina State University, Raleigh, NC
- Research Assistant Professor March 2009 – June 2011
Center for Research in Scientific Computation, North Carolina State University, Raleigh, NC
 - Using elastic and electromagnetic waves to detect a buried target.
 - Dynamical differential games with uncertainty in the context of electromagnetics
 - Modeling and optimal control of immune response of transplant patients.

- Postdoctoral Research Associate January 2005 – February 2009
Center for Research in Scientific Computation, North Carolina State University, Raleigh, NC
Mentor: Dr. H. T. Banks
 - Developed qualitative models for analyzing the system that provides the rapid production of large quantities of therapeutic and/or preventative countermeasures responding to bio-toxic attacks on populations. Questions pertaining to use of models to design this system in an efficient manner involve modeling, sensitivity analysis, parameter estimation, and propagation of uncertainty in deterministic dynamical system.
 - Seek to systematically integrate mathematical and statistical modeling in the clinical research process to help design innovative treatment strategies for HIV Patients. This involves modeling HIV infection and immune suppression, developing a computational framework to fit these models to clinical data, using these models to inform the clinical trial design, and applying nonlinear filtering approaches (e.g., Extended Kalman Filter, Gaussian Quadrature Filter and Unscented Kalman Filter) to estimate the current state of HIV patients that are needed to design adaptive treatment schedules for the patients.
- Research Assistant January 2004–July 2004
Department of Mathematics, University of Louisiana at Lafayette, Lafayette, LA
Advisor: Dr. Azmy S. Ackleh
Participated in writing the following two software packages:
 - A Spatially Explicit Model for Nutria Population Dynamics and Management
 - A Numerical Solver for General Size-Structured Population Models
- Research Assistant June 2003–July 2003
Department of Mathematics, University of Louisiana at Lafayette, Lafayette, LA
Advisor: Dr. Azmy S. Ackleh

TEACHING EXPERIENCE

- Instructor August 2008–December 2008
Department of Mathematics, North Carolina State University, Raleigh, NC.
Taught one *Applied Differential Equation* course.
- Instructor August 2007–December 2007
Department of Mathematics, North Carolina State University, Raleigh, NC
Co-taught one *Applied Differential Equations* course.
- TA Instructor
Department of Mathematics, University of Louisiana at Lafayette, Lafayette, LA
Taught one *College Algebra* course.
- TA Instructor August 2003–December 2003
Department of Mathematics, University of Louisiana at Lafayette, Lafayette, LA
Taught two *Elementary and Intermediate Algebra* courses.

- TA Instructor January 2003–May 2003
Department of Mathematics, University of Louisiana at Lafayette, Lafayette, LA
Taught two *Elementary and Intermediate Algebra* courses.
- Teaching Assistant August 2001–December 2002
Department of Mathematics, University of Louisiana at Lafayette, Lafayette, LA
Graded tests and homework and held office hours for *Elementary Statistics, Survey of Calculus* and *Differential Equations* courses.
- Internship March 1998–April 1998
No. 47 Middle School of Qingdao, Qingdao, Shandong, P. R. China

REFEREED JOURNAL PUBLICATIONS

- A New Derivative Free Optimization Method Based on Conic Interpolation Model (with Q. Ni), *Acta Mathematica Scientia Series B*, English edition, 24 (2004) 281-290.
- A Quasilinear Hierarchical Size Structured Model: Well-Posedness and Approximation (with A.S. Ackleh and K. Deng), *Applied Mathematics and Optimization*, 51 (2005) 35-59.
- Parameter Estimation in a Coupled System of Nonlinear Size-Structured Populations (with A.S. Ackleh, H.T. Banks and K. Deng), *Mathematical Biosciences and Engineering*, 2 (2005) 289-315.
- A Hierarchical Bayesian Approach for Parameter Estimation in HIV Models (with H.T. Banks, S.L. Grove and Y. Ma), *Inverse Problems*, 21 (2005) 1803-1822.
- Modeling Shrimp Biomass and Viral Infection for Production of Biological Countermeasures (with H.T. Banks, V.A. Bokil, A.K. Dhar, R.A. Bullis, C.L. Browdy and F.C.T. Allnut), *Mathematical Biosciences and Engineering*, 3 (2006) 635-660.
- Monotone Approximation for a Nonlinear Size and Class Age Structured Epidemic Model (with H.T. Banks and V.A. Bokil), *Nonlinear Analysis: Real World Applications*, 8 (2007) 834–852.
- On a Nonlinear Size-Structured Phytoplankton-Zooplankton Aggregation Model (with A.S. Ackleh and K. Deng), *Dynamics of Continuous, Discrete and Impulsive Systems, Series A*, 14 (2007) 265-285.
- Comparison Between Stochastic and Deterministic Selection-Mutation Models (with A.S. Ackleh), *Mathematical Biosciences and Engineering*, 4 (2007) 133-157.
- Modeling HIV Immune Response and Validation with Clinical Data (with H.T. Banks, M. Davidian, G.M. Kepler and E.S. Rosenberg), *Journal of Biological Dynamics*, 2 (2008) 357–385.
- Sensitivity Equations for a Size-Structured Population Model (with H.T. Banks and S.L. Ernstberger), *Quarterly of Applied Mathematics*, 67 (2009) 627–660.
- A Comparison of Probabilistic and Stochastic Formulations in Modeling Growth Uncertainty and Variability (with H.T. Banks, J.L. Davis, S.L. Ernstberger, A.K. Dhar, C.L. Browdy and E. Artimovich), *Journal of Biological Dynamics*, 3 (2009) 130-148.

- Experimental Design and Estimation of Growth Rate Distribution in Size-Structured Shrimp Populations (with H.T. Banks, J.L. Davis, S.L. Ernstberger, E. Artimovich, and A.K. Dhar), *Inverse Problems*, 25 (2009) 095003.
- A Comparison of Nonlinear Filtering Approaches in the Context of an HIV Model (with H.T. Banks, Z.R. Kenz and H.T. Tran), *Mathematical Biosciences and Engineering*, 7 (2010) 213–236.
- Electromagnetic Interrogation and the Doppler Shift Using the Method of Mappings (with H.T. Banks and W.C. Thompson), *Mathematical and Computer Modelling*, 51 (2010) 389–399.
- A Brief Review of Elasticity and Viscoelasticity for Solids (with H.T. Banks and Z.R. Kenz), *Advances in Applied Mathematics and Mechanics*, 3 (2011) 1–51.
- Dynamic Evasion-Interrogation Games with Uncertainty in the Context of Electromagnetics (with H.T. Banks, K. Ito and S.G. Muccio), *Numerical Mathematics: Theory, Methods and Applications*, 4 (2011) 359–378.
- Host Immune Responses That Promote Initial HIV Spread (with K. Wendelsdorf, G. Dean, S. Nordone, and H.T. Banks), *Journal of Theoretical Biology*, 289 (2011) 17–35.
- Nonlinear Stochastic Markov Processes And Modeling Uncertainty In Populations (with H.T. Banks), CRSC-TR11-02, Center for Research in Scientific Computation, North Carolina State University, 2011; *Mathematical Biosciences and Engineering*, accepted.

BOOK CHAPTERS AND CONFERENCE PROCEEDINGS

- A Computational Comparison of Alternatives to Including Uncertainty in Structured Population Models (with H.T. Banks and J.L. Davis), CRSC-TR09-14, Center for Research in Scientific Computation, North Carolina State University, 2009; in *Three Decades of Progress in Control Sciences* (X. Hu, U. Jonsson, B. Wahlberg and B. Ghosh, eds), Springer, 2010, pp. 19-33.

SUBMITTED MANUSCRIPTS

- A Zero-Sum Electromagnetic Evader-Interrogator Differential Game with Uncertainty (with H.T. Banks), CRSC-TR11-04, Center for Research in Scientific Computation, North Carolina State University, February, 2011; submitted to *Applicable Analysis*.
- Modeling and Optimal Control of Immune Response of Renal Transplant Recipients (with H.T. Banks, T. Jang and H.-D. Kwon), CRSC-TR11-07, Center for Research in Scientific Computation, North Carolina State University, July, 2011; submitted to *Journal of Biological Dynamics*.
- Propagation of Uncertainty in Dynamical Systems (with H.T. Banks), CRSC-TR11-11, Center for Research in Scientific Computation, North Carolina State University, October, 2011.

TECHNICAL REPORTS

- A Two-Player Zero-Sum Electromagnetic Differential Game with Uncertainty (with H.T. Banks), CRSC-TR10-15, Center for Research in Scientific Computation, North Carolina State University, 2010.

CONFERENCES AND WORKSHOPS PRESENTATIONS

- Invited lecture, Southeastern-Atlantic Regional Conference on Differential Equations, Virginia Tech, Blacksburg, VA. *A Comparison of Nonlinear Filtering Approaches in the Context of an HIV Model*, October, 2010.
- Invited lecture, Atlantic Coast Symposium on the Mathematical Sciences in Biology and Biomedicine, NC State University, Raleigh, NC. *Comparison of Probabilistic and Stochastic Formulations in Modeling Growth Uncertainty and Variability*, April, 2008.
- Invited lecture, 7th International Conference on Computational and Mathematical Methods in Science and Engineering, CMMSE2007, Illinois Institute of Technology, Chicago, Illinois. *Modeling and Numerical Simulating of Shrimp Biomass and Vaccine Production System*, Industrial Mathematics, June 2007.
- Invited lecture, Atlantic Coast Conference on Mathematics in the Life and Biological Sciences, Virginia Tech, Blacksburg, VA. *Mathematical Formulation of Shrimp Biomass and Viral Production System*, May 2007.
- Invited lecture, Dynamics of Infectious Diseases: Longitudinal Data Acquisition and Analysis, Population and In-Host Models, and Statistical and Mathematical Methodologies, SAMSI, NC. *Akaike Information Criterion*, April 2007.
- Invited lecture, MAA PREP Workshop on Mathematics Meets Biology: Competitive Exclusion, Coexistence and Data Fitting, University of Louisiana at Lafayette, *Markov Chain Monte Carlo and Its Application in Parameter Estimation for HIV Models*, May 2005.
- Invited lecture, 29th Annual SIAM Southeast Atlantic Section Meeting, Charleston, SC. *Parameter Estimation in a Coupled System of Nonlinear Size-Structured Populations*, Inverse Problems in Electromagnetics and Biology Minisymposium, March 2005.
- Contributed lecture, AMS National Meeting, Atlanta, GA. *A Quasilinear Hierarchical Size Structured Model: Well-Posedness and Approximation*, session on Statistics and Numerical Analysis II, January 2005.

COMPUTER SKILLS

- Language and Software: Matlab, SAS (certificate for base level), Fortran, C, Maple and HTML.
- Operating Systems: Linux, Windows, Mac and Unix.

AWARDS AND HONORS

- Lord Robert May Best Paper Prize 2010
 “Modeling HIV Immune Response and Validation with Clinical Data” published in the 2008 volume of *Journal of Biological Dynamics*.

PROFESSIONAL SERVICES

- Volunteer in USGS Wetland Research Center Summer, 2004

- Faculty Advisor July 24–August 1, 2006
2006 Industrial Mathematical and Statistical Modeling Workshop for Graduate Students, Center for Research in Scientific Computation, North Carolina State University, Raleigh, NC.
- Served as a referee for the following journals: Nonlinear Analysis: Real World Applications, Mathematical Biosciences and Engineering, AIMS Proceedings, Quarterly Applied Mathematics, Inverse Problems In Science & Engineering, Advances in Applied Mathematics and Mechanics, Natural Resource Modeling, Journal of Mathematical Analysis and Applications, Bulletin of Mathematical Biology.

PROFESSIONAL DEVELOPMENT

- New Faculty Workshop, sponsored by College of Engineering, and Physical and Mathematical Sciences, North Carolina State University, August 2007.
- Developing a Teaching Portfolio, sponsored by the Faculty Center for Teaching and Learning, North Carolina State University, March 2006.

PROFESSIONAL SOCIETIES

- Society for Industrial and Applied Mathematics