

Vrushali Avinash Bokil

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Professional Interests:

- Computational acoustics and electromagnetics
 - Forward and Inverse problems for (dispersive) wave phenomena
 - Homogenization of Maxwell's equations
 - Perfectly matched layers
- Parameter estimation, statistical inference and optimization techniques
- Fictitious domain (domain imbedding) methods, finite difference methods, finite element methods, operator splitting schemes
- Structured population models, infectious disease dynamics, semigroup theory

Education:

Doctor of Philosophy, Mathematics May, 2003
University of Houston, Houston, TX
Committee: Professors R. Glowinski (adviser), M. W. Buksas, E. J. Dean, K. J. Marfurt,
and T. W. Pan
Thesis: *Computational Methods for Wave Propagation Problems on Unbounded Domains*
GPA 3.88/4.00

Master of Science, Mathematics May, 1996
New Mexico State University, Las Cruces, NM
Non-thesis option, GPA 3.87/4.00

Master of Science, Applied Mathematics July 1993
Indian Institute of Technology, Bombay, India
Advisor: Dr. A. K. Pani
Thesis: *Mathematical Modeling of Chemical Processes Using the Equation Oriented Approach*

Bachelor of Science, Mathematics
Minor in Physics and Statistics
Fergusson College, University of Poona, Pune, India

December, 1991

Professional Experience:

Postdoctoral Fellow:

August 2003 - Present

Center for Research in Scientific Computation
North Carolina State University, Raleigh, NC

- Forward and inverse problems for dispersive wave phenomena
- Parameter estimation, statistical inference and optimization techniques
- Perfectly matched layer absorbing boundary conditions
- Homogenization of Maxwell's equations for dispersive dielectrics
- Size and class age structured population models for modeling viral epidemics, semi-group theory
- Advisor: Dr. H. T. Banks

LACSI Research Fellow:

August 2001 - July 2003

Department of Mathematics
University of Houston, Houston, TX

- Member of the Los Alamos Computer Science Initiative (LACSI) working group on "Parallel Numerical Methods for the Diffusion Equation in Heterogeneous Media on Strongly Distorted Meshes" led by Dr. Y. Kuznetsov, Dr. R. Glowinski, and Dr. L. Johnsson
- Fictitious domain methods for wave propagation problems
- Operator splitting schemes
- Advisor: Dr. Roland Glowinski

Graduate Research Assistant (Summer): May 1999 - August 2002
Mathematical Modeling and Analysis, T-7
Los Alamos National Laboratories, Los Alamos, NM

- Mimetic finite difference schemes for Maxwell's equations
- The perfectly matched layer technique in computational electromagnetics
- Development of numerical PML formulation in the PDEUM framework (a library of C++ classes designed to simplify applications in scientific computing)
- Studied advanced C++ programming techniques for scientific computing
- Advisors: Dr. J. M. Hyman and Dr. M. W. Buksas

Graduate Teaching Fellow: August 1998 - May 2001
Department of Mathematics
University of Houston, Houston, TX

- Instructor for undergraduate courses in mathematics, including Finite Mathematics, and Elements of Mathematics
- Taught large sections (over 100 students)

Graduate Teaching Assistant: August 1994 - June 1998
Department of Mathematical Sciences
New Mexico State University, Las Cruces, NM

- Instructor for Calculus I, Calculus II, Finite Mathematics, Matrices and Linear Programming
- Tutor in the Mathematics Learning Center; provided one on one help for students

Summer Research Assistant: May 1995 - July 1995
Department of Electrical and Computer Engineering
New Mexico State University, Las Cruces, NM

- The perfectly matched layer technique in computational electromagnetics
- Advisor: Dr. S. Castillo

Graduate Research Fellow:

July 1993 - December 1993

Department of Chemical Engineering
Indian Institute of Technology, Bombay, India

- Differential-algebraic equations
- Advisors: Dr. A. K. Pani and Dr. K. M. Moudgalya

Publications:

Refereed Journal Publications:

- H. T. Banks, V. A. Bokil, S. Hu, A. K. Dhar, R. A. Bullis, C. L. Browdy and F.C.T. Allnut, “Modeling Shrimp Biomass and Viral Infection for Production of Biological Countermeasures”, To appear in *Mathematical Biosciences and Engineering*.
- H. T. Banks, V. A. Bokil and S. Hu, “Monotone Approximation for a Nonlinear Size and Age Structured Epidemic Model”, To appear in *Nonlinear Analysis: Real World Applications*.
- V. A. Bokil and R. Glowinski, “A Distributed Lagrange Multiplier Based Fictitious Domain Method for Maxwell’s Equations”, To appear in *International Journal of Computational and Numerical Analysis and Applications*.
- H. T. Banks, V. A. Bokil, D. Cioranescu, N. L. Gibson, G. Griso, and B. Miara, “Homogenization of Periodically Varying Coefficients in Electromagnetic Materials”, To appear in *Journal of Scientific Computing*
- H. T. Banks, and V. A. Bokil, “A Computational and Statistical Framework for Multidimension Domain Acoustooptic Material Interrogation”, in *Quarterly of Applied Mathematics*, Volume LXIII, Number 1, March 2005, Pages 156-200
- V. A. Bokil and R. Glowinski, “An Operator Splitting Scheme with a Distributed Lagrange Multiplier Based Fictitious Domain Method for Wave Propagation Problems” in *Journal of Computational Physics*, 205, 242-268, 2005
- V. A. Bokil and R. Glowinski, “A fictitious domain method with operator splitting for wave problems in mixed form” in *Mathematical and numerical aspects of wave propagation—WAVES 2003*, 437–442, Springer, Berlin, 2003

Technical Reports:

- H. T. Banks, V. A. Bokil and S. Hu, “Monotone Approximation for a Nonlinear Size and Age Structured Epidemic Model”, Tech. Rep. CRSC-TR06-09, Center for Research in Scientific Computation, North Carolina State University, Jan, 2006.
- V. A. Bokil and R. Glowinski, “A Distributed Lagrange Multiplier Based Fictitious Domain Method for Maxwell’s Equations”, Tech. Rep. CRSC-TR06-04, Center for Research in Scientific Computation, North Carolina State University, Jan, 2006.
- H. T. Banks, V. A. Bokil, S. Hu, A. K. Dhar, R. A. Bullis, C. L. Browdy and F.C.T. Allnutt, “Modeling Shrimp Biomass and Viral Infection for Production of Biological Countermeasures”, Tech. Rep. CRSC-TR05-45, Center for Research in Scientific Computation, North Carolina State University, Dec, 2005
- G. M. Kepler, R. A. Albanese, H. T. Banks, and V. A. Bokil, “Reflection of Microwave pulses from acoustic waves: Summary of experimental and computational studies”, Tech. Rep. CRSC-TR05-23, Center for Research in Scientific Computation, North Carolina State University, May, 2005
- H. T. Banks, V. A. Bokil, D. Cioranescu, N. L. Gibson, G. Griso, and B. Miara, “Homogenization of Periodically Varying Coefficients in Electromagnetic Materials”, Tech. Rep. CRSC-TR05-05, Center for Research in Scientific Computation, North Carolina State University, January 2005
- H. T. Banks, and V. A. Bokil, “Parameter Identification for dispersive dielectrics using pulsed microwave interrogating signals and acoustic wave induced reflections in two and three dimensions” Tech. Rep. CRSC-TR04-27, July, 2004

Papers/Work in Progress:

- H. T. Banks, and V. A. Bokil, “A Theoretical Analysis of a Coupled Electromagnetic and Acoustooptic model in Dispersive Dielectrics using Energy Methods”
- H. T. Banks, V. A. Bokil and N. L. Gibson, “Comparison of Stability, Dispersion and Phase Error in Finite Element and Finite Difference Schemes for First and Second Order Dispersive Dielectrics”
- H. T. Banks, V. A. Bokil and S. Hu, “Weak Solutions and Semigroup Formulations for a Nonlinear Size and Class Age Structured Epidemic Model”
- V. A. Bokil and M. W. Buksas, “ Comparison of a Perfectly Matched Layer Formulation for Finite Difference and Finite Element Schemes”

Presentations:

Invited Presentations:

- The Third International Conference on Inverse Problems: Modeling and Simulation, Oludeniz, Turkey. “Inverse Problem Methodology for Complex Dielectric Materials”, *Inverse Problems Related to Scattering in Complex Structures Session*, organized by J. A. Burns and H. T. Banks, May 2006.
- 8th US National Congress on Computational Mechanics, Austin, TX, “A Fictitious Domain Method with Operator Splitting and Perfectly Matched Layers for Wave Propagation Problems”, *Domain Decomposition and Fictitious Domain Methods*, organized by I. Herrera and R. Glowinski, July 24-28, 2005
- Sixth SIAM Conference on Control and its Applications, New Orleans, LA, “Parameter Estimation for Electromagnetic Materials using Homogenization of Periodically Varying Coefficients”, *Inverse Problems in Electromagnetics and Biology Minisymposium*, organized by H. T. Banks and A. S. Ackleh, July 2005
- 29th Annual SIAM Southeast Atlantic Section Meeting, Charleston, SC, “Parameter Identification for Dispersive Dielectrics using Acoustooptic Material Interrogation”, *Inverse Problems in Electromagnetics and Biology Minisymposium*, organized by H. T. Banks and N. L. Gibson, March 2005
- SAMSI Multiscale Working Group Closing Workshop, RTP, NC, “Multiscale and Polarization in Dielectric Materials: An Homogenization Approach”, invited by R. C. Smith, September 2004
- Department of Mathematics, Indian Institute of Technology (IIT) Bombay, India, “A Computational and statistical framework for multidimensional domain acoustooptic interrogation”, invited by Dr. A. K. Pani, July 2004
- SIAM Annual meeting, San Diego, CA, “A 2-D Finite Element Formulation of the Uniaxial Perfectly Matched Layer” *Computational Methods for Use in Electromagnetic Interrogation*, organized by H. T. Banks and J. K. Raye, July 2001

Graduate Presentations:

- Center for Nonlinear Studies (CNLS) and DOE MICS, Los Alamos Summer Program in Applied Mathematics and Modeling, Los Alamos National Laboratory, Los Alamos, NM, “The Perfectly Matched Layer Technique for the Reflectionless Absorption of Electromagnetic Waves”, August 1999,
- Los Alamos Summer Program, LANL, “A 2D Finite Element Formulation of the Uniaxial Perfectly Matched Layer”, August 2000,

- Los Alamos Summer Program, LANL, “Mixed Finite Elements and Perfectly Matched Layers for Computational Electromagnetics”, August 2002

Computer Experience:

- Languages/Software
 - C/C++
 - Fortran 90
 - MPI
 - Matlab
 - Maple
 - Mathematica
 - HTML
- Operating Systems
 - Linux
 - Unix
 - Windows

Professional and Honorary Societies:

- Society for Industrial and Applied Mathematics
- Mathematical Association of America
- Association for Women in Mathematics

References:

- Prof. H. T. Banks* **htbanks@ncsu.edu**
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- Dr. J. M. Hyman **hyman@lanl.gov**
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* denotes teaching reference