

# RALPH C. SMITH

February 1, 2012

## Personal Information

Date of Birth - 10/14/60  
Citizenship - United States

## Education

Ph.D., Mathematics, Montana State University, 1990  
M.S., Mathematics, Montana State University, 1987  
A.B., Applied Mathematics, Harvard University, 1983

## Professional Experience

2000 - Present Associate Director, Center for Research in Scientific Computation (CRSC), North Carolina State University, Raleigh, NC.

2005 - 2008 Associate Director, Statistical and Applied Mathematical Sciences Institute (SAMSI)

2002 - Present Professor, Department of Mathematics, NC State Univ., Raleigh, NC.

2002 - 2004 Co-Director, Operations Research Program, NC State University, Raleigh, NC.

1993 - 2002 Scientific Consultant, Institute for Computer Applications in Science and Engineering (ICASE), Hampton, VA.

1998 - 2002 Associate Professor, Department of Mathematics, NC State Univ., Raleigh, NC.

1998 - 2000 Assistant Director, CRSC, North Carolina State University, Raleigh, NC.

1993 - 1997 Assistant Professor, Department of Mathematics, Iowa State Univ., Ames, IA.

1990 - 1993 Staff Scientist, Institute for Computer Applications in Science and Engineering (ICASE), Hampton VA.

## Awards and Honors

2003 The paper “Analytical and Experimental Issues in Ni-Mn-Ga Transducers” (see [44] in Proceedings Papers), presented by LeAnn Faidley, was awarded the *2nd Place Best Student Paper Award 2003* at the SPIE Symposium on Smart Structures and Materials, March 2003.

2002 The paper “Nonlinear Adaptive Parameter Estimation Algorithms for Hysteresis Models of Magnetostrictive Actuators” (see [35] in Proceedings Papers), presented by James Nealis, was awarded the *3rd Place Best Student Paper Award 2002* at the SPIE Symposium on Smart Structures and Materials, March 2002.

- 1999 The paper “A Coupled Structural-Magnetic Strain Model for Magnetostrictive Transducers” (see [20] in Proceedings Papers), presented by Marcelo Dapino, was awarded the *1999 Smart Structures and Materials Best Student Paper Award* at the SPIE Symposium on Smart Structures and Materials, March 1999.
- 1997 Recipient of the *Iowa State University Foundation Award for Early Achievement in Research*.
- 1996 The paper “The Modeling and Control of Acoustic/Structure Interaction Problems via Piezoceramic Actuators: 2-D Numerical Examples,” (see [6] in Journal Papers), was awarded the *1994/1995 Best-paper in Structures, Structural Dynamics, and Control*. Award sponsored by the Adaptive Structures and Material Systems Committee of the ASME Aerospace Division.
- 1994 Individual recipient of a *NASA Group Achievement Award* for “Development of important insights into basic fluid mechanical phenomena and theoretical analysis tools which have contributed to major advances in flow prediction and control including laminar flow control” as a member of the ICASE Fluid Mechanics Group, 1994.

### Research Interests

Mathematical modeling of smart materials, numerical analysis and numerical methods for physical systems, parameter estimation, control theory.

### Professional Memberships

Member of ASME, IEEE, MRS and SIAM.

### Undergraduate, Master’s and Ph.D. Committees

#### Praktikum Advisor

Konstanze Wulf – “Optimization Routines for Parameter Estimation in Structural Models,” Augsburg University, 1995.

#### Master’s Advisor

Ricardo del Rosario – “Numerical Approximation of Thin Shell Dynamics,” Master’s Oral 4/12/95, enrolled in a PhD program at North Carolina State University.

Wei Li – “Spline Approximation of a Thick Plate Model,” Master’s Oral 8/1/95, enrolled in a PhD program at the University of California, Berkeley.

Paul Spiker – “Model Development and Numerical Approximation of Acoustic Power Radiation from a Non-Uniform Composite Beam,” Master’s Oral 7/11/98.

William Turner – “Time-Discretization of Structural Problems,” Master’s Oral 4/12/96, enrolled in a PhD program at North Carolina State University.

Danny Kolepp – “Broadband, Narrowband and Hybrid Control Design for Structural Systems,” Master’s Oral 11/6/00, high school teacher in Raleigh, NC.

- Jessica Matthews – “Monte Carlo Simulation of Nafion Structure,” Master’s Oral 7/29/04, Constella Group, Durham, NC.
- Thomas Braun – “Model Development and Numerical Implementation Algorithms for Electric and Magnetic Transducers,” Master’s Oral 6/20/06, PhD Program, North Carolina State University, Raleigh, NC.
- Brendan O’Connor – “Model Development for a Cymbal Transducer,” Master’s Oral 6/21/06, MIT Lincoln Laboratory, Lexington, MA.
- Francesca Reale – “Stastical Emulator Construction for Nonlinear Smart Systems,” Master’s Oral 11/6/09, The Johns Hopkins University Applied Physics Laboratory, Laurel, MD.

### Master’s Committees

Campolattaro, Melissa	Math	2001	
Choung, George	Math	2000	
Clark, Jon	Nuclear Eng.	2004	
Finkel, Dan	Math	2000	
Frautschi, Jason	MAE	2003	
Hamrin, John	Math	1996	(Supported by AEEM)
Hamrin, Ramae	Math	1996	
Horton, Kirk	Math/OR	2000	
Lynch, Cameron	EE	2011	
Moore, Matt	AEEM	1997	
Nagarajan, Rajesh	OR	2002	
Peterson, Brock	Math	1997	
Spiker, Paul	Math	1998	(Supported by AEEM)
Tsuyama, Masataka	Ind. Eng.	1996	
Wiegandt, Ted	AEEM	1997	
Zhong, Jinghua	MAE	2003	
Zrostlik, Rick	AEEM	2000	

### Ph.D. Advisor

- Lucus Van Blaircum – Present
- Jessica Matthews – “Sensitivity Analysis and Development of a Model that Quantifies the Effect of Soil Moisture and Plant Age on Leaf Conductance,” PhD Defense 7/23/10. Employed as a postdoc at NOAA’s National Climatic Data Center (NCDC), Asheville, NC.
- Heather Wilson – “Model Development Nanotube-Infused Polyimides,” SMART Fellowship, PhD Defense 7/28/09. Employed as a computer scientist at the Naval Undersea Warfare Center, Newport, RI.
- Fan Xiang – “Model-Based Adaptive Control of Hysteresis in Smart Materials,” RA Support (AFOSR), PhD Defense 7/24/09.
- Ryan Siskind – “Model Development for Shape Memory Polymers,” RA Support (NSF-RTG), PhD Defense 7/22/08. Employed at Advertising.com.

- Jon Ernstberger – “High Speed Parameter Estimation for a Homogenized Energy Model,” RA Support (AFOSR), PhD Defense 6/23/08. Employed at LaGrange College, LaGrange, GA.
- Thomas Braun – “High Speed Model Implementation and Inversion Techniques for Smart Material Transducers,” GAANN Fellow, PhD Defense 8/1/07. Employed at National Geospatial-Intelligence Agency (NGA).
- Brian Ball – “Characterization of Stress Effects in Ferroelectrics with Application to Transducer Design,” RA Support (NASA, AFOSR, NSF), PhD Defense 8/15/06. Employed at General Electric.
- Andrew Hatch – “Model Development and Control Design for Atomic Force Microcopy,” RA Support (DARPA, NSF), PhD Defense 8/25/04. Employed at CNA Corporation, Alexandria, VA.
- Jordan Massad – “Macroscopic Models for Shape Memory Alloy Characterization and Design,” RA Support (NSF), PhD Defense 6/3/03. Employed at Sandia National Laboratory, Albuquerque, NM. University.
- James Nealis – “Model-Based Robust Control Designs for High Performance Magnetostrictive Transducers,” RA Support (AROSR), *3rd Place Best Student Paper Award 2002* at the SPIE Symposium on Smart Structures and Materials, PhD Defense 5/23/03. Employed at 454 Life Sciences, Branford, CT. University.

### **Ph.D. Committees**

Andjelkovic, Ivan	Math	Present
Barry, Edwin	Electrical Engineering	2009
Benedict, Brandy	Math	2008
Calkins, Frederick T.	AEEM	1997
Cole, Cammey	Math	2001
Dapino, Marcelo	AEEM	1999
Davis, Brian	MAE	Present
Deng, Shaozhong	Math	2000
Del Rosario, Ricardo	Math	1998
Drake, Kimberly	Math	2003
Englesone, Anna	OR	2006
Ghattas, Rony	ECE	2007
Gray, Scott	Math	2002
Hardy, Sarah	Statistics	1999
Hays, Scott	MAE	2012
Heller, Martin	Math	2009
Heintz, Olaf,	MAE	2005
Horton, Kirk,	Math/OR	2001
Horton, Michael	Math	2000
Kim, Eunjung	Math	2009
Kwon, Soon-Geol	Math	1996
Kyei, Yaw	Math	2004
Lai, Ruey-Gang	Math	1996
Lang, David	Math	Present
Li, Qifu	MAE	2006

**Ph.D. Committees – Continued**

Pausley, Matthew	MAE	Present
Slaughter, Julie	AEEM	1997
Stover, Tracy	NE	2011
Sweetingham, Kelly	Math	2009
Turner, Will	Math	2002
Zager, Michael	Math	2003
Zhang, Qin	Math	2009

**Post-Doc Advisor**

Emily Lada – Support (SAMSI, AFOSR), 2003-2004; Employed at SAS Institute, Inc., Cary, NC.

Billy Oates – Support (AFOSR), 2004-2006; Faculty member in Mechanical Engineering, Florida State University, Tallahassee, FL.

Jayasimha Atulasimha – Support (Etrema/ONR), 2007-2008; Faculty member in Mechanical Engineering, Virginia Commonwealth University, Richmond, VA.

Michael Stuebner – Support (NSF RTG), 2007-2010; Senior Scientist at Global Engineering and Materials, Inc., Princeton, NC.

Zhengzheng Hu – Support (NSF RTG), 2009-2012.

John Crews – Support (AFOSR), 2011-2012.

**Publications****Books**

1. H.T. Banks, R.C. Smith and Y. Wang, *Smart Material Structures: Modeling, Estimation and Control*, Masson/John Wiley, Paris/Chichester, 1996, 304 pages.
2. P.A. Gremaud, Z. Li, R.C. Smith and H.T. Tran, eds., *Industrial Mathematics: The 1998 CRSC Workshop*, SIAM, Philadelphia, 2000, 70 pages.
3. R.C. Smith and M.A. Demetriou (Editors), *Research Directions in Distributed Parameter Systems*, SIAM, Philadelphia, 2003, 271 pages.
4. R.C. Smith, *Smart Material Systems: Model Development*, SIAM, Philadelphia, 2005, 524 pages.

**Chapters in Books (Invited)**

1. H.T. Banks and R.C. Smith, “Models for Control in Smart Material Structures,” in *Identification and Control in Systems Governed by Partial Differential Equations*, SIAM, Philadelphia 1993, pp. 26-44.
2. H.T. Banks and R.C. Smith, “Active Control of Acoustic Pressure Fields Using Smart Material Technologies,” in *Flow Control*, Institute for Mathematics and Its Applications (IMA) Volume 68, Springer-Verlag, 1995, pp. 1-33.

3. H.T. Banks and R.C. Smith, "Numerical Techniques for Simulation, Parameter Estimation and Noise Control in Structural Acoustic Systems," in *Dynamics and Control of Distributed Systems*, Editors: H.S. Tzou and L.A. Bergman, Cambridge University Press, 1998, pp. 202-263.

### Papers (Refereed Journals)

1. R.C. Smith, G.A. Bogar, K.L. Bowers and J. Lund, "The Sinc-Galerkin Method for Fourth-Order Differential Equations," *SIAM Journal on Numerical Analysis*, 28(3), 1991, pp. 760-788.
2. R.C. Smith, K.L. Bowers and J. Lund, "A Fully Sinc-Galerkin Method for Euler-Bernoulli Beam Models," *Numerical Methods for Partial Differential Equations*, 8, 1992, pp. 171-202.
3. K.M. McArthur, R.C. Smith, K.L. Bowers and J. Lund, "The Sinc-Galerkin Method for Parameter Dependent Self-Adjoint Problems," *Applied Mathematics and Computation*, 50, 1992, pp. 175-202.
4. H.T. Banks, W. Fang, R.J. Silcox and R.C. Smith, "Approximation Methods for Control of Acoustic/Structure Models with Piezoceramic Actuators," *Journal of Intelligent Material Systems and Structures*, 4(1), 1993, pp. 98-116.
5. R.C. Smith and K.L. Bowers, "Sinc-Galerkin Estimation of Diffusivity in Parabolic Problems," *Inverse Problems*, 9(1), 1993, pp. 113-135.
6. H.T. Banks, R.J. Silcox and R.C. Smith, "The Modeling and Control of Acoustic/Structure Interaction Problems via Piezoceramic Actuators: 2-D Numerical Examples," *ASME Journal of Vibration and Acoustics*, 116(3), 1994, pp. 386-396.
7. H.T. Banks and R.C. Smith, "Feedback Control of Noise in a 2-D Nonlinear Structural Acoustics Model," *Discrete and Continuous Dynamical Systems*, 1(1), 1995, pp. 119-149.
8. H.T. Banks, R.C. Smith and Y. Wang, "The Modeling of Piezoceramic Patch Interactions with Shells, Plates and Beams," *Quarterly of Applied Mathematics*, 53(2), 1995, pp. 353-381.
9. H.T. Banks and R.C. Smith, "Well-Posedness of a Model for Structural Acoustic Coupling in a Cavity Enclosed by a Thin Cylindrical Shell," *Journal of Mathematical Analysis and Applications*, 191, 1995, pp. 1-25.
10. H.T. Banks and R.C. Smith, "Parameter Estimation in a Structural Acoustic System with Fully Nonlinear Coupling Conditions," *Mathematical and Computer Modelling*, 23(4), 1996, pp. 17-50.
11. H.T. Banks, M.A. Demetriou and R.C. Smith, "An  $H^\infty$ /MinMax Periodic Control in a 2-D Structural Acoustic Model with Piezoceramic Actuators," *IEEE Transactions on Automatic Control*, 41(7), 1996, pp. 943-959.
12. H.T. Banks, M.A. Demetriou and R.C. Smith, "Robustness Studies for  $H^\infty$  Feedback Control in a Structural Acoustic Model with Periodic Excitation," *International Journal of Robust and Nonlinear Control*, 6, 1996, pp. 453-478.
13. H.T. Banks, R.C. Smith and Y. Wang, "Inverse Problems in Smart Material Structures," *Journal of Inverse and Ill-Posed Problems*, 4(5), 1996, pp. 371-380.

14. H.T. Banks, R.C. Smith, D.E. Brown, V.L. Metcalf and R.J. Silcox, "The Estimation of Material and Patch Parameters in a PDE-Based Circular Plate Model," *Journal of Sound and Vibration*, 199(5), 1997, pp. 777-799.
15. R.C. Smith, K.L. Bowers and C.R. Vogel, "Numerical Recovery of Material Parameters in Euler-Bernoulli Beam Models," *Journal of Mathematical Systems, Estimation and Control*, 7(2), 1997, pp. 157-195.
16. R.C. Smith, "A Galerkin Method for Linear PDE Systems in Circular Geometries with Structural Acoustic Applications," *SIAM Journal on Scientific Computing*, 18(2), 1997, pp. 371-402.
17. H.T. Banks, R.C. Smith, D.E. Brown, R.J. Silcox and V.L. Metcalf, "Experimental Confirmation of a PDE-Based Approach to Design of Feedback Controls," *SIAM Journal on Control and Optimization*, 35(4), 1997, pp. 1263-1296.
18. R.C.H. del Rosario and R.C. Smith, "Spline Approximation of Thin Shell Dynamics," *International Journal for Numerical Methods in Engineering*, 40, 1997, pp. 2807-2840.
19. H.T. Banks, R.C. Smith and Y. Zhang, "Damage Detection as Inverse Problems for Distributed Parameter Systems: Computational Approaches," *International Journal of Applied Electromagnetics and Mechanics*, 8, 1997, pp. 61-76.
20. H.T. Banks, M.A. Demetriou and R.C. Smith, "Utilization of Coupling Effects in Compensator Design for Structural Acoustic Systems," *Journal of the Acoustical Society of America*, 103(2), 1998, pp. 872-887.
21. R.C. Smith, "Hysteresis Modeling in Magnetostrictive Materials Via Preisach Operators," *Journal of Mathematical Systems, Estimation and Control*, 8(2), 1998.
22. R.C.H. del Rosario and R.C. Smith, "LQR Control of Thin Shell Dynamics: Formulation and Numerical Implementation," *Journal of Intelligent Material Systems and Structures*, 9(4), 1998, pp. 301-320.
23. R.C. Smith, "A Nonlinear Optimal Control Method for Magnetostrictive Actuators," *Journal of Intelligent Material Systems and Structures*, 9(6), 1998, pp. 468-486.
24. R.C. Smith and C.L. Hom, "Domain Wall Theory for Ferroelectric Hysteresis," *Journal of Intelligent Material Systems and Structures*, 10(3), 1999, pp. 195-213.
25. F.T. Calkins, R.C. Smith and A.B. Flatau, "An Energy-Based Hysteresis Model for Magnetostrictive Transducers," *IEEE Transactions on Magnetics*, 36(2), 2000, pp. 429-439.
26. M.J. Dapino, R.C. Smith and A.B. Flatau, "A Structural-Magnetic Strain Model for Magnetostrictive Transducers," *IEEE Transactions on Magnetics*, 36(3), 2000, pp. 545-556.
27. H.T. Banks and R.C. Smith, "Hysteresis Modeling in Smart Material Systems," *Applied Mechanics and Engineering*, 5(1), 2000, pp. 31-45.
28. H.T. Banks, R.C.H. del Rosario and R.C. Smith, "Reduced Order Model Feedback Control Design: Numerical Implementation in a Thin Shell Model," *IEEE Transactions on Automatic Control*, 45(7), 2000, pp. 1312-1324.
29. J.C. Piquette and R.C. Smith, "Analysis and Comparison of Four Anhysteretic Polarization Models for Lead Magnesium Niobate (PMN)" *Journal of the Acoustical Society*, 108(4), 2000, pp. 1651-1662.

30. R.C. Smith and Z. Ounaies, "A Domain Wall Model for Hysteresis in Piezoelectric Materials," *Journal of Intelligent Material Systems and Structures*, 11(1), 2000, pp. 62-79.
31. M.J. Dapino, R.C. Smith, L.E. Faidley and A.B. Flatau, "A Coupled Structural-Magnetic Strain and Stress Model for Magnetostrictive Transducers," *Journal of Intelligent Material Systems and Structures*, 11(2), 2000, pp. 134-152.
32. S. Chandrasekaran, D.K. Lindner and R.C. Smith, "Optimized Design of Switching Amplifiers for Piezoelectric Actuators," *Journal of Intelligent Material Systems and Structures*, 11, 2000, pp. 887-901.
33. R.C. Smith, "Inverse Compensation for Hysteresis in Magnetostrictive Transducers," *Mathematical and Computer Modelling*, 33, 2001, pp. 285-298.
34. D.M. Bortz, A.D. Rubio, H.T. Banks, A.B. Cain and R.C. Smith, "Control of Open Bay Acoustics by Harmonic Mass Injection," *International Journal of Aeroacoustics*, 1(1), 2002, pp. 65-81.
35. M.J. Dapino, R.C. Smith, F.T. Calkins and A.B. Flatau, "A Magnetoelastic Model for Villari-Effect Magnetostrictive Sensors," *Journal of Intelligent Material Systems and Structures*, 13(11), 2002, pp. 737-748.
36. R.C. Smith, M.J. Dapino and S. Seelecke, "A Free Energy Model for Hysteresis in Magnetostrictive Transducers," *Journal of Applied Physics*, 93(1), 2003, pp. 458-466.
37. J.E. Massad and R.C. Smith, "A Domain Wall Model for Hysteresis in Ferroelastic Materials," *Journal of Intelligent Material Systems and Structures*, 14(7), 2003, pp. 455-471.
38. R.C. Smith, S. Seelecke, Z. Ounaies and J. Smith, "A Free Energy Model for Hysteresis in Ferroelectric Materials," *Journal of Intelligent Material Systems and Structures*, 14(11), 2003, pp. 719-739.
39. R.C. Smith and C.L. Hom, "A Temperature-Dependent Constitutive Model for Relaxor Ferroelectrics," *Journal of Intelligent Material Systems and Structures*, 16(5), pp. 433-448, 2005.
40. J.E. Massad and R.C. Smith, "A homogenized free energy model for hysteresis in thin-film shape memory alloys," *Thin Solid Films*, 489(1-2), pp. 266-290, 2005.
41. R.C. Smith and A.G. Hatch, "Parameter Estimation Techniques for a Class of Nonlinear Hysteresis Models," *Inverse Problems*, 21, pp. 1363-1377, 2005.
42. R.C. Smith, A.G. Hatch, B. Mukherjee and S. Liu, "A Homogenized Energy Model for Hysteresis in Ferroelectric Materials: General Density Formulation," *Journal of Intelligent Material Systems and Structures*, 16(9), pp. 713-732, 2005.
43. R.C. Smith, S. Seelecke, M.J. Dapino and Z. Ounaies, "A Unified Framework for Modeling Hysteresis in Ferroic Materials," *Journal of the Mechanics and Physics of Solids*, 54(1), pp. 46-85, 2005.
44. S. Seelecke, S-J. Kim, B. Ball and R.C. Smith, "A Rate-Dependent Two-Dimensional Free Energy Model for Ferroelectric Single Crystals," *Continuum Mechanics and Thermodynamics*, 17(4), pp.337-350, 2005.
45. L.M. Weiland, E.K. Lada, R.C. Smith and D.J. Leo, "Application of Rotational Isomeric State Theory to Ionic Polymer Stiffness Predictions," *Journal of Materials Research*, 20(9), pp. 2443-2455, 2005.

46. J.L. Matthews, E.K. Lada, L.M. Weiland, R.C. Smith and D.J. Leo, "Monte Carlo Simulation of a Solvated Ionic Polymer with Cluster Morphology," *Smart Materials and Structures*, 15, pp. 187–199, 2006.
47. T.R. Braun, R.C. Smith and M.J. Dapino, "Experimental Validation of a Homogenized Energy Model for Magnetic After-Effects," *Applied Physics Letters*, 88, pp. 122511- 122513, 2006.
48. R.C. Smith, M.J. Dapino, T.R. Braun and A.P. Mortensen, "A Homogenized Energy Framework for Ferromagnetic Hysteresis," *IEEE Transactions on Magnetics*, 42(7), pp. 1747-1769, 2006.
49. R.C. Smith and M.J. Dapino, "A Homogenized Energy Model for the Direct Magnetomechanical Effect," *IEEE Transactions on Magnetics*, 42(8), pp. 1944-1957, 2006.
50. T.R. Braun and R.C. Smith, "Efficient Implementation Algorithms for Homogenized Energy Models," *Continuum Mechanics and Thermodynamics*, 18(3-4), pp. 137-155, 2006.
51. B.L. Ball, R.C. Smith, S-J. Kim and S. Seelecke, "A Stress-Dependent Hysteresis Model for Ferroelectric Materials," *Journal of Intelligent Material Systems and Structures*, 18(1), pp. 69–88, 2007.
52. A.G. Hatch, R.C. Smith, T. De and M.V. Salapaka, "Construction and Experimental Implementation of a Model-Based Inverse Filter to Attenuate Hysteresis in Ferroelectric Transducers," *IEEE Transactions on Control Systems Technology*, 14(6), pp. 1058–1069, 2006.
53. J.M. Nealis and R.C. Smith, "Model-Based Robust Control Design for Magnetostrictive Transducers Operating in Hysteretic and Nonlinear Regimes," *IEEE Transactions on Control Systems Technology*, 15(1), pp. 22–39, 2007.
54. R.C. Smith, A.G. Hatch, T. De, M.V. Salapaka, R.C.H. del Rosario and J.K. Raye, "Model Development for Atomic Force Microscope Stage Mechanisms," *SIAM Journal on Applied Mathematics*, 66(6), pp. 1998-2026, 2006.
55. M. Lenczner and R.C. Smith, "A Two-Scale Model for an Array of AFM's Cantilever in the Static Case," *Mathematical and Computer Modeling*, 46, pp. 776–805, 2007.
56. M.A. Demetriou, K. Ito and R.C. Smith, "Adaptive Monitoring and Accommodation of Nonlinear Actuator Faults in Positive Real Infinite Dimensional Systems," *IEEE Transactions on Automatic Control*, 52(12), pp. 2332–2338, 2007.
57. W.S. Oates and R.C. Smith, "Nonlinear Optimal Control Techniques for Vibration Attenuation Using Magnetostrictive Actuators," *Journal of Intelligent Material Systems and Structures*, 19(2), pp. 193–209, 2008.
58. T.R. Braun and R.C. Smith, "High Speed Model Implementation and Inversion Techniques for Ferroelectric and Ferromagnetic Transducers," *Journal of Intelligent Material Systems and Structures*, 19(11), pp. 1295–1310, 2008.
59. W.S. Oates and R.C. Smith, "Optimal Tracking Using Magnetostrictive Transducers Operating in the Nonlinear and Hysteretic Regime," CRSC Technical Report CRSC-TR05-36; *Journal of Dynamic Systems, Measurement, and Control*, 131(3), 2009.
60. M.A. Demetriou, K. Ito and R.C. Smith, "Adaptive Techniques for the MRAC, Adaptive Parameter Identification, and On-Line Fault Monitoring and Accommodation for a Class of Positive Real Infinite Dimensional Systems," *International Journal of Adaptive Control and Signal Processing*, 23(2), pp. 193-215, 2009.

61. W.S. Oates, P.G. Evans, R.C. Smith and M.J. Dapino, “Experimental Implementation of a Hybrid Nonlinear Control Design for Magnetostrictive Actuators,” *Journal of Dynamic Systems, Measurement, and Control*, 131, 041004, 2009.
62. M. Stuebner, J. Atulasimha and R.C. Smith, “Quantification of Hysteresis and Nonlinear Effects on the Frequency Response of Ferroelectric and Ferromagnetic Materials,” *Smart Materials and Structures*, 18, 104019, 2009.
63. W.S. Oates, R. Zrostlik, S. Eichhorn and R.S. Smith, “A Nonlinear Optimal Control Design Using Narrowband Perturbation Feedback for Magnetostrictive Actuators,” *Journal of Intelligent Material Systems and Structures*, 21(16), pp. 1681–1693, 2010.
64. Z. Hu, R.C. Smith and J.M. Ernstberger, “Data-Driven Techniques to Estimate Parameters in a Rate-Dependent Ferromagnetic Hysteresis Model,” *Physica B: Physics of Condensed Matter*, to appear; online version: <http://dx.doi.org/10.1016/j.physb.2011.06.084>.

### Papers (Refereed Proceedings)

1. H.T. Banks, W. Fang and R.C. Smith, “Active Noise Control: Piezoceramic Actuators in Fluid/Structure Interaction Models,” Proc. 30th IEEE Conf. Dec. and Control, London, 1991.
2. H.T. Banks, H.C. Lester and R.C. Smith, “A Piezoelectric Actuator Model for Active Vibration and Noise Control in Thin Cylindrical Shells,” Proc. 31st IEEE Conf. Dec. and Control, Tucson, AZ, 1992, pp. 1797-1802.
3. H.T. Banks, D.E. Brown, V. Metcalf, R.J. Silcox, R.C. Smith and Y. Wang, “Noise Control in a 3-D Structural Acoustic System: Numerical and Experimental Implementation of a PDE-Based Methodology,” Proc. 33rd IEEE Conf. Dec. and Control, Orlando, FL, 1994, pp. 305-310.
4. H.T. Banks, M.A. Demetriou and R.C. Smith, “Adaptive Parameter Estimation in a 2-D Structural Acoustic Model with Piezoceramic Actuators,” Proc. Thirteenth ACC Conf., Baltimore, MD, 1994.
5. H.T. Banks, M.A. Demetriou and R.C. Smith, “ $H^\infty$  Control of Noise in a 3-D Structural Acoustic System,” Proc. 34th IEEE Conf. Dec. and Control, New Orleans, LA, 1995, pp. 3719-3724.
6. R.C. Smith, “A Nonlinear Model-Based Control Method for Magnetostrictive Actuators,” Proc. 36th IEEE Conf. Dec. and Control, San Diego, CA, 1997, pp. 3715-3720.
7. R.C.H. del Rosario and R.C. Smith, “LQR Control of Shell Vibrations via Piezoceramic Actuators,” *International Series of Numerical Mathematics*, Vol. 126, Birkhäuser, Basel, 1998, pp. 247-265.
8. S. Coorpender, D. Finkel, J. Kyzar, R. Sims, A. Smirnova, M. Tawhid, C. Bouton and R.C. Smith, “Modeling and Optimization Issues Concerning a Circular Piezoelectric Actuator Design,” Adaptive Structures and Materials Systems 1999, pp. 199-204, 1999.
9. R.C. Smith and Z. Ounaies, “A Hysteresis Model for Piezoceramic Materials,” CRSC Technical Report CRSC-TR99-21; Proceedings of the 1999 Winter Annual Meeting of the ASME.

10. R.C. Smith and R. Zrostlik, "Inverse Compensation for Ferromagnetic Hysteresis," Proc. 38th IEEE Conf. Dec. and Control, Phoenix, AZ, pp. 2875-2880, 1999.
11. A.B. Cain, A.D. Rubio, D.M. Bortz, H.T. Banks and R.C. Smith, "Optimizing Control of Open Bay Acoustics," Proceedings of the AIAA, AIAA-2000-1928, Maui, June 2000.
12. R.C. Smith and Z. Ounaies, "A Model for Asymmetric Hysteresis in Piezoceramic Materials," in *Materials for Smart Systems III*, Material Research Society Symposium Proceedings Volume 604, pp. 285-290, 2000.
13. R.C. Smith, C. Bouton and R. Zrostlik, "Partial and Full Inverse Compensation for Hysteresis in Smart Material Systems," Proceedings of the 2000 American Control Conference, Chicago, IL, June 28-30, pp 2750-2754, 2000.
14. D.J. Kolepp and R.C. Smith, "Narrowband Control Design for Smart Structural Systems," Proceedings of the 2001 ASME Design Engineering Technical Conferences and Computers and Information in Engineering Conference, Vol 6, Pt B, 2001.
15. R.C. Smith and J.E. Massad, "A Unified Methodology for Modeling Hysteresis in Ferroic Materials," Proceedings of the 2001 ASME Design Engineering Technical Conferences and Computers and Information in Engineering Conference, Vol 6, Pt B, pp. 1389-1398, 2001.
16. J.M. Nealis and R.C. Smith, "An Adaptive Control Method for Magnetostrictive Transducers with Hysteresis," Proc. 40th IEEE Conf. Dec. and Control, pp. 4260-4265, 2001.
17. R.C. Smith and Z. Ounaies, "Model Development for High Performance Piezoelectric Polymers," Material Research Society Symposium Proceedings Volume 698, pp. 217-222, 2002.
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Proceedings Papers (Not Refereed)

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71. Z. Hu and R.S. Smith, "A strain model for piezoelectric materials operating in highly hysteretic regimes," Proceedings of the ASME 2011 Conference on Smart materials, Adaptive Structures, and Intelligent Systems," submitted.

### Papers (Submitted)

1. J.M. Nealis and R.C. Smith, "Adaptive Parameter Estimation Techniques for Magnetic Transducers Operating in Hysteretic Regimes," CRSC Technical Report CRSC-TR04-36; *IEEE Transactions on Control Systems Technology*, submitted.
2. W.S. Oates and R.C. Smith, "Nonlinear Control Design for a Piezoelectric-Driven Nanopositioning Stage," CRSC Technical Report CRSC-TR05-43; *Automatica*, submitted.
3. T.R. Braun and R.C. Smith, "High Speed FPGA Model Implementation for Ferroelectric and Ferromagnetic Transducers Operating in Hysteretic Regimes," CRSC Technical Report CRSC-TR09-07; *Journal of Computational Physics*, submitted.
4. J.L. Matthews, E.L. Fiscus and R.C. Smith, "An empirical model quantifying the effect of soil moisture and plant development on soybean (*Glycine max* (L.) Merr.) leaf conductance. Part 1: Model formulation," *Journal of Experimental Botany*, submitted.
5. J.L. Matthews, E.L. Fiscus and R.C. Smith, "An empirical model quantifying the effect of soil moisture and plant development on soybean (*Glycine max* (L.) Merr.) leaf conductance. Part 2: Confidence interval estimation," *New Phytologist*, submitted.

### Technical Reports

1. H.T. Banks, R.C. Smith and Y. Wang, "Modeling Aspects for Piezoceramic Patch Activation of Shells, Plates and Beams," Center for Research in Scientific Computation Technical Report, CRSC-TR92-12, North Carolina State University, November 1992, 63 pages.
2. H.T. Banks and R.C. Smith, "The Modeling and Approximation of a Structural Acoustics Problem in a Hard-Walled Cylindrical Domain," Center for Research in Scientific Computation Technical Report, CRSC-TR94-26, North Carolina State University, December 1994, 79 pages.
3. H.T. Banks and R.C. Smith, "Implementation Issues Regarding PDE-Based Controllers – Control of Transient and Periodic Plate Vibrations," Center for Research in Scientific Computation Technical Report CRSC-TR95-16, North Carolina State University, April 1995, 64 pages.
4. R.C.H. del Rosario and R.C. Smith, "Spline Approximation of Thin Shell Dynamics – Numerical Examples," Center for Research in Scientific Computation Technical Report CRSC-TR96-5, North Carolina State University, February 1996, 61 pages.
5. P.A. Gremaud, Z. Li, R.C. Smith and H.T. Tran, "Industrial Mathematics Modeling Workshop for Graduate Students," Center for Research in Scientific Computation Technical Report CRSC-TR99-16, North Carolina State University, May 1999, 70 pages.
6. P.A. Gremaud, Z. Li, R.C. Smith and H.T. Tran, "Industrial Mathematics Modeling Workshop for Graduate Students," Center for Research in Scientific Computation Technical Report CRSC-TR00-19, North Carolina State University, July 2000, 66 pages.
7. P.A. Gremaud, Z. Li, R.C. Smith and H.T. Tran, "Industrial Mathematics Modeling Workshop for Graduate Students," Center for Research in Scientific Computation Technical Report CRSC-TR00-24, North Carolina State University, October 2000, 112 pages.

Videos

1. H.T. Banks, R.J. Silcox and R.C. Smith, "Feedback Control of Fluid/Structure Interactions: Active Noise Suppression," produced at NASA Langley Research Center, 1992.
2. H.T. Banks, R.J. Silcox and R.C. Smith, "Feedback Control of Nonlinear Fluid/Structure Interaction Models," produced at the North Carolina Supercomputing Center, 1992.

Grants**Grants Awarded**

- 1994-1997 Co-Principal Investigator (with H.T. Banks), NASA grant NAG-1-1600, "Computation of Feedback Gains and Compensators in a Noise Suppression Control System," \$160,758. Provided two months summer support per year and travel. It also provided two months summer support for Ricardo del Rosario in 1995.
- 1995-1998 Co-Principal Investigator (with H.T. Banks and K. Ito), AFOSR grant AFOSR-F49620-95-1-0236, "Modeling and Control in Distributed Parameter Physical Systems," \$238,245. Provided one month summer support per year.
- 1996 ISU Foreign Travel Grant, \$850. Provided travel expenses to Graz, Austria to present a paper at the "International Conference on Control and Estimation of Distributed Parameter Systems."
- 1996 ISU Miller Faculty Fellowship. Provided one semester course reduction to develop an integrated calculus/statics/physics sequence in collaboration with Frank Rizzo, AEEM.
- 1998-2000 Co-Principal Investigator (with H.T. Banks), AFOSR grant AFOSR-F49620-98-1-0180, "Modeling, Inverse Problems and Feedback Control for Distributed Dynamical Systems," \$247,243. Provided two months summer support and travel.
- 1998-1999 Co-Principal Investigator (with A.B. Flatau and M.J. Dapino), Etrema Products, Inc. (Ames, IA) and NSF cost share, "Low Frequency and Ultrasonic Magnetostrictive Motor Modeling," \$18,346.
- 1998-1999 Principal Investigator (with P. Gremaud, H. Tran, Z. Li), NSA grant "Industrial Mathematics Modeling Workshop for Graduate Students," \$30,000. Provided support for the 1999 workshop but no salary for the PI's.
- 2000-2001 Principal Investigator (with P. Gremaud, H. Tran, Z. Li), NSF grant "Industrial Mathematics Modeling Workshop for Graduate Students," \$40,000. Provided support for the 2000 workshop but no salary for the PI's.
- 2000-2001 Principal Investigator (with M. Demetriou), AFOSR, ARO and NSF grants, "Conference on Future Directions in Distributed Parameter Systems," AFOSR - \$22,600, ARO - \$4000, NSF - \$5000. Provided support for the conference facilities and food, travel and local support for the plenary speakers, students and junior faculty attending the conference, and expenses associated with publishing the plenary volume.
- 2000-2002 Principal Investigator, NASA grant NAG-1-01041, "Model Development for High Performance Piezoceramic-Based Actuators," \$61,885. Provided support for 1 graduate student and travel.

- 2001-2002 Principal Investigator (with P. Gremaud, H. Tran, Z. Li), NSF grant DMS-0098783 “Industrial Mathematics Modeling Workshop for Graduate Students,” \$36,500. Provided support for the 2001 workshop but no salary for the PI’s.
- 2001-2003 Principal Investigator, AFOSR grant AFOSR-F49620-01-1-0107, “Model-Based Compensator and Control Design for High Performance Nonlinear Transducers,” \$182,855. Provided support for 1 graduate student, two months summer support, and travel.
- 2001-2004 Principal Investigator (with D. Lindner, VPI), NSF Division of Civil and Mechanical Systems, CMS-0099764, “Control Design for Nonlinear Smart Actuators,” \$185,666. Provided student support and travel.
- 2002-2003 Principal Investigator (with P. Gremaud, H. Tran, Z. Li), NSF grant “Industrial Mathematics Modeling Workshop for Graduate Students,” \$40,000. Provided support for the 2002 workshop but no salary for the PI’s.
- 2002-2003 Co-Principal Investigator (with K. Holzer, UCLA), DARPA Mosaic Program, “Model Development and Control Design for an Atomic Force Microscope,” \$97,044. Provided student support, one month summer support and travel.
- 2002-2005 Co-Principal Investigator (with M. Salapaka, Iowa State University), NSF Division of Civil and Mechanical Systems, CMS-0201560, “Model Development and Control Design for Broadband Nanopositioners,” \$137,617, Provided student support, one month summer support and travel.
- 2004-2007 Principal Investigator, AFOSR Grant AFOSR FA9550-04-1-0203, “Model Development and Model-Based Control Design for High Performance Nonlinear Smart Systems,” \$379,653, Provided student support, post-doc support, summer support and travel.
- 2005-2007 Co-Principal Investigator (PI: James Berger, Duke), NSF–Subcontract to Duke University, “Statistical and Applied Mathematical Sciences Institute (SAMSI),” \$1,928,269. Provided operational expenses for SAMSI.
- 2006-2007 Principal Investigator, Etrema Products, Inc./ONR, “Magnetostrictive Transducer Development: Modeling, Nonlinear Control Design, and Experimental Implementation, \$26,009, Provided student support and travel.
- 2007-2008 Principal Investigator, Etrema Products, Inc./ONR, “Magnetostrictive Transducer Development: Modeling, Nonlinear Control Design, and Experimental Implementation, \$56,721, Provided postdoc support and travel.
- 2007-2112 Principal Investigator, NSF, DMS-0636590, “EMSW21-RTG Mathematics of Materials: Model Development, Analysis, Simulation and Control,” \$1,899,908. Provides support for 1-2 postdocs, 7-8 graduate students, and 5 undergraduates as well as travel and equipment.
- 2007-2008 Co-Principal Investigator (PI: James Berger, Duke), NSF–Subcontract to Duke University, “Statistical and Applied Mathematical Sciences Institute (SAMSI),” \$2,630,491. Provided operational expenses for SAMSI.
- 2008-2011 Principal Investigator, AFOSR Grant AFOSR FA9550-08-1-0348, “Model Development and Model-Based Control Design for Nonlinear Smart Composite Systems,” \$468,483, Provides student and postdoc support, summer support and travel.

- 2008-2011 Principal Investigator, AFOSR Grant AFOSR FA9550-11-10152 “Development of a Framework for Model-Based Analysis, Uncertainty Quantification, and Robust Control Design of Nonlinear Smart Composite Systems,” \$359,901, Provides student and postdoc support, summer support and travel.

### Conference Talks, Workshops, Colloquia and Plenary Lectures

(\* = support received from organizers)

#### Conference Talks

- 1988 “A Sinc-Galerkin Approximation to Fourth-Order Linear Ordinary Differential Equations,” Eleventh Annual Idaho State University Spring Conference, Pocatello, ID, April 27.
- “Efficient Numerical Solution of Fourth-Order Problems in the Modeling of Flexible Structures,” Bozeman Conference on Computation and Control, Bozeman, MT, August 2 (Invited).
- 1989 “A Sinc-Galerkin Method for Flexible Structures,” Minisymposium on Numerical Methods in Parameter Identification, SIAM Conference on Control in the 90’s, San Francisco, CA, May 18 (Invited).
- 1990 “A Fully Galerkin Method for the Recovery of Stiffness and Damping Parameters in Euler-Bernoulli Beam Models,” Second Bozeman Conference on Computation and Control, Bozeman, MT, August 2 (Invited).
- 1991 “A Sinc-Galerkin Method for the Recovery of Material Parameters in Euler-Bernoulli Beams,” Minisymposium on Sinc Procedures for Time-Dependent Problems in Mathematical Physics at ICIAM 91, Washington, D.C., July 10 (Invited).
- 1992 “Approximation Methods for Control of Acoustic/Structure Models with Piezoceramic Actuators,” Conference on Recent Advances in Adaptive and Sensory Materials and Their Applications, Virginia Polytechnic Institute and State University, Blacksburg, VA, April 29.
- \* “A Piezoelectric Actuator Model for Feedback Control of Noise in Thin Cylindrical Shells,” Third Bozeman Conference on Computation and Control, Bozeman, MT, August 6 (Invited).
- “Feedback Control of Nonlinear Fluid/Structure Interaction Models via Piezoceramic Actuators,” Minisymposium on Computational Control of Distributed Parameter Systems, SIAM Conference on Control and Its Applications, Minneapolis, MN, September 19 (Invited).
- “Modeling, Approximation and Feedback Control in a Structural Acoustics Problem,” Session on Control of Smart Structures, 31st IEEE Conference on Decision and Control, Tucson, AZ, December 17 (Invited).
- 1993 “Modeling of the Structural Acoustic Coupling Inside a Thin Cylindrical Shell,” Session on Computational Methods II, North American Conference on Smart Structures and Materials, Albuquerque, NM, February 1.

- “Modeling and Parameter Estimation Issues in Structural Acoustic Control Applications,” Second Conference on Recent Advances in Active Control of Sound and Vibration, Virginia Polytechnic Institute and State University, Blacksburg, VA, April 28.
- 1994 “A PDE-Based Methodology for Modeling, Parameter Estimation and Feedback Control in Structural and Structural Acoustic Systems,” Session on Structural Acoustics, 1994 North American Conference on Smart Structures and Materials, Orlando, FL, February 15.
- “Noise Control in a 3-D Structural Acoustic System,” Second International Conference on Intelligent Materials, Williamsburg, VA, June 8.
- “Parameter Estimation in a 3-D Structural Acoustic System,” 2nd IEEE Mediterranean Symposium on New Directions in Control and Automation, Maleme, Chania, Crete, June 21 (Invited).
- \* “Distributed Parameter Control Techniques for Structural Acoustic Systems – Numerical Issues,” Fourth Bozeman Conference on Computation and Control, Bozeman, MT, August 5 (Invited).
- “Noise Control in a 3-D Structural Acoustic System: Numerical and Experimental Implementation of a PDE-Based Methodology,” Session on Control of Fluid Dynamical Systems, 33rd IEEE Conference on Decision and Control, Orlando, FL, December 14 (Invited).
- 1995 “Distributed Parameter Control Techniques for Structural Acoustic Systems,” Minisymposium on Applications of PDE Control Methods, Third SIAM Conference on Control and Its Applications, St. Louis, MO, April 29 (Invited).
- “Parameter Estimation for an Imperfectly Clamped Plate – Numerical Examples,” Minisymposium on Parameter Estimation, 1995 ASME Design Engineering Technical Conferences, Boston, MA, September 18 (Invited).
- “PDE-Based Control of Structural Vibrations Using Piezoceramic Actuators,” Session on Smart Material Applications, 24<sup>th</sup> Midwestern Mechanics Conference, Ames, IA, October 3 (Invited).
- “PDE-Based Control of Vibration and Sound in Structural and Structural Acoustic Systems,” Session on Acoustics and Vibration, 1995 SIAM Annual Meeting, Charlotte, NC, October 26.
- “ $H^\infty$  Control of Noise in a 3-D Structural Acoustic System,” Minisymposium on Control and Identification of Hybrid Distributed Parameter Systems, 34th IEEE Conference on Decision and Control, New Orleans, LA, December 15 (Invited).
- 1996 \* “PDE-Based Compensators for Structural Acoustic Systems,” 1996 AMS-IMS-SIAM Summer Research Conferences in the Mathematical Sciences, Session on Optimization Methods in Partial Differential Equations, Mount Holyoke College, South Hadley, MA, June 18 (Invited).
- \* “PDE-Based Controllers for Structural and Structural Acoustic Systems,” International Conference on Control and Estimation of Distributed Parameter Systems, Vornau, Austria, July 16 (Invited).

- “PDE-Based Compensator Design for Structural Acoustic Systems,” Minisymposium on Identification and Control in Distributed Parameter Systems, 1996 SIAM Annual Meeting, Kansas City, MO, July 22.
- \* “The Modeling of Magnetostrictive Transducers,” Fifth Bozeman Conference on Computation and Control, Bozeman, MT, July 31 (Invited).
- 1997 “Modeling Aspects Concerning Magnetostrictive Transducers,” SPIE’s Fourth Annual Symposium on Smart Structures and Materials, San Diego, CA, March 3.
- “Modeling Hysteresis and Material Nonlinearities in Magnetostrictive Transducers,” Minisymposium on Mathematical Issues in Smart or Active Material Structures and Devices, Second SIAM Conference on Mathematical Aspects of Materials Science, Philadelphia, PA, May 12 (Invited).
- \* “Modeling and Control Issues Concerning Magnetostrictive Actuators,” Conference on Control and Partial Differential Equations, CIRM, Marseille-Luminy, France, June 20 (Invited).
- “Identification and Control Issues Concerning Magnetostrictive Materials,” Minisymposium on Implementation Issues Concerning Control and Identification in Distributed Parameter Systems, SIAM’s 45th Anniversary and Annual Meeting, Palo Alto, CA, July 14.
- “Hysteresis Modeling for Magnetostrictive Materials,” Session on Stability and Stabilization, 18th IFIP Conference on System Modelling and Optimization, Detroit, MI, July 24 (Invited).
- “LQR Control of Shell Vibrations via Piezoceramic Actuators,” Session on Shape Optimization and Control of Elastic Systems, 18th IFIP Conference on System Modelling and Optimization, Detroit, MI, July 25 (Invited).
- “Experimental Confirmation of a PDE-Based Approach to Feedback Design,” Session on Distributed Parameter Systems III, 36th IEEE Conference on Decision and Control, San Diego, CA, December 11 (Invited).
- “A Nonlinear Model-Based Control Method for Magnetostrictive Actuators,” Session on Modeling for Identification and Control of Controllable Material Structures, 36th IEEE Conference on Decision and Control, San Diego, CA, December 12 (Invited).
- 1998 “An Active and Structural Strain Model for Magnetostrictive Transducers,” SPIE’s Fifth Annual Symposium on Smart Structures and Materials, San Diego, CA, March 3.
- “Modeling and Control Issues Concerning Nonlinear Transducers,” Session on Implementation Issues Concerning Identification and Control in Distributed Parameter Systems, Fourth SIAM Conference on Control and its Applications, Jacksonville, FL, May 9 (Invited).
- \* “Modeling and Control Issues Concerning Nonlinear Smart Material Transducers,” Computation and Control VI, Bozeman, MT, August 7 (Invited).
- 1999 “A Domain Wall Model for Ferroelectric Hysteresis,” SPIE’s Sixth Annual Symposium on Smart Structures and Materials, Newport Beach, CA, March 1.

“Modeling Aspects Concerning THUNDER Actuators,” SPIE’s Sixth Annual Symposium on Smart Structures and Materials, Newport Beach, CA, March 4.

- \* “Modeling and Control Issues Concerning Magnetostrictive Actuators,” Eighteenth Annual Conference on Properties and Applications of Magnetic Materials, Illinois Institute of Technology, Chicago, IL, April 28 (Invited).

“Modeling and Control Issues Concerning Smart Materials with Hysteresis,” Minisymposium on Control Problems for Nonlinear Partial Differential Equations, 20th Annual Meeting of the Canadian Applied and Industrial Mathematics Society, Université Laval, Québec, Canada, June 12 (Invited).

- \* “Modeling and Control Issues Concerning Smart Materials with Hysteresis,” NSF-CBMS Workshop on Control of Distributed Parameter Systems, University of Nebraska, Lincoln NE, August 10 (Invited).

“Modeling and Control Issues Concerning Smart Materials,” Session on Engineering Acoustics: Transducer Loss Mechanisms, 138th Meeting of the Acoustical Society of America, Columbus, OH, November 1 (Invited).

“Modeling and Control Issues Concerning Smart Materials with Hysteresis,” Adaptive Structures and Material Systems Symposium, 1999 ASME International Mechanical Engineering Congress and Exposition, Nashville, TN, November 17.

“Modeling Aspects Concerning THUNDER Actuators,” Adaptive Structures and Material Systems Symposium, 1999 ASME International Mechanical Engineering Congress and Exposition, Nashville, TN, November 18.

“Modeling and Optimization Issues Concerning a Circular Piezoelectric Actuator Design,” Adaptive Structures and Material Systems Symposium, 1999 ASME International Mechanical Engineering Congress and Exposition, Nashville, TN, November 18.

“Modeling and Control Issues Concerning Smart Materials with Hysteresis,” Smart Materials Symposium, Fall Meeting of the Materials Research Society, Boston, MA, December 2.

“Inverse Compensation for Hysteresis in Piezoceramic, Electrostrictive and Magnetostrictive Materials,” Session on Control of Distributed Parameter Systems: New Approaches and Applications, 38th IEEE Conference on Decision and Control, Phoenix, AZ, December 9 (Invited).

- 2000 “A Domain Wall Model for Hysteresis in Piezoelectric Materials,” SPIE’s Seventh Annual Symposium on Smart Structures and Materials, Newport Beach, CA, March 7.

“Control Strategies for Smart Material Systems with Hysteresis,” SPIE’s Seventh Annual Symposium on Smart Structures and Materials, Newport Beach, CA, March 7.

“A Temperature-Dependent Constitutive Model for Relaxor Ferroelectrics,” SPIE’s Seventh Annual Symposium on Smart Structures and Materials, Newport Beach, CA, March 8.

“Development and Validation of a Hysteresis Model for Piezoelectric Actuators,” Session on Analytic and Experimental Characterization of Piezoelectric Materials, Third SIAM Conference on Mathematical Aspects of Materials Science, Philadelphia, PA, May 23 (Invited).

“Partial and Full Inverse Compensation for Hysteresis in Smart Material Systems,” Session on Control of Distributed Parameter Systems, 2000 American Control Conference, Chicago, IL, June 29 (Invited).

“Hysteresis Modeling for an Atomic Force Microscope,” Computation and Control VII, Bozeman, MT, August 4 (Invited).

2001 “A Unified Model for Hysteresis in Ferroic Materials,” SPIE’s Eighth Annual Symposium on Smart Structures and Materials, Newport Beach, CA, March 5 (Invited).

“A Displacement Model for THUNDER Actuators Having General Loads and Boundary Conditions,” SPIE’s Eighth Annual Symposium on Smart Structures and Materials, Newport Beach, CA, March 6.

“A Frequency-Dependent Model for Relaxor Ferroelectrics,” SPIE’s Eighth Annual Symposium on Smart Structures and Materials, Newport Beach, CA, March 7.

“Compensation for Hysteresis in Smart Material Systems,” SPIE’s Eighth Annual Symposium on Smart Structures and Materials, Newport Beach, CA, March 8.

\* “The Modeling and Control of Hysteresis and Nonlinear Dynamics in an Atomic Force Microscope,” 8th Conference on Control of Distributed Parameter Systems,” Graz, Austria, July 19 (Invited).

“Modeling of Hybrid Piezoelectric/Magnetostrictive Transducers,” 2001 ASME Design Engineering Technical Conferences, Pittsburgh, PA, September 10.

“A Unified Model for Hysteresis in Ferroic Materials,” 2001 ASME Design Engineering Technical Conferences, Pittsburgh, PA, September 10.

“Narrowband Control Design for Smart Structural Systems,” 2001 ASME Design Engineering Technical Conferences, Pittsburgh, PA, September 10.

“Model Development for High-Performance Piezoelectric Polymers,” Symposium on Electroactive Polymers and their Applications as Actuators, Sensors and Artificial Muscles, Fall Meeting of the Materials Research Society, Boston, MA, November 27.

“Adaptive Estimation and Control Design for Smart Systems with Hysteresis,” 40th IEEE Conference on Decision and Control, Orlando, FL, December 7.

2002 “A Free Energy Model for Hysteresis in Piezoceramic Materials,” SPIE’s 9th Annual Symposium on Smart Structures and Materials, San Diego, CA, March 18.

“An Energy Formulation for Preisach Models,” SPIE’s 9th Annual Symposium on Smart Structures and Materials, San Diego, CA, March 18.

“Model Development and Control Design for Atomic Force Microscopy,” SPIE’s 9th Annual Symposium on Smart Structures and Materials, San Diego, CA, March 19.

“Model Development for Piezoelectric Polymer Unimorphs,” SPIE’s 9th Annual Symposium on Smart Structures and Materials, San Diego, CA, March 20.

“A Free-Energy Model for Hysteresis in Ferroelectric and Ferromagnetic Materials,” Symposium on Continuum Mechanics and Thermodynamics, 14th US National Congress of Theoretical and Applied Mechanics, Blacksburg, VA, June 28 (Invited).

“Modeling and Control Issues Associated with Atomic Force Microscopy,” Fifteenth International Symposium on Mathematical Theory of Networks and Systems, South Bend, IN, August 16 (Invited).

“Model Development and Control Design for High Performance Nonlinear Smart Material Systems,” Symposium on New Trends in Nonlinear Dynamics and Control, and Their Applications, Naval Postgraduate School, Monterey, CA, October 19.

“Model Development and Control Design for High Speed Nanopositioning,” 41st IEEE Conference on Decision and Control, Las Vegas, NV, December 13.

2003 “A Unified Model for Hysteresis in Ferroic Materials,” SPIE’s 10th Annual Symposium on Smart Structures and Materials, San Diego, CA, March 3.

“A Fully Coupled Free Energy Model for Hysteresis in Magnetostrictive Transducers,” SPIE’s 10th Annual Symposium on Smart Structures and Materials, San Diego, CA, March 3.

“Design of a Membrane Aperture Deployable Structure,” 44th AIAA/ASME/ASCE/AHS Structures, Structural Dynamics and Materials Conference, Norfolk, VA, April 7.

“A Free Energy-Based Model for Hysteresis and Nonlinearities in Piezoceramic Materials,” 105th Annual Meeting and Exposition of the American Ceramic Society, Symposium on High Strain Piezoelectric Materials, Devices and Applications, Nashville, TN, May 30 (Invited).

“A Unified Model for Hysteresis in Ferroic Materials,” Fifth International Conference on Intelligent Materials, The Pennsylvania State University, State College, PA, June 15.

“Modeling and Control Issues Arising in the Quest for Single Electron Spin Detection,” Computational Control and Biological Systems VIII, Bozeman, MT, July 31 (Invited).

“Control Design for Nonlinear Smart Transducers,” 42nd IEEE Conference on Decision and Control, Maui, HA, December 10.

“Model Development for Piezoceramic Nanopositioners,” 42nd IEEE Conference on Decision and Control, Maui, HA, December 10 (Invited).

2004 “Parameter Estimation Techniques for Nonlinear Hysteresis Models,” SPIE’s 11th Annual Symposium on Smart Structures and Materials, San Diego, CA, March 16.

“Electrostatic Operation and Curvature Modeling for a MEMS Flexible Film Actuator,” SPIE’s 11th Annual Symposium on Smart Structures and Materials, San Diego, CA, March 16.

“Model Development and Control Design for High Performance Systems,” World Congress of Nonlinear Analysts, Orlando, FL, July 2.

“Multiscale Models for Smart Material Transducers,” SIAM Annual Meeting, Portland, OR, July 14.

“Experimental Implementation of a Model-Based Inverse Filter to Attenuate Hysteresis in an Atomic Force Microscope,” 43rd IEEE Conference on Decision and Control, Paradise Island, The Bahamas, December 16.

- 2005 “Application of Monte Carlo Simulations to the Prediction of the Effective Elastic Moduli of Hydrated Nafion,” SPIE’s 12th Annual Symposium on Smart Structures and Materials, San Diego, CA, March 9.
- “Application of Monte Carlo Simulations to the Prediction of Effective Elastic Moduli of Hydrated Ionic Polymers,” Minisymposium on Nonlinear Smart Material Control Systems, Sixth SIAM Conference on Control and Its Applications, New Orleans, LA, July 13 (Invited).
- “A Stress-Dependent Hysteresis Model for Ferromagnetic Transducer Materials,” ASME International Mechanical Engineering Congress and Exposition, Orlando, FL, November 9.
- 2006 “A Reptation Model for Magnetic Materials,” SPIE’s 13th Annual Symposium on Smart Structures and Materials, San Diego, CA, February 28.
- “Nonlinear Perturbation Control for Magnetic Transducers,” 45th IEEE Conference on Decision and Control, San Diego, CA, December 14.
- 2007 “Perturbation Control Techniques for Magnetic Transducers,” Minisymposium on Nonlinear Smart Material Systems, SIAM Conference on Control and Its Applications, San Francisco, CA, June 29 (Invited).
- “Model Development for Shape Memory Polymers,” 44th Annual Technical Meeting, Society of Engineering Science, College Station, TX, October 23.
- “High Speed Model Implementation for Real-Time Control of Ferroelectric and Ferromagnetic Transducers Operating in Nonlinear and Hysteretic Regimes,” 46th IEEE Conference on Decision and Control, New Orleans, LA, December 12 (Invited).
- 2008 “An Energy Derivation for Classical and Extended Preisach Models,” Minisymposium on Nonlinear Smart Material Systems, SIAM Conference on Mathematical Aspects of Materials Science, Philadelphia, PA, May 14 (Invited).
- “An Energy Formulation for Preisach Models with Applications to Structural Models,” Eighteenth International Symposium on Mathematical Theory of Networks and Systems (MTNS2008), Blacksburg, VA, July 29 (Invited).
- 2009 “Efficient Algorithms for Implementation of Hysteresis Models,” SPIE’s 16th Symposium on Smart Structures and Materials, San Diego, CA, March 9.
- “Adaptive Control Design for Hysteretic Systems Modeled by the Homogenized Energy Framework,” Minisymposium on Model Development and Control Design for Hysteretic Systems, SIAM Conference on Control and Its Applications, Denver, CO, July 7 (Invited).
- 2010 “Adaptive Nonlinear Control Design for Hysteretic Smart Systems,” SPIE’s 17th Symposium on Smart Structures and Materials, San Diego, CA, March 8.
- 2011 “Data-Driven Techniques to Estimate Parameters in Rate-Dependent Hysteresis Models,” International Symposium on Hysteresis Modelling and Micromagnetics (HMM 2011), Levico, Italy, May 11.
- “Model Development, Uncertainty Quantification, and Control Design for Nonlinear Smart Material systems,” SIAM Conference on Control and Its Applications, Baltimore MD, July 25 (Invited).

Invited Workshop Talks

- 1992 “Feedback Control of Noise in Structural Acoustics Models via Piezoceramic Actuators,” NASA Langley Research Center Workshop on Adaptive/Intelligent/Smart Materials & Structures, Hampton, VA, October 26.
- 1995 “PDE-Based Control of Noise and Vibration in Structural Acoustic Systems,” NASA Interior Noise Workshop, NASA Langley Research Center, Hampton, VA, April 27.
- 1996 “Galerkin Methods for Constructing PDE-Based Controllers,” Second International ISU Workshop on Numerics for Dynamical Systems,” Iowa State University, Ames, IA, April 15.
- “Model-Based Compensator Design for Structural Acoustic Systems,” NASA Interior Noise Workshop, NASA Langley Research Center, Hampton, VA, September 11.
- “Model-Based Controllers for Structural Acoustic Systems,” ICASE/LaRC Second Industry Roundtable, Session on Structural Acoustics, Williamsburg, VA, October 9.
- 1997 “Active Control of Noise,” 1997 AFOSR Workshop on Dynamics and Control, Wright-Patterson AFB, OH, May 22.
- 1998 “Reduced Order Control Design for High Order Systems,” NASA Interior Noise Workshop, Hampton, VA, February 22.
- “Strain Modeling for Magnetostrictive Transducers,” 1998 ONR Transducer Materials and Transducers Workshop, Penn State University, State College, PA, May 13.
- “Reduced Order Control Design for High Order Systems,” 1998 AFOSR Workshop on Dynamics and Control, Pasadena, CA, May 28.
- 1999 “A Domain Wall Model for Ferroelectric Hysteresis,” 1999 U.S. Navy Workshop on Acoustic Transduction Materials and Devices, Penn State University, State College, PA, April 14.
- “Modeling and Control Issues Concerning Smart Materials with Hysteresis,” Fourth ARO Workshop on Smart Structures, Penn State University, State College, PA, August 16.
- 2000 “A Magnetoelastic Model for Magnetostrictive Sensors,” 2000 U.S. Navy Workshop on Acoustic Transduction Materials and Devices, Penn State University, State College, PA, April 12.
- “A Domain Wall Model for Hysteresis in Piezoelectric Materials,” 2000 U.S. Navy Workshop on Acoustic Transduction Materials and Devices, Penn State University, State College, PA, April 13.
- “A Domain Wall Model for Hysteresis in Ferroic Materials,” Twelfth International Workshop on Hysteresis, Metastability and Aftereffect, University of Illinois at Chicago, IL, August 30.
- 2001 “Control Design for High Performance Nonlinear Smart Transducers,” 2001 AFOSR Workshop on Dynamics and Control, Wright-Patterson AFB, OH, July 31.
- 2002 “A Free-Energy Model for Hysteresis in Ferroelectric and Ferromagnetic Materials,” 2002 U.S. Navy Workshop on Acoustic Transduction Materials and Devices, Baltimore, MD, May 14.

- \* “Modeling and Control Challenges for High Performance Materials in Aerospace and Aeronautic Applications,” Symposium in Honor of ICASE’s 30th Anniversary, Newport News, VA, July 25.  
“Control Design for High Performance Nonlinear Smart Transducers,” 2002 AFOSR Workshop on Dynamics and Control, Pasadena, CA, August 13.
- 2003 “Control Design for Nonlinear Smart Transducers,” 2003 AFOSR Workshop on Dynamics and Control, Destin, FL, September 9.
- 2004 \* “Model Development, Numerical Approximation and Control Design for Nonlinear Smart Material Systems,” Conference on Emerging Methodologies and Applications in Numerical PDE’s, Florida State University, Tallahassee, FL, March 9.  
“Control Design for High Performance Nonlinear Smart Transducers (Poster),” 2004 AFOSR Workshop on Dynamics and Control, Pasadena, CA, August 13.
- 2005 “Multiscale Model Development for Smart Materials,” SAMSI Undergraduate Workshop, Research Triangle Park, NC, February 19.  
“A Unified Model for Hysteresis in Ferroic Materials,” 2005 U.S. Navy Workshop on Acoustic Transduction Materials and Devices, Penn State University, State College, PA, May 12.
- \* “Model Development and Nonlinear Optimal Control Design for Nonlinear Smart Material Systems,” International Workshop on Control of Infinite-Dimensional Systems, University of Waterloo, Waterloo, Ontario, July 29.  
“Model Development and Model-Based Control Design for High Performance Nonlinear Smart Systems,” 2005 AFOSR Joint Program Review, Long Beach, CA, September 2.
- \* “Multiscale Model Development for Ionic Polymers,” ICAM Workshop on Mathematics as an Enabling Science, Blacksburg, VA, October 1.
- 2006 \* “Model Development, Numerical Approximation and Control Design for High Performance Nonlinear Smart Material Systems,” CSRI Workshop on Numerical PDEs in the 21st Century, Albuquerque, NM, April 21.  
“Model Development and Model-Based Control Design for High Performance Nonlinear Smart Systems,” 2006 AFOSR Joint Program Review, Atlanta, GA, August 11.  
“Piezoelectric Hysteresis Software,” ICAT 47th International Smart Actuator Symposium, Penn State University, State College, PA, October 4.
- 2007 “High Speed Implementation of Ferroic Hysteresis Models,” 2007 U.S. Navy Workshop on Acoustic Transduction Materials and Devices, Penn State University, State College, PA, May 15.  
“Model Development and Model-Based Control Design for High Performance Nonlinear Smart Systems,” 2007 AFOSR Joint Program Review, Long Beach, CA, August 9.  
“FPGA-Based Model Implementation for Real-Time Control of Smart Material Systems Operating in Hysteretic Regimes,” CANSMART 2007, Montreal, Quebec, Canada, October 10.

- 2008 “Model Development and Model-Based Control Design for Nonlinear Smart Composite Systems,” 2008 AFOSR Joint Program Review, Washington, DC, August 5.
- 2009 “Efficient Algorithms for Implementation and Identification of Hysteresis Models,” 2009 U.S. Navy Workshop on Acoustic Transduction Materials and Devices, Penn State University, State College, PA, May 13.
- “Model Development and Model-Based Control Design for Nonlinear Smart Composite Systems,” 2009 AFOSR Joint Program Review, Washington, DC, July 15.
- 2010 “Model Development and Model-Based Control Design for Nonlinear Smart Composite Systems,” 2010 AFOSR Joint Program Review, Washington, DC, August 9.
- 2011 “Model Development and Model-Based Control Design for Nonlinear Smart Composite Systems,” 2011 AFOSR Joint Program Review, Washington, DC, June 15.
- “Model Development, Uncertainty Quantification, and Control Design for Nonlinear Smart Material systems,” 7th Workshop on Control of Distributed Parameter Systems (CDPS 2011), Wuppertal, Germany, July 20.

### Colloquia and Seminars

- 1991 \* “A Fully Sinc-Galerkin Method for Parameter Recovery in Parabolic Problems,” Numerical Analysis Seminar, North Carolina State University, Raleigh, NC, April 22.
- \* “Active Noise Control in Acoustic/Structure Interaction Models via Piezoceramic Actuators,” Numerical Analysis Seminar, North Carolina State University, Raleigh, NC, September 17.
- 1992 \* “Active Noise Suppression in Acoustic/Structure Interaction Models: Feedback Control via Piezoceramic Actuators,” Interdisciplinary Center for Applied Mathematics Seminar, Virginia Polytechnic Institute and State University, Blacksburg, VA, March 30.
- “Active Noise Suppression in Acoustic/Structure Interaction Models: Feedback Control via Piezoceramic Actuators,” ICASE Colloquium, Hampton, VA, May 5.
- 1993 “Parameter Estimation and Noise Control in a Structural Acoustic System,” Mathematics Colloquium, Iowa State University, Ames, IA, October 12.
- 1994 \* “Parameter Estimation and Noise Control in Structural Acoustic Systems,” Mathematics Colloquium, Institut Für Mathematik, Karl-Franzens-Universität Graz, Graz, Austria, June 17.
- 1996 “PDE-Based Controllers for Coupled Systems,” Control Systems Seminar, Department of Electrical Engineering, Iowa State University, Ames, IA, February 16.
- “Smart Material Actuators and Sensors,” Control Systems Seminar, Department of Electrical Engineering, Iowa State University, Ames, IA, April 12.
- “Preisach Modeling of Hysteresis in Magnetostrictive Materials,” Mathematics Colloquium, Iowa State University, Ames, IA, December 3.
- 1997 \* “Smart Material Controllers for Structural Systems,” Colloquium, Department of Mathematics, University of Wisconsin - La Crosse, La Crosse, WI, April 4.

- \* “Modeling and Design Issues for Smart Material Controllers,” Colloquium, Department of Computational and Applied Mathematics, Rice University, Houston, TX, April 14.
- \* “Modeling and Control Issues Concerning Magnetostrictive Materials,” Colloquium, Department of Mathematics, University of Arkansas, Fayetteville, AR, October 17.
- 1998 \* “Nonlinear Control Issues Concerning Smart Material Systems,” Colloquium, Department of Mathematics, University of Southern California, Los Angeles, CA, March 5.
- \* “Modeling and Control Issues Concerning Nonlinear Smart Material Actuators,” Colloquium, Electrical and Computer Engineering Department, University of California, Santa Barbara, Santa Barbara, CA, March 6.
- \* “Modeling and Control Issues Concerning Nonlinear Smart Material Actuators,” Colloquium, Department of Mathematics, Virginia Polytechnic Institute and State University, Blacksburg, VA, October 23.
- 1999 \* “Modeling and Control Issues Concerning Smart Materials with Hysteresis,” Colloquium, Department of Applied Mechanics & Engineering Sciences, University of California, San Diego, San Diego, CA, March 5.
- \* “Modeling and Control Issues Concerning Smart Materials with Hysteresis,” Colloquium, Department of Electrical Engineering & Institute for Systems Research, University of Maryland, College Park, MD, March 15.
- “Modeling and Control Issues Concerning Smart Materials with Hysteresis,” Colloquium, Bradley Department of Electrical and Computer Engineering, Virginia Polytechnic Institute and State University, Blacksburg, VA, September 20.
- 2000 \* “Modeling and Control Issues Concerning Smart Materials with Hysteresis,” Colloquium, Department of Electrical Engineering, Iowa State University, Ames, IA, May 12.
- \* “The Modeling and Control of Hysteresis and Nonlinear Dynamics in an Atomic Force Microscope,” Colloquium, Department of Mathematical Sciences, Clemson University, Clemson, SC, September 22.
- “The Modeling and Control of Hysteresis and Nonlinear Dynamics in an Atomic Force Microscope,” Colloquium, Department of Mathematics, University of Massachusetts-Dartmouth, Dartmouth, MA, October 13.
- 2001 \* “The Modeling and Control of Hysteresis and Nonlinear Dynamics in an Atomic Force Microscope,” Colloquium, Department of Mathematics, Texas Tech University, Lubbock, TX, February 15.
- “Modeling and Control of Hysteresis and Nonlinear Dynamics in an Atomic Force Microscope,” Colloquium, Department of Electrical Engineering, Iowa State University, April 13.
- \* “Modeling and Control Issues Associated with Atomic Force Microscopy,” Colloquium, Division of Applied Mathematics, Brown University, Providence, RI, September 28.
- \* “Modeling and Control Issues Associated with Atomic Force Microscopy,” Colloquium, Department of Mathematics, Michigan State University, East Lansing, MI, November 8.

- 2002 \* “Modeling and Control Issues Associated with Atomic Force Microscopy,” Colloquium, Department of Mechanical Engineering, Ohio State University, Columbus, OH, January 18.
- “Model Development and Control Design for High Performance Nonlinear Smart Material Systems,” Colloquium, Sandia National Laboratories, Albuquerque, NM, January 29.
- \* “Model Development and Control Design for High Performance Nonlinear Smart Material Systems,” Colloquium, Electrical and Computer Engineering Department, University of California, Santa Barbara, Santa Barbara, CA, March 22.
- “Model-Based Control Design for High Performance Nonlinear Smart Systems,” Colloquium, Bradley Department of Electrical and Computer Engineering, Virginia Polytechnic Institute and State University, Blacksburg, VA, September 20.
- “Model-Based Control Design for High Performance Nonlinear Smart Systems,” Colloquium, Mechanical and Aerospace Engineering, North Carolina State University, Raleigh, NC, September 26.
- “Research and Career Options in Mathematics and Operations Research,” Seminar, Department of Mathematics, Virginia Commonwealth University, Richmond, VA, November 18.
- \* “Model Development and Control Design for High Performance Nonlinear Smart Material Systems,” Colloquium, School of Computational Science and Information Technology, Florida State University, Tallahassee, FL, November 22.
- 2003 \* “Model Development and Control Design for High Performance Nonlinear Smart Material Systems,” Colloquium, Department of Applied Mechanics & Engineering Sciences, University of California, San Diego, San Diego, CA, March 7.
- “Models for Piezoceramic, Magnetostrictive and Shape Memory Alloy Characterization and Design,” Seminar, Acoustics and Fluid Mechanics Group, The Boeing Company, Seattle, WA, May 28.
- 2004 \* “Model Development and Control Design for High Performance Nonlinear Smart Material Systems,” Colloquium, Department of Mathematics, University of Wyoming, Laramie, WY, January 29.
- \* “Model Development and Control Design for High Performance Nonlinear Smart Material Systems,” Colloquium, Department of Mathematics, Clemson University, Clemson, SC, April 8.
- 2005 \* “Multiscale Model Development for Ionic Polymers,” Colloquium, Department of Mathematical Sciences, Montana State University, Bozeman, MT, February 10.
- 2006 “Model Development and Control Design for High Performance Nonlinear Smart Material Systems,” Colloquium, Department of Mathematical Sciences, Montana State University, Bozeman, MT, November 30.
- 2007 “Multiscale Model Development for Ionic Polymers,” Colloquium, Department of Mechanical Engineering, Florida State University, Tallahassee, FL, February 1.
- “Model Development and Control Design for Structural Systems,” Seminar, Idaho National Laboratory, Idaho Falls, ID, March 15.

“Model Development and Control Design for High Performance Nonlinear Smart Material Systems, Colloquium, Department of Mathematics, University of Waterloo, Waterloo, Ontario, April 26.

“Model Development and Control Design for High Performance Nonlinear Smart Material Systems, Mechanics and Materials Seminar, North Carolina State University, Raleigh, NC, December 5.

“Model Development and Real-Time Model-Based Control Design for High Performance Nonlinear Smart Systems,” Seminar, Starfire Optical Range, Kirtland Air Force Base, Albuquerque, NM, December 13.

2008 “Model Development and Real-Time Model-Based Control Design for High Performance Nonlinear Smart Systems,” Colloquium, Department of Electrical and Computer Engineering, University of Wyoming, Laramie, WY, September 12.

“Model Development and Real-Time Model-Based Control Design for High Performance Nonlinear Smart Systems,” Applied Math Seminar, Duke University, Durham, NC, September 22.

2010 “Model Development and Model-Based Control Design for Nonlinear Smart Composite Systems,” Colloquium, Department of Mathematics, University of Waterloo, Waterloo, Ontario, June 15.

“Model Development and Control Design for High Performance Smart Material Systems,” Colloquium, Applied Mathematics Department, University of Colorado Boulder, August 27.

### Plenary and Keynote Lectures

2001 \* “Modeling and Control Issues Associated with Atomic Force Microscopy,” Workshop on Pluralism in Distributed Parameter Systems,” University of Twente, The Netherlands, July 3.

\* “Model Development and Control Design for High Performance Nonlinear Smart Material Systems,” SIAM Conference on Control and Its Applications, San Diego, CA, July 14.

2006 \* “Model Development and Control Design for Nonlinear Smart Material Systems,” SIAM-SEAS 30th Annual Meeting, Auburn University, Auburn, AL, March 31.

\* “Model Development and Control Design for High Performance Nonlinear Smart Material Systems,” (Keynote) Fourth World Conference on Structural Control and Monitoring, San Diego, CA, July 12.

### Editing, Refereeing and Reviews

Editor in Chief – SIAM Book Series on *Advances in Design and Control*: November 2004-Present.

Member of Editorial Board – SIAM’s *Frontiers in Applied Mathematics*, 1998-2006.

Associate Editor – *Journal of Intelligent Material Systems and Structures*, 01/04 - Present.

Associate Editor – *Continuum Mechanics and Thermodynamics*, 01/05 - Present.

Associate Editor – *Dynamics of Continuous, Discrete and Impulsive Systems, Series B (DCDIS-B)*, 05/07 - Present.

Associate Editor – *Joint 2005 International Symposium on Intelligent Control and 13th Mediterranean Conference on Control and Automation (2005 ISIC-MED)*, 2005.

#### Book and Chapter Reviews

- *Numerical Mathematics and Computing*, 3rd Edition, Cheney and Kincaid, reviewed for Brooks/Cole Publishing Company (1996).
- “Magnetostrictive Materials: Their Use in Smart Structure Applications,” *Encyclopedia of Smart Materials*, reviewed for John Wiley & Sons (2000).
- “Piezoelectric Materials,” *Encyclopedia of Biomaterials and Biomedical Engineering*, reviewed for Marcel Dekker, Inc. (2003).
- *UQ 2 Go*, Gray and Canales, reviewed for SIAM (2009).

#### Program Reviews – Fields Institute Thematic Program (2010)

Grant Reviews – Air Force Office of Scientific Research (1997,1998,1999,1999,2002,2003,2005,2005)

- Air Force Office of Scientific Research (2006, 2009, 2009, 2010, 2011)
- AFOSR Young Investigator Research Program (YIP) (2009, 2009)
- Army Research Office (2001)
- Austrian Science Fund (2011,2011)
- Canada Foundation for Innovation (2002)
- Department of Energy (1998)
- Defense R&D Canada (DRDC) Technology Investment Fund (2009,2010)
- Israel Science Foundation (2007)
- Maryland Industrial Partnerships Program (2007)
- Mathematics of Information Technology and Complex Systems (MITACS) (2000)
- Natural Sciences and Engineering Research Council of Canada (NSERC) (2003,2005)
- NSERC (2010)
- NSF Applied Mathematics Program (1997,1999,2000,2000,2001, 2001,2001,2001)
- NSF Applied Mathematics Program (2002,2002,2005,2006,2010, 2010)
- NSF Condensed Matter and Materials Theory Program: (2009)
- NSF Condensed Matter and Materials Theory Program: CAREER (2008)
- NSF EPSCoR MONTS 2000 Program (2000)
- NSF International Research Fellow Awards (2007)
- Netherlands Organization for Scientific Research (NWO) (2001,2002)
- United States Civilian Research and Development Foundation (CRDF) (2005)
- University of Wisconsin-Milwaukee Research Growth Initiative (2009,2011)

#### Funding Agency Panel –

Panelist for the Sensors Technology Program in the Civil and Mechanical Systems Division of the NSF, July 6-7, 2000. This involved reviewing, preparing summary statements, and ranking 33 proposals.

#### External Reviewer –

–Reviewer for a case involving promotion to Associate Professor with tenure, Engineering Mechanics, University of Nebraska, 2002.

- Reviewer for a case involving promotion to Full Professor with tenure, Mathematics, University of Southern California, 2003.
- Reviewer for a case involving promotion to Associate Professor with tenure, Department of Mathematical Sciences, Montana State University, 2004.
- Reviewer for a case involving promotion to Associate Professor with tenure, Department of Mathematical Sciences, University of Wisconsin, Milwaukee, 2004.
- Reviewer for a case involving promotion to Associate Professor with tenure, Department of Mechanical Engineering, University of Wyoming, 2004.
- Reviewer for a case involving promotion to Associate Professor with tenure, Department of Mathematics and Statistics, Georgia State University, Atlanta, 2005.
- Reviewer for a case involving promotion to Associate Professor with tenure, Department of Mathematical Sciences, Clemson University, 2005.
- Reviewer for the Air Force Summer Faculty Fellowship Program (SFFP) (2005,2005)
- Reviewer for a case involving promotion to Associate Professor with tenure, Department of Mathematics and Computer Science, Meredith College, 2006.
- Reviewer for a case involving promotion to Associate Professor with tenure, Department of Mathematical Science, University of Wisconsin, Milwaukee, 2006.
- Reviewer for a case involving promotion to Associate Professor with tenure, Department of Mathematics and Statistics, Texas Tech University, 2006.
- Reviewer for a case involving promotion to Associate Professor with tenure, Department of Electrical and Computer Engineering, University of Waterloo, 2007.
- Reviewer for a case involving promotion to Associate Professor with tenure, Department of Electrical and Computer Engineering, Michigan State University, 2009.
- Reviewer for a case involving promotion to Associate Professor with tenure, Department of Mathematics, VA Tech University, 2010.

#### Refereeing of papers

- *AIAA Journal* (2002)
- *Applied Mathematical Letters* (1996,1996,1996)
- *Applied Numerical Mathematics* (1992)
- *Applied Physics Letters* (2010)
- *ASME International Mechanical Engineering Congress and Exposition*(2003,2003,2004,2006)
- *ASME Journal of Applied Mechanics* (2005)
- *ASME Journal of Dynamic Systems, Measurement, and Control* (1997,2003,2006,2009,2009)
- *ASME Journal of Dynamic Systems, Measurement, and Control* (2010)
- *ASME Journal of Mechanical Design* and *ASME Journal of Vibration and Acoustics*, 40<sup>th</sup> Anniversary Combined Issue (1995)
- *ASME Journal of Vibration and Acoustics* (1992,1993,1998,2000,2003)
- *Automatica* (2003,2004,2005,2006,2009)
- *Composites Science and Technology* (2002,2004)
- *Computational Optimization and Applications* (2011)
- *Computers and Mathematics with Applications* (2001)
- *Continuum Mechanics and Thermodynamics* (2005)
- *Discrete and Continuous Dynamical Systems* (1995)
- *Dynamics of Continuous, Discrete and Impulsive Systems: Series B* (2003)
- *ESAIM: Control, Optimization and Calculus of Variations* (1999)

- *Finite Elements in Analysis and Design*(2009)
- *IEEE Control Systems Magazine* (2007)
- *IEEE Transactions on Automatic Control* (1997,2004,2004,2004,2005,2005,2007,2007,2008)
- *IEEE Transactions on Automatic Control* (2009,2009)
- *IEEE Transactions on Control Systems Technology* (2002,2005,2005,2006,2006,2008,2010)
- *IEEE Transactions on Magnetics* (2002,2006)
- *IEEE Transactions on Mechatronics* (2011)
- *IEEE Transactions on Signal Processing* (1999)
- *IEEE Transactions on Ultrasonics, Ferroelectrics, and Frequency Control* (2010)
- *Integrated Ferroelectrics* (2005)
- *International Journal of Computer Mathematics* (2007)
- *International Journal for Numerical Methods in Engineering* (1996,1997,2005)
- *International Journal of Control* (2000)
- *International Journal of Smart and Nano Materials* (2011)
- *International Journal of Solids and Structures* (1999,2000,2004)
- *Inverse Problems* (2004)
- *Inverse Problems in Science and Engineering* (2009)
- *Journal of Applied Mathematics* (2004)
- *Journal of Applied Mathematics and Optimization* (1998)
- *Journal of Applied Physics* (2000,2001,2008,2009,2010)
- *Journal of Colloidal and Interface Science* (2005)
- *Journal of Computational and Applied Mathematics* (2008)
- *Journal of Differential Equations* (2001)
- *Journal of Engineering Mathematics* (2005)
- *Journal of Intelligent Material Systems and Structures* (1993,1994,1994,1994,1994)
- *Journal of Intelligent Material Systems and Structures* (1995,1995,1995,1996,1997,1997)
- *Journal of Intelligent Material Systems and Structures* (1997,1997,1998,1998,1998,1998)
- *Journal of Intelligent Material Systems and Structures* (1998,1998,1999,1999,1999,1999)
- *Journal of Intelligent Material Systems and Structures* (1999,1999,1999,1999,2000,2000)
- *Journal of Intelligent Material Systems and Structures* (2002,2003,2003,2005,2006,2007,2007)
- *Journal of Intelligent Material Systems and Structures* (2011,2011)
- *Journal of Magnetism and Magnetic Materials* (2006)
- *Journal of Materials Research* (2003)
- *Journal of Mathematical Physics*(2007)
- *Journal of Mathematical Systems, Estimation and Control* (1997)
- *Journal of Optimization Theory and Applications* (1997)
- *Journal of Vibration and Control* (2004,2007,2007,2009)
- *Journal of the Acoustical Society of America* (1998)
- *Journal of the Mechanics and Physics of Solids* (2010)
- *Journal of the Optical Society of America* (2005)
- *Kybernetika* (1998)
- *Mathematical and Computer Modelling* (1998,1998,1998,1998,1998,1998,1998,2003,2005)
- *Mechatronics* (2008,2011)
- *Nonlinear Analysis Series B: Real World Applications* (2004)
- *Nuclear Science and Engineering* (2011)
- *Numerical Algorithms* (2008)
- *Numerical Methods for Partial Differential Equations* (1998)
- *Optimal Control Applications and Methods* (2001)
- *Physica B* (2008,2011)
- *Polymer* (2004)

- *Precision Engineering* (2011)
- *Proceedings of the American Control Conference* (2000,2000,2001,2001,2001,2002)
- *Proceedings of the American Control Conference* (2003-7 papers,2006,2006,2008,2008)
- *Proceedings of the Automatic Control Conference* (1998)
- *Proceedings of the European Control Conference* (1994)
- *Proceedings of the IEEE Conference on Decision and Control* (1998,1998,1999,1999,2000)
- *Proceedings of the IEEE Conference on Decision and Control* (2000,2001-21 Long, 5 Short)
- *Proceedings of the IEEE Conference on Decision and Control* (2002,2002,2002,2002,2003)
- *Proceedings of the IEEE Conference on Decision and Control* (2003,2005,2005)
- *Proceedings of the IEEE Conference on Decision and Control* (2008-24 papers; Reviewed and handled as editor)
- *Proceedings of the International Conference on Control and Estimation of Distributed Parameter Systems* (1997)
- *Quarterly of Applied Mathematics* (1996,1997,1997,1998,1999)
- *SIAM Journal on Control and Optimization* (1998,2003)
- *SIAM Journal on Numerical Analysis* (1998)
- *SIAM Journal on Optimization* (1997)
- *SIAM Review* (2010)
- *Smart Materials and Structures* (2008,2009,2011,2011,2011)
- *Solid State Electronics* (2005)
- *Structural Engineering and Mechanics* (2001)
- *Surface and Coatings Technology* (2004)
- *Systems and Control Letters* (2002,2002)
- *Ultrasonics* (2010)

### Organization of Seminars

Fall 94 - Spring 95      “Modeling and Control Seminar,” Iowa State University

### Service

#### **Departmental (Iowa State University)**

Applied Mathematics Committee, 1997.

Applied Mathematics Qualifier Committee, 1994-95.

Computer Committee, 1994-95.

Functional Analysis Committee – ad hoc committee to revise functional analysis sequence, 1997.

Numerical Analysis Search Committee, 1995-96.

Undergraduate Committee, 1996-1998.

#### **Departmental (North Carolina State University)**

- Technology Committee, 1999.

- Graduate Committee, 1999-2000.

- Chair Search Committee, 2000-2002.

- Co-Chair General Search Committee, 2005-present.

- Mathematics Ph.D. Preliminary Exam Committee, 2000-present.

- OR Qualifying Exam Committee, 2000-present.
- Co-organized the Industrial Mathematics Modeling Workshop for Graduate Students held at North Carolina State University: 1998-present.

### College

- Graduate Academic Advisory Committee (GAAC)

### University

- COE and PAMS New Faculty Workshop: Panel on Research – 8/7/03

### SAMSI (Statistical and Applied Mathematical Sciences Institute)

- Program leader for the 2003-2004 *Program on Multiscale Model Development and Control Design*. Organized and chaired the Opening Workshop which brought together 110 scientists from Mathematics, Statistics, Material Science, Physics, and Engineering to investigate the synergy between deterministic and stochastic analysis for modeling, approximation and control design in the context of advanced materials.

### Workshop and Conference Chair

- Co-organized and chaired the *Industrial Mathematics Modeling Workshop for Graduate Students* held at North Carolina State University, July 26-August 3, 1999, July 24-August 1, 2000.
- Organized and chaired the *Conference on Future Directions in Distributed Parameter Systems* held at North Carolina State University on October 5-7, 2000. This conference was funded by AFOSR, ARO and NSF and brought together over 100 attendees from more than 12 countries. This resulted in the monograph *Research Directions in Distributed Parameter Systems*, SIAM, Philadelphia, 2003 (see [3] in Books).
- Co-chair of the 2001, 2002 *Conference on Modeling, Signal Processing, and Control*, SPIE's Annual International Symposium on Smart Structures and Materials.
- Chair of the 2003, 2004 *Conference on Modeling, Signal Processing, and Control*, SPIE's Annual International Symposium on Smart Structures and Materials.
- Co-chair of the 2005, 2007 *SIAM Conferences on Control and Its Applications*.

### Other Professional Service

- Organized the minisymposium *Structural Acoustics*, 1994 North American Conference on Smart Structures and Materials, Orlando, FL, February 13-18, 1994.
- Organized the minisymposium *Parameter Estimation VI*, 1995 ASME 15<sup>th</sup> Biennial Conference on Mechanical Vibration and Noise & 1995 ASME Design Technical Conferences, Boston, MA, September 17-21, 1995.
- Organized the minisymposium *Identification and Control in Distributed Parameter Systems*, 1996 SIAM Annual Meeting, Kansas City, MO, July 22-26, 1996.

- Co-organized the minisymposium *Implementation Issues Concerning Control and Identification in Distributed Parameter Systems*, SIAM 45th Anniversary Meeting, Palo Alto, CA, 1997.
- Organized the minisymposium *Implementation Issues Concerning Control and Identification in Distributed Parameter Systems*, Fourth SIAM Conference on Control and its Applications, Jacksonville, FL, 1998.
- Co-organized the minisymposium *Distributed Parameter Methods for Flow and Acoustic Applications*, Fourth SIAM Conference on Control and its Applications, Jacksonville, FL, 1998.
- Co-organized the minisymposia *Experimental and Analytical Characterization of Piezoelectric Materials: I and II*, Third SIAM Conference on Mathematical Aspects of Materials Science, Philadelphia, PA, 2000.
- Co-organized the session *Control of Distributed Parameter Systems*, American Control Conference, Chicago, IL, 2000.
- Co-organized the minisymposium on *Active Control of Fluids – Theoretical Development and Applications: I and II*, Fifth SIAM Conference on Control and its Applications, San Diego, CA, 2001.
- Co-organized the minisymposium on *Nonlinear Smart Material Control Systems*, Fifth SIAM Conference on Control and its Applications, San Diego, CA, 2001.
- Co-organized the minisymposium on *Nonlinear Intelligent Material Systems and Structures*, Fifth SIAM Conference on Control and its Applications, San Diego, CA, 2001.
- Co-organized the symposium on *Hysteresis and Vibration*, 18th ASME Biennial Conference on Mechanical Vibration and Noise, Pittsburgh, PA, 2001.
- Co-organized the minisymposium on *Model Development and Control Design for Hysteretic Systems*, SIAM Conference on Control and its Applications, Denver, CO, 2009.
- Member of the Program Committee: Conference on Mathematics and Control in Smart Structures, SPIE's Annual International Symposium on Smart Structures and Materials, 1999, 2000, 2001, 2002, 2003.
- Member of the Program Committee: 2001 and 2002 Conference on Decision and Control (CDC).
- SIAM Liaison to the IEEE for the 1999 – 2010 CDC Meetings.
- Program Director: SIAM Activity Group on Control and Systems Theory (CST) – 1/1/05–12/31/07.
- Chair SIAM Activity Group on Control and Systems Theory (CST) – 1/1/08–Present.
- Pipeline Issues Workshop for Faculty of Women's Colleges and Minority Serving Institutions: Gave the presentation "Opportunities for Students and Faculty at SAMSI" on September 30, 2006.
- PAMS Alumni and Friends Weekend: Gave the class "Smart Materials" on October 13, 2006.