Mark R. Paul

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Academic Appointments

2004 – present Assistant Professor, Virginia Tech
Department of Mechanical Engineering
Affiliate Faculty Appointments: Departments of Physics, Computer Science, Engineering Science and Mechanics, School of Biomedical Engineering and Science

Postdoctoral Positions

2001 – 2004 California Institute of Technology, Theoretical Physics
Advisor: Professor Michael Cross
Nonequilibrium pattern formation and spatiotemporal chaos in fluid convection,
BioNEMS: Biofunctionalized nanoelectromechanical systems

2000 Duke University, Theoretical Physics
Advisors: Professors Henry Greenside and Michael Cross (Caltech)
Nonequilibrium pattern formation and spatiotemporal chaos in fluid convection

Degrees

2000 Ph.D. University of California at Los Angeles, Mechanical Engineering
Advisor: Professor Ivan Catton

1994 M.S. University of California at Los Angeles, Mechanical Engineering
Advisor: Professor Ivan Catton

1993 B.S. University of California at Los Angeles, Aerospace Engineering

Visiting Appointments

2005 The Newton Institute for Mathematical Sciences, Cambridge, England (4 weeks). Participated and lectured in the program on "Pattern Formation in Large Domains."

2003 The Kavli Institute of Theoretical Physics at the University of California at Santa Barbara (4 weeks). Participated and lectured in the program on "Patterns in Physics and Biology Program."

Honors and Awards

2008 NSF CAREER Award

2008 Virginia Tech College of Engineering Outstanding New Assistant Professor Award

2001 Burroughs Wellcome Computational Molecular Biology Postdoctoral Fellowship, Department of Physics, Caltech

Significant Travel Invitations

2006 Lectured at the program on "Nonlinear Dynamics of Nanosystems", Chemnitz, Germany

2003 Lectured at the program on "Trends in Pattern Formation: From Amplitude Equations to Applications, Max-Planck-Institute for Complex Systems, Dresden, Germany

Journal Papers

PDF copies are available at `http://www.me.vt.edu/mpaul` .

(21) D. Barik, M.R. Paul, W.T. Baumann, Y. Cao, and J.J. Tyson, Stochastic Simulation of Enzyme-Catalyzed Reactions with Disparate Time Scales, submitted to *Biophysical Journal*, (2008).

(20) A. Duggleby, K.S. Ball, and M.R. Paul, Relaminarization and the importance of short wavelength outer-layer structures in the self-sustaining mechanism of turbulence, submitted *International Journal of Heat and Mass Flow*, (2008).

(19) M.T. Clark and M.R. Paul, The Stochastic Dynamics of Rectangular and V-shaped Atomic Force Microscope Cantilevers in a Viscous Fluid and Near a Solid Boundary, to appear *Journal of Applied Physics*, (2008).

(18) N. Hashemi, H. Dankowicz and M.R. Paul, The Nonlinear Dynamics of Tapping Mode Atomic Force Microscopy with Capillary Force Interactions, to appear *Journal of Applied Physics*, (2008).

(17) S. Misra, H. Dankowicz, and M.R. Paul, Event-Driven Feedback Tracking and Control of Tapping-Mode Atomic Force Microscopy, to appear *Proceedings of the Royal Society A*, (2008).

(16) M.R. Paul, M.I. Einarsson, P.F. Fischer, and M.C. Cross, Extensive Chaos in Rayleigh-Bénard Convection", *Physical Review E*, **17**, 045203, (2007).

(15) A. Duggleby, K.S. Ball, and M.R. Paul, The Effect of Spanwise Wall Oscillation on Turbulent Pipe Flow Structures Resulting in Drag Reduction, *Physics of Fluids*, **19**, 125107, (2007).

(14) A. Duggleby, K.S. Ball, M.R. Paul, and P.F. Fischer, Dynamical Eigenfunction Decomposition of Turbulent Pipe Flow, *Journal of Turbulence*, **8**, 1–24, (2007).

(13) M.T. Clark and M.R. Paul, The Stochastic Dynamics of an Array of Atomic Force Microscopes in a Viscous Fluid, *International Journal of Nonlinear Mechanics*, (2007).

(12) M.R. Paul, M.T. Clark, and M.C. Cross, The stochastic dynamics of micron and nanoscale elastic cantilevers in fluid: fluctuations from dissipation, *Nanotechnology*, **17**, 4502–4513 (2006).

(11) J. Solomon and M.R. Paul, The Kinetics of Analyte Capture on Nanoscale Sensors, *Biophysical Journal*, **90**, 1842–1852 (2006).

(10) M.R. Paul, K.-H. Chiam, and M.C. Cross, Rayleigh-Bénard Convection in Large-Aspect-Ratio Domains, *Physical Review Letters*, **93**, 064503 (2004).

(9) M.R. Paul and M.C. Cross, The Response of Nanoscale Cantilevers Immersed in a Viscous Fluid, *Physical Review Letters*, **92**, 235501 (2004).

(8) M.R. Paul and I. Catton, The Relaxation of Two-Dimensional Rolls in Rayleigh-Bénard Convection, *Physics of Fluids*, **16**, 1262–1266 (2004).

(7) J.D. Scheel, M.R. Paul, M.C. Cross, and P.F. Fischer, Traveling Waves in Rotating Rayleigh-Bénard Convection: Analysis of modes and mean flow, *Physical Review E*, **69**, 066216 (2003).

(6) M.R. Paul, K.-H. Chiam, M.C. Cross, P.F. Fischer, and H.S. Greenside, Pattern Formation and Dynamics in Rayleigh-Bénard Convection: Numerical Simulations of Experimentally Realistic Geometries, *Physica D*, **184**, 114–126 (2003).

(5) K.-H. Chiam, M.R. Paul, M.C. Cross, and H.S. Greenside, Mean Flow Dynamics of Stripe Textures and Spiral Defect Chaos in Rayleigh-Bénard Convection, *Physical Review E*, **66**, 056206 (2003).

(4) M.R. Paul, M.C. Cross, and P.F. Fischer, Rayleigh-Bénard Convection with a Radial Ramp in Plate Separation, *Physical Review E*, **66**, 046210 (2002).

(3) M.R. Paul, M.C. Cross, P.F. Fischer, and H.S. Greenside, Power-Law Behavior of Power Spectra in Low Prandtl Number Rayleigh-Bénard Convection, *Physical Review Letters*, **87**, 154501 (2001).

(2) M.R. Paul, F. Issacci, I. Catton, and G.E. Apostolakis, Characterization of smoke particles generated in terrestrial and microgravity environments, *Fire Safety Journal*, **28**, 233-252 (1997).

(1) G.E. Apostolakis, I. Catton, F. Issacci, S. Jones, M.R. Paul, T. Paulos, and K. Paxton, Risk based fire safety experiments, *Reliability Engineering and System Safety*, **49**, 275-291 (1995).

Book Chapters (peer reviewed)

(2) M.R. Paul and J. Solomon, The Physics and Modelling of MEMS and NEMS, in Nanodevices for Life Sciences, Wiley-VCH (2006).

(1) M.L. Roukes, J. Arlett, M.R. Paul, S.E. Fraser, J. Solomon and M.C. Cross, Nanomechanical devices for single molecule biophysics, in Controlled Nanoscale Motion in Biological and Artificial Systems, Springer-Verlag, as part of Nobel Symposium 131 (2005).

Conference Papers (peer reviewed)

(8) A. Duggleby and M.R. Paul, Exploring Extensive Chaos in Rayleigh-Benard convection using fractal and Karhunen-Loeve dimensions, XXII International Conference on Theoretical and Applied Mechanics, Adelaide, Australia, August, 25-29 (2008) (manuscript in review).

(7) H. Dankowicz and M.R. Paul, Tapping at the Nanoscale: Discontinuity Induced Degeneracies in Atomic Force Microscopy, 9th Biennial ASME Conference on Engineering Systems Design and Analysis, Haifa, Israel, July 7-9 (2008) (manuscript in review).

(6) N. Hashemi, M.R. Paul, and H. Dankowicz, Exploring the Basins of Attraction of Tapping Mode Atomic Force Microscopy with Capillary Force Interactions, ASME International Mechanical Engineering Congress and Exposition, Seattle, WA, November 11-15 (2007).

(5) N. Hashemi, M.R. Paul, J. Alcazar, and R. Radovitzky, A Fully Lagrangian Numerical Method for Calculating the Dynamics of Oscillating Micro and Nanoscale Objects Immersed in Fluid, ASME International Mechanical Engineering Congress and Exposition, Seattle, WA, November 11-15 (2007).

(4) G.E. Apostolakis, I. Catton, F. Issacci, S. Jones, M.R. Paul, T. Paulos, and K. Paxton, Experimental Needs for Spacecraft Risk Assessment, Fourth International Symposium on Fire Safety Science, Ottawa, Ontario, Canada, June 13-17 (1994).

(3) S. Jones, M.R. Paul, F. Issacci, I. Catton, and G.E. Apostolakis, A Zone Model for Determining Atmospheric Contaminant Transport Aboard Human-Crewed Spacecraft, Proceedings, Probabilistic Safety Assessment and Management, PSAM II, Vol. 3, Session 085, p. 1-4, San Diego, CA, March 20-25 (1994).

(2) M.R. Paul, F. Issacci, I. Catton, and G.E. Apostolakis, Elemental Description of Smoke Particles, AIAA Paper No. 94-0433, 32nd AIAA American Sciences Meeting, Reno, NV, January 10-13 (1994).

(1) M.R. Paul, F. Issacci, I. Catton, and G.E. Apostolakis, Morphological description of particles generated from the overheating of wire insulation in microgravity and terrestrial environments, ASME, Heat Transfer in Microgravity Systems, 29th National Heat Transfer Conference, Atlanta, GA (1993).

Technical Reports

(2) N. Hashemi, H. Dankowicz, and M.R. Paul, Dynamical-Systems-Based Techniques for Numerical Analysis of Tapping Mode Atomic Force Microscopy, Research Report submitted to industrial collaborator, Veeco Metrology, February (2007).

(1) S. Misra, H. Dankowicz and M.R. Paul, Discontinuity-Driven Control of Tapping-Mode Atomic Force Microscopy, Research Report submitted to industrial collaborator, Veeco Metrology, December (2006).

Theses

M.R. Paul, An Investigation of Relaxation of Two Dimensional Rolls in Rayleigh-Bénard Convection, PhD Thesis, UCLA (2000).

M.R. Paul, The Characterization of Smoke Particles Generated in Terrestrial and Microgravity Environments, Master's Thesis, UCLA (1994).

Invited Presentations

(20) The Stochastic Dynamics of Nanoscale Systems Fluctuations from Dissipation, Yale University, September 2007.

(19) The Stochastic Dynamics of Nanoscale Systems Fluctuations from Dissipation, Boston University, October 2007.

(18) Spatiotemporal Chaos in Fluid Convection: New Insights from Numerics, University of Kentucky, April 2007.

(17) Quantifying Spatiotemporal Chaos in Rayleigh-Benard Convection – New Insights from Numerics, Georgia Tech, March 2007.

(16) The Stochastic Dynamics of Nanoscale Systems – Fluctuations from Dissipation, Large Scale Integration of Nanosystems, Caltech, December 2006.

(15) The stochastic dynamics of arrays of micro and nanoscale cantilevers in a viscous fluid, California Institute of Technology, April 2006.

(14) New Insights from Numerics: Spatiotemporal Chaos in Fluid Convection and the Stochastic Dynamics of Nanoscale Cantilevers, University of California at Los Angeles, April 2006.

(13) The stochastic dynamics of micron and submicron scale cantilevers in a viscous fluid, Veeco Metrology, Santa Barbara, CA, November 2005.

(12) Quantifying Spatiotemporal Chaos, Georgia Institute of Technology, October 2005.

(11) New physical insights from experimentally realistic numerical simulations of Rayleigh-Bénard convection, The Newton Institute of Mathematical Sciences, Cambridge University, England, August 2005.

(10) The stochastic dynamics of micron and submicron scale mechanical oscillators, SIAM Conference on Applications of Dynamics Systems, Snowbird, UT, May 2005.

(9) New physical insights from experimentally realistic numerical simulations: Spatiotemporal Chaos and BioNEMS, presented to the Civil Engineering Department at Virginia Tech, January 2005.

(8) New physical insights from experimentally realistic numerical simulations: Spatiotemporal Chaos and BioNEMS, presented to the Physics Department at Virginia Tech, December 2004.

(7) New physical insights from experimentally realistic numerical simulations: Spatiotemporal Chaos and BioNEMS, presented to the Physics Department at New York University, New York, December 2004.

(6) BioNEMS: Biofunctionalized Nano Electro Mechanical Systems, DARPA BioFlips/Simbiosys Conference, Vail CO, October 2004.

(5) BioNEMS: Biofunctionalized Nano Electro Mechanical Systems, DARPA BioFlips/Simbiosys Conference, Monterey CA, September 2003.

(4) Rayleigh-Bénard Convection in Large-Aspect-Ratio Domains, Workshop on Patterns in Physics, The Fields Institute, Toronto Canada, November 2003.

(3) Spatiotemporal Dynamics, Kavli Institute for Theoretical Physics at the University of California at Santa Barbara, Program on Pattern Formation in Physics and Biology, October 2003.

(2) Rayleigh-Bénard Convection as metaphor for large-aspect-ratio nonequilibrium dynamics, Trends in Pattern Formation: From Amplitude Equations to Applications, Max-Planck-Institute for Complex Systems, Dresden Germany, August 2003.

(1) New Insights from Simulations of Rayleigh-Bénard Convection, presented for the Duke University Center for Complex and Nonlinear Systems, 19 April 2001.

Presentations

(31) C. Carvajal and M.R. Paul, The Fluid-Coupled Motion of Micro and Nanoscale Elastic Objects, American Physical Society Division of Fluid Dynamics Meeting, Salt Lake City, UT, 2007.

(30) M.M. Smith, M.T. Clark, and M.R. Paul, Quantifying the Dynamics of Thermoelastically Driven Nanoscale Beams in Fluid, American Physical Society Division of Fluid Dynamics Meeting, Salt Lake City, UT, 2007.

(29) M.T. Clark, and M.R. Paul, The Stochastic Dynamics of a Traingular Atomic Force Microscope Near a Solid Boundary, American Physical Society Division of Fluid Dynamics Meeting, Salt Lake City, UT, 2007.

(28) N. OConnor, E. Knobloch, P.F. Fischer, and M.R. Paul, Numerical Simulations of Viscous Faraday Waves, American Physical Society Division of Fluid Dynamics Meeting, Salt Lake City, UT, 2007.

(27) M. R. Paul and M. I. Einarsson, Extensive Chaos in Rayleigh-Benard Convection, Society of Industrial and Applied Mathematics Meeting on Applied Dynamical Systems, Snowbird UT, 2007.

(26) A. Duggleby and M. R. Paul, A Karhunen-Loeve Decomposition of Spatiotemporal Chaos, Society of Industrial and Applied Mathematics Meeting on Applied Dynamical Systems, Snowbird UT, 2007.

(25) N. Hashemi, M.R. Paul, and H. Dankowicz, Quantifying the Dynamics of Tapping Mode Atomic Force Microscopy, Society of Industrial and Applied Mathematics Meeting on Applied Dynamical Systems, Snowbird UT, 2007.

(24) M. Smith M.T. Clark and M.R. Paul, Quantifying the Dynamics of Thermoelastically Driven Nanoscale Beams in Fluid Summer Undergraduate Research Program Symposium on Advanced Materials, Virginia Tech, 2007.

(23) N. Hashemi, H. Dankowicz, and M.R. Paul, A Dynamical Systems Approach for Tapping Mode Atomic Force Microscopy, Virginia Tech Graduate Student Research Symposium, March 2007.

(22) M.T. Clark and M.R. Paul, Exploiting the Stochastic Dynamics of Microscale Cantilevers for Single Molecule Measurements, American Physical Society Division of Fluid Dynamics Meeting, Tampa, FL, November 2006.

(21) M.R. Paul and M.I. Einarsson, Extensive Chaos is Rayleigh-Benard Convection, American Physical Society Division of Fluid Dynamics Meeting, Tampa, FL, November 2006.

(20) A. Williams, C. Clawson, M.R. Paul, and P. Vlachos, Laminar mixing via steady streaming - Using an active ionic polymer actuators, American Physical Society Annual March Meeting, Baltimore, MD, March 2006.

(19) A. Duggleby, K. Ball and M.R. Paul, The mechanism of drag reduction in turbulent pipe flow with spanwise wall oscillation, American Physical Society Annual March Meeting, Baltimore, MD, March 2006.

(18) K. Ball, A. Duggleby, and M.R. Paul, "The dynamics of relaminarization in turbulent pipe flow", American Physical Society Annual March Meeting, Baltimore, MD, March 2006.

(17) M. Clark and M.R. Paul, The Stochastic Dynamics of an Array of Atomic Force Microscope Cantilevers in a Viscous Fluid, American Physical Society Annual March Meeting, Baltimore, MD, March 2006.

(16) M. Einarsson and M.R. Paul, Quantifying Spatiotemporal Chaos in Rayleigh-Bénard Convection, American Physical Society Annual March Meeting, Baltimore, MD, March 2006.

(15) N. Hashemi and M.R. Paul, A Numerical Investigation of the Non-Linear Interaction Forces in Tapping Mode Atomic Force Microscopy, American Physical Society Annual March Meeting, Baltimore, MD, March 2006.

(14) M.R. Paul and M. Clark, The stochastic dynamics of micron and submicron scale mechanical oscillators, American Physical Society Annual March Meeting, Los Angeles, CA, March 2005.

(13) J.D. Scheel, M.C. Cross, M.R. Paul, Lyapunov exponents for small aspect ratio Rayleigh-Bénard convection, American Physical Society Annual March Meeting, Los Angeles, CA, March 2005.

(12) M.R. Paul, J.D. Scheel and M.C. Cross, Quantifying Spatiotemporal Chaos, 57^{th} Annual Meeting of the Division of Fluid Dynamics, APS, Seattle, WA, 21-23 November 2004.

(11) M.R. Paul, K.-H. Chiam, M.C. Cross, and P.F. Fischer, Coarsening in Rayleigh-Bénard Convection, Rocky Mountain Workshop on Dynamics and Bifurcation of Patterns in Dissipative Systems, Ft. Collins, CO, 19-22 May 2003.

(10) M.R. Paul, R. Radovitzky, M.C. Cross, The Numerical Design of a Nano-Biodetector, 55^{th} Annual Meeting of the Division of Fluid Dynamics, APS, Dallas, TX, 24-26 November 2002.

(9) J.D. Scheel, M.R. Paul, M.C. Cross, Rotating Convection and Travelling Waves, 55^{th} Annual Meeting of the Division of Fluid Dynamics, APS, Dallas, TX, 24-26 November 2002.

(8) R. Radovitzky, M.R. Paul, A Numerical Approach for the Design of Nanomechanical Biodetectors, Fourteenth U.S. National Congress of Theoretical and Applied Mechanics, Blacksburg, VA, 23-28 June 2002.

(7) M.R. Paul, R. Radovitzky, D. Meiron, M.C. Cross, The Numerical Design of a Nanoelectromechanical Biodetector, Poster presented at the Nanoscale/Molecular Mechanics Conference, Maui, HI, 12-17 May 2002.

(6) M.R. Paul, R. Radovitzky, D. Meiron, M.C. Cross, BioNEMS: The Design of a Nano-Biodetector, Caltech Computational Molecular Biology Retreat, Buellton, CA, 25-27 April 2002.

(5) K.-H. Chiam, M.R. Paul, M.C. Cross, H.S. Greenside, P.F. Fischer, Transport of Passive Scalars in Rayleigh-Bénard Convection, Annual American Physical Society March Meeting, Indianapolis, IN, 18-22 March 2001.

(4) M.R. Paul, M.C. Cross, P.F. Fischer, H.S. Greenside, Rayleigh-Bénard Convection with a Radial Ramp in Plate Separation, 54^{th} Annual Meeting of the Division of Fluid Dynamics, APS, San Diego, CA, 18-20 November 2001.

(3) K.-H. Chiam, M.R. Paul, M.C. Cross, H.S. Greenside, Mean Flow and Spiral Defect Chaos in Rayleigh-Bénard Convection, 54^{th} Annual Meeting of the Division of Fluid Dynamics, APS, San Diego, CA, 18-20 November 2001.

(2) M.R. Paul, M.C. Cross, P.F. Fischer, H.S. Greenside, Rayleigh-Bénard Convection with a Radial Ramp in Plate Separation, Sixth SIAM Conference on Applications of Dynamical Systems, Snowbird, UT, May 20-24 2001.

(1) M.R. Paul, M.C. Cross, P.F. Fischer, H.S. Greenside, A Numerical Investigation of Low Prandtl Number Rayleigh-Bénard Convection in Cylindrical Domains, Poster presented at Dynamic Days 2001 Conference, Chapel Hill, NC, Jan 2-6 2001.

Research Funding

(9) 400K, NSF CAREER award, The Spatiotemporal Chaos of Fluid Convection: New Insights from Numerics" (03/01/08-03/01/13).

(8) 1,100K (my level of responsibility 15% or 165K), NIH, Stochastic Models of Cell Cycle Regulation in Eukaryotes, (Co-PI's J. Tyson, A. Sandu, W. Baumann, Y. Cao, C. Shaffer, and L. Watson 01/01/06-01/01/10).

(7) 200K, AFOSR, Pushing measurement to the ultimate stochastic limit: the stochastic dynamics of fluid-coupled nanocantilevers (11/01/06-10/31/09).

(6) 50K, NSF, SGER: Symmetry-breaking bifurcations in an oscillating fluid layer, (Co-PI E. Knobloch, 08/01/06-02/28/08). SGER is a Small Grant for Exploratory Research.

(5) 31K, Virginia Tech Aspires Award, Fluid-Coupled Nanomechanical Sensors, (2006).

(4) 20K, NSF Research Experiences for Undergraduates, 3 year, 12-week summer program (2005-2007).

(3) 40K subcontract with the University of Illinois at Urbana Champaign, Analysis and design of discontinuity-driven bifurcations (CO-PI H. Dankowicz, 2006-2007).

(2) 55K from NSF GOALI award to study Minimum Contact Atomic Force Microscopy (Co-PIs H. Dankowicz, C. Prater, 2006-2007). GOALI is a Grant Opportunity for Academic Liason with Industry.

(1) 44K of research funds from DARPA have been subcontracted from Caltech to Virginia Tech (2004).

Selected Supercomputing Allocations

(6) M.R. Paul, "Open challenges in spatiotemporal chaos, symmetry breaking bifurcations, and nonlinear dynamics at the nanoscale", award for 600,000 CPU hours on Virginia Tech System X (current).

(5) M.R. Paul, J.D. Scheel, and P.F. Fischer, "Unresolved problems in spatiotemporal chaos", award for 100,000 CPU hours on the Jazz at Argonne National Laboratory (current).

(4) M.R. Paul, M.C. Cross and P.F. Fischer, "Unresolved problems in spatiotemporal chaos", NRAC award for 400,000 CPU hours on the TeraGrid Supercomputer, 2003-2006.

(3) M.R. Paul, M.C. Cross and P.F. Fischer, "Characterizing Spatiotemporal Chaos in Experimentally Realistic Systems", NERSC Seaborg supercomputer award 200,000 hours, September 2003.

(2) M.R. Paul and H.S. Greenside, 'Quantitative Predictions of Large-Aspect-Ratio Convective Dynamics Using a Parallel Spectral Element Code" award for 130,000 CPU hours on the North Carolina Supercomputing Center, July 2002.

(1) M.R. Paul and H.S. Greenside, "Quantitative Predictions of Large-Aspect-Ratio Convective Dynamics Using a Parallel Spectral Element Code", award for 130,000 CPU hours on the North Carolina Supercomputing Center, January 2000.

Academic Advising (completed)

(5) C. Carvajal, The Fluid-Coupled Motion of Micro and Nanoscale Cantilevers, Masters Thesis, Virginia Tech (December 2007).

(4) M.I. Einarsson, Quantifying Spatiotemporal Chaos, Masters Thesis, Virginia Tech (June 2006).

(3) M.T. Clark, The Stochastic Dynamics of an Array of Micron Scale Cantilevers in Viscous Fluid, Masters Thesis, Virginia Tech (June 2006).

(2) A. Duggleby, Characterization of the Mechanism of Drag Reduction Using a Karhunen-Love Analysis on a Direct Numerical Simulation of Turbulent Pipe Flow, Ph.D. Thesis, (co-adviser with K.S. Ball), Virginia Tech (June 2006).

(1) Ivan Gregoriev (co-advised), postdoc research on numerical simulations of bioconvection, (2004).

Undergraduate Research (completed)

(4) Corbin Clawson, Modeling of an Ionomer Active Fluid Mixer, Summer Undergraduate Research Project as part of a NSF funded program on advanced materials, Summer 2006.

(3) Margarita Villa, Quantifying the Dynamics of Thermoelastically Driven Nanoscale Beams in Fluid, Summer Undergraduate Research Project as part of a NSF funded program on advanced materials, Summer 2007.

(2) Margarita Villa, Nanoscale Physics for Engineering Application, Technical Elective, Fall 2007.

(1) Jonathan Metzmann, Exploring Chaos with Simple Models, Technical Elective, Spring 2007.

Academic Advising (current)

(6) Debashis Barik, Postdoc (co-advising), Stochastic models of cell cycle regulation in eukaryotes.

(5) Sandip Kar, Postdoc (co-advising), Stochastic models of cell cycle regulation in eukaryotes.

(4) Matthew Clark, PhD student, The stochastic dynamics of nanoscale cantilevers immersed in a viscous fluid. Expected graduation Summer 2008.

(3) Nastaran Hashemi, PhD Student, The nonlinear dynamics of tapping mode atomic force microscopy. Expected graduation Spring 2008.

(2) Nicholas O'Connor, Masters Student, Spatiotemporal chaos and nonlinear dynamics in fluid dynamics. Expected graduation Spring 2008.

(1) Margarita Villa, Masters Student, Pushing measurement to the ultimate stochastic limit using nanoscale objects in fluid. Expected graduation Summer 2009.

Teaching

Graduate Level Fluid Mechanics, Virginia Tech

Taught and developed graduate course ME 5404 Fluid Dynamics (2004-present, a total of 4 semesters). Upon taking over this course in 2004 I redesigned it significantly and developed materials from scratch. This is a graduate course on viscous incompressible fluid dynamics. Typical enrollment is 25 graduate students.

Development of a New Graduate Course on the Modeling of MEMS and NEMS, Virginia Tech

Developed a new graduate course ME 5764: Modeling of MEMS and NEMS (2005-present, a total of 3 semesters). The course is about the construction, analysis and interpretation of mathematical models of microelectromechanical and nanoelectromechanical (MEMS and NEMS) systems. The major goal is to develop a *physical intuition* for the fundamental and dominant physics at these small scales. Typical enrollment is 20 graduate students.

Undergraduate Introduction to Thermal-Fluid Engineering, Virginia Tech

Taught undergraduate course ME 2124: Introduction to Thermal and Fluid Engineering (2004-present, a total of 4 semesters). This is an introductory course covering the basic principles of thermodynamics, fluid mechanics, and heat transfer. Typical enrollment is 50 undergraduate students.

Extensive Undergraduate Teaching Experience While a Graduate Student, UCLA

As a graduate student at UCLA I funded my PhD research entirely through teaching and, as a result, I gained significant teaching experience. In the Mechanical Engineering department I was the teaching assistant for an upper division undergraduate transport phenomena course (3 quarters, approximately 100 students in a class). In the Chemistry department I was a teaching assistant for a large introductory inorganic chemistry class (3 quarters, nearly 200 students in the main lectures with multiple TA sections containing 30 students). I was also the instructor for 9 consecutive quarters of a Mechanical Engineering course on numerical methods and scientific computing with a class size of approximately 60 students (this was the only graduate instructor position offered by the department).

Consistently Receive Excellent Student Evaluations

Throughout all of my teaching experience I have consistently received excellent student evaluations. Further information is available upon request.

Professional Activities

Reviewer for:
- *Physical Review Letters*
- *Journal of Fluid Mechanics*
- *Nanotechnology*
- *Physical Review E*
- *Proceedings of the Royal Society A*
- *Journal of Nonlinearity*
- *Journal of Computational and Nonlinear Dynamics*
- *Journal of Physics D Applied Physics*
- *New Journal of Physics*
- *International Journal of Nonlinear Mechanics*
- *International Journal of Thermal Sciences*

Proposal review for:
- National Science Foundation, Directorate or Engineering
- National Science Foundation, Computer and Information Science and Engineering Division
- Department of Energy, Office of Basic Energy Sciences
- Petroleum Research Fund

Member:
- The American Physical Society, APS
- The Society for Industrial and Applied Mathematicians, SIAM
- The American Society of Mechanical Engineers, ASME

Invited panel member: DARPA, Defense Sciences Office, Bio-Exploitation: Better Understanding Through Biology.

Conference session chair:
- Nanofluids Session at the American Physical Society Meeting of the Division of Fluid Dynamics, Salt Lake City Utah, November 2007.
- Partial Differential Equation Modeling session II at the Society for Industrial and Applied Mathematics conference on Applications of Dynamical Systems, Snowbird Utah, May 2007.
- Session on Convection and Buoyancy Driven Flows at the American Physical Society Meeting of the Division of Fluid Dynamics, Tampa Florida, November 2006.

Selected University Service

Co-organizer of the Virginia Tech Fall Fluid Mechanics Symposium (with M. Stremler and P. Vlachos). To be held every Fall beginning in 2007. The symposium is a collection of presentations by Virginia Tech faculty, postdocs, and and students that will be given at the Annual Meeting of the American Physical Society Division of Fluid Dynamics. The symposium showcases the ongoing fluid mechanics research for the Virginia Tech community.

Served on the PhD and Masters committees of 33 students at Virginia Tech (2004-present).

Faculty mentor for NSF Funded Summer Undergraduate Research Program (SURP) on Advanced Materials, (2006-2008).

Member of the allocations committee for the Virginia Tech Terascale Computing Facility, (2007-present).

Member of a Mechanical Engineering Department Faculty Search Committee, (2007).

Member of the Mechanical Engineering Department Scholarship Committee, (2007).

Mechanical Engineering Personnel Committee, Summer (2006).

Served as a member of the Engineering Science and Mechanics Departments Center for Excellence in Undergraduate Teaching committee on Microfluidics, Fall (2004).