Mark R. Paul

University Address
Virginia Tech
Randolph Hall (0238)
Blacksburg, VA 24061

Voice: (540) 231-4758
Fax: (540) 231-9100
email: mrp@vt.edu
http://www.me.vt.edu/mpaul

Academic Appointments

2009 – present	Associate Professor, Virginia Tech
2004 – 2009	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
2000	Duke University, Theoretical Physics

Degrees

2000	Ph.D. University of California at Los Angeles, Mechanical Engineering
1994	M.S. University of California at Los Angeles, Mechanical Engineering
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 – 2013	National Science Foundation CAREER Award
2008	College of Engineering Outstanding New Assistant Professor Award, Virginia Tech
2007 – 2008	Dean's Honor List for Excellence in Teaching
2001 – 2003	Burroughs Wellcome Computational Molecular Biology Postdoctoral Fellowship, Department of Physics, Caltech

Journal Papers (under review)

See `http://www.me.vt.edu/mpaul` for most current information.

(27) A. Karimi, and M.R. Paul, Deviations from Extensive Chaos in the Lorenz-96 Model, submitted to *Physical Review E*, (2009).

(26) A. Duggleby and M.R. Paul, The consequences of finite-time proper orthogonal decomposition for an extensively chaotic flow field, submitted to *Computers and Fluids*, (2009).

(25) S. Misra, H. Dankowicz, and M.R. Paul, Degenerate discontinuity-induced bifurcations in tapping-mode atomic-force microscopy, submitted to *Physica D*, (2008).

Journal Papers

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

(24) H. Dankowicz and M.R. Paul, Discontinuity-induced bifurcations in systems with hysteretic force interactions, *Journal of Computational and Nonlinear Mechanics*, **1**, (2009).

(23) M.M. Villa and M.R. Paul, The Stochastic Dynamics of Micron Scale Doubly-Clamped Beams in a Viscous Fluid, *Physical Review E*, **74**, (2009).

(22) S. Kar, W. Baumann, M.R. Paul, and J.J. Tyson, Exploring the Roles of Noise in the Eukaryotic Cell Cycle, to appear *Proceedings of the National Academy of Sciences*, (2009).

(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, *Biophysical Journal*, **95**, 3563–3574, (2008).

(20) N. Hashemi, M.R. Paul, H. Dankowicz, M. Lee, and W. Jhe, The Dissipated Power in Atomic Force Microscopy due to Interactions with a Capillary Fluid Layer, *Journal of Applied Physics*, **104**, 063518, (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, *Journal of Applied Physics*, **103**, 094910, (2008).

(18) N. Hashemi, H. Dankowicz and M.R. Paul, The Nonlinear Dynamics of Tapping Mode Atomic Force Microscopy with Capillary Force Interactions, *Journal of Applied Physics*, **103**, 093512, (2008).

(17) S. Misra, H. Dankowicz, and M.R. Paul, Event-Driven Feedback Tracking and Control of Tapping-Mode Atomic Force Microscopy, *Proceedings of the Royal Society A*, **2095**, (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*, **42**, 690–696, (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) J.L. Arlett, M.R. Paul, J. Solomon, M.C. Cross, S.E. Fraser, and M.L. Roukes, BioNEMS: Nanomechanical Systems for Single-Molecule Biophysics, in Controlled Nanoscale Motion in Biological and Artificial Systems, Lecture Notes in Physics **711**, as part of Nobel Symposium 131, 241–270, (2007).

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

Conference Papers (peer reviewed)

(8) A. Duggleby and M.R. Paul, Exploring Extensive Chaos in Rayleigh-Bénard Convection using fractal and Karhunen-Loève Dimensions, XXII International Conference on Theoretical and Applied Mechanics, Adelaide, Australia, (2008).

(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, (2008).

(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, (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, (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, (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, (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, (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, (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, (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

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

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

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

(19) Quantifying Spatiotemporal Chaos in Rayleigh-Bénard Convection – New Insights from Numerics, Georgia Tech, (2007).

(18) Lectured at the program on "Nonlinear Dynamics of Nanosystems," Chemnitz, Germany, (2006).

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

(16) The Stochastic Dynamics of Arrays of Micro and Nanoscale Cantilevers in a Viscous Fluid, California Institute of Technology, (2006).

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

(14) The Stochastic Dynamics of Micron and Submicron Scale Cantilevers in a Viscous Fluid, Veeco Metrology, Santa Barbara, CA, (2005).

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

(12) New Physical Insights from Experimentally Realistic Numerical Simulations of Rayleigh-Bénard convection, The Newton Institute of Mathematical Sciences, Cambridge University, England, (2005).

(11) The Stochastic Dynamics of Micron and Submicron Scale Mechanical Oscillators, SIAM Conference on Applications of Dynamics Systems, Snowbird, UT, (2005).

(10) New Physical Insights from Experimentally Realistic Numerical Simulations: Spatiotemporal Chaos and BioNEMS, presented to the Civil Engineering Department at Virginia Tech, (2005).

(9) New Physical Insights from Experimentally Realistic Numerical Simulations: Spatiotemporal Chaos and BioNEMS, presented to the Physics Department at Virginia Tech, (2004).

(8) New Physical Insights from Experimentally Realistic Numerical Simulations: Spatiotemporal Chaos and BioNEMS, presented to the Physics Department at New York University, New York, (2004).

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

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

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

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

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

Presentations

(31) A. Karimi and M.R. Paul, Exploring Extensive Chaos in Rayleigh-Bnard Convection, American Physical Society Division of Fluid Dynamics Meeting, San Antonio TX, (2008).

(30) M.T. Clark, M.R. Paul, J.E. Sader, and J.P. Cleveland, The Brownian Force on a Microscopic Cantilever in Viscous Fluid, American Physical Society Division of Fluid Dynamics Meeting, San Antonio TX, (2008).

(29) 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).

(28) 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).

(27) 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).

(26) 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).

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

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

(23) 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).

(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, (2006).

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

(20) A. Williams, C. Clawson, M.R. Paul, and P. Vlachos, Laminar Mixing via Steady Streaming - Using Active Ionic Polymer Actuators, American Physical Society Annual March Meeting, Baltimore, MD, (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, (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, (2006).

(17) M.T. 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, (2006).

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

(14) M.R. Paul and M.T. Clark, The Stochastic Dynamics of Micron and Submicron Scale Mechanical Oscillators, American Physical Society Annual March Meeting, Los Angeles, CA, (2005).

(13) J.D. Scheel, M.C. Cross, and M.R. Paul, Lyapunov Exponents for Small Aspect Ratio Rayleigh-Bénard Convection, American Physical Society Annual March Meeting, Los Angeles, CA, (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, (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, (2003).

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

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

(8) R. Radovitzky and M.R. Paul, A Numerical Approach for the Design of Nanomechanical Biodetectors, 14^{th} U.S. National Congress of Theoretical and Applied Mechanics, Blacksburg, VA, (2002).

(7) M.R. Paul, R. Radovitzky, D. Meiron, and M.C. Cross, The Numerical Design of a Nanoelectromechanical Biodetector, Nanoscale/Molecular Mechanics Conference, Maui, HI, (2002).

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

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

(4) M.R. Paul, M.C. Cross, P.F. Fischer, and 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, (2001).

(3) K.-H. Chiam, M.R. Paul, M.C. Cross, and 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, (2001).

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

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

External Research Funding

(8) 400K, National Science Foundation CAREER award. The Spatiotemporal Chaos of Fluid Convection: New Insights from Numerics, (2008 – 2013).

(7) 1,100K (my level of responsibility 165K), National Institutes of Health, Stochastic Models of Cell Cycle Regulation in Eukaryotes. Co-PI's J. Tyson, A. Sandu, W. Baumann, Y. Cao, C. Shaffer, and L. Watson, (2006 – 2010).

(6) 200K, Air Force Office of Scientific Research, Pushing Measurement to the Ultimate Stochastic Limit: the Stochastic Dynamics of Fluid-Coupled Nanocantilevers, (2006 – 2009).

(5) 50K, National Science Foundation Small Grant for Exploratory Research (SGER), Symmetry-Breaking Bifurcations in an Oscillating Fluid Layer. Co-PI E. Knobloch (Berkeley), (2006 – 2007).

(4) 333K (my level of responsibility 28K). National Science Foundation Research Experiences for Undergraduates (REU). PI Judy Riffle, I am one of 12 Co-PI's. This is a 12-week summer program each summer for three years and is also referred to as a Summer Undergraduate Research Program (SURP), (2006 – 2008).

(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) 189K (my level of responsibility 55K). National Science Foundation Grant Opportunity for Academic Liason with Industry (GOALI) award, Minimum Contact Atomic Force Microscopy. Co-PIs H. Dankowicz and C. Prater, (2005 – 2007).

(1) 44K, Defense Advanced Research Projects Agency funds subcontracted from Caltech, Nanoscale Physics for Biological Applications, (2004).

Internal Research Funding

The following research grants were awarded based upon internal competitions at Virginia Tech.

(2) 150K (my level of responsibility 21K), Virginia Tech Institute for Critical Technology and Applied Science (ICTAS) Grant, Cardiovascular Non-Invasive Diagnostics and Therapies. PI Pavlos Vlachos, Co-PI's R. De Vita, D. Leo, T. Long, M. Roan, and D. Tafti, (2007 – 2008).

(1) 31K, Virginia Tech Aspires Award, Fluid-Coupled Nanomechanical Sensors, (2006).

Selected Supercomputing Allocations

(6) M.R. Paul, Open Challenges in Spatiotemporal Chaos, Symmetry Breaking Bifurcations, and Nonlinear Dynamics at the Nanoscale, 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, 100,000 CPU hours on 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 National Science Foundation's 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, (2003).

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

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

Academic Advising (current)

Postdoctoral Researchers:

(9) Dr. Debashis Barik, Stochastic Models of Cell Cycle Regulation in Eukaryotes. Co-advised with J. Tyson and W. Baumann.

(8) Dr. Sandip Kar, Stochastic Models of Cell Cycle Regulation in Eukaryotes. Co-advised with J. Tyson and W. Baumann.

(7) Dr. Matthew Clark, The Stochastic Dynamics of Nanoscale Cantilevers Immersed in a Viscous fluid.

PhD Students:

(6) Alireza Karimi, The Spatiotemporal Chaos of Fluid Convection. Expected graduation 2010.

(5) Jared Hobeck, The Dynamics of Micron Scale Resonators in a Viscous Fluid. Expected graduation 2013.

Masters Students:

(4) Margarita Villa, Pushing Measurement to the Ultimate Stochastic Limit using Nanoscale Elastic Objects in Fluid. Expected graduation Spring 2009.

Undergraduate Students:

(3) John Bowen, Exploring Chaos using Simple Models.

(2) Brian Pering, Exploring Chaos using Simple Models.

(1) Brandon Holt, Exploring Chaos using Simple Models.

Academic Advising (completed)

Postdoctoral Researchers:

(12) Dr. Ivan Gregoriev (co-advised with Beate Schmittmann and Royce Zia), postdoctoral research on numerical simulations of bioconvection, (2004).

Graduated PhD Students:

(11) Matthew Clark, The Stochastic and Driven Dynamics of Nanoscale Cantilevers in a Viscous Fluid, (2008). Dr. Clark is currently a postdoctoral researcher in the Paul group.

(10) Nastaran Hashemi, Exploring the Nonlinear Dynamics of Tapping Mode Atomic Force Microscopy with Capillary Layer Interactions, (2008). Dr. Hashemi is currently a postdoctoral researcher at the Naval Research Laboratory.

(9) Andrew Duggleby, Characterization of the Mechanism of Drag Reduction Using a Karhunen-Loève Analysis on a Direct Numerical Simulation of Turbulent Pipe Flow, (co-advised with K.S. Ball), (2006). Dr. Duggleby is currently an assistant professor of Mechanical Engineering at Texas A&M University.

Graduated Masters Students:

(8) Nicholas O'Connor, The Complex Spatiotemporal Dynamics of a Shallow Fluid Layer, (2008).

(7) Carlos Carvajal, The Fluid-Coupled Motion of Micro and Nanoscale Cantilevers, (2007).

(6) Magnus Einarsson, Quantifying Spatiotemporal Chaos in Rayleigh-Bénard Convection, (2006).

(5) Matthew Clark, The Stochastic Dynamics of an Array of Micron Scale Cantilevers in Viscous Fluid, (2006).

Completed Undergraduate Research:

(5) John Bowen, Exploring Chaos Using Simple Models, Summer Undergraduate Research Program funded by the National Science Foundation, Summer 2008.

(3) Margarita Villa, Quantifying the Dynamics of Thermoelastically Driven Nanoscale Beams in Fluid, Summer Undergraduate Research Program funded by the National Science Foundation, Summer 2007.

(4) Corbin Clawson, Modeling of an Ionomer Active Fluid Mixer, Summer Undergraduate Research Program funded by the National Science Foundation, Summer 2006.

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

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

Teaching

Further information is available at `www.me.vt.edu/mpaul` and also upon request.

- Developing a New Graduate Course on Spatiotemporal Chaos, Virginia Tech

  ME 6984: Spatiotemporal Chaos (beginning Spring 2009). The course will explore many of the open challenges facing science and engineering involving spatially extended nonlinear dynamical systems that are driven far-from-equilibrium. Important examples include fluid turbulence, the dynamics of the weather and climate, excitable media such as cardiac tissue and nerve fibers, population dynamics, combustion and transport efficiency in the presence of complex flow fields, and the dynamics of the biomass in the oceans. The course will discuss analytical and numerical approaches to gain fundamental physical insights into these systems using both simplified mathematical models and physical examples that can be directly compared with experimental measurements. Expected enrollment is around 20 students.

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

  ME/ESM/SBES 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. This course is cross listed in the Engineering Science and Mechanics (ESM) department and in the School of Biomedical Engineering and Sciences (SBES). Typical enrollment is 20 graduate students.

- Graduate Level Fluid Mechanics, Virginia Tech

  ME 5404 Fluid Dynamics (2004-present, a total of 4 semesters). The course develops and applies the fundamental principles of fluid mechanics with emphasis on incompressible flow. Typical topics covered are flow kinematics, constitutive relations, exact solutions of the Navier-Stokes equations, vorticity dynamics, decomposition of flow fields, potential flow, asymptotic methods, low Reynolds number flow, flow stability, and an introduction to computational fluid dynamics. Typical enrollment is 25 graduate students.

- Undergraduate Introduction to Thermal-Fluid Engineering, Virginia Tech

  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.

- University Lecturing, UCLA

  My PhD research was entirely funded through teaching. I was the instructor of a course on numerical methods and scientific computing in the Mechanical Engineering department for 3 years (9 quarters). Typical class size of approximately 60 students. I was also a teaching assistant for several large undergraduate courses (enrollments of 100 students or more) in the Mechanical Engineering and Chemistry departments.

- Student Teaching Evaluations

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

Professional Activities

- Journal 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
  Journal of Theoretical Biology
  Applied Numerical Mathematics
  Journal of Mechanical Engineering and Science
  BMC Systems Biology

- Proposal reviewer 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
  Louisiana Board of Regents

- Professional Societies:

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

- Invited panel member:

Defense Advanced Research Projects Agency, Defense Sciences Office, Bio-Exploitation: Better Understanding Through Biology, (2007).

- Conference session chair:

  Nanofluids Session at the American Physical Society Meeting of the Division of Fluid Dynamics, Salt Lake City Utah, (2007).

  Partial Differential Equation Modeling session II at the Society for Industrial and Applied Mathematics conference on Applications of Dynamical Systems, Snowbird Utah, (2007).

  Session on Convection and Buoyancy Driven Flows at the American Physical Society Meeting of the Division of Fluid Dynamics, Tampa Florida, (2006).

Selected Outreach and Service

- Numerical experiments for middle school and high-school students (beginning 2009).

  I am developing Java programs to be used in problem solving sessions to demonstrate the use of computers in gaining insights into nonlinear and chaotic challenges facing engineering and science today. The focus will be on the use of simple models and knowledge of programming is not required. Topics will include the difficulty of weather forecasting, the limits of predictability, and the scientific meaning of the "Butterfly Effect". Java programs will be used for their portability and all of the programs and source code will be freely available on a website designed for this purpose. I am working closely with Virginia Tech and the Center for the Enhancement of Engineering Diversity (CEED) to integrate the problem solving sessions with the following programs:

  (i) *C-Tech*^{2}: a two-week summer camp for high school girls.

  (ii) *Imagination*: a one-week summer camp for seventh and eighth and graders from local communities.

  (iii) *The Pre-College Initiative* (PCI): a year-long program for African-American high school students that involves 5 weekend long visits to Virginia Tech.

  (iv) *Women in Computing Day*: a one-day event held at Virginia Tech for middle school girls for hands on experiences with computing.

- Co-organizer of the Virginia Tech Fall Fluid Mechanics Symposium (2007,2008).

  Details for this year's symposium can be found at `http://www.me.vt.edu/fluids`. The symposium is an annual event that began in November 2007 and is a collection of presentations by faculty, postdocs, and students from Virginia Tech and surrounding universities. The majority of the presentations will also be given at the Annual Meeting of the American Physical Society Division of Fluid Dynamics. The symposium showcases the ongoing fluid mechanics research at Virginia Tech and in our region. Co-organizers are P. Vlachos and M. Stremler.

- Mechanical Engineering Committee on Graduate Mathematics (2009 – present).
- Member of PhD and Masters committees of 38 students at Virginia Tech (2004 – present).
- Allocations committee for the Virginia Tech Terascale Computing Facility (2007 – present).
- Mechanical Engineering Department Faculty Search Committee (2007).
- Mechanical Engineering Department Scholarship Committee (2007 – 2008).
- Mechanical Engineering Personnel Committee, Summer (2006).
- Center for Excellence in Undergraduate Teaching Committee on Microfluidics, Department of Engineering Science and Mechanics, Fall (2004).

August, 2009