CAMS

Center for Applied Mathematics and Statistics

ANNUAL REPORT

2005-2006

NJIT

New Jersey's Science & Technology University

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I. FROM THE DIRECTOR

For the past two and a half years, the Department of Mathematical Sciences (DMS) has had the pleasure of being one of a select few NJIT departments to receive funding as part of a university-wide strategic initiative. These funds support the departmental mission of research and training in the applied mathematical sciences, with a particular focus in fluid dynamics and mathematical biology, two areas of strength within the department. The strategic initiative funds have helped the department rise to become one of the most prominent national programs in applied mathematics. One measure of this prominence is the substantial funding that members of the department and the Center for Applied Mathematics and Statistics (CAMS) continue to receive from sources such as the National Science Foundation, National Institutes of Health, National Aeronautics and Space Administration, Office of Naval Research, Department of Energy, and the Air Force Office of Scientific Research.

Especially notable among recent awards is the million-dollar grant from the Howard Hughes Medical Institute given to DMS at NJIT, Rutgers-Newark, and the University of Medicine and Dentistry of New Jersey for an innovative graduate program in quantitative neuroscience. The grant to the three schools, one of only 10 given nationwide, will support their vision of an interdisciplinary doctoral program that will prepare neuroscientists to work on research frontiers where, increasingly, success requires integrating the biomedical, physical and computational sciences.

Some of the other highlights and significant achievements of this past year include:

- The continuing funding of an Undergraduate Biology and Mathematics Training Program Proposal (UBMTP) from the National Science Foundation. This award, given to only six programs nationwide, marks another significant step in the department's efforts to provide innovative training and research experience at the interface of mathematics and biology. The program is currently in its second year. Student presentations from the first round of projects to DMS faculty and students in the spring of 2006 were quite impressive. One of these students has presented the research conducted under the UBMTP program at several scientific conferences. Upon graduation, UBMTP students will be in a unique position to pursue doctoral studies in either mathematics or biology programs, as well as opportunities in bio-tech and pharmaceutical companies.

- The awarding of a Course, Curriculum and Laboratory Improvement (CCLI) grant from the National Science Foundation to greatly enhance the experimental capabilities of the DMS CAPSTONE Laboratory. The CAPSTONE Laboratory was set up in 1996 for the purpose of combining mathematical modeling and analysis, physical experiment, and numerical computation in a two-semester, senior-level undergraduate course. The course has been very successful over the past nine years and, with the aid of the CCLI funding, will be one of the leading facilities of its type nationwide.

- The continuing funding of a Major Research Instrumentation (MRI) grant from the National Science Foundation for a 134 processor parallel computer cluster. The cluster, online as of April 2005, is the most powerful computer on campus and one of the largest of its kind contained within a mathematics department nationwide. The cluster is being used for research projects in interfacial fluid dynamics, granular flow, molecular dynamics, mathematical neuroscience and other areas. The cluster will no doubt serve as a first-rate computational tool for many years to come.

- The hosting of the third annual "Frontiers in Applied and Computational Mathematics (FACM)" conference in May 2006. This year's meeting was focused on Mathematical Fluid Dynamics, and attracted over 125 participants. We are grateful for the many compliments from participants verifying that FACM has become a leading forum for the dissemination of new research and ideas in applied and computational mathematics.

- The recruitment of two new tenure track faculty and three postdoctoral associates during the 2005-2006 academic year. The new faculty greatly bolster DMS and CAMS research activities in mathematical biology and biostatistics. These researchers work in a variety of areas including mathematical biology, computational fluid dynamics, biostatistics, and inverse problems in acoustics.

CAMS and departmental faculty continuously strive to develop innovative programs for the training of undergraduate students in the applied mathematical sciences. Recently, DMS and CAMS members have submitted a proposal to NSF for Computational Science Training for Undergraduates in the Mathematical Sciences (CSUMS), which seeks to build on and enhance the existing curriculum combining mathematics and scientific computation. The proposed program will establish significant group research involvement for undergraduates majoring in mathematical sciences, and will prepare DMS majors for graduate studies in mathematical sciences with an emphasis on scientific computing, or industrial careers requiring strengths in both mathematics and computation.

The accomplishments of CAMS have been built with the support, inspiration, and dedication of many individuals. We are grateful to Fadi Deek, Dean of CSLA, Priscilla Nelson, Provost and Sr. Vice President for Academic Affairs, and Donald Sebastian, Sr. Vice President for Research and Development, for encouraging CAMS through their strong support of scientific research. Finally, we thank President Robert A. Altenkirch, who has been a constant source of support for CAMS and its mission. We are sure that under his capable leadership at NJIT, CAMS will continue to prosper.

Daljit S. Ahluwalia, Director **Michael Siegel, Associate Director**

II. MISSION STATEMENT

The Center for Applied Mathematics and Statistics (CAMS) is an interdisciplinary research center dedicated to supporting applied research in the mathematical sciences at NJIT. CAMS was established in 1986 to promote research in the mathematical sciences at the New Jersey Institute of Technology. Members of the Department of Mathematical Sciences naturally form the core of CAMS membership, but the importance of mathematics for science and technology has made CAMS an interdisciplinary organization.

CAMS brings researchers from academia, industry, and government to NJIT by organizing interdisciplinary workshops and by bringing together researchers with common goals whose strengths are complementary. CAMS activities also include support for the submission of research proposals, which is done through dissemination of information, organization of group projects, collegial advice and assistance with application documents. Graduate student research is encouraged through the CAMS Summer Research Program and support for students to attend conferences. CAMS sponsors an annual meeting, "Frontiers in Applied and Computational Mathematics," which has become a leading forum for the presentation of new research in applied mathematics and the sciences.

In the future, CAMS hopes and expects to maintain its high standards of professionalism and scholarship and plans to extend its activities to include fostering more research by undergraduate students and developing long-term relationships with industry.

Department of Mathematical Sciences

Advisory Board - 2006

Dr. John S. Abbott	Corning Incorporated
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Dr. Peter E. Castro	Eastman Kodak Company (formerly)
Dr. Ned J. Corron	U.S. Army AMCOM
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Ms. Krystyna J. Monczka	Hewitt Associates
Dr. Richard Silberglitt	Rand Corporation
Dr. James W. Watson	AT&T Laboratories (formerly)
Dr. Benjamin White	Exxon Research & Engineering

III. MEMBERS AND VISITORS

Department of Mathematical Sciences

Ahluwalia, Daljit S.
Andrushkiw, Roman
Bechtold, John
Bhattacharjee, Manish
Blackmore, Denis
Booty, Michael
Bose, Amitabha
Bukiet, Bruce
Choi, Wooyoung
Dhar, Sunil
Dios, Rose
Drover, Jonathan
Elmer, Christopher
Goldberg, Vladislav
Goldman, Daniel
Golowasch, Jorge
Goodman, Roy
Gordon, Peter
Horntrop, David
Jain, Aridaman
Jiang, Shidong
Kappraff, Jay
Khan, Hafiz M. R.
Kondic, Lou
Kriegsmann, Gregory A.
Luke, Jonathan
Matveev, Victor
Michalopoulou, Zoi-Heleni
Milojevic, Petronije
Miura, Robert M.
Moore, Richard
Muratov, Cyrill
Nadim, Farzan
Ozen, Ozgur
Papageorgiou, Demetrios
Perez, Manuel
Petropoulos, Peter G.
Raymond, Christopher
Russell, Gareth
Siegel, Michael
Stickler, David
Tao, Louis
Tavantzis, John
Venkateswaran, Venkat
Wang, Sheldon
Young, Yuan-Nan

Department of Civil and Environmental Engineering: Meegoda, Jay

Department of Computer Science: Ma, Marc Qun

Department of Information Systems: Deek, Fadi P.

Department of Mechanical Engineering: Aubry, Nadine; Rosato, Anthony

Federated Department of Biological Sciences: Holzapfel, Claus (Rutgers University)

CAMS Research Professors

Booth, Victoria	University of Michigan, Ann Arbor
Diez, Javier	University Nacional del Centro, Tandil, Argentina
Erneux, Thomas	Université Libre de Bruxelles, Belgium
Georgieva, Anna	Novartis Pharmaceuticals Corporation, East Hanover, NJ
Huang, Huaxiong	York University, Toronto, Canada
Lott, Dawn	Delaware State University, Dover
Mauri, Roberto	Università degli Studi di Pisa, Italy
Vanden-Broeck, Jean-Marc	University of East Anglia, Norwich, England

IV. COLLOQUIA AND SEMINARS

Department of Mathematical Sciences Colloquium

September 2	**Bernard J. Matkowsky**, Northwestern University *Dynamics of Hot Spots in Solid Fuel Combustion*
September 9	**Hillel Chiel**, Case Western Reserve University *Differential Penetrance and Biological Principles*
September 16	**Colin McKinstrie**, Lucent Technologies *Phase Jitter in Optical Communications Systems*
September 23	**Guillaume Bal**, Columbia University *Radiative Transfer Equations and Applications*
October 7	**Gavin Schmidt**, Goddard Institute for Space Studies *Climate Models, Climate Forcings and Climate Change*
October 14	**Chris Jones**, University of North Carolina *Do Forcing and Viscosity Drive Chaotic Advection?*
October 21	**Gareth J. Russell**, NJIT and Rutgers-Newark *Modeling Biological Invasions - from Beetles in New Jersey to Plants in the Everglades*
October 28	**Wooyoung Choi**, NJIT *First Step Toward Detecting Giant Internal Solitary Waves*
November 4	**Peter Gordon**, NJIT *Detonation and Deflagration in Porous Media Combustion*
November 11	**L. Mahadevan**, Harvard University *Extreme Elastohydrodynamics: of Flags, Fishes, and Plants*
November 18	**J. D. Gunton**, Lehigh University *Condensation of Globular Proteins from Solution*
December 2	**Oliver Buhler**, Courant Institute, NYU *Small Waves, Large Vortices and the Gait of the Water Strider*
January 20	**David Keyes**, Columbia University *Scientific Discovery through Advanced Computing*
January 27	**Kyle Becker**, The Pennsylvania State University *Seabed Sediment Properties Inferred from Shallow-Water Acoustic Field Data*
February 3	**David Sattinger**, Yale University *How Deep is the Bay of Bengal?*

February 10 **Alan Weiss**, Bell Laboratories
Mathematics of Training an Optical Switch

February 17 **Peter Kramer**, Rensselaer Polytechnic Institute
Exploring Lagrangian Turbulence Closure Schemes Through Simple Mathematical Models

February 24 **Thomas Wanner**, George Mason University
Computational Homology and the Evolution of Complex Patterns

March 3 **Chjan Lim**, Rensselaer Polytechnic Institute
A Second Modulus of Elasticity for an Ensemble of Vortex Lines - New Vortex Matter in Superfluid He4 and Superconductors

March 10 **Robert Miura**, New Jersey Institute of Technology
Solitons and the Inverse Scattering Method: An Historical View

March 24 **Roberto Camassa**, University of North Carolina
Spinning Rods, Microfluidics, and Mucus Propulsion by Cilia in the Lung

March 31 **Eldar Giladi**, Rensselaer Polytechnic Institute
Asymptotically Derived Boundary Element and Finite Element Methods for the Helmholtz Equation in High Frequency

April 7 **Peter Smereka**, University of Michigan
Efficient Computational Methods for Epitaxial Growth

April 21 **Tim Schulze**, University of Tennessee
The Many Facets of Simulating Epitaxial Growth

April 28 **Victor Roytburd**, Rensselaer Polytechnic Institute
Dynamics of Non-Equilibrium Interfaces

Statistics Seminar

October 12 **Javier Cabrera**, Department of Statistics, Rutgers University
Jose Alvir and **Ha Nguyen**, Pfizer Pharmaceuticals
ARF - Bite into Juicy Parts of your Data

November 9 **Daniel Zelterman**, Biostatistics :School of Public Health, Yale University
Statistical Inference for Familial Disease Clusters

February 16 **Jyotirmoy Dey**, Schering-Plough Research Institute
When the Data Speaks for Itself, Why Interrupt?

April 20 **Dhammika Amaratunga**, Johnson & Johnson Pharmaceutical Research and Development
Exploration and Analysis of DNA Microarray Data

April 27 **Zailong Wang**, Novartis Pharmaceuticals and Mathematical Biosciences Institute, The Ohio State University; **Shili Lin**, (Department of Statistics, OSU), **Magdalena Popesco** and **Andrej Rotter** (Department of Pharmacology, OSU)
Statistical Modeling and Analysis of SAGE Libraries

Mathematical Biology Seminar

September 13 **Eric Salathé**, Department of Mathematics, Lehigh University
Mathematical Modeling of Oxygen Transport to Tissue

September 20 **Nicolas Brunel**, CNRS, Laboratory of Neurophysics and Physiology, Université Paris 5
Optimal Information Storage and the Distribution of Synaptic Weights: Experiment vs Theory

September 27 **Jonathan D. Drover**, Department of Mathematical Sciences, NJIT
A Model of Electrically Induced Phosphenes

October 4 **Pascale Rabbah**, Department of Biological Sciences, Rutgers-Newark
Investigation of the Intrinsic and Synaptic Properties of Pacemaker Neurons in an Oscillatory Neural Network

October 11 **Remus Osan**, Department of Biomedical Engineering, Boston University
Single and Multiple-Spikes Traveling Wave Solutions in Integrate and Fire Neural Networks

October 18 **Avraham Soffer**, Department of Mathematics, Rutgers University, New Brunswick
Dynamics of DNA: A New Model and Some Applications

November 1 **Neuroscience Symposium:** *Illuminating the Biological Manuscript: Imageable Function in Channels, Cells, Circuits, and Cognition*

November 8 **R. E. Lee DeVille**, Courant Institute of Mathematical Sciences, New York University
Finite-Size Effects and Stochastic Resonance

November 17 **Michael Graupner**, CNRS, Laboratory of Neurophysics and Physiology, Université Paris
Transitions in a Bistable Model of the Calcium/Calmodulin-Dependent Protein Kinase Phosphatase System in Response to STDP Protocols

November 29 **Ernest Barreto**, Department of Physics and Astronomy and the Krasnow Institute for Advanced Study, George Mason University
Models of Electric Field Modulation of Synchronization and Activity Propagation

December 6 **Esther Stern**, Department of Physiology and Biophysics, Mount Sinai School of Medicine
A Method for Decoding Neurophysiological Responses to Arbitrary Spike Trains

January 26 **Sara Del Valle**, Los Alamos National Laboratory
Unleashing Virtual Plagues in Real Cities

January 30 **Kunj Patel** and **Jonathan Lansey** (UBM Program), Dept of Math Sciences, NJIT and Federated Dept of Biological Sciences, Rutgers-Newark
Deja Vu Communities and Spatial Dynamics of Frontiers of Competing Plant Species

January 30 **Diana Martinez**, **Matt Malej**, and **Angelie Mascarinas** (UBM Program), Dept of Math Sciences, NJIT and Federated Dept of Biological Sciences, Rutgers-Newark
Using Experimental Methods and Mathematical Modeling to Determine the Position of Gap Junctional Coupling Between Two Neurons

February 6 **Paul Atzberger**, Department of Mathematics, Rensselaer Polytechnic Institute
A Stochastic Immersed Boundary Method Incorporating Thermal Fluctuations: Toward Modeling Cellular Micromechanics

February 7 **Alex Proekt**, Department of Physiology and Biophysics, Mount Sinai School of Medicine
Predicting the Environment from CNS Dynamics

February 8 **Horacio Rotstein**, Center for Biodynamics & Department of Mathematics, Boston University
Subthreshold Oscillations and the Onset of Spikes in Entorhinal Cortex Stellate Cells: A Dynamical Systems Approach

February 9 **Rodica Curtu**, Transilvania University of Brasov, Romania
Dynamical Characteristics Common to Neuronal Competition Models

February 16 **Robert Clewley**, Department of Mathematics, Cornell University
Reduced Biophysical Models that Explore the Roles of Electrical Coupling Between Neurons

February 28 **Evelyn Sander**, Department of Math Sciences, George Mason University
Short-Term Synaptic Plasticity in Epileptic Seizures

March 7 **Usman W. Roshan**, Computer Science Department, NJIT
Boosting Phylogeny Reconstruction using Recursive-Iterative-DCM3

March 21 **Kevin K. Lin**, Courant Institute of Mathematical Sciences, NYU
Entrainment and Chaos in Pulse-Driven Oscillators

March 28 **Ning Qian**, Center for Neurobiology & Behavior and the Mahoney Center for Brain & Behavior Research, Columbia University
An Optimization Principle for Determining Movement Duration

April 4 **Eric Shea-Brown,** Courant Institute and the Center for Neural Science, NYU
How Architecture Restricts Spiking Patterns in Phase Oscillator Networks

April 11 **Kevin Hall**, Laboratory for Biological Modeling, NIDDK, National Institutes of Health
Computational Model of Human Energy Metabolism and the Regulation of Body Weight

April 18 **Boyce Griffith**, Courant Institute of Mathematical Sciences, NYU
Adaptive Immersed Boundary Methods for Simulating Cardiac Blood-Muscle-Valve Mechanics and Electrophysiology

April 25 **Carol Venanzi**, Department of Chemistry & Environmental Science, NJIT
Mathematical Modeling of Drugs to Treat Cocaine Abuse

May 2 **Sorinel Oprisan**, Dept of Physics and Astronomy, College of Charleston
A Computational Model of Dopamine Neuron

Fluid Mechanics Seminar

September 12 **Jun Zhang**, Courant Institute, New York University
Unidirectional Flight of a Flapping Wing

October 10 **Jerzy Blawzdziewicz**, Department of Mechanical Engineering, Yale University
Many-Particle Hydrodynamic Interactions in Split Pores and Thin Liquid Films

November 14 **Hao Lin**, Department of Mechanical and Aerospace Engineering, Rutgers University
Complex Electrokinetic/Electrohydrodynamic Flows in Microfluidic Applications

December 5 **Lou Kondic**, Department of Mathematical Sciences, NJIT
Modeling Dense Granular Systems

December 12 **Jonathan Luke**, Department of Mathematical Sciences, NJIT
Symmetries and Global Structure in a Sedimenting Suspension

January 23 **Xinfeng Liu**, SUNY, Stony Brook
Turbulent Mixing with Physical Surface Tension and Mass Diffusion

February 13 **Lyudmyla Barannyk**, Department of Mathematics, University of Michigan, Ann Arbor
A Study of Vortex Sheet Motion with Density Stratification in an Inclined Channel

February 27 **Daniel Attinger**, Department of Mechanical Engineering, Columbia University
Microscale Transport Phenomena in the Presence of Interfaces

March 27 **Hantao Ji**, PPPL, Princeton University
Laboratory Astrophysics: Hydrodynamic Results from Princeton Magnetorotational Instability Experiment

April 3 **Wooyoung Choi**, Department of Mathematical Sciences, NJIT
The Hodograph Transformation and its Generalization for Fully Nonlinear Water Waves

April 10 **Sunny Jung**, AML, New York University
Periodic Motion of Body in High and Low Reynolds Numbers Flow

April 17 **Mahesh M. Bandi**, Department of Physics, Pittsburgh University
Entropy Extraction Rate and a Test for Fluctuation Relation in Compressible Turbulence

May 1 **Ozgur Ozen**, Department of Mathematical Sciences, New Jersey Institute of Technology
Electrohydrodynamic Instabilities in Microchannels

Waves on Wednesdays Seminar

October 5	**David Stickler**, NJIT *Ray Theory and Layered Media*
October 19	**David Trubatch**, US Military Academy at West Point *Recurrence in the Korteweg-de Vries Equation?*
November 2	**David Stickler**, NJIT *Inversion of the Born Approximation for the Half-Line Dirichlet Problem*
November 9	**Deborah Berebichez**, New York University *Time-Reversal for Temporal Compression and Spatial Focusing of Acoustic Waves in Enclosures*
November 16	**Semyon Tsynkov**, North Carolina State University *Numerical Solution of the Nonlinear Helmholtz Equation Using Nonorthogonal Expansions*
December 7	**Boguk Kim**, Massachusetts Institute of Technology *Transverse Instability of Gravity-Capillary Solitary Waves and Formation of Lumps*
March 1	**Kai Huang**, University of California at Irvine *Long Range Wave Propagation and Time Reversal*
March 8	**Christopher Elmer**, NJIT *Finding Traveling Wave Solutions to Bistable Reaction-Diffusion Equations on Spatially Discrete Domains (with Some Applications)*
March 23	**Yassine Boubendir**, University of Minnesota *Domain Decomposition Methods for Scattering Problems*
March 29	**Andrew Poje**, College of Staten Island *What's Wrong with Gulf Stream Rings: A Lagrangian Model Analysis*
April 19	**Harish Bhat**, Columbia University *Waves in Discrete Electronic Lattices*

V. PUBLICATIONS, PRESENTATIONS, AND REPORTS

A. PUBLICATIONS

JOURNAL PUBLICATIONS

Nadine Aubry

Trapping Force on a Finite Sized Particle in a Dielectrophoretic Cage (with P. Singh), Physical Review E 72, 016602-1:016602-5, July 2005.

Dynamics of Microfluidic Mixing using Time Pulsing (with A. Goullet and I. Glasgow), Discrete and Continuous Dynamical Systems-A 13 Suppl., 327-336, August 2005.

Dielectrophoresis Induced Clustering Regimes of Viable Yeast Cells (with J. Kadaksham and P. Singh), Electrophoresis 26(19), 3738-3744, October 2005.

Control of Vortex Shedding behind a Circular Cylinder using Electromagnetic Forces (with Z. Chen, B. Fan and B. Zhou), Modern Physics Letters B 19(28-29), 1627-1630, December 2005.

Manipulation of Particles using Dielectrophoresis (with J. Kadaksham and P. Singh), Mechanics Research Communications 33(1), 108-122, January 2006.

Influence of Particle-Particle Interactions and Particle Rotational Motions in Traveling Wave Dielectrophoresis (with P. Singh), Electrophoresis 27(3), 703-715, February 2006.

Electrohydrodynamic Linear Stability of Two Immiscible Fluids in Channel Flow (with O. Ozen, D. Papageorgiou, and P. Petropoulos), Electrochimica Acta 51, 11425-1:11525-8, March 2006.

Electro-Hydrodynamic Micro-Fluidic Mixer (with A. Ould El Moctar and J. Batton), La Houille Blanche 3/2006, 1-7, March 2006.

Monodisperse Drop Formation in Square Microchannels (with O. Ozen, P. Papageorgiou, and P. Petropoulos), Physical Review Letters 96, 144501-1:144501-4, April 2006.

Trapping Heavy Metals by using Calcium Hydroxyapatite and Dielectrophoresis (with J. Batton, A. Kadaksham, A. Nzihou, and P. Singh), Journal of Hazardous Materials, April 2006.

Control of Electrostatic Particle-Particle Interactions in Dielectrophoresis (with P. Singh), Europhysics Letters 74(4), 623-629, April 2006.

Effects of Microchannel Geometry on Pulsed Flow Mixing (with A. Goullet and I. Glasgow), Mechanics Research Communications 33(5), 739-746, June 2006.

John Bechtold

Nonlinear Oscillations in Diffusion Flames (with H. Y. Wang and C. K. Law), Combust. Flame, 145, pp. 376-389, January 2006.

Denis Blackmore

New Models for Chaotic Dynamics, Reg. & Chaotic Dyn. (Special Poincare 150th Anniversary Issue), Vol. 10, pp. 307-321, July 2005.

Integrability by Quadratures of Hamiltonian Systems and Picard-Fuchs Equations: the Modern Differential-Geometric Aspects (with A. Prykarpatsky, Y. Prykarpatsky, and Y. Samoilenko), Miskolc Math. Notes, Vol. 6, pp. 65-103, July 2005.

The Ergodic Measures Related to Nonautonomous Hamiltonian Systems and Their Homology Structure. Part I (with A. Prykarpatsky, Y. Prykarpatsky, and Y. Samoilenko), CUBO, Vol. 7, pp. 49-63, December 2005.

Michael Booty

Steady Deformation and Tip-Streaming of a Slender Bubble with Surfactant in an Extensional Flow (with M. Siegel), J. Fluid Mech., Vol. 544, pp.243-275, December 2005.

Amitabha Bose

The Effects of Varying the Timing of Inputs on a Neural Oscillator (with C. Ambrosio and F. Nadim), SIAM J. Appl. Dyn. Syst. Vol. 5, pp. 108-139, February 2006.

Wooyoung Choi

On the Realm of Validity of Strongly Nonlinear Asymptotic Approximations for Internal Waves (with R. Camassa, H. Michallet, P. Rusas and J. K. Sveen), J. of Fluid Mech., Vol. 549, pp. 1-23, February 2006.

The Effect of a Background Shear Current on Large Amplitude Internal Solitary Waves, Phys. Fluids, Vol. 18, 036601, March 2006.

Sunil Dhar

On the Characterization of a Bivariate Geometric Distribution (with Srinivasan Balaji), Journal of Communications in Statistics, Theory and Methods, Vol. 35(5), pp. 759-766, May 2006.

Development of a Recursive Finite Difference Pharmacokinetic Model of Propofol from an Exponential Model (with Glen Atlas), Journal of Pharmaceutical Sciences, Vol. 95, pp. 810-20, April 2006.

A Bootstrap-Based Test for Establishing Noninferiority in Clinical Trials (with Michael Chen and Farid Kianifard), Journal of Biopharmaceutical Statistics, Vol. 16, pp. 357-363, June 2006.

Computation of Tests to Evaluate Randomness (with Varun Oberoi), Journal of Statistical Theory and Applications, Vol. 4(2), pp. 109-120, 2005.

The Small Sample Robust Minimum Distance Estimators of Shift in the Two-Sample Location Model (with Dalai Chen), Journal of Applied Statistical Science, Vol. 14(1), pp. 127-139, 2005.

Javier Diez

Unstable Spreading of a Fluid Filament on a Vertical Plane: Experiments and Simulations (with A. G.

Gonzalez, J. Gomba, L. Kondic, and R. Gratton), Physica D, Vol. 209, pp. 49-61, July 2005.

On Nontrivial Traveling Waves in Thin Film Flows Including Contact Lines (with Lou Kondic), Physica D, Vol. 209, pp. 135-144, July 2005.

Thomas Erneux

Parametric Amplification of Frequency-Shifted Optical Feedback (with A. Witomski, E. Lacot, and O. Hugon) Physical Review A 72, 023801, August 2005.

Two-Field Description of Chaos Synchronization in Diode Lasers with Incoherent Optical Feedback and Injection (with D.W. Sukow, A. Gavrielides, M.J. Baracco, Z.A. Parmenter, and K.L. Blackburn), Physical Review A 72, 043818, October 2005.

Delayed Pulse Dynamics in Single Mode Class B Lasers (with B. Ségard and P. Glorieux), Applied Physics B 81, 989-992, November 2005.

Bifurcation to Large Period Oscillations in Physical Systems Controlled by Delay (with H.-O. Walther), Phys. Review E 72, 066206, December 2005.

Mesa-Type Patterns in the One-Dimensional Brusselator and their Stability (with T. Kolokolnikov and J. Wei), Physica D 214, 63-77, February 2006.

Fast Self-Pulsing through Nonlinear Incoherent Feedback (with P. Kockaert, C. Cambournac, M. Haelterman, and G. Kozyreff), Optics Letters 31, 495-497, February 2006.

Modulation of Neuronal Excitability by Intracellular Calcium Buffering: From Spiking to Bursting (with C. Roussel, S.N. Schiffmann, and D. Gall), Cell Calcium 39, 455-466, May 2006.

Vladislav V. Goldberg

To the Memory of a Friend (Russian) (with M. A. Akivis, S. H.Haroutinyan, Yu. G. Lumiste, V. A. Mirzoyan, B. A. Rosenfeld, and A.M. Shelekhov), Contemporary Mathematics and Its Applications, Vol.32, pp. 3-6 (Russian). English translation: J. Math. Sci. **32** (2005), pp. 3-6, October 2005.

On the Blaschke Conjecture for 3-webs (with V. V. Lychagin), J. Geom. Anal., Vol. 16, no. 1, pp. 69-115, March 2006.

Local Algebras of a Differentiable Quasigroup (with M. A.Akivis), Bull. Amer. Math. Soc., Vol. 43, no. 2, pp. 207-226, April 2006.

Daniel Goldman

Effect of Decreased O2 Supply on Skeletal Muscle Oxygenation and O2 Consumption During Sepsis: Role of Heterogeneous Capillary Spacing and Blood Flow (with R. M. Bateman and C. G. Ellis), Am. J. Physiol. Heart Circ. Physiol., Vol. 290, pp. H2277-H2285, June 2006.

Jorge Golowasch

Signal Transmission between Gap-Junctionally Coupled Passive Cables is Most Effective at an Optimal Diameter (with F. Nadim), J. Neurophysiology, 95 (6): 3831-3843, 2006.

Roy Goodman

Kink-Antikink Collisions in the Phi-Four Equation: The n-Bounce Resonance and the Separatrix Map (with R. Haberman), SIAM J. Appl. Dyn. Sys., Vol. 4, pp1 195-1228, November 2005.

Peter Gordon

On Metastable Deflagration in Porous Medium Combustion (with N.M. Bessonov, G.I. Sivashinsky and A. Zinoviev), Applied Mathematics Letters, Vol. 18(8), pp. 897-903, August 2005.

Quenching and Propagation of Combustion Fronts in Porous Media, Communications in Mathematical Sciences, Vol. 4, Number 2, pp. 471-479, June 2006.

Claus Holzapfel

Annual Plant-Shrub Interactions Along an Aridity Gradient in Israel (withK. Tielbörger, H.A. Parag, J. Kigel, and M. Sternberg), Basic and Applied Ecology 7: 268-279, 2006.

David J. Horntrop

Mesoscopic Simulation for Self-Organization in Surface Processes (with M. Bailon), Applied Mathematics and Computation, Vol. 176, pp. 383-387, May 2006.

Huaxiang Huang

Grown-in Defects Modeling of InSb Crystals and Computation Defects inside InSb Crystals (with N. Vaidya and D. Liang), Communication in Computational Physics, 1(3), 513-529, 2006.

A Semi-Analytical Model for the Cz Growth of Type III-V Compounds (with S. Bohun, I. Frigaard, and S. Liang), SIAM Journal on Applied Mathematics, 66 (5), 1533-1562, 2006.

Shidong Jiang

Hyperpolarizabilities for the One-Dimensional Infinite Single-Electron Periodic Systems I. Analytical Solutions under Dipole-Dipole Correlations (with M. Xu), J. Chem. Phys., Vol. 123, 064901, August 2005.

Hyperpolarizabilities for the One-Dimensional Infinite Single-Electron Periodic Systems II. Dipole-Dipole versus Current-Current Correlations (with M. Xu), J. Chem. Phys., Vol. 123, 064902, August 2005.

Lou Kondic

Stabilization of Nonlinear Velocity Profiles in Athermal Systems Undergoing Planar Shear Flow (with N. Xu and C. O'Hern), Phys. Rev. E, Vol. 72, 041504, pp. 1-10, November 2005.

Velocity Profiles, Stresses, and Bagnold Scaling of Sheared Granular System in Zero Gravity (with O. Baran), Phys. Fluids, Vol. 17, 073304, pp. 1-15, November 2005.

On Nontrivial Traveling Waves in Thin Film Flows Including Contact Lines (with J. Diez), Physica D, Vol. 209, pp. 135-144, September 2005.

On Undercompressive Shocks in Constrained Two-Layer Flows (with T. Segin and B. Tilley), Physica D, Vol. 209, pp. 245-259, September 2005.

Unstable Spreading of a Fluid Filament on a Vertical Plane: Experiments and Simulations (with J. Diez, A. G. Gonzalez, J. Gomba, and R. Gratton), Physica D, Vol. 209, pp. 49-61, September 2005.

Gregory A. Kriegsmann

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Jay N. Meegoda

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Zoi-Heleni Michalopoulou

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Petronije S. Milojevic

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Robert M. Miura

Spatial Buffering Mechanism: Mathematical Model and Computer Simulations (with B. Steinberg, Y. Wang, and H. Huang), Math. Biosci. and Engin. 2, pp. 675-702, 2005.

Richard O. Moore

Soliton Broadening under Random Dispersion Fluctuations: Importance Sampling Based on Low-Dimensional Reductions (with T. Schaefer and C. K. R. T. Jones), Optics Communications, Vol. 256, pp. 439-450, December 2005.

Cyrill Muratov

Traveling Wave Solutions of Harmonic Heat Flow (with M. Bertsch and I. Primi), Calc. Var. PDE 26, 489-509, 2006.

Optimal Grid-Based Methods for Thin Film Micromagnetics Simulations (with V. V. Osipov), J. Comput. Phys. 216, 637-653, 2006.

Signal Propagation and Failure in Discrete Autocrine Relays (with E. Vanden Eijnden and W. E), Physica D, Vol. 210, pp. 227–240, August 2005.

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Homogenization of Boundary Conditions for Surfaces with Regular Arrays of Traps (with A. M. Berezhkovskii, M. I. Monine, and S. Y. Shvartsman), J. Chem. Phys., Vol. 124, pp. 036103 1-3, January 2006.

Farzan Nadim

Proprioceptor Regulation of Motor Circuit Activity by Presynaptic Inhibition of a Modulatory Projection Neuron (with M.P. Beenhakker, N.D. DeLong, S.R. Saideman, M.P. Nusbaum), J. Neuroscience, Vol 25, pp. 8794-8806, September 2005.

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The Effects of Varying the Timing of Inputs on a Conditional Oscillator (with C. Ambrosio and A. Bose), SIAM Journal on Applied Dynamical Systems, Vol 5, pp. 108-139, January 2006.

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The Interaction Between Facilitation and Depression of Two Release Mechanisms in a Single Synapse (with L. Zhou and R. LoMauro), Neurocomputing, Vol 69, pp. 1001-1005, June 2006.

Ozgur Ozen

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Monodisperse Drop Formation in Square Microchannels (with N. Aubry, D. T. Papageorgiou, and P. G. Petropoulos), Physical Review Letters, 96, 144501, April 2006.

Electrohydrodynamic Linear Stability of Two Immiscible Fluids in Channel Flow (with N. Aubry, D. T. Papageorgiou, and P. G. Petropoulos), Electrochimica Acta, March 2006.

D.T. Papageorgiou

On Compound Liquid Threads with Large Viscosity Contrasts (with R.V. Craster and O. Matar), J. Fluid Mech., Vol.533, pp. 95-124, July 2005.

Accurate and Efficient Boundary Integral Methods for Electrified Liquid Bridge Problems (with D. Volkov and P.G. Petropoulos), SIAM J. Sci. Comp., Vol. 26, pp. 2102-2132, June 2005.

Gravity Capillary Waves in Fluid Layers under Normal Electric Fields (with P.G. Petropoulos and J.-M. Vanden-Broeck), Phys. Rev. E, 72 (5): 051601 Part 1, November 2005.

The Absolute Instability of an Inviscid Compound Jet (with A. Chauhan, C. Maldarelli and D.S. Rumschitzki), J. Fluid Mech., Vol. 549, pp. 81-98, February 2006.

Monodisperse Drop Formation in Square Microchannels (with O. Ozen, N. Aubry and P.G. Petropoulos), Phys. Rev Letters, 96 (14): 144501, April 2006.

Nonlinear Stability of a Charged Electrified Viscous Liquid Sheet under the Action of a Horizontal Electric Field (with O.Ozen and P.G. Petropoulos), Phys. Fluids, 18 (4): 042102, April 2006.

Wave Evolution on Electrified Falling Films (with D. Tseluiko), J. Fluid Mech., Vol. 556, pp. 361-386, June 2006.

Peter G. Petropoulos

Accurate and Efficient Boundary Integral Methods for Electrified Liquid Bridge Problems (with D. Volkov and D.T. Papageorgiou), SIAM Journal on Scientific Computing, Vol. 26, pp. 2102-2132, June 2005.

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Gravity Capillary Waves in Fluid Layers under Normal Electric Fields (with D.T. Papageorgiou and J-M. Vanden-Broeck), Physical Review E, Vol. 72, pp. 0516011-0516019, November 2005.

Monodisperse Drop Formation in Square Microchannels (with O. Ozen, N. Aubry, and D.T. Papageorgiou), Physical Review Letters, Vol. 96, pp. 1445011-1445014, April 2006.

Nonlinear Stability of a Charged Electrified Viscous Liquid Sheet under the Action of a Horizontal Electric Field (with O. Ozen and D.T. Papageorgiou), Physics of Fluids, Vol. 18, pp. 0421021-04210210, April 2006.

Anthony Rosato

Migration of an Intruder in a Boundary Driven Granular Flow (with J. Liu), J. Phys: Condens. Matter 17, S2609-S2622, 2005.

Michael Siegel

Steady Deformation and Tip-Streaming of a Slender Bubble with Surfactant in an Extensional Flow (with M.B. Booty), J. Fluid Mech., Vol. 544, pp. 243-275, December 2005.

Louis Tao

Kinetic Theory for Neuronal Network Dynamics (with D. Cai, A. V. Rangan, and D. W. McLaughlin), Comm. Math. Sci., Vol. 4, pp. 97-127, April 2006.

Jean-Marc Vanden-Broeck

Monte Carlo Simulation of an Inhomogeneous Dielectric Continuum Model for B-DNA (with S. Grandison and R. Penfold), Phys.Chem. Chem. Phys. Vol 7, pp 3486-3495, October 2005.

Forced Solitary Waves and Fronts Past Submerged Obstacles (with B. Binder and F. Dias), Chaos Vol 15, 037106, September 2005.

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Three-Dimensional Gravity-Capillary Solitary Waves in Water of Finite Depth and Related Problems (with E. Parau and M.J. Cooker), Phys. Fluids Vol 17, 122101, December 2005.

Nonlinear Gravity Three Dimensional Gravity Capillary Solitary Waves and Related Free Surface Flows (with E. Parau and M. Cooker), J. Fluid Mech. Vol. 536, pp 99-105, August 2005.

New Solutions for Capillary Waves on Curved Sheets of Fluids (with M.Blyth), IMA J. Appl. Math. Vol 70, pp 588-601, August 2005.

Free Surface Flows Past Surfboards and Sluice Gates (with B. Binder), Eur. J. Applied Mathematics, Vol 16, pp 601-619, December 2005.

X. Sheldon Wang

From Immersed Boundary Method to Immersed Continuum Method, International Journal for Multiscale Computational Engineering, Vol. 4(1), 2006.

Dynamic Modelling of Prosthetic Chorded Mitral Valves Using the Immersed Boundary Method (with P.N. Watton, X.Y. Luo, G.M. Bernacca, P. Molloy, and D.J. Wheatley), Journal of Biomechanics, 2006.

Immersed Finite Element Method and Its Applications to Biological Systems (with W.K. Liu, Y. Liu, D. Farrell, L. Zhang, Y. Fukui, N. Patankar, Y. Zhang, C. Bajaj, X. Chen, and H. Hsu), Computer Methods in Applied Mechanics and Engineering, Vol. 195, pp. 1722-1749, 2006.

Yuan-Nan Young

Surface Tension in Incompressible Rayleigh-Taylor Mixing Flow (with F. E. Ham), Journal of Turbulence, June 2006.

BOOKS AND BOOK CHAPTERS

Amitabha Bose

Bursting in 2-Compartment Neurons: A Case Study of the Pinsky-Rinzel Model, in Bursting: The Genesis of Rhythm in the Nervous System (with V. Booth), Eds. Stephen Coombes and Paul Bressloff, pp. 123-144, December 2005.

PROCEEDINGS PUBLICATIONS

Roman Andrushkiw

The Exact Confidence Limits for Unknown Probability in Bernoulli Models (with D. Klyushin, Yu. Petunin, M. Savkina), Proceedings of the 27th International Conference on Information Technology Interfaces, V. Luzar-Stiffler, ed., pp. 175-179, IMACS & SRCE University Computing Center, University of Zagreb, July 2005.

Denis Blackmore

Accuracy and Computational Complexity Analysis of Design Model Created by Virtual Sculpting (with M.C. Leu, X. Peng, and W. Zhang), Proc. 2005 IMECE, pp. 245-250, Orlando, FL, November 2005.

Thomas Erneux

Modelling Nonlinear Optics Phenomena Using Delay Differential Equations (with L. Larger, K. Green, and D. Roose), in "Equadiff 2003", F. Dumortier, H. Broer, J. Mawhin, A. Vanderbauwhede, and S. Verduyn Lunel, Eds. , World Scientific, London, pp. 756-761, 2005.

Polarization Dynamics in Semiconductor Lasers with Incoherent Optical Feedback (with D.W. Sukow, A. Gavrielides, T. Erneux, M. J. Baracco, Z. A. Parmenter, and K.L. Blackburn). Proceedings of the SPIE 5722: Physics and Simulation of Optoelectronic Devices XIII, M. Osinski, F. Henneberger, H. Amano, Eds, 256-266, 2005.

Dynamique Nonlinéaire à Retard, Compte-Rendus de la 8e Rencontre du Nonlinéaire, J.-R. Chazottes, A. Joets, C. Letellier, R. Ribotta, Eds., 73-78, 2005.

Multiple Time Scale Analysis of Delay Differential Equations Modeling Mechanical Systems, DETC2005-85028, Proceedings of IDETC/CIE, 1-7, 2005.

Roy Goodman

Trapping Light with Grating Defects (with M. Weinstein, R. Slusher, and M. Klaus). Contemporary Mathematics 379: Mathematical Studies in Nonlinear Wave Propagation, pp. 83-92, July 2005.

Lou Kondic

Elastic Energy, Fluctuations and Temperature for Granular Materials (with R. P. Behringer), Proceedings of the 5th International Conference on Micromechanics of Granular Media (Powders and Grains 2005), ed. R.

Garcia-Rojo, H. J. Herrmann, S. McNamara, Balkema Publishers, Leiden, The Netherlands, ISBN 0-415-38347-1, pp. 397-400, July 2005.

Marc Q. Ma

SNP Auto-Calling using Support Vector Machines (with K. Zhang, H.-Y. Wang, Y. Wang, M. Banerjee, A. Karmaker, F. Shih, J. Wang, and H. Li), In Proceedings of the 8th Joint Conference on Information Sciences, pp. 1199-1202, Salt Lake City, July 2005.

Precise Gridding of Microarray Images by Detecting and Correcting Rotations in Subarrays (with Y. Wang and F. Shih), In Proceedings of the 8th Joint Conference on Information Sciences, pp. 1195-1198, Salt Lake City, July 2005.

Robust Microarray Image Segmentation and Quantification using Extended Local Background (with K. Zhang, H.-Y. Wang, Y. Wang, T. Wang, I.-J. Yeh, L. Jia, F. Shih, and P. Soteropoulos), In Proceedings of the 8th Joint Conference on Information Sciences, pp. 587-590, Salt Lake City, July 2005.

Linking Multiple Genes to Human Chromosomal Locations to Facilitate Knowledge Discovery (with T. Wang and P. Soteropoulos), In Proceedings of the 8th Joint Conference on Information Sciences, pp. 1181-1184, Salt Lake City, July 2005.

GO-Chart, A Toolkit for Visualization of Genes in the Context of Gene ontology with Variable p-Values (with D. Shah and G. Tromp), In Proceedings of the 8th Joint Conference on Information Sciences, pp. 1177-1180, Salt Lake City, July 2005.

Jay N. Meegoda

A Numerical Model to Predict Settlements and Moisture Distribution in Bioreactor Landfills (with C. H. Hettiarachchi and P. Hettiaratchi), Canadian Society for Civil Engineering Annual Meeting, Calgary, Canada, May 2006.

Zoi-Heleni Michalopoulou

Interference Cancellation for Shallow Water Source Localization, Proceedings of the 8th European Conference on Underwater Acoustics, Carvoeiro, Portugal, June 2006.

Christopher Raymond

Stability of the Oil-Air Boundary in Fluid Dynamic Bearings of Hard Disk Drives (with F. Hendriks, J. Billingham, D. Edwards, B. Tilley, et al.), Proceedings of the Twenty-first Annual Workshop on Mathematical Problems in Industry, pp. 41-69, Worcester Polytechnic Institute, Worcester MA, 2005.

Anthony Rosato

Discrete Element Simulations of Floor Pressure due to Granular Material in a Cylindrical Vessel (with S. Chester and O. R. Walton), Proc. of the 5th World Congress in Particle Tech., Orlando, FL, April 2006.

B. PRESENTATIONS

Roman Andrushkiw

May 2006: Frontiers in Applied and Computational Mathematics, NJIT, Newark, NJ
Heat Transfer Problem in Cryosurgery

June 2006: International Conference on Bioinformatics and Computational Biology (BIOCOMP'06), Las Vegas, Nevada
1) Computer-Aided Cytogenetic Method of Breast Cancer Diagnosis. Part I - Decision Rule
2) Computer-Aided Cytogenetic Method of Breast Cancer Diagnosis. Part II - Test Criteria

Nadine Aubry

April 2005: US National Committee on Theoretical and Applied Mechanics (USNC/TAM), USNC/TAM Annual Meeting, Washington D.C.
An Introduction to the US National Committee on Theoretical and Applied Mechanics (USNC/TAM)

November 2005: 58th Annual Meeting of the Division of Fluid Dynamics, American Physical Society, Chicago, IL
1) Dynamic Simulation of Dielectrophoresis in Colloidal Suspension (poster)
2) Details of Chaotic Advection in Pulsed Micro-Mixing
3) Squeeze Film Flow Analysis of Pulsed Microjet Actuators
4) Electrohydrodynamic Instability of the Interface Between Two Fluids in Channel Flow

February 2006: National Science Foundation, Washington D.C.
The US National Committee on Theoretical and Applied Mechanics (USNC/TAM)

April 2006: Experimental Biology 2006, San Francisco, CA
Aging Alters Cardiac Cytoskeletal Components

May 2006: 13th Annual Weinstein Cardiovascular Development Conference, St Petersburg, FL
Miniature Tissue Culture System a New Approach to Study Heart Valve Development

May 2006: FACM'06 Conference: Mathematical Fluid Dynamics, NJIT, Newark, NJ
1) Microfluidic Mixing in Channels of Simple Geometry
2) Electric Field Induced Deformation and Breakup of a Drop in a Microfluidic Device (poster)
3) Particle Manipulation Using Traveling Electric Fields in Microfluidic Chambers (poster)
4) Deformation of Leucocytes Near an Uneven Wall (poster)
5) Coupled Reduced Model for the System Response of a Clamped Membrane Subject to a Time Dependent Electrostatic Field and a Fluid Squeeze Film (poster)
6) Computation of Suspensions Subjected to Electric Fields Using Multi-Image Method (poster)
7) Direct Numerical Simulation (DNS) of Suspensions in Spatially Varying Electric Fields (poster)
8) Electrohydrodynamic Instabilities of Miscible and Immiscible Fluids in Microchannels (poster)

May 2006: 6th Understanding Complex Systems Symposium, University of Illinois at Urbana-Champaign, IL
Using a Polymer Construct for Multi-Use Atomic Force Microscope Imaging of a Vascular Smooth Muscle Cell (poster)

June 2006: Fifteenth U.S. National Congress of Theoretical and Applied Mechanics, Boulder, CO
1) Details of Chaotic Advection in Pulsed Flow
2) Electrohydrodynamic Mixing in Microchannels

Denis Blackmore

July 2005: NSF Workshop on Computational Topology, Denison University, Denison, OH
Differential Computational Topology

October 2005: SIAM Conference on Mathematics for Industry, Detroit, MI
Computational Topology of Projected Objects

October 2005: NJIT Colloquium on Granular and Multiphase Flows, Newark, NJ
Simple Dynamical Models of Complex Granular Flows

February 2006: NJIT Chemical Engineering Graduate Seminar, Newark, NJ
Chaos and Mixing in Vortex Dominated Flows

Michael Booty

November 2005: APS Division of Fluid Dynamics, Chicago, IL
1) Two-Dimensional Sails in a Uniform Potential Flow
2) Surfactant Effects on Bubble Pinch-Off

May 2006: Frontiers in Applied and Computational Mathematics, NJIT
Effect of Surfactant and Surfactant Solubility on the Breakup of a Bubble via Thread Formation (poster)

Amitabha Bose

July, 2005: Park City Mathematics Institute, Park City, UT
Localized Activity Patterns in Excitatory Neuronal Networks

October 2005: Krasnow Institute, George Mason University, VA
Role of Synaptic Plasticity in Neuronal Networks

October 2005: Department of Biomedical Engineering, New Jersey Institute of Technology, NJ
Role of Synaptic Plasticity in Neuronal Networks

March 2006: National Science Foundation UBM PIs meeting, Arlington, VA
The UBM program at NJIT

May 2006: Frontiers in Applied and Computational Mathematics, NJIT
Combining Synaptic and Cellular Resonance in a Feed-Forward Neuronal Network

June 2006: Gordon Conference on Theoretical Biology, Tildon, NH
Role of Synaptic Plasticity in Neuronal Networks

Bruce Bukiet

May 2006: Frontiers in Applied and Computational Mathematics Conference, NJIT, Newark, NJ
Math Modeling, Statistics and Optimization for Value Assessment in Major League Baseball (poster)

July 2005: Ronald E. McNair Postbaccalaureate Achievement Program Conference, Pennsylvania State University, University Park, PA
Math Modeling, Statistics and Optimization for Value Assessment in Major League Baseball (poster)

December 2005: Invited Presentation-Mathematics Department Seminar, University of South Alabama
Mathematical Modeling of Human Balance: Evaluating Postural Stability to Diagnose Balance Problems

December 2005: Mobile Math Circle, University of South Alabama, Mobile, AL
Math Magic, Baseball and Why Study Math

January 2006: Hudson County Community College in partnership with New Jersey City University and Passaic County Community College, Jersey City, NJ
The PoweR of Math: A Seminar for Faculty Development

November 2005: INFORMS Annual Meeting, San Francisco, CA
Using Mathematical Modeling to Investigate Some Claims, Conjectures and Questions Inspired by Moneyball

Wooyoung Choi

July 2005: International Symposium on Ocean Wave Measurement and Analysis, Madrid, Spain
A Formulation of Nonlinear Surface Waves in Water of Variable Depth

November 2005: 58th Annual Meeting of the Division of Fluid Dynamics, American Physical Society, Chicago, IL
1) A Model for Nonlinear Wave-Current Interaction
2) On Instability of Large Amplitude Long Interfacial Waves

February 2006: Ocean Science Meeting, American Geophysical Union, Honolulu, HI
1) Numerical Solutions of a Strongly Nonlinear Model for Internal Waves Propagating over Bottom Topography
2) Nonlinear Surface Waves Interacting with Surface Currents and Bottom Topography

May 2006: ONR Program Review Meeting, Ann Arbor, MI
Short-term Forecasts of Evolving Nonlinear Wave Fields

May 2006: Frontiers in Applied and Computational Mathematics, NJIT, Newark, NJ
A Numerical Study of the Evolution of Nonlinear Water Waves

June 2006: Workshop on Waves in Fluids, Sao Paulo, Brazil
First Steps Toward Understanding Surface Signatures of Giant Internal Waves

Sunil Dhar

September 2005: 20th International Congress of the Israel Society of Anesthesiologists
Development of a Recursive Finite Difference Pharmacokinetic Model of Propofol from an Exponential Model (poster)

August 2005: Joint Statistical Meeting 2005, Minneapolis, MN
1) Improved Methods for Establishing Noninferiority in Clinical Trials
2) Linear and Log-Linear Models Based on Generalized Inverse Sampling Scheme
Sponsor: American Statistical Association, Institute of Mathematical Statistics, International Biometrics

Society: Eastern North American Region and Western North American Region, Statistical Society of Canada

August 2005: Informal Biostatistics Meeting, East Hanover, NJ
A Bootstrap-Based Test for Establishing Noninferiority in Clinical Trials

Javier Diez

January 2006: IPAM (Institute for Pure and Applied Mathematics) Workshop on Thin Films and Fluid Interfaces, Los Angeles, CA
Instability of a Fluid Strip

March 2006: IUTAM Symposium Interactions for Dispersed Systems in Newtonian and Viscoelastic Fluids, Guanajuato, Mexico
Pearling Process of a Fluid Strip on a Partially Wetting Surface

September 2005: Reunión Nacional de Fisica, La Plata, Buenos Aires, Argentina
1) Resolucion Numerica de Flujos de Lubricacion con Grilla No Uniforme
2) Ruptura de Filamentos en Condiciones de Mojabilidad Parcial

Thomas Erneux

June 2005: CLEO/Europe – EQEC, Munich, Germany
Frequency Locked Pulsating Regimes of Semiconductor Lasers Subject to a Delayed Feedback

September 2005: ASME 2005 International Design Engineering Technical Conferences & Computers and Information in Engineering Conference, Long Beach, CA
Multiple Time Scale Analysis of Delay Differential Equations Modeling Mechanical Systems

November 2005: Workshop on Complex Time-Delay Systems, Paris, France
Delay Differential Equations Modeling Physical Systems

Vladislav V. Goldberg

April 2006: Formal Theory of Partial Differential Equations andTheir Applications, University of Joensuu, Finland
The Abelian Equations and Webs

May 2006: International Conference Geometry in Odessa - 2006 in Honor of Professor Vladislav Goldberg on his 70th birthday, Odessa, Ukraine
Abelian Equations and Differential Invariants of Webs

Daniel Goldman

September 2005: Biomedical Engineering Society, Baltimore, MD
Effect of Capillary Network Blood Flow Distributions in a Computational Model of Tumor Growth and Angiogenesis

Jorge Golowasch

April 2006: Origin and Regulation of Bursting Activity in Neurons Meeting, Georgia State University, Atlanta

Pacemaker Activity Recovery After Decentralization: Role of Neuromodulators and Calcium Pump

March 2006: 32nd Annual East Coast Nerve Net, Woods Hole, MA
1) Ionic Current Changes During Pyloric Rhythm Recovery after Decentralization in Crab STG
2) The Effect of Neuromodulator on the Recovery of Rhythmic Pyloric Activity after Decentralization
3) Gap Junction Position can be Estimated from Somatic Recordings

November 2005: 2005 Annual STG Meeting, Washington, DC
Mechanism of Activity-Dependent and Spontaneous State Changes in (Cultured) STG Cells

November 2005: Washington, DC
Cables Coupled by Gap Junctions have an Optimal Diameter for Electrical Signaling. Soc. Neurosci Abs., 735.2.

November 2005: Washington, DC
Modeling Dynamics of Rhythmic Activity Recovery: Role of a Calcium Pump. Soc. Neurosci Abs., 752.9.

Roy Goodman

October 2005: International Workshop on Applied Dynamical Systems - Mechanics, Turbulence, Knots, Cockroaches, and Chaos, CRM, Montreal, QC, Canada
The Two-Bounce Resonance Phenomenon

May 2006: Frontiers in Applied and Computational Mathematics, NJIT, Newark, NJ
The n-Bounce Resonance Phenomenon

May 2006: Frontiers in Applied and Computational Mathematics, NJIT, Newark, NJ
Modules for an Undergraduate Capstone Course

Peter Gordon

June 2006: Seminaire de Mathmatiques Appliquees, Universite Bordeaux 1, Bordeaux, France
Traveling Fronts in Porous Media Combustion

June 2006: Recent Advances in Nonlinear Partial Differential Equations and Applications. A Workshop in Honor of Peter D. Lax and Louis Nirenberg, Toledo, Spain
Traveling Fronts in Porous Media Combustion (poster)

May 2006: Frontiers in Applied and Computational Mathematics, New Jersey Institute of Technology
A Stretch-Temperature Model for Flame-Flow Interaction (poster)

April 2006: Applied Math - PDE Seminar, University of Wisconsin-Madison
Traveling Fronts in Porous Media Combustion

March 2006: Workshop Reaction-diffusion and Free Boundary Problems, Banff, Canada
Propagation of Fronts in Porous Media Combustion

February 2006: Mathematical Sciences Colloquium, Rensselaer Polytechnic Institute
Propagation of Fronts in Porous Media Combustion

February 2006: Differential Equations Seminar, North Carolina State University
Propagation of Fronts in Porous Media Combustion

January 2006: Applied Mathematics Seminar, Ben-Gurion University, Israel
Propagation of Fronts in Porous Media Combustion

January 2006: Mathematical Analysis and Applications Seminar, The Weizmann Institute of Science, Israel
Propagation of Fronts in Porous Media Combustion

Claus Holzapfel

August 2005: Ecological Society of America, Montreal, Canada
1) Being Reckless in a Tough World: Two Invasive Grasses and their Relationship with a Native Desert Shrub
2) Déjà Vu Communities: When Invaders Meet Again

November 2005: Penn State University, College Station, PA
On Cooperation, Good Neighbors and Playing Games: A Plant's Perspective

November 2005: Ithaca College, Ithaca, NY
On Cooperation, Good Neighbors and Playing Games: A Plant's Perspective

April 2006: California State University, Fullerton, CA
On Cooperation, Good Neighbors and Playing Games: A Plant's Perspective

January 2006: University of Goettingen, Germany
Scales of Biodiversity: Type & Pattern, Process, Application, and Function

David J. Horntrop

May 2006: Frontiers in Applied and Computational Mathematics, Newark, NJ
Simulating Domain Coarsening in Surface Processes Using Spectral Schemes for Stochastic Partial Differential Equations

Huaxiang Huang

November 2005: City University of Hong Kong
Optimal Consumption and Asset Allocation

April 2006: City University of Hong Kong
Ruined Moments and Ruin Probability

May 2006: New Jersey Institute of Technology, Newark, NJ
Moisture Transport in Bread Baking

June 2006: Fudan University, Shanghai, China
Mass and Heat Transport in Porous Media"; and "Extensional Flows with Viscous Threads

Lou Kondic

June 2006: School of Engineering, Universidad de Buenos Aires, Buenos Aires, Argentina
Instabilities in the Flow of Thin Liquid Films

May 2006: INTEC (Instituto de Desarrollo Tecnico para la Industria Quemica), Santa Fe, Argentina

Instabilities in the Flow of Thin Liquid Films

May 2006: Department of Physics, Universidad Nacional de Cuyo, Mendoza, Argentina
Instabilities in the Flow of Thin Liquid Films

March 2006: IUTAM Symposium on Interactions for Dispersed Systems in Newtonian and Viscoelastic Fluids, Guanajuato, Mexico
Dense Granular Systems

February 2006: UCLA-IPAM-NSF workshop on Thin Films and Fluid Interfaces, Los Angeles, CA
On Splitting of a Liquid Strip

February 2006: Courant Institute of Mathematical Sciences, New York University, New York, NY
Dense Granular Systems

February 2006: Department of Mechanical Engineering, New Jersey Institute of Technology, Newark, NJ
Dense Granular Systems

February 2006: Department of Mathematical Sciences, New Jersey Institute of Technology, Newark, NJ
Dense Granular Systems

November 2005: IPAM Multiscale Analysis and Computation Workshop, Los Angeles, CA
On Fluctuations and Signal Propagation in Dense Granular Systems

November 2005: American Physical Society-Division of Fluid Dynamics Annual Meeting, Chicago, IL
On Dimpled Thin Liquid Films

September 2005: Annual Meeting of Argentinian Physical Society, La Plata, Argentina
Thin Liquid Films: From Theory to Applications,

July 2005: Department of Physics, Twente University, Enschede, The Netherlands
Instabilities, Coalescence and Rupture in the Flow of Thin Liquid Films

July 2005: Powders and Grains 2005, Stuttgart, Germany
Elastic Energy, Fluctuations and Temperature for Granular Materials

Gregory A. Kriegsmann

November 2005: IAM-PIMS-MITACS Distinguished Colloquium Series, University of British Columbia, Vancouver
Microwave Heating of Materials: A Mathematical Overview

April 2006: Department of Engineering Science and Applied Mathematics, Northwestern University, Evanston, Illinois
Electromagnetic Propagation In Periodic Porous Structures

April 2006: Department of Mathematics, Rutgers University, New Brunswick, NJ
Complete Transmission Through a Two-Dimensional Diffraction Grating

June 2006: Applications of Asymptotic Analysis Workshop, Oberwolfach, Germany
Electromagnetic Propagation in a Translationaly Invariant, Periodic Medium

Dawn Lott

July 2005: Summer Programfor Women in Math, George Washington University, Washington, DC
Algorithms of an African American Female Mathematician

July 2005: Girls Exploration in Math and Science Program (GEMS), Delaware State University, Dover, DE
Improving One's Health with Mathematics

July 2005: International Society for Analysis, its Application and Computation, University of Catania, Catania, Italy
1) Two-Dimensional Finite Volume Analysis to Assess Flow Characteristics of an In Vitro Aneurysm Model
2) The Configuration of the Aneurysm Neck and Proximal Dome Profoundly Affects Shear Stress and Flow Velocities within an Aneurysm and its Parent Vessel

July 2005: Society for Industrial and Applied Mathematics, New Orleans, LA
The Configuration of the Aneurysm Neck and Proximal Dome Profoundly Affects Shear Stress and Flow Velocities within an Aneurysm and its Parent Vessel (poster)

August 2005: Applied Mathematics Summer Workshop, Delaware State University, Dover, DE
Three-Dimensional Stress Distribution in Axisymmetric Cerebral Saccular Aneurysm

January 2006: Joint Mathematics Meeting, San Antonio, TX
Three-Dimensional Stress Distribution in Axisymmetric Cerebral Saccular Aneurysm

January 2006: NAM Panel Discussion, Joint Mathematics Meeting, San Antonio, TX
The National Association of Mathematicians: Perspectives for the Future from Younger Mathematicians

Jonathan Luke

November 2005: 58th Annual Meeting of the Division of Fluid Dynamics, Chicago, IL
Decay of Large Scale Fluctuations in Sedimenting Suspensions

May 2006: Frontiers in Applied and Computational Mathematics, Newark, NJ
Dynamics of Initial Fluctuation Decay in a Sedimenting Suspension

Victor Matveev

July 2005: 14th Annual Computational Neuroscience Meeting, Madison, WI
Multistability in a Two-Cell Inhibitory Network with Short-Term Facilitation

November 2005: Society for Neuroscience 35th Annual Meeting, Washington, DC
Effect of Synaptic Facilitation on Multistability in a Two-Cell Inhibitory Network with T-like Currents

February 2006: 50th Annual Biophysical Society Meeting, Salt Lake City, UT
1) A Bound Calcium Model of Synaptic Facilitation Revisited
2) Inactivation of CaV1,2 Channels Increases Pore Affinity to Calcium

April 2006: Origin and Regulation of Bursting Activity in Neurons, GSU, Atlanta, GA
Multistability in a Two-Cell Inhibitory Network with T-like Currents

April 2006: Department of Applied Mathematics, Cornell University, Ithaca, NY
Multistability in a Two-Cell Inhibitory Network with T-Currents and Synaptic Facilitation

June 2006: Gordon Research Conference on Theoretical Biology and Biomathematics, Tilton School, Tilton, NH
Effect of Synaptic Facilitation on Multistability in a Two-Cell Inhibitory Network with T-like Currents

Jay N. Meegoda

October 2005: NCTIP, 7th Annual NJDOT Research Showcase, Princeton, NJ
Components of Computerized Management of Transportation Assets to Comply with GASB-34

November 2005: New Jersey Institute of Technology, Environmental Engineering and Applications, A Seminar for High School Teachers, Newark, NJ
Remediation of Contaminated Sites in New Jersey

March 2006: The 6th seminar in the Spring 2006 Earth & Environmental Sciences Seminar Series, Rutgers University, Newark, NJ
Electrical Method to Predict the Effective Porosity of Contaminated Soils

May 2006: Canadian Society for Civil Engineering Annual Meeting, Calgary, Canada
Characterization of Chromite Ore Processing Residue

Zoi-Heleni Michalopoulou

June 2006: Meeting of the Acoustical Society of America, Providence, RI
1) Optimal Source Localization in the Presence of Interfering Sources
2) Tabu Inversion in the East China Sea

Robert M. Miura

September 2005: Conference on Solitons, Singularities, Surreals, and Such: A Conference in Honor of Martin Kruskal's Eightieth Birthday, Department of Mathematics, Rutgers University – Busch Campus, Piscataway, NJ
Solitons and the Inverse Scattering Method: An Historical View

December 2005: Conference on Prospects of Mathematical Sciences, Institute of Mathematics, Academia Sinica, Taipei, Taiwan
Solitons and the Inverse Scattering Method: An Historical View

March 2006: Applied Mathematics Colloquium, Department of Mathematical Sciences, New Jersey Institute of Technology, Newark, NJ
Solitons and the Inverse Scattering Method: An Historical View

April 2006: Second Annual NJIT Provost's Student Research Showcase
Prediction of Polyadenylation Sites Using Support Vector Machines (poster)

April 2006: Department of Mathematics and Statistics, University of South Alabama
1) Spreading Cortical Depression: An Enigma
2) Solitons and the Inverse Scattering Method: An Historical View

May 2006: Biology and Mechanics: Applications of Mathematics and Computation, University of

California at Irvine, Irvine, CA
Formation of Glass Microelectrodes

Richard O. Moore

November 2005: Applied Mathematics Seminar, Michigan State University
Stability and Dynamics of Thermally Coupled Pulses in the Parametrically Forced Nonlinear Schroedinger Equation

March 2006: Graduate Student Faculty Seminar, NJIT
Current Topics in Nonlinear Optical Communications and Devices

March 2006: Workshop on Nonlinearity and Randomness in Complex Systems, Buffalo, NY
Pulse Interactions in Self-Heated Parametric Gain Devices

Cyrill Muratov

October 2005: Workshop on "Mathematical Analysis of Complex Phenomena in Life Sciences", University of Tokyo, Tokyo, Japan
Noise-Induced Target Pattern Formation in Excitable Media

November 2005: PDE seminar, Division of Applied Mathematics, Brown University, Providence, RI
Traveling Wave Solutions and Propagation Phenomena in Gradient Reaction-Diffusion Systems

January 2006: PDE seminar, Techincal University of Eindhoven, Eindhoven, The Netherlands
Traveling Wave Solutions and Propagation Phenomena in Gradient Reaction-Diffusion Systems

March 2006: Pure Mathematics Seminar, Department of Mathematics, University of Bristol, Bristol, UK
Traveling Wave Solutions and Propagation Phenomena in Gradient Reaction-Diffusion Systems

March 2006: Applied Mathematics Colloquium, NJIT, Newark, NJ
Noise-Induced Target Pattern Formation in Excitable Media

May 2006: Special PDE Seminar, UC Berkeley, Berkeley, CA
Traveling Wave Solutions and Propagation Phenomena in Gradient Reaction-Diffusion Systems

Farzan Nadim

July 2005: Computational Neurosci Meeting, Madison, WI
1) Multistability in a Two-Cell Inhibitory Network with Short-Term Facilitation
2) The Interaction between Facilitation and Depression of Two Release Mechanisms in a Single Synapse

November 2005: Society for Neuroscience Annual Meeting, Washington, DC
1) Dynamics of Pacemaker Synapses and Their Contribution to Phase Maintenance in an Oscillatory Neural Network
2) Resonant Properties of the Neurons and Synapses in a Central Pattern Generator
3) Neuromodulation of the Two Components of a Single Synapse in a Rhythmic Network
4) The Interaction between Two Synapses with Distinct Dynamics in a Reciprocally Inhibitory Rhythmic Network
5) Comparing Neuromodulator- and Projection-Neuron-Elicited Oscillations: A Modeling Study
6) Cables Coupled by Gap Junctions have an Optimal Diameter for Electrical Signaling
7) Effect of Synaptic Facilitation on Multistability in a Two-Cell Inhibitory Network with T-Like Currents

8) Activation of a Peripheral Modulatory System Elicits a Distinct Gastric Mill Rhythm
9) Sensory Regulation of Rhythmic Motor Activity via Presynaptic Inhibition
10) Dopamine Regulates Period by Enhancing Synaptic Inhibition of Pacemaker Neurons in a Rhythmic Motor Network
11) Computational Exploration of a Multi-Compartment Model of the Lobster Pyloric Pacemaker Kernel

December 2005: Rutgers University, Camden, NJ
The Role of Synapses and Synaptic Dynamics in the Generation of Oscillations in a Small Network

April 2005: East Coast Nerve Net, Woods Hole, MA
1) Investigating Projection Neuron and Neuromodulator Effects on the Operation of a Rhythmic Network: A Modeling Study
2) Divergent Cotransmitter Actions Mediate Sensorimotor Integration
3) Gap Junction Position can be Estimated from Somatic Recordings

Ozgur Ozen

November 2005: 58th Annual Meeting of the Division of Fluid Dynamics, Chicago, IL
Electrohydrodynamic Instability of the Interface between Two Fluids in Channel Flow

May 2006: Frontiers in Applied and Computational Mathematics (FACM '06), NJIT, Newark, NJ
Electrohydrodynamic Instabilities of Miscible and Immiscible Fluids in Microchannels

June 2006: 15th U.S. National Congress on Theoretical and Applied Mechanics, Boulder, CO
Electrohydrodynamic Mixing in Micro Channels

D.T. Papageorgiou

July 2005: Applied Mathematics Colloquium, Department of Applied Mathematics, University of Crete, Greece
Mathematical Problems in Interfacial Electrohydrodynamics

October 2005: Workshop in Group Analysis of Differential Equations and Integrable Systems (European Network), Department of Mathematics and Statistics, University of Cyprus
Asymptotic Derivation of the KdV Equation for Water Waves

March 2006: Mathematics Colloquium, Department of Mathematics and Statistics, University of Cyprus
Mathematical Problems in Surface Tension Flows

May 2006: Frontiers in Applied and Computational Mathematics (FACM ’06), NJIT, Newark, NJ
Interfacial Capillary Waves in the Presence of Electric Fields

Peter G. Petropoulos

November 2005: Mathematical Sciences Colloquium, Rensselaer Polytechnic Institute, Troy, NY
A Review of the Perfectly Matched Layer for Hyperbolic Systems and Some New Results

November 2005: 58th Annual Meeting of the Division of Fluid Dynamics, Chicago, IL
Electrohydrodynamic Instability of the Interface between Two Fluids in Channel Flow

January 2006: AFOSR Annual Electromagnetics Workshop, San Antonio, TX
Asymptotics and Numerics of Propagation in Dielectrics with Fractional Relaxation

May 2006: Frontiers in Applied and Computational Mathematics (FACM '06), NJIT, Newark, NJ
Electrohydrodynamic Instabilities of Miscible and Immiscible Fluids in Microchannels

June 2006: Conference on the Mathematics of Finite Elements and Applications 2006,
The Brunel Institute of Computational Mathematics, West London, UK
A Review of the Perfectly Matched Layer for Hyperbolic and Elliptic Wave Problems and Some New Results

June 2006: 15th U.S. National Congress on Theoretical and Applied Mechanics, Boulder, CO
Electrohydrodynamic Mixing in Micro Channels

Anthony Rosato

April 2006: Sigma Xi 2006 Colloquium, New Jersey Institute of Technology, Newark, NJ
Galton's Board - Simple Chaos

Michael Siegel

November 2005: Workshop on Multiscale Analysis and Computation, Institute for Pure and Applied Mathematics, Los Angeles, CA
The Regularized Evolution of Material Surfaces with Large Surface Energy Anisotropy

November 2005: Applied Mathematics Seminar, University of California, Irvine, CA
Examples of Finite Time Singularity Formation in Fluid Dynamics

May 2006: Frontiers in Applied and Computational Mathematics, NJIT
Effect of Surfactant and Surfactant Solubility on the Breakup of a Bubble via Thread Formation (poster)

Louis Tao

July 2005: Beijing University Summer School on Applied and Computational Mathematics (Lecture Series), Beijing, China
Introduction to Neuroscience: Single Neuron Physiology and Network Dynamics

October 2005: Annual Neuroscience Meeting, Washington, DC
Orientation Selectivity in Visual Cortex by Fluctuation-Controlled Criticality (poster)

February 2006: Columbia University Applied Mathematics Colloquium
Orientation Selectivity by Fluctuation-Controlled Critical States

Jean-Marc Vanden-Broeck

October 2005: Workshop on Splashes, The University College London, UK
Self Similar Breaking and Merging of Liquid Jets

November 2005: APS Meeting, Chicago, IL
Nonlinear Flows Past Sails

December 2005: Workshop on Rogue Waves, Edinburgh, UK
Nonlinear Three Dimensional Gravity Capillary Waves

January 2006: Memorial Meeting for Andy King, Reading, UK
Nonlinear Free Surface Flows Past a Step

March 2006: Seminar, The University of Birmingham, UK
Nonlinear Free Surface Flows

April 2006: British Applied Mathematics Colloquium, Keele, UK
1) New Free Surface Flows Over Topography
2) The Stability of Interfacial Capillary Waves in the Presence of Electric Fields
3) Three Dimensional Gravity and Gravity Capillary Interfacial Waves
4) Inverse Acoustic Scattering Theory: Searching for Oil, Finding Cracks, Making Chocolate?
5) Weakly Nonlinear Models for Electrified Fluid Sheets

April 2006: Seminar, Cyprus University
Numerical Methods for Nonlinear Free Surface Flows

May 2006: Frontiers in Applied and Computational Mathematics FACM '06, NJIT
Gravity Capillary Waves in the Presence of Electrical Fields

Yuan-Nan Young

November 2005: Department of Mechanical Engineering, Department Seminars
Effects of Both Insoluble and Soluble Surfactants on Bubble Breakup

November 2005: APS Division of Fluid Dynamics, Chicago, IL
Surfactant Effects on Bubble Breakup and Filament Formation

March 2006: Mathematics Seminars, Montclair State University, NJ
Surfactant Effects on Bubble Breakup

May 2006: FACM poster presentation, NJIT
1) Novel Dynamics of Elastic Filament in Stokes Flow
2) Interesting Dynamics of Viscous Drops in a Straing Flow with Rotation
3) Effect of Surfactant and Surfactant Solubility on the Breakup of a Bubble via Thread Formation (poster)

C. TECHNICAL REPORTS

REPORT 0506-1: *Proprioceptor Regulation of Motor Circuit Activity by Presynaptic Inhibition of a Modulatory Projection Neuron*
Mark P. Beenhakker, Nicholas D. DeLong, Shari R. Saideman, Farzan Nadim, and Michael P. Nusbaum

REPORT 0506-2: *Intrinsic Properties, Not Synaptic Dynamics, Determine Proper Phase of Activity in a Central Pattern Generator*
Pascale Rabbah and Farzan Nadim

REPORT 0506-3: *Convergence of Neuronal Activity Phenotype Result from Spontaneous or Induced Activity via a Common Ionic Mechanism in Adult Isolated Neurons*
Rodolfo Haedo and Jorge Golowasch

REPORT 0506-4: *Kinetic Theory for Neuronal Network Dynamics*
David Cai, Louis Tao, Aaditya V. Rangan, and David McLaughlin

REPORT 0506-5: *A Bound-Calcium Model of Synaptic Facilitation Revisited*
Victor Matveev, Richard Bertram, and Arthur Sherman

REPORT 0506-6: *Quenching and Propagation of Combustion Fronts in Porous Media*
Peter Gordon

REPORT 0506-7: *From Immersed Boundary Method to Immersed Continuum Method*
X. Sheldon Wang

REPORT 0506-8: *Immersed Finite Element Method and Its Applications to Biological Systems*
Wing Kam Liu, Yaling Liu, David Farrell, Lucy Zhang, X. Sheldon Wang, and Others

REPORT 0506-9: *Using Experimental Methods and Mathematical Modeling to Determine Gap Junction Coupling in Neural Networks*
Diana Martinez, Matt Malej, Angelie Mascarinas, Farzan Nadim, and Jorge Golowasch

REPORT 0506-10: *Border Properties of Allopatric and Sympatric Plant Species Interactions*
Kunj Patel, Jonathan Lansey, Claus Holzapfel, and Amitabha Bose

REPORT 0506-11: *The Geometry of Neuronal Recruitment*
Jonathan Rubin and Amitabha Bose

REPORT 0506-12: *Properties of Fast and Slow Endogenous Buffers at the Presynaptic Terminals of the Crayfish Neuromuscular Junction*
Victor Matveev and Jen-Wei Lin

REPORT 0506-13: *Generalized Poincare-Bertrand Formula on a Regular Surface in Three Dimensions*
Shidong Jiang and Fengbo Hang

REPORT 0506-14: *Scaling Law for Second-Order Hyperpolarizability of Periodic Finite Chain Under Su-Schrieffer-Heeger Model*
Shidong Jiang and Minzhong Xu

REPORT 0506-15: *Surface Tension in Incompressible Rayleigh-Taylor Mixing Flow*
Yuan-Nan Young and Frank E. Ham

REPORT 0506-16: *Limits of the Potential Flow Approach to the Single-Mode Rayleigh-Taylor Problem*
P. Ramaprabhu, Guy Dimonte, Yuan-Nan Young, Alan C. Calder, and Bruce Fryxell

REPORT 0506-17: *On the Formation of Glass Microelectrodes*
H. Huang, J. Wylie, R. M. Miura, and P. Howell

REPORT 0506-18: *Traveling Waves in Coupled Reaction-Diffusion Models with Degenerate Sources*
Jonathan J. Wylie and Robert M. Miura

REPORT 0506-19: *Log-linear Modeling Under Generalized Inverse Sampling Scheme*
Soumi Lahiri and Sunil K. Dhar

REPORT 0506-20: *Steady Deformation and Tip-Streaming of a Slender Bubble with Surfactant in an Extensional Flow*
M.R. Booty and M. Siegel

REPORT 0506-21: *Mathematical Model for the Rupture of Cerebral Saccular Aneurysms through Three-Dimensional Stress Distribution in the Aneurysm Wall*
Hans R Chaudhry, Dawn A. Lott, Charles J. Prestigiacomo, and Thomas W. Findley

REPORT 0506-22: *Maximum a Posteriori Multiple Source Localization with Gibbs Sampling*
Zoi-Heleni Michalopoulou

REPORT 0506-23: *An Explicit Formulation for the Evolution of Nonlinear Surface Waves Interacting with a Submerged Body*
Christopher P. Kent and Wooyoung Choi

REPORT 0506-24: *The Effect of a Background Shear Current on Large Amplitude Internal Solitary Waves*
Wooyoung Choi

REPORT 0506-25: *Breeding Birds on Small Islands: Island Biogeography or Optimal Foraging?*
Gareth J. Russell, Jared M. Diamond, Timothy M. Reed, and Stuart L. Pimm

REPORT 0506-26: *A Stretch-Temperature Model for Flame-Flow Interaction*
Michael L. Frankel, Peter Gordon, and Gregory I. Sivashinsky

REPORT 0506-27: *A Mathematical Modelling Approach to One-Day Cricket Batting Orders*
M. Ovens and B. Bukiet

REPORT 0506-28: *Kink-Antikink Collisions in the Phi-Four Equation: The n-Bounce Resonance and the Separatrix Map*
Roy H. Goodman and Richard Haberman

REPORT 0506-29: *Long-Wave Linear Stability Theory for Two-Fluid Channel Flow Including Compressibility Effects*
Tetyana M. Segin, Lou Kondic, and Burt S. Tilley

REPORT 0506-30: *Stabilization of Nonlinear Velocity Profiles in Athermal Systems Undergoing Planar Shear Flow*
Ning Xu, Corey S. O'Hern, and Lou Kondic

REPORT 0506-31: *Elastic Energy, Fluctuations and Temperature for Granular Materials*
L. Kondic and R. P. Behringer

REPORT 0506-32: *Numerical Methods for Solving Kinetic Equations of Neuronal Network Dynamics*
Aaditya V. Rangan, DavidCai, and Louis Tao

REPORT 0506-33: *Soliton Broadening under Random Dispersion Fluctuations: Importance Sampling Based on Low-Dimensional Reductions*
Richard O. Moore, Tobias Schaefer, and Christopher K. R. T. Jones

REPORT 0506-34: *Renormalization Group Reduction of Pulse Dynamics in Thermally Loaded Optical Parametric Oscillators*
Richard O. Moore and Keith Promislow

REPORT 0506-35: *A Method to Compute Statistics of Large, Noise-Induced Perturbations of Nonlinear Schrödinger Solitons*
Richard O. Moore, Gino Biondini, and William L. Kath

REPORT 0506-36: *Neuromodulation of Short-Term Synaptic Dynamics Examined in a Mechanistic Model Based on Kinetics of Calcium Currents*
Lian Zhou, Shunbing Zhao, and Farzan Nadim

REPORT 0506-37: *Combining Synaptic and Cellular Resonance in a Feed-Forward Neuronal Network*
Jonathan D. Drover, Vahid Tohidi, Amitabha Bose, and Farzan Nadim

REPORT 0506-38: *Modeling Recovery of Rhythmic Activity: Hypothesis for the Role of a Calcium Pump*
Yili Zhang and Jorge Golowasch

REPORT 0506-39: *Ionic Mechanism Underlying Recovery of Rhythmic Activity in Adult Isolated Neurons*
Rodolfo J. Haedo and Jorge Golowasch

REPORT 0506-40: *A Family of Probability Generating Functions Induced by Shock Models*
Satrajit Roychoudhury and M.C. Bhattacharjee

REPORT 0506-41: *Analysis of Biological Neurons via Modeling and Rule Mining*
Tomasz G. Smolinski, Pascale Rabbah, Cristina Soto-Treviño, Farzan Nadim, and Astrid A. Prinz

REPORT 0506-42: *A Global Description of Solutions to Nonlinear Perturbations of the Wiener-Hopf Integral Equations*
P. S. Milojevič

REPORT 0506-43: *Thermal Instability in Drawing Viscous Threads*
Jonathan J. Wylie, Huaxiong Huang, and Robert M. Miura

REPORT 0506-44: *Spatial Buffering Mechanism: Mathematical Model and Computer Simulations*
Benjamin Steinberg, Yuqing Wang, Huaxiong Huang, and Robert M. Miura

REPORT 0506-45: *Phase Boundaries as Electrically Induced Phosphenes*
Jonathan D. Drover and G. Bard Ermentrout

REPORT 0506-46: *On the Calculation of Convolutions with Gaussian Kernels*
Martin L. Bailon and David J. Horntrop

REPORT 0506-47: *Mesoscopic Simulation for Self-Organization in Surface Processes*
David J. Horntrop

REPORT 0506-48: *Prediction of mRNA Polyadenylation Sites by Support Vector Machine*
Yiming Cheng, Robert M. Miura, and Bin Tian

VI. EXTERNAL ACTIVITIES AND AWARDS

A. FACULTY ACTIVITIES AND AWARDS

Daljit S. Ahluwalia

Member, Organizing Committee for Frontiers in Applied and Computational Mathematics Conference (FACM '06), NJIT, May 2006.

Editorial Board Member, Mathematical Sciences Research Hot-Line International Journal.

Nadine Aubry

Vice Chair, US National Committee on Theoretical and Applied Mechanics (USNC/TAM), 2004 – 2006.

Member-at-large, US National Committee on Theoretical and Applied Mechanics (USNC/TAM), 2001 – 2005, two terms.

Member or Chair of various USNC/TAM subcommittees: Member, Internal Affairs Committee; Member, IUTAM Nomination Subcommittee, 2004-2006; Chair, Ad-Hoc Committee on Member Societies, 2004-2006; General Chair, Publications Committee, 2004-2006; Chair, 2004-2006, Research Publications Subcommittee, 2004-2005; Member, Internal Affairs Committee; Member, Operations Subcommittee, 2005-2006.

Member, Congress Committee, International Union for Theoretical and Applied Mechanics (IUTAM), 2004-2008.

Chair, American Physical Society (APS), Division of Fluid Dynamics (DFD) Nominating Committee, 2004-2005.

Secretary, ME Department Heads Committee, American Society of Mechanical Engineers (ASME), 2004-2005.

Member, National Science Foundation (NSF) Panel for Graduate Fellowship Program (GRP) (Mechanical and Aeronautical Engineering Panel), February 2006.

National Science Foundation (NSF), Nanotechnology Science and Engineering Technology (NSEC) Site Visit Team, June 2006.

Chair, Session "Microfluidics: Mixing" 58th Annual Meeting of the Division of Fluid Dynamics, American Physical Society, Chicago, IL, November 20-22, 2005.

Chair and Organizer, Minisymposium on Mixing in Micro-Fluidic Systems, 15th National Congress of Theoretical and Applied Mechanics, University of Colorado, Boulder, CO, June 25-30, 2006.

Member, Ford Foundation Diversity Predoctoral Fellowships Evaluation Panel (Engineering Panel), U.S. National Research Council (NRC), 2006.

Member, American Physical Society, Division of Fluid Dynamics Fellowship Committee, 2005-2007.

Memberships in professional societies: American Association for the Advancement of Science (AAAS), American Institute of Aeronautics and Astronautics (AIAA), American Physical Society (APS) (Fellow), American Society of Mechanical Engineers (ASME) (Fellow), Society for Industrial and Applied Mathematics (SIAM), the Mathematical Association of America (MAA), the American Mathematical Society (AMS), European Mechanics Society (EUROMECH), Society of Automotive Engineers (SAE), American Society for Engineering Education (ASEE), Society of Women Engineers (SWE).

John Bechtold

NJIT Excellence in Teaching Award, Lower Division Undergraduate Instruction, October 2005.

Received designation of NJIT Master Teacher, October 2005.

Co-chair for the 31st International Symposium on Combustion (laminar flames), Heidelberg, August 2006.

Member, Organizing Committee for Frontiers in Applied and Computational Mathematics Conference (FACM '06), NJIT, May 2006.

Manish Bhattacharjee

Elected Member of the International Statistical Institute, The Hague, The Netherlands.

Member, Editorial Board Calcutta Statistical Association (CSA) Bulletin.

Denis Blackmore

Editorial Board, ACS Journal of Chemical Information and Modeling (since 2003).

Editorial Board, Mechanics Research Communications (since 2005).

Member of Scientific Committee, Conference on Dynamical Systems: Theory and Applications, Lodz, Poland, December 2005.

Member of Scientific Committee, IUTAM Symposium on Hamiltonian Dynamics, Vortex Structures, and Turbulence, Steklov Institute, Moscow, August 27-31, 2006.

Amitabha Bose

Invited to participate in the Research Program in Mathematical Biology at the Park City Mathematics Institute, Park City, UT, June-July 2005.

Wooyoung Choi

Member, Organizing Committee for the Frontiers in Applied and Computational Mathematics Conference, NJIT, May 15-16, 2006.

Vladislav V. Goldberg

Editorial Board Member, Journal of Generalized Lie Theory and Applications.

Editorial Board Member, Webs and Quasigroups (Tver, Russia).

Editorial Board Member, Rendiconti del Seminario Matematica diMessina (elected in March 2002).

Honored in May 2006: The International Conference Geometry in Odessa-2006 (Odessa, Ukraine) was dedicated to his 70th birthday.

Jorge Golowasch

July 2005: Co-Director and Faculty at the Marine Biological Laboratories, Woods Hole, MA, Neural Systems and Behavior course.

Roy Goodman

Panelist, National Science Foundation Division of Mathematical Sciences.

Aridaman Jain

Judge for the March 2006 New Jersey Science Fair representing the American Statistical Association for judging the Mathematics/Statistics/Science projects of Juniors/Seniors from NJ high Schools.

Lou Kondic

Established a Collaborative Ph.d. Program in Applied Mathematics and Physics between NJIT and UNCPBA (Universidad National del Centro de la Provinincia de Buenos Aires), Argentina.

Invited Plenary Talk at the 100th Annual Meeting of Argentinian Physical Society, La Plata, Argentina, September 2005.

Gregory A. Kriegsmann

Vice President of Publications, SIAM (second term ended on December 31, 2005).

Associate Editor, Wave Motion.

Associate Editor, IMA Journal on Applied Mathematics.

Associate Editor, SIAM Journal on Applied Mathematics.

Associate Editor, European Journal on Applied Mathematics.

Associate Editor, Journal of Engineering Mathematics.

Dawn A. Lott

National Association of Mathematicians, Vice President, January 2005 to present.

Association for Women in Mathematics, Executive Committee, January 2006 to present.

Mathematical Association of America, Committee on Undergraduate Program in Mathematics on Mathematics across the Disciplines, January 2006 to present.

Jay N. Meegoda

Chair of the Search committee for Senior Faculty in Critical Infrastructure Systems.

Editorial Board member, ASTM Geotechnical Testing Journal.

Associate Editor, ASCE Practice Periodical of Hazardous, Toxic, and Radioactive Waste Management.

Ronald E. McNair Faculty Mentor.

Petronije S. Milojevic

Member of the Editorial Board of Facta Universitatis

Robert M. Miura

Leroy P. Steele Prize for Seminal Research Contribution, American Mathematical Society (with C.S. Gardner, J.M. Greene, and M.D. Kruskal), 2006.

Fellow of the American Association for the Advancement of Science (since 2005).

Fellow of the Royal Society of Canada (since 1995).

Chair, Organizing Committee, Conference on Frontiers in Applied and Computational Mathematics, Mathematical Fluid Dynamics, NJIT, May 15-16, 2006.

Co-Organizer, Organizing Committee for the Third Pacific Rim Conference on Mathematics, August 17-21, 2005, Shanghai, China (since 2001).

Co-Chair, Organizing Committee for the Fourth Pacific Rim Conference on Mathematics, December 2007, City University of Hong Kong, Hong Kong (since 2006).

Organizing Committee, SIAM Conference on Mathematics for Industry, 2007.

Co-Editor-in-Chief, Analysis and Applications (World Scientific, publisher) (since 2000).

Editorial Board, Integrative Neuroscience (World Scientific, publisher) (since 1999).

Editorial Board, Canadian Applied Mathematics Quarterly (since 1991).

Editorial Board, SIAM Monographs on Mathematical Modeling and Computations (since 2005).

Scientific Advisory Panel (since 2002) and Scientific Nominating Committee (since 2003), Fields Institute for the Mathematical Sciences, Toronto, Canada.

Vice Chair of the Society for Industrial and Applied Mathematics (SIAM) Activity Group on Life Sciences (since 2005).

Farzan Nadim

Albert and Ellen Grass Faculty Fellowship, Marine Biological Laboratory, Woods Hole, MA.

Associate Editor, Journal of Neuroscience.

D.T. Papageorgiou

Co-Editor in-Chief, IMA Journal of Applied Mathematics.

Editorial Board Member, SIAM Journal on Applied Mathematics.

Editorial Board Member, Computational and Applied Mathematics.

Fellow of the Institute of Mathematics and its Applications.

Organizing Committee, Frontiers in Applied and Computational Mathematics, May 16-17, 2006, NJIT.

Michael Siegel

Member, Organizing Committee for Conference and Workshop Organization: Frontiers in Applied and Computational Mathematics, NJIT, May 2006.

Panelist, National Science Foundation, Division of Mathematical Sciences.

Invited long-term participant, Workshop on Bridging Time and Length Scales in Materials Science and Biophysics, Institute of Pure and Applied Mathematics (IPAM), 2005.

Jean-Marc Vanden-Broeck

Associate editor for the ANZIAM Journal and the Quarterly Journal of Mechanics and Applied Mathematics.

Fellow of the Institute of Mathematics and its Applications in the UK.

X. Sheldon Wang

Co-Organizer of Mini-Symposium, "Immersed Boundary Method and Its Extensions" in the 7th World Congress on Computational Mechanics 2006.

Yuan-Nan Young

Session Chair of the AIChE annual meeting, 2006.

B. CONFERENCE ON FRONTIERS IN APPLIED AND COMPUTATIONAL MATHEMATICS (FACM '06)

On May 15-16, more than 120 mathematicians from around the world attended the third annual Conference on Frontiers in Applied and Computational Mathematics at New Jersey Institute of Technology (NJIT) for news of the foremost advances in mathematical fluid dynamics which was the focus of this year’s conference. Plenary speakers included mathematician Charles S. Peskin, Ph.D., of the Courant Institute of

Mathematical Sciences at New York University, well known for his research on mathematical models of the beating heart; John Hinch, Ph.D., department of applied mathematics and theoretical physics at Cambridge University, England and a Fellow of the Royal Society; Grigory Barenblatt, Ph.D., a renowned applied mathematician from the University of California at Berkeley who studies the flow of fluids, and Tom Hou, Ph.D., a professor at California Institute of Technology, also famous for his work on the flow of fluids.

Today mathematicians, thanks to the ability of supercomputers, employ mathematical modeling to create remarkably accurate scenarios of unexplained phenomena in the physical and natural sciences. “In turn,” said Robert Miura, PhD, acting chair, of the department of mathematical sciences at NJIT, “scientific researchers find themselves teaming up with mathematicians to learn of better ways to eliminate or control the damage from natural disasters and other crises.”

Barenblatt’s research attracts the attention of not only mathematicians, but engineers and physicists. Using mathematics, he studies the flow of fluids, said Michael Siegel, Ph.D., professor in the Department of Mathematical Sciences at NJIT. When gases and liquids, such as air and water, do not follow a uniform motion and become chaotic-- the behavior of physical systems become unpredictable. Barenblatt understands the mathematics behind these turbulent chaotic fluid motions.

“We have many mathematicians who wanted to hear Barenblatt,” said Siegel. “His theories may be useful in understanding why materials like metals crack, how flame waves move and the mechanics of explosions.”

Barenblatt’s presentation, “Incomplete Similarity in Continuum Mechanics,” focused on the chaotic or whirling motions of fluids (also known as turbulence), special similarity solutions and scaling laws in fluid dynamics.

Peskin is famous for his mathematical models using a computer representation of a beating heart. “This is very impressive stuff,” said Siegel. For example, Peskin might be able to work out for heart surgeons precise worst-case scenarios showing what happens to the blood flow if, say, a heart were to develop an atrial fibrillation.

Front row (left to right): Daljit. S. Ahluwalia and Grigory Barenblatt
Back row (left to right): Tom Hou, John Hinch, Charles S. Peskin, and Robert Miura

Siegel said that Peskin creates a mathematical model of the human heart, modeled as an elastic object embedded in a fluid. The difficulty of what he does is to link the fluid flow to the heart’s elastic motion. Peskin has been working on this research for more than 20 years. The new element, which he discussed at the meeting, was mathematically incorporating electric signals into his models.

Signals are important because they govern the coordination and control of the heartbeat, said Siegel. The electric signal tells the heart when to contract and when to relax. Peskin’s talk was entitled “Cardiac

Mechanics and Electrophysiology by the Immersed Boundary Method."

Hinch's presentation analyzed the collapse of a column of grains. His research is motivated by the desire to understand landslides, explained Siegel. Hinch is well known for his work on the dynamics of drops and bubbles in fluids and for his work on suspensions. Hinch showed mathematically how the column of grains collapsed onto a horizontal, flat plain. Such an experiment offers researchers a better understanding of the distance the grains run out.

His research is really important because his model imitates the motion of particles in a landslide, Siegel explained. The model leads to simple rules concerning the distance the grains run out, which is in agreement with experimental and numerical simulations.

Hou presented recent work on what is considered an outstanding open problem in mathematical fluid dynamics. He asked and answered the question: Do the equations that govern the motion of frictionless fluids have reasonable solutions? The title of the presentation was: "The Interplay Between Local Geometric Properties and the Global Regularity of the 3-D Incompressible Euler Equations."

C. MISCELLANEOUS DEPARTMENTAL ACTIVITIES AND EVENTS

Robert Miura receives the Leroy P. Steele Prize from AMA

Robert Miura, Ph.D., a professor in the Departments of Mathematical Sciences and Biomedical Engineering at New Jersey Institute of Technology (NJIT) was honored on January 18, 2006, by his colleagues at NJIT for receiving the Leroy P. Steele Prize for a Seminal Contribution to Research in Mathematics from the American Mathematical Society (http://www.ams.org/prizes-awards). The prize honors the work of Miura and his co-authors C. S. Gardner, J. M. Greene and M. D. Kruskal. Their work was done some 40 years ago when Miura was a postdoctoral student at the Princeton Plasma Physics Laboratory.

The quartet unraveled the Korteweg-de-Vries equation, which had stumped mathematicians for decades. To solve the equation, Miura helped develop the inverse scattering method for solving nonlinear partial differential equations. The equation was originally published in 1895 by Dutch mathematicians Diederik Johannes Korteweg (1848-1941) and Gustav de Vries (1866-1934). The work was published as "Korteweg-de-Vries equation and generalizations. VI. Methods for exact solution, Comm. Pure Appl. Math. 27 (1974).

"Mathematicians regard the Steele prize very highly," said Daljit S. Ahluwalia, PhD, director of the Center for Applied Mathematics at NJIT. "It is awarded for work that has proved to be of fundamental or lasting importance in its field, or a model of important research. The list of past winners consists of many luminaries of mathematics, including John Nash and Andre Weil."

At the reception at NJIT, Miura said he was very fortunate to have had the opportunity to work with and to have been mentored by the other three men. "The two years at the Princeton Plasma Physics Laboratory were the happiest and most exciting years in my research career. Every day came with the time to think deeply about new ideas and to produce results."

At the NJIT reception, from left to right: NJIT President Robert A. Altenkirch, Robert M. Miura, and Daljit S. Ahluwalia

Miura said a major breakthrough in solving this fascinating problem was the development of a method for the exact solution which the mathematicians called the inverse scattering method. “The method utilized the scattering problem for the time-independent Schrodinger equation,” said Miura. “At the time, we thought this method was very special and only could be applied to that equation. However, other researchers soon showed us how to generalize the method to systems of equations. The rest is history.”

The Korteweg-de-Vries equation was originally published in 1895 by Dutch mathematicians Diederik Johannes Korteweg (1848-1941) and Gustav de Vries (1866-1934). The American Association for the Advancement of Science (AAAS) will elected Miura a Fellow in February 2006. He is one of only four individuals this year in math to receive this other honor. Miura shares the Steele Prize with three others.

Miura’s current research interests focus on developing mathematical models in neuroscience for cell dynamics. He works with biologists to help them understand how and why a type of depressed brain activity induced in animals spreads as a slow, pathological wave. A Fellow of the John Simon Guggenheim Foundation (1980) and the Royal Society of Canada (1995), Miura joined NJIT in 2001. Prior to that, he spent 26 years at the University of British Columbia, Vancouver, as a professor of mathematics.

Vladislav Goldberg Lauded for Work, Including Notable Publications

Vladislav Goldberg, PhD, a distinguished professor in the Department of Mathematical Sciences at New Jersey Institute of Technology (NJIT), and an expert in web geometry, was honored in May 2006 for a lifetime of scholarship. The International Geometry in Odessa Conference in Ukraine lauded the 70-year-old mathematician during a multi-day conference. Goldberg, born and schooled in Moscow, emigrated to the US in 1979 during the immigration wave of the 1970s that brought into the US a number of highly educated Jewish scientists. Today, Goldberg has retained a network of scholarly friends in Russia, the US, Israel and many other countries.

Goldberg is renowned for his understanding of a little-known branch of geometry: web geometry. Only a small number of scholars study this field, although their expertise is frequently tapped by economists and physicists, especially those scientists studying thermodynamics. The late S.S. Chern, PhD, of the University of California, Berkeley, numbered among the past century's noted mathematicians who worked in web geometry.

Web geometry focuses on the non-changing, or invariant, properties of a series of curved lines laid over a grid of horizontal and vertical lines.

Goldberg and a small international group of other web mathematicians create the rules for studying or understanding web geometry. If there is only one family of curves to overlay the grid, a curvilinear three-web is produced," said Goldberg. "Two families of curves produce a curvilinear four-web. We can use an infinite number of curves in each web family, but only a finite number of families produce a web. The grid, which is the foundation, or starting point, always counts as the first two families."

Economists and physicists use web geometry as a tool to prove their theories. Through the years, Goldberg has served many colleagues in other disciplines. His most memorable collaboration was in 2003 with Nobel Prize economists Paul A. Samuelson of MIT, Thomas Russell of University of Santa Clara and James B. Cooper of Johannes Kepler Universität Linz, Austria. The trio challenged him to answer an unsolved problem. "They asked to me find the conditions under which a curvilinear web can be mapped into a web with all transversal families being families of straight lines," said Goldberg.

Goldberg accepted the challenge and in 2004 and again in 2006, he co-authored two breakthrough works refuting a 1938 assertion by Wilhelm Blaschke, a noted German mathematician credited with founding the field of web geometry. Blaschke (1862-1955), a colorful character in his own right, ended up snubbed by nations and academics later in life for his public Nazi sympathies during World War II.

In Einfuehrung in die Geometrie der Waben (1955) Blaschke wrote that it was "hopeless" for mathematicians to find the conditions under which a curvilinear web can be mapped into a new web with transversal, nonintersecting straight lines.

"By hopeless, he meant that the problem had impossible calculations to carry out by hand," explained Goldberg. Of course, Blaschke's words were penned prior to the arrival of personal computing. Some 60 years later, Goldberg and coauthors, with the aid of advanced computer software programs, proved Blaschke wrong.

In 2004, Maks A. Akivis, of the Jerusalem Institute of Technology, Goldberg and Valentin V. Lychagin, of the University of Tromso, Norway, each a renowned mathematical author and scholar, solved the problem for all webs, except three-webs. Selecta Mathematica published "Linearizability of d-webs, d> 4, on two-dimensional manifolds" in December of 2004. Then, in 2005, Goldberg and Lychagin solved the more difficult variant of the problem, finding the conditions under which a curvilinear three-web can be mapped into a linear three-web with transversal straight lines. The Journal of Geometric Analysis published "On the Blaschke conjecture for 3-webs" in March of 2006. Comptes Rendus Mathematique published a six-page version of the same work in August of 2005.

Since 1958, Goldberg has published four monographs, eight textbooks, three book chapters and more than 120 scientific papers. Goldberg received his master's and doctoral degrees in mathematics from Moscow State University. From 1964 to 1978, Goldberg was a professor in the department of mathematics at Moscow Institute of Steel and Alloys.

In 1979, after immigrating to the US, Goldberg worked at Lehigh University for two years as a visiting professor. In 1981, he joined NJIT as a full professor. In 1985, NJIT made Goldberg one of the university's earliest distinguished professors.

At the ceremony this past May in Ukraine, Goldberg's colleagues from different countries warmly lauded his contribution to science and education. They presented him with a formal bound document which was read aloud to him at the ceremony. The document said: "We wish that you continuously move ahead and successfully complete all your plans and intentions. Let the welfare and success and health of all your family members assure your peace of mind and good mood. Let your loyal friends and your highly professional colleagues, united by joint goals, support your professional success which will bring progress and success to our common cause."

Lou Kondic Receives Fulbright To Study Thin Film Science in Argentina

Ever wonder how manufacturers produce the thinnest and finest materials for cell phone displays and even smaller electronic products? If so, you are entering the burgeoning new world of "thin film" science and the life work of theoretical physicist and applied mathematician Lou Kondic, PhD, associate professor, Department of Mathematical Sciences at New Jersey Institute of Technology (NJIT).

Kondic recently received a 2005-2006 Fulbright Scholar grant to study a dimension of thin film science focusing on the thinnest fluids. Kondic will travel next spring to Argentina for three months, where he will help physicists discover better ways to coat very delicate, almost invisible glass fibers. For almost two decades, scientists around the world have been searching for better polymers (more commonly known as plastics) to accomplish this task. These fibers are used to conduct electrical signals in microelectronics, optics and nanotechnology applications.

Interest in thin film science has sky-rocketed because of recent scientific and technological breakthroughs. Aside from coating glass fibers, these new thin microscopic coatings are used to enhance the durability of products ranging from the outer covering of NASA space ships to army tanks in Iraq.

In Argentina, Kondic will focus on how polymers are used to create a thin coating of a fluid film around an existing surface. Scientists consider fluids made of polymers to be complex. "My research will concentrate," said Kondic, "on the instabilities and patterns that form during the flows of these complex thin films."

Kondic's work especially interests researchers in the computer industry who want to know more about how to reach uniform coverage of a rotating silicon surface with a thin film polymer. Kondic hopes his work in Argentina will shed more light.

To achieve results, Kondic will use large scale numerical simulations to analyze the problems and find solutions. These simulations will be performed on a large computer located at NJIT, purchased with funds from the National Science Foundation.

This kind of work is often referred to as mathematical modeling. Mathematical modelers, like Kondic, formulate mathematical equations that are believed to describe physical, biological, or sociological phenomena. The modelers take the known and accepted formulas of physics and/or chemistry and create mathematical equations that described unexplained phenomenon--such as why two fluids may adhere.

While mathematical modeling may not always validate a fundamental physical or chemical principle, if the answer matches most of the presumed data, then researchers know they may be on the right path. Scientists in many fields, including biology, chemistry, physics, and engineering use mathematical modeling in their research. Economists, sociologists, and political scientists also utilize sophisticated mathematical modeling to deal with detailed problems associated with human behavior.

Kondic is the author of more than 50 research articles. His most recent scholarly article, "On Nontrivial Traveling Waves in Thin Film Flows, Including Contact Lines" appeared in September of 2005 in Physica D. The National Science Foundation, NASA, and the International Exchange of Scholars have supported Kondic's work. Kondic received his doctorate in physics from City College of City University of New York.

AAAS Elects NJIT Robert Miura as Fellow for Math Modeling Research on the Brain

The American Association for the Advancement of Science (AAAS) announced on October 28, 2005, that Robert Miura, Ph.D., was elected an AAAS Fellow. Miura is one of only four individuals this year to receive this honor in mathematics.

Miura's most recent accomplishments have been to develop mathematical models in neuroscience for cell dynamics. Earlier in his career, he solved the Korteweg-de Vries equation with mathematicians from the Princeton Plasma Physics Laboratory.

"In contrast to the past century of successes in understanding the mechanisms responsible for physical phenomena," said Miura, "the complexity of biological phenomena and the synergy of mechanisms responsible for these phenomena have made the understanding of biological systems much more difficult. Mathematical modeling isolates and quantifies each mechanism and its contribution. The importance and ability of mathematical modeling to tease out these separate mechanisms is still not fully appreciated by most biological and biomedical scientists."

Miura works with biologists to help them better understand how and why a type of depressed brain activity induced in animals spreads as a slow, pathological wave. Researchers, who study this wave, call it "spreading cortical depression." The research is intended to help people who experience a related disease, better known as a spontaneous migraine headache. Such headaches are preceded by an odd visual pattern of light, called an aura, which disappears and about a half hour later is followed by the onset of migraine, which can last up to 48 hours.

"Spreading depression was discovered some 60 years ago by a Brazilian neuro-physiologist A. A. Leao, who was studying epilepsy." said Miura, "Yet today, little is known about these chemical waves in the brain, which is why using mathematical modeling is helpful."

Miura also uses mathematical modeling to develop what he calls "designer microelectrodes" to help neurophysiologists create a better and more effective way of studying the electrical behavior of brain cells. "The tips of these electrodes must be extremely fine, about a micron in diameter," he said.

To solve the Korteweg-de Vries equation, Miura helped develop the inverse scattering method for solving nonlinear partial differential equations. The equation was originally published in 1895 by Dutch mathematicians Diederik Johannes Korteweg (1848-1941) and Gustav de Vries (1866-1934) at what is now the Technological Institute of Delft.

Miura recently co-authored "Spatial Buffering Mechanism: Mathematical Model and Computer Simulations," Mathematical Biosciences and Engineering, Volume 2 (2005); "Membrane Resonance and Stochastic Resonance Modulate Firing Patterns of Thalamocortical Neurons," Journal of Computational

Neuroscience, Volume 16 (2004).

A Fellow of the John Simon Guggenheim Foundation (1980) and the Royal Society of Canada (1995), Miura joined NJIT in 2001. Prior to that, he spent 26 years at the University of British Columbia, Vancouver, as a professor of mathematics.

Miura is co-editor-in-chief of the journal, Analysis and Applications and vice chair for the life sciences activity group of Society of Industrial and Applied Mathematics (SIAM). He serves on the editorial boards of the Canadian Applied Mathematics Quarterly, Integrative Neuroscience, and SIAM Book Series on Monographs on Mathematical Modeling and Computation.

Miura received his BS and MS in mechanical engineering from the University of California at Berkeley and his MA and PhD in aerospace and mechanical sciences from Princeton University.

The tradition of AAAS Fellows began in 1874. Members are considered for the rank of Fellow if nominated by the steering group of their respective sections by three Fellows, or by the chief executive officer of AAAS. AAAS, founded in 1848, is the world's largest general scientific society, and publisher of the journal, Science (www.sciencemag.org).

$1 Million Grant From Howard Hughes Medical Institute To Fund Joint Neuroscience Program at NJIT, Rutgers-Newark, UMDNJ

A $1 million, 3-year grant from the Howard Hughes Medical Institute (HHMI) awarded jointly to three prominent research universities – all located in Newark, NJ – will be used to develop a novel doctoral program designed to train future neuroscientists who can integrate approaches used in mathematics, biomedical sciences and computation as they investigate emerging questions in the neural sciences. The consortium of the New Jersey Institute of Technology (NJIT), Rutgers-Newark, and the University of Medicine and Dentistry of New Jersey (UMDNJ)-New Jersey Medical School was among 10 awardees selected from 132 applicants.

The inter-institutional quantitative neurosciences doctoral training program will be co-directed by Joshua Berlin of UMDNJ-New Jersey Medical School, Robert Miura of NJIT, and James Tepper of Rutgers-Newark. It will employ state-of-the-art interdisciplinary approaches to explore and better explain the complex mechanisms underlying nerve and brain function.

“Although tremendous progress has been made in the neurosciences, daunting challenges remain,” Tepper said. “The solutions to these problems are likely to be found by bringing together the tools and approaches from many different disciplines. The HHMI award will allow us to train a new generation of scientists who can work at the interface of quantitative, computational and biological science to address these problems.”

Miura said that by working together, the three universities will be able to create a particularly effective doctoral program. “The HHMI training grant represents a significant new opportunity to take advantage of the myriad complementary strengths of the faculty of UMDNJ-New Jersey Medical School, Rutgers-Newark and NJIT,” he noted. “With their physical proximity and close ties among the faculty, these three institutions will create a unique environment unparalleled in interdisciplinary neuroscience training.”

Berlin agreed. “The HHMI program will serve as a catalyst to bring together students and faculty from many neuroscience-related disciplines into a single entity devoted to studying complex questions posed by present-day and future medical science,” he said. “This effort will lead to a much greater degree of collaboration among the many universities and biomedical research institutes in Newark."

Joshua Berlin received his BA and MS in chemistry from Northwestern University and his PhD in pharmacology from Michigan State University. He is a professor of pharmacology and physiology at UMDNJ-New Jersey Medical School and serves as co-director of the joint program in biomedical engineering between UMDNJ and NJIT. Berlin is the recipient of numerous awards and grants from the National Institutes of Health (NIH) and the American Heart Association, and his research focuses on molecular mechanisms controlling function of ion transporters and channels in nerve and muscle.

Robert Miura's research focuses on developing mathematical models in neuroscience for cell dynamics. He is a Fellow of the American Association for the Advancement of Science, the John Simon Guggenheim Foundation and the Royal Society of Canada. He is a professor of the department of mathematical sciences at NJIT. Miura is co-editor-in-chief of Analysis and Applications and vice chair for the life sciences activity group of the Society for Industrial and Applied Mathematics. He serves on editorial boards for Canadian Applied Mathematics Quarterly and Integrative Neuroscience. Miura received his MA and PhD in aerospace and mechanical sciences from Princeton University and his BS and MS in mechanical engineering from the University of California-Berkeley.

James Tepper received his PhD in biological psychology from the University of Colorado-Boulder. He is a professor of neuroscience at the Center for Molecular and Behavioral Neuroscience at Rutgers-Newark. Tepper is a highly published investigator who serves on the editorial boards of Neuroscience and the Journal of Neuroscience, and is president-elect of the International Basal Ganglia Society. His research funded by the NIH focuses on the functional circuitry of the basal ganglia at the systems level.

The Howard Hughes Medical Institute (HHMI) is dedicated to discovering and disseminating new knowledge in the basic life sciences. HHMI grounds its research programs on the conviction that scientists of exceptional talent and imagination will make fundamental contributions of lasting scientific value and benefit to mankind when given the resources, time and freedom to pursue challenging questions. The institute prizes intellectual daring and seeks to preserve the autonomy of its scientists as they pursue their research. A nonprofit medical research organization, HHMI was established in 1953 by the aviator-industrialist. The institute, headquartered in Chevy Chase, Md., is one of the largest philanthropies in the world with an endowment of $14.8 billion at the close of its 2005 fiscal year. HHMI spent $483 million in support of biomedical research and $80 million for support of a variety of science education and other grants programs in fiscal 2005.

VII. FUNDED RESEARCH

A. EXTERNALLY FUNDED RESEARCH

CONTINUING FUNDED PROJECTS

1. *Accuracy and Stability of Computational Representations of Swept Volume Operations*

   NSF/DARPA: July 1, 2003 - June 30, 2007
   Denis Blackmore
   Ming Leu
   William Regli
   Wei Sun

2. *Functional Roles for Short-Term Synaptic Plasticity in Neuronal Networks*

   National Science Foundation: July 2003 - June 2006
   Amitabha Bose
   Victoria Booth

3. *UBM: An Undergraduate Training Program in Biology and Mathematics at NJIT*

   National Science Foundation: September 2004 - August 2009
   Amitabha Bose
   Jorge Golowasch
   Farzan Nadim

4. *Activity-Dependent Regulation of Ionic Currents*

   National Institute of Mental Health (MH64711-01): December 1, 2001 – November 30, 2006
   Jorge Golowasch

5. *The Pyloric Model Group: Functional Analysis of a Complex, Distributed Biological Neural Network*

   National Science Foundation (0090250): March 1, 2001 – March 28, 2006
   Scott Hooper
   Jorge Golowasch
   Ron Harris-Warrick
   Eve Marder
   Farzan Nadim
   Michael P. Nusbaum

6. *ITR: Mesoscopic Modeling and Simulation: A Novel Approach to Monte Carlo Methods*

   National Science Foundation: September 1, 2002 - August 31, 2005
   David J. Horntrop
   Markos A. Katsoulakis (University of Massachusetts)
   Dionisios G. Vlachos (University of Delaware)

7. *Spectral Schemes for Stochastic Partial Differential Equations for Surface Processes*

National Science Foundation: July 1, 2004 - June 30, 2007
David J. Horntrop

8. *Gravity and Granular Materials*

NASA: April 1, 2004 - October 30, 2007
Lou Kondic
Robert P. Behringer (Duke University)

9. *Establishment of Linked PhD Programs*

Council for International exchange of Scholars August 1, 2004 - July 30, 2006
Lou Kondic
Javier Diez (University Nacional del Centro, Tandil, Argentina)

10. *Dynamics of Non-Newtonian Liquid Films Involving Contact Lines*

The Fulbright Foundation September 1, 2005 - August 31, 2006
Lou Kondic

11. *Acquisition of a Computer Cluster for the Center of Applied Mathematics and Statistics at NJIT*

National Science Foundation, Division of Mathematical Science, Major Research Instrumentation:
Sept 1, 2004 – August 31, 2007
Daljit S. Ahluwalia
Marc Q. Ma
Michael Siegel
Louis Tao
Lou Kondic
David Horntrop
Peter Petropoulos
Roy Goodman

12. *Applied Mathematical Problems in Microwave Processing of Ceramics*

Department of Energy: September 15, 2004 - September 15, 2007
Gregory A. Kriegsmann

13. *Presynaptic Ca2+ Dynamics, Ca2+ Buffers and the Mechanisms of Facilitation*

National Science Foundation - Mathematical Sciences Division: August 15, 2004 - July 31, 2007
Victor Matveev

14. *Efficient Shallow Water Matched Field Inversion: Extension*

Office of Naval Research: February 1, 2005 - December 31, 2007
Zoi-Heleni Michalopoulou

15. *Regulation of Neuronal Oscillations by Synaptic Dynamics*

National Institute of Mental Health: December 1, 2000 - November 30, 2006
Farzan Nadim

16. *Mechanisms of Dose- and State-Dependence of Neuromodulation*

United States-Israel Binational Science Foundation: September 1, 2002-August 31 2007
Yair Manor
Farzan Nadim
Eve Marder

17. *Mathematical Problems in Electrohydrodynamics*

National Science Foundation-Mathematical Sciences Division: July 1, 2004 - June 31, 2007
D.T. Papageorgiou

18. *Uniform in Time Asymptotic and Numerical Methods for Propagation in Dielectrics Exhibiting Fractional Relaxation, and Efficient and Accurate Impedance BoundaryConditions for High-Order Time-Domain Numerical Schemes for Maxwell's Equations*

Air Force Office of Scientific Research: January 1, 2005 - January 1, 2008
Peter G. Petropoulos

19. *Transport and Heterogeneity in Surface-Volume Biochemical Reactions: Modeling and Experiment, with Applications to Immunocolloid Labeling and Surface Plasmon Resonance Devices*

National Institutes of Health: August 1, 2002 - July 31, 2007 (subcontract from University of Wisconsin)
Paul Milewski
Christopher S. Raymond
David A. Edwards
Ralph Albrecht

20. *Focused Research Group: Singularity Formation for the Three-Dimensional Euler Equations and Related Problems*

National Science Foundation-Mathematical Sciences Division: July 1, 2004 - June 30, 2007
Michael Siegel

21. *Numerical Investigations of Three and Two Dimensional Free Boundary Problems*

National Science Foundation-Mathematical Sciences Division: August 1, 2002 - July 31, 2006
Jean-Marc Vanden-Broeck

PROJECTS FUNDED DURING PRESENT FISCAL YEAR

1. *Surface Expressions of Nonlinear Internal Waves*

   Office of Naval Research: January 1, 2005 - December 31, 2007
   Wooyoung Choi
   Dave Lyzenga

2. *Optimum Vessel Performance in Evolving Nonlinear Wave Fields*

   Office of Naval Research: May 1, 2005 - April 30, 2010
   Wooyoung Choi
   Robert Beck
   Marc Perlin

3. *Equipment and Modules for a Capstone Course in Applied Mathematics*

   National Science Foundation: September 1, 2005 - August 31, 2008
   Daniel Goldman
   Michael Booty
   Bruce Bukiet
   Lou Kondic
   Michael Siegel

4. *Propagation of Fronts in Porous Media Combustion*

   National Science Foundation-Mathematical Sciences Division: August 1, 2005 - June 30, 2007
   Peter Gordon

5. *Development of a Quantitative Neurosciences Doctoral Training Program*

   Howard Hughes Medical Institute: 1/1/2006-12/31/2008
   R. Miura (Program Director)
   J. Berlin (Program Co-Director, UMDNJ-NJMS)
   J. Tepper (Program Co-Director, Rutgers)
   Marc Q. Ma: Program Participant (among 14 other faculty members as participants)

6. *Conference on Frontiers in Applied and Computational Mathematics*

   National Science Foundation: June 1 - November 30, 2006
   Robert M. Miura

7. *Interdisciplinary Graduate Training Program in Quantitative Neurosciences*

   Howard Hughes Medical Institute: January 1, 2006 - December 31, 2008
   Robert M. Miura
   Joshua Berlin (NJMS - UMDNJ)
   James Tepper (RU - Newark)

8. *Conference on Frontiers in Applied and Computational Mathematics*

National Science Foundation: June 1 - November 30, 2005
Robert M. Miura

9. *Conference on Frontiers in Applied and Computational Mathematics*

Air Force Office of Scientific Research: June 1 - November 30, 2005
Robert M. Miura

10. *Conference on Frontiers in Applied and Computational Mathematics*

Society for Mathematical Biology: April 1 - September 30, 2005
Robert M. Miura

11. *Collaborative Research: Patterns, Stability, and Thermal Effects in Parametric Gain Devices*

National Science Foundation: July 15, 2005 - July 14, 2008
Richard O. Moore
Keith Promislow, Michigan State University

12. *Collaborative Research: Multiscale Analysis of Epithelial Patterning: Modeling and Experiments*

National Institutes of Health: August 1, 2005 - July 31, 2008
Joseph Duffy
Cyrill Muratov
Stanislav Shvartsman

13. *Cortical Processing Across Multiple Spatial and Time-Scales*

National Science Foundation: August 1, 2005 - July 31, 2008
David Cai
Gregor Kovacic
David McLaughlin
Michael Shelley
Louis Tao

B. PROPOSED RESEARCH

PROJECTS PROPOSED DURING PRESENT FISCAL YEAR

1. *MSPA-ENG: Simple Dynamical Models of Complex Granular Flows*

National Science Foundation: September 1, 2006 - August 31, 2009
Denis Blackmore
Anthony Rosato

2. *MSPA-MCS: Topologically Correct Visualization of High Performance Computing Architectures*

National Science Foundation: September 1, 2006 - August 31, 2009
Denis Blackmore
Ralph Kopperman
Thomas Peters

3. *The Role of Short-Term Synaptic Plasticity in Feedback Neuronal Networks*

National Science Foundation: July 2006 - June 2009
Amitabha Bose

4. *The Role of Descending Projection Neurons and Feedback in Rhythmic Motor Pattern Generation*

National Science Foundation: July 2006 - June 2011
Farzan Nadim
Amitabha Bose
Michael Nusbaum

5. *Estimation of the Gravity-Capillary Wave Spectrum from Subsurface Light Field Measurements*

Office of Naval Research: October 1, 2005 - September 30, 2006
Wooyoung Choi
Dave Lyzenga

6. *CMG Collaborative Research: A systematic Approach to Large Amplitude Internal Wave Dynamics: An Integrated Mathematical, Observational, and Remote Sensing Model*

National Science Foundation: September 1, 2006 - August 31, 2010
Wooyoung Choi
Yuan-Nan Young
Roberto Camassa
Dave Lyzenga
Steve Ramp

7. *Linearization of Webs with Applications*

Banff International Research Station (BIRS) for Mathematical Innovation and Discovery:
November - December 2006
Vladislav V. Goldberg
Valentin V. Lychagin

8. *Integrative Modeling of Microvascular Transport and Tissue Metabolism During Sepsis*

National Institutes of Health: December 1, 2006 - November 30, 2011
Daniel Goldman

9. *CAREER: Dynamical Systems Methods for Wave Interactions and Fluid Mixing*

National Science Foundation: June 1, 2006 - May 30, 2011
Roy Goodman

10. *AMC-SS: Mesoscopic Simulation for Self-Organization in Surface Processes*

National Science Foundation: July 1, 2006 - June 30, 2009
David J. Horntrop

11. *Bridging the Spatial and Temporal Scales in Dense Granular Systems*

National Science Foundation: July 1, 2006 - June 30, 2009
Lou Kondic

12. *Pan-American Study Institute on Interfacial Fluid Dynamics*

National Science Foundation: August 1, 2006 - October 31, 2007
Lou Kondic
George Homsy (UCSB)

13. *Developing a Thermodynamic Description of Dense Granular Flows*

National Science Foundation: July 1, 2006 - June 30, 2009
Robert Behringer (Duke University)
Corey O'Hern (Yale University)
Lou Kondic

14. *Statistical Properties of Dense Granular Flows*

National Science Foundation: July 1, 2006 - October 30, 2009
Robert Behringer (Duke University)
Corey O'Hern (Yale University)
Lou Kondic

15. *McKnight Technological Innovations in Neuroscience Awards*

McKnight Endowment Fund for Neuroscience: 2006-2008
Robert M. Miura

16. *Simulation of Rare Events in Lightwave Systems*

National Science Foundation University-Industry Cooperative Research Programs in the Mathematical Sciences: September 1, 2006 - August 31, 2008
Richard O. Moore
Colin S. McKinstrie (Lucent Technologies)

17. *Regulation of Neuronal Oscillations by Synaptic Dynamics*

National Institutes of Health: August 1, 2006 - July 31, 2011
Farzan Nadim

18. *Analysis and Computations of Electrified Viscous Free Surface Flows*

National Science Foundation
D.T. Papageorgiou
J.-M. Vanden-Broeck

19. *Simulation and Analysis of the Rayleigh-Taylor Mixing of Two Fluids*

National Science Foundation: August 1, 2006 - July 31, 2009
Yuan-Nan Young

C. EXTERNALLY FUNDED PROJECTS -- NOT THROUGH CAMS

CONTINUING PROJECTS — NOT THROUGH CAMS

1. *New Jersey Center for Micro-Flow Control*

New Jersey Commission on Science and Technology, December 1, 2000 – June 30, 2006
N. Aubry
S. Sundaresan (Princeton University)
P. Singh (Associate Director)
E. Geskin
Y. Kevrekidis (Princeton University)
B. Khusid

2. *Protective Jackets for Multi-Hazard Mitigation Measures (ProJack-M): Proof of Concept*

Multidisciplinary Center for Earthquake Engineering Research: October 1, 2005 - September 30, 2006
A. Saadeghvaziri (NJIT Civil Engineering Department)
B. Bukiet

3. *Training Program in Biostatistics to Clinicians*

Novartis Pharmaceuticals Corporation, East Hanover, NJ: March – April 2006
Sunil Dhar

4. *Inter-University Attraction Pole of the Belgian Governement on Photonics* (2001-2006)
Thomas Erneux is responsable for the workpackage entitled "Laser Dynamics"

5. *Salt Runoff Collection System*

US Department of Transportation/NJ Department of Transportation: January 2005 - December 2006
G. Golub
B. Dresnack
J. Meegoda
T. Harhaba
W. Konon
E. Filippone

6. *Corrugated Steel Culvert Pipe Deterioration*

US Department of Transportation/NJ Department of Transportation: January 2003 - September 2006
J. Meegoda
T. Juliano

7. *Sustainable Biocell Technology for Energy and Resource Recovery*

Natural Science and Engineering Research Council of Canada (NSERC Strategic Grants Program): November, 2004 - October 2007

P. Hettiaratchi
A. Mehrotra
G. Achari
M. Warith
J. Wilson
J. N. Meegoda
City of Calgary and Stantech Consulting

8. *US-France Cooperative Research (INRIA): Approximate Boundary Conditions for Computational Wave Problems*

National Science Foundation-Office of International Science and Engineering: August 1, 2003 - July 31, 2006

Jan Hesthaven (Brown University)
Peter G. Petropoulos (New Jersey Institute of Technology)
Patrick Joly (INRIA-Rocquencourt)
Eliane Becache (INRIA-Rocquencourt)
Houssem Haddar (INRIA-Rocquencourt)

9. *Nonlinear Electrohydrodynamics*

EPSRC (Engineering and Physical Sciences Research Council in the UK): October 1, 2004 - September 30, 2006

Jean-Marc Vanden-Broeck

10. *Three Dimensional Gravity Gravity Free Surface Flows*

EPSRC (Engineering and Physical Sciences Research Council in the UK): October 1, 2003 - September 30, 2006

Jean-Marc Vanden-Broeck

11. *Mathematical and Computational Modeling for Problems from Biological and Industrial Applications*

Natural Science and Engineering Research Council of Canada: April 1, 2005 - March 31, 2010

Huaxiong Huang

12. *Mathematical Modeling of Fibrous Porous Medium Flow with Phase Change*

Mathematics of Information Technology and Complex System: April 1, 2005 - March 31, 2007

Huaxiong Huang

13. *Numerical Methods for Incompressible Flows with (Moving) Interfaces: Algorithm, Error Analysis and Biological Application*

Chinese National Science Foundation: January 1, 2005 - December 31, 2008

Huaxiong Huang (Joint with C. Lu in Shanghai Jiatong University)

14. *Flujos con Superficies Libres y Dinamica Superficial*

Agencia Nacional de Promocion de la Ciencia y la Tecnologia (Argentina): July 2004 - July 2007
Javier Diez

NEW FUNDING – NOT THROUGH CAMS

1. *Linearization of Webs with Applications*

Banff International Research Station (BIRS) for Mathematical Innovation and Discovery:
November - December 2006
Vladislav V. Goldberg
Valentin V. Lychagin

2. *Molecular Dynamics Simulations to Assist the Design of New Drugs*

UPS Foundation and the College of Computing Sciencs of NJIT: January 1, 2006 – December 31, 2006
Marc Q. Ma

3. *Conversion of Chromium Ore processing Residue to Chrome Steel*

New Jersey Department of Environmental Protection: May 2006 - April 2008
Jay Meegoda

4. *Development of a THz 2-D Imaging System for Stand-off Detection of Concealed Explosives*

US Army - Picatinny Arsenal: July 1, 2006 - June 30, 2007
John Federici
Bob Barat
Dale Gary
Zoi-Heleni Michalopoulou

5. *Proprioceptive Feedback to a Motor Pattern Generating Network*

Albert and Ellen Grass Foundation: June 15, 2006 - August 15, 2006
Farzan Nadim

6. *Nonlinear Electrified Viscous Free-Surface Flows Over Topography*

EPSRC (Engineering and Physical Sciences Research Council in the UK): June 1, 2006 - May 31, 2008
Jean-Marc Vanden-Broeck
M. Blyth

7. *Applied Mathematics Research Center*

Department of Defense: July 1, 2005 - June 30, 2009
Fengshan Liu (Delaware State University)
Dawn A. Lott (Delaware State University)
Dragoljub Pokrajac (Delaware State University)
Mazen Shahin (Delaware State University)
Xiquan Shi (Delaware State University)

8. *Financial Risk Modeling*

RBC Financial Group: May 1, 2006 - December 31, 2006
Huaxiong Huang

D. PROPOSED PROJECTS – NOT THROUGH CAMS

1. *TECHS-NJ Teacher Education Collaboration for High-Need Schools*

New Jersey NSF-DUE: September 2006 - August 2010
Bruce Bukiet
Arthur Powell
Gayle Griffin
Ismael Calderon

2. *Invigorating New Jersey Education Through College Transfer (INJECT)*

NSF-DUE: September 2006 – August 2011
Bruce Bukiet
Fadi Deek
Rob Friedman

3. *CAREER: Unraveling the Mechanisms of Allosteric Regulation of Enzymes*

National Science Foundation: July 2005
Marc Q. Ma

4. *Maximizing Resource Utilization by Autonomous Migration of Operating Systems*

National Science Foundation: August 2005
Marc Q. Ma

5. *Model-Based Design and Screening of Allosteric Activators of Soluble Guanylyl Cyclase*

NIH: October 2005
Marc Q. Ma

6. *Molecular Dynamics of Guanylyl Cyclase Activation*

American Health Assistance Foundation: October 2005
Marc Q. Ma

7. *Probing Enzyme Regulation using Molecular Simulations and Experimental Validation*

National Science Foundation: January 2006
Marc Q. Ma

8. *Novel Quasi-Multiscale Integrators for Molecular Dynamics*

American Chemical Society - Petroleum Research Fund: April 2006
Marc Q. Ma

9. *Collaborative Research: Surface Tension and Surfactant Effects in Rayleigh-Taylor Instability*

National Science Foundation: August 1, 2006 - July 31, 2009
Y.-N. Young
Y. Zheng (Stony Brook)

10. *Collaborative CMG Research: Experiments, Analyses, and Numerical Simulations on Continental Drift*

August 1, 2006 - July 31, 2010
J. Zhang (NYU Courant/Physics)
Y.-N. Young

11. *Fellowships for Interdisciplinary Research in Science and Technology (The FIRST Scholars Program)*

National Science Foundation January 1, 2007 - December 31, 2010
Dawn A. Lott (Delaware State University)
Sabrina Brougher (Delaware State University)
Nourredine Melikechi (Delaware State University)
Dragoljub Pokrajac (Delaware State University)

12. *Computers and Laboratories Integrated with Mathematics to Enhance Biosciences (The CLIMB Project)*

National Science Foundation: January 1, 2007 - December 31, 2008
Dawn A. Lott (Delaware State University)
Melissa Harrington (Delaware State University)

13. *Partnership for the Revitalization of Inquiry in School Mathematics and Sciences (PRISMS)*

National Science Foundation: January 1, 2007 - December 31, 2011
Dawn A. Lott (Delaware State University)
Dewayne Fox (Delaware State University)
Patrick Gleeson (Delaware State University)
Juliet Hahn (Delaware State University)
William McIntosh (Delaware State University)

VIII. COMMITTEE REPORTS AND ANNUAL LABORATORY REPORT

A. READING ROOM

The CAMS Reading Room has continued to function as a location for informal gathering of faculty and graduate students. The daily teatime is now completely organized by graduate students, who also in this way contribute more and more to the department activities. The most active days are Fridays, when faculty and students have a chance to interact more closely with the DMS and CAMS Colloquium speaker, in addition to other days when attractive and interesting seminars in mathematical biology, fluid dynamics, statistics and wave propagation take place.

B. SEMINAR COMMITTEE REPORT

CAMS sponsored a very active Applied Mathematics Colloquium Series in 2005-2006. The weekly series, which began modestly in 1986, has grown into a prestigious forum for internationally-known applied mathematicians, physicists and engineers to lecture on current developments in science and engineering.

The audience at the colloquia has also grown in numbers in recent years, and is a testament to CAMS' commitment to foster cooperation and collaboration within the local scientific community. In addition to faculty and grad students in the Department of Mathematical Sciences, the lectures routinely attract members of other departments at NJIT as well as several area universities.

In addition to the weekly applied math colloquia, CAMS now hosts seminar series in fluid mechanics, mathematical biology, waves, and statistics. On virtually any day, one can attend a CAMS-sponsored activity. Indeed, the CAMS colloquia and seminar series has firmly established itself as a vibrant hub of intellectual activity at NJIT!

C. MAJOR RESEARCH INSTRUMENTATION COMPUTER CLUSTER

Last year, the Department of Mathematical Sciences (DMS) and Center for Applied Mathematics and Statistics (CAMS) at the New Jersey Institute of Technology, under the auspices of the MRI program at NSF, acquired a 64-node Beowulf-class computer cluster for research in the mathematical sciences. Each compute-node of the cluster is composed of two 2.0 GHz, 64-bit processors (AMD Opteron CPU); the

cluster includes a total of 256 GB of memory, mass storage devices, scientific software, and hardware for a high speed Myrinet network. The machine is dedicated to the support of research by faculty and graduate students in CAMS and DMS, and is used for projects which involve mathematical modeling and the development of computational techniques to study fundamental processes in physical science and biology. Examples of these projects include: the development of efficient molecular dynamics methods with applications to fluid flow in nano-devices and drug molecule/protein target interactions; simulations of large interacting systems of neurons in the visual cortex; investigations of granular systems; studies of mesoscopic models for surface processes in biology; simulations of surface evolution in crystalline materials; and improved numerical methods for studying aspects of electromagnetic wave propagation.

The research activities are primarily involved with the mathematical modeling of important processes in science and technology and hence are of benefit to scientists and engineers in a wide variety of disciplines. For example, the research on molecular dynamics methods is used to obtain insights in the interactions between drug molecules and their protein targets, numerical simulations of interacting neurons in the visual cortex can lead to an improved understanding of high-level visual processing events, such as ``edge-detection,'' and studies of surface evolution in crystalline materials aid in the design of novel microelectronic devices. In addition, the described research promotes interdisciplinary collaborations between applied mathematicians and scientists in diverse areas. The computational resources available for CAMS fluid dynamics scientists are substantial. The cluster is used to obtain numerical solutions to continuum models of fluid dynamic phenomena, molecular dynamics simulations, the study of flows in granular media, and many other complex fluid flow problems. Graduate students and postdocs involved in the research receive training in state-of-the-art numerical techniques.

D. STATISTICAL CONSULTING LABORATORY REPORT

The mathematical sciences faculty serves the NJIT community and outside individuals and organizations as statistical consultants. Here are some examples of such consulting activities.

Date: July – August 2005 Client: Manalapan-Englishtown Regional Schools
Description: Analyzed the middle school students' data, identified the relationship between student performance and demographic variables, and presented the results to the officials of the Manalapan-Englishtown Regional Schools.
Consultants: Xun Yang (M.S. student) and Professor Aridaman K. Jain

Date: December 2005 – January 2006 Client: David Abramowitz (Window shapes)
Description: Developed mathematical formulas for determining the window angles as functions of height, width, and frame thickness for unusually-shaped windows.
Consultants: Jon Porus (M.S. student) and Professor Aridaman K. Jain

Date: February 2006 Client: Chimezie Ozurumba (Rutgers University)
Description: Developed statistical models for assessing the impact of casino revenues on state budgets.
Consultants: Chunsheng Yang (Ph.D. student) and Professor Aridaman K. Jain

Date: January – June 2006 Client: Francisco Artigas (New Jersey Meadowlands Commission – Environmental Research Institute)
Description: Analyzed water quality data and developed Time Series models for predicting the future values of water quality based on their relationship to past data and some auxiliary variables.
Consultants: Satrajit Roychoudhury and Soumi Lahiri (Ph.D. students) and Professors Ken Johnson and Aridaman K. Jain

Date: February – June 2006 Client: Innospire Systems Corporation
Description: Develop new and improved algorithms for the high school class scheduling problem.
Consultant: Professor Venkat Venkateswaran

IX. CURRENT AND COLLABORATIVE RESEARCH

A. RESEARCH AREAS IN CAMS

Mathematical Biology

Researchers in CAMS working on problems related to Mathematical Biology: Booth, Bose, Bukiet, Dhar, Elmer, Georgieva, Goldman, Golowasch, Holzapfel, Khan, Lott, Ma, Nadim, Matveev, Miura, Muratov, Perez, Raymond, Tao, and Wang.

Mathematical Biology broadly refers to the branch of mathematics that is devoted to the study of biological processes. Historically, applications have arisen in a number of disparate areas such as population ecology, pattern formation, blood flow in mammals, and nerve impulse propagation in the central nervous system. More recently, there has been quite a bit of emphasis on the intersection of mathematics with developmental biology, neurophysiology, and especially genomics. Moreover, mathematicians are applying their modeling and analytical skills to the study of various diseases, such as diabetes, Parkinson's disease, multiple sclerosis, Alzheimer's disease, and HIV-AIDS. The kinds of mathematics needed to describe and address problems in these areas of Mathematical Biology are quite vast and include dynamical systems, partial differential equations, fluid dynamics, mechanics, and statistics, to name only a few. Researchers in Mathematical Biology at NJIT have strong interdisciplinary research programs since most of them have active collaborations with experimentalists. This group of Mathematical Biologists is the largest in a department of mathematics in North America.

A primary focus of the Mathematical Biology group is in experimental, computational, and mathematical Neuroscience. The experimental research in neuroscience within CAMS is headed up by Jorge Golowasch and Farzan Nadim. Both researchers run labs in which they conduct experiments on various aspects of the crustacean stomatogastric nervous system (STNS). The main focus of Nadim's research is to understand how synaptic dynamics, such as short-term depression and facilitation contribute to the generation and control of oscillatory neuronal activity. Experiments in Nadim's lab involve characterizing the synaptic dynamics in the STNS and studying the contributions of these dynamics, through mathematical modeling, to the output from the biological network. Using both electrophysiological and computational tools, Golowasch studies mechanisms of neuronal plasticity and homeostasis of the ionic currents that determine the excitability and electrical activity of neurons and simple neural networks in the STNS. Currently, he also is screening several neuropeptides for their possible involvement in trophic regulation of dissociated adult neurons in culture and in long term organotypical culture. These neuropeptides are known to have short-term neuromodulatory effects.

Various aspects of Computational and Mathematical neuroscience are being studied by Victor Matveev, Louis Tao, Amitabha Bose, and Robert Miura. Matveev studies mechanisms responsible for short-term synaptic plasticity. He is particularly interested in understanding the role of residual calcium in synaptic facilitation. Tao is interested primarily in the modeling and analysis of the dynamics of neuronal networks, with application to visual cortex and other large-scale cortical networks. He focuses on developing analytical techniques to study networks in simplified settings and on identifying possible biological functions of emergent network dynamics. Bose is interested in developing mathematical techniques to understand the role of short-term synaptic plasticity in producing multi-stable periodic solutions within neuronal networks. He is also interested in developing models for persistent localized activity in excitatory networks. Miura has worked extensively on modeling and analysis of models for electrical activity in excitable cells, including neurons and pancreatic beta-cells. He is currently working on mathematical models for spreading depression, a slowly propagating chemical wave in the cortex of various brain structures, which has been implicated in migraine with aura. Also, he is working on developing a theory for the formation of glass microelectrodes, which are used daily in electrophysiology laboratories around the world.

In the area of Developmental Biology, Cyrill Muratov is interested in developing models that describe the patterning events leading to the formation of dorsal appendages during Drosophila egg development. He studies a system of coupled reaction-diffusion equations driven by a localized input and characterizes the oocyte phenotype by the number of peaks in the signaling pattern. Dan Goldman and Sheldon Wang use techniques of fluid dynamics to study various biological phenomenon. The research of Dan Goldman is centered on developing a flexible, efficient and highly realistic computational model for simulating microvascular blood flow and oxygen delivery. His model has been used to study both steady-state and time-dependent oxygen delivery, which is of primary interest for understanding physiological functioning. Current studies use this model to understand blood flow and oxygen transport during sepsis and at the onset of exercise. Sheldon Wang is developing new immersed boundary/continuum methods which will provide a platform for effective modeling of highly deformable shells/beams and solids immersed in biological fluids. These methods will facilitate further research in multi-scale and multi-physics coupling of complex fluid-solid systems with microscopic models. Chris Raymond is interested in mathematical modeling for immunocolloid labeling. In this process, colloidal metal particles are conjugated to ligand molecules which bind to the molecule of interest, commonly a receptor molecule on a cell surface. With experimental and mathematical collaborators, he is developing mathematical models for the immunocolloid labeling process with the goal of optimizing the choice of experimentally adjustable parameters to maximize labeling efficiency.

Fluid Dynamics

Researchers in CAMS working on problems related to Fluid Dynamics: Aubry, Bechtold, Booty, Bukiet, Choi, Diez, Goldman, Gordon, Huang, Jiang, Kondic, Luke, Ozen, Papageorgiou, Petropoulos, Rosato, Siegel, Vanden-Broeck, Wang, and Young.

There are ten faculty members within the Department of Mathematical Sciences (DMS) and Center for Applied Mathematics and Statistics (CAMS) whose research is in fluid dynamics or the closely related area of combustion. This group of fluid dynamics scientists is one of the largest contained within a department of mathematics in the United States.

Fluid dynamics is concerned with the motion of fluids and gases. Many beautiful and striking phenomena occur in fluid flows. Familiar examples include the giant vortices shed by airplane wings, the persistent red spot of Jupiter, and the formation of crystalline patterns in solidifying fluids (i.e., snowflakes).

The basic equations of inviscid fluid dynamics have been known for over 250 years and viscous flow equations were derived over 180 years ago. They are nonlinear partial differential equations and are simply written. However, analyzing the solutions to these equations is extremely challenging. Mathematicians have played a leading role in the development of analytical, asymptotical and numerical methods for solving the equations of fluid dynamics. Mathematical techniques originally developed to study fluid phenomena have found wide application in other areas of science and engineering. Examples include asymptotic methods, the inverse scattering transform, numerical methods such as boundary integral methods and level set methods, and theoretical techniques to study the qualitative nature of solutions to nonlinear differential equations. Mathematical research in fluid dynamics continues to drive broad advances in mathematical methods, numerical methods and mathematical analysis.

The fluid dynamics group in the Department of Mathematical Sciences at NJIT has an active research program covering interfacial fluid dynamics, thin films, nanofluidics, electrohydrodynamics, hydrodynamic stability theory, sedimentation, and combustion. A particular focus for six of the faculty members is the study of free and moving boundary problems. These are particularly challenging problems in that partial differential equations have to be solved in a region which is not known in advance, but must be determined as part of the solution. A famous example is the Stefan problem for melting ice or freezing water, but also the dynamics of bubbles, jets, shock waves, flames, tumor growth, crack propagation and contact problems all can be classified under this heading.

Wave Propagation

Researchers in CAMS working on problems related to Wave Propagation: Booty, Elmer, Erneux, Goodman, Jiang, Kriegsmann, Michalopoulou, Miura, Moore, Petropoulos, and Wang.

The analysis of wave propagation has a long and storied tradition in the history of applied mathematics, and the exploration of wave behavior has been a source of countless problems that have changed our understanding of acoustics, hydrodynamics, electromagnetics, optics, and even matter itself. These studies also have led to the development of powerful new mathematical and computational techniques, which have on occasion revolutionized entire fields of study. Several members of the CAMS faculty have research interests in the area of wave propagation; the following is a brief overview of the field and of their particular interests.

For obvious reasons, water waves have been studied the longest, and are still regarded as the point of reference for wave phenomena in other fields. George Stokes' notoriously intractable equations describing the motion of water waves were rendered far more accessible by the various small-amplitude limits considered by Joseph Boussinesq, D. J. Korteweg, and Gustav de Vries. Their explorations laid the groundwork for a discovery that would prove to have far-reaching consequences in several fields: the soliton, a solitary wave with special self-preserving properties. This exotic ``soliton'' propagates as a solitary wave without spreading due to the competing influences beween nonlinearity and dispersion, but preserves its shape and speed through collisions with other solitons. Even more important than the solitons themselves is the structure that makes their existence possible. Their study and the study of equations that support them now fall generally under the heading of ``integrable systems'', and have given rise to such mathematical tools as the inverse scattering transform.

One field that has been affected very profoundly by the relatively new science of nonlinear waves is optical communications. Pulse-like waveforms that maintain their shape for long times and over great distances are of obvious interest to an industry seeking to ensure error-free transmission of digital information. Every environment is subject to some form of noise, whether it be thermal noise, electronic noise, or quantum noise, so these pulses must also be tested for their resistance to external influences. Richard Moore is currently using perturbation theory and statistical techniques to develop efficient ways to characterize the effect of perturbations on solitons used for optical communications. The same nonlinear and dispersive properties that give rise to solitons can be manipulated to condition light for use in novel devices that will ultimately replace the electronics upon which telecommunications and computing still depend. Dr. Roy Goodman uses Hamiltonian mechanics and asymptotic methods to explore how light can be slowed, delayed, or ``trapped'' by engineering defects in nonlinear periodic structures.

The simple cylindrical geometry of an optical fiber lends itself to analytical treatment of the electromagnetic wave propagating inside of it; however, the vast majority of electromagnetic scattering problems have far more complexity due to complicated geometries and inhomogeneous material properties with disparate spatial scales. The treatment of transient electromagnetic signals such as those arising in signal analysis, spectroscopic applications, and the nondestructive testing of structures requires sophisticated numerical techniques that are stable, fast, and accurate, and that have reasonable memory requirements. Peter Petropoulos is conducting research on a variety of approaches that address these restrictions, including high-order finite difference schemes, boundary integral methods, and perfectly matched layers. Shidong Jiang investigates nonreflecting boundary conditions and scattering problems for acoustic and electromagnetic waves by open surfaces. He employs fast algorithms, including the fast multipole method, iterative solvers, and integral equation formulation of boundary value problems for such problems and for related large-scale problems in physics and engineering.

Even in cases where deterministic wave propagation is relatively well understood, the related inverse problem is far more challenging. The identification of certain characteristics of a source of acoustic waves, such as its location and intensity, through the analysis of information gathered by receivers placed strategically or at random within the same medium, is of obvious use in national defense, in environmental studies, in seismology, etc. Zoi-Heleni Michalopoulou has developed a localization-deconvolution approach based on Gibbs sampling that explores the space of allowable configurations with improved speed and accuracy over conventional approaches.

Finally, the propagation of waves through materials is often influenced by parameters that depend on the waves in a way that requires fundamentally different physics. The microwave heating of ceramics or the passage of optical fields through photorefractive crystals, for instance, couples hyperbolic equations to parabolic equations governing the evolution of thermal profiles and chemical species. In optics, this can lead to the generation of self-guided optical beams and, given the difference in time scales dominating the hyperbolic and parabolic behaviors, bistability. In the case of microwave heating of ceramics, it can lead to the formation of weak spots that compromise the quality of the material. Gregory Kriegsmann and Richard Moore are investigation asymptotic and numerical methods to treat such coupled hyperbolic-parabolic systems.

Dynamical Systems

Researchers in CAMS working on problems related to Dynamical Systems: Aubry, Blackmore, Bose, Elmer, Goldman, Golowasch, Jiang, Kappraff, Kriegsmann, Matveev, Miura, Moore, Nadim, Papageorgiou, Siegel, Tao, Tavantzis, Wang, and Young.

Today's research in the theory and applications of dynamical systems all have their roots in the work of early innovators in differential equations and mathematical modeling, such as Newton, the Bernoullis, Euler, Lagrange, Laplace, Legendre, Gauss, Cauchy, Abel, Fourier, Liouville, Weierstrass, Dirichlet, Hamilton, and Riemann. But we have come a long way since the middle of the nineteenth century in terms of our understanding and the variety of applications of both finite-dimensional dynamical systems (ordinary differential equations) and infinite-dimensional dynamical systems (partial differential equations).

A major revolution in dynamical systems research took place during the late nineteenth and early twentieth century characterized by innovations in the study of integrability such as those of Kovalevskaya, and culminating in the ground-breaking work of Poincare on nonintegrable Hamiltonian systems. Poincare brought a new infusion of topological methods to dynamical systems research that has illuminated and served as a source of inspiration for virtually all subsequent investigations. In the process, he introduced a new perspective on nonlinearity and complex motion that predated chaos theory. This new topological trend continued and was greatly advanced by such notables as Birkhoff, Kolmogorov, Arnold, and Moser.

Then in the 1960's, the face of dynamical systems research was dramatically altered by Smale and others with the introduction of a variety of techniques from differential topology that provided amazing new insights into the nature of chaotic dynamics. At about the same time, a dramatic advance in research on infinite-dimensional Hamiltonian systems was occuring as a result of several extraordinary discoveries concerning integrability, solitons, and the inverse scattering transform made by the likes of Gardner, Greene, Kruskal, Lax, and our own Robert Miura. These remarkable breakthroughs established the foundations of what has come to be known as the modern theory of dynamical systems, and catalyzed an explosion of applied and fundamental research in nonlinear dynamics.

Dynamical systems research in CAMS has a decidedly applied focus, and is extremely active in a wide and diverse range of areas including mathematical biology, fluid dynamics, wave propagation, computational topology, nonlinear optics, and quantum field theory and its applications to such things as quantum computing. There are a significant number of researchers who employ techniques from nonlinear dynamics in their work, and a smaller but sizeable core group whose interests are centered around dynamical systems and their applications. One of the most appealing aspects of research in dynamical systems is the wealth of opportunities it provides for interdisciplinary studies, and our dynamical systems group is one of the most active in such efforts.

CAMS research in dynamical systems can be described briefly as follows: Nadine Aubry uses methods from dynamical systems to characterize fluid flows and how they can be controlled by a variety of mechanisms such as the placement of vortex configurations. Denis Blackmore applies nonlinear dynamics to study the motion of vortices and vortex filaments in fluids and particles in granular flows, the chaotic evolution of biological populations, the computational topological nature of certain geometric objects, and quantum computing. He also does fundamental research in bifurcation theory, chaos theory, and algebraic and differential integrability analysis of infinite-dimensional Hamiltonian dynamical systems. Amithaba Bose employs dynamical systems techniques in his studies of coupled neuronal oscillators; in particular, he uses geometric singular perturbation theory to effect reductions in dimension of high dimensional systems, so that they can be more readily analyzed using such techniques as Poincare maps. Recently, he has studied the global effects of localized neuronal activity with regard to phase relationships and multi-stability. Christopher Elmer's research focus is on both finite- and infinite-dimensional time dependent differential equations that are discrete in space. He employs both analytical and computational methods to analyze the regular and singular behavior of these systems, and to interpret his findings with regard to several physical applications of these types of systems. Daniel Goldman uses a variety of techniques from dynamical systems theory to study dynamical systems arising from the modeling of fluid mechanical phenomena related to biological applications. Jorge Golowasch employs approaches from nonlinear dynamics to investigate the cellular mechanism of activity-dependent regulation of ionic currents, neuronal excitability, and neural network activity. Dynamical systems methods applied to nonlinear waves and optics is the focus of Roy Goodman's research. A key ingredient in his work is the development of methods for obtaining insights from finite-dimensional reductions of infinite-dimensional systems such as the nonlinear Schrodinger equation.

Shidong Jiang applies methods from nonlinear dynamics in his research on mathematical fluid dynamics, and wave propagation. Jay Kappraff has used dynamical systems techniques to uncover interesting relationships among regular geometric figures, matrix groups, chaotic regimes, and fractal geometry. Lou Kondic employs a variety of dynamical systems approaches in his research on interfacial fluid dynamics, and granular flows. Gregory Kriegsmann's research in applied mathematics has involved the application of bifurcation theory and differential equation techniques in several problems related to wave propagation and electromagnetics. Victor Matveev's work in computational neuroscience, stochastic process theory, and statistical mechanics has employed several methods from nonlinear dynamics. In his research on the kinetic theory of gases, mathematical biology, interfacial surface tension, and direction reversal in Brownian motion, Robert Miura has employed a variety of techniques from dynamical systems theory. For example, some of his recent work in mathematical biology has made use of the theory of Hopf bifurcations and saddle-node bifurcations.

Richard Moore studies nonlinear wave equations with both deterministic and stochastic perturbations with the aid of a variety of techniques from dynamical systems theory. Cyrill Muratov studies, among other things, traveling wave solutions and propagation phenomena in gradient reaction-diffusion systems using both variational and dynamical systems methods. He also studies several other types of infinite-dimensional dynamical systems arising from such areas as mathematical biology and fluid dynamics. Farzan Nadim makes liberal use of techniques from nonlinear dynamics in his research in computational and analytical neuroscience. Demetrius Papageorgiou employs ideas from infinite-dimensional dynamical systems theory, such as inertial manifolds and chaotic dynamics, in his research in fluid dynamics. Nonlinear dynamical techniques related to vortex dynamics play a key role in some of Michael Siegel's research in fluid dynamics. Louis Tao employs methods from dynamical systems theory in his work in neuroscience and mathematical biology. John Tavantzis has been investigating relationships between biologically generated time series and dynamical systems models for the associated phenomena, and also methods for capturing periodic orbits. Sheldon Wang has made several contributions to the literature in applications of dynamical systems, and is currently working on the development of methods for capturing periodic orbits of finite-dimensional dynamical systems. Yuan-Nan Young uses a variety of nonlinear dynamics approaches in his research in fluid dynamics and complex systems.

Numerical Methods

Researchers in CAMS working on problems related to Numerical Methods: Bhattacharjee, Bukiet, Choi, Elmer, Goldman, Goodman, Horntrop, Jiang, Kondic, Luke, Ma, Matveev, Michalopoulou, Moore, Muratov, Papageorgiou, Petropoulos, Rosato, Siegel, Tao, Wang, and Young.

Given the rapid development of the power of computers in recent decades, the use of computation as a means of scientific inquiry has also greatly increased and now is ubiquitous in most areas of applied mathematics. CAMS researchers are involved in all aspects of this scientific revolution from the development of new, more efficient and accurate numerical algorithms to the creation of computational packages for use by researchers throughout the world. The computational work of CAMS researchers is supported by state of the art facilities including numerous workstations and a 134 processor cluster.

Virtually every CAMS member uses computation in some aspect of their research. Some of the specific computational tools that are being used and developed by CAMS researchers are described below. Boundary integral methods are being used to study moving interfaces in materials science and fluid dynamics. Computational solutions of nonlinear partial differential equations are used in studies of the formation of finite-time singularities in aerodynamic and interfacial problems. A wide variety of finite difference methods for ordinary and partial differential equations, often in conjunction with iterative solvers and conjugate gradient methods, are used in studies of advection-diffusion problems, wave propagation, blood circulation, the visual cortex, as well as synaptic function and intracellular spatio-temporal calcium dynamics. Level set methods are used to study interfaces in materials. Novel techniques for differential difference equations are also used to better understand materials. Convergence of fast multipole methods is analyzed and these methods are used to study wave propagation. Novel techniques to remove spurious reflections of waves at computational boundaries are being developed. Signal detection and estimation techniques rely upon global optimization techniques used and developed by CAMS researchers. Finite element methods are used to study mechanical systems; the immersed boundary method is being developed and refined in order to improve computational accuracy and efficiency near interfaces.

Stochastic computation also receives a great deal of attention by CAMS researchers. Monte Carlo methods based upon the principles of statistical mechanics are used in studies of granular materials. Monte Carlo simulation is used to study molecular biology and bioinformatics. Stochastic models of sedimentation are being developed and refined through a combination of analysis and simulation. Markov Chain Monte Carlo methods are used in studies in statistics and biostatistics. Simulations taking advantage of variance reduction techniques are being used to study the effects of stochastic perturbations on solitons. New computational techniques for stochastic partial differential equations based upon spectral methods are being developed and applied to multiscale models of surface processes.

Statistics

Researchers in CAMS working on problems in Applied Probability and Statistics: Bhattacharjee, Dhar, Dios, Khan, and Jain.

Applied Probability and Statistics, as a discipline, is concerned with the study and analysis of processes in which uncertainty plays a significant role. The need for uncertainty modeling and statistical analysis is assuming increasing importance in virtually every field of human activity, e.g., in the comparative study of DNA databases, evaluation of drug safety and effectiveness, design and analysis of modern communication protocols, stochastic models in finance, study of aging and performance analysis of components and complex systems.

While research in Probability and Statistics is driven by the need to solve applied problems, its progress and development comes from basic research and from their application to solve specific problems arising in practice. This interplay of basic and applied research has benefited both. Real life problems have often posed new theoretical challenges which had to be overcome by developing new methods (e.g., survival analysis, adaptive randomization in clinical trials). Conversely, new theoretical ideas and methods which were developed in a specific applied context were later seen to be of much broader applicability to other areas (e.g., nonparametric aging ideas which owe their origins to research in stochastic modeling of hardware reliability of physical systems were later seen as useful constructs in many other areas including queuing systems, stochastic scheduling, and branching processes.)

The Statistical Consulting Laboratory (SCL), which operates under the umbrella of CAMS, provides methodological/data analysis consulting services to the University community on request, as well as to external clients. Consulting activities channeled through the SCL, are under the overall administrative supervision of a statistics faculty member (currently, A. Jain).

The current research interests of the Statistics faculty are in the following areas: distribution theory and statistical inference (Bhattacharjee, Dhar, Khan), minimum distance estimation (Dhar), Bayesian modeling (Bhattacharjee) and Bayesian inference (Khan), DNA microarray analysis (Khan), orthogonal arrays in experimental designs (Dios), applied probability models (Bhattacharjee, Dhar), statistical theory of reliability and survival analysis (Bhattacharjee), stochastic orders and their applications (Bhattacharjee), discrete multivariate distribution/reliability statistical issues in clinical trials (Dhar), and non-traditional applications of reliability theory (Bhattacharjee).

B. RESEARCH DESCRIPTIONS

Daljit S. Ahluwalia

The research of Daljit S. Ahluwalia is in the field of applied mathematics, mainly in the areas of asymptotics and wave propagation. Using analytic and asymptotic methods, he has addressed a wide range of phenomena including scattering, diffraction, reflection, guided waves, dispersion and shock waves. Applications of this work include ocean acoustics, water waves, electromagnetics, and elastic waves.

Roman Andrushkiw

The research of Roman Andrushkiw has focused on the spectral theory of operator-valued functions and the analysis of free boundary problems, with application to numerical modeling in the area of cryosurgery and medical diagnostics. His study of operator-valued functions deals with spectral theory and approximation methods for eigenvalue problems that depend nonlinearly on the spectral parameter. His study of Stefan-type free boundary problems is concerned with modeling of heat transfer phenomena in the freezing of living tissue, involved in cryosurgery. His current projects include the development of a variational method for approximating the eigenvalues of polynomial differential operator pencils, and the study of a pattern recognition algorithm in medical diagnostics related to breast cancer.

Nadine Aubry

Nadine Aubry's research involves the development of novel, enabling technologies leading to new classes of products through radical flow performance gains via miniaturized actuation. Such gains will result in manipulation of micro- and nano-size objects in suspensions, mixing enhancement, suppression/enhancement of turbulence, suppression of flow-generated noise and vibrations, and thermal management. She is working on the development of computational fluid dynamics software for complex flows, miniaturized flows and flows subjected to actuators, the development of flow control software, the development of miniaturized sensors and actuators with required characteristics, the development of integrated MFC devices, and the development of validation techniques for the latter. She is the Director of the New Jersey Center for Micro-Flow Control and is in close collaboration with the following labs: W.M. Keck Laboratory, Electro-hydrodynamics, and Computational Fluid Dynamics.

John Bechtold

The research of John K. Bechtold has focused on the modeling and analysis of physical problems, primarily in the area of theoretical combustion. His studies cover a wide range of topics in both premixed and non-premixed combustion, including stability, ignition, extinction, and complex flame/flow interactions. His current projects include the development of new generalized models of near-stoichiometric flames, stability of expanding and converging flames, and radiation-driven flows in microgravity.

Manish C. Bhattacharjee

The research of Manish Bhattacharjee has focused on applied probability models and related problems of statistical inference. Such work includes the use of various stochastic orders to investigate aging and degradation concepts. Current research includes work on (i) some strong versions of the 'decreasing failure rate' property and their ramifications, (ii) some problems of statistical inference in discrete time branching processes.

Denis Blackmore

Dynamical systems (nonlinear dynamics) theory is a rich amalgam of techniques from algebra, analysis, chaos theory, differential equations, differential geometry, differential topology, fractals, geometry, singularity theory, and topology, and has important applications in every branch of science and engineering. Denis Blackmore's research is primarily in the theory and applications of dynamical systems and closely related fields. He has studied a plethora of applications in such areas as acoustics, automated assembly, biological populations, computer aided geometric design, fluid mechanics, granular flows, plant growth (phyllotaxis), relativistic and quantum physics, and rough surface analysis. His theoretical work includes fundamental results on solution properties and integrability of differential equations, and analysis of hypersurface singularities. Among his current projects are acoustically generated particle flows, biocomplexity of marshes, competing species dynamics, dynamical models in economics, integrability of infinite-dimensional dynamical systems (PDEs), particle dynamics, phyllotaxis, virtual reality systems, vortex dynamics, and weak shock waves.

Victoria Booth

The research of Victoria Booth is in the area of computational neuroscience focusing on mathematical and biophysical modeling of the electrical firing behavior of neurons and neuronal networks. Her studies in single cell modeling involve the development of models from experimental data, mathematical analysis of cell properties and mechanisms that generate experimentally observed firing patterns, and investigation of pharmacological modulation of cell behaviors. An additional area of her research is in the implementation of optimization schemes for parameter determination in neuronal models. Her network modeling studies involve the development of small scale networks to mathematically analyze the role of cell properties and the synaptic connections among cells in generating observed network behavior. Her current projects include the development of network models of region CA3 in the hippocampus to study the firing patterns of place cells, and modeling the pyloric network in the crab stomatogastric ganglion to investigate properties of its observed rhythmic firing patterns.

Michael Booty

Michael Booty's principal research interests are in mathematical modeling and asymptotic analysis, and most of the applications he has considered are in the area of fluid mechanics and combustion. His main studies in combustion have focused on the time-dependent and multidimensional dynamics of propagating reaction waves in gas mixtures, solid phase mixtures, and porous media, analyzed by a combination of multiple scale, stability, and bifurcation techniques. His other studies have included prototype reaction-diffusion models, the dynamics of fast reaction waves, and time-dependent effects in droplet burning. He has also collaborated (with members of the Department of Chemistry and Environmental Science at NJIT) on experimental studies for conditions that minimize pollutant formation in the thermal oxidation of common materials.

His current research interests include: time-dependent effects in droplet burning, collaborative studies on bubbles with surfactant (with Michael Siegel), localized thermal waves in microwave heating and processing of materials (with Gregory A. Kriegsmann), and studies of the interaction of flexible membranes, or sails, in two-dimensional potential flow (with Jean-Marc Vanden-Broeck, of the University of East Anglia).

Amitabha Bose

The research of Amitabha Bose focuses on the applications of dynamical systems to mathematical neurophysiology. His studies in neurophysiology include modeling sleep rhythms in the thalamocortical system, phase precession of hippocampal place cells, and the development of rigorous mathematical techniques to analyze such problems. His current projects include modeling phase maintenance in the pyloric network of crustaceans, persistent activity in cortical circuits and rhythmogenesis in frog ventilatory systems.

Bruce Bukiet

Bruce Bukiet's research concerns mathematical modeling of physical phenomena. He has studied the dynamics of detonation waves, including curved detonations and detonation models of discrete mixtures. He currently uses his expertise in this area to study issues related to homeland security. Prof. Bukiet also researches biological systems and has done work modeling stresses in the heart, blood flow in arteries, and air flow in the lungs, and currently works in the area of postural stability. The goal of this work is in diagnosis of balance problems and evaluation of treatment options. Finally, he works on understanding and optimizing aspects of baseball from a mathematical modeling perspective.

Wooyoung Choi

Wooyoung Choi's research interest lies mainly in fluid mechanics and nonlinear waves, in particular, with applications to geophysical flow problems. His recent research focuses on the development of simple but accurate mathematical models to describe various physical processes in the ocean and, in collaboration with physical oceanographers, their validation with field and laboratory measurements. His current research projects include the development of new asymptotic models and efficient numerical methods to study the short-term evolution of nonlinear ocean surface waves with enhanced physical parameterizations of wave breaking and wind forcing, and the dynamics of large amplitude internal waves in density stratified oceans and their surface signatures.

Fadi P. Deek

Fadi Deek's primary research interest is in learning systems and collaborative technologies, with applications to software engineering, and in computer science education. His approach to research involves a mixture of theoretical development, software system implementation, controlled experimental evaluation, and ultimately deployment of the systems developed. His interest in learning systems revolves around the development of new technologies that take into consideration the cognitive behavior and needs of end-users. The specific types of learning systems that he is interested in are related to computing which has motivated his work in software engineering. Because both learning and software engineering are highly collaborative activities, he has also become interested in understanding how collaboration works, ranging from the dynamics of collaborative groups to the technologies required for computer-supported work. His original interest in learning systems was sparked by a long standing interest in computer science education which continues to engage him. These underlying interests in learning systems and collaboration are the unifying theme for his publications, dissertation advisement, system development and professional involvement. Most of this research has been supported by grants where he has been the principal or co-principal investigator.

Sunil K. Dhar

The research focus of Sunil Dhar has been on model building and inference. His ongoing research involves proving existence, computing and developing robust and efficient minimum distance estimators such as L2-distance type, under the following models: linear, AR [k], the additive effects outliers, and the two-sample location model. He also developed functional least squares estimators under the additive effects outliers model. An optimization technique for the general class of sums of absolute multivariate linear functionals has been developed by him. He extended the negative multinomial distribution; this new model has many applications. His ongoing research in multivariate lifetime reliability models involves deriving new multivariate geometric and generalized discrete analogs of Freund's models, with demonstrated applications. Other discrete models developed by him are in the area of models of order k. He has acquired statistical consulting experience.

Javier Diez

Javier Diez's research focuses on free surface flows and interface phenomena. He is particularly interested in coating flows and the dynamics of the contact line, where where the liquid, the solid substrate and the surrounding environment (gas or liquid) intersect. Current projects include using a combination of experimental measurements (usually by means of optical techniques) and numerical simulations of the fluid dynamic equations.

Rose Dios

The research of Rose Dios has focused upon statistical design of experiments with particular emphasis on the study of the existence of balanced fractional factorial designs arising from orthogonal and balanced arrays. She also has applied statistical modelling techniques to research problems in remote sensing, environmental engineering, and clinical medicine, including cardiac risk analysis and recurrence of cancer.

Christopher E. Elmer

The research of Christopher E. Elmer has focused on developing analytical and numerical solution methods for functional differential equations of mixed type and their application to phase transitions in solids. His studies of spatially discrete reaction-diffusion equations include functional analysis and iterative numerical techniques to demonstrate the solution properties of propagation failure, lattice anisotropy, and step-like interfaces. His studies of solution techniques for general differential-difference equations has led to his development of a relaxation variant of Newton's method and the creation of a collocation code. His current projects include developing a public domain collocation code for solving differential-difference equations, analyzing error due to applying differencing methods to reaction-diffusion equations, analyzing multiple interface solutions to spatially discrete reaction-diffusion equations, analyzing the solutions of the spatially discrete sine-Gordon equation, developing an orthogonal spline collocation tool for studying diffusion induced grain boundary motion in thin films, and modeling crystalline material growth with energy equations which contain a spatially discrete gradient.

Thomas Erneux

The research of Thomas Erneux is mainly concerned with laser dynamical instabilities and their practical use in applications. More recently, he became interested in delay differential equations appearing in different areas of science and engineering. The response of lasers can be described by ordinary, partial, or delay diffential equations. He uses a combination of numerical and singular perturbation techniques to investigate their solutions. A large part of his research is motivated by specific collaborations with experimental groups.

Anna Georgieva

Anna Georgieva's work in the Modeling and Simulation Department at Novartis Pharmaceuticals involves use of mathematical modeling and statistical approaches to aid drug development. More precisely, she has concentrated on the use of network inference algorithms to recover gene regulatory networks and pathway fragments from high throughput genomics data. At the same time, she is developing mechanistic models to assess the pro-arrythmic potential of various therapeutic agents prior to entry into the clinic. Another current project involves the use of quantitative proteomics data to develop detailed mathematical models of signalling pathways and use these models to come up with optimal combination therapy for cancer patients.

Vladislav V. Goldberg

The research of Vladislav V. Goldberg is in the field of differential geometry: projective differential geometry, conformal differential geometry, and the theory of webs. In the first field, he studies submanifolds with degenerate Gauss maps in a multidimensional projective space; in the second one, he studies the theory of lightlike submanifolds; and in the third one, his studies concern the local theory of webs and the algebraic aspects of this theory. His current projects include an investigation of the structure of varieties with degenerate Gauss maps and their singularities, finding conditions of linearizability of d-webs on a two-dimensional differentiable manifold, and writing the book Differential Geometry of Varieties with Degenerate Gauss Maps for Springer-Verlag.

Daniel Goldman

The research of Daniel Goldman has focused on the analysis and simulation of nonlinear partial differential equations, the development of numerical methods for PDEs, and the modeling of complex physiological processes. His work on the Ginzburg-Landau equation has involved the characterization of chaotic behavior in one and two spatial dimensions using tools from both turbulence and dynamical systems. His work in numerical analysis has covered operator splitting schemes for dissipative systems and efficient methods for solving reaction-convection-diffusion problems in complex geometries. His work in theoretical and computational biology has studied affinity maturation in the immune system and the relationship between capillary network structure and tissue oxygen delivery. His current projects include improvement of numerical methods for studying time-dependent microvascular transport, investigation of the factors that determine the hemodynamic properties of capillary networks, and modeling of various pathophysiological processes that occur in the microcirculation.

Jorge Golowasch

The research of Jorge Golowasch focuses mainly on the cellular and network mechanisms of long-term regulation of electrical activity in a simple model neural network, the pyloric network of the stomatogastric ganglion of crustaceans. An undesirable consequence of plasticity is the potential instability of the system. In the nervous system, the activity of neurons and neural networks remains quite stable over very long periods of time. Conductances, however, also express plasticity. How this plasticity contributes to stability, however, is a question largely unexplored. Using both electrophysiological and computational tools, he and his students in the laboratory study mechanisms of neuronal plasticity and homeostasis of the ionic currents that determine the excitability and electric activity of neurons and simple neural networks. He is also interested in how neurons interact to form rhythmic pattern generating networks.

Roy Goodman

Roy Goodman's research focuses, broadly, on nonlinear wave phenomena. The tools he uses consist mainly of asymptotic methods, dynamical systems analysis, and numerical simulation. Physical applications he has studied include storm propagation in the atmosphere at middle latitudes and the interaction of light pulses in telecommunications optical fibers. Recently, he has been investigating the interaction of nonlinear waves with localized changes to the media through which they propagate. This includes the enticing possibility of "light trapping" at specified locations in optical fibers, as well as more abstract studies of classical nonlinear wave equations.

Peter Gordon

The research of Peter Gordon is focused on the analysis of reaction diffusion advection equations and systems arising in the context of combustion and fluid mechanics. More specifically, his research covers the analytical study of front propagation in hydraulically resistant media. This includes the classification of propagation regimes, initiation of detonation, and quenching and transition from deflagration to detonation. In fluid mechanics, he has studied the effects of advection on propagation of combustion fronts, and in particular how cellular flow can lead to enchantment, blow off and extinction of a flame.

Claus Holzapfel

As a community ecologist Claus Holzapfel is fascinated by the intriguing ways of how species interact with each other. Within that topic his research addresses ecological and evolutionary processes and their outcome in plant populations and communities. The leading question is whether communities are more than simple chance assemblies. Perturbed systems - systems that are altered from their pristine state - are ideal study objects to address such a question, since here possible coevolved interactions are likely disrupted. Good examples are plant communities that are invaded by non-native organisms or systems otherwise heavily impacted by human activity (climate change, land-use change).

David J. Horntrop

The research of David J. Horntrop has focused on the development and numerical simulation of stochastic models of physical phenomena for problems ranging from materials science to fluid dynamics. His studies of turbulent diffusion were based on random field models for the advection of passive scalars and involved asymptotics, stochastic analysis, and the creation of novel wavelet-based Monte Carlo numerical schemes for the simulation of random fields. His current studies of materials involve the development and use of mesoscopic models to describe surface processes in order to gain insight on the importance of small scale phenomena on the creation of large scale patterns. He is presently developing and validating new spectral methods for the numerical solution of stochastic partial differential equations for these studies.

Huaxiong Huang

Huaxiong Huang's research interests include Fluid Mechanics, Scientific Computing, Mathematical Modeling and Industrial Mathematics. Recently, he has been working on problems on stress/defects reduction of InSb crystals, ruin probability and asset allocation related to personal finance, multiphase mass and heat transport problems in cloth assemblies, bread baking, and multiphase bubbly flow related to water purification; extensional viscous flow related to optical fiber drawing and pulling of microelectrodes; and finally in biologically related problems such as the spatial buffering and viral membrane fusion.

Shidong Jiang

The research of Shidong Jiang has mainly focused on fast numerical algorithms for PDEs and their applications to large scale problems in physics, chemistry and engineering. He has developed a fast and accurate numerical algorithm for the nonreflecting boundary conditions for the Schrodinger equation. He also developed a stable second integral equation formulation for scattering by open surfaces in two dimensions. When the SKIE formulation is combined with a Fast Multipole Method and iterative solver, a fast and stable numerical algorithm has been developed for large scale open surface problems arising in biology and antenna and radar design. Recently, he has derived analytical solutions for the hyperpolarizabilities for the one dimensional infinite single electron periodic systems which showed that the overall symmetry in nonlinear optics is actually broken.

Lou Kondic

The research of Lou Kondic has concentrated on modeling and numerical simulations of two groups of physical systems: a) two fluid flows with emphasis on the interfacial dynamics, as well as free surface flows, and b) dynamics of granular systems. His studies of supersonic dynamics of gas bubbles in liquids exposed to acoustic radiation involved analytical and computational modeling of the convective and radiative energy transfer between fluids, and were applied predominantly to the effect of single bubble sonoluminescence. His research in the field of granular materials consisted of developing analytical models, as well as molecular dynamics simulations of 2D and 3D granular systems, with emphasis on the collective effects. His work on the dynamics of thin liquid films involved performing large-scale computational simulations with the goal of understanding contact line instabilities and resulting pattern formation. Currently, he is involved in modeling and simulations of granular materials in a microgravity environment, and in the development of numerical methods for highly nonlinear partial differential equations related to the flows of thin liquid films.

Gregory A. Kriegsmann

The research of Gregory A. Kriegsmann has focused on the modeling, analysis, and numerical simulations of physical problems arising in industrial and technological settings. His studies in microwave heating of materials describe the nonlinear interaction between electromagnetic waves and materials, and the effect of cavity geometry. His research on acoustic and electromagnetic scattering theory includes applications to radar, structural acoustics, and acoustics in flows. His studies in circuit theory cover the design and analysis of oscillators and power supplies. His current work is focused on microwave assisted chemical vapor infiltration, thermal patterns in microwave heating experiments, and microwave assisted ceramic sintering.

Dawn A. Lott

The research of Dawn A. Lott focuses on the numerical computation of partial differential equations which model physical phenomena in solid and fluid mechanics and biomechanics. Her studies in solid mechanics cover the topics of strain, thermo-viscoplastic, and strain gradient localization, and antiplane motions of nonlinearly elastic bodies. Her research in fluid mechanics covers the use of boundary element methods for slender bubbles subject to Stokes flow. In the area of biomechanics, her research covers convolution methods for calcium ion release and nonlinearly elastic/viscoelastic models for the deformation of human skin. Numerical methods utilized include spectral methods, Godunov-type schemes, and finite elements methods. Her current projects include the analysis of optimal patterns of wound closure based on stress analysis, nonlinear viscoelastic models for wound closure, simulations of slender bubbles with surfactants, determination of the release of calcium ions from intracellular storage sites in skeletal and cardiac muscle, and two dimensional viscoplastic localization as a result of strain gradient regularization.

Jonathan H. C. Luke

The research of Jonathan H. C. Luke has focused on the modeling and analysis of physical problems primarily in the areas of low-Reynolds-number fluid dynamics and wave propagation in complex media. His studies in sedimentation theory cover the topics of velocity fluctuations, renormalization, the method of reflections, cluster dynamics, and variational and numerical methods. His studies of electromagnetic waves in highly dispersive media mainly concern energy deposition and numerical methods. His current projects include analysis of the stability of numerical implementations of no-slip boundary conditions for the Navier-Stokes equations in streamfunction-vorticity form, simulation and analysis of energy deposition from electromagnetic waves in dispersive materials, and effective boundary conditions for heating and scattering problems in microwave cavities.

Marc Qun Ma

The research of Marc Qun Ma is in the field of computational biology and bioinformatics, mainly in the areas of biomolecular modeling and simulation and microarray data analysis. In modeling and simulation, his group designs multiscale methods for molecular dynamics simulations, and investigates complex biological processes including allosteric activation of enzymes and industrial biocatalysis. In genomics/bioinformatics, Dr. Ma's group develops methods and software toolkit for robust microarray image analysis, and fast and accurate determination of genotypes in high-throughput single nucleotide polymorphism genotyping microarray experiments.

Victor Matveev

The research of Victor Matveev is in the area of computational neuroscience, and is focused primarily on biophysical modeling and numerical simulations of synaptic function and its mechanisms. In his work, Victor Matveev employs analytical methods as well as a variety of computational techniques, from stochastic modeling to numerical solution of partial and ordinary differential equations. Victor Matveev performs most of his work in collaboration with experimental neurophysiologists, and develops models to explain and fit the experimental data. His current projects include the study of the mechanisms of short-term synaptic facilitation and other calcium-dependent processes involved in neurotransmitter secretion, and the modeling of presynaptic calcium diffusion and buffering. To facilitate his research, Victor Matveev also has been working on the development of a software application designed for solving the reaction-diffusion equation arising in the study of intracellular calcium dynamics ("Calcium Calculator").

Roberto Mauri

Roberto Mauri's research focuses on two areas. In the first, the transport of heat, mass, and momentum in two phase systems is studied, both experimentally and theoretically. Familiar examples include the flow of suspensions through pipes and the heat and mass conduction through composite materials. Recent results include the determination of the effective velocity and diffusivity of solutes in porous media and in turbulent flow fields and the shear-induced diffusivity of suspensions of rigid spheres. In the second research effort, the phase separation and mixing of liquid mixtures into two phases is studied. Since the phase transition process can be triggered by changing either the temperature or the composition of the system, separation can be achieved either by heating and cooling the solvent mixtures across their miscibility curve, or by adding a solubility modifier. Using this second approach, a new process has been developed to obtain monodisperse distributions of nanoparticles for bioengineering applications.

Jay Meegoda

Jay Meegoda's research can be best described as mechanics of geo-environmental engineering where he utilizes scientific concepts and engineering technologies in real world applications. Under the heading of mechanics of geo-environmental engineering, his research can be further subdivided into five main trust areas: engineering properties of contaminated soils; centrifugal modeling of contaminant transport; micro-mechanics of civil engineering materials; reuse of contaminated soils; and ultrasound research. Micro-mechanic models were used to explain the mechanical behavior of civil engineering materials. He received the best practice paper award in 2001 from the Environmental Multimedia Council of the Environmental and Water Resources Institute (EWRI) of the American Society of Civil Engineers (ASCE) for a publication resulting from the above research. Currently, his research is focused on use of a laser to detect segregation in asphalt pavements and development of smart pipes for drinking and waste water distributions.

Zoi-Heleni Michalopoulou

The research of Zoi-Heleni Michalopoulou focuses on inverse problems in underwater acoustics. Currently, new global optimization approaches based on the tabu methodology are being developed for matched-field source localization and geoacoustic inversion. Also, arrival time and amplitude estimation in uncertain environments is pursued via a novel Gibbs sampling scheme.

Petronije Milojevic

The research of P.S. Milojevic is focused on studying semilinear and (strongly) nonlinear operator equations using a combination of topological, approximation, and variational methods and applications to ordinary and partial differential equations. He has developed various fixed point results for condensing and A-proper maps. His studies of semilinear operator equations with monotone and (pseudo) A-proper maps involve nonresonance and resonance problems with Fredholm and hyperbolic-like perturbations of singlevalued and multivalued nonlinear maps, and Hammerstein equations. He has widely applied these abstact theories to BVPs for (contingent) ordinary and elliptic PDEs, to periodic and BVPs for semilinear hyperbolic and parabolic equations and to nonlinear integral equations. His study of nonlinear and strongly nonlinear operator equations is concerned with the existence and the number of solutions of such equations involving condensing, monotone, and various types of approximation maps. His current research deals with Hammerstein equations and weakly inward A-proper and pseudo A-proper maps and applications to differential and integral equations.

Robert M. Miura

The research of Robert M. Miura covers several areas in mathematical physiology, especially in neuroscience. The techniques used are mathematical modelling, mathematical analysis, approximation methods, and numerical simulations. His research on excitable biological cells, including neurons, cardiac cells, and pancreatic beta-cells, is aimed at understanding electrical effects on cell function and signalling. These studies involve detailed investigations of membrane electrical properties, subthreshold resonance, stochastic resonance, signal propagation on dendrites, and mechanisms leading to bursting electrical activity. His studies on spreading cortical depression, and more generally intercellular communication via ion flows, include analysis and simulations of partial differential equation models. Diffusion of ions in the brain is studied using the lattice Boltzmann method.

Richard O. Moore

Richard Moore's research focuses on wave phenomena in optical communication systems and optical devices. He is particularly interested in how such systems and devices are disturbed by a variety of influences relevant to their operating environments. Current projects include using a combination of perturbation methods and importance sampling to simulate rare events in optical communication lines, and using dynamical systems techniques and rigorous reduction methods to analyze the impact of heating due to optical field absorption in devices that convert optical frequencies using parametric gain media.

Cyrill B. Muratov

The main research direction of Cyrill B. Muratov is pattern formation, self-organization, and non-linear dynamics in systems described by coupled reaction-diffusion equations, with primary applications to biological systems and materials science. He uses dynamical systems theory, singular perturbation techiniques, matched asymptotics, non-local eigenvalue problems, as well as exact analytic, variational, and numerical methods, to study traveling wave solutions, interfacial patterns, and more complicated spatiotemporal patterns. Current ongoing projects with biological applications include analytical studies of excitability, pulse propagation, and spiral waves in excitable biological cells, and modeling and computational analysis of autocrine loops in cell signaling networks. His research in materials science involve studies of the kinetics of domain pattern formation in systems with long-range interactions and polymer-liquid crystal systems, as well as formation of hot spots in ceramic and other materials.

Farzan Nadim

Farzan Nadim studies rhythmic motor activity generated in the central nervous system by combining experiments and computational techniques. Nadim has a joint appointment with the Federated Department of Biological Sciences and runs a laboratory that conducts experiments on isolated nervous systems of crustacea. These experiments involve elecrophysiological recordings from multiple nerves and neurons, pharmacological manipulations of the system, and immunohistology. The neuronal circuits studied all produce oscillatory output of various frequencies. The lab also models these systems both at the detailed biophysical level and using analytic mathematical techniques. His current focus is on contribution of synaptic dynamics to network output and the interaction between multiple oscillatory systems.

Demetrios T. Papageorgiou

The research of Demetrios T. Papageorgiou focuses on the modeling, analysis, and computation of physical and technological problems that involve fluid dynamics and aerodynamics. His studies in surface tension driven flows cover the stability, dynamics, and breakup of single and compound liquid jets, both in the presence and absence of surface active agents, which affect interfacial tension. Analysis of finite-time-singularities has been used to motivate experiments for rheological measurements. His studies in bubble dynamics are a theoretical and experimental collaborative research effort to control the drag on rising bubbles using surfactants. Current projects include jet and bubble dynamics, nonlinear stability of core-annular flows when surfactants are present, nonlinear stability of electrified liquid films, and study of viscous flows in pulsating channels or tubes by construction of Navier-Stokes solutions both numerically and analytically with particular emphasis on chaotic regimes and their influence on applications.

Manuel Perez

The research of Manuel Perez is in the areas of heat transfer, drying of porous media, expert systems, medical diagnosis by computer, and mechanical properties of fibrous webs. He is now working on survival studies of prostate cancer patients, and on evaluating the efficacy of surgical procedures and radiation treatment for various stages of the disease.

Peter G. Petropoulos

The research of Peter G. Petropoulos has focused on the numerical modeling and asymptotic analysis of physical problems in the areas of transient electromagnetic wave propagation in complex media. His studies of pulsed electromagnetic waves in dispersive media mainly concern the asymptotic and numerical methods for studying the response of relaxing (Debye) and fractionally-relaxing (Cole-Cole) dielectrics, as well as the development fourth-order accurate finite difference methods for the time-domain Maxwell equations with discontinuous coefficients. His current projects include analysis of the error in problems where impedance boundary conditions are employed, development of numerical techniques to simulate pulse propagation in Cole-Cole dielectrics, analysis of perfectly matched absorbing boundary conditions in relation to exact absorbing boundary conditions, and the development of fourth-order accurate schemes in the presence of curved boundaries.

Christopher Raymond

The research of Christopher S. Raymond has focused on mathematical modeling and the development of asymptotic, perturbative, and numerical techniques for studying reaction-diffusion systems in which the reactions are confined to the vicinity of either propagating interfaces (applications to combustion, material synthesis, and frontal polymerization) or to portions of the boundary of the domain of interest (biological applications). He is currently concentrating on developing and analyzing mathematical models for immunocolloid labeling, a novel technique for imaging molecular scale features on cell surfaces using electron microscopy.

Anthony D. Rosato

Anthony Rosato's research is concerned with granular flows as related to the solids handling and processing industries. The flows are modeled using dissipative molecular dynamics simulations to identify governing mechanisms that affect observable behavior. Currently, he is studying the development of velocity field structures in boundary-driven flows, and how they may influence segregation behavior in polydisperse systems. He is also interested in the application of dynamical systems modeling to these systems.

Michael Siegel

The research of Michael Siegel is focused on the analysis and numerical computation of moving boundary problems that arise in fluid mechanics, materials science, and physiology. His research in fluid dynamics covers singularity formation on interfaces for inviscid and low Reynolds number (Stokes) flow, the dynamics of drops and bubbles (including the influence of surfactant), and effect of small regularization--such as surface tension--on mathematically ill-posed interfacial flow problems. His studies in materials science primarily involve crystal growth and diffusion controlled moving boundary problems. In physiology, he has studied optimal suturing patterns for skin wounds and formulated models for determining the stress and strain distribution in the heart wall that occur due to changes in heart geometry.

David Stickler

The research of David Stickler has centered on the application of asymptotic and numerical methods to study some basic problems in wave propagation and diffusion. The wave propagation problems have application in electromagnetics, acoustics, and elasticity. They include some problems in inverse scattering. The diffusion problems include work in thermal conduction and thermo-elastic diffusion. In this work, both uniform and non-uniform asymptotic methods have been developed. His current research focuses on the equilibrium configuration of elastic membranes with the emphasis on cylindrically symmetric annular rings.

Louis Tao

The research of Louis Tao focuses on large-scale scientific computation, through a combination of numerical simulations, bifurcation theory, and asymptotics. He is mainly interested in the modeling and analysis of the dynamics of networks, with applications to specific problems in neuroscience and mathematical biology. His work in computational neuroscience has been in two distinct areas: a) how neurons in the visual cortex process elementary features of the visual scene and b) how recurrent networks perform computations. His current projects include the modeling of orientation selectivity in cortex and the analysis of the network dynamics that arises.

John Tavantzis

The research of John Tavantzis is in the field of operations research applied to problems of parking allocations. Given several parking lots with certain capacities, how does one assign parking so as to minimize total cost to individuals who need to park during certain time intervals. Discrete and probabilistic models are considered.

Jean-Marc Vanden-Broeck

Jean-Marc Vanden-Broeck's research is concerned with fluid mechanics and the theory of free boundary problems. He uses a combination of numerical and asymptotic methods to investigate new properties of nonlinear solutions. A large part of his research focuses on the effects of surface tension and on the computations of waves of large amplitude. Interfacial flows generated by moving disturbances, three dimensional solitary waves, waves on electrified fluid sheets, and the stability of Stokes flows in the presence of electric fields are among his recent interests.

Sheldon Wang

The research of Sheldon Wang focuses on combining computational fluid and solid mechanics with various modeling of physical and chemical phenomena at different temporal and spatial scales. A current generic model problem of interest to him involves a deformable cell immersed in viscous fluid environment. The evolution of such a fluid-solid system can be triggered by chemical kinetics, thermal fluctuation, reaction, diffusion, or even convection due to environment alternation, osmotic pressure gradient, and solid deformation. The understanding of this model system will shed light on behaviors of cells and biosystems.

Yuan-Nan Young

The research of Yuan-Nan Young focuses on the multiphase flows in computational fluid dynamics (CFD), and relevant issues in numerical treatment of moving boundary problems. In particular he has numerically investigated how surfactants, both soluble and insoluble, can affect the pinch-off of bubbles in viscous fluids. He also investigates numerical schemes to optimize the accuracy of regularization of surface tension force in CFD codes. His current projects also include an investigation on the hysteretic behavior of drop deformation in highly viscous straining flows.

C. SELECTED RESEARCH RESULTS

Wooyoung Choi
"Modeling Strongly Nonlinear Internal Waves"

Jonathon Drover, Amitabha Bose, Vahid Tohidi, and Farzan Nadim
"Combining Synaptic and Cellular Resonance"

Vladislav V. Goldberg
"Linearizability of d-Webs"

Daniel Goldman
"Blood Flow in Tumor Capillary Networks"

Peter Gordon
"Deflagration to Detonation Transition in Porous Media Combustion"

David J. Horntrop
"Simulation of the Late Stages of Domain Coarsening in Surface Processes"

Shidong Jiang
"Nonlinear Optics--Hyperpolarizabilities for One-Dimensional Infinite Single-Electron Periodic Systems"

Victor Matveev, Amitabha Bose, and Farzan Nadim
"Multistability in a Two-Cell Inhibitory Network with T-Currents Analyzed via a 1D Poincare Map"

Robert M. Miura
"Traveling Waves in Coupled Reaction-Diffusion Models with Degenerate Sources"
(joint work with Jonathan J. Wylie, City University of Hong Kong)

Cyrill Muratov
"Noise-Induced Generation of a Coherent Target Pattern in an Excitable Medium"

X. Sheldon Wang
"Mixed Finite Element Formulation for Acoustoelastic Fluid-Structure Interactions"

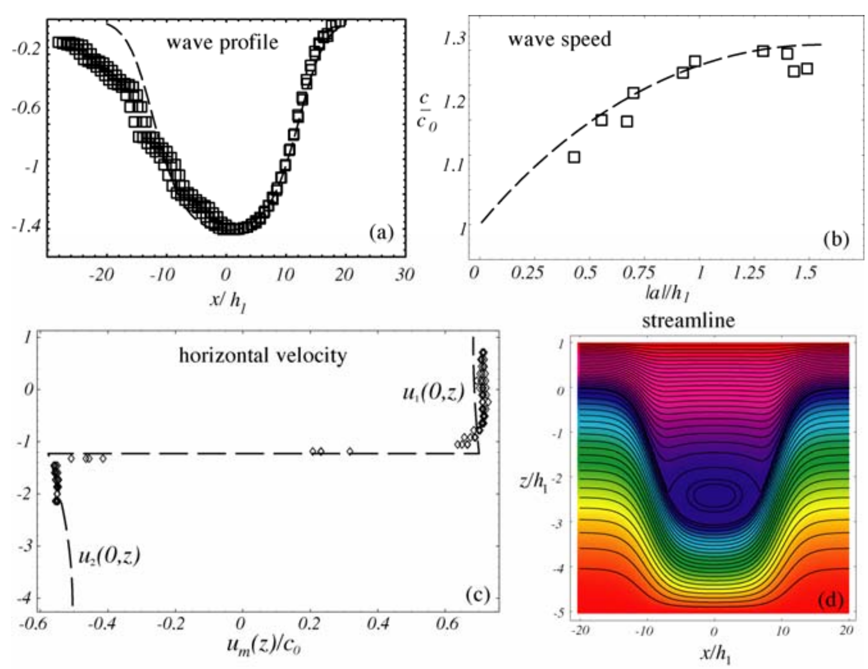
Yuan Young, Michael Booty, Ji Lie, and Michael Siegel
"Effect of Surfactant Solubility on Deformation and Breakup of a Bubble in a Viscous Surrounding"

Wooyoung Choi

Title: Modeling Strongly Nonlinear Internal Waves

Packets of large amplitude internal waves are ubiquitous in many coastal regions around the world and they are typically generated by the interaction of stratified tidal flow with strong topographic features such as underwater sills or the edge of the continental shelf. Mathematically, the large amplitude regimes which are easily attained by internal waves, both experimentally and in the field, make this class of wave phenomena especially challenging. In particular, the strong nonlinearity causes the failure of models based on the quasi-linear approximation of the fundamental equations of motion. These equations, be they the Euler system, or the full Navier-Stokes equations when viscous effects need to be included, are hardly amenable to analytic methods of solution and can be very costly to simulate in even relatively simple situations. Thus, we develop mathematical models that are sufficiently accurate to capture the dynamics occurring in physically realistic situations, yet that are simple enough to be efficiently simulated numerically. With adopting an approach based on a systematic asymptotic expansion method for long waves of arbitrary wave amplitudes, the strongly nonlinear evolution models have been obtained and their solitary wave solutions and the fluid velocities that they generate have been extensively compared with experimental data for large internal waves in a variety of configurations. The agreement and predictive capability of the model was found to be rather remarkable for all the available data even for large (near maximum amplitude) internal solitary waves, as shown in Figure 1. Limitations to the application of the model of course do exist, and the model remains to be improved for realistic oceanic applications, including the effects of bottom topography, viscous dissipation at the interface, background shear, etc. Detailed validation with field data in the South China Sea are currently underway.

Figure 1 Comparison of strongly nonlinear model solitary wave solutions with laboratory data: dashed lines -- closed form solutions from the model, symbols -- laboratory experiment. (a) Solitary wave profile. (b) Wave speed. (c) Horizontal velocity distribution in depth. (d) Streamlines for a solitary wave in a linear shear current (A well-defined recirculating eddy appears at the wave crest).



Jonathon Drover, Amitabha Bose, Vahid Tohidi, and Farzan Nadim

Title: Combining Synaptic and Cellular Resonance

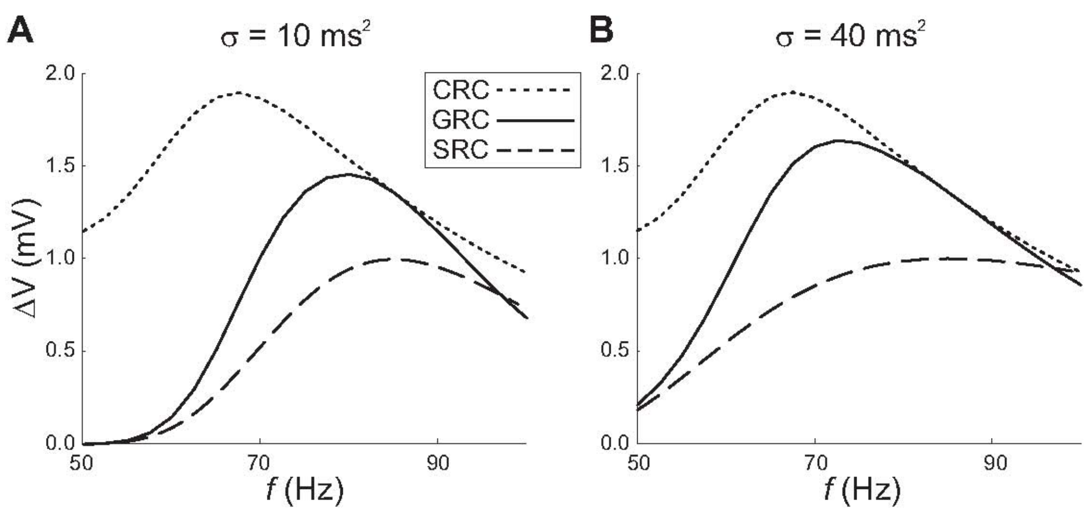
Cellular resonance is a preferred subthreshold response to inputs of a fixed frequency. The frequency that elicits the largest response is called the resonant frequency. Similarly, synaptic resonance refers to the preferential response of a synapse to certain fixed presynaptic frequencies. Our work over the past year has been to describe the subthreshold response of a resonant postsynaptic cell where the input is provided by a resonant synapse.

Our results consist of three functions of input frequency. The CRC (cellular resonance curve) is the subthreshold amplitude of oscillations in the postsynaptic cell as a function of frequency where the input is not via a synapse. The SRC (synaptic resonance curve) is the synaptic efficacy as a function of frequency. FInally, the GRC (generalized resonance curve) is the amplitude of postsynaptic subthreshold oscillations asa function of presynaptic frequency. These three figures are shown in the attached figure.

This work is motivated by experiments done in the STG lab at Rutgers- Newark by Vahid Tohidi and Farzan Nadim. They were able to demonstrate that both types of resonance are present in the pyloric central pattern generator of the crab.

The work has been presented, as a poster, at the 2nd Young Researchers Workshop in Mathematical Biology, the CNS meeting in Edinburgh, and the joint SMB-SIAM Conference on the Life Sciences in Raleigh, NC.

We have begun work on the transition to superthreshold behavior and what impact resonance can play in the spiking behavior of networks.



Vladislav V. Goldberg

Title: Linearizability of d-webs

A planar d-web is formed by d (d = 3, 4, ...) families of curves in the plane. Among such webs, there are linear d-webs formed by dfamilies of straight lines. If a curvilinear d-web W (d) can be mapped onto a linear d-web, then W (d) is called linearizable.

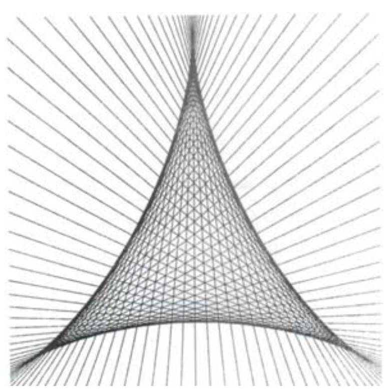
In the 1930s Blaschke posed the problem of finding invariant necessary and sufficient conditions for curvilinear d-web W (d) to be linearizable. He made some conjectures about the order ofderivatives of the function defining W (d) occurring in suchconditions: for d = 4 Blaschke conjectured that the order will be 4, and for d = 3, his conjecture was that the order will be 9.

In the paper, "Linearizability of d-webs, d > 3, on two-dimensional manifolds" (published in Selecta Mathematica), the authors proved the linearization problem for 4-webs and confirm the Blaschke conjecture: the order of derivatives occurring in linearizability conditions is really 4. Moreover, in "On linearization of planar three-webs and Blaschke's conjecture" (published in Comptes Rendus de l'Académie des Sciences - Series I- Mathematics), the authors found linearizability conditions for planar d-webs, d > 4; for them, the order of derivatives occurring in linearizability conditions is also 4. The authors also gave Mathematica codes for testing 4-and d-webs (d > 4) for linearizability and examples of their usage.

In the paper, "On the Blaschke conjecture for 3-webs" (published in Journal of Geometric Analysis), Lychagin and Goldberg solved the much more complicated problem of finding linearizability conditions for planar 3-webs. It appeared that the Blaschke conjecture was almost correct: the order of derivatives occurring in linearizabilityconditions is 8 and 9. The authors also presented an algorithm fordetermining whether a given planar 3-web is linearizable.

Note that linearizability conditions of planar d-webs are important in applications: in nomography and in economics. In economics, two Nobel prize winners (G. Debreu and Paul S.Samuelson) used planar d-webs in their research. Goldberg's recent interest to the linearizability problems was inspired by discussions with Professor T. Russell (Univ. of Santa Clara, CA), the colleague and co-author of Samuelson, who indicated that economists are needed the linearizabilty conditions for planar4-webs.

Among linearizable planar *d*-webs, there are algebraizable *d*-webs. They are diffeomorphic to the so-called algebraic *d*-webs. The latter are formed by the tangents to third-degree planar algebraic curves. On the figure below, you can see algebraic 3-webs produced by different third-degree algebraic curves.

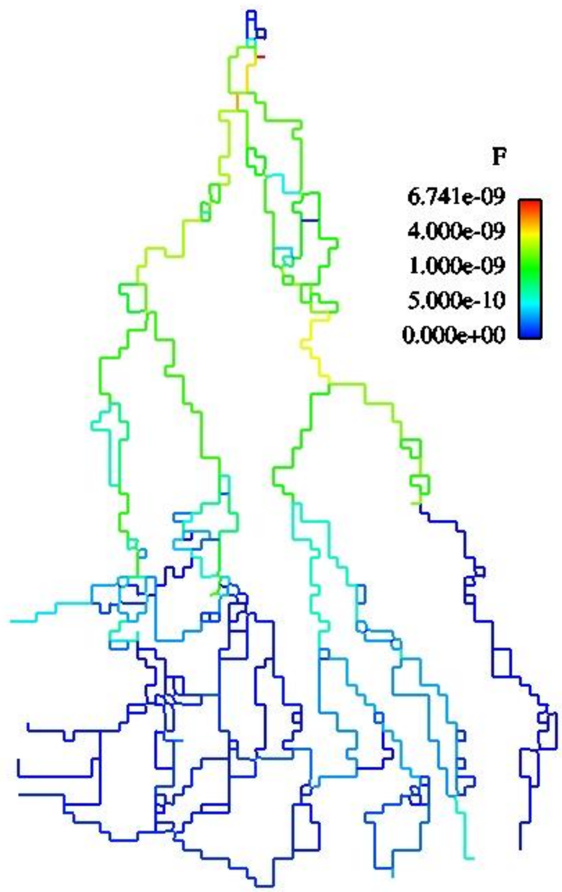


Algebraic 3-web. Through any point there are three straight lines tangent to cubic curve.

Daniel Goldman

Title: Blood Flow in Tumor Capillary Networks

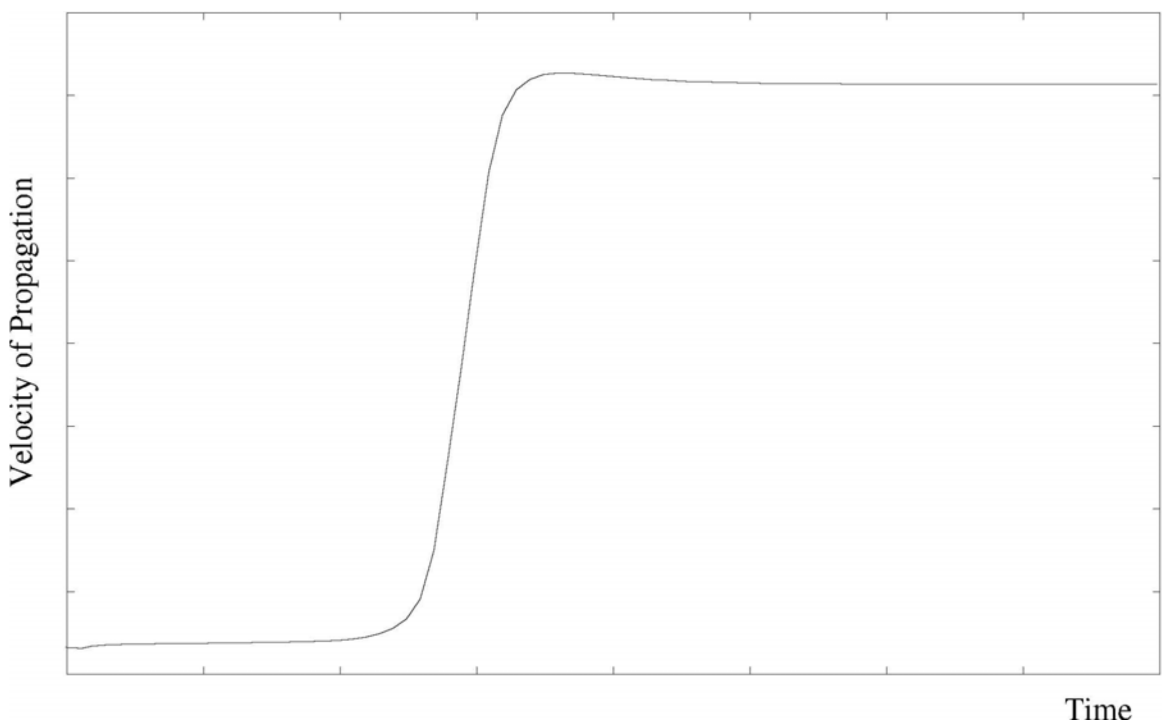
Shown below is the calculated blood flow distribution (ml/s) in one capillary sub-network of a tumor during tumor growth and angiogenesis. Realistic blood flow is being added to an existing tumor model to determine its effects on tumor nutrient delivery, size, and fragmentation. Joint work with Y. N. Young, V. Cristini and X. Zheng.



Peter Gordon

Title: Deflagration to Detonation Transition in Porous Media Combustion

During the period under review the main research effort was the study of how small but finite thermal diffusivity may affect combustion process in highly resistable porous media. The effect of the small thermal diffusivity (small compare to the pressure diffusivity) is crucial for understanding transition from slow propagation (deflagration wave) to the fast propagation (detonation wave). This transition which is called deflagration to detonation transition (DDT) is one of the major challenges of the combustion theory. Study of this phenomena in the framework of the propagation in a highly resistable media is very attractive since it preserves main qualitative features of the phenomena but described by the system of equations which are more tractable then one for the general combustion process. There was conjectured by physicists that the small thermal diffusivity has no or very little effect on the propagation of the stable detonation fronts in a highly resistable porous media. It was possible to show that the traveling front solution exists for all positive thermal diffusivities. Moreover, when the thermal diffusivity approaches zero traveling waves approach one corresponding to the zero diffusivity. In addition uniqueness of the traveling waves for sufficiently small thermal diffusivity was established. These results in particular imply that there exist no traveling wave solutions corresponding to the deflagration regime and thus transition from deflagration to detonation regime is unavoidable unless quenching has occurred.



Transition from the slow (deflagration) to fast (detonation) combustion

David J. Horntrop

Title: Simulation of the Late Stages of Domain Coarsening in Surface Processes

The spontaneous self-organization of particles in a two phase system into larger structures via diffusion is a commonly observed phenomenon in materials science known as Ostwald ripening. A better understanding of the rate of the self-organization and the mechanism driving this behavior is important for a number of applications. One set of useful models for Ostwald ripening are the mesoscopic models. These models consist of stochastic partial differential equations which are derived from particle descriptions of diffusion. The results given below are from numerical simulations of mesoscopic model equations using recently developed spectral schemes for stochastic partial differential equations.

Figure 1 contains a time series of contour plots for a system which is initialized with two circular regions of different radii having a high concentration of particles contained in a region of very low concentration of particles. Such a configuration can be thought of as modeling the late stages of Ostwald ripening. In these plots, regions of high concentration are hot pink while regions of low concentration are burnt orange; the upper circle initially has a radius 10% larger than the lower circle. As expected under Ostwald ripening, the larger circle is observed to grow at the expense of the smaller circle, with the growing region showing greater deformation from circular at time progresses.

In later times than shown, the remaining region of high concentration eventually becomes circular. Figure 2 quantifies the results shown in Figure 1 by plotting the effective radius of the upper and lower regions of concentration as a function of time (with averaging over 500 independent realizations). The red curve represents the upper region while the blue curve represents the lower region. Whereas power law growth is observed and predicted in the early stages of Ostwald ripening, power law growth is not observed in these simulations for the late stages of Ostwald ripening.

This research is supported by NSF grants.

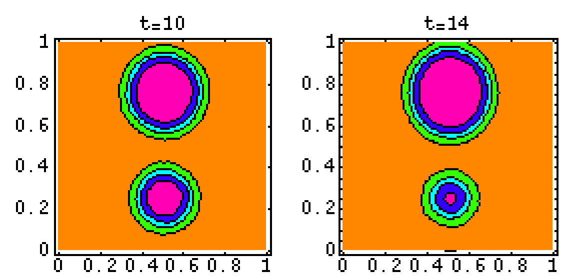


Figure 1: Contour plots showing the time evolution of the concentration field undergoing Ostwald ripening when the initial field consists of two circular regions of high concentration with the lower circle having smaller radius. The larger region grows at the expense of the smaller region as expected.

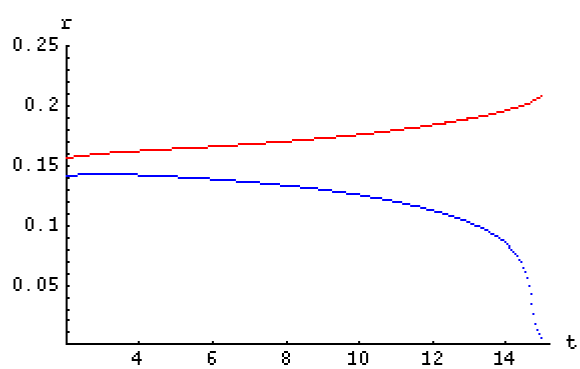


Figure 2: Plot of the effective radius of each of the regions versus time. The upper region is plotted in red while the lower region is blue. Power law behavior is not observed in these simulations of the late stages of Ostwald ripening.

Shidong Jiang

Title: Nonlinear Optics--Hyperpolarizabilities for One-Dimensional Infinite Single-Electron Periodic Systems

The nonlinear optical (NLO) properties of polymers have been a long-lasting research interest to both experimentalists and theorists. Among these polymers, polyacetylene (PA) is the simplest conjugated polymer and has been extensively studied. PA consists of chains of CH units that form a pseudo one dimensional lattice. Classical periodic single electron models such as Su-Shrieffer-Heeger (SSH) and Takayama-Lin-Liu-Maki (TLM) have been established to interpret the optical properties of polyacetylene. However, theorectical computation based on these models is very difficult to carry out and numerical simulation often provides unstable and contradictory results.

In collaboration with Dr. Mingzhong Xu at New York University, I have obtained the analytical solutions for the general-four-wave-mixing hyperpolarizabilities on infinite chains under both SSH and TLM models of trans-polyacetylene through the scheme of dipole-dipole correlation. Analytical expressions of DC Kerr effect, DC-induced second harmonic generation, optical Kerr effect and DC-electric-field-induced optical rectification are derived. By including or excluding terms in the calculations, comparisons show that the intraband contributions dominate the hyperpolarizabilities if they are included. The gradient term or intraband transition leads to the break of the overall permutation symmetry in hyperpolatizabilites even for the low frequency and non-resonant region, hence it breaks the Kleinman symmetry that is directly based on the overall permutation symmetry. Our calculations provide a clear understanding of the Kleinman symmetry breaks that are widely observed in many experiments. And we also suggest a feasible experiment to test the validity of overall permutation symmetry and our theoretical prediction.

We have also derived analytical expressions for the third-harmonic generation, DC Kerr effect, DC-induced second harmonic optical Kerr effect, optical Kerr effect or intensity-dependent index of refraction and DC-electric-field-induced optical rectification under the static current-current correlation under the static current-current correlation for one-dimensional infinite chains. We then compared the results of hyperpolarizabilities under current-current correlation with those obtained using the dipole-dipole correlation. And the comparison shows that the conventional current-current correlation, albeit quite successful for the linear case, is actually incorrect for studying the nonlinear optical properties.

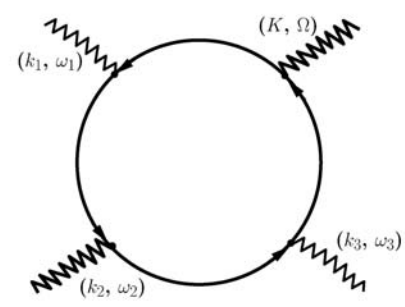


Figure 1: The Feynman diagram for hyperpolarizabilities

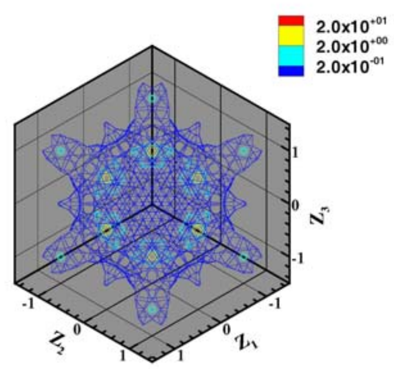


Figure 2: The magnitude of four-wave mixing under SSH model

Victor Matveev, Amitabha Bose, and Farzan Nadim

Title: Multistability in a Two-Cell Inhibitory Network with T-Currents Analyzed via a 1D Poincare Map

Networks of neurons reciprocally coupled by inhibitory synapses generate rhythmic firing in a variety of neural systems, from the invertebrate motor pattern generators to the mammalian brainstem and hippocampus. In many of these inhibitory networks, cells fire bursts of action potentials, as a result of the interplay between synaptic inhibition and the regenerative ionic currents such as the hyperpolarization-activated T-type calcium current. To gain a better insight into this phenomenon, we study the dynamics of two model neurons coupled by reciprocal inhibition and endowed with T-currents (Fig. 1). This network exhibits anti-phase bursting activity (see Fig. 2A), whereby at each point in time, one of the cells is active (bursting) and suppresses the other cell. Figure 2A shows the time course of the electric potential of each cell (V1, V2: top panel), as well as the time course of its T-current de-/inactivation (h1, h2: bottom panel). Note that h grows (T-current de-inactivates) when the cell is passive and is hyperpolarized by the inhibitory input received from the active cell. In contrast, h decreases (inactivates) when the cell is spiking. As a result of such inactivation, the inter-spike interval of the active cell gradually increases during the burst, eventually becoming too large, and thus allowing the passive cell to escape from inhibition and initiate its own burst. This terminates the burst of the active cell, in turn hyperpolarizing it and leading to the gradual de-inactivation of its T-current (h grows).

Although the dynamics of this network is governed by a system of eight differential equations, we found that its periodic states can be obtained using a 1-dimensional Poincare map relating the lengths of two successive bursts. Note that the burst length (BL(n+1) in Fig. 2A) is completely controlled by the level of T-current de-inactivation at burst onset, h*: BL(n+1) = F(h*). The value of h* is in turn completely determined by the length of the preceding burst of the partner cell: h* = G(BL(n)). Thus, the Poincare map is given by

$$BL(n+1) = P(BL(n)) = F(h^*) = F(G(BL(n)))$$

Since an increase in h* increases the number of spikes per burst, F(h*) is a piecewise continuous function, with intervals of continuous monotonic decay corresponding to a fixed number of spikes per burst (blue curve in Fig. 2B). On the other hand, G(BL) has a very simple exponential form, since T-current inactivation is approximated by simple first-order linear kinetics. The fixed points of the Poincare map yield the periodic solutions, BL=P(BL)=F(G(BL)). These solutions correspond to the intersections of the curve BL=F(h*), and the inverse of the curve h*=G(BL), shown in red in Fig. 2B. Interestingly, we find that in general these curves may have more than one intersection, suggesting the coexistence of several periodic solutions with different number of spikes per burst. We verify the existence of such multiple co-stable bursting solutions numerically. Apart from providing the periodic solutions to network dynamics, the Poincare map also allows us to understand more easily the parameter sensitivity of the network activity states.

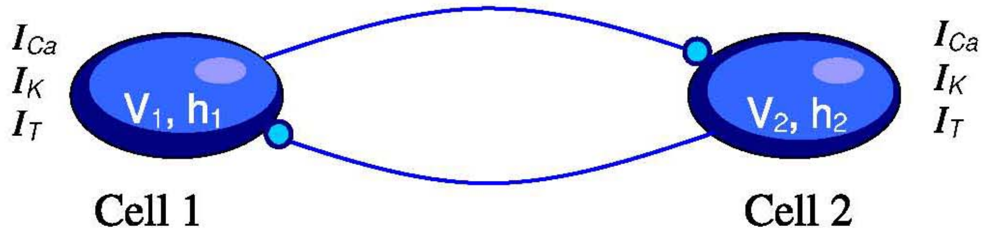


Figure 1

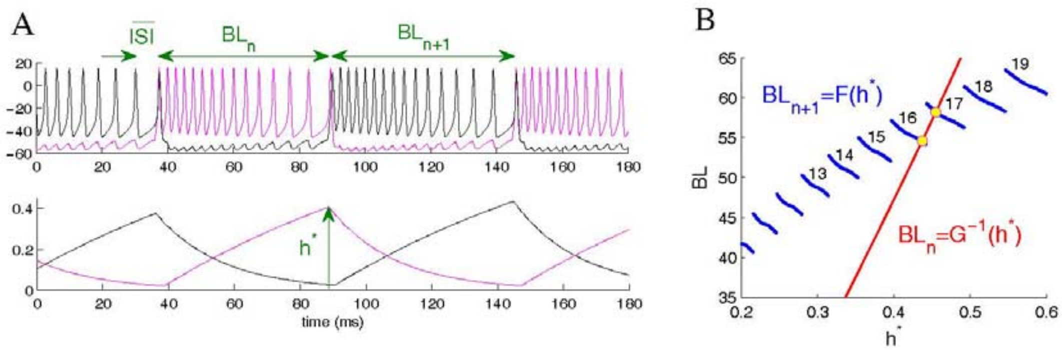


Figure 2

Robert M. Miura

Title: Traveling Waves in Coupled Reaction-Diffusion Models with Degenerate Sources
(joint work with Jonathan J. Wylie, City University of Hong Kong)

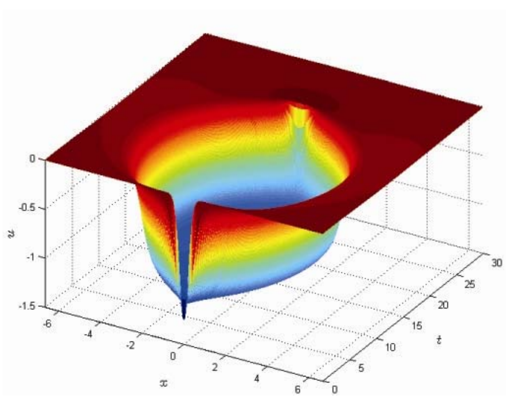
Nonlinear diffusion models have been studied extensively in the context of different biological, chemical, and physical phenomena. In many different applications, highly localized disturbances of a stable rest state can lead to wave propagation. Specific biological examples include the generation of an ‘action potential’ wave by electrical current stimulation of the Hodgkin-Huxley equations, which describe how the dynamics of the electrical potential across membranes of nerve cells, and instigation of waves of spreading cortical depression in the cortex of various brain structures in a variety of animals by injecting a bolus of potassium chloride into the cortex.

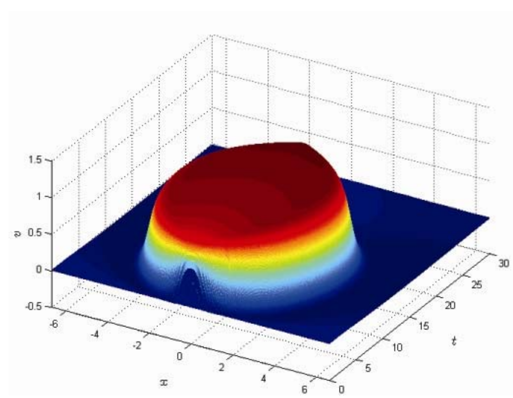
We have studied a specific class of coupled nonlinear diffusion equations that are characterized by not having isolated rest states, i.e., the rest states are not unique and depend continuously on one or more parameters. In particular, we have examined a coupled system of two nonlinear diffusion equations for the variables u and v with nonlinear source terms of equal magnitude

$$u_t = u_{xx} + g(u,v), \quad v_t = Dv_{xx} - g(u,v), \quad -\infty < x < \infty, \quad t > 0,$$

The variables have been rescaled such that the diffusion coefficient for u is unity and D is the diffusion coefficient for v.

We show that the degeneracy in the source terms implies that traveling waves have a number of surprising properties that are not present for systems with non-degenerate source terms. We also show that such systems can lead to a pair of waves that initially propagate outwards from the disturbance, slow down, and reverse direction before ultimately colliding and annihilating each other, see the figures below.

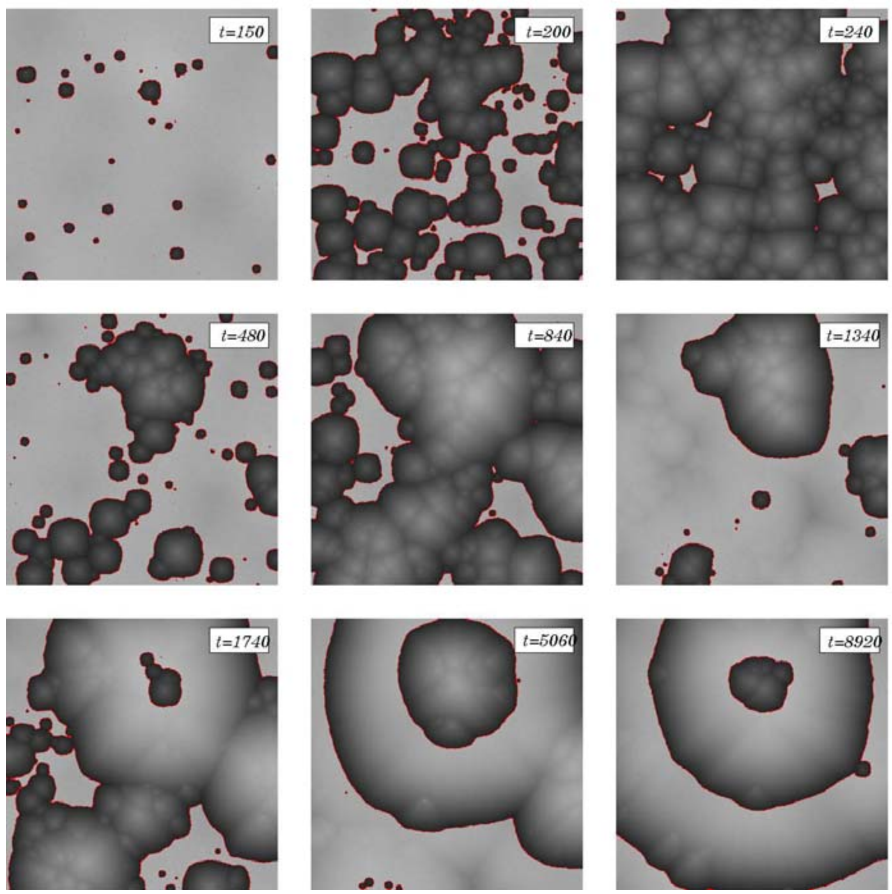




Cyrill Muratov

Title: Noise-Induced Generation of a Coherent Target Pattern in an Excitable Medium

The figure shows the results of a numerical simulation of a coarsely discretized reaction-diffusion system driven by delta-correlated white noise. In the absence of noise, the system supports propagating waves and exhibits all the standard features of an excitable medium. The addition of noise, however, changes the behavior of the system qualitatively. As a result of the self-induced stochastic resonance mechanism, a localized source of the waves emerges spontaneously, giving rise to a coherent target pattern. This simulation suggests a new possible mechanism for generating this type of patterns which are frequently observed in many biological contexts.



X. Sheldon Wang

Title: Mixed Finite Element Formulation for Acoustoelastic Fluid-Structure Interactions

In linear acoustoelastic analysis, it has been widely reported that the displacement-based fluid elements employed in frequency or dynamic analyses exhibit spurious non-zero frequency circulation modes. Various approaches have been introduced to obtain improved formulations, including a 4-node element based on a reduced integration technique, the displacement potential and pressure formulation, and the velocity potential formulation. The mixed displacement/pressure finite element formulation originally proposed by Wang and Bathe, 1997, has been proven to be reliable and free of spurious nonzero frequencies. A recent mathematical study of this formulation was also published in Bao, Wang, and Bathe, 2001. In this work, mixed finite element formulations are extended to the study of cochlea, in particular, the resonant frequency of the enclosed cavity with different geometries. In essence, immersed flexible structures with and without opening are compared at different physical parameters such as variable thickness, fluid and solid densities.

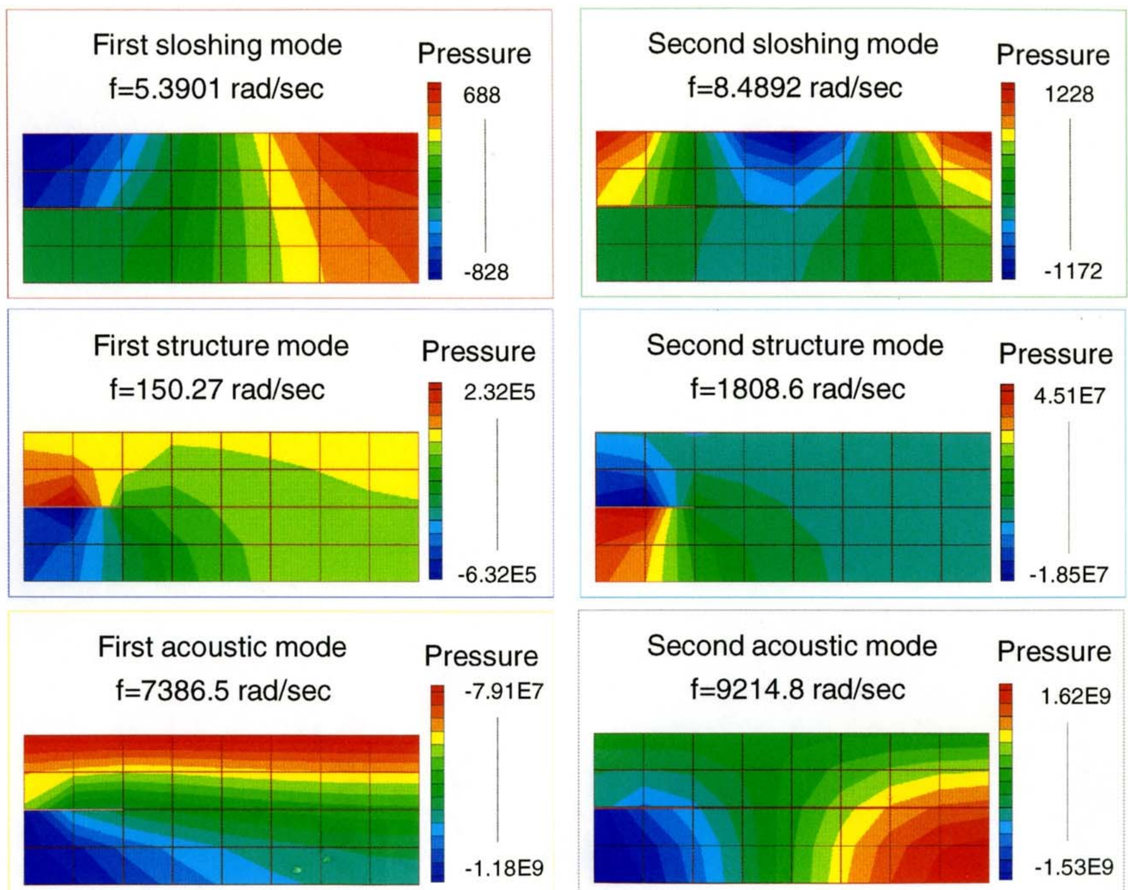


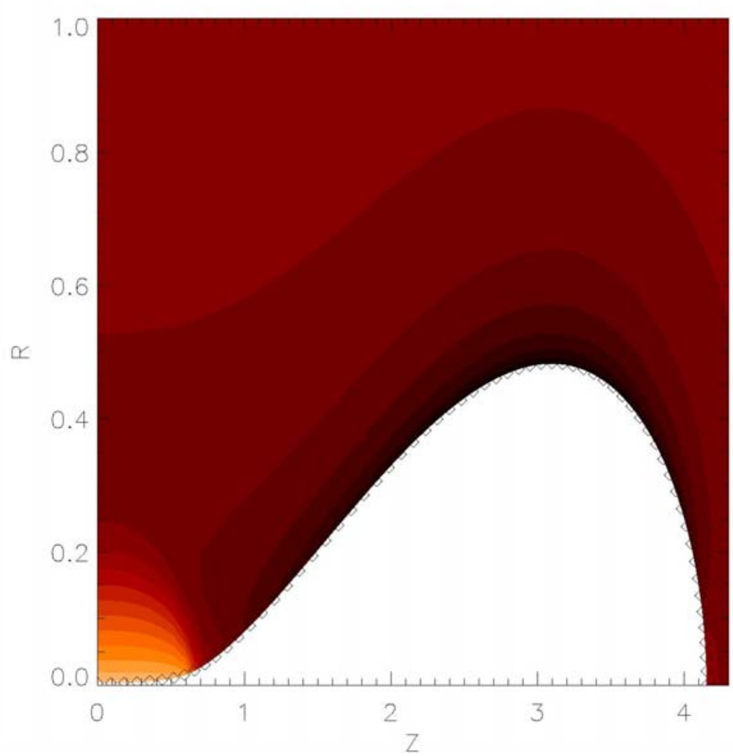
Figure 1: Pressure bands of the first two sloshing, structural, and acoustic modes of the acoustoelastic system with the sloshing of its free surface.

Yuan Young, Michael Booty, Ji Lie, and Michael Siegel

Title: Effect of Surfactant Solubility on Deformation and Breakup of a Bubble in a Viscous Surrounding

The effect of surfactant on the pinch-off of an inviscid bubble surrounded by a viscous fluid is studied theoretically and numerically. Equations governing the evolution of the interface and surfactant concentration in zero-Reynolds-number flow are derived using a long wavelength approximation. In the case of soluble surfactant the derivation assumes either zero bulk Peclet number Pe, or infinite Pe. Results of the long wavelength model are compared against numerical simulations of the full problem, performed using a highly accurate arbitrary Lagrangian-Eulerian (ALE) method. The presence of insoluble surfactant significantly retards pinch-off: This is due to the development of a long, slender, quasi-stable cylindrical thread at the location of minimum radius, where the destabilizing influence of capillary pressure is balanced by the internal pressure. For soluble surfactant, depending on parameter values, a filament may form first and pinch off later due to the exchange between bulk and surface surfactants. In particular, a transition from necking to thread-formation breakup is found as the bulk-surface exchange is reduced. The ratio of surfactant adsorption to desorption rates also leads to novel bubble pinch-off, where the bubble neck bounces before the eventual pinch-off. These findings help solidate the quantification of surfactant effects on bubble pinch-off, and is useful for controling the bubble size distribution using both soluble and insoluble surfactants.

The figure shows a snapshot of the collapse of an axisymmetric, prestretched bubble. The z-axis is the symmetry axis, and one quarter of a bubble cross section through this axis is shown. The concentration field of soluble surfactant is depicted on the exterior of the bubble. Brighter colors (e.g., yellow and orange) correspond to higher levels of surfactant concentration. Surfactant concentration is highest near z=0, where a slender thread forms prior to collapse. The bright colors indicate that the surfactant concentration is high near the collapsing thread. This is a consequence of the high surface concentration of surfactant on the slender thread that results from the local reduction of surface area.



D. COLLABORATIVE RESEARCH

Roman Andrushkiw

Proximity Measure between Empirical Samples, D. Klyushin, Yu. Petunin (U. of Kyiv).

Computer Aided Cytogenetic Method of Breast Cancer Diagnosis, N. Boroday, V. Chekhun (Institute of Oncology and Radiology NASU), and D. Klyushin, Yu. Petunin (U. of Kyiv).

Equations of Interface Dynamics for Quasi-Stationary Stefan Problem, V. Gafiychuk (U. of Krakow).

John Bechtold

Mathematical Modeling and Experiments of Premixed and Diffusion Flames, C. K. Law, G. Jomaas, and H. Wang (Princeton University).

Amitabha Bose

The Geometry of Neuronal Recruitment, J. Rubin (University of Pittsburgh).

Wooyoung Choi

Surface Expression for Nonlinear Internal Waves, David Lyzenga (University of Michigan).

Two-Dimensional Wave Breaking Experiments and Parameterizations, Marc Perlin (University of Michigan).

Numerical Modeling of Internal Waves Propagating over Bottom Topography, Taechang Jo (Inha University, Korea).

A Pseudo-Spectral Method for Nonlinear Wave-Body Interaction, Christopher Kent (Florida Institute of Technology).

Instability and Regularization of Interfacial Waves in Two-layer System, Robert Krasny and Lyudmyla Barannyk (University of Michigan).

Parallel Short-Term Wave Prediction Model, Yuan-Nan Young (NJIT).

Vladislav V. Goldberg

Rank Problems for Planar Webs, V. V. Lychagin (University of Tromso, Norway).

Local Algebras of a Differentiable Quasigroup, M. A. Akivis (Jerusalem College of Technology, Israel).

Daniel Goldman

Microvascular Oxygen Transport during Sepsis, C. G. Ellis (University of Western Ontario) and R. M. Bateman (University of British Columbia).

Tumor Growth, Transport, and Angiogenesis, Y. N. Young (New Jersey Institute of Technology) and

V. Cristini and X. Zheng (University of California at Irvine).

Jorge Golowasch

The Pyloric Model Group: Functional Analysis of a Complex, Distributed Biological Neural Network (NSF funded), Ron Harris-Warrick (Cornell University, NY), Scott Hooper (Ohio University), Eve Marder (Brandeis University), Farzan Nadim (NJIT), and Michael Nusbaum (University of Pennsylvania).

Regulation of Ion Channel mRNA in Identified Neurons, David Schulz (University of Missouri).

Roy Goodman

Bragg Gratings in Optical Fiber Communications, Michael Weinstein (Columbia University).

Dynamical Systems Modeling of Wave-Defect and Wave-Wave Interactions, Richard Haberman (Southern Methodist University).

Peter Gordon

Stability of Traveling Waves in Porous Media Combustion, Anna Ghazaryan and Christopher Jones (both at University of North Carolina at Chapel Hill).

Free Interface Models in Combustion and Related Topics, Gregory Sivashinsky (Tel Aviv University, Israel) and Claude-Michel Brauner (Universite Bordeaux 1, France).

David J. Horntrop

Mesoscopic Modeling for Pattern Formation in Materials, M. Katsoulakis (University of Massachusetts) and D. Vlachos (University of Delaware).

Shidong Jiang

Hyperpolarizabilities for the One-Dimensional Single-Electron Systems, M. Xu (New York University).

Generalized Poincare-Bertrand Formula on a Regular Surface in Three Dimensions, F. Hang (Princeton University).

Lou Kondic

Dense Granular Systems, Robert P. Behringer (Duke University) and Corey O'Hern (Yale University).

Thin Liquid Films, Javier Diez (University Nacional del Centro, Tandil, Argentina).

Two-Fluid Flow, Burt Tilley (Olin College) and Annette Hosoi (MIT).

Dawn A. Lott

Two-Dimensional Finite Element Analysis to Assess Flow Characteristics of an in vitro Aneurysm Model, Hans R. Chaudhry (NJIT), Michael Siegel (NJIT), and Charles J. Prestigiacomo (UMDNJ).

The Configuration of the Aneurysm Neck and Proximal Dome Profoundly Affect Shear Stress and Flow Velocities within an Aneurysm and its Parent Vessel, Hans R. Chaudhry (NJIT), Michael Siegel (NJIT), and

Charles J. Prestigiacomo (UMDNJ).

Three-Dimensional Stress Distribution in Axisymmetric Cerebral Saccular Aneurysm, Hans R. Chaudhry (NJIT), Charles J. Prestigiacomo (UMDNJ), Michael Siegel (NJIT), and Thomas W. Findley (UMDNJ).

Marc Q. Ma

Microarrays: Data Exploration and Analysis, Frank Shih (CS, NJIT), H-Y Wang (Public Health Research Institute (PHRI), and P. Soteropolous (PHRI).

Multiscale Molecular Dynamics, B. Leimkuhler (University of Leicester, UK).

Molecular Conformational Dynamics Study on Soluble Guanylyl Cyclase, A. V. Beuve (NJ Med School of UMDNJ).

Robust Biocatalysis Agents by Modifying the Heme Structure, Edgardo T. Farinas (Chemistry and Environmental Science, NJIT) and Sergiu Gorun (Chemistry and Environmental Science, NJIT).

Multiphysics Modeling of Sickle Cell Dynamics, Sheldon Wang (DMS, NJIT).

Victor Matveev

Properties of Endogenous Calcium Buffers at the Crayfish Neuromuscular Junction, Jen-Wei Lin (Boston University).

Mechanisms of Short-Term Synaptic Facilitation and the Modeling of Calcium-Secretion Coupling, Arthur Sherman (National Institutes of Health) and Richard Bertram (Florida State University).

Near-Membrane Calcium Dynamics and the Calcium-Dependent Inactivation of Voltage-Dependent Calcium Channels, Roman Shirokov (UMDNJ - New Jersey Medical School).

Jay N. Meegoda

University of Calgary, Canada, 2004-2007, Sponsored by the Natural Science and Engineering Research Council of Canada.

American University of Cairo, Egypt, 2005-2008, Sponsored by the US National Science Foundation.

Tsinghua University, Peoples Republic of China, 2005-2007, Sponsored by the Asia-link Program of the European Union.

Tomas Bata University in Zlin, Czech Republic, 2004-2006, Sponsored by Foundation Becario, Czech Republic.

Zoi-Heleni Michalopoulou

Remote Sensing for Coastal Water Quality Assessment, L. Axe, S. Bagheri, N. Steffen-Fluhr (NJIT).

Robert M. Miura

Spatial Buffering Mechanism: Mathematical Model and Computer Simulations, B. Steinberg (University of Toronto), Y. Wang (Toronto), and H. Huang (York University).

On the Formation of Glass Microelectrodes, H. Huang (York University), J. Wylie (City University of Hong Kong), and P. Howell (University of Oxford).

Thermal Instability in Drawing Viscous Threads, J. Wylie (City University of Hong Kong) and H. Huang (York University).

Analysis of Systems of Reaction-Diffusion Equations with Degenerate Sources, J. Wylie (City University of Hong Kong).

Mathematical Modelling of Ion Transport in the Brain-Cell Microenvironment with Cell Volume Change, H. Huang (York University) and J. Wylie (City University of Hong Kong).

Shape Control of Glass Microelectrodes, P. Howell (University of Oxford), J. Wylie (City University of Hong Kong), and H. Huang (York University).

Prediction of mRNA Polyadenylation Sites by Support Vector Machines, Y. Cheng (NJIT) and B. Tian (UMDNJ).

Models for Spreading Cortical Depression, A. Panda (NJIT).

Richard O. Moore

Analysis and Computation of Thermally Induced Pattern Formation and Dynamics in Parametric Gain Devices, K. Promislow (Michigan State University).

Simulation of Rare Events in Optical Communications, E. T. Spiller (Northwestern University), C. J. McKinstrie (Lucent Technologies) and W. L. Kath (Northwestern University).

Cyrill Muratov

Modeling and Computational Analysis of Cell Communication in Drosophila oogenesis, S. Y. Shvartsman (Princeton University).

Self-Induced Stochastic Resonance Phenomena in Excitable Systems, Weinan E (Princeton University) and Eric Vanden Eijnden (Courant Institute of Mathematical Sciences).

A Variational Approach to Traveling Waves and Propagation Phenomena for Ginzburg-Landau and Combustion Problems in Infinite Cylinders, M. Novaga (University of Pisa, Italy).

Strong Segregation Limit Energetics in Block Copolymer Systems, M. Novaga (University of Pisa, Italy), G. Orlandi (University of Verona, Italy), and C. Garcia-Cervera (UCSB).

Structure and Simulations of Domain Walls in Thin Film Micromagnetics, V. Osipov (New Physics Devices).

Farzan Nadim

Neuromodulation of Synaptic Dynamics, R.M. Harris-Warrick and B. Johnson (Cornell University).

Configuration of Circuit Dynamics by Modulatory Fibers, M.P. Nusbaum (University of Pennsylvania Medical School).

Exploration of Pacemaker Kernel Neuron Models, A. Prinz (Emory University).

D.T. Papageorgiou

Breakup of Liquid Jets with Surfactants, M. Siegel and Y.-N. Young (NJIT), M. Hameed (City College of New York).

Mathematical Models of Core-Annular Flows with Surfactants, M. Siegel (NJIT), S. Kas-Danouche (Universidad de Oriente, Venezuela).

Evolution Equations in Interfacial Electrohydrodynamics: Modelling, Analysis and Computations, D. Tseluiko (NJIT and now University of East Anglia), J,-M. Vanden-Broeck (University of East Anglia).

Gravity Capillary Waves under Electric Fields, Theory and Numerical Calculations, J.-M. Vanden-Broeck, S. Grandison, H. Gleeson, and P. Hammerton (University of East Anglia).

Numerical Analysis of Systems of Nonlinear Semi-Linear Parabolic Equations, Y.S. Smyrlis (University of Cyprus) and G. Akrivis (University of Ioannina, Greece).

Theory and Experiment on the Stagnant Cap Regime in the Motion of Spherical Surfactant Laden Bubbles, C. Maldarelli and A. Taneja (City College of New York).

Peter G. Petropoulos

Energy Estimates and Stability Issues Pertaining to the Unsplit Perfectly Matched Layer for Hyperbolic Systems of Partial Differential Equations, Eliane Becache (Projet Ondes, INRIA-Rocquencourt, France).

Christopher Raymond

Mathematical Modeling for Immunocolloid Labeling, Paul Milewski (University of Wisconsin-Madison), Ralph Albrecht (University of Wisconsin-Madison), and David Edwards (University of Delaware).

Viscous Shear Flow in a Narrow Slot, John Billingham (University of Nottingham), David Edwards (University of Delaware), Ferdinand Hendriks (Hitachi), and Burt Tilley (Olin College).

Michael Siegel

Singularity Formation for the Three-Dimensional Euler Equations, Russ Caflisch (UCLA), and Tom Hou and Dale Pullin (Caltech).

Surface-Tension-Driven Breakup of an Air Bubble in a Viscous Liquid, Peter Howell (Oxford), Wendy Zhang (University of Chicago).

Effect of Surfactant and Surfactant Solubility on the Deformation and Breakup of a Bubble in a Viscous Surrounding, Michael Booty, Demetrious Papageorgiou, Yuan Young (NJIT), Muhammad Hameed and Charles Maldarelli (Levich Institute, CUNY), and Jie Li (Cambridge University).

Louis Tao

Dynamics of Visual Cortical Neuronal Networks, David Cai (CIMS, NYU), J. Andrew Henrie (UCLA), David McLaughlin (CIMS, NYU), Adityaa Rangan (CIMS, NYU), Dario Ringach (UCLA), Robert Shapley

(CNS, NYU), and Michael Shelley (CIMS, NYU).

Spike-Triggered Correlation Analysis in Neuroscience, David Cai (CIMS, NYU) and Gregor Kovacic (RPI).

Bifurcations and Oscillations in Coupled Oscillators, Gregor Kovacic and Christina Lee (RPI).

Dynamics of Neuronal Networks of Small-World Architecture, David Cai (CIMS, NYU).

Estimation of Synaptic Conductances in Neurons in Recurrent Networks, Antoni Guillamon (Universitat Politecnica de Catalunya, Barcelona) and David Terman (Ohio State).

Cell-Surface-Mediated Reactions, Tom Chou (UCLA).

Instabilities in Dusty Gases, Edward Spiegel (Columbia University) and Philip Yecko (Montclair State University).

Jean-Marc Vanden-Broeck

Nonlinear Steady and Unsteady Free Surface Flow Disturbances Created by Submerged Obstructions, F. Dias (Ecole Normale Superieure, France).

Nonlinear Two and Three Dimensional Free Surface Flows, M. Blyth, M. Cooker, P. Hammerton, E. Parau, and S. Grandison (University of East Anglia, UK).

Exponential Asymptotics, J. Chapman (OCIAM, Oxford University).

Yuan-Nan Young

Extensible Filament Dynamics and Transport, M. Shelley (NYU, Courant).

Hysteretic Drop Dynamics in Straing Flow with Rotation, J. Blawzdziewicz (Yale University).

X. STUDENT ACTIVITIES

A. UNDERGRADUATE ACTIVITIES

Zoi-Heleni Michalopoulou, Director of Undergraduate Studies

Pi Mu Epsilon Induction Ceremony on April 26, 2006

The Pi Mu Epsilon honor society inducted six new members this year on April 26, 2006: Carlos Orozco, Matthew Paccione, Mandip Kaur, Daniel Fong, Mark Argente, and Daniel Turek. Pictured below, left to right, are Carlos Orozco, Matthew Paccione, Mandip Kaur, Daniel Fong, Mark Argente, and Prof. Roy Goodman. Not pictured: Daniel Turek

Pi Mu Epsilon Induction Ceremony

NJIT Math Club Hosts Second Annual Integral Bee on April 26, 2006

Students and faculty in NJIT's Department of Mathematical Sciences participated in the second annual Integral Bee hosted by the NJIT Math Club. The winners included: Abel George, a junior majoring in electrical engineering, first place; Stephen Istivan, a junior majoring in chemical engineering, second place; and Matt Peragine, a freshman majoring in math, third place.

Foucault's Pendulum Experiment; Confirming Earth's Rotation

In Fall 2005, Ikemefuna Agbanusi (Ike) and Jonathan Lansey built a working foucault's pendulum in a stairwell at NJIT. It was an official NJIT mathclub event (e-mail mathclub@oak.njit.edu to join the Pi-Landers).

Motivation:
1) Measure the Earths rotation!
2) Observe that sin(x)=x for small angles.
3) Test the period of a pendulum is 2*pi*sqrt(L/g)

Apparatus:
The bowling ball knocked over the black chess pieces to its left as it made a clockwise precession. In the southern hemisphere it would have knocked over the white pawns to its right.

16 pound weight, 17 Meter rope (56 feet), 8 second period (measured for large and small amplitudes!).
Swing of about a foot after left for 25 minutes. Thank you Claus Holzapfel for use of your way long measuring tape.

FAQ:
Why would I purchase a Purple bowling ball?! It was given to me by a stranger in a bowling alley . . . no seriously it was.

Why chess pawns? There weren't enough bishops.
Note: The humor in knocking over the tiny pins with a bowling ball was not missed.

What did you do to reduce friction?
If your weight is heavy enough, most of the friction comes from the very top. As shown in the diagram below (not to scale) the weight was supported by the gray bar. The rope was then held slightly to the side by the tight webbing (black circle per diagram). The rope was able to bend with little friction at such small angles. (The rope always stayed in contact with the webbing).

Ike watches the earth spin before his very eyes.

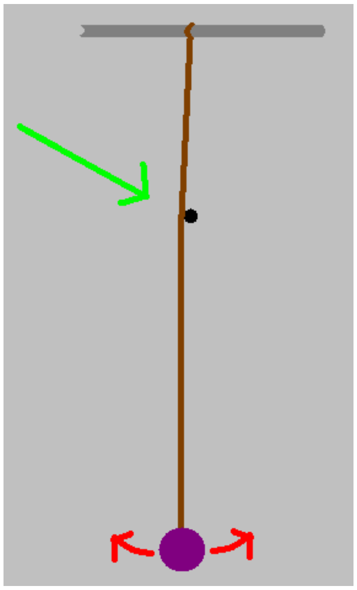
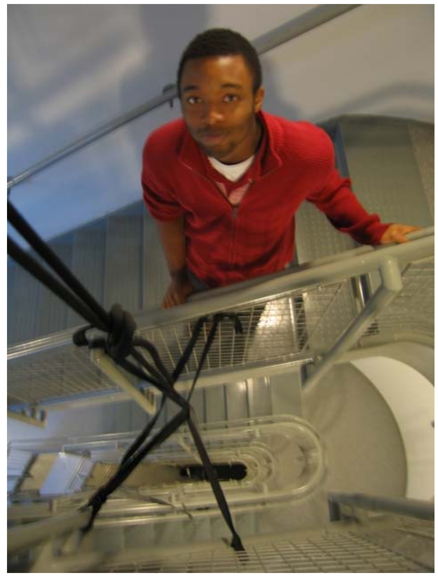
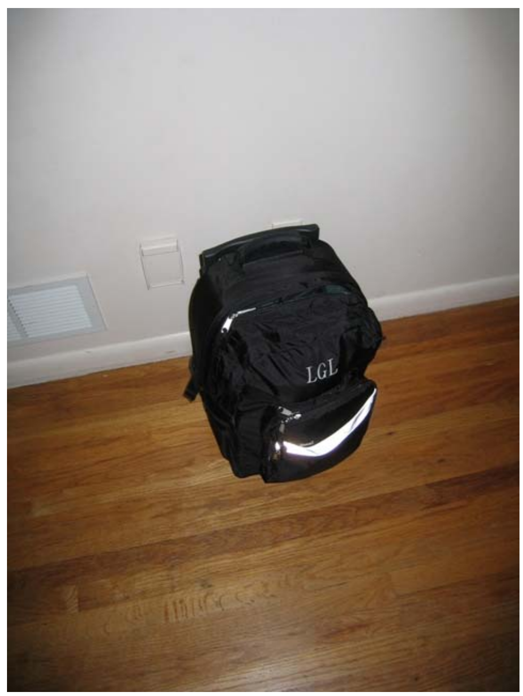


Diagram (not to scale)


The view from the top


Jonathan Lansey



And it all fits in a little bag! (wheels of course)

If we cut the rope instead of burning through- it would jerk the ball into an elliptical path . . .
Not good at all for precise pawn targeting. If you call that a fire hazard- I have no respect for you

Looking up (zoomed in)

Capstone Laboratory Projects:

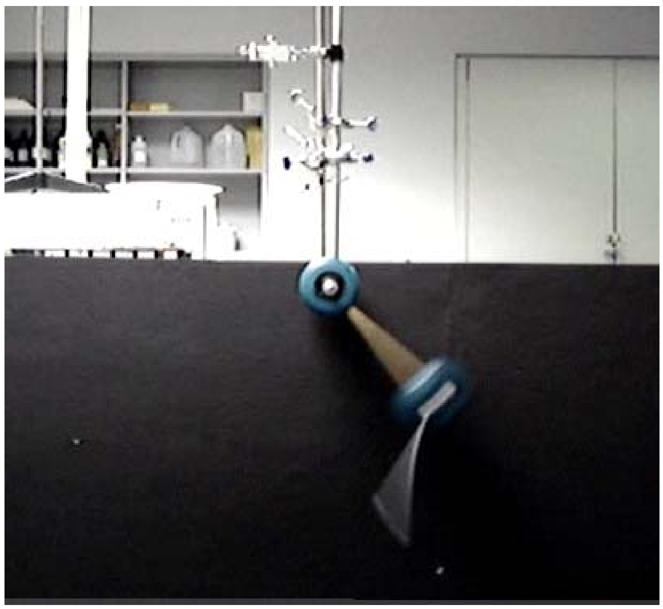
Title: Mathematical Chaos

Advisor: Roy Goodman

Students: Ryszard Blonski, Jason Czapla, Adam Hines, Lukasz Kieloch, Maciej Malej, Ina-Vanessa Sandiego, Daniel Turek, and Quynhnhi Vo

The double pendulum is a system often used to demonstrate mathematical chaos. Students in the capstone class built a double pendulum using rollerblade wheels and bearings to reduce friction.

They analyzed the motion of the pendulum--real experimental data as well as a mathematical model--and demonstrated the system is indeed chaotic.



Title: Classical Mechanics--Rigid Body Motions

Advisor: Roy Goodman

Students: Gerardo Giordano, Laura Medwick, Alexander Minicozzi, Varun Oberoi, Ankit Shah, Bryan Shaw, and Kelly Winters

In a recent preprint, Diaconis, Holmes, and Montgomery have shown that under general conditions, a coin is inherently biased to land heads-up if it leaves the hand heads-up. This effect does not diminish as the coin is thrown higher or with more vigorous rotation. This bias arises because the coin precesses as it tumbles, and is a straightforward, though novel, application of results due to Euler in about 1750.

This result formed the basis of a capstone course in applied mathematics at NJIT. The first few weeks of the course were spent teaching the relevant results from classical mechanics. We reproduced experiments in which flipping coins are filmed using a high speed video camera in the laboratory of Edward Dreizin, NJIT Department of Mechanical Engineering, and used the Matlab Image Processing Toolbox to analyze the motion and quantify the bias. The bias arises from the interaction between two types of angular motion: flipping end over end, and the rotation of the coin's face. This is related to an angle theta defined from the initial conditions. In one experiment, we found that the coin, starting heads up would land heads up with a probability of 50.3% and verified the angle theta was consistent with this probability. We also analyzed "Feynman's plate" and the motion of the heavy top using the same techniques. The experiments are very simple, yet analyzing them required a great deal of knowledge and computational sophistication.

Included are pictures of the laboratory setup and images from our experiments.

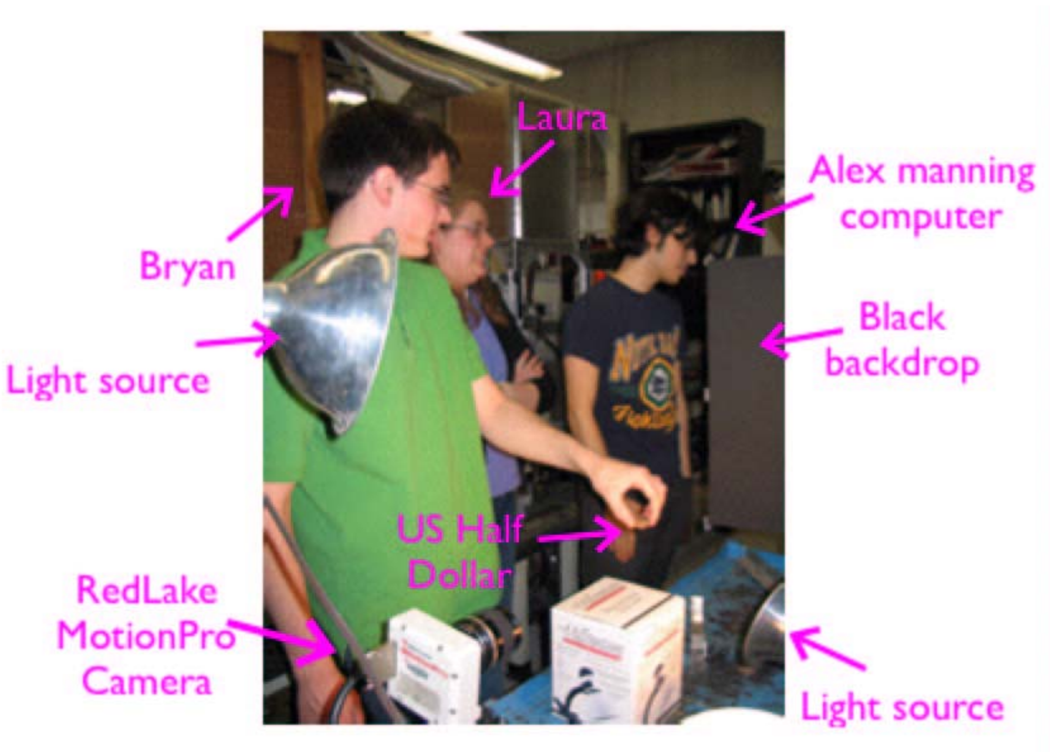


Figure 1: The gyroscope group

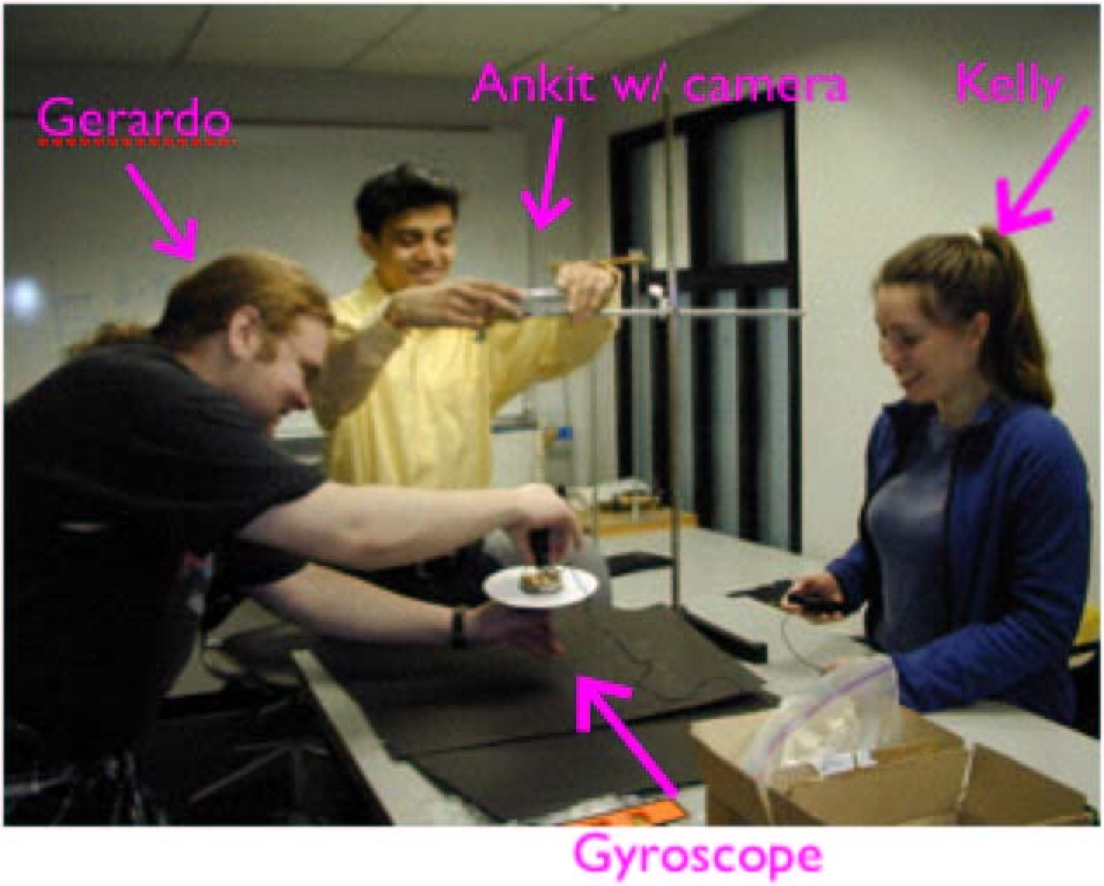


Figure 2: The coin toss group

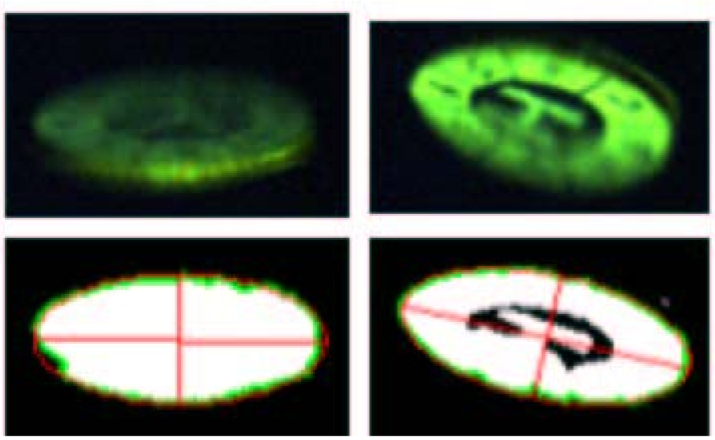


Figure 3: Stills from the coin toss video and least-squares fits to ellipses used to determine the coin's orientation

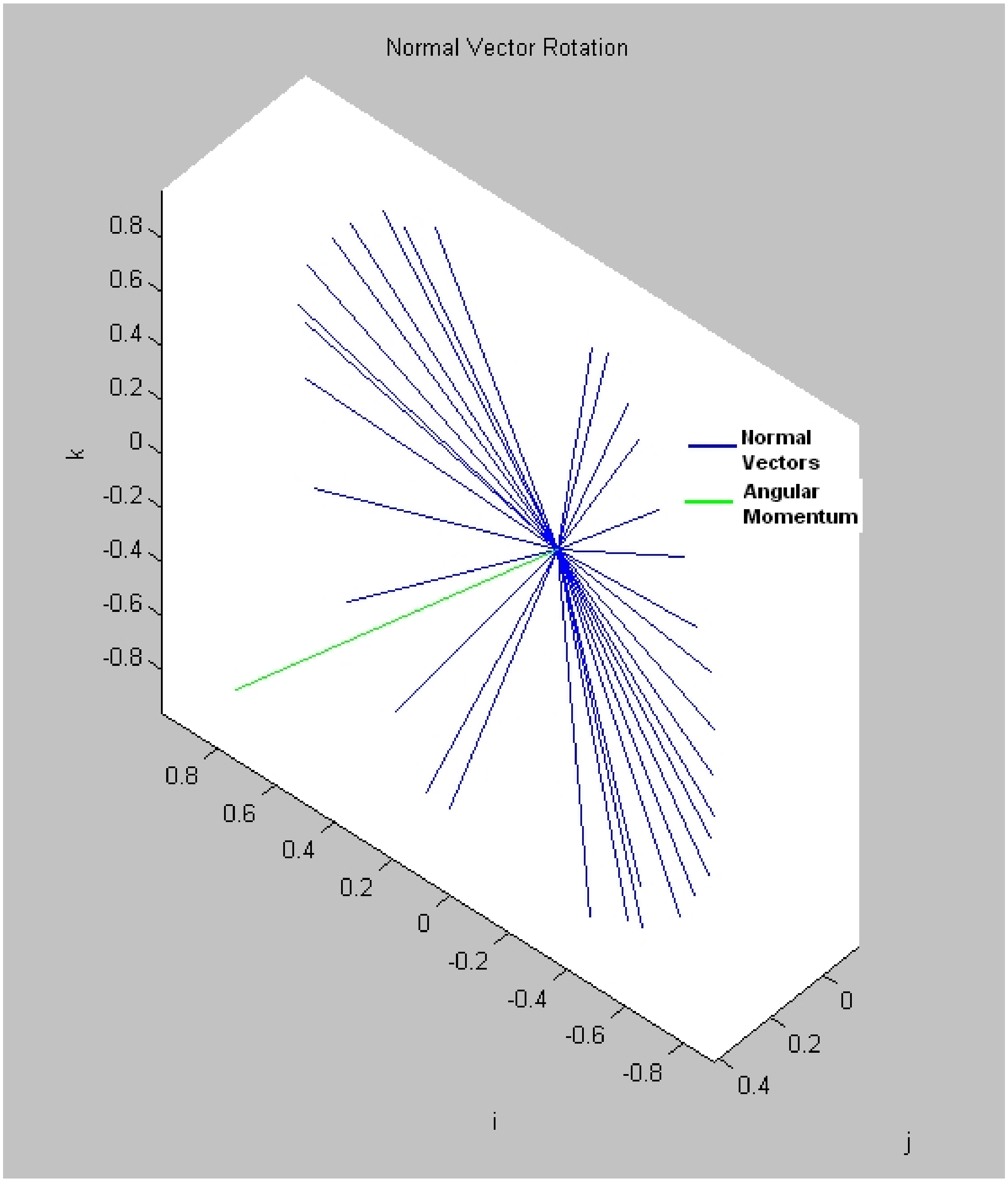


Figure 4: The mathematical reconstruction of the coin's orientation vectors (blue) and its angular velocity vector (green)

B. GRADUATE STUDENT RESEARCH PROGRAMS

Michael Booty, Director of the Graduate Program

Ph.Ds Awarded:

Ivan Zorych, August 2005
Thesis: A Bayesian Approach to Wireless Location Problems
Advisors: Dr. Manish Bhattacharjee and Dr. David Madigan

Soumi Lahiri, May 2006
Thesis: Linear and Log-Linear Models Based on Generalized Inverse Sampling Scheme
Advisor: Dr. Sunil Dhar

Dmitri Tseluiko, May 2006
Thesis: Mathematical Problems Arising in Interfacial Electrohydrodynamics
Advisor: Dr. D.T.Papageorgiou

MS Degrees Awarded:

A total of seven MS degrees in Applied Mathematics and eighteen MS degrees in Applied Statistics were awarded in the academic year 2005-2006.

Publications, Presentations, and Conference Participation

Sibabrata Banerjee:

GSA-Student Achievement Award, NJIT, 2005.

GSA-Student Achievement Award, NJIT, 2006.

Joint Statistical Meeting. Contributed talk `A comparison study of models for the human sex ratio'. Minneapolis, August 7-11, 2005.

Yiming Cheng:

Recipient of Presidential Strategic Initiative Scholar Award, 2005-2006.

GSA-Student Achievement Award, NJIT, 2006.

MBI Workshop. Participant. Ohio State University, August 1-19, 2005.

Graduate Student Research Day. Poster presentation `Using SVM to predict Polyadenylation Sites.' NJIT, March 6, 2006.

Second Annual Provost's Student Research Showcase. Poster presentation `Analysis of equivalent distorted ratchet potentials' (with Robert Miura). NJIT, April 12, 2006.

Frontiers in Applied and Computational Mathematics. Poster presentation `Prediction of polyadenylation sites using support vector machines' (with Robert Miura and Bin Tian). NJIT May 15-16, 2006.

Third Graduate Student Mathematical Modeling Camp. Participant. Rensselaer Polytechnic Institute, June 6-9, 2006.

Twenty-Second Annual Mathematical Problems in Industry Workshop. Participant. Olin College, June 12-16, 2006.

Leo Espin:

Poster:
Frontiers in Applied and Computational Mathematics, NJIT May 15th, 2006
Flow in Pulsating Channels in the Presence of a Horizontal Pressure Gradient

Nickolas Kintos:

GSA General Travel Award, Fall 2005.

Graduate Student Research Day. Poster presentation (with Farzan Nadim) `A modeling study of neuromodulator-elicited rhythmic oscillations.' NJIT, March 6, 2006.

East Coast Nerve Net. Contributed talk `Investigating projection neuron and neuromodulator effects on the operation of a rhythmic network: a modeling study.' Marine Biological Laboratory, Woods Hole, Massachusetts, April 1, 2006.

Second Annual Provost's Student Research Showcase. Poster presentation (with Farzan Nadim) `Comparing neuromodulator- and projection neuron-elicited oscillations: a modeling study.' NJIT, April 12, 2006.

Soumi Lahiri :

Presentations:
Contributed Speaker in Joint Statistical Meeting (JSM), Minnepolis, MN on August 7-11, 2005.
Log-linear Model Based on Generalized Inverse Sampling Scheme

Contributed Speaker in ENAR meeting, Tampa, FL on March 26-29, 2006.
Modeling Rare Events Using Generalized Inverse Sampling Scheme

Poster Presentation in Graduate Student Reserach Day at NJIT on March 6, 2006.
Modeling Rare Events Using Generalized Inverse Sampling Scheme

Poster Presentation in Provost's Student Reserach Day at NJIT in April, 2006.
Modeling Rare Events Using Generalized Inverse Sampling Scheme

Nebojsa Murisic:

Posters:
GSA Graduate Research Day, NJIT in April 2006. Instabilities of evaporating droplets
Graduate Student Research Day. Poster presentation `Octopus-shaped instabilities of evaporating droplets.' NJIT, March 6, 2006.

Conference on Applied and Computational Mathematics (FACM ’06), NJIT, May 2006. Instabilities of evaporating droplets

Presentation:
Instituto de Fisica Arroyo Seco, Universitad Nacional del Centro de la Provincia de Buenos Aires, Tandil, Argentina, April 2006. Instabilities of evaporating droplets

Workshops:
GSMMC, Math Modeling Camp, RPI, June 2006. MPI, math workshop, Olin College of Engineering, June 2006. IMSM, math workshop, North Carolina State University, Raleigh, NC, July 2006

Filippo Posta:

NJIT University Teaching Award for Excellence in Instruction by a Teaching Assistant, June 2006

Twenty-Second Annual Mathematical Problems in Industry Workshop. Participant. Olin College, June 12-16, 2006.

Ninth Pacific Institute for the Mathematical Sciences (PIMS) Graduate Industrial Mathematical Modeling Camp, and Tenth PIMS Industrial Problem Solving Workshop. Participant. Simon Fraser University, British Columbia. June 21 to June 24, June 26 to June 30.

Satrajit Roychoudhury:

Joint Statistical Meeting. Contributed talk. Minneapolis, August 7-11, 2005.

Graduate Student Research Day. Poster presentation `On mixtures of probability generating functions.' NJIT, March 6, 2006.

Second Annual Provost's Student Research Showcase. Poster presentation. NJIT, April 12, 2006.

Dmitri Tseluiko:

Recipient of Presidential Strategic Initiative Scholar Award, 2005-2006.

Department of Mathematics, Virginia Polytechnic Institute and State University. Invited seminar. January 6, 2006.

Graduate Student Research Day. Poster presentation `Mathematical problems arising in interfacial electrohydrodynamics'. NJIT, March 6, 2006.

Second Annual Provost's Student Research Showcase. Poster presentation. NJIT, April 12, 2006.

Xinli Wang:

Participant in the program `Bridging time and length scales in materials science and bio-physics'. Institute for Pure and Applied Mathematics, University of California at Los Angeles. September 12 to December 16, 2005.

Bridging time and length scales in materials science and bio-physics. Poster presentation - Influence of surfactant on air entrainment at a contact line. Institute for Pure and Applied Mathematics, UCLA. November 17, 2005.

Ivan Zorych:

Publication:
Location Estimation in Wireless Networks: A Bayesian Approach (with D. Madigan, P. Krishnan, and A.S. Krishnakumar), Statistica Sinica, vol. 16, #2, pp. 495-522, April 2006.

Presentation:
A Bayesian Approach to Wireless Location Problems (with D. Madigan), DIMACS Mixer Series, Stevens Institute of Technology, October 14, 2005.

At the GSA-Sponsored Graduate Student Research Day, held on March 6, 2006. Six of our graduate students participated: Yiming Cheng, Nick Kintos, Soumi Lahiri, Nebojsa Murisic, Satrajit Roychoudhury, and Dmitri Tseluiko.

At the Second Annual Provost's Student Research Showcase, held on April 12, 2006, five of our graduate students gave poster presentations: Yiming Cheng, Nickolas Kintos, Soumi Lahiri, Satrajit Roychoudhury, and Dmitri Tseluiko. The event was held during the afternoon of the External Advisory Board's visit to the University and its departments. Dr. Ned J. Corron of the U.S. Army AMCOM, who is a member of the Mathematical Sciences Department's Advisory Board, took part as one of the judges at the event, and remarked on the high quality of the presentations.

Report of the Ph.D. Qualifying Exam Committee by Michael Booty

There are three parts to the qualifying exams in both the applied mathematics and applied probability and statistics tracks of the program. Students must obtain a grade A to pass each part of the exams, and in general they are allowed to take each part at most twice.

In August 2005, qualifying exams were given in Analysis, Applied Mathematics, and Linear Algebra with Distribution Theory and Statistical Inference. The timing of the August exams is such as to accommodate incoming students who have sufficient background to take the exams on entry, the aim being timely graduation. As a result, two students successfully completed all parts of the exams and began research work with a faculty advisor.

In January 2006, exams in Applied Mathematics and in Topics in Statistics were offered. As a result, five students successfully completed all three parts of the exams and began work with a faculty advisor.

In June 2006, all three exams in the applied mathematics track and all three exams in the statistics track were offered. A total of twelve students took a total of twenty exams, gaining a total fourteen passes, which is a slightly higher pass rate than is usual. As a result, one student successfully completed all three parts of the exams and began research work with a faculty advisor. Of the total twelve students, eight students each took two exams of whom four passed both exams at the first attempt.

NJIT’s SIAM Student Chapter and GSA Mathematical Sciences Group

As part of its commitment to improving the quality of graduate student life, a decision was made by the Mathematical Sciences Department to reinvigorate the NJIT SIAM Student Chapter. The main purpose of the Chapter is to foster the awareness and interest of students, and graduate students in particular, in research in the Mathematical Sciences.

Yiming Cheng volunteered to be the Chapter's student representative and webmaster, and Michael Booty was appointed as faculty advisor for 2005-2006. The Chapter's activities were integrated, in part, with the academic activities of the Graduate Student Association (GSA) sponsored Mathematical Sciences Group, or `Math Club'. Activities included:

Sponsorship of the Friday Applied Mathematics Colloquium speaker, Professor Lakshminarayanan Mahadevan of the Division of Engineering Sciences at Harvard University, who visited on November 11 to speak on `Extreme Elastohydrodynamics: of Flags, Fishes and Plants.'

Organization of an open forum discussion on `Career Opportunities in Applied Mathematics', between faculty and graduate students in the Monday series of Graduate Student-Faculty Seminars. It was interesting to note from statistics generated by SIAM (the Society for Industrial and Applied Mathematics) and the AMS (American Mathematical Society) over recent years, that the most promising career opportunities identified in the discussion seem to occur in the many organizations that are engaged in scientific research in industry and federal government.

Organization and partial sponsorship, together with the GSA Math Club, of a field trip to the Cold Spring Harbor Laboratory, on Long Island, NY. The trip took place on May 11, the day after Spring final exams, and included twenty two graduate students from the Mathematical Sciences Department and the College of Computer Science who were accompanied by three faculty. We would like to express our sincere thanks to Dr. Peter Sherwood of CSHL for hosting the day's field trip, for providing a tour of the laboratory, and for organizing the afternoon's seminars given by Dr. Dmitri Chklovskii and Dr. Sheldon McKay.

Graduate students and faculty outside Grace Auditorium on the SIAM Student Chapter field trip to Cold Spring Harbor Laboratory

The activities were aided by a $500 grant donated by SIAM to the NJIT Student Chapter. The field trip was co-sponsored by the GSA Math club.

The Chapter was asked to nominate a Chapter member to take part in the Student Day activities at the SIAM Annual Meeting, which was held in Boston from Monday July 10 to Friday July 14. As a result, Yiming Cheng gave a talk entitled `Highly Accurate Prediction of mRNA Polyadenylation Sites Using a

Support Vector Machine', which was delivered to members of the SIAM leadership and the SIAM Educational Committee. Professor Jonathan Luke was invited to represent the NJIT faculty at both the event and the day's breakfast meeting with SIAM leadership. SIAM provided a further $500 student travel grant to Yiming Cheng to attend the meeting.

Workshops on Mathematical Problems in Industry

An increasing number of well-organized workshops are being organized by universities on the general but important topic of problems in industrial applied mathematics. The workshops provide fertile ground for the practice and development of problem-solving skills. Graduate students and faculty attending the workshops are presented with a selection of problems of current interest by representatives of the various industries taking part, and are invited to provide a mathematical formulation of a problem with an at least partially complete solution during a one-week meeting.

This provides all attendees with a lively, no-holds-barred challenge to share ideas while thinking on their feet in front of a chalkboard and computer. Often a report is prepared after the meeting and submitted to participating industries. The workshops were pioneered twenty years ago by faculty at Rensselaer Polytechnic Institute and the general theme has been taken up since then by Universities in many countries.

The Mathematical Sciences Department at NJIT has for a long time encouraged participation in the workshops. This year's events and participants include:

The 22nd Annual Mathematical Problems in Industry (MPI) Workshop which was held from June 12 to June 16 at Olin College, Needham MA, and was preceded by the 3rd Annual Graduate Student Mathematical Modeling Camp at Rensselaer Polytechnic Institute from June 6 to June 9.
See http://www.math.rpi.edu/Faculty/Schwendeman/Workshop/GSMMCamp2006/home.html and http://projects.olin.edu/mpi2006/ for more details.

The NSF-sponsored RPI modeling camp awards places on a competitive basis to about 24 students each year. This year, four of our students, Yiming Cheng, Nebojsa Murisic, Rashi Jain, and Yu Zhang were accepted for the camp. They continued to the workshop at Olin College the following week where they were joined by Filippo Posta.

A similar event, the 9th Pacific Institute for the Mathematical Sciences (PIMS) Graduate Industrial Mathematical Modeling Camp was held at Simon Fraser University, in Burnaby, British Columbia, from June 21 to June 24, and was followed by the 10th PIMS Industrial Problem Solving Workshop from June 26 to June 30. See http://www.pims.math.ca/industrial/2006/06gimmc/ and http://www.pims.math.ca/ipsw/ for more details. Two of our students, Filippo Posta and Yu Zhang, were accepted for both events at Simon Fraser University, which includes the award of expenses including travel.

The Industrial Mathematics and Statistical Modeling Workshop for Graduate Students (IMSM 2006) was held at North Carolina State University from July 24 to August 1 in Raleigh NC. See http://www.ncsu.edu/crsc/events/imsm06/ One of our students, Nebojsa Murisic, was accepted on the workshop, which includes award of expenses including travel.

Graduate Student-Faculty Seminars

Co-sponsored by the Graduate Student Association Mathematical Sciences Group and the NJIT-SIAM Student Chapter

The aim of the seminars is to provide an opportunity for graduate students to present their research work to their peers and faculty, and for faculty to introduce graduate students to their area of research specialization. As such, it aims to promote the general level of awareness of research among the graduate student body.

The seminar series' website http://m.njit.edu/Seminars/Grad_seminars_S06.html lists recent (Spring 2006) seminar speakers with their titles and abstracts. Details of previous seminars are archived and can be found from http://math.njit.edu/seminars/archive.php

Fall 2005 semester. Seminars given by graduate students

October 19 Speaker: Nebojsa Murisic Advisor: Prof. Lou Kondic
Title: On Formation of "Octopus-like" Structures in the Evolution of Droplets

October 26 Speaker: Myongkeun Oh Advisor: Prof. Victor Matveev
Title: Asymptotic Analysis of Buffered Calcium Diffusion Near a Point Source

November 2 Speaker: Yogesh Joshi Advisor: Prof. Daniel Goldman
Title: The Effect of Interactions Between Nitric Oxide and Oxygen on Tissue Oxygenation

November 9 Speaker: Rashi Jain Advisor: Prof. Eliza Michalopoulou
Title: Simulated Annealing Methods

November 16 Speaker: Manmeet Kaur Advisor: Prof. Cyrill Muratov
Title: Modeling of Cell Communication in Tissues

November 30 Speaker: Shuchi Agrawal Advisor: Prof. Michael Booty
Title: Spatial Patterns due to Diffusion-driven Instability

Spring 2006 Semester. Seminars given by Faculty

February 6 Speaker: David J. Horntrop
Title: Stochastic Modeling and Simulation of Surface Diffusion

February 13 Speaker: Sheldon Wang
Title: Multi-Scale and Multi-Physics Modeling of Flexible Biological Shell-Like Structures in Aqueous Environment

February 20 Speaker: Peter Gordon
Title: Some Applications of Reaction Diffusion Advection Equations

February 27 Speaker: Richard Moore
Title: Current Topics in Nonlinear Optical Communications and Devices

March 20 Speaker: Michael Booty
Title: Open Forum Discussion on Career Opportunities in Applied Mathematics
(Co-Sponsored by the NJIT SIAM Student Chapter)

March 27 Speaker: Roy Goodman
Title: The Two-bounce Resonance Phenomenon

April 3 Speaker: Eliza Michalopoulou
Title: Inverse Problems in Underwater Acoustics

April 17 Speaker: Peter Petropoulos
Title: Applied Mathematical Modeling of Wave Propagation and Fluid Interface Motion

April 24 Speaker: Yuan-Nan Young
Title: Interesting Dynamics of Drops and Filaments in Stokes Flow

April 24 Speaker: Wooyoung Choi
Title: Highly Nonlinear Waves in Geophysical Flows

Summer Program Seminars, 2006

May 25 Speaker: Leo Espin (advisor, D.T. Papageorgiou)
Title: Flow in Pulsating Channels in the Presence of a Horizontal Pressure Gradient

May 30 Speaker: Sheldon Wang
Title: Challenges in the Modeling of Biological Systems

June 1 Speaker: Nebojsa Murisic (advisor L. Kondic)
Title: Instabilities of Evaporating Droplets

June 6 Speaker: G.A. Kriegsmann
Title: A Very Brief Overview of Electromagnetics and the Analysis of a Quarter Wave Vertical Antenna

June 8 Speaker: Xinli Wang (advisor M. Siegel)
Title: Gravity Spreading of a Viscous Drop Over a No-Slip Surface

June 13 Speaker: Jonathan Drover
Title: Windows of Spiking Activity and Synaptic Depression

June 22 Speaker: Joon Ha (advisor A. Bose)
Title: The Dynamics of an Electronically Coupled Theta Neuron Model

June 27 Speaker: Amit Bose
Title: The Geometry of Neuronal Recruitment

June 29 Speaker: Lakshmi Chandrasekaran (advisor A. Bose)
Title: Analysis of Clustered Solutions in a Globally Inhibitory Network of Spiking Cells

Summer Program Seminars, July 2005

July 6 Speaker: Yiming Chen (Advisor, R. Miura)
Title: Introduction to Gene Expression

July 13 Two part seminar:

Speaker: Lakshmi Chandrasekaran (Advisor A. Bose)
Title: Geometric Analysis of Neuronal Activity

Speaker: Joon Ha (Advisor A. Bose)
Title: A Two-Compartment Morris-Lecar Model

July 20 Two-part seminar:

Speaker: Daniel Goldman
Title: Microcirculatory Transport: Modeling and Applications

Speaker: Michael Booty
Title: A Model for Two-Dimensional Sails in a Uniform Potential Flow
(on joint work with J.M. Vanden Broeck)

Soccer Match

This was the third consecutive year in which faculty and students have met for a friendly soccer match on the Reading Day before final exams during the Spring semester. We hope this will become an annual event.

In 2004 and 2005, the faculty enlisted the graduate students on their side to play the undergraduates. It was believed to be a winning strategy and in both years the `faculty side', as the department's faculty referred to it, won by a comfortable margin.

This year perhaps the undergraduates were less mindful that other fixtures such as final exams, grades and graduation were in the near future, or perhaps the faculty's winning strategy had some other unforeseen flaw. In 2006 the result was a 11-3 win to the undergraduates.

Teams at the 2006 soccer match. The undergraduates are mostly to the right.

Biology Program Activities:

Shawn Abraham, "Conformational Analysis of a GBR 12909 Analog." Mentor: Carol Venanzi Poster presented at Intercollegiate Council of Student Affiliate Chapters, American Chemical Society on April 28, 2006, at Fairleigh Dickinson University.

Supreet S. Bindra, Deepangi Pandit and Anna Fiorentino, "Singular Value Decomposition of Analogs of GBR 12909." with Mentor: Carol Venanzi. Poster presented at Intercollegiate Council of Student Affiliate Chapters, American Chemical Society on April 28, 2006, at Fairleigh Dickinson University.

Mutuza Jaffari, and Nirumpama Gupta. "Development of a High-Throughput Screen for Increased Redox Potential in Laccase." Mentor: Edgardo Farinas. Poster presented at The Laboratory Robotics Interest Group, Mid Atlantic Chapter, March 23, 2006, at Montclair State University.

Diana Martinez, "Exploring Gap Junctional Location and Strength using Mathematical Modeling and Experimental Methods." Mentors: Amitabha Bose, Jorge Golowasch and Farzan Nadim.
Talk presented at the Moravian College 20th Annual Student Mathematics Conference, February 18, 2006.

Jennifer To received a Foundation for Higher Education Undergraduate Research Grant for summer 2006 in the amount of $2500. She is working with Prof. Mill Jonakait . She will be examining the expression of cholinergic markers in the brains of offspring whose mothers have received inflammatory stimuli during gestation.

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