CAMS

Center for Applied Mathematics and Statistics

ANNUAL REPORT

2003-2004

NJIT
New Jersey Institute of Technology

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I. FROM THE DIRECTOR

This has been a banner year for CAMS and the Department of Mathematical Sciences (DMS). Recently, the President of NJIT, Robert Altenkirch, introduced a university-wide strategic initiative that challenged all departments to propose ways in which they can be brought to levels of national and international prominence. We are happy to report that, on the basis of its recognized excellence in research and education, DMS was selected as one of three departments to receive strategic initiative funding for five years starting in 2004. The initiative funds will be used to support the broader departmental mission of research and training in the applied mathematical sciences, and will be focused in the areas of fluid dynamics and mathematical biology, two areas of strength within the department. With these funds the university recognizes the national reputation of DMS, and the Department has initiated a plan to position itself among the top-ranked departments in applied mathematics within the next five years.

This year also witnessed the department's first major conference, entitled “Frontiers in Applied and Computational Mathematics" (FACM '04), which was held at the New Jersey Institute of Technology in May 2004. There was an extremely enthusiastic response to this event and by all accounts the conference was a great success. The range of topics covered in the presentations illustrates the breadth of applied mathematical research and its relevance to workers in science, engineering and technology. FACM is not a one time event; we have planned this conference as the first of an annual series of meetings funded by the strategic initiative, and expect that this will be an event which the applied mathematics community looks forward to attending in the coming years.

The CAMS mission requires that we both support established work and develop new areas where application of the mathematical sciences is likely to yield substantial gains for science and technology. In this spirit, CAMS and DMS have established NJIT as a world center in research and education in the developing area of Mathematical Biology, with particular emphasis in neuroscience. The addition of two mathematical neuroscientists in Fall 2003 has solidified CAMS' standing as one of the largest groups in Mathematical Biology in North America with nine active researchers, including six in neuroscience. These research efforts are supported by five major grants from government and private organizations, covering areas such as immunocolloid labeling and analysis of cell communication, as well as mathematical neuroscience. CAMS members have strived to expose undergraduates to the excitement of mathematical biology. In support of this goal, CAMS faculty have submitted a grant to the National Science Foundation which proposes innovative ideas for involving undergraduate students in research at the interface of mathematics and biology.

CAMS and DMS researchers also enjoy a national reputation in Fluid Dynamics, a second focus area of the strategic initiative. This past year, CAMS members presented fifteen talks at the yearly meeting of the American Physical Society Division of Fluid Dynamics, the premier annual meeting in the field. The number of faculty and student presentations from DMS was among the largest of any single department nationwide. Other milestones of the fluid dynamics group include the presentation of the Stewartson Memorial Lecture during the annual meeting of the British Applied Mathematics Society, and the awarding of a prestigious National Science Foundation ``Focused Research Group'' grant with a DMS faculty member as principal investigator. The latter award involves a team of distinguished researchers from Caltech and UCLA who will work on theoretical studies in fluid dynamics and turbulence. The research activity in fluid dynamics is supported by eight major grants from government agencies.

Even as mathematical biology and fluid dynamics have developed rapidly, CAMS has continued to support the work of researchers in other fields. Current research projects in the areas of material science, wave propagation (including electromagnetics and underwater acoustics), stochastic computing, and computational geometry are supported by eight major government grants. This past year, CAMS researchers have teamed up with a new faculty member of the NJIT Department of Computer Science (and a new CAMS member) in a proposal for a massively parallel computer cluster. The cluster will be one of the leading computational facilities contained

within a department of mathematical sciences in the United States. The projects that have been proposed for the cluster have a close connection with areas of application, and illustrate the interdisciplinary strengths of CAMS. We are grateful to David Ullman, Associate Provost for Information Services and Technology, David Perel, Director of Engineering Computing, and their staff for their continued support in maintaining our state-of-the-art computing facilities.

The accomplishments of CAMS have been built with the support, inspiration, and dedication of many individuals. CAMS is grateful to Joel Bloom, Interim Provost of NJIT, William Van Buskirk, former Provost of NJIT, Fadi P. Deek, Acting Dean of CSLA, and Donald Sebastian, Vice President for Research and Development, for encouraging CAMS through their strong support of scientific research. President Robert A. Altenkirch, who came to NJIT in Fall 2002, has already demonstrated his 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) 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. The formal structure of CAMS consists of the Director, Associate Director, and various committees. However, the essential nature of the organization is that of a voluntary association of individual researchers from many disciplines joined in a collegial collaboration to enhance mathematical research at NJIT.

CAMS undertakes a wide range of activities in pursuing its mission. CAMS brings together researchers from academia, industry, and government with complementary strengths and common goals to NJIT and neighboring institutions by organizing interdisciplinary workshops. In some cases, CAMS secures the appointment of Research Professors to formalize this relationship to NJIT so that grants can be jointly pursued. CAMS provides its members with laboratory support by maintaining the CAMS/Math Computational Laboratory, the NSF Capstone Laboratory, and the Statistical Consulting Laboratory. CAMS activities also include support for the submission of research proposals, which is done through the dissemination of information, organization of group projects, collegial advice, and assistance with the application documents. Senior members of CAMS commit a significant amount of time and effort in providing guidance and mentoring to young researchers in their efforts to obtain funding. Exploring new areas of application of the mathematical sciences for the purpose of maintaining a presence in the forefront of science is a fundamental function of CAMS. Graduate student research is encouraged through the CAMS Summer Research Program and with support for students to attend conferences.

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 research and academic relationships with industry and business.

Department of Mathematical Sciences

Advisory Board - 2004

Dr. John S. Abbott	Corning Incorporated
Dr. Richard Albanese	Brooks Air Force Base
Dr. Peter E. Castro	Eastman Kodak Company
Dr. Ned J. Corron	U.S. Army AMCOM
Dr. Patrick S. Hagan	Bloomberg LP
Dr. Zahur Islam	Novartis Pharmaceuticals
Dr. James McKenna	Bell Laboratories (formerly)
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
Connell, Cameron
Dhar, Sunil
Dios, Rose
Elmer, Christopher
Goldberg, Vladislav
Goldman, Daniel
Golowasch, Jorge
Goodman, Roy
Horntrop, David
Jiang, Shidong (2004)
Kappraff, Jay
Kondic, Lou
Kriegsmann, Gregory A.
Luke, Jonathan
Matveev, Victor
Michalopoulou, Zoi-Heleni
Milojevic, Petronije
Miura, Robert M.
Moore, Richard (2004)
Muratov, Cyrill
Nadim, Farzan
Papageorgiou, Demetrios
Perez, Manuel
Petropoulos, Peter G.
Raymond, Christopher
Siegel, Michael
Spencer, Thomas
Stickler, David
Tao, Louis
Tavantzis, John
Yoo, Wonsuk (2004)
Young, Yuan-Nan (2004)

Visiting Members in the Department of Mathematical Sciences

Baran, Oleh
Chakrabarti, Aloknath
Volkov, Darko

Department of Civil and Environmental Engineering

Meegoda, Jay N.

Department of Computer Science

Ma, Marc Qun

Department of Information Systems

Deek, Fadi P.

Department of Mechanical Engineering

Aubry, Nadine
Rosato, Anthony

CAMS Research Professors

Booth, Victoria	University of Michigan, Ann Arbor
Erneux, Thomas	Université Libre de Bruxelles, Belgium
Georgieva, Anna	Novartis Pharmaceuticals Corporation, East Hanover, NJ
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

Applied Mathematics Colloquium

September 5 **Paul Barbone**, Department of Aerospace and Mechanical Engineering, Boston University
"Well-Posedness of an Elastic Inverse Problem Arising in Medical Imaging"

September 12 **Markos A. Katsoulakis**, Department of Mathematics & Statistics, University of Massachusetts, Amherst
"Coarse-Grained Stochastic Processes and Monte Carlo Simulations in Lattice Systems"

September 19 **Laurent Simon**, Department of Chemical Engineering, New Jersey Institute of Technology
"An Analytical Solution for Percutaneous Drug Absorption: Application and Removal of the Vehicle"

September 26 **Prosenjit Bagchi**, Department of Mechanical Engineering, Rutgers University
"Microscale Direct Simulation of Particle-Turbulence Interaction"

October 3 **Alparslan Oztekin**, (Joint with Mechanical Engineering) Department of Mechanical Engineering, Lehigh University
"Steady Axisymmetric Swirling Flows in Confined Geometries"

October 10 **Talid Sinno,** Department of Chemical and Biomolecular Engineering, University of Pennsylvania
"Towards a Quantitative Understanding of Solid State Aggregation: Atomistic Simulations, Mean-Field Theory, and Continuum Process Models"

October 17 **Corey S. O'Hern,** (Joint with Mechanical Engineering) Departments of Mechanical Engineering and Physics, Yale University
"Effective Temperatures in a Driven, Athermal System Near Jamming"

October 22 **Doyle D. Knight,** (Joint with Mechanical Engineering) Department of Mechanical and Aerospace Engineering, Rutgers University
"Laser Energy Deposition for Flow Control in High Speed Flows"

October 24 **David Cai,** Courant Institute of Mathematical Sciences, New York University
"Kinetic Theory of Neuronal Networks: Mean-Driven vs. Fluctuation-Driven Dynamics"

October 29 **Andrea Prosperetti,** (Joint with Mechanical Engineering) Department of Mechanical Engineering, Johns Hopkins University
"Two Computational Methods for Multiphase Flows"

October 31 **Ilya Rybak,** School of Biomedical Engineering, Drexel University
"Modeling the Respiratory Rhythm Generation and Neural Control of Breathing"

November 7 **Jonathan Rubin**, Department of Mathematics, University of Pittsburgh
"Bumps in the Road: Localized Activity in Neuroscience Models"

November 14 **Geoffrey McFadden**, National Institute of Standards and Technology
"Phase-Field Model of Electrochemistry"

November 17 **Sascha Hilgenfeldt**, Faculty of Applied Physics, University of Twente, The Netherlands
"The Power of Bubbles: Cell Manipulation, Microfluidics, and More"

November 21 **Huaxiong Huang**, Department of Mathematics, York University
"A Perturbation Model for the Growth of ZnS Crystals"

December 3 **Thomas R. Blake**, (Joint with Mechanical Engineering) Dean of the Newark College of Engineering, New Jersey Institute of Technology
"Low Reynolds Number Flow Around a Burning Particle"

December 5 **Joel Rogers**, Department of Mathematics, Polytechnic University
"Some Strange Results in Free-Surface Hydrodynamics"

January 23 **Anita Mayo**, Department of Mathematics, Baruch College, City University of New York
"On Particle Mesh Methods for the Evaluation of Fields Induced by Vortex Sheets"

February 6 **Percy Deift**, Department of Mathematics and Courant Institute of Mathematical Sciences, New York University
"Universality for Mathematical and Physical Systems"

February 9 **Hans Johnston**, (Applied Mathematics/Fluid Dynamics Seminar) Department of Mathematics, University of Michigan
"Numerical Schemes for the Navier-Stokes Equations Based on Explicit Treatment of the Pressure"

February 11 **Tim Lewis**, Center for Neural Science and Courant Institute of Mathematical Sciences, New York University
"The Effects of Nonexcitable Regions on Signal Propagation in Excitable Media"

February 12 **Richard Moore**, Department of Mathematical Sciences, University of Delaware
"Finding Failures in Optical Communications"

February 13 **Wonsuk Yoo**, (Applied Mathematics/Statistics Seminar)
Department of Biometry and Epidemiology, Medical University of South Carolina
"Model Selection of a Bayesian Hierarchical Changepoint Model for Early Detection of Prostate Cancer"

February 18 **K. R. Rajagopal**, (Joint with Mechanical Engineering) Department of Mechanical Engineering, Texas A&M University
"On Some Important Contributions of Stokes to Fluid Mechanics That Deserve Careful Study"

February 20 **Keith Worsley** (Applied Mathematics/Statistics Colloquium) Department of Mathematics and Statistics, McGill University
"Random Fields of Multivariate Test Statistics, with an Application to Shape Analysis"

February 25 **Roman Samulyak** (Joint with Mechanical Engineering) Center for Data Intensive Computing, Brookhaven National Laboratory
"Computational Models for Multiphase MHD Flow"

February 27 **David Isaacson**, Department of Mathematical Sciences, Rensselaer Polytechnic Institute
"Electrical Impedance Tomography in Heart Disease and Breast Cancer"

March 1 **Shidong Jiang**, Department of Computer Science, Yale University
"Nonreflecting Boundary Conditions for the Schrodinger Equation"

March 4 **Horacio G. Rotstein**, Center for Biodynamics and Department of Mathematics, Boston University
"Mechanistic and Mathematical Aspects of a Theta Rhythm (8-12 Hz) in a Model of the Hippocampal CA1 Area"

March 5 **Jerry Bona**, Department of Mathematics, Statistics, and Computer Science, University of Illinois, Chicago
"Two- and Three-Dimensional Water Waves"

March 9 **Yuan-Nan Young**, Center for Turbulence Research, Stanford University
"Mixing of Two Fluids: From an Interfacial (Wind-Driven) Instability to Bubble (Drop) Dynamics in Turbulence"

March 11 **Luoding Zhu**, Department of Computer Science, University of California at Santa Barbara
"Simulation of Fluid Slip at Three-Dimensional Hydrophobic Microchannel Walls by the Lattice Boltzmann Method"

March 12 **Ellis Cumberbatch**, School of Mathematical Sciences, Claremont Graduate University
"Math Problems from Industry"

March 26 **Edward A. Spiegel**, Department of Astronomy and Astrophysics, Columbia University
"On the Bifurcation of Species"

April 1 **Thomas Yu**, Department of Mathematical Sciences, Rensselaer Polytechnic Institute
"Multiscale Synthesis and Analysis of Signal and Geometry"

April 2 **Michael Shelley**, Department of Mathematics, Center for Neural Science and Courant Institute of Mathematical Sciences, New York University
"Flows Interacting with Flexible and Moving Bodies"

April 16 **Gregor Kovacic**, Department of Mathematical Sciences, Rensselaer Polytechnic Institute
"The Truncated Burgers-Hopf Equation: a Test-Bed for Statistical and Hamiltonian Mechanics"

April 23 **M. Gregory Forest**, Department of Mathematics, University of North Carolina
"A Control and Design Roadmap for Multi-Functional, Polymer Nano-Composite *Properties"*

April 30 **Norman J. Zabusky**, (Joint with Mechanical Engineering) Department of Mechanical and Aerospace Engineering, Rutgers University
"Visiometrics: From Solitons to Vortex Projectiles- Art and Science of Fluid Motions"

May 5 **Slavik Jablan,** Department of Mathematical Sciences, New Jersey Institute of Technology and The Mathematical Institute, Belgrade, Yugoslavia
"Modularity in Art"

May 19 **Peter Roper**, Laboratory for Biological Modeling, NIDDK, National Institutes of Health
"Analysis of Burst Structure in Vasopressin Neurones"

Statistics Colloquium

October 22 **S.P. Mukherjee**, Department of Statistics, Calcutta University, India
"Estimation of Weibull Parameters"

November 19 **Bikas K. Sinha**, Math-Stat Division, Indian Statistical Institute, Kolkata, India
"On Some Probabilistic and Statistical Aspects of Discovery of Species"

December 3 **Glenn Shafer**, Rutgers School of Business (Newark Campus), Rutgers University
"Probability & Finance: a Game-Theoretic Foundation for Probability"

February 2 **Madhuja Mallick**, Department of Statistics, University of Connecticut
"Frailty Models Based on the Positive Stable Distribution"

February 23 **Danielle Sheng**, Division of Biostatistics, New York University School of Medicine
"A Gap Time Approach for the Analysis of Interval-Censored Recurrent Event Data"

April 28 **J. Medhi**, Department of Statistics, Gauhati University, India
"Long Tail Distributions for Modeling Spatial Variability of Data Traffic"

Mathematical Biology Seminars

September 16 **Louis Tao**, Department of Mathematical Sciences, New Jersey Institute of Technology
"The Simple and the Complex of Visual Cortical Dynamics"

September 23 **Ferenc Mechler**, Department of Neurology and Neuroscience, Weill Medical College of Cornell University
"V1 Simple and Complex Cells Emerge due to the Nonlinearity of the Spike Threshold"

September 30 **Qun Marc Ma**, Department of Computer Science, New Jersey Institute of Technology
"Large-Time-Step Molecular Dynamics for Macromolecule"

October 7 **Ken Harris**, Department of Molecular and Behavioral Neuroscience, Rutgers-Newark
"Organization of Cell Assemblies in the Hippocampus"

October 14 **Steven H. Kleinstein**, Department of Computer Science, Princeton University
"Estimating Hypermutation Rates from Clonal Tree Data"

October 21 **Vladimir Brezina**, Department of Physiology and Biophysics, Mt Sinai School of Medicine
"Organization and Control of Neuromuscular Function in Aplysia Feeding Behavior: Models and Experiments"

October 28 **Daniel Lee**, Department of Electrical Engineering and Bioengineering, University of Pennsylvania
"Learning in Artificial Sensorimotor Systems"

November 4 **Gloster Aaron**, Department of Biological Sciences, Columbia University
"Repeating Motifs of Synaptic Activity in Neocortex"

November 18 **Linghai Zhang,** Department of Mathematics, Lehigh University
"Eigenvalue-Function and Exponential Stability of Traveling Pulse Solutions of a Singularly Perturbed System of Integral Differential Equations Arising from Neuronal Networks"

November 25 **Georgi Medvedev**, Department of Mathematics, Drexel University
"Multimodel Regimes in Chains of Electrically Coupled Oscillators of Morris-Lecar Type"

December 2 **Christopher Fall**, Center for Neural Science, New York University
"Intrinsic Bistability in Models of Working Memory"

December 9 **Robert Clewley**, Center for Biodynamics, Boston University
"Epilepsy in Small World Networks"

February 3 **Victor Matveev**, Department of Mathematical Sciences, New Jersey Institute of Technology
"Calcium Diffusion in the Presence of Buffers and the Mechanisms of Synaptic Facilitation"

February 10 **Alex Reyes**, Center for Neural Science, New York University
"Propagation of Signals in In Vitro Neural Networks"

February 17 **Kukjin Kang**, Courant Institute of Mathematical Sciences, New York University
"Neuronal Coding of Orientation in Primary Visual Cortex"

February 24 **Tom Chou**, Department of Biomathematics, University of California at Los Angeles
"Statistical Mechanics of Nuclear Material"

March 9 **Andrew Sornborger**, Department of Mathematics / Faculty of Engineering, University of Georgia
"Vasomotion, Phase Locking and the 'Initial Dip'"

March 23 **Eric Brown**, Department of Mathematics, Princeton University
"From Spikes to Speed Accuracy via the Brainstem"

March 30 **Guillermo Cecchi**, Biometaphorical Computing, IBM
"Scaling and Self-Organizing in Functional Brain Networks"

April 6 **Chris Wiggins**, Department of Applied Physics and Applied Mathematics, Columbia University
"New Ideas in 'Network Physics': Applications of Machine Learning and Information Theory to Biological Networks"

April 13 **Robert Uglesich**, Laboratory of Applied Mathematics, Mount Sinai School of Medicine
"Imaging the Functional Architecture of Orientation and Spatial Frequency Processing in Primary Visual Cortex"

April 20 **Peter Roper**, Laboratory for Biological Modeling, NIDDK, National Institutes of Health
"Excitable Bursting in the Hypothalamus: A Rapid Response to a Sudden Stress"

April 27 **Christina Ambrosio**, Department of Mathematical Sciences, New Jersey Institute of Technology
"The Effect of Modulatory Neuronal Input on Gastric Mill Frequency"

April 29 **Hongxue Cai**, NIDCD, National Institutes of Health
"Computational Auditory Micromechanics: Fluid-Structure Interactions and Motion Patterns in the Inner Ear"

May 4 **Arjun Raj**, Courant Institute of Mathematical Sciences, New York University and Public Health Research Institute
"The Influence of Chromosome Flexibility on Anaphase A Chromosome Movement as Driven by an Imperfect Brownian Ratchet Molecular Motor"

May 12 **John Pearson**, Los Alamos National Laboratory
"Sheet Excitability and Nonlinear Wave Propagation"

Fluid Mechanics Seminars

October 20 **James J. Feng**, Levich Institute, City College, New York
"A Diffuse-Interface Method for Simulating Two-Phase Systems of Complex Fluids"

January 26 **Nicolas Vandenberghe**, Applied Mathematics Laboratory, Courant Institute of Mathematical Sciences, New York University
"Symmetry Breaking Leads to Forward Flapping Flight"

February 23 **Pushpendra Singh**, Department of Mechanical Engineering, New Jersey Institute of Technology
"Fluid Dynamics of Floating Particles"

V. PUBLICATIONS, PRESENTATIONS, AND REPORTS

A. PUBLICATIONS

JOURNAL PUBLICATIONS

Nadine Aubry

Electro-Hydrodynamic Micro-Fluidic Mixer (with A. Ould El Moctar and J. Batton), Lab on a Chip 3, 273-280, 2003.

Dynamics of Electrorheological Suspensions Subjected to Spatially Nonuniform Electric Field (with J. Kadaksham and P. Singh), J. Fluids Engin., 126, 170-179, 2004.

John Bechtold

A Diffusional-Thermal Theory of Near-Stoichiometric Premixed Flames (with E. S. Antoniou and M. Matalon), SIAM J. Appl. Math., 64, No. 4, 1434-1456, 2004.

Manish C. Bhattacharjee

New Order Preserving Properties of Geometric Compounds (with S. Ravi, R. Vasudeva, N.R. Mohan), Statistics & Probability Letters, 64, 113-120, 2003.

Discrete Convex Ordered Lifetimes: Characterization, Equivalence and Applications, Sankhya 65, 292-306, 2003.

Denis Blackmore

On the Lax Solution to a Hamilton-Jacobi Equation and Its Generalizations. Part 2 (with A. Prykarpatsky, I. Mykytiuk) Nonlin. Anal. 55, 629-640, 2003.

Morse Index for Autonomous Linear Hamiltonian Systems (with C. Wang) Int. J. Diff. Eqs. Appl. 7, 295-309, 2003.

The Hopf Algebras and the Heisenberg-Weil Coalgebra Related Integrable Flows (with A. Prykarpatsky, A. Samoilenko) Ukr. J. Math. 56, 88-96, 2004.

Victoria Booth

Contribution of Synaptic Depression to Phase Maintenance in a Model Rhythmic Network (with Y. Manor, A. Bose and F. Nadim), J. Neurophysiol., 90, 3513-3529, 2003.

Michael Booty

Reflection and Transmission from an Inhomogeneous Cylinder in a Recatngular TE10 Waveguide (with G.A. Kriegsmann), Prog. Electromagnetics Res., 47, 263-296, 2004.

Amitabha Bose

High-Frequency, Depressing Inhibition Facilitates Synchronization in Globally Inhibitory Networks, (with S. Kunec) Network: Comput. Neural Syst., 14, 647-672, 2003.

The Contribution of Synaptic Depression to Phase Maintenance in a Model Rhythmic Network, (with Y. Manor, V. Booth and F. Nadim), J. of Neurophysiol., 90, 3513-3528, 2003.

Localized Activity Patterns in Excitatory Neuronal Networks, (with J. Rubin) Network: Comput. Neural Syst., 15, 133-158, 2004.

Bruce Bukiet

Computational Method to Evaluate Ankle Muscle Stiffness with Ground Reaction Forces, Journal of Rehabilitation Research and Development, 41, 207-214, 2004.

Analysis of Stress and Pressure in the Human Alveolar Wall Before Bursting, (with H. R. Chaudhry and S. Kirshblum) Journal of Mechanics in Biology and Medicine, 4, 153-159, 2004.

Cameron Connell

Coarsening of Step Bunches in Step Flow Growth: A Reaction-Diffusion Model and Its Travelling Wave Solutions, Physica D, 189, 287-316, 2004.

Rose Dios

Further Investigations on Balanced Arrays of Strength Six (with D.V. Chopra), J. of Combinatorial Mathematics and Combinatorial Computing, 48, 89-94, 2004.

A Note on an Upper Bound for the Constraints of Some Balanced Arrays (with D.V. Chopra), J. Comb. Math. Comb. Comp., 45, 129-135, 2003.

Christopher E. Elmer

Anisotropy, Propagation Failure, and Wave Speedup in Traveling Waves of Discretizations of a Nagumo PDE (with E.S. Van Vleck), J. Comp. Phys., 185, 562-58, 2003.

Thomas Erneux

Bursting Oscillations in Optical Parametric Oscillators (with A. Amon, M. Nizette, and M. Lefranc), Phys. Rev. A 68, 023801, 2003.

Singular Hopf Bifurcation to Strongly Pulsating Oscillations in Lasers Containing a Saturable Absorber (with G. Kozyreff), Europ. J. Appl. Math.14, 407-420, 2003.

Hopf Bifurcation Subject to a Large Delay in a Laser System (with D. Pieroux, A. Gavrielides, and V. Kovanis), SIAM Rev. 45, 523-540, 2003.

External Cavity Modes of Semiconductors Lasers with Phase-Conjugate Feedback, (with A. Gavrielides, K. Green, B. Krauskopf), Phys. Rev. E 68, 066205, 2003.

Waveguiding Effects in Self-Pulsing Vertical-Cavity Surface-Emitting Lasers (with G. Van der Sande, K. Panajotov, M. Peeters, I. Veretennicoff, J. Danckaert), Optics Letts. 29, 53-55, 2004.

Propagating Waves in 1-Dimensional Discrete Networks of Coupled Units (with Y. De Decker, G.A. Tsekouras, A. Provata, and G. Nicolis), Phys. Rev. E 69, 036203, 2004.

Subcritical Hopf Bifurcation in Dynamical Systems Described by a Scalar Nonlinear Delay differential Equation (with L. Larger, J.-P. Goedgebuer), Phys. Rev. E 69, 036210, 2004.

Vladislav V. Goldberg

Four-Webs in the Plane and Their Linearizability, Acta Applicandae Mathematicae, 80, 35-55, 2004.

Smooth Lines on Projective Planes over Two-Dimensional Algebras and Submanifolds with Degenerate Gauss Maps (with M. A. Akivis), Beitraege zur Algebra und Geometrie, 44, 165-178, 2003.

Alexander M. Shelekhov (with M. A. Akivis, V. F. Kirichenko, M. Kikkawa and J. D. H. Smith), Webs Quasigroups, 7-10, 2003.

Varieties with Degenerate Gauss Maps with Multiple Foci and Twisted Cones (with M. A. Akivis), Izv. Vyssh. Uchebn. Zaved. Matematika, 2003, 3-14, 2003.

Jorge Golowasch

Episodic Bouts of Activity Accompany Recover y of Rhythmic Output By a Neuromodulator-and Activity-Deprived Adult Neural Network (with J. Luther, A.A. Robie, J. Yarotsky, Ch. Reina, E. Marder) J. Neurophysiol., 90, 2720-2730, 2003.

Roy H. Goodman

Strong NLS Soliton-Defect Interactions (with P. J. Holmes and M. I Weinstein) Phys. D, 192, 215-248, 2004.

Marc Qun Ma

Targeted Mollified Impulse -- A Multiscale Stochastic Integrator for Long Molecular Dynamics Simulations (with J. A. Izaguirre) SIAM Multiscale Model. Simul., 2, 1-21, 2003.

Victor Matveev

Facilitation through Buffer Saturation: Constraints on Endogenous Buffering Properties (with R.S. Zucker and A. Sherman), Biophys. J., 86, 2691-2709, 2004.

Jay. Meegoda

Centrifuge Modeling of LNAPLs Transport in Unsaturated Soils (with I. Lo and L. Hu) ASCE J. Geotech. Geoenviron. Engin., 130, 535-540, 2004.

Micro-Mechanical Simulation of Geotechnical Problems using Massively Parallel Computers, (with D. Washington) Intl. J. Num. Anal. Meth. Geomech., 27, 1227-1234, 2003.

Zoi-Heleni Michalopoulou

Tabu for Matched-Field Source Localization and Geoacoustic Inversion (with Urmi Ghosh-Dastidar), J. Acoust. Soc. Amer., 115, 135-145, 2004.

Petronije S. Milojevic

Solvability and the Number of Solutions of Hammerstein Equations, Electro. J. Diff. Eqns., 1-25, 2004.

Robert M. Miura

Membrane Resonance and Stochastic Resonance Modulate Firing Patterns of Thalamocortical Neurons (with S. Reinker and E. Puil), J. Comp. Neurosci., 16, 15-25, 2004.

The Influences of I_h on Temporal Summation in Hippocampal CA1 Pyramidal Neurons: A Modeling Study (with A.E. Desjardins, Y.-X. Li, S. Reinker, and R. Neuman), J. Comp. Neurosci., 15, 131-142, 2003.

Cyrill Muratov

An Asymptotic Study of the Inductive Pattern Formation Mechanism in Drosophila Egg Development (with S.Y. Shvartsman), Physica D, 186, 93-108, 2003.

Breakup of Universality in the Generalized Spinodal Nucleation Theory, (with E. Vanden Eijnden), J. Stat. Phys., 114, 605-623, 2004.

Linear vs. Nonlinear Selection for the Propagation Speed of the Solutions of Scalar Reaction-Diffusion Equations Invading an Unstable Equilibrium (with M. Lucia and M. Novaga), Comm. Pure Appl. Math., 57, 616-636, 2004.

Demetrios T. Papageorgiou

Pinchoff and Satellite Formation in Compound Viscous Jets (with R.V. Craster and O. Matar) Phys. Fluids, 15, 3409-3428, 2003.

Large Amplitude Capillary Waves in Electrified Fluid Sheets (with J.-M. Vanden-Broeck) J. Fluid Mech., 508, 71-88, 2004.

Manuel Perez

Glandular Metastasis on Radical Prostatectomy (with Mario Reis, Francisco Pina, Macedo Dias, and Henrique Barros), Acta Medica Portuguesa, 17, 1-7, 2004.

Adjuvant Radiotherapy After Radical Prostatectomy in Patients with Extracapsular Tumor Extension (with Mario Reis, Francisco Pina, Macedo Dias, and Henrique Barros), URO, 9, 7-14, 2004.

Peter G. Petropoulos

On the Long-Time Behavior of Unsplit Perfectly Matched Layers (with E. Becache and S. D. Gedney), IEEE Trans. Antennas and Propagation, 52, 1335-1342, 2004.

Michael Siegel

Persistence of Memory in Drop Breakup: The Breakdown of Universality (with P. Doshi, I. Cohen, W. W. Zhang, P. Howell, O. A. Basaran, and S. R. Nagel), Science, 302, 1185-1188, 2003.

Evolution of Material Voids for Highly Anisotropic Surface Tension (with M. Miksis and P. Voorhees), J. Mech. Phys. Solids, 52, 1319-1353, 2004.

Louis Tao

An Egalitarian Network Model for the Emergence of Simple and Complex Cells in Visual Cortex (with M. Shelley, D. McLaughlin, and R. Shapley), Proc. Natl. Acad. Sci. USA, 101, 366-371, 2004.

An Effective Kinetic Representation of Fluctuation-Driven Neuronal Networks with Application to Simple and Complex Cells in Visual Cortex (with D. Cai, M. Shelley and D. McLaughlin), Proc. Natl. Acad. Sci. USA, 101, 7757-7762, 2004.

Jean-Marc Vanden-Broeck

Capillary Waves Past a Flat Plate in Water of Finite Depth, (with S. Tooley), IMA J. Appl. Math., 69, 259-269, 2004.

Large Amplitude Capillary Waves in Electrified Fluid Sheets, (with D.T. Papageorgiou), J. Fluid Mech., 508, 71-88, 2004.

Trapped Waves between Submerged Obstacles (with F. Dias), J. Fluid Mech., 509, 93-102, 2004.

New Solutions for Capillary Waves on Fluid Sheets (with M. Blyth), J. Fluid Mech., 507, 255-264, 2004.

BOOKS AND BOOK CHAPTERS

Vladislav V. Goldberg

Tensor Calculus with Applications (with M. A. Akivis), World Scientific Publishers, Singapore, 2003, xiii+367 pp., November 2003.

Tensor Calculus (with M.A. Akivis)(in Russian), FIZMATLIT, Moscow, 304 pp., November 2003.

Differential Geometry of Varieties with Degenerate Gauss Maps (with M. A. Akivis), Springer-Verlag, xxi+255 pp., January 2004.

Preface. (On the occasion of the 70th birthday of Alexander Samuilovich Solodovnikov.) (with M. A. Akivis, A. V. Aminova, A.T. Fomenko, V. A. Igoshin and I. G. Shandra), J. Math. Sci., 113, 361-366, October 2003.

PROCEEDINGS PUBLICATIONS

Roman Andrushkiw

Construction of the Bulk of General Population in the Case of Exchangeable Sample Values (with D.A. Klyushin, V.N. Lysyuk, Yu. I. Petunin), Proceedings of the International Conference on Mathematics and Engineering Techniques in Medicine and Biological Sciences, pp. 486-490, July 2003.

Stratification of General Populations and Its Application in the Analysis of Resistant Tumor Cells (with D.A Klyushin, Yu. I. Petunin, A. German, M. Yu. Savkina), Proceedings of the International Conference on Mathematics and Engineering Techniques in Medicine and Biological Sciences, pp. 490-494, July 2003.

Nadine Aubry

Pulsed Flow Mixing for BioMEMS Applications, (with I. Glasgow), 2003 MicroTAS Conference Proceedings, Squaw Valley, CA, October 5-9, 2003.

Design and Fabrication of Electrostatically Actuated Synthetic Microjets, (with M. Roman), ASME Paper No. IMECE2003-41579, New York: American Society of Mechanical Engineers, November 2003.

Microfluidic Platform for Manipulating Micro- and Nanoscale Particles, (with J. Kadaksham, J. Batton, and P. Singh), ASME Paper No. IMECE2003-41582, New York: American Society of Mechanical Engineers, November 2003.

Mixing Enhancement in Simple Geometry Microchannels, (with Ian Glasgow), ASME Paper No. IMECE2003-41586, New York: American Society of Mechanical Engineers, November 2003.

Measurement of the Transverse Apparent Elastic Modulus in Mammalian Cardiac Myocytes, (with S. Lieber, J. Pain, G. Diaz, S. Kim and S. Vatner), ASME Paper No. IMECE2003-41469, New York: American Society of Mechanical Engineers, November 2003.

John Bechtold

Response of Rotating Spherical Diffusion Flames with General Lewis Numbers (with S. W. Yoo, J. Qian, and C. K. Law), Proceeding of the Western States Section of the Combustion Institute, Paper No. 04S-18, March 2004.

Denis Blackmore

Vorticity Jumps Across Shock Surfaces (with L. Ting), Proceedings of the 2nd MIT Conference on Computational Fluid and Solid Mechanics, Vol. 1, K. J. Bathe, ed., Elsevier, Amsterdam, 847-849, July 2003.

Quantum Holonomic Computing Via Lax Flows on Grassmannian Manifolds and the Dual Momentum Mappings (with A. Prykarpatsky, U. Taneri), Proceedings Symmetry in Nonlinear Math. Physics, Kyiv, Ukraine, 224-237, Aug. 2003.

Some New Extensions of the Poincare-Birkhoff Theorem (with J. Champanerkar), Proceedings Conference on Dynamical Systems Theory and Applications, Lodz, Poland, 13-24, Dec. 2003.

Fadi P. Deek

Large Eddy Simulation of Rotating Turbulent Convection Using the Estimation Subgrid Scale Model, (with S. Kimmel), Proceedings of the International Conference on Thermal Engineering Theory and Applications, Beirut, Lebanon, 2004.

Sunil K. Dhar

Urban Bicycle Route Safety Rating Logistic Model (with Allen-Munley Cheryl and Daniel Janice), Proceedings of the Transportation Research Board 83rd Annual Meeting, Washington DC, January 2004.

Inspection, Cleaning, Condition Assessment and Prediction of Remaining Service Life of CSCPs (with Meegoda , Jay N., Juliano, Thomas M., Ayoola, Gbolagade M.), Proceedings of the Transportation Research Board 83rd Annual Meeting, Washington DC, January 2004.

A Methodology to Predict the Remaining Service Life of CSCPs (with Meegoda , Jay N., Juliano, Thomas M., Ayoola, Gbolagade M.), Proceedings of the Fifth International Conference on Case Histories in Geotechnical Engineering, New York, NY, April 2004.

Daniel Goldman

Modeling of Oxygen Diffusion from the Blood Vessels to Intracellular Organelles, (with A. S. Popel and A. Vadapalli), Advances in Experimental Medicine and Biology, 530, 485-95, September 2003.

Lou Kondic

Instability of the Contact Line and Thickness Profiles in Vertical Oil Spreading (with J. Gomba, A. G. Gonzalez, J. A. Diez, R. Gratton), Anales de la Asociacion Fisica Argentina, Vol. 14, Asociacion Fisica Argentina (AFA) publishers, 86-91, November 2003.

Spreading of Thin Two-Dimensional Strip of Fluid on a Vertical Plane: Experiments and Modeling (with A. G. Gonzalez, J. A. Diez, J. Gomba, R. Gratton) Proceedings of the VIII Meeting on Recent Advances in Physics of Fluids and its Applications, 18-36, November, 2003.

Gregory A. Kriegsmann

Microwave and Radio Frequency Applications: Proceedings of the Third World Congress On Microwave and Radio Frequency Applications. Editors: D. C. Folz, J. H. Booske, D. E. Clark and J. F. Gerling. Publisher: The American Ceramic Society, 47-56, 2003.

Jay N. Meegoda

A Methodology to Predict the Remaining Service Life of CSCPSs, J. N. Meegoda, T. M. Juliano, M. G. Ayoola and S. Dhar, Proceedings: Fifth International Conference on Case Histories in Geotechnical Engineering, New York, NY, April 2004.

A Model Based on Mechanics to Predict Settlements in Bioreactor Landfills, C. H. Hettiarachchi, J. N. Meegoda and J. P. Hettiaratchi, Proceedings: Fifth International Conference on Case Histories in Geotechnical Engineering, New York, NY, April 2004.

Inspection, Cleaning, Condition Assessment and Prediction of Remaining Service Life of CSCPs, J. N. Meegoda, T. M. Juliano, G. M. Ayoola and S. Dhar, 83rd Annual Meeting of the Transportation Research Board, Washington, DC, January 2004.

Double Porosity Model for Contaminated Soils, J. N. Meegoda and P. Ratnaweera, 17th ASCE Engineering Mechanics Conference, University of Delaware, Newark, DE, June 2004.

Simulation and Parametric Study of Resilient Modulus Tests on Granular Soil, Q. Wu, P. Ratnaweera and J. N. Meegoda, 17th ASCE Engineering Mechanics Conference, University of Delaware, Newark, DE, June 2004.

Cyrill Muratov

Free Boundary Problem and Its Applications to Reaction-Diffusion Systems of Activator-Inhibitor Type, Proceedings of the Conference on Dynamics of Patterns in Reaction-Diffusion Systems and Related Topics, RIMS, Kyoto, Japan, 63-78, July 2003.

Peter G. Petropoulos

Long-Time Behavior of the Unsplit PML, (with E. Becache and S. D. Gedney), Mathematical and Numerical Aspects of Wave Propagation WAVES 2003, Springer-Verlag, 120-124, July 2003.

Christopher Raymond

Mathematical Modeling for Immunocolloid Labeling, (with P. Milewski), Nanotech 2004 Proceedings, 1, 155-159, March 2004.

Jean-Marc Vanden-Broeck

Waves, Bubbles and Jets, in A Celebration of Mathematical Modeling, The Joseph B. Keller Anniversary Volume, edited by D. Givoli, M. J. Grote and G. C. Papanicolaou, Kluwer Academic Publishers, March 2004.

B. PRESENTATIONS

Roman Andrushkiw

June 2004: International Conference on Mathematics and Engineering Techniques in Medicine and Biological Sciences (METMBS 2004), Las Vegas
1) Diagnosis of Colon Cancer and Cancer of the Esophagus Based on Blood Mechanoemission.
2) Retrospective Cohort Investigation of Risk Factors in Breast Cancer

July 2004: Fourth World Congress of Nonlinear Analysts (WCNA-2004), Orlando
Generalized Solution of Nonlinear Operator Equations

Nadine Aubry

October 2003: Homecoming/Family/Alumni Weekend 2003, Newark, NJ
Vision to Promote Excellence in Education and Research

October 2003: A Micro-fluidics Update Panel Discussion and Tour,
New Jersey Technology Council Meeting on Microfluidics, Newark, NJ
Micro-Fluidics

October 2003: 2003 MicroTAS Conference, Squaw Valley, CA
Pulsed Flow Mixing for BioMEMS Applications

November 2003: 2003 ASME International Mechanical Engineering Congress and R&D Expo, Washington, DC
Design and Fabrication of Electrostatically Actuated Synthetic Microjets

November 2003: 2003 ASME International Mechanical Engineering Congress and R&D Expo, Washington, DC
Microfluidic Platform for Manipulating Micro- and Nanoscale Particles

November 2003: 2003 ASME International Mechanical Engineering Congress and R&D Expo, Washington, DC
Particle Separation Using Dielectrophoresis

November 2003: 2003 ASME International Mechanical Engineering Congress and R&D Expo, Washington, DC
Mixing Enhancement in Simple Geometry Microchannels

November 2003: 2003 ASME International Mechanical Engineering Congress and R&D Expo, Washington, DC
Measurement of the Transverse Apparent Elastic Modulus in Mammalian Cardiac Myocytes

November 2003: 56th Annual Meeting of the Division of Fluid Dynamics, American Physical Society, East Rutherford, NJ
Microfluidic Mixing Using Pulsing in Simple Geometry Channels

November 2003: 56th Annual Meeting of the Division of Fluid Dynamics, American Physical Society, East Rutherford, NJ
Electro-Hydrodynamic Micro-Fluidic Mixer

November 2003: 56th Annual Meeting of the Division of Fluid Dynamics, American Physical Society, East Rutherford, NJ
Low Dimensional Model of a Synthetic Micro-Jet

December 2003: NJIT/Lucent Meeting, Newark, NJ
A Micro-Fluidics Update

June 2004: AIMS<92> Fifth International Conference on Dynamical Systems and Differential Equations, California State Polytechnic University, Pomona
Mixing in Micro-Fluidics

June 2004: Pan-American Advanced Studies Institutes on Micro Electro Mechanical Systems (MEMS)
San Carlos de Bariloche, Patagonia, Argentina
New Developments in Micro-Fluidics

Oleh Baran

May 2004: Frontiers in Applied and Computational Mathematics, NJIT
Sheared Granular Systems: Velocity Profiles, Stresses, and Bagnold Scaling.

November 2003: Division of Fluid Dynamics 56th Annual Meeting, New Jersey
3D Simulations of Sheared Granular Flow in Couette Geometry.

John Bechtold

November 2003: APS Division of Fluid Dynamics, East Rutherford, NJ
Propagation of Non-Adiabatic Premixed Flames in Non-Uniform Flows

Denis Blackmore

October 2003: DIMACS Workshop on Computational Geometry and Manufacturing, Rutgers, New Brunswick
Applications of the Computational Topology of Swept Volumes

November 2003: Drexel University
Computing the Shape of Swept Volumes and Their Intersections

December 2003: International Conference on Dynamical Systems Theory and Applications, Lodz, Poland (plenary lecture)
Some New Extensions and Applications of the Poincare-Birkhoff Theorem

April 2004: University of Missouri-Rolla
Swept Volumes from the Computational Topology Viewpoint

May 2004: NSF/DARPA CARGO Grantees Conf., Madison, Wisconsin
(1) Computational Topology, Swept Volumes and Applications
(2) Applications of Regular Stratification of Swept Volumes
(3) Homology Criteria for Transverse Intersections

May 2004: Frontiers in Applied and Computational Mathematics, NJIT
Experimental, Simulation and Nonlinear Dynamics Analysis of Galton's Board

June 2004: AIMS Dynamical Systems Conference, Cal. Poly Pomona
Stability of Perturbed Point Vortex Motions

Amitabha Bose

May 2004: Frontiers in Applied and Computational Mathematics, NJIT
Two-Oscillator Model of Ventilatory Rhythmogenesis in the Frog

Bruce Bukiet

November 2003: APS Division of Fluid Dynamics
Modeling Air Flow in the Lungs during In-Exsufflation (with H. R. Chaudhry and S. Kirshblum)

July 2003: NJIT Summer Seminar Series
Mathematical Modeling of Air Flow in the Lungs (with H. R. Chaudhry, S. Kirshblum and J. R. Bach)

November 2003: William Patterson University Math Fair
Applications of Math at the High School Level

March 2004: Gambling, Sports, Money and the Power of Math, Monash University (Australia) LunchMaths Presentation

March 2004: Monash University (Australia), Department of Mechanical Engineering Seminar, Mathematical Modeling of Human Balance

March 2004: Deakin University (Australia), Department of Information Technology Seminar, Mathematical Modelling and Applications

April 2004: Swinburne University of Technology (Australia), School of Mathematical Sciences Seminar, Mathematical Modelling of Baseball and Some Comments on Cricket

May 2004: Monash University (Australia), Department of Mathematical Sciences Colloquium, Mathematical Modelling of Baseball and Some Comments on Cricket

May 2004: LaTrobe University (Australia), Department of Mathematical Sciences Colloquium, Mathematical Modelling and Math PoweR

Aloknath Chakrabarti

June 2004: International Conference on Advances in Fluid Mechanics, Bangalore University, India
Trapped Modes (with D.S. Ahluwalia)

Cameron Connell

March 2004: APS March Meeting
Elastic Field of Nanostructures in Heteroepitaxy

Sunil K. Dhar

May 2004: Frontiers in Applied and Computational Mathematics, NJIT
Evaluating Randomness and Related tests

Thomas Erneux

June 2003: CLEO-EQEC Conf. Munich
The Narrow Filter Limit of a Semiconductor Laser with Filtered Optical Feedback

July 2003: Equadiff 2003, Hasselt, Belgium
New Delay Differential Equations Problems in Monlinear Optics

September 2003: Bristol, UK
Asymptotic Methods for Delay Differential Equations

February 2004: Rochester Institute of Technology, New York, USA
Delay Equations and Applications

March 2004: Royal Academy of Sciences (Belgium)
Les Equations à Retard et Leurs Applications

April 2004: Photonics Europe, SPIE meeting, Strasbourg, France
1) Bifurcations of Injection-Locked Semiconductor Lasers Subject to Optical Feedback
2) Analytical Theory of External Cavity Modes of a Semiconductor Laser with Phase Conjugate Feedback
3) The Injection Laser Limit of Lasers Subject to Optical Feedback

May 2004 : IAP Doctoral School, Les Rièzes et les Sarts, Belgium
Laser Dynamics: Present and Future

Vladislav V. Goldberg

October 2003: Colloquium of Department of Mathematics, Rutgers University, Newark, NJ
Linearizability Conditions for d-webs in the Plane with Applications

June 2004: Overwolfach Seminar: Discrete Differential Geometry,
Mathematisches Forschungsinstitut Oberwolfach, Germany
Linearizability Criterion for a 4-web in the Plane (with V. V. Lychagin)

June 2004: Oberseminar ueber Differentialgeometrie, Mathematische Fakultaet
der Universitaet Freiburg, Germany
Linearizability Criterion for a d-web in the Plane with Applications (with V. V. Lychagin)

Daniel Goldman

October 2003: Biomedical Engineering Society, Nashville, TN
Skeletal Muscle Oxygen Delivery and Utilization During Sepsis Studied Using a Computational Model

October 2003: Department of Mechanical Engineering, Boston University
Experiment-Based Modeling of Blood Flow and Transport in the Microcirculation During Sepsis

April 2004: Experimental Biology/Microcirculatory Society, Washington, DC
Simulations of the Effect of Altered Hemodynamics and Arterial Oxygen Content on Tissue Oxygenation During Sepsis

May 2004: Frontiers in Applied and Computational Mathematics, NJIT
Modeling Oxygen Transport at the Microvascular Level During Sepsis

Jorge Golowasch

March 2004: Department of Mathematical Sciences, NJIT
Activity of a Rhythmic Neuronal Network

April 2004: 30th Annual East Coast Nerve Net Meeting, Woods Hole, MA
Is the Pyloric Rhythm Recovery from Decentralization Activity-Dependent?
(With Rosa Rodriguez)

November 2003: Soc Neurosci Abs., New Orleans, LA
Trophic Effect of Neuromodulators on Crustacean Neurons (with Latha Nambiar)

November 2003: Soc Neurosci Abs., New Orleans, LA
Role of Calcium-Activated Potassium Current in Pattern Generation in the Crab Stomatogastric Ganglion. (with L. Mukhamedieva, F. Nadim)

November 2003: Soc Neurosci Abs., New Orleans, LA
Effects of Electrical Coupling on the Measurements of Intrinsic and Synaptic Currents. (with P.M. Rabbah, F. Nadim)

May 2004: Conference: Frontiers in Applied and Computational Mathematics, NJIT, Newark
1) Regulation of Rhythmic Activity in Cultured Neurons by Patterned Electrical Activity (with Rodolfo Haedo)
2) Is Neuronal Rhythmic Activity Dependent on Network Activity Itself? (with Rosa Rodriguez, Luis Correa)
3) Modeling Rhythmic Activity Recovery After Decentralization (with Yili Zhang)

Roy H. Goodman

September 2003: Mathematics Colloquium, Department of Mathematics and Statistics, University of Vermont, Burlington, VT
Interaction of Sine-Gordon Solitons with Defects

October 2003: AMS Southeast Regional Meeting, Chapel Hill, NC
Interaction of Sine-Gordon Solitons with Defects

January 2004: 23rd Annual Dynamics Days Conference, Chapel Hill, NC
Strong NLS Soliton-Defect Interactions

February 2004: Dynamical Systems/Nonlinear Science Seminar, Program in Applied and Computational Mathematics, Princeton University, Princeton, NJ
Interaction of Sine-Gordon Solitons with Defects

May 2004: Frontiers in Applied and Computational Mathematics, NJIT, Newark, NJ
The Two-Bounce Resonance in Hamiltonian Wave Interactions

David J. Horntrop

May 2004: SIAM Conference on Mathematical Aspects of Materials Science, Los Angeles, CA
Mesoscopic Simulation for Surface Processes

Lou Kondic

June 2004: 5th International Conference on Dynamical Systems and Differential Equations Ponoma, CA
On stability and undercompressive shocks in gas-liquid countercurrent flow in an inclined channel (with B. Tilley and T. Segin)

June 2004: Second New England/New York Granular materials workshop, New Haven, CT, June 2004.
Sheared Granular Systems: Velocity Profiles, Stresses, and Bagnold Scaling (with O. Baran)

May 2004: Frontiers in Applied and Computational Mathematics, NJIT, Newark, NJ
1) Instabilities in the Flow of Thin Liquid Films Including Contact Lines
2) On Undercompressive Shocks in Gas-Liquid Countercurrent Flow in an Inclined Channel (with T. Segin and B. Tilley)
3) Sheared Granular Systems: Velocity Profiles, Stresses, and Bagnold Scaling (with O. Baran)

April 2004: Workshop on Fluctuations and Continuum Equations for Granular Flow, Statistical and Applied Mathematical Sciences Institute, RTP, NC
Elastic Granular Temperature (with R. P. Behringer)

March 2004: General Meeting of APS, Montreal, Canada, March 2003
Statistical Properties of Slowly Sheared Granular Materials (with R. P. Behringer, K. Daniels, B. Utter)

December 2003: Banff Fluids Workshop, Banff, Alberta, Canada
Flow of Thin Films on Heterogenous Surfaces (with J. Diez)

December 2003: Banff Fluids Workshop, Banff, Alberta, Canada
Contact Line Instability: Comparison Between Experiments and Numerical Simulations (with J. Gomba, A. G. Gonzalez, J. A. Diez, R. Gratton)

December 2003: Banff Fluids Workshop, Banff, Alberta, Canada
Undercompressive Shocks in Two-Layer Flows (with T. Segin and B. Tilley)

November 2003: APS Division of Fluid Dynamics, East Rutherford, NJ
1) Extended Granular Temperature (with R. P. Behringer)
2) 3D Simulations of Sheared Granular Flow in Couette Geometry (with Oleh Baran)
3) Undercompressive Shocks in Two-Layer Flows (with T. Segin and B. Tilley)
4) Contact Line Instability: Comparison Between Experiments and Numerical Simulations (with J. Gomba, A. G. Gonzalez, J. A. Diez, R. Gratton),

November 2003: Argentinian Physical Society, Division of Fluid Dynamics, Tandil, Argentina
1) Instability of a Contact Line: Comparison Between Experiments and Numerical Simulations (with J. Gomba, A. G. Gonzalez, J. A. Diez, R. Gratton),
2) Undercompressive Shocks in Two-Layer Flows (with T. Segin and B. Tilley)

Gregory A. Kriegsmann

October 2003: SIAM Conference on Mathematics for Industry: Challenges and Frontiers, Toronto, Canada
Microwave Heating of Silicon Wafers in Cylindrical TM Cavities: A Mathematical Model.

October 2003: Department of Mathematics, IUPUI, Indiana University-Purdue, Indianapolis,
Scattering Matrix Analysis of a Photonic Fabry-Perot Resonator.

November 2003: Department of Mathematics, Illinois Institute of Technology, Chicago, IL.
An S-Matrix Based Hybrid Method.

March 2004: Department of Mathematics, Louisiana State University, Baton Rouge, LA.
Complete Transmission Through a Two-Dimensional Grating.

Dawn A. Lott

January 2004: Joint Mathematics Meetings, Phoenix, AZ
Two-Dimensional Finite Element Analysis to Assess Flow Characteristics of an In Vitro Aneurysm Model

November 2003: NAM Undergraduate MATHFest XIII, Delaware State University, Dover, DE
Numerical Approximations to Wall Shear Stress Due to Saccular Aneurysm Grown in Cerebral Arteries

Jonathan Luke

November 2003: 2003 APS Division of Fluid Dynamics 56th Annual Meeting, East Rutherford, NJ
Simulation of stratification and velocity decay in a sedimenting suspension

May 2004: Frontiers in Applied and Computational Mathematics, Newark, NJ
Transient Dynamics of a Sedimenting Suspension

Marc Qun Ma

September 2003: CAMS, NJIT
Large-Time-Step Molecular Dynamics for Macromolecules

October 2003: Comp. Biology Center, IBM, Yorktown Heights, NY
Novel Multiscale Integrators for Efficient Conformational Search in Ligand-Receptor Simulations

December 2003: Cancer Institute of New Jersey, UMDNJ-Robert Wood
Johnson Medical School, New Brunswick, NJ
Recent Advances in Multiscale Molecular Dynamics

February 2004: Center for Applied Genomics, Public Health Research Institute, Newark, NJ
Multiscale Molecular Dynamics and Multiplex PCR

April 2004: College of Science and Mathematics, Montclair State University, NJ
Data Classification in SNPs High-Throughput Genotyping Microarray

Victor Matveev

November 2003: Society for Neuroscience Annual Meeting, New Orleans
1) Facilitation through Buffer Saturation: Conditions on Endogenous Buffering Properties
2) The Control of Bursting in Pituitary Somatotrophs by the Progressive Recruitment of BK Channels

February 2004: Mathematical Biology Seminar, NJIT
Calcium Diffusion in the Presence of Buffers and the Mechanisms of Synaptic Facilitation.

March 2004: Mathematical Biosciences Institute, Ohio State University,
Workshop "Signal Transduction II: Muscles and Synapse"
Facilitation of Calcium Transients Through Saturation of Endogenous Calcium Buffers.

Jay Meegoda

February 2004: The National University of Singapore
Centrifugal Modeling of Contaminant Transport Through Saturated and Unsaturated Soils

January 2004: TRB Conference, Washington DC
1) Inspection, Cleaning, Condition Assessment and Prediction of Remaining Service Life of CSCPs
2) Simulation and Parametric Study of Resilient Modulus Tests on Granular Soil

December 2003: Graduate Seminar of the Department of Civil Engineering at Kansas State University, Manhattan, KS
Predicting the Service Life of Transportation Infrastructure with Application to Corrugated Steel Culvert Pipes

Zoi-Heleni Michalopoulou

August 2003: International Conference on Theoretical and Computational Acoustics, Honolulu, Hawaii
Matched Field Source Localization via Parameter Elimination

March 2004: Women in technology leadership awards, NJIT, NJ
A Gibbs Sampling Approach to Maximum A Posteriori Time-Delay and Amplitude Estimation

May 2004: 147th Meeting of the Acoustical Society of America, New York
Tabu Evaluation in Geoacoustic Inversion

Petronije S. Milojevic

May 2004: Frontiers in Applied and Computational Mathematics, Department of Mathematical Sciences, NJIT, Newark, NJ
Unique Solvability and the Number of Solutions of Hammerstein Equations with Applications

Robert M. Miura

July 2003: Applications of Mathematics in Medicine Workshop, Fields Institute, Toronto, Canada
Ion Diffusion and the Spatial Buffer Mechanism in the Brain-Cell Microenvironment

January 2004: AMS-SIAM Special Session on Mathematical Modeling in Neuroscience, Biomedicine, Genetics, and Epidemiology, Joint Mathematics Meetings, Phoenix, Arizona
Modelling Spreading Cortical Depression in the Brain-Cell Microenvironment

January 2004: Mathematical Biology Seminar, University of British Columbia, Vancouver, Canada
Spreading Depression: A Paradigm for Understanding Basic Brain Mechanisms

March 2004: Applied Mathematics Seminar, University of Delaware
Modelling Nonlinear Waves of Spreading Cortical Depression

March 2004: BioMaPS/DIMACS Seminar Series in Quantitative Biology,
BIOMAPS Institute, Rutgers University, Piscataway, NJ
Modeling Spreading Cortical Depression

May 2004: International Conference on Mathematics and Its Applications (Plenary Lecture)
City University of Hong Kong, Hong Kong
Waves of Spreading Cortical Depression in the Brain

Cyrill Muratov

July 2003: Department of Mathematics, University of Bonn, Germany
Free Boundary Problem and Its Applications to Reaction-Diffusion Systems of Activator-Inhibitor Type

October 2003: Applied Mathematics Colloquium, Department of Mathematics, Princeton University, Princeton, NJ
Signal Transmission by Autocrine Cells in Model Epithelial Layers

October 2003: Applied Mathematics Colloquium, Courant Institute of Mathematical Sciences, New York, NY
Phase Transformation Kinetics in Ginzburg-Landau-Type Problems

February 2004: Applied Mathematics Colloquium, Department of Applied Mathematics, Northwestern University, Evanston, IL
Transmission of Autocrine Signals in Epithelial Layers: Modeling and Analysis

March 2004: Mathematical Aspects of Invasion Phenomena in Life Sciences, CIRM, Luminy, France
Propagation and Traveling Waves in Gradient Systems: A Variational Approach

May 2004: Frontiers in Applied and Computational Mathematics, NJIT, Newark, NJ
Eggshell Patterning in Drosophila Oogenesis: Modeling, Analysis, Experiments

May 2004: SIAM Conference on Mathematical
Aspects of Materials Science, Los Angeles, CA
Interfacial Patterns in Systems with Long-Range Interactions of Coulomb Type

D. T. Papageorgiou

November 2003: American Institute of Chemical Engineers Annual Meeting, San Francisco, CA
The Formation of Stagnant Caps of Surfactant on Translating Bubbles Due to the Adsorption of Surfactant from Micellar Solutions (with A. Taneja, R. Balasubramanian, and C. Maldarelli)

November 2003: 55th Annual Meeting, American Physical Society, Division of Fluid Dynamics, NYC/New Jersey
1) Nonlinear Antisymmetric Capillary Waves in Electrified Fluid Sheets. (with J.-M. Vanden-Broeck)

2) Long Wave Equations for a Viscous Thread Surrounded by Another Viscous Fluid. (with M. Booty and M. Siegel)
3) Evolution of Vortex Sheets in a Channel (with L. Barannyk)
4) Compound Viscous Jets (with R.V. Craster and O. Matar)

March 2004: Department of Mathematics, University of Michigan, Ann Arbor, Applied Mathematics Colloquium
Dynamics and Rupture in Surface Tension Driven Flows

April 2004: Applied Mathematics Lab Seminar, Courant Institute, NYU
Modeling, Computations, and Experiments for Rising Gas Bubbles in Surfactant Solutions

April 2004: Stewartson Memorial Lecture (invited plenary), British Applied Mathematics Colloquium. University of East Anglia
Surface Tension Dominated Flows

May 2004: Frontiers in Applied and Computational Mathematics, NJIT
1) Vortex Sheets in a Channel (with L. Barannyk and R. Krasny)
2) Influence of Surfactant on the Breakup of a Fluid Jet (with M. Hameed, M. Siegel, and C. Maldarelli)
3) Capillary Waves in Electrified Fluid Sheets (with J.-M. Vanden-Broeck)
4) Remobilization of Spherical Bubbles Rising in a Micellar Surfactant Solution (with A. Taneja and C. Maldarelli)
5) Numerical and Analytical Studies of Modified Kuramoto-Sivashinsky Equations Arising in Interfacial Electrohydrodynamics (with D. Tseluiko)
6) Accurate and Efficient Boundary Integral Methods for Electrified Liquid Bridge Problems (with D. Volkov and P.G. Petropoulos)

Peter G. Petropoulos

July 2003: Sixth International Conference on Mathematical and Numerical Aspects of Wave Propagation, Jyvaskyla, Finland
Long-Time Behavior of the Unsplit PML

July 2003: Summer Faculty Seminar Series, Department of Mathematical Sciences, NJIT
Absorbing Boundary Conditions for Numerical Solution of the Time-Dependent Maxwell Equations in Open Domains

October 2003: Program in Applied Mathematics Colloquia Series, University of Arizona, Tucson
Absorbing Boundary Conditions for Numerical Solution of the Time-Dependent Maxwell Equations in Open Domains

January 2004: AFOSR Annual Electromagnetics Workshop, San Antonio, TX
Modeling Propagation of Time-Domain Pulses in Cole-Cole Dielectrics

April 2004: Department of Mathematics Colloquia Series, University of New Mexico, Albuquerque
Two Problems in Computational Electromagnetics

Christopher Raymond

January 2004: Dynamics Days 2004, Chapel Hill, NC
Mathematical Modeling for Immunocolloid Labeling

March 2004: Nanotech 2004, Boston, MA
Mathematical Modeling for Immunocolloid Labeling

March 2004: University of Tennessee-Knoxville Mathematics Department Colloquium
A Mathematical Model for Immunogold Labeling

May 2004: University of Delaware Department of Mathematical Sciences, Colloquium
A Mathematical Model for Immunogold Labeling

May 2004: Frontiers in Applied and Computational Mathematics, NJIT
Asymptotics for a Model of Immunocolloid Labeling

Anthony Rosato

October 2003: Stanford University, Rapid Prototyping Laboratory, Department of Mechanical Engineering
Intruder Segregation in Boundary Driven Shear Flows

September 2003: Isaac Newton Institute for Mathematical Sciences, Summer School on Granular and Particle-Laden Flows
Intruder Dynamics in a Boundary Driven Shear Flow

Michael Siegel

November 2003: APS Division of Fluid Dynamics, Secaucus, NJ
1) Exact Solutions for the Evolution of a Bubble in Stokes Flow (with D. Crowdy)
2) Long Wave Equations for a Viscous Thread Surrounded by Another Viscous Fluid (with M. Booty and D. Papageorgiou)
3) Turning of Drop Breakup: Surface Tension Driven Traveling Wave Solutions (with W. Zhang)
4) Nonunversal Drop Breakup (with P. Doshi, I. Cohen, W. W. Zhang, P. Howell, O. A. Basaran, and S. R. Nagel)

May 2004: Frontiers in Applied and Computational Mathematics, NJIT
Influence of Surfactant on the Breakup of a Fluid Jet (with M. Hameed, D. Papageorgiou, and C. Maldarelli)

Louis Tao

September 2003: Mathematical Biology Seminar at Department of Mathematical Sciences, NJIT
The Simple and the Complex of Visual Cortical Dynamics

November 2003: Annual Neuroscience Meeting, New Orleans, LA
1) Fluctuation-Driven Network Dynamics or Orientation Selectivity -- A Kinetic Theory Approach
2) Precision of Response Timing in Primary Visual Cortex: Evidence for a High Conductance State?
3) Orientation Selectivity of Simple and Complex Cells in Visual Cortex

December 2003: Cornell University, Department of Neurology and Neuroscience, New York, NY
The Simple and the Complex of Visual Cortical Dynamics

May 2004: Frontiers in Applied and Computational Mathematics, NJIT, Newark, NJ
The Dynamics of Fluctuation-Driven Neuronal Networks

June 2004: American Institute of Mathematical Sciences Fifth International Conference on Dynamical Systems and Differential Equations, Pomona, CA
An Embedded Network Approach for the Modelling of Large-Scale Neuronal Networks

Darko Volkov

December 2003: LSU, Baton Rouge
Accurate and Efficient Boundary Integral Methods for Electrified Liquid Bridge Problems

J.-M. Vanden-Broeck

July 2003: Equadiff conference, Hasselt, Belgium
Generalised Fronts and Related Free Surface Flows

September 2003: Workshop on Free Surface Flows, Nottingham, UK
Large Amplitude Capillary Waves in Electrified Fluid Sheets

October 2003: University of Keele, UK
Antisymmetric Waves on Electrified Fluid Sheets

November 2003: APS Division of Fluid Dynamics, New Jersey
Large Amplitude Capillary Waves in Electrified Fluid Sheets

January 2004: Birmingham University, UK
Waves on Electrified Fluid Sheets

April 2004: British Applied Mathematics Colloquium, University of East Anglia, UK
Three Dimensional Gravity Capillary Free Surface Flows

April 2004: British Applied Mathematics Colloquium, University of East Anglia, UK
Nonlinear Free Surface Flows Past Submerged Disturbances

April 2004: British Applied Mathematics Colloquium, University of East Anglia, UK
Electrostatic Models of Proteins

May 2004: Frontiers in Applied and Computational Mathematics, NJIT
Two and Three Dimensional Gravity Capillary Waves

C. TECHNICAL REPORTS

REPORT 0304-1: C. B. Muratov
A Global Variational Structure and Propagation of Disturbances in Reaction-Diffusion Systems of Gradient Type

REPORT 0304-2: David Stickler
A Shallow Water Ocean Acoustics Inverse Problem

REPORT 0304-3: Lou Kondic and Javier A. Diez
Instabilities in the Flow of Thin Films on Heterogeneous Surfaces

REPORT 0304-4: Lou Kondic and Robert P. Behringer
Elastic Energy, Fluctuations and Temperature for Granular Materials

REPORT 0304-5: Christopher E Elmer and Erik S Van Vleck
Spatially Discrete FitzHugh-Nagumo Equations

REPORT 0304-6: Christopher E Elmer and Erik S Van Vleck
Dynamics of Monotone Traveling Fronts for Discretizations of Nagumo PDE's

REPORT 0304-7: Maks A. Akivis and Vladislav V. Goldberg
Varieties with Degenerate Gauss Maps with Multiple Foci and Twisted Cones

REPORT 0304-8: Maks A. Akivis, Vladislav V. Goldberg, and Arto V. Chakmazyan
Induced Connections on Submanifolds

REPORT 0304-9: Maks A. Akivis and Vladislav V. Goldberg
Dually Degenerate Varieties and the Generalized Griffiths-Harris Theorem

REPORT 0304-10: M. A. Akivis, V. V. Goldberg, and J. M. Landsberg
On the Structure of Varieties with Degenerate Gauss Mappings

REPORT 0304-11: Maks A. Akivis, Vladislav V. Goldberg, and Valentin V. Lychagin
Linearizability of d-Webs, d > 3, on Two-Dimensional Manifolds

REPORT 0304-12: H. R. Chaudhry, B. Bukiet, and S. Kirshblum
Analysis of Stress and Pressure in the Human Alveolar Wall Before Bursting

REPORT 0304-13: H. R. Chaudhry, T. Findley, K. S. Quigley, B. Buckiet, Z. Ji, T. Sims, and M. Maney
Measures of Postural Stability

REPORT 0304-14: Zhiming Ji, Thomas Findley, H. Chaudhry, and B. Bukiet
Computational Method to Evaluate Ankle Postural Stiffness with Ground Reaction Forces

REPORT 0304-15: B. Bukiet, H. Chaudhry, and S. Kirshblum
Mathematical Modeling of Air Flow in the Branches of the Lungs

REPORT 0304-16: Amitabha Bose, Timothy Lewis, and Richard Wilson
Two-Oscillator Model of Ventilatory Rhythmogenesis in the Frog

REPORT 0304-17: Christina Ambrosio, Amitabha Bose, and Farzan Nadim
The Effect of Modulatory Neuronal Input on Gastric Mill Frequency

REPORT 0304-18: Roy Goodman, Philip Holmes, and Michael Weinstein
Strong NLS Soliton-Defect Interactions

REPORT 0304-19: Roy H. Goodman and Richard Haberman
Interaction of Sine-Gordon Kinks with Defects: TheTwo-Bounce Resonance

REPORT 0304-20: Jonathan Rubin and Amitabha Bose
Localized Activity Patterns in Excitatory Neuronal Networks

REPORT 0304-21: Akira Mamiya and Farzan Nadim
Dynamic Interaction of Oscillatory Neurons Coupled with Reciprocally Inhibitory Depressing Synapses Acts to Stabilize the Rhythm Period

REPORT 0304-22: T.M. Segin, B. S. Tilley, and L. Kondic
On Undercompressive Shocks in Constrained Two-Layer Flows

REPORT 0304-23: Lou Kondic and Javier Diez
On Nontrivial Traveling Waves in Thin Film Flows Including Contact Lines

REPORT 0304-24: J. Diez, A. G. Gonzalez, J. Gomba, R. Gratton, and L. Kondic
Unstable Spreading of a Fluid Filament on a Vertical Plane: Experiments and Simulations

REPORT 0304-25: Victor Matveev, Robert S. Zucker, and Arthur Sherman
Facilitation Through Buffer Saturation: Constraints on Endogenous Buffering Properties

REPORT 0304-26: A. Bose, Y. Manor, and F. Nadim
The Activity Phase of Postsynaptic Neurons in a Simplified Rhythmic Network

REPORT 0304-27: Louis Tao, Michael Shelley, David McLaughlin, and Robert Shapley
An Egalitarian Network Model for the Emergence of Simple and Complex Cells in Visual Cortex

REPORT 0304-28: David Cai, Louis Tao, Michael Shelley, and David McLaughlin
A New Kinetic Representation of Fluctuation-Driven Neuronal Networks with Application to Simple & Complex Cells in Primary Visual Cortex

REPORT 0304-29: Louis Tao, David Cai, and Michael Shelley
Bistability and Tunable Gating in a Recurrent Neuronal Network with Synaptic Failure and Hidden Neurons

REPORT 0304-30: P.S. Milojevic
Solvability and the Number of Solutions of Hammerstein Equations

REPORT 0304-31: Debra E. Wood, Yair Manor, Farzan Nadim, and Michael P. Nusbaum
Inter-Circuit Control via Rhythmic Regulation of Projection Neuron Activity

REPORT 0304-32: **V.E. Orel, D.A. Klyushin, A.V. Romanov, Yu.I. Petunin, and R.I. Andrushkiw**
Diagnostic Method for Cancer of the Digestive Tract Based on the Analysis of Blood Mechanoemmission Curves

REPORT 0304-33: A. Chakrabarti and D.S. Ahluwalia
On the Existence of Trapped Waves Involving a Two-Layer Fluid

REPORT 0304-34: S. Kimmel and F.P. Deek
Large Eddy Simulation of Rotating Turbulent Convection Using the Estimation Subgrid Scale Model

REPORT 0304-35: M.C. Bhattacharjee
Comparison of Random Sums in Some Integral Orderings and Applications

REPORT 0304-36: M.C. Bhattacharjee
Adaptive Economic Choices under Recurrent Disasters: A Bayesian Perspective

REPORT 0304-37: M. Booty and G.A. Kriegsmann
Reflection and Transmission from a Thin Inhomogeneous Cylinder in a Rectangular TE10 Waveguide

REPORT 0304-38: Ben Steinberg, Yuqing Wang, Huaxiong Huang, and Robert M. Miura
Spatial Buffering Mechanism: Mathematical Model and Computer Simulations

REPORT 0304-39: Morikazu Toda and Robert M. Miura
Nonlinear Toys

REPORT 0304-40: O. Baran and L. Kondic
On Velocity Profiles, Stresses and Bagnold Scaling of Sheared Granular System in Zero Gravity

REPORT 0304-41: Michael Siegel, Russel E. Caflisch, and Sam Howison
Global Existence, Singular Solutions and Ill-Posedness for the Muskat Problem

REPORT 0304-42: Darren Crowdy and Michael Siegel
Exact Solutions for the Evolution of a Bubble in Stokes Flow: A Cauchy Transform Approach

REPORT 0304-43: P.D. Howell and M. Siegel
The Evolution of Slender Non-Axisymmetric Drop in an Extensional Flow

REPORT 0304-44: Pankaj Doshi, Itai Cohen, Wendy W. Zhang, Michael Siegel, Peter Howell, Osman A. Basaran, and Sidney R. Nagel
Persistence of Memory in Drop Breakup: The Breakdown of Universality

REPORT 0304-45: M. Siegel, M.J. Miksis, and P.W. Voorhees
Evolution of Material Voids for Highly Anisotropic Surface Energy

VI. EXTERNAL ACTIVITIES AND AWARDS

A. FACULTY ACTIVITIES AND AWARDS

Daljit S. Ahluwalia

Received the Exceptional Leadership and Service Award from the College of Sciences and Liberal Arts in April 2004

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

Roman Andrushkiw

Associate Editor, Proceedings of the International Conference on Mathematics and Engineering Techniques in Medicine and Biological Sciences

Co-Editor of the book, Development of the Mathematical Ideas of M. Kravchuka, published by The National Technical University of Ukraine and Shevchenko Scientific Society (USA), ISBN-0-88054-141-5, May 2004, 780 p.

Program Committee Member, International Conference on Mathematics and Engineering Techniques in Medicine and Biological Sciences, June 2003

Achievement Award: The 2003 International MultiConference in Computer Science and Computer Engineering Las Vegas, Nevada, June 23, 2003

Nadine Aubry

Member-at-large (one of six), US National Committee on Theoretical and Applied Mechanics (USNC/TAM) November 1, 2001 - Present, elected as next vice chair of committee.

Member of the APS/DFD (American Physical Society/Division of Fluid Dynamics) Publications Committee.

Member of the USNC/TAM Publications Committee, Research Publications and Communications.

Vice Chair of the American Physical Society (APS), Division of Fluid Dynamics (DFD) Nominating Committee.

Chair of the USNC/TAM ad hoc committee on USNC/TAM Society Memberships.

Member of the selection paper committee, 2004 International Congress for Theoretical and Applied Mechanics (ICTAM), Warsaw, Poland.

Member of the travel sub committee, 2004 International Congress for Theoretical and Applied Mechanics (ICTAM), Warsaw, Poland.

National Science Foundation (NSF) panel for Graduate Fellowship Program (GRP) (Mechanical and Aeronautical Engineering Panel), Arlington, VA, February, 2004.

Memberships in professional societies: American Physical Society (APS), American Society of Mechanical Engineers (ASME), 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), and the Society of Women Engineers (SWE).

Manish C. Bhattacharjee

Editorial Board Member, Calcutta Statistical Association (CSA) Bulletin (January 2004)

Elected Member: International Statistical Institute, Hague, Netherlands.

Denis Blackmore

Editorial Board, ACS Journal of Chemical Information and Computer Sciences

Nominated as an International Educator of the Year by the IBC

Nominated for induction into ABI Hall of Fame for dedicated and remarkable achievements in the mathematical sciences

Listed in Academic Keys Who's Who in Sciences Higher Education

Served on NSF Panel

Michael Booty

Book Review: `Modeling MEMS and NEMS' By John.A. Pelesko and David.H. Bernstein, in SIAM Review, Vol. 46, pp. 150-151, March 2004.

Vladislav V. Goldberg

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

Editorial Board Member, Rendiconti del Seminario Matematico di Messina (elected in March 2002)

Vladislav V. Goldberg was awarded by German Mathematical Society and Mathematical Research Institute Oberwolfach to participate in the program Research in Pairs (RiP): with Valentin V. Lychagin, University of Tromsoe, Norway

Gregory A. Kriegsmann

1991 – Fellow, The Acoustical Society of America

1992 – Fellow, Institute for Mathematics and Its Applications

1992 – Editorial Board, Journal of Engineering Mathematics

1994 – Editorial Board, SIAM Journal on Applied Mathematics

1996 – Editorial Board, I.M.A. Journal of Applied Mathematics

1997 – Editorial Board, Analysis and Applications

2000 -- Editorial Board, Wave Motion

2002 – Vice President of Publications, SIAM Journal on Applied Mathematics

January 2004: Member of the Panel for the National Science Foundation, Division of Mathematical Sciences (DMS)

Dawn A. Lott

Mathematical Association of America Certificate of Appreciation, Dec 2003

Jay Meegoda

Editorial Board Member ASTM Geotechnical Testing Journal

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

ASCE North Jersey Section, Chairperson of Geotechnical Group.

Member of Millburn Environmental Commission, Township of Millburn, NJ

Member of the Passaic Valley Groundwater Protection Committee

National Science Foundation Review panel for Geo-environmental Program, March 12.

Zoi-Heleni Michalopoulou

Fellow of the Acoustical Society of America

Robert Miura

Fellow of the Royal Society of Canada

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

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

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).

Organizer, Third Pacific Rim Conference on Mathematics, Shanghai, China, 2005 (since 2001).

Cyrill Muratov

Co-organizer, Mini-symposium entitled "Long-range interactions and microstructure", SIAM Conference on Mathematical Aspects of Materials Science, Los Angeles, CA, May 2004.

Farzan Nadim

Associate Editor for the Journal of Neuroscience

D. T. Papageorgiou

Associate Editor of the SIAM Journal on Applied Mathematics.

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

Peter G. Petropoulos

Organized a mini-symposium at the May 2004 Frontiers in Applied and Computational Mathematics Conference, entitled: Computational Wave Propagation, New Jersey Institute of Technology, Newark, NJ

Anthony Rosato

Editorial Board Member: International Journal of Nonlinear Science and Numerical Simulation
Associate Editor: Mechanics Research Communications

Thomas Spencer

2003 Franz Edelman Award for Achievement in Operations Research and the Management Sciences

Louis Tao

Minisymposium Organizer at AIMS's Fifth International Conference on Dynamical Systems and Differential Equations (Minisymposium title) Computational Neuroscience: From Physiology to Mathematical Modelling, June 2004

Jean-Marc Vanden-Broeck

Chair of the British Applied Mathematics Colloquium in 2004

Editorial Board Member, The Quarterly Journal of Mechanics and Applied Mathematics
Editorial Board Member, The ANZIAM Journal

B. CSLA AWARDS CEREMONY

The College of Science and Liberal Arts held its 2nd Annual Awards Banquet on Wednesday April 28, 2004. Several members associated with CAMS and the Department of Mathematical Sciences were honored for their achievements and contributions to the Institute.

Exceptional Leadership and Service
Dr. Daljit S. Ahluwalia, Chair of the Mathematical Sciences Department, was honored for his outstanding contributions to NJIT.

Outstanding Staff Member
Ms. Susan Sutton was the recipient of the Outstanding Staff Member Award.

Exceptional Graduate Student Awards
Ph.D. students Lin Zhou (Advised by Prof. Gregory Kriegsmann) and Yuriy Mileyko (Advised by Prof. Denis Blackmore) were awarded Exceptional Graduate Student Awards.

Extraordinary Undergraduate Student Awards
In recognition of their excellent achievement in the undergraduate program, Jennifer Dorn and Jonathan J. Porus were presented with Extraordinary Undergraduate Student Awards.

Graduate Alumnus
Roman Samulyak (Ph.D. Mathematical Sciences ‘99), a research scientist at the Center for Data Intensive Computing at the Brookhaven National Laboratory, was honored for his achievements post-NJIT by receiving the Graduate Alumnus Award.

In addition to the awards described above, Bobby Hancock (B.S. Statistics and Actuarial Sciences ‘01) received the Undergraduate Alumnus Award and John Gilchrist (Ph.D. Mathematical Sciences ‘98) received a Graduate Alumnus Award. Neither was able to attend the CSLA Banquet.

C. CONFERENCE ON FRONTIERS IN APPLIED AND COMPUTATIONAL MATHEMATICS (FACM '04)

More than 150 mathematical researchers, scientists and professors attended the two-day conference on applied and computational mathematics at the New Jersey Institute of Technology (NJIT) on May 21-22, 2004. The event featured spirited discussions about mathematical biology, fluid dynamics, applied statistics, computational methods for partial differential equations, nonlinear optics, and wave propagation.

"The conference is the first of a series of events to enhance the visibility and reputation of the mathematical sciences department," said Daljit Singh Ahluwalia, professor of mathematics and chair of NJIT's Department of Mathematical Sciences, during his introductory remarks. NJIT's President, Dr. Robert Altenkirch (pictured at right), in his welcoming address, explained how this conference was an excellent start to the designation of the DMS as a program of excellence that would be given additional resources under NJIT's new strategic initiative in order to achieve national and international prominence.

Four plenary lectures were delivered during the conference. John G. Milton, MD, PhD, Co-Director, Clinical Neurophysiology Lab, University of Chicago Hospitals, a renowned expert in mathematical biology, discussed the development of expertise in physical tasks. Milton began by describing experimental and mathematical techniques for determining how expertise is achieved in such activities as stick balancing and golf.

David McLaughlin, PhD, Provost of New York University (NYU), described modeling, analysis and simulation of complex neuronal interactions in the visual cortex region of the brain. McLaughlin is also a professor of mathematics at the Courant Institute of Mathematical Sciences at NYU. He and his collaborators showed how they have developed innovative methods to incorporate statistical and averaging techniques leading to large systems of integro-differential equations. Although such systems are complicated, they are at least amenable to analysis via asymptotic and computational methods, he said.

James Glimm, PhD, of SUNY Stony Brook and Brookhaven National Laboratory, an expert in mathematical fluid dynamics, described new simulations of steady acceleration-driven chaotic mixing flows. Glimm described a new set of averaged equations to model these phenomena.

Dale Pullin, PhD, California Institute of Technology gave the final plenary lecture on forces exerted on an accelerating plate and applications to hovering insect flight. Pullin described his work to develop a model of wing motion using an inviscid approximation to follow the evolution of spiral vortex sheets.

In addition to the plenary lectures, minisymposia, and poster session, Dr. Deborah Lockhart of the National Science Foundation (NSF) and Dr. Arje Nachman of the Air Force Office of Scientific Research (AFOSR) made excellent presentations outlining potential funding opportunities. Many interesting points were made and they expertly fielded a variety of questions.

Several sessions of Mathematical Biology talks were organized by Robert Miura, Professor of Mathematical Sciences and of Biomedical Engineering, NJIT. Speakers included Charles Peskin, New York University, Van Mow, Columbia University, Carson Chow, University of Pittsburgh and the National Institutes of Health, Larry Sirovich, Mt. Sinai School of Medicine, Sheldon Weinbaum, City College of New York, Stas Shvartsman, Princeton University, John Milton, University of Chicago Hospitals, and from NJIT, Daniel Goldman, Victor Matveev, Cyrill Muratov, Farzan Nadim, Chris Raymond, and Louis Tao. Talks in these sessions addressed modeling of fiber architecture of the heart, deformation and flow of electrically charged biological tissue, localized activity in neural field equations, modeling of oxygen transport at the microvascular level during sepsis, and causes and roles for short-term synaptic plasticity in neuronal networks.

Many sessions of Fluid Dynamics talks were organized by Demetrius Papageorgiou Professor of Mathematical Sciences, NJIT and Michael Siegel, Associate Professor of Mathematical Sciences, NJIT. Speakers included John Bush, MIT, Charles Maldarelli, City College of New York, Richard Braun, University of Delaware, Michael Brenner, Harvard University, Michael Shelley, New York University, Michael Miksis, Northwestern University, Yuriko Renardy, Virgina Tech, Michael Renardy, Virginia Tech, Robert Krasny, University of Michigan, Saleh Tanveer, Ohio State University, and from NJIT, Nadine Aubry and Lou Kondic. Topics covered in these sessions included evolution of 2-D bubbles in Stokes flow, locomotion by destabilizing symmetries, tear film drainage after blinking, the onset of chaos in vortex sheet flow, and instabilities in flows of thin liquid films with contact lines.

Gregory A. Kriegsmann, Distinguished Professor of Mathematical Sciences, NJIT, led a group discussing wave propagation. Participants were Paul Martin, Colorado School of Mines, I. David Abrahams, University of Manchester, England, and Paul D. Smith, Macquarie University, Australia.

Peter Petropoulos, Associate Professor of Mathematical Sciences, NJIT, chaired a minisymposium on computational methods featuring Vladimir Druskin, Schlumberger-Doll Research, Ridgefield, CT, Peter Monk, University of Delaware; and Thomas Hagstrom, University of New Mexico.

Manish Bhattacharjee, PhD, Professor of Mathematical Sciences, NJIT, organized and chaired a minisymposium on applied statistics. Speakers were Tapan K. Nayak, George Washington University; Jin Cao, Lucent Technologies/Bell Laboratories, and David Madigan, Rutgers University.

Roy Goodman, Assistant Professor of Mathematical Sciences, NJIT, organized a session on nonlinear optics featuring John K. Shaw, NSF, Evgenii Narimanov, Princeton University, Michael Weinstein, Columbia University and Lucent Technologies/Bell Laboratories; and Mordechai Segev, Princeton University and Technion University, Israel.

Twenty-two graduate students and postdocs from several universities (SUNY at Stony Brook, University of Michigan, University of Texas, University of New Mexico, University of Southern California, Drexel University), including NJIT and Rutgers-Newark, presented posters and received registration fee and/or travel subsidies.

At the end of the first day of the meeting, the conference participants headed for the Conference Reception and Banquet, where they had an opportunity to renew acquaintances, make new friends and engage in informal discussions on problems of mutual interest over drinks and hors d'oeuvres, followed by a dinner. Short informal speeches at dinner by Dave McLaughlin and Daljit S. Ahluwalia good-naturedly praised the audience and ambience of the conference and recalled some old times at the Heights Campus of New York University.

The conference organizers were Daljit S. Ahluwalia, Chair, Denis Blackmore, Co-Chair, Gregory A. Kriegsmann, Robert M. Miura, and Demetrios Papageorgiou. By almost all accounts, the conference was a great success.

From left: Gregory Kriegsmann, Daljit S. Ahluwalia, Robert Miura (NJIT), and David McLaughlin (NYU)

Plenary lecture by Dale Pullin (Caltech)

From left: Sheldon Weinbaum (City College of New York), Fadi P. Deek (Acting Dean of CSLA,. NJIT), William Van Buskirk and Daljit S. Ahluwalia (NJIT)

Deborah F. Lockhart, Program Director
Division of Mathematical Sciences
National Science Foundation

James Glimm (State University of New York at Stony Brook) and Daljit S. Ahluwalia (NJIT)

Denis Blackmore (NJIT) giving his introductory remarks before Dr. Glimm's plenary lecture

Poster Presenter Pascale Rabbah
Federated Department of Biological Sciences
(Rutgers University/NJIT)

Poster Session Question and Answer Period

VII. FUNDED RESEARCH

A. EXTERNALLY FUNDED RESEARCH

CONTINUING FUNDED PROJECTS

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

   National Science Foundation: July 1, 2003 - June 30, 2006
   Amitabha Bose
   Victoria Booth

2. *Differential-Difference Equations and Their Application to Crystalline Growth*

   National Science Foundation: July 15 2002 - June 30 2005
   Christopher E Elmer

3. *An Experiment-Based Computational Study of Blood Flow and Transport during Sepsis*

   The Whitaker Foundation: September 1, 2001 - August 30, 2004
   Daniel Goldman

4. *Activity-Dependent Regulation of Ionic Currents*

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

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

   National Science Foundation: March 2001 - February 2006
   Jorge Golowasch
   Ron Harris-Warrick
   Scott Hooper
   Eve Marder
   Farzan Nadim
   Michael Nusbaum

6. *Pulse Propagation and Capture in Bragg Grating Optical Fibers*

   National Science Foundation: July 1, 2002 - June 30, 2005
   Roy Goodman

7. *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)

8. *Instabilities in the Flow of Thin Liquid Films*

   National Science Foundation: February 01, 2002 - January 31, 2005.
   Lou Kondic

9. *Microwave Processing of Materials*

   National Science Foundation: August 2000 - January 2004
   Gregory A. Kriegsmann

10. *Applied Mathematical Problems in Microwave Processing of Ceramic Materials*

    Department of Energy: August 2000 - December 2003
    Gregory A. Kriegsmann

11. *Efficient Shallow Water Matched Field Inversion*

    ONR: January 1, 2002 - December 31, 2004
    Zoi-Heleni Michalopoulou

12. *Graduate Traineeship Award: Detection and Localization in the Ocean in the Presence of Coherence Loss Mechanisms*

    ONR: October 1, 2000 - June 30, 2004
    Zoi-Heleni Michalopoulou
    Urmi Ghosh-Dastidar

13. *Collaborative Research: Modeling and Computational Analysis of Cell Communication in Drosophila Oogenesis*

    National Science Foundation: July 1, 2002 - June 30, 2005
    Cyrill Muratov
    Stanislav Y. Shvartsman

14. *Regulation of Neuronal Oscillation of Synaptic Dynamics*

    National Institutes of Health: December 15, 2000 - November 30, 2005
    Farzan Nadim

15. *Hydrodynamics of Bubble Motion and Oscillatory Flows*

    National Science Foundation: July 1, 2000 - May 31, 2004
    Demetrios T. Papageorgiou

16. *Numerical Modeling of Electromagnetic Wave Propagation and Scattering: High-Order Schemes, Impedance Boundary Conditions and Cole-Cole Dielectrics*

    Air Force Office of Scientific Research: January 1, 2002 - January 1, 2005
    Peter G. Petropoulos

17. *Transport and Heterogeneity in Surface-Volume Reactions*

    NSF/NIGMS Joint Mathematical Biology Initiative: August 1, 2002 - July 31, 2007
    Christopher Raymond

18. *Analysis and Numerical Computations of Moving Boundaries in Fluid Dynamics and Materials Science*

    National Science Foundation: July 23, 2001 - July 31, 2004
    Michael Siegel

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

National Science Foundation: July 1, 2002 - June 30, 2005
J.-M. Vanden-Broeck

PROJECTS FUNDED DURING PRESENT FISCAL YEAR

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

NSF/DARPA: July 1, 2003 - June 30, 2006
Denis Blackmore
Ming Leu
William Regli
Wei Sun

2. *Gravity and Granular Materials*

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

3. *Establishment of Linked Ph.D. Programs*

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

4. *Mathematical Problems in Electrohydrodynamics*

National Science Foundation: June 2004 - May 2007
Demetrios T. Papageorgiou

5. *FRG: Singularity Formation in the Three Dimensional Euler Equations and Related Problems*

National Science Foundation: June 1, 2004 - May 31, 2007
Michael Siegel
Russ Caflisch
Tom Hou
Dale Pullin

B. PROPOSED RESEARCH

PROJECTS PROPOSED DURING PRESENT FISCAL YEAR

1. *EMSW21-MCTP: Mentoring and Research Plan for New BS/MS Programs and Related Activities in the Mathematical Sciences*

   National Science Foundation: June 6, 2004 - May 31, 2007
   Daljit S. Ahluwalia
   John Bechtold
   Denis Blackmore
   Amitabha Bose
   David Horntrop
   Dawn Lott
   Robert M. Miura
   Farzan Nadim
   Zoi-Heleni Michalopoulou
   Demetrius Papageorgiou

2. *Computer-Aided Cytogenetic Method of Cancer Diagnosis*

   U.S. Civilian Research and Development Foundation: September 1, 2004 - March 1, 2005
   Roman Andrushkiw
   Y. Petunin
   D. Klyushin
   N. Boroday
   L. Ostapchenko
   D. Kristol
   L. Bilaniuk

3. *Dynamics of Near Limit Flames*

   National Science Foundation: July 1, 2004 - June 30, 2007
   John Bechtold

4. *Asymptotic and Singular Perturbation Methods for Bifurcation Problems with Applications*

   National Science Foundation: July 1, 2004 - June 30, 2007
   Thomas Erneux

5. *Applied Mathematical Problems in Microwave Processing of Ceramic Materials*

   Department of Energy: January 1, 2005 - December 2007
   Gregory A. Kriegsmann

6. *Segregation and Fractionation of Suspended Particles Using Acoustic and Flow Fields*

   National Science Foundation-SGER: December 1, 2003 - November 30, 2004
   Jay Meegoda
   Denis Blackmore

7. *A New Technology and Mathematical Modeling-Particle Segregation and Fractionation with Acoustic and Flow Fields*

   National Science Foundation: September 1, 2004 - August 31, 2007
   Jay Meegoda
   Denis Blackmore

8. *Studies in Microwave Heating and Combustion Phenomena*

   National Science Foundation: July 1, 2004 - June 30, 2007
   Michael Booty

9. *UBM: An undergraduate training program in biology and mathematics at NJIT*

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

10. *Conduction in Myelinated Nerve Axons, from Mathematical Modeling and Analysis to Verification in Experiments*
    National Science Foundation: July 1, 2004 - June 30, 2007
    Christopher E. Elmer

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

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

12. *Gravity and Granular Materials*

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

13. *Establishment of Linked PhD Programs*

    Council for International Exchange of Scholars/Fulbright Foundation: August 1, 2004-July 31, 2006
    Lou Kondic
    Javier Diez (University Nacional del Centro, Tandil, Argentina)

14. *Statistical properties of dense granular systems*

    Department of Energy, August 1, 2004 - July 31, 2007
    Lou Kondic
    R. Behringer (Duke University)

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

    National Science Foundation: July 1, 2004 - June 30, 2007
    Victor Matveev

16. *Modelling and Analysis of Spreading Depression: A Paradigm for Understanding Basic Brain Mechanisms*

    National Science Foundation: July 2004 - June 2007
    Robert M. Miura

17. *Mathematical Problems in Electrohydrodynamics*

    National Science Foundation: June 2004 - May 2007
    Demetrios T. Papageorgiou

18. *FRG: Singularity Formation in the Three Dimensional Euler Equations and Related Problems*

National Science Foundation: June 1, 2004 - May 31, 2007
Michael Siegel
Russ Caflisch
Tom Hou
Dale Pullin

19. *RTG: Analysis, Computations and Focused Experiments in Interfacial Fluid Dynamics*

National Science Foundation: July 1, 2004 - June 30, 2007
Daljit S. Ahluwalia
Lou Kondic
Demetrios T. Papageorgiou
Michael Siegel

20. *Analysis and Simulation of the Dynamics of Visual Cortical Network*

National Science Foundation: August 1, 2003 - July 31, 2005
Louis Tao

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

National Science Foundation: September 1, 2004 - August 31, 2007
Daljit S. Ahluwalia
Qun Ma
Michael Siegel
Roy Goodman
David Horntrop
Lou Kondic
Peter Petropoulos
Louis Tao

C. EXTERNALLY FUNDED PROJECTS -- NOT THROUGH CAMS

1. *Laboratory for Electro-Hydrodynamics*

W. M. Keck Foundation: January 2000 - January 2005
N. Aubry
B.Khusid

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

New Jersey Commission on Science and Technology: December 1, 2000 - November 30, 2005
N. Aubry
E. Geskin
Y. Kevrekidis (Princeton University)
B. Khusid
P. Singh
S. Sundaresan (Princeton University)

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

   National Science Foundation: 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)

4. *ADVANCE Fellows Award: Theta Phases of Hippocampal Place Cell Firing in REM Sleep and Waking*

   National Science Foundation: April 15, 2004 - April 14, 2007
   Victoria Booth

5. *Active Living Research: Impacting Physical Activity Levels Through Improved Roadway Safety*

   The Robert Wood Johnson Foundation: September 01, 2004 - September 01, 2007
   Sunil K. Dhar
   Janice R. Daniel
   Rongfang Liu
   Joshua Curley

6. *Service Life Prediction of Underground Infrastructure and Development of Intelligent Systems for Continuous Monitoring*

   National Science Foundation: April 2004 - June 2007
   Sunil K. Dhar
   Jay N. Meegoda
   Thomas M. Juliano
   Edip Niver
   Roumiana Petrovar
   Frank Y. Shih

7. *Linearizability Conditions for 3-Webs and Their Application to Economics and Thermodynamics*

   German Mathematical Society and Mathematical Research Institute Oberwolfach: May 30, 2004 - June 19, 2004
   Vladislav V. Goldberg
   Valentin V. Lychagin, University of Tromsoe, Norway

8. *Analysis, Computations, and Experiments on Pinch-Off in Liquid Jets*

   Banff International Research Station, Focused Research Group, Banff, Alberta, Canada: March 2005
   Robert M. Miura
   Huaxiong Huang (York University, Canada)
   Demetrius Papageorgiou
   Michael Siegel

9. *Mathematical Problems in Nonlinear Interfacial Electrohydrodynamics*

   Engineering and Physical Sciences Research Council: June 1, 2004 - May 31, 2006
   J.-M. Vanden-Broeck
   Demetrios T. Papageorgiou

10. *Large Amplitude Capillary Waves in Electrified Fluid Sheets*

EPSRC, 2004-2006
J.-M. Vanden-Broeck

11. *NATO Collaborative Linkage Grant*: July 2002-July 2004
J.-M. Vanden-Broeck
Demetrios T. Papageorgiou
Touvia Miloh

D. PROPOSED PROJECTS – NOT THROUGH CAMS

1. *On-Line Electrohydrodynamic Filter (OLEF)*

Office of Naval Research (ONR), April 1, 2004 – July 29, 2005
N. Aubry
P. Singh

2. *Simulation of Conformons and Frustrations in Protein-Like Lattices*

Rutgers University, Busch Biomedical Research Grant: July 2004 – June 2006
Sungchul Ji (Rutgers University)
Robert M. Miura
William J. Welsh (Robert Wood Johnson Medical School)

3. *Mathematical Biosciences Network*

Australian Research Council: 2004 - 2009
Nalini Joshi (University of Sydney, Australia)
Robert M. Miura

VIII. COMMITTEE REPORTS AND ANNUAL LABORATORY REPORT

A. READING ROOM by Lou Kondic

The CAMS Reading Room has continued to function as a location for informal gathering of faculty and graduate students. Due to increased interest, this year the schedule of weekly teas has been extended to four days a week. In addition, the weekly tea 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 Tuesdays and Fridays when faculty and students have a chance to interact more closely with the CAMS Mathematical Biology Seminar speaker (Tuesdays) and the CAMS colloquium speaker (Fridays).

B. COMMITTEE REPORTS

SEMINAR COMMITTEE REPORT by Daniel Goldman

In 2003-2004, the Colloquium Committee Members were Daniel Goldman and Manish Bhattacharjee. The 2003-2004 Department of Mathematical Sciences and CAMS Colloquium Series was a successful and popular event. This year our seminar schedule included an Applied Mathematics series (Goldman), a Statistics series (Bhattacharjee), a Mathematical Biology series (Louis Tao), and a Fluid Mechanics series (Demetrios Papageorgiou and Nadine Aubry). The lectures, delivered by well-known mathematicians and engineers from academia and industry, covered a variety of fields including materials science, fluid mechanics, numerical analysis, neuroscience, biomedical imaging, and evolution. In addition, eight colloquia were jointly sponsored with the NJIT Department of Mechanical Engineering.

C. ANNUAL LABORATORY REPORT

STATISTICAL CONSULTING LABORATORY by Sunil K. Dhar

The Mathematical Sciences faculty serves the NJIT community and outside individuals and organizations, as statistical consultants. Here are examples of a few of them.

Date: March 2004 Client: Ph.D. Student Johnathan Dalco, of Professor Athanassios Bladikas, Industrial Manufacturing Engineering, NJIT.
Description: read the problem and statistical aspect of his dissertation proposal, "Developing Operating Cost Models for Bus Transit System Using Multivariate Statistical Regression" and pointed some refinements to the proposal.
Consultants: Ph.D. student Soumi Lahiri and Sunil K. Dhar

Date: Spring 2004 Client: Ph.D. Student Viswanath Neelavalli, of Dr. Vincent Oria, Department of Computer Science, NJIT.
Description: Helped with reading linear Model based journal article and discussed Carleman Moment conditions for uniqueness of distributions and related research towards digitized image processing. Consultant: Sunil K. Dhar

Date: December 2003 Client: Triton Development, Inc.
Description: Consulting Agreement to perform mathematical and statistical modeling for analysis of baseball problems. Consultants: Professor Bruce Bukiet,and Ph.D. student Ivan Zorych

Date: November 2003 Client: Frederic B. Bogui, Special Lecturer, School of Management, NJIT
Description: Advice on appropriate statistical methodology for analysis of data collected for his research study, Compare cash management practices in public and private sectors at the environmental, organizational and individual levels.
Consultants: Ph.D. student Soumi Lahiri and Professor M.C. Bhattacharjee

IX. CURRENT AND COLLABORATIVE RESEARCH

A. 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 primary focus of the research by Manish C. Bhattacharjee is on applied probability with particular emphasis on reliability theory and corresponding statistical issues arising in stochastic modeling of system performance and degradation. His studies in statistical reliability theory covers the topics of nonparametric classes of survival distributions, their closure properties under formation of systems with similarly aging components, related characterization problems, repairable systems and non-traditional applications of reliability theoretic methods and ideas to other areas such as (i) queueing - in operations research, (ii) branching processes in applied probability, and (iii) modeling economic inequality. His current projects include investigation of

conditions for shape-duality between hazard rate and mean residual life functions, and closure properties of randomly stopped sums with geometric stopping times that arise in many applications, such as in queueing, ruin probability problems in actuarial science, and shock models of failure.

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 also has collaborated 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, and collaborative studies on bubble dynamics and slow, localized thermal waves in material processing.

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 studies biological systems with regard to stresses in the heart. His current focus in biology concerns flow in the lungs with the goal of improving medical treatments. Professor Bukiet also is interested in understanding and optimizing aspects of baseball from a mathematical modeling perspective.

Cameron Connell

Cameron Connell's current interests are in applications of mathematics to materials science. The focus of his work is on the interface between atomistic and continuum methods for modelling materials. This is driven by its fundamental role in the current drive for multiscale modelling of materials. He is particularly interested in applications to the modelling of epitaxial growth of semiconductors and metals.

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 involve deriving new multivariate geometric and the generalized discrete analog 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.

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.

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.

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.

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 functional genomics. His study of biomolecular modeling and simulation addresses the multiscale nature of the biological systems. He has designed a family of multiscale large timestep molecular dynamics integrators to reduce drasticly the amount of time needed in solving the very large set of ordinary differential equations. These integrators are also applicable in the study of nano fluidic systems. His study of functional genomics deals with fast and accurate determination of genotypes in high-throughput single nucleotide polymorphism multiplex PCR genotyping microarray experiments. He has invented novel methods using support vector machine (SVM), a machine-learning method, for solving this problem and got encouraging results. The results of genotyping determination will aid the analysis of concerted behavior of certain genes that regulate cancerous proliferation of cells. Ultimately, in conjection with other methods, his research will help achieve the goal of personalized genomic-level treatment of many types of cancers. He also studies the gene annotation problem via gene expression profiling microarray experiments. The idea is to add the missing annotation for the genes that are involved in certain functions in which other genes already have annotation. More complete annotation of gene functions leads to more accurate understanding of life in the genomic level.

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").

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 involves 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 BVP's for (contingent) ordinary and elliptic PDE's, to periodic and BVP's 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, includes analysis and simulations of partial differential equation models. Diffusion of ions in the brain is studied using the lattice Boltzmann method.

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.

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.

Thomas Spencer

The research of Thomas Spencer III has focused on the applications of statistics, and operations research to large scale business problems, especially those that arise out of operational issues in call centers. For his work on simulating call centers, he received the Franz Edelman Award in 1993 from the Institute of Operations Research and the Management Sciences. He also has done work on the distributions of waiting times associated with sequences of exchangeable random variables. In addition he has an active interest in statistics and probability in sports, and the analysis of sports data.

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.

B. SELECTED RESEARCH RESULTS

Oleh Baran and Lou Kondic

Denis Blackmore and Yuriy Mileyko

Amitabha Bose, Christina Ambrosio, and Farzan Nadim

Sunil Dhar

Daniel Goldman

Roy Goodman

David J. Horntrop

Lou Kondic and Tetyana Segin

Victor Matveev

Zoi-Heleni Michalopoulou

Michael Siegel

Louis Tao

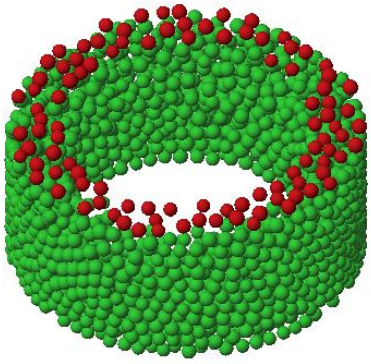
Oleh Baran and Lou Kondic

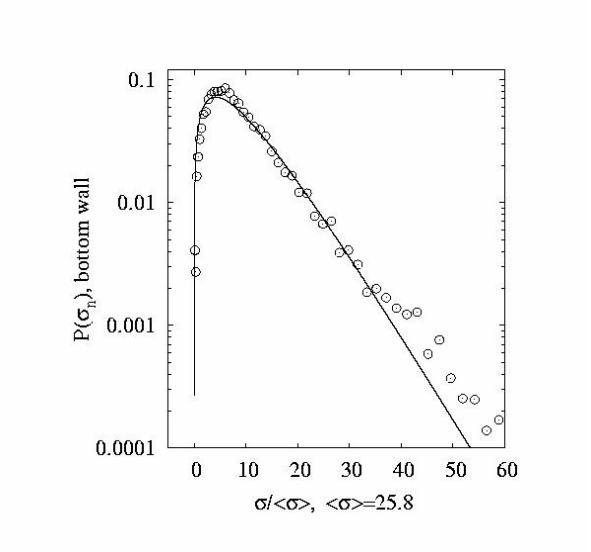
Title: Study of normal stress distributions in low volume faction granular systems in zero gravity

Granular systems are known to generate stresses that often cannot be described by Gaussian distribution. It is also known that the granular systems can be found in different states, such as close packed, random packed, crystallized, fluidized, etc. Each state can be characterized by different distribution of stresses inside the system or on the boundaries. For example the stresses in dense static granular system are characterized by the distribution with power-law increase of probability for low stresses and exponential decrease for high stresses. Few models have been suggested to explain these distributions. One of the most successful model is a q-model which predicts the distribution with power-law increase characterized by power n=2 and exponential tail. However, little is known about the distribution of stresses in 3D granular systems of lower volume fraction. One of the reason is that all typical experimental studies are conducted in the presence of gravity which compacts the system to the state of volume fraction > 55%.

In my current research I use computer simulations to study stress distributions in the systems of 40% volume fraction in the absence of gravity. The typical set-up includes frictional and inelastic particles placed between two concentric cylinders. The top wall of the container (Couette cell) is covered with particles glued to its surface and is rotated around the vertical axes of the cell, inducing the shear in granular layer. Figure 1 shows the one-time frame of our granular layer in described set-up, with glued particles colored red.

Figure 2 shows a typical Probability Distribution Function for normal stresses, registered by the grid of numerical "sensors" placed on the bottom wall of Couette cell. The distribution data are fitted with the functional form similar to the q-model function, but with different power parameter n. The knowledge of the functional form of distribution allows to predict the stresses and their distribution obtained using different sizes and time responses of "sensors". As is shown in my research, in certain regimes these predictions fail, indicating the presence of spatio-temporal correlations between particles.



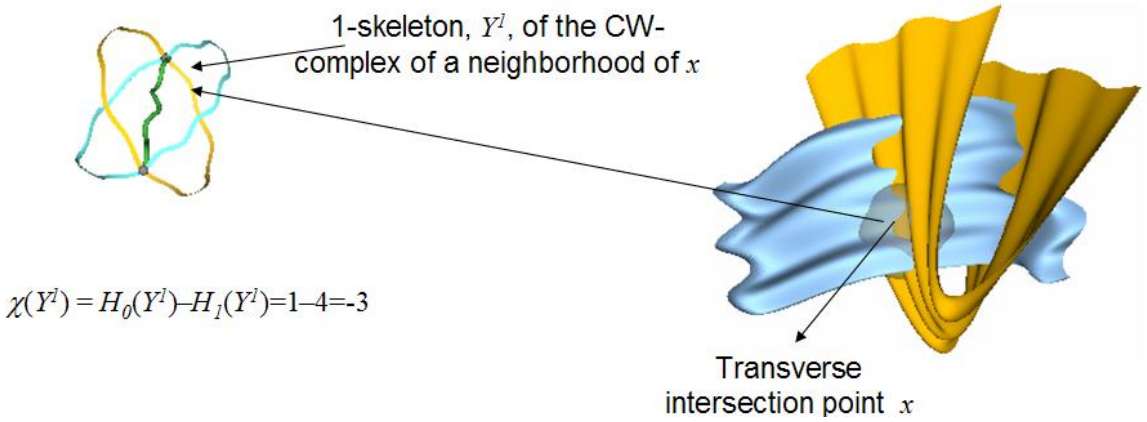


(Supported by NASA)

Denis Blackmore and Yuriy Mileyko

Title: Computational Topology of Swept Volumes

The figure shows how the intersection points of swept surfaces can be detected by topological (homology) invariants that are effectively computable (calculable by an algorithm). It portrays the essence of the new field of computational topology, which is concerned with the algorithmic analysis and rendering of geometric objects in ways that preserve topological characteristics. We are studying swept volumes – geometric configurations comprised of the totality of points traversed by an object as it moves (and possibly deforms) through space. By employing techniques from dynamical systems, singularity theory and topology, we have developed accurate, efficient, shape preserving programs for analyzing and representing swept volumes - such as the one used to create the figure. These programs also are being applied to problems in virtual design and manufacturing, and the modeling of heterogeneous biomaterials, such as bones.



(Sponsored by an NSF/DARPA)

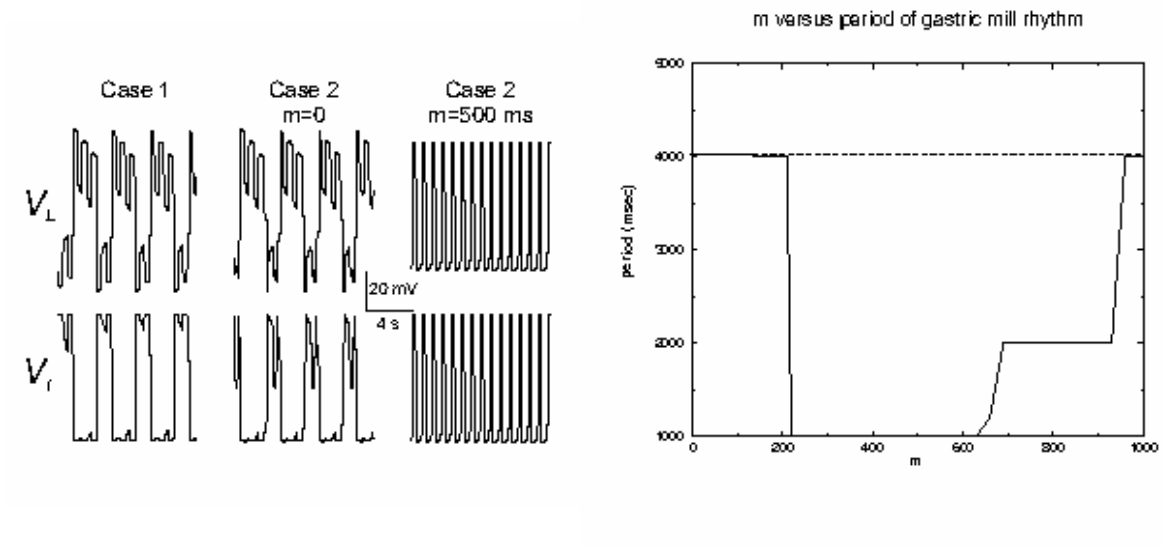
Amitabha Bose, Christina Ambrosio, and Farzan Nadim

Title: The Effect of Modulatory Neuronal Input on Gastric Mill Frequency

Neuronal networks involved with coordinated rhythmic behaviors are often associated with half center oscillators. The stomatogastric ganglion (STG) of the crab Cancer borealis is one such network and, thus, provides a useful means of studying rhythmicity. The rhythmic neuronal activity generated by the stomatogastric ganglion subnetwork, the gastric mill, is generated by the interaction of the neurons lateral gastric (LG) and interneuron 1 (Int1) which form an asymmetric half center oscillator. The frequency of this subnetwork is controlled by slow excitatory input from modulatory commissural neuron 1 (MCN1) to LG and fast, periodic inhibition from the pyloric network pacemaker neuron, anterior burster (AB), to both Int1 and MCN1. The AB inhibition of Int1 has the effect of periodically disinhibiting LG while the AB inhibition of MCN1 has the effect of periodically removing the slow excitation to LG.

We investigate the effects of these synaptic inputs on the gastric mill cycle frequency by constructing a reduced model of the gastric mill network in which we regulate the strength and timing of the inputs. We show that when there is little or no time delay between the AB input to MCN1 and the direct AB input to the gastric mill, which is the normal situation in the STG, the disinhibition of LG is countered by the removal of excitation from MCN1 to LG. In this case, the slow excitation from MCN1 alone dictates the gastric mill cycle frequency. In contrast, with a large delay in the timing of the AB input to MCN1 and to Int1, the disinhibition of LG does not coincide with the AB inhibition of MCN1. Thus, the effect of the AB disinhibition of LG is not mitigated by the periodic removal of the MCN1 excitation to LG. In this case the slow excitatory input from MCN1 and the fast input from AB work together to set the gastric mill cycle frequency.

The figures below show the voltage traces of Int1 and LG for two different cases. Case 1 occurs when there is no input from AB to Int1. For case 2, we show results from two different values of m, the synaptic delay between AB activity and its effect on Int1. As shown in the Figures, the period of case 1 and case 2 (m=0) are identical, although the voltage traces differ slightly, indicating that MCN1 alone sets the frequency. When m=500, both AB and MCN1 contribute to frequency selection.



(Supported by the National Science Foundation)

Sunil Dhar

Title: Kolmogorov - Smirnov Type Test for Goodness-of-Fit

Let $X_1,\ldots,X_n$ be a random sample from uniform (0, 1). Let x be any real number strictly between 0 and 1. Then this ideal random sample should satisfy the fact that the number of data points out of n whose magnitude is below x, is distributed binomial with parameters n, x. Even if one of these tests fail then the data would fail to be a random sample. The test that reflects this feature is described as follows. Let $F_n(x,\omega)=\dfrac{\sum_{i=1}^{n} I(X_i \le x)}{n}$ and $T=\underset{0\le x\le 1}{Sup}\dfrac{\left|\sqrt{n}\left\{F_n(x,\omega)-x\right\}\right|}{\sqrt{x(1-x)}}$.

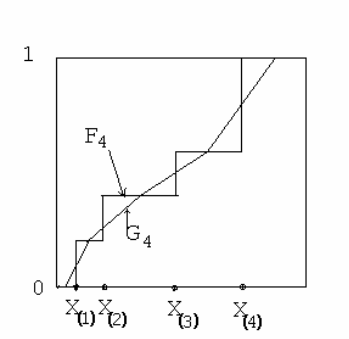
Reject H_o: the data is a random sample from Uniform (0, 1) if T > C. Notice that this test not only takes the independence into account due binomial trials but also the fact that the data is identically distributed, under "success" probability for each trial has to be the same.

Now, let $X_1,\ldots,X_n$ be a random sample from any distribution F. Then, make the transformation $z=F^{-1}(x)$, and $F(X_i)$ is distributed Uniform (0, 1), when F is continuous, these give motivation to define the test statistics in the general case as

$$T=\underset{z:0\le F(z)\le 1}{Sup}\frac{\left|\sqrt{n}\left\{F_n(z,\omega)-F(z)\right\}\right|}{\sqrt{F(z)[1-F(z)]}}.$$

Serfling (1980) shows that it is enough to study the limiting distribution of T when sample is drawn from uniform distribution. The preceding statement follows from the fact that if F is continuous then $F(X_1),\ldots,F(X_n)$ forms a random sample from Uniform (0,1). The Central limit theorem gives T for each fixed 0 < x < 1, converges in distribution to the standard normal random variable. As in Billingsley (1968) we reproduce Figure 1 below to see that $F_n(x,\omega)$ can be approximated by a piece wise linear function $G_n(x,\omega)$ that is continuous on [0,1] and is such that

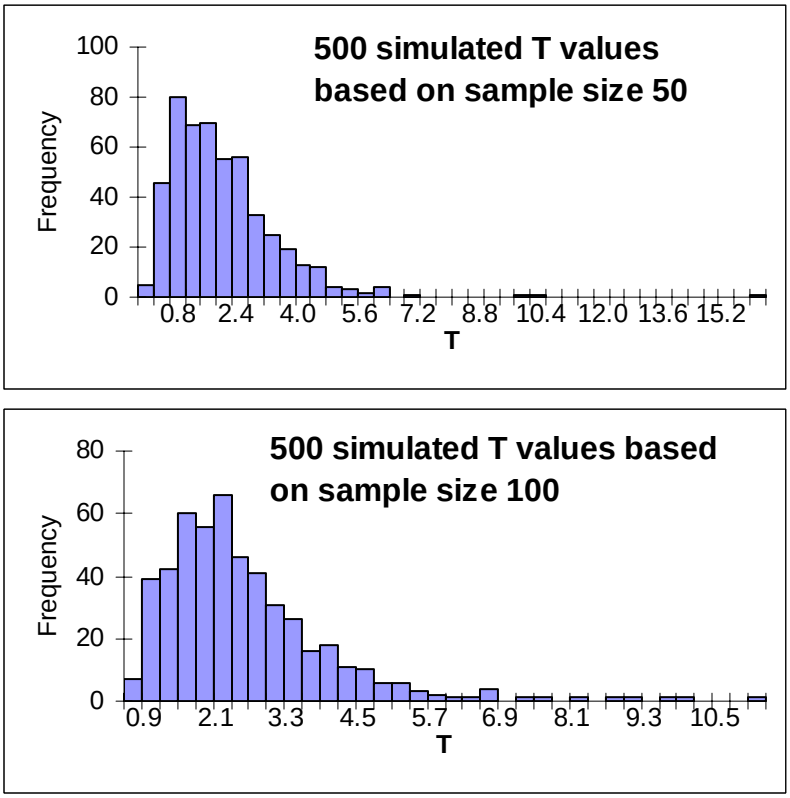
Figure 1



$\underset{0\le x\le 1}{Sup}\sqrt{n}\left|F_n(x,\omega)-G_n(x,\omega)\right|\le\dfrac{1}{\sqrt{n}}$. In light of this, assuming F_n can be replaced by G_n, one intuitively can guess the sup norm convergence of T to the folded standard normal. To evaluate this fact, a program in C++ (please see Appendix) was written to create 500 sets of random numbers. Each set had 50 or 100 random numbers in it. The above sup norm statistics was computed for each of the data sets. Note that the sup computation reduced to a finite search of the function inside the sup at the boundary points based on the ordered data. The graph created (Figure 2) for the two sample sizes shows the distribution right skewed and certainly not folded in the center.

Dhar (continued)

Figure 2

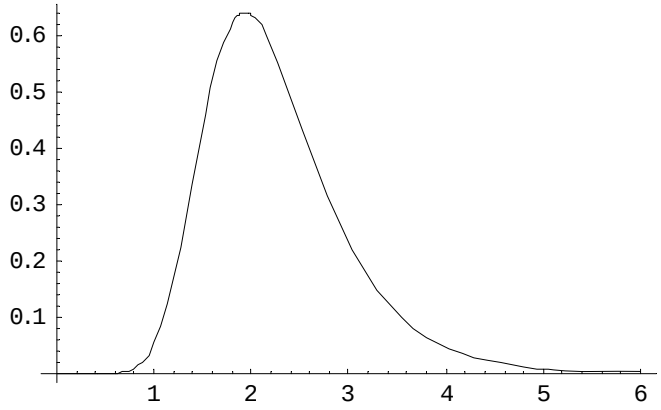


Interestingly, Csáki, Endre (1984, p. 415) points out that the stabilized version of T's limiting distribution was found by Jaeschke (1979) and is given by

$$P\left(A_n \underset{0\le x\le 1}{Sup} \frac{\left|\sqrt{n}\left\{F_n(x,\omega)-x\right\}\right|}{\sqrt{x(1-x)}} - B_n \le y \right) = \exp\left\{\frac{-2\exp(-y)}{\sqrt{\pi}}\right\}, \text{ where } A_n = \sqrt{(2\log\log n)},$$

$B_n = 2\log\log n + \frac{1}{2}(\log\log\log n)$ and the log is to the base e. Using n = 100 we will get the graph of the approximate density of T. Please see Figure 3 below. The graphs in Figure 2 are consistent with those in Figure 3.

Figure 3

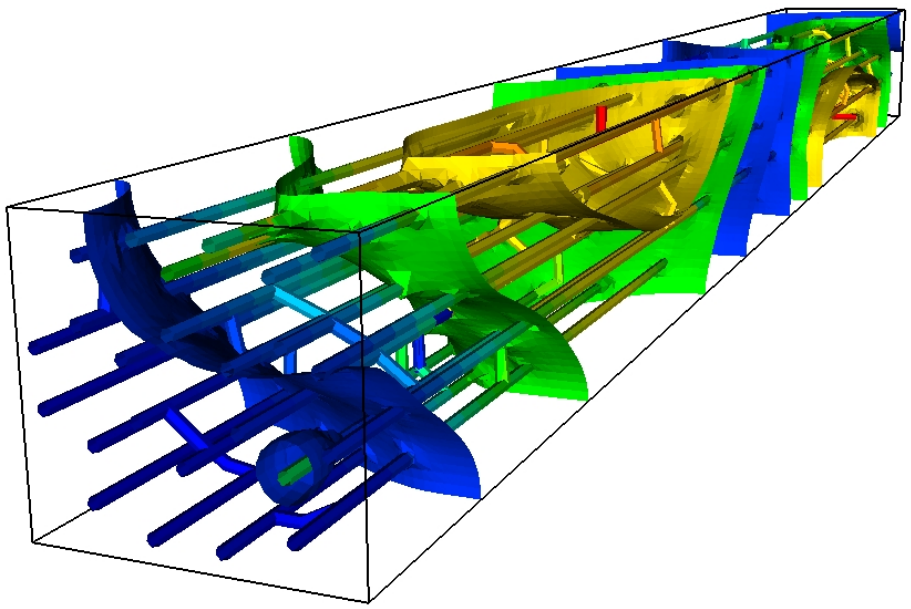


Daniel Goldman

Title: Oxygen Transport in the Heart During Sepsis

We have been performing numerical simulations of oxygen transport in skeletal muscle capillary networks under various control and sepsis conditions in order to determine how observed changes in blood flow affect tissue oxygen delivery and utilization, and now are beginning similar studies in the heart. We are investigating how the degree of microvascular injury caused by sepsis impacts the spatial heterogeneity of oxygen transport and the occurrence of localized tissue hypoxia. Shown is a simulated three-dimensional capillary network in the heart, where two feeding arterioles (red segments) and four draining venules have been included. The blood vessels are color-coded according to their oxygen partial pressure (PO2), and oxygen distributions in the surrounding tissue are visualized using PO2 isosurfaces. Red and blue represent high and low oxygen, respectively, and in particular, the isosurfaces shown correspond to 1 (blue), 10 (green), and 25 (yellow) mmHg.

The results shown are for normal capillary network geometry, but with reduced overall blood supply, producing significant hypoxia. Current work aims at studying the effect on O2 delivery of increased numbers of stopped- or low-flow capillaries, as is observed in sepsis.



(Supported by the Whitaker Foundation)

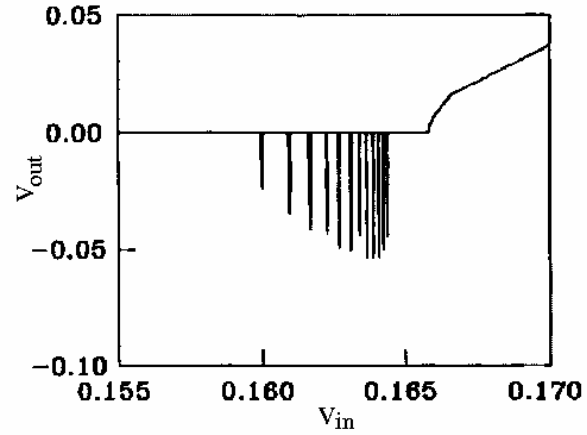
Roy Goodman

Title: The Two-Bounce Resonance in Wave Interactions (with R. Haberman)

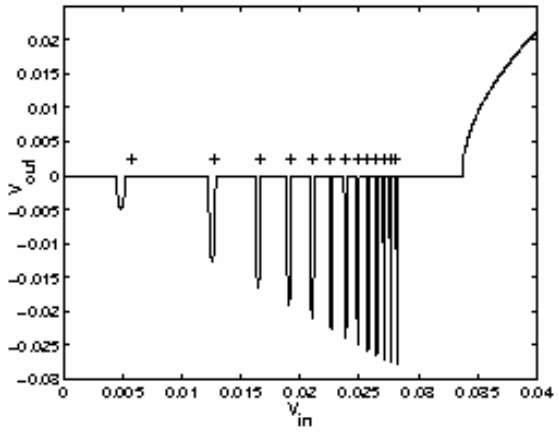
The two-bounce resonance is a phenomenon that has been seen in equations modeling many physical systems: including light-pulse interactions in birefringent optical fibers and planar domain-wall interactions in cosmology, as well as in many canonical nonlinear wave equations. The phenomenon arises in systems where a solitary wave (a localized solution that propagates at constant velocity) is initialized traveling toward a localized defect in the medium through which it travels. Above a critical speed, the wave passes by the defect. Below this critical velocity, most waves are trapped at the location of the defect, except a few in "resonance" windows, which are instead reflected. A similar phenomenon is seen in the collisions between traveling waves. This is shown in the computations of Fei, Kivshar, and Vazquez of Fig. 1 for "kink" solitary waves in the sine-Gordon problem. The output velocity is shown as a function of the input velocity.

A qualitative understanding of this phenomenon is that energy is extracted by a secondary mode of vibration. If enough energy is lost, the solitary wave does not have enough energy to pass the defect and gets captured by the defect. At certain velocities, the secondary mode is able to hand the energy back to the propagating wave, which leads to the reflection windows. We have developed a general theory for such problems that allows us to estimate the critical velocity as well as the initial velocities necessary for resonant reflection. This involves use of the Melnikov integral method from dynamical systems, and matched asymptotic expansions. We have applied this to the sine-Gordon problem, and found excellent qualitative agreement (Fig. 2). (Our predictions are shown by the '+' signs.) We have applied this to other systems with similar success.

(Fig. 1)



(Fig. 2)

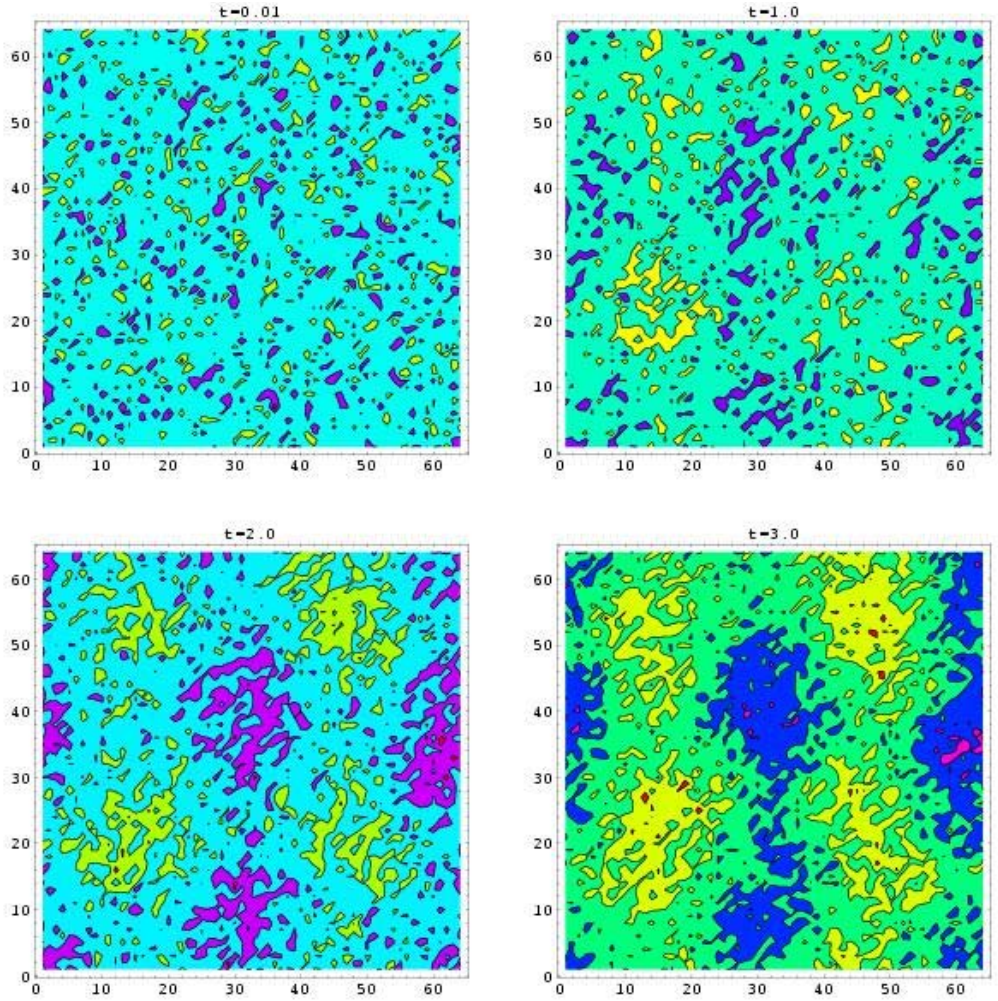


(Supported by the National Science Foundation)

David J. Horntrop

Title: Simulation of Mesoscopic Models for Surface Processes

The spontaneous self-organization of particle into larger structures is a commonly observed phenomenon in materials science. A better understanding of the rate of the self-organization and the mechanism driving this behavior would be beneficial in the design of catalytic surface reactors as well as in the creation of advanced materials. One means by which this behavior can be studied is through the use of mesoscopic models. Mesoscopic models are stochastic partial differential equations which are derived from microscopic dynamics yet involve macroscopic variables. The results given below are from numerical simulations of mesoscopic model equations using recently developed spectral schemes for stochastic partial differential equations. These plots contain a time series of contour plots where regions of low concentration are depicted with yellow whereas regions of high concentration are depicted with dark blue/purple. The first picture in the upper left-hand corner shows the very small, randomly located regions where the concentration differs from its mean value by more than 5% after a very short simulation time. As time evolves, these regions quite noticeably become much larger reflecting the self-organization that occurs.



(Supported by the National Science Foundation)

Lou Kondic and Tetyana Segin

Title: On Undercompressive Phenomenon in Two-Layer Gas-Liquid Flows

We consider the problem of two immiscible viscous fluids in a vertical thin channel flowing under gravity and imposed pressure forces. We report the results of numerical simulations of a coupled nonlinear system of partial differential equations describing the evolution of the interfacial thickness and the leading-order pressure. These equations are obtained through a lubrication approximation of the conservation of mass and the Navier-Stokes equations. We follow the air-water case, which is found in a variety of engineering systems.

We consider the different ways to drive the flow: either by fixing the volumetric flow rate of the gas phase or by fixing the total pressure drop over a downstream length of the channel, or by fixing liquid flow rate and gas pressure drop. In all three cases, we find that the undercompressive shock paradigm found in Marangoni-driven fluid layers is applicable in the counter-current flow regime (gas and liquid moving in the opposite directions). Small differences in the upstream and downstream interfacial height results in the formation of Lax shocks (Fig. 1). Larger differences in the upstream and downstream heights result in the combination of undercompressive and Lax shocks (Fig. 1b). Increasing this differential still further results in the formation of undercompressive shock and rarefaction wave (Fig. 1c,d). In the case of the flow driven by a constant pressure drop and a given liquid flow rate, we observe the unsteady growth of the interfacial profiles in all cases.

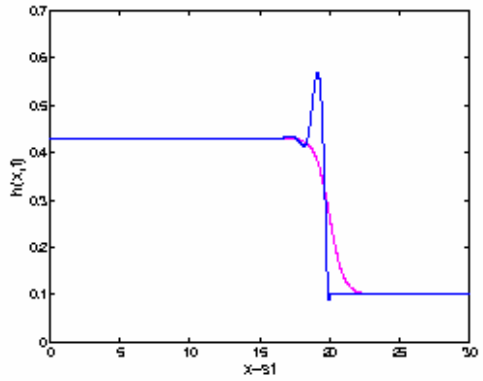


Fig. 1

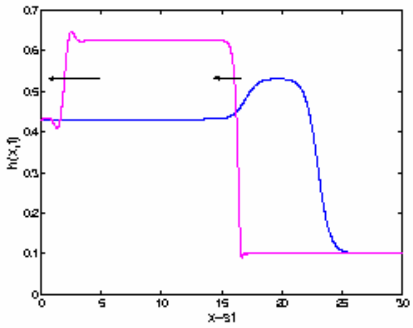


Fig. 1b

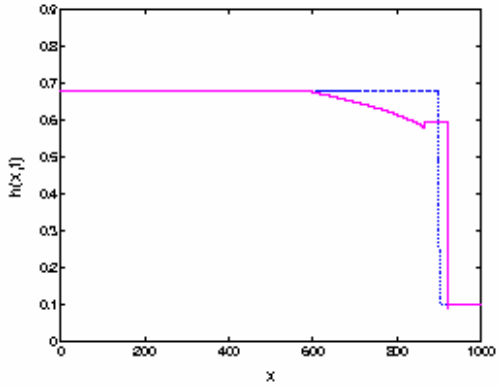


Fig. 1c

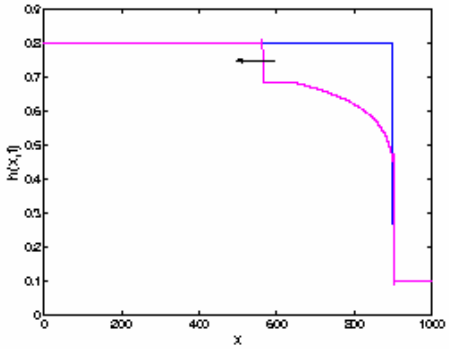


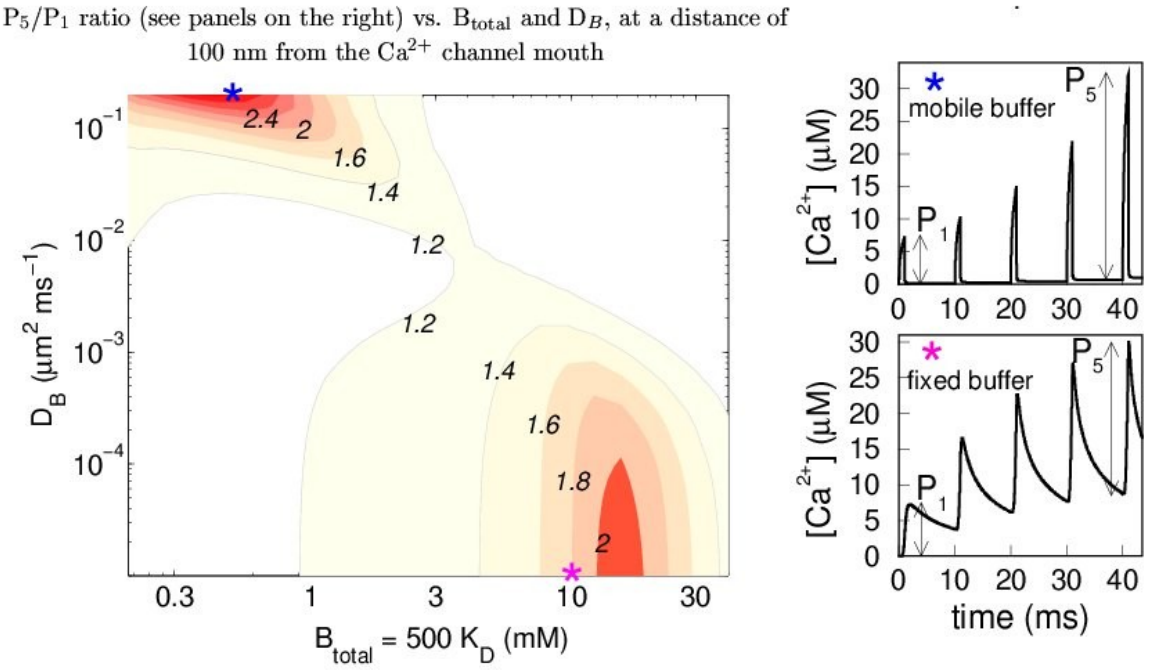
Fig. 1d

Victor Matveev

Title: Synaptic Facilitation Through Saturation of Endogenous Calcium Buffers: Dependence on Buffer Mobility and Concentration.

The reliability of inter-neuronal synaptic information transmission is not constant but changes on many different time scales, a phenomenon termed synaptic plasticity. While long-term plasticity is believed to underlie learning and memory, much more prevalent is short-term plasticity, which is likely to play an important role in regulating the dynamics of neural activity on fast time scales. Synaptic facilitation is one of the ubiquitous forms of short-term plasticity, exhibited by practically all synapses under appropriate conditions.

Although facilitation is known to depend on the presynaptic accumulation of residual calcium (Ca2+), its precise mechanism is under debate. It has been proposed [1] that facilitation may result from the saturation of endogenous Ca2+ buffers (the intracellular substances that bind Ca2+). According to this hypothesis, buffers get gradually depleted by the intracellular Ca2+ accumulating during sustained synaptic stimulation, leading to an increase in the peak Ca2+ transients achieved during each successive action potential, and thereby to an increase in synaptic response. Recently such buffer saturation mechanism was shown to underlie facilitation at certain mammalian central synapses [2]. In this work we use computational modeling of buffered Ca2+ diffusion to explore the conditions on endogenous buffering properties required to produce significant facilitation of Ca2+ transients (FCT) due to buffer saturation.



Matveev (continued)

The Figure demonstrates some of our results, showing the ratio of the last and the first Ca2+ transients produced in response to a five-pulse train of model action potentials (see panels on the right), as the buffer's concentration and diffusion coefficient are being varied (left panel). Interestingly, one sees that FCT depends non-monotonically on the total buffer concentration (B_total), reaching its maximum at a certain optimal buffer concentration for any given fixed value of mobility (D_B). Further, FCT is also non-monotonic with respect to the buffer mobility: curiously, significant FCT requires either a highly mobile buffer (parameter point marked by a blue asterisk on the left corresponds to the [Ca2+] trace on upper right), or a highly immobilized buffer (left panel, magenta asterisk, and the [Ca2+] trace on lower right). Therefore, our results point to an existence of two qualitatively distinct facilitation/buffering regimes: whereas in the mobile buffer case facilitation results from the global (whole-synapse) saturation of an endogenous Ca2+ buffer, in the fixed buffer case it becomes possible for a buffer to absorb a significant fraction of the Ca2+ influx before it reaches the relevant Ca2+ sensor (i.e. buffers saturate locally), resulting again in a high FCT magnitude. The low-mobility FCT peak is located to the right of the high-mobility peak, since local saturation (local Ca2+ influx entrapment) requires much greater buffer concentration. Further, the lower right trace shows that under the fixed buffer condition, facilitation receives a significant contribution from the accumulation of residual Ca2+. These results further clarify the important influences that the Ca2+ buffers exert on the dynamics of intracellular Ca2+ accumulation.

References:

[1] Klingauf J, Neher E (1997) Modeling buffered Ca2+ diffusion near the membrane: implications for secretion in neuroendocrine cells. Biophys J, 72:674-690; Neher E (1998) Usefulness and limitations of linear approximations to the understanding of Ca2+ signals, Cell Calcium, 24:345-357.

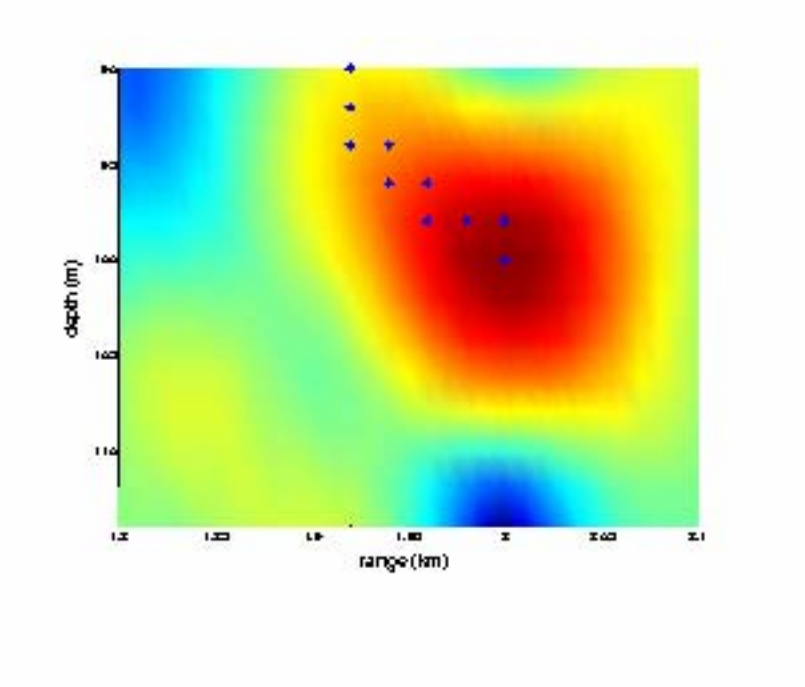
[2] Blatow M, Caputi A, Burnashev N, Monyer H, Rozov A (2003) Ca2+ buffer saturation underlies paired pulse facilitation in calbindin-D28k-containing terminals. Neuron, 38:79.

Zoi-Heleni Michalopoulou

Title: Global Optimization for the Solution of Non-Linear Inverse Problems

We have developed a Tabu global optimization scheme for source localization and geoacoustic inversion with acoustic data. The method exploits memory for an efficient navigation of the search space and has been tested on synthetic and real data with impressive results both in terms of accuracy and computational speed.

In global optimization for the solution of non-linear inverse problems, it is of particular significance to identify the manner in which correlated parameters are handled. Inversion methods are faster when they ``climb up'' high correlation ridges following the directionality of each ridge. The figure below shows how Tabu deals with the correlated parameters of source range and depth in a source localization application; circles identify the points visited by Tabu and are superimposed over a Bartlett ambiguity surface. The search starts from an initial condition of 1.9~km and 90~m for range and depth; it then quickly identifies the direction of maximum change in the correlation-objective efunction. Without additional moves outside the high correlation direction, the process climbs up the ridge to identify the global maximum at 2 km in range and 100 m in depth.



(Supported by the Office of Naval Research)

Michael Siegel

Press Release for publication in *Science*

Hanging by a Thread: Persistent Memory in a Dripping Drop Leads to Unexpected but Potentially Useful Discovery

Scientists have long believed that the breakup of all fluids, whether produced by a dripping faucet, a splashing fountain or the sun's boiling surface, exhibit the same type of dynamics. Now a group of scientists has discovered an exceptional dynamic associated with the breakup of a water drop in a highly viscous oil. This dynamic could potentially be used to create microscopically small fibers, wires and particles.

The discovery will be announced in the Nov. 14 issue of Science by researchers at the University of Chicago, Purdue University, Harvard University, the New Jersey Institute of Technology and the University of Oxford.

The path to discovery began when Itai Cohen, currently a postdoctoral scientist at Harvard, was a graduate student at the University of Chicago in 1999. For one of his experiments he dripped water into viscous oil and saw a smooth parabolic shape near the narrowest point, which then transformed into a long and thin thread just shortly before breakup. This is unlike any of the previously observed breakup dynamics.

Cohen and Sidney Nagel, the Stein-Freiler Professor in Physics at the University of Chicago, enlisted the aid of Purdue's Osman Basaran, who ran a series of computer simulations on the water-in-oil breakup process. The simulations conducted by one of his students, Pankaj Doshi, produced results that matched the experimental data and revealed in addition fine-scale details such as velocity and pressure data the experiment could not provide.

The new story emerged when theorists Wendy Zhang, Assistant Professor in Physics at the University of Chicago, Peter Howell at the Mathematical Institute in Oxford, and Michael Siegel of the New Jersey Institute of Technology were able to show that the smooth profile observed is associated with drop breakup dynamics that is driven by a uniform inward collapse of the viscous oil outside the drop. Zhang first noticed the possibility of this breakup mode in graduate school, but dismissed it because it occurs only if the inside of the drop is essentially stationary, "something that no sensible person would think happens because here's a drop, it's breaking. Of course the things inside have to be moving out of the way!" Zhang said.

Independently, Siegel had run across the same breakup mode and was working with Howell on the theory. A chance conversation between Siegel and Zhang at a meeting led to the eventual collaboration. ``Before meeting Wendy, I had only been thinking about the theoretical possibilities,'' said Siegel. "To see these possibilities actually realized in the experiments has been eye-opening.''

This apparently impossible dynamic is achieved by the breakup of a water drop in oil because the motion of the water in the drop's interior is much faster than the motion of the viscous oil on the outside, so that the interior always settles down much faster than the exterior flow. This makes the interior appear static.

As breakup is approached, the two flows become more comparable. This results in the sudden transformation of the smooth parabolic neck into a long and thin thread, estimated to be two millimeters (eight hundredths of an inch) in length, and eight microns wide (about a tenth the width of a human hair).

"This breakup dynamic is exceptional in that it preserves a memory of the drop shape before breakup down to very small length-scale, right down to the point when the thin thread forms," Zhang said.

Before its discovery, scientists believed that when a liquid drop breaks, the process of breakup always erases all memory of conditions at the onset of breakup.

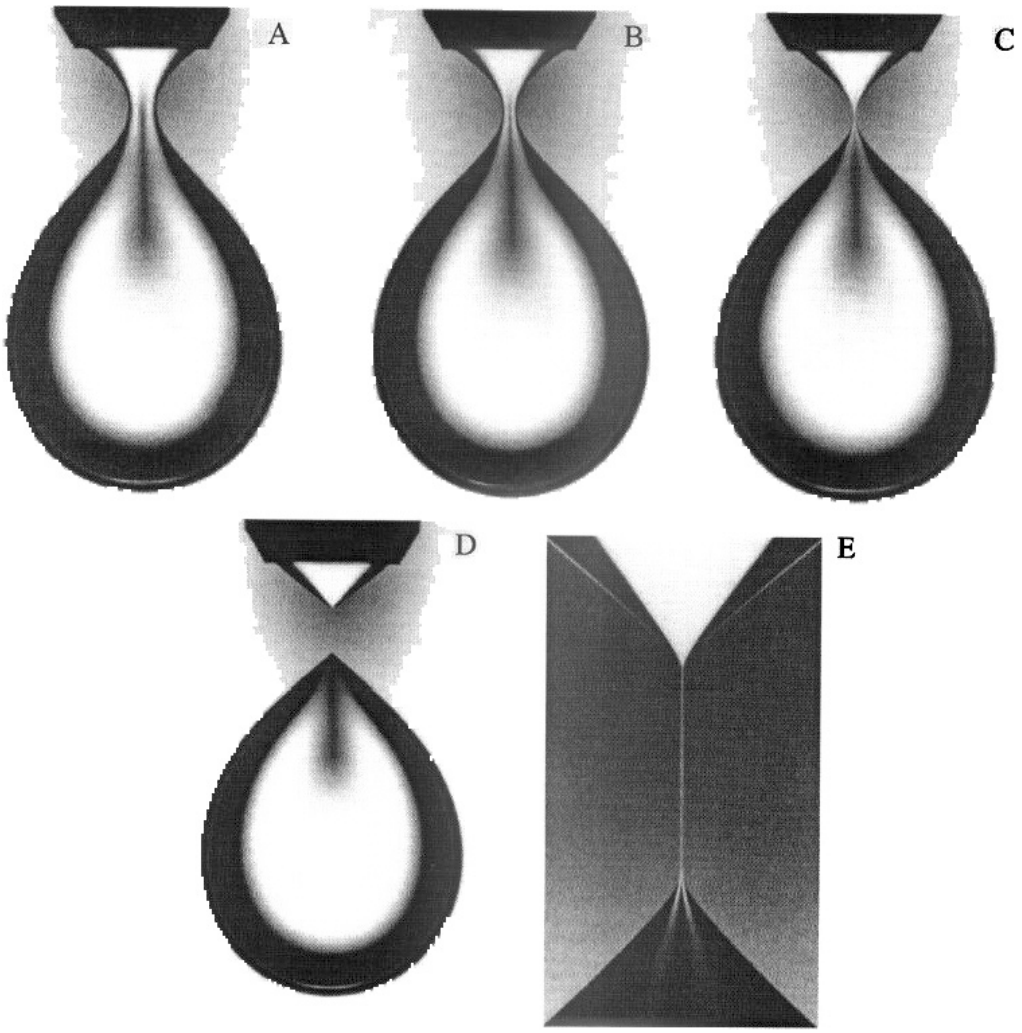
The persistence of memory during breakup and the subsequent formation of the thin thread potentially opens the way to a new method for producing microscopic structures for electronics, pharmaceuticals and other applications by manipulating fluids on a millimeter scale.

The scientists are quick to point out that despite this new understanding, some aspects of the breakup process remain mysterious. "This drop is breaking up in a way that's very inconvenient: by developing such a long and thin thread right before breakup," noted Zhang. "It certainly wouldn't be the way I would do it if I were to prescribe how a drop breaks."

Siegel (continued)

Nagel noted that the project could only have achieved success by bringing together a team of experimentalists, theorists and simulators.

"Everybody had a little piece of the action," Nagel said. "It never would have gotten anywhere without experiment, but it wouldn't have been understood without theory and we wouldn't have known how to connect the two in any way whatsoever if it hadn't been for the simulation.



Experimental results for a water drop dripping through silicone oil. (A to C) Initial stages of the breakup show a parabolic interfacial profile, as predicted by asymptotic theory. (D) Effect of drop viscosity alters the drop shape from a parabola to one with a long thin thread at the minimum. (E) A close-up of (D). (Reprinted from Doshi et. al., Science, Vol. 302, November 14, 2003).

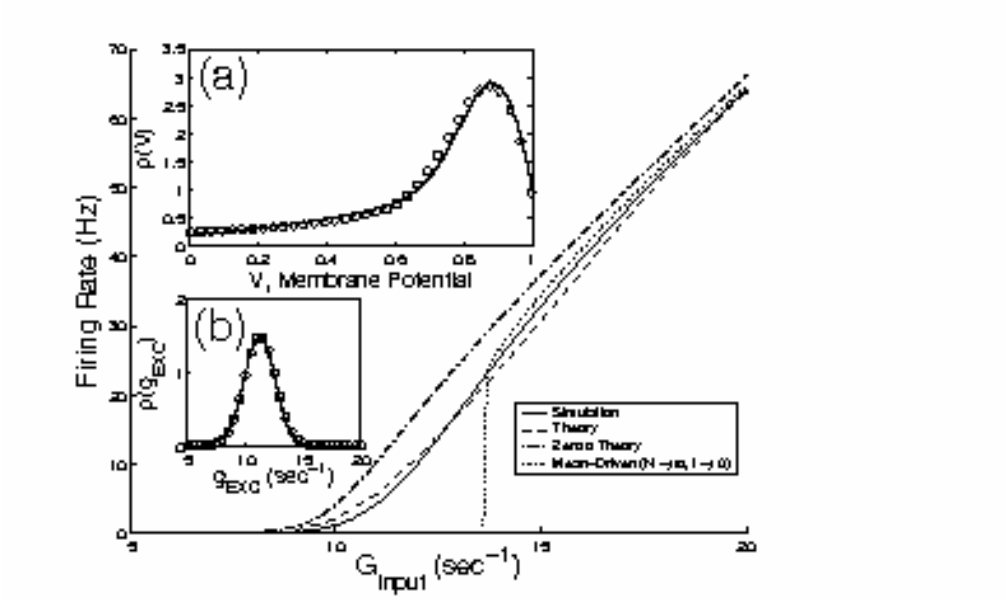
Louis Tao

Title: An effective kinetic representation of fluctuation-driven neuronal networks with application to simple and complex cells in visual cortex

(with David Cai, Michael Shelley, and David W. McLaughlin)

We develop a new coarse-grained representation of neuronal network dynamics directly from the original large-scale integrate-and-fire (I&F) network. This theory captures the full dynamic range of neuronal networks from the mean-driven to the fluctuation-driven limit, where the time-averaged input is not sufficiently strong to evoke spiking. Using this new representation, analytic insight can be achieved. This is illustrated by a study of the dynamical properties of networks in the visual cortex, which exhibit rich dynamic phenomena, such as bistability and hysteresis, even in the presence of temporal fluctuations. Understanding a) how temporal fluctuations affect network dynamics and b) which neuronal parameters control fluctuations allow us to model networks in visual cortex, which will be detailed in publications under preparation.

This figure shows direct comparison between the predictions of kinetic theory with full numerical simulations of the I&F network and can be found in our recent publication in Proc. Natl. Acad. Sci. USA, Vol. 101, pp. 7757-7762 (2004). The main panel shows the average firing rate per neuron as a function of input strength. Our kinetic theory captures subthreshold behavior accurately and efficiently. Subpanels a) and b) compare the probability distributions of the membrane potential and excitatory conductances between simulation (solid curve) and theory (circles).



C. COLLABORATIVE RESEARCH

Daljit S. Ahluwalia

Trapped Modes, Aloknath Chakrabarti (Indian Institute of Science, Bangalore, India)

Roman Andrushkiw

Pattern recognition methods in computer diagnostics of cancer, Y. Petunin and D. Klyushin (Taras Shevchenko University, Kyiv), N.Boroday (Institute of Experimental Pathology and Radiology, Kyiv), V.Orel (Institute of Oncology, Kyiv), L.Bilaniuk (School of Medicine, University of Pennsylvania)

John Bechtold

Analytical Investigations of Self-Extinguishing and Self-Wrinkling Flames, M. Matalon and C. Cui (Northwestern University)

Modeling and Experiments of Premixed and Diffusion Flames, C. K. Law, S. W. Yoo, G. Jomaas, and H. Wang (Princeton University)

Denis Blackmore

Biocomplexity measures for salt marsh ecosystems, M. Levandowsy (Pace), J. Champanerkar (NJIT)

Algebraic dynamical systems, L. Ting (Courant)

Vortex field-shock interactions, L. Ting (Courant)

Vortex filament dynamics, O. Knio (Johns Hopkins), A. Prykarpatsky (Krakow), L. Ting (Courant)

Vortex dynamics on a sphere, C. Lim (RPI)

Phyllotaxis dynamics, J. Kappraff (NJIT)

Galton's board dynamics, A. Rosato (NJIT)

Deformational viscoelastic flows, P. Singh (NJIT)

Dynamics of suspended particles, J. Meegoda (NJIT), N. Aboobaker (NJDOT)

Periodic orbits and bifurcations in dynamical systems, J. Champanerkar (NJIT), C. Wang (Rutgers)

Computational topology, M. Leu (UMR), Y. Mileyko (NJIT), W, Regli and W. Sun (Drexel)

Infinite-dimensional integrable dynamical systems and their applications to quantum computing, A. Prykarpatsky (Krakow), V. Samoilenko (Kiev), U. Taneri (Wisconsin)

Victoria Booth

Hippocampal place cell firing in REM sleep and waking, Gina R. Poe (University of Michigan)

Modeling Neuromusculoskeletal Alterations after Spinal Cord Injury, Ranu Jung (Arizona State University) and James Abbas (Arizona State University)

Multistability in reciprocally connected inhibitory networks, A. Bose (NJIT)

Amitabha Bose

Determining the activity phase of post-synaptic neurons in feedforward networks, Yair Manor (Ben-Gurion University of the Negev, Bersheeva, Israel), and Farzan Nadim (NJIT)

Localized activity patterns in excitatory neuronal networks, J. Rubin (University of Pittsburgh)

Two-oscillator model of ventilatory rhythmogenesis in the frog, T. Lewis (New York University), Richard Wilson (University of Calgary)

Multistability in reciprocally connected inhibitory networks, V. Booth (University of Michigan)

Bruce Bukiet

Mathematical Modeling of Cricket, Matthew Ovens and Pam Norton (Monash University)

Modeling Postural Stability, T. Findley, K. S. Quigley, and M. Maney (VA Hospital East Orange), H. R. Chaudhry and Z. Ji (NJIT)

Modeling Flow in the Lungs, H. R. Chaudhry (NJIT) and S. Kirshblum (Kessler Institute for Rehabilitation)

Vladislav V. Goldberg

Veronese webs, M. A. Akivis (Jerusalem Institute of Technology)

Linearization problems for three-webs, V. V. Lychagin (University of Tromsoe, Norway)

Daniel Goldman

Microcirculatory blood flow and transport in skeletal muscle and heart during sepsis, C. G. Ellis, M. D. Sharpe (University of Western Ontario) and R. M. Bateman (University of British Columbia)

Experiment-based computational modeling of physiological oxygen transport in the microcirculation, C. G. Ellis (University of Western Ontario), R. M. Bateman (University of British Columbia), and A. S. Popel (Johns Hopkins University)

Oxygen transport by capillaries and capillary networks in the presence of hemoglobin-based blood substitutes, A. S. Popel (Johns Hopkins University) and N. Tsoukias (Florida International University)

The effect of different modes of angiogenesis on microvascular oxygen transport, A. S. Popel (Johns Hopkins University) and N. Tsoukias (Florida International University)

Jorge Golowasch

The Pyloric Model Group: Functional Analysis of a Complex, Distributed Biological Neural network, Ron Harris-Warrick (Cornell University, NY), Scott Hooper (Ohio University), Eve Marder (Brandeis University), Farzan Nadim (NJIT), and Michael Nusbaum (University of Pennsylvania)

Analysis of Space-clamp errors in geometrically complex neurons, Farzan Nadim (NJIT)

Roy Goodman

Bragg gratings in optical fiber communications, Michael Weinstein (Columbia University/Bell Laboratories)

Dynamical systems modeling of wave-defect interactions, Philip Holmes (Princeton University), Michael Weinstein (Columbia University/Bell Laboratories), and Richard Haberman (Southern Methodist University)

Roughening of solutions to nonlinear Schrodinger equations, Michael Weinstein (Columbia University/Bell Laboratories)

Dynamics and Pattern Formation in Myxobacteria, Louis Tao (NJIT)

David J. Horntrop

Mesoscopic modeling for pattern formation in materials, M. Katsoulakis, (University of Massachusetts) and D. Vlachos (University of Delaware)

Lou Kondic:

Flow of thin liquid films, J. Diez (University del Centro, Tandil, Argentina)

Stability of Two Fluid flows, B. Tilley (Olin College of Engineering)

Statistical properties of dense granular systems, R. Behringer (Duke University), C. O'Hern (Yale University)

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)

Effectiveness of numerical techniques for calculating the quantity of calcium species during calcium sparks in heart muscle, Joshua R. Berlin (UMDNJ)

Marc Qun Ma

Data exploration and analysis for high-throughput multiplex genotyping (RT-) PCR microarrays, H. Li, H-Y Wang, G. Yue, and M. Luo (UMDNJ-Robert Wood Johnson Medical School)

Partial Thermal Statting Molecular Dynamics
B. Leimkuhler (University of Leicester, UK) and Z. Jia (University of Leicester, UK)

Victor Matveev

Determination of the properties of endogenous calcium buffers at the crayfish neuromuscular junction using calcium fluorescence measurements, J.-W. Lin (Boston University)

Mechanisms of short-term synaptic facilitation, R.S. Zucker (UC, Berkeley) and A. Sherman (National Institutes of Health)

Control of bursting in pituitary somatotrophs, P. Roper and A. Sherman (National Institutes of Health)

Robert M. Miura

Traveling Waves of Spreading Cortical Depression, H. Ikeda (Toyama University, Japan)

Ion Diffusion and Spatial Buffering in the Brain, Y.Q. Wang (Royal Bank, Canada), H. Huang (York University, Canada), and B. Steinberg (University of Toronto, Canada)

Perturbation Analysis of Glass Microelectrode Formation, H. Huang (York University, Canada)

Spreading Cortical Depression - Continuum and Lattice Boltzmann Models, H. Huang (York University, Canada)

Protein Folding - Conformons and Frustrations in Protein-Like Lattices, S. Ji (Rutgers University) and W.J. Welsh (Robert Wood Johnson Medical School)

Cyrill Muratov

Modeling and computational analysis of cell communication in Drosophila oogenesis, S. Y. Shvartsman (Princeton University)

Pulse initiation in noisy excitable systems, Weinan E (Princeton University), Eric Van den-Eijnden (Courant Institute of Mathematical Sciences), and Weiqing Ren (Princeton University)

Existence of traveling wave solutions for Ginzburg-Landau-type problems in infinite cylinders, M. Lucia (Rutgers University) and M. Novaga (University of Pisa, Italy)

360-degree domain walls in thin film micromagnetics, V. Osipov (Hewlett-Packard Research Laboratories)

Demetrios T. Papageorgiou

Theory and experiment on the motion of a bubble with an adsorbed surfactant monolayer above the critical micelle concentration, Charles Maldarelli and Ashish Taneja (City College of New York).

Large amplitude capillary waves in electrified fluid sheets, and liquid films under normal electric fields, Jean-Marc Vanden-Broeck (University of East Anglia, Norwich, England)

Accurate and efficient boundary integral methods for electrified liquid bridge problems, Darko Volkov and Peter Petropoulos (NJIT)

Electrohydrodynamic mixing in microchannels, Nadine Aubry, Fu Li, and Peter Petropoulos (NJIT)

Dynamics and breakup of two fluid viscous liquid threads using asymptotic theories and experiments, Michael Siegel, Michael Booty, and Muhammad Hameed (all NJIT) and Charles Maldarelli (City College of New York)

Absolute and convective instability problems on the half-line, A.S. Fokas (Cambridge University)

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, R. Albrecht and P. Milewski (University of Wisconsin-Madison) and D. Edwards (University of Delaware)

Michael Siegel

Global existence, singular solutions and ill-posedness for the Muskat problem, S. Howison (Oxford University) and R. Caflisch (UCLA)

The evolution of a slender non-axisymmetric drop in an extensional flow, P. D. Howell (Oxford University)

Exact solutions for the evoution of a bubble in Stokes flow, a Cauchy transform approach, D. Crowdy (Imperial College, London)

Nonlinear stability of core annular film flows in the presence of surfactant, Said Kas-Danouche (Univ. de Oriente, Venezuela) and D. Papageorgiou (NJIT)

Instability and complex traveling waves for axisymmetric flow with swirl, Russ Caflisch (UCLA)

An analytical study of the effects of surfactants on deformation and breakup of slender bubbles, M. Booty (NJIT)

Two-dimensional finite element analysis to assess flow characteristics of an in vitro aneurysm model, Hans R. Chaudhry (NJIT), Dawn Lott (Delaware State University), 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), Dawn Lott (Delaware State University), and Charles J. Prestigiacomo (UMDNJ)

Three dimensional stress distribution in axisymmetric cerebral saccular aneurysm, Hans R. Chaudhry (NJIT), Charles J. Prestigiacomo (UMDNJ), Dawn Lott (Delaware State University), and Thomas W. Findley (UMDNJ)

Dynamics and breakup of two fluid viscous liquid threads using asymptotic theories and experiments, Demetrios Papageorgiou, Michael Booty, and Muhammad Hameed (all NJIT) and Charles Maldarelli (City College of New York)

Louis Tao

Dynamics of visual cortical neuronal networks, David Cai (CIMS, NYU), J. Andrew Henrie (CNS, NYU), David McLaughlin (CIMS, NYU), Robert Shapley (CNS, NYU), and Michael Shelley (CIMS, NYU)

Spike-triggered correlation analysis in neuroscience, David Cai (CIMS, NYU), Gregor Kovacic (RPI), and Michael Shelley (CIMS, NYU)

Estimation of synaptic conductances in neurons in recurrent networks, Antoni Guillamon (Universitat Politecnica de Catalunya, Barcelona) and David Terman (Ohio State)

Dynamics and pattern formation in myxobacteria, Roy Goodman (NJIT)

Instabilities in rotating shear flows, Edward Spiegel (Columbia) and Philip Yecko (Columbia)

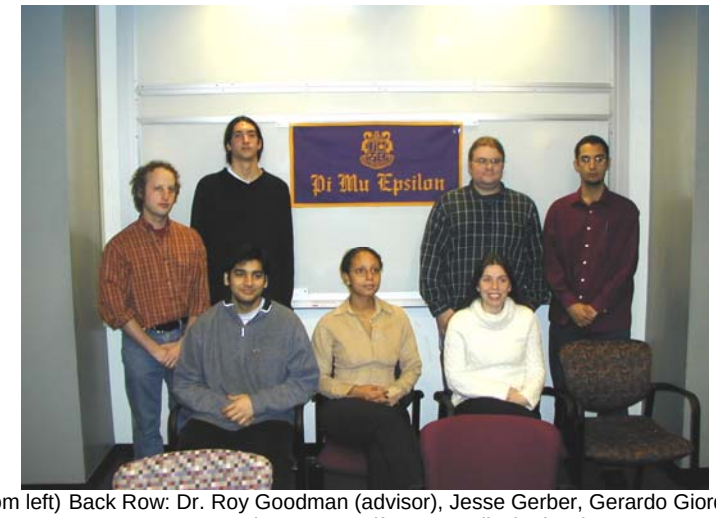
X. STUDENT ACTIVITIES

A. UNDERGRADUATE ACTIVITIES

Amitabha Bose, Director of Undergraduate Studies

Pi Mu Epsilon:

The New Jersey Kappa Chapter of Pi Mu Epsilon inducted 9 students into Pi Mu Epsilon on April 25, 2004: Jennifer Dorn, Jesse Gerber, Gerardo Giordano, Iman Kazerani, Mani Rana, Ankit Shah, Kelly Elizabeth Winters, Minran Wu, and Xun Yang.



Pictured Above (from left) Back Row: Dr. Roy Goodman (advisor), Jesse Gerber, Gerardo Giordano, Iman Kazerani
Front Row: Mani Rana, Jennifer Dorn, Elizabeth Winters

Math Club:

The math club had several meetings and attended the 2004 Garden State Undergraduate Mathematics Conference. At the conference, one student presented a research talk, and a team of three participated in a mathematics competition.

Awards and Scholarships:

Students in the Department of Mathematical Sciences received several awards and merit-based scholarships for AY 2003-2004. They were:

Actuarial Sciences Scholarship: Iman Kazerani, Sophomore (Math Sci and CS), Priti Patel, Junior (Math Sci)

Daljit S. and Devinder K. Ahluwalia Scholarship for Applied Mathematics: Edward Folger, Senior (Math Sci and CS), Seth Levy, Senior (Math Sci and Appl Chem)

Santokh S. and Labh K. Ahluwalia Award: Miao Li, Senior (Math Sci and CS), Robert Miller, Senior (Math Sci and CS)

Buck Consultants Inc. Scholarship: Matt Karasiewicz, Senior (Math Sci and Management)

Simon Cohen Memorial Scholarship: Carlos Orozco, Sophomore (Math Sci and CS), Jonathan Porus, Senior (Math Sci and CS)

College of Science and Liberal Arts Extraordinary Undergraduate Student Awards: Jennifer Dorn, Senior (CS and Math Sci), Jonathan Porus, Senior (Math Sci and CS)

Mathematical Sciences Awards: Gerardo Giordano, Junior (Math Sci), Josh Isralowitz, Junior (Math Sci), Dan Turek, Sophomore (Math Sci and Mech Eng)

Gary Thomas Award: Laura Medwick, Junior (Math Sci and Hist)

Activities:

CSLA Oustanding Undergraduate Student Awards were given to Jonathan Porus and Jennifer Dorn. Both students graduated in May 2004 with a double major in Mathematical Sciences and Computer Sciences.

Research and Co-op Positions:

Jonathan Porus worked at Novartis Pharmaceuticals during the summer of 2003. There he was placed on a Simulations and Modeling Team. Among his tasks were to analyze and implement a Bayesian Network approach for mapping gene influence diagrams, to model genomic, proteomic and drug dosage data and to perform simulations of these models to help form predictions in collaboration with biologists and other modelers about drug interactions.

Henry Rodriguez completed a co-op internship during the spring semester of 2004 at the company TSL Services. He worked in their IT division and was responsible for systems management and compilation and analysis of monthly statistics reports.

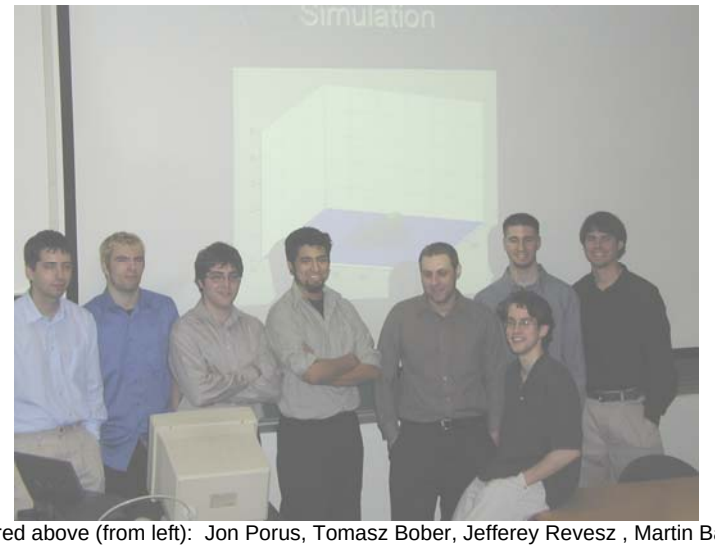
Alumni:

Iftach Bashan, working in computer industry
Tomasz Bober, graduate program in transportation at NJIT
Edward Folgar, BS/MS program in computer science at NJIT
Seth Levy, BS/MS program in mathematical sciences at NJIT
Jovana Vlajic, Master's program in mathematical education at Columbia University
Hung-Wei Yeh, BS/MS program in computer science at NJIT

Capstone Laboratory Projects:

Annual Capstone Presentations

Each Spring, senior Mathematical Sciences majors take the Methods of Applied Mathematics II, or Capstone, course in which small teams of students conduct applied research projects under the guidance of faculty members. These projects, carried out in a special laboratory created under a National Science Foundation grant, involve performing physical experiments and analyzing the results using mathematical and computational techniques learned as part of the undergraduate curriculum. In 2004, two groups of students completed and presented capstone projects. The photos were taken after the final presentation. The following pages describe in more detail their research projects.



Pictured above (from left): Jon Porus, Tomasz Bober, Jefferey Revesz , Martin Bailon, Seth Levy, Ed Silkworth (sitting), Ed Folgar, Robert Miller

Pictured above (from left): Back Row: Jovana Vlajic, Iftach Bashan, Esmond Siew, Dr. Michael Booty (advisor),
Middle Row: Mohamed Ismail, Henry Rodriguez, David Yu
Front Row: Hung-Wei Yeh, Josh Isaralowitz, Silvino Sanchez

CAPSTONE PROJECT: Dynamics of Sliding Drops

Advisor: Lou Kondic

Students: Martin Bailon, Tomasz Bober, Guillermo Falquez, Ed Folgar, Seth Levy, Robert Miller, Jon Porus, Jefferey Revesz, and Ed Silkworth.

Graduate Student Assistant: Tsezar Seman

The experimental part of this project has been performed using previously build platform (see Cams Annual Report 2000/01) consisting of a frame covered by a sheet of glass. The fluid is then released to flow under gravity down a plane. This year's project consisted of analyzing the dynamics of isolated fluid drops that spread under gravity down an inclined surface. This dynamics shows some interesting features including change of shape of the drops as the inclination angle of the spreading plane is modified.

The theoretical part has involved a number of different directions. Students, or student groups, were assigned complementary projects with the idea of having them concentrate on one given aspect or technique, but also be exposed to the complete problem via interaction with their colleagues, weekly informal seminars, etc. The student projects have included linear stability analysis, numerical simulations of highly nonlinear PDE's using explicit and implicit methods, and analysis of the self-similar solutions. The figures show the results of numerical simulations in 3D space using ADI (alternative direction implicit) method. First figure shows the initial shape, and the second one the shape to which the drop evolves after some time period. The students' results were presented in a Special Applied Math Seminar on May 12, 2004.

Fig. 1
Initial Shape

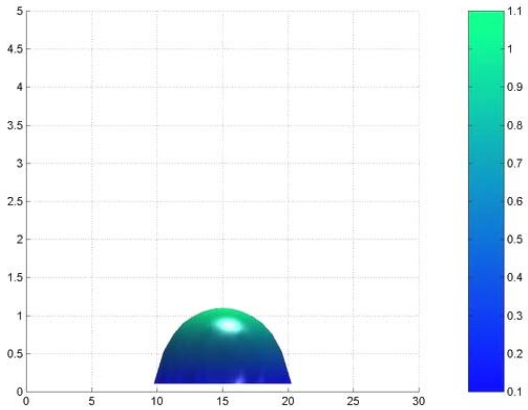
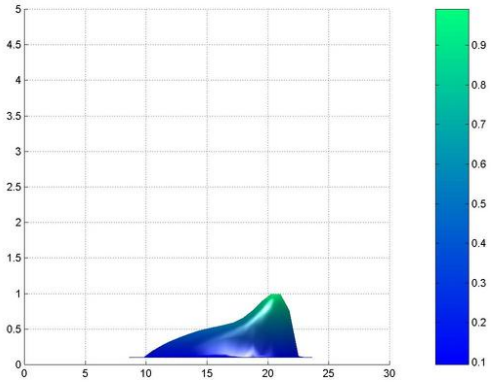


Fig. 2
Shape at a
later time



CAPSTONE PROJECT: Theory, Design, and Use of a Ripple Tank to Illustrate Linear Wave Phenomena

Advisor: Michael Booty

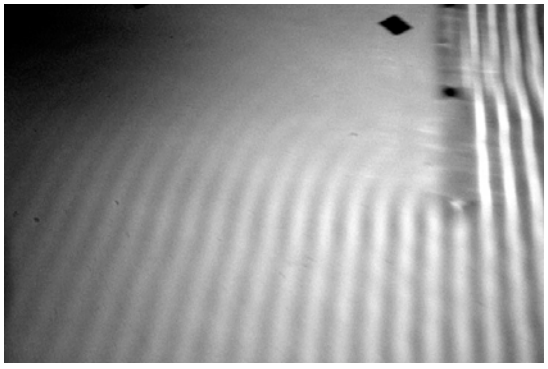
Students: Iftach Bashan, Mohamed Ismail, Josh Isaralowitz, Henry Rodriguez, Silvino Sanchez, Esmond Siew, Jovana Vlajic, Hung-Wei Yeh, and David Yu

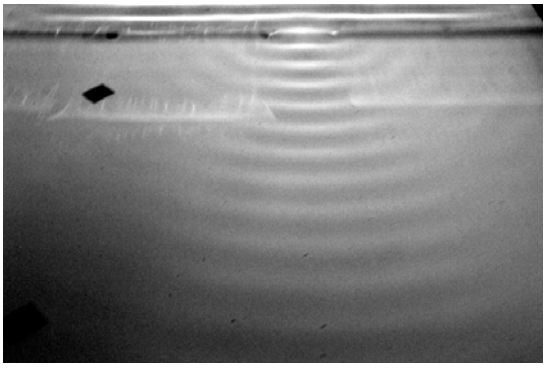
Graduate Student Assistant: Tsezar Seman

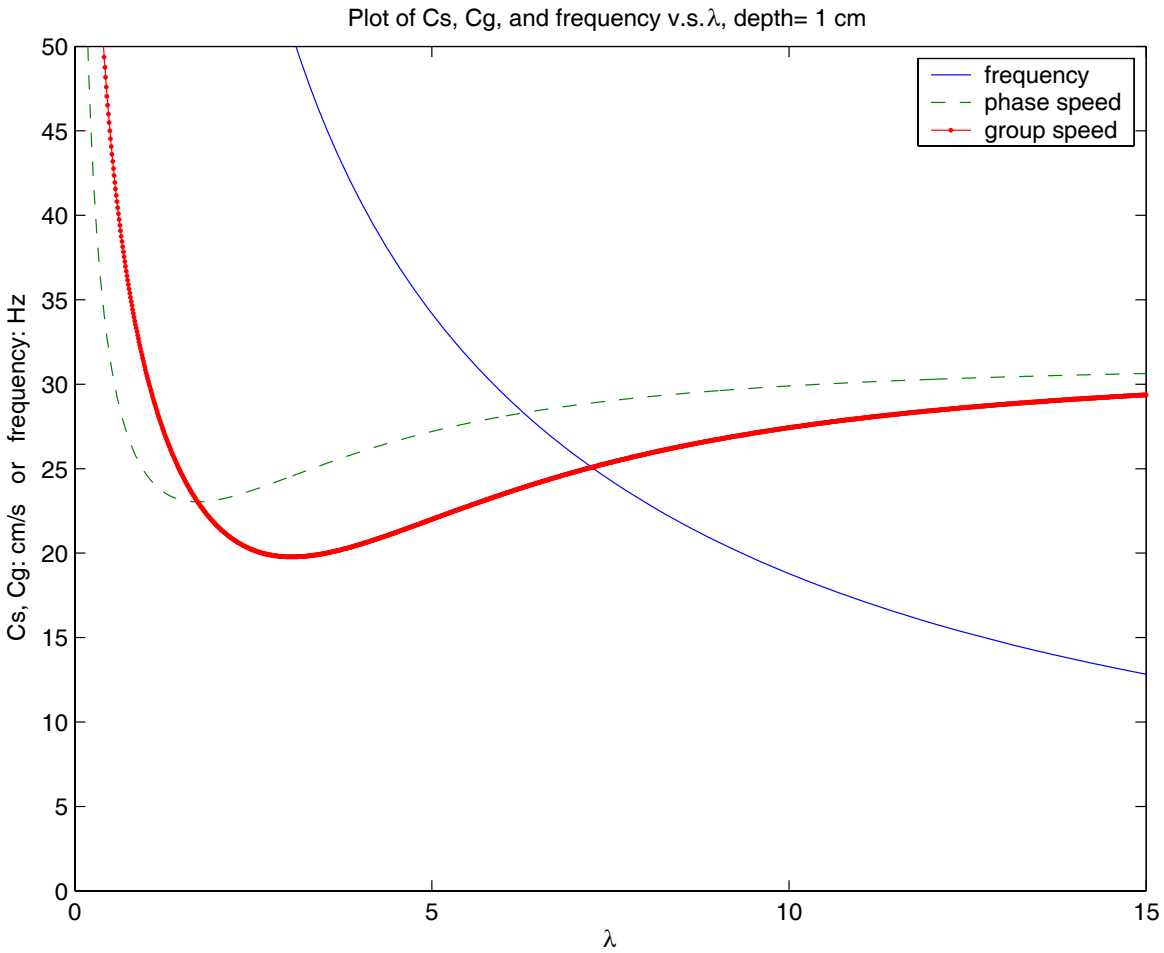
Many phenomena of linear wave propagation can be shown using a ripple tank and a simple optical arrangement. These range from the simplest demonstrations of wave reflection and refraction to the scattering of acoustic waves in a complex geometry. We chose to look at some fundamental issues in the design and use of a ripple tank to illustrate dispersion and diffraction. These wave effects are important in practical imaging applications and are not often studied in the undergraduate curriculum.

The analysis of linear gravity-driven waves at a free water-air interface with surface tension was used to derive the dispersion relation for waves under various conditions, including undisturbed water depth. Individual projects were then assigned to see how a ripple tank can be used to illustrate the difference between phase speed and group speed, and various instances of diffraction. In each case, mathematical models were formulated and analyzed, and their results were compared with experiments using a ripple tank.

CAPTION: FIGURE 1
Left: Ripple tank image of the diffraction of plane waves by a half-line (the Sommerfeld problem). Right: Diffraction of plane waves by an aperture of 2.5 wavelengths. At top, with student group: Fresnel diffraction for an aperture of 7 wavelengths.







CAPTION: FIGURE 2
Frequency (Hz), phase speed (cm/s), and group speed (cm/s) versus wavelength (cm) for waves on a ripple tank with undisturbed depth 1 cm.

B. GRADUATE STUDENT RESEARCH PROGRAMS

Demetrios T. Papageorgiou, Director of the Graduate Program

The academic year 2003-04 was another successful year for the Department's mission of high quality graduate education in the mathematical sciences. Approximately 30 Ph.D. students were in the program and most of them were supported by outside research funds as well as resources from the Institute. The Department of Mathematical Sciences is making significant strides in becoming one of the leading applied mathematics and applied statistics departments in the nation dedicated to excellence in research and graduate education. In what follows, we include some of the scholarly activities of our graduate students during the academic year 2003-04 as well as pertinent details of the summer research activities.

Ph.D.s Awarded:

Arnaud Goullet, May 2004
Thesis: Mixing Enhancement by Dual Speed Rotating Stirrer
Advisor: Dr. Nadine Aubry
Current Position: Postdoctoral Fellow, Department of Mechanical Engineering, NJIT

Michele Picarelli, May 2004
Thesis: A Gibbs Sampling Approach to Maximum A Posteriori Time Delay and Amplitude Estimation
Advisor: Dr. Zoi-Heleni Michalopoulou
Current Position: Instructor, St. Peter's College, Jersey City, New Jersey

Tetyana Segin, May 2004
Thesis: Nonlinear Long-Wave Interfacial Stability of Two-Layer Gas-Liquid Flow
Advisor: Dr. Lou Kondic
Current Position: Postdoctoral Fellow, University of Alberta, Edmonton, Alberta, Canada

Publications, Presentations, and Conference Participation:

Christina Ambrosio: Poster entitled "Distinct Synaptic Pathways Control the Frequency of a Rhythmic Network" for the Center for Molecular and Behavioral Neuroscience minisymposium at Rutgers, Newark. Also presented same poster at the Frontiers in Applied and Computational Mathematics Conference at NJIT, May 21-22, 2004.

Poster presentation at the Computational Neuroscience Meeting July 18-20 in Baltimore, MD with an accepted publication in the CNS proceedings entitled "The Effect of Modulatory Neuronal Input on Gastric Mill Frequency" (with Amit Bose and Farzan Nadim).

Gave talk on April 27, entitled "The Effect of Modulatory Neuronal Input on Gastric Mill Frequency" for the NJIT Mathematical Biology seminar series.

Sibabrata Banerjee: Received the Laha Award (given by the Institute of Mathematical Statistics, IMS) to present his thesis at the IMS Annual Meeting (6th Bernoulli World Congress) held in Barcelona, Spain, July 2004.

Attended the Fifth Biennial International Conference on Statistics, Probability and Related Areas, May 14-16, University of Georgia, Athens

Gave a talk on: "Finite Sample Efficiency of Local Linear Estimation in EXPAR Models" in the Time series session, chaired by Dr Robert Lund. Gave a poster presentation on the same topic in the FACM conference NJIT, May 21-22

Jyoti Champanerkar: Publication: Extensions and applications of the Poincare-Birkhoff theorem, (joint with D. Blackmore), Proc. Conf. on Dynamical Systems -Theory and Applications, Lodz, Poland, Dec 8-11, 2003, pp13-2.

Attended a One-Week Workshop on Dynamics of Complex Systems, conducted by Prof. Yaneer Bar-Yam (President, NECSI) from Jan 5-9, 2004, at MIT, Boston.

Poster presentation at the Conference on Frontiers in Applied and Computational Mathematics, organized by the Department of Mathematical Sciences, NJIT, May 21-22, 2004.

Contributed talk in AIM's Fifth International Conference on Dynamical Systems and Differential Equations, Pomona, California, June 16-19, 2004, Title: Pitchfork bifurcation of invariant manifolds.

Arnaud Goullet: "Chaotic Mixing with a Single Stirrer" presented at the APS Division of Fluid Dynamics 56th Annual Meeting at East Rutherford (New Jersey) November 2003, "Microfluidic Mixing Using Time Pulsing" AIMS' Fifth International Conference on Dynamical Systems and Differential Equations. Wednesday June 16 2004-Saturday June 19 2004. Department of Mathematics and Statistics California State Polytechnic University Pomona. (On behalf of Dr. Nadine Aubry, NJIT).

Mohammad Hameed: Student Seminar in Summer 2003 at the Department of Mathematical Sciences, NJIT, on July 29, 2003, Title: Influence of Insoluble Surfactant on the Break-up of a Fluid Jet Inside in Another Viscous Fluid.

Talk in a Group Meeting Chemical Engineering Department CUNY New York on August 7, 2003. Title: Effect of Surfactant on the Break-up of an Inviscid Jet in Exterior Viscous Fluid

Poster at Frontiers in Applied and Computational Mathematics (FACM-04) Conference at NJIT on May 21-22, 2004. Title: Influence of Surfactant on the Break-up of a Fluid Jet

Participated in The First Annual Graduate Student Modeling Camp (GSMMC2004) June 15-18, 2004 held at Rensselaer Polytechnic Institute.

Participated in The Twentieth Annual Workshop on Mathematical Problems in Industry (MPI2004) June 21-25, 2004, held at University of Delaware.

Nickolas Kintos: Conference Attended (Attended with my advisor Prof. Nadim): East Coast Nerve Net, 4/2/04 - 4/4/04, Marine Biological Laboratory, Woods Hole, MA

Poster Presentation: FACM '04 5/21/04 - 5/22/04 NJIT, Title of Poster: "Modeling Actions of a Neuromodulator on a Rhythmic Network"

Attended the Computational Neuroscience Meeting and Workshop in Baltimore, Maryland, July 18 - July 22

Valerij Lukyanov: Poster Presentation: V.V. Lukyanov and G.A. Kriegsmann "On Computation of Electromagnetic Field in Photonic Crystals", Frontiers in Applied and Computational Mathematics, May 21-22, 2004.

Yuriy Mileyko: Frontiers in Applied and Computational Mathematics, May 21-22, 2004, New Jersey Institute of Technology, Newark, NJ, Swept Manifolds Intersections, poster

NSF/DARPA Computational and Algorithmic Representations of Geometric Objects (CARGO) Program Review, May 18-20, 2004, Madison, WI, Homology Criteria for Transverse Intersections, poster

The 15th Annual Saint Joseph's University Sigma Xi Student Research Symposium, April 23, 2004, Philadelphia, NJ, Swept Surfaces Intersections, poster

SIAM Conference on Geometric Design and Computing, Nov. 10-13, 2003, Seattle, Washington, Differential Equation Approach to Manifold Intersections, talk

DIMACS Workshop on Computer Aided Design and Manufacturing, Oct. 7-9, 2003, DIMACS Center, Rutgers University, (presentation, co-author of the talk by Prof. Blackmore)

College of Science & Liberal Arts Award: Exceptional Graduate Student (April 28, 2004)

Tetyana Segin: Segin, T. M., Kondic, L., and Tilley, B. S., Undercompressive shocks in two-layer flows, 56th Annual Meeting of the Division of Fluid Dynamics, American Physical Society, East Rutherford, NJ, November 23-25, 2003. (presentation)

Segin, T. M., and Kondic, L., and Tilley, B. S. Double shock wave structures in gas-liquid flows,Fluidos 2003, Instituto de Fisica Arroyo Seco, Tandil, Argentina, November 13-16, 2003. (presentation)

Tsezar Seman: Frontiers in Applied and Computational Mathematics (FACM'04) at New Jersey Institute of Technology. Newark, NJ. May 21-22, 2004.

The 15th Annual Saint Joseph's University Sigma Xi Student Research Symposium, Philadelphia, PA. April 23, 2002.

Dmitri Tseluiko: Frontiers in Applied and Computational Mathematics, May 21-22, 2004. The poster presented at the conference is "Numerical and Analytical Studies of Modified Kuramoto-Sivashinsky Equations Arising in Interfacial Electrohydrodynamics"

Workshops: Graduate Student Mathematical Modeling (GSMM) Camp at RPI, June 15-18, 2004. Mathematical Problems in Industry (MPI) at the University of Delaware, June 21-25, 2004.

Lin Zhou: Received the "Exceptional Graduate Student Award" from CSLA on April 28th, 2004. Poster in FACM '04 in NJIT on May 21-22, 2004, and the title is "Perturbation analysis on dispersive properties of microstrip".

Ivan Zorych: Poster presentation at FACM '04: A Bayesian Modeling Approach to Location Estimation (with D. Madigan, Rutgers University)

Participating in the project: Dates (contract period): December 19, 2003 - May 31, 2005
Client: Triton Development, Inc., New York, NY. Description: Consulting Agreement to perform mathematical and statistical modeling for analysis of baseball problems.
Consultants:Professor Bukiet, Bruce and Ph. D. student Zorych, Ivan.

Graduate Students (Applied Probability & Statistics) Research Program by Manish Bhattacharjee

Publications, Presentations, and Conference Participation:

1. Ivan Zorych gave a poster presentation titled: A Bayesian modeling approach to Location estimation (joint with D. Madigan) in the contributed paper category, in the FACM (Frontiers in Applied and Computational Mathematics) Conference, held at the New Jersey Institute of Technology, May 21-22, 2004.

2. Ivan Zorych was selected in April 2004, to participate in the August summer program at the Institute of Mathematics and its Applications, at the University of Minnesota, Minneapolis. He will be participating in the project titled: Probablistic Modeling in Complex Communication Networks.

3. Sibabrata Banerjee attended the annual IISA meeting held at the University of Georgia, Athens, GA, held during May 14-16, 2004. He presented a paper titled: Finite sample Efficiency of Local Linear estimation in EXPAR Models (joint with Anindya Roy, University of Maryland Baltimore County) in the contributed paper category. He also gave a poster presentation on the same paper, in the FACM (Frontiers in Applied and Computational Mathematics) Conference, held at the New Jersey Institute of Technology, May 21-22, 2004.

Ivan Zorych successfully defended his thesis proposal in April 2004.

Graduate students/alumni, admitted to Ph.D. programs elsewhere:

Ms. Priyal Gogri, who completed her M.S. in Applied Statistics at NJIT is pursuing her Ph.D. in Biostatistics at the University of Pittsburgh, starting in Fall 2004.

Ms. Adrienne Tin, who will be in the 3rd and final semester of her enrollment for MS (APST) was nominated by us and won the EWNJ (Executive Women of New Jersey) Graduate Merit Award Scholarship. The award of $4,000 will assist Ms. Tin in completing her master's degree in applied statistics.

Report of the Ph.D. Qualifying Exam Committee by Demetrios T. Papageorgiou

In August 2003, qualifying exams were given in Analysis and Linear Algebra and Numerical Methods. Students must achieve an A grade in order to pass an exam and must pass all exams in order to become doctoral candidates and remain in the program. Two passes were achieved in Analysis and five passes were achieved in Linear Algebra and Numerical Methods.

In January 2004, all three qualifying exams were offered as well as Topics in Statistics. Three students achieved an A grade in Applied Mathematics, one in Linear Algebra/Numerical Methods, one A in Analysis/Probability Theory, and one A in Topics in Statistics.

Summer Activities:

An additional research activity was added this summer which involved Ph.D. students who had completed their first year of course work and who passed the qualifying exams they took in the beginning of the summer. This is a new activity whose aim is to involve students in self-contained projects and give them the opportunity to gain first hand experience in research. Each student was assigned a faculty member (or members) who guided them in studying a fundamental topic of applied mathematics. The students performed analytical and numerical calculations and presented their results during a one day workshop which consisted of thirty minute talks and which was open to the university community. This activity was very successful and we plan to establish it going forward.

Details of the different research projects are given below.

Title: Modeling Single-Capillary Oxygen Delivery in Working Muscle
Author: Anisha Banerjee Advisor: Daniel Goldman

Abstract:This project uses a series of modifications to the classic Krogh tissue cylinder model to study oxygen transport from individual capillaries in exercising skeletal muscle. Physiologically important features studied include intravascular and interstitial resistance, myoglobin facilitation, mitochondrial clustering, and Michaelis-Menten consumption kinetics.

Title: The Study of Flame Propagation in a Gas Mixture
Author: Nebojsa Murisic Advisors: John Bechtold and Michael Booty

Abstract:The presentation covers overview of derivation of governing equations and study of the structure of premixed flames. First we introduce the variables and the governing equations in non-dimensional form. Then, we do some modeling and make certain assumptions in order to

simplify the analysis. We assume the situation with single deficient reactant, and a premixed flame with Mach number much less than 1. Furthermore, we analyze the system for 1-D steady flame, and consider the situation when gas is supplied in uniform flow to keep location fixed. Finally, we consider the so-called cold boundary difficulty, and do a bit of activation energy asymptotics: we come up with inner and outer solutions and do the matching. This gives us the last piece of the puzzle- the expression for flame speed.

Title: The creeping gravity currents of a non-Newtonian Liquid
Author: Xinli Wang Advisor: Lou Kondic

Abstract: Recently several experiments on creeping gravity currents have been performed,using highly viscous silicone oils and putties. The interpretation of the experiments relies on the available theoretical results that were abtained by means of the lubrication approximation with the assumption of a Newtonan rheology. I will talk about the governing equations with a power-law rheology, generalizing the usual lubrication approximation. Similarity solutions for currents whose volume varies as a power of time are botained. The application of the Boltzmann transform is briefly discussed.

Title: Direction reversal of Biased Brownian Motion on Distorted Ratchets.
Author: Yiming Cheng Advisor: Robert M. Miura

Abstract: In some cases, we want to separate Brownian particles (such as protein particles) based on their size, charges, and the viscosity of the medium. If we impose potentials on these particles, they can move. We want to investigate the relationship between the direction of the movement and the potentials. Also Direction Reversal (DR) and some available results of DR will be introduced.

Title: A short look at different types of Bifurcations.
Author: Kamyar Malakuti Advisor: Amitabha Bose

In this presentation, we will give an introduction to Saddle-Node, Transcritical, Pitchfork, and Hopf Bifurcations, and also, at the end, we will introduce "XPPAUT" and its applications to dynamical systems.

Title: The approach of solutions of Non Linear Diffusion equations to Travelling Front solutions.
Author: Lakshmi Chandrasekaran Advisor: Christopher Elmer

This project is concerned with the existence and uniqueness of solutions of the Non Linear Diffusion equations (cable equation) where the solution is called the traveling front. Here I am showing that when an excitable membrane is incorporated into a non linear cable equation it can give rise to traveling waves of electrical excitation.

Title: Hodgkin-Huxley Equation & Action Potential
Author: Ming Lu Advisor: Jorge Golowasch

Neuron activities are subject to injected external current, or applied current. By changing the strength and patterns of the applied current in the Hodgkin-Huxley model, the model is able to mimic these neuron activities. In HH Model, the dynamics of the ionic conductance are governed by the activation and inactivation variables, or gates of the sodium and potassium channels; the different time scales and voltage dependencies of these gates enable the HH Model to reproduce firing patterns, such as the spikes, decaying of the spikes amplitude, refractory period, undershoot, and the frequency of the spikes. For these reasons, the HH Model provides a great insight in understanding neuron activities.

Summer Lecture Series:

As in previous years, a twelve-week summer research program was implemented in order to provide a core of scholarly activities for graduate students at different points of their studies. In particular, a seminar series was developed consisting of two weekly lectures, one by a graduate student presenting his/her research, and one by a faculty member. This activity was very successful and it helped expose graduate students to each other's research by giving presentations in front of their peers, as well as to acquaint students with faculty research areas and interests.

Faculty Lectures:

May 27	Darko Volkov, "Integral equation methods for the statics and the dynamics of an electrified fluid bridge"
June 3	Pankaj Doshi, "Self-similar pinch-off of generalized Newtonian fluids"
June 10	David Ambrose, Courant Institute, "Vortex sheets with surface tension"
June 17	Peter Petropoulos, "Electromagnetic Pulse Propagation in Cole-Cole Dielectrics"
June 24	Amitabha Bose, "Two-oscillator model of ventilatory rhythmogenesis in the frog"
July 1	Christopher Elmer, "Differential Difference Equations and Their Applications: Part I - Interface Motion in Crystalline Materials"
July 8	David Horntrop, "Mesoscopic Simulation for Domain Coarsening in Surface Processes"
July 15	Manish Bhattacharjee, "Ramanujan, the internet, and the art of probability"
July 22	Cyrill Muratov, "Pseudodifferential operators, optimal grids, and evolution equations: a case study for micromagnetics"
July 29	Ramesh Sarangapani, "Biologically-based modeling and parameter estimation to support drug development"
Aug. 5	Roy Goodman, "Polynomials, waves, and storm propagation"

Graduate Student Lectures:

June 1	Yuriy Mileyko, “Swept Manifolds in CAGD: Intersection Problem”
June 8	Mohammad Hameed, “Influence of Surfactant on the Break-up of Fluid jet”
June 15	Soumi Lahiri and Satrajit Roychoudhury, “Randomized Response and Its Application”
June 22	Christina Ambrosio, “Rhythmic Behavior of Model Network with an Introduction to Neurophysiology”
June 29	Lin Zhou, “Complete Transmission Through a periodically Perforated Rigid Solid”
July 6	Roger Bustamante, “Complex Variable Method in the Linear Elasticity”
July 14	Dmitri Tseluiko, “Numerical and Analytical Studies of Modified Kuramoto-Sivashinsky Equations Arising in Interfacial Electrohydrodynamics”
July 20	Ivan Zorych, “Bayesian approach to wireless location problem”
July 27	Jing Yu, “Developing Bayesian Network Inference Algorithms to Predict Causal Functional Pathways in Biological Systems”
August 3	Nicholas Kintos, “Modeling Actions of a Neuromodulator on a Rhythmic Network”

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