# CAMS

## Center for Applied Mathematics and Statistics

# ANNUAL REPORT

# 2010-2011

NJIT
New Jersey's Science & Technology University

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## I. FROM THE DIRECTOR

This year the Center for Applied Mathematics and Statistics (CAMS) is proud to celebrate its 25th anniversary. The center was established in 1986 as a vehicle to support research by faculty in mathematics and other departments at NJIT, and we are pleased to show in this report how its activities have expanded through the years. Several special events were held at the department's annual Frontiers in Applied and Computational Mathematics meeting to commemorate the anniversary, including a dinner attended by many of our Ph.D. alumni. We are grateful that our former students could join us to commemorate the CAMS anniversary.

We take particular pride in the undergraduate research supported by CAMS, which has significantly increased in the past few years. Examples include the recently renewed Undergraduate Mathematics and Biology Training Program (UBMTP) funded by the National Science Foundation, which provides innovative training and research at the intersection of mathematics and biology, and the NSF funded Computational Science Training for Undergraduates in the Mathematical Sciences (CSUMS) program. NJIT Provost Ian Gatley has encouraged increased efforts at undergraduate research university wide, and CAMS and the Department of Mathematical Sciences are happy to take a leading role in this endeavor.

DMS also receives substantial funding for graduate student and faculty research from sources such as the National Science Foundation, National Institutes of Health, Office of Naval Research, Department of Defense, NASA, the Howard Hughes Medical Institute, NJ Meadowlands Commission and private industry. This year, CAMS faculty were awarded 7 new NSF grants and one U.S. Department of Defense grant.

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

- The hosting of the Mathematical Problems in Industry (MPI) workshop and Graduate Student Mathematical Modeling Camp on June 11-17, 2011. MPI is a problem solving workshop that attracts leading applied mathematicians and scientists from universities, industry, and national laboratories.

- Continued hosting of the Frontiers in Applied and Computational Mathematics (FACM) conference. The eighth conference was held on June 9-11, 2011. The three day meeting focused on wave propagation and its applications, and attracted over 140 participants.

- The awarding of a Gary Thomas Fellowship to Mathematical Sciences doctoral student Cassandra Basarab. This fellowship is the leading award given by the university to a student pursuing doctoral studies.

- The support of 5 postdoctoral fellows, one by the department and 4 by outside funding.

As always, the accomplishments of CAMS have been built with the support and dedication of many individuals. We are grateful to Ian Gatley, Provost and Sr. Vice President of Academic Affairs, Fadi Deek, Dean of CSLA, and Don Sebastian, Sr. Vice President for Research, for encouraging CAMS through their strong support of scientific research. Finally, we thank President Robert A. Altenkirch, who has been a constant source of support for CAMS and its mission. We look forward to continued fruitful interactions with these individuals in the upcoming year.

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

## II. MISSION STATEMENT

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

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

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

### Department of Mathematical Sciences

### Advisory Board - 2011

| | |
|---|---|
| Dr. John S. Abbott | Corning Incorporated |
| Dr. Richard Albanese | Brooks Air Force Base |
| Dr. Peter E. Castro | Eastman Kodak Company (formerly) |
| Dr. Ned J. Corron | U.S. Army AMCOM |
| Mr. Erik Gordon | Trillium Trading, LLC |
| Dr. Patrick S. Hagan | JP Morgan Chase |
| Dr. Zahur Islam | Novartis Pharmaceuticals |
| Ms. Krystyna J. Monczka | Hewitt Associates |
| Mr. George Quillan | Prudential Financial |
| Dr. Richard Silberglitt | Rand Corporation |
| Dr. Benjamin White | Exxon Research & Engineering |

## III. MEMBERS AND VISITORS

### Department of Mathematical Sciences

Afkhami, Shahriar
Ahluwalia, Daljit S.
Andrushkiw, Roman
Bechtold, John
Bhattacharjee, Manish
Blackmore, Denis
Booty, Michael
Bose, Amitabha
Boubendir, Yassine
Bukiet, Bruce
Bunker, Daniel
Chermisi, Milena
Choi, Wooyoung
Cummings, Linda
Deek, Fadi
Dhar, Sunil
Dios, Rose
Golowasch, Jorge
Goodman, Roy
Gordon, Peter
Goullet, Arnaud
Guo, Wenge
Higley, Michael
Horntrop, David
Jain, Aridaman
Jiang, Shidong
Johnson, Kenneth
Kappraff, Jay
Kondic, Lou
Kriegsmann, Gregory A.
Luke, Jonathan
Matveev, Victor
Michalopoulou, Zoi-Heleni
Milojevic, Petronije
Miura, Robert M.
Moore, Richard
Muratov, Cyrill
Nadim, Farzan
Perez, Manuel
Petropoulos, Peter
Rotstein, Horacio
Russell, Gareth
Siegel, Michael
Subramanian, Sundar
Sverdlove, Ronald
Wang, Qiming
Young, Yuan-Nan

**Department of Civil and Environmental Engineering:** Meegoda, Jay

**Department of Mechanical Engineering:** Rosato, Anthony

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

### CAMS Research Professors

| | |
|---|---|
| Booth, Victoria | University of Michigan, Ann Arbor |
| Diez, Javier | University Nacional del Centro, Tandil, Argentina |
| Erneux, Thomas | Université Libre de Bruxelles, Belgium |
| Huang, Huaxiong | York University, Toronto, Canada |
| Papageorgiou, Demetrios | Imperial College, London |
| Tao, Louis | Peking University, China |
| Vanden-Broeck, Jean-Marc | University of East Anglia, Norwich, England |
| Wylie, Jonathan | City University of Hong Kong |

## IV. COLLOQUIA AND SEMINARS

### Department of Mathematical Sciences Colloquium

September 3 **Amit Bose**, NJIT
*Relating Dynamics to Structure on Random Graphs*

September 10 **Wah-Keat Lee**, Argonne National Laboratory
*X-ray imaging of complex dynamics at the Advanced Photon Source: Ferrofluids, Bugs and Sprays*

September 17 **Jeff Morris**, Levich Institute, City College New York
*Inertia in Suspension Dynamics*

September 24 **John White**, Utah
*Mechanisms and Consequences of Coherent Activity*

October 1 **Shelley Anna**, Carnegie Mellon
*Competing Timescales for Surfactant Transport and Flow at Microscale Fluid-Fluid Interfaces*

October 8 **Charles Peskin**, Courant Institute, NYU
*A Look-ahead Model for the Transcriptional Dynamics of RNA Polymerase*

October 15 **Qiang Du**, Penn State
*Diffuse Interface Modeling of Some Interface Problems*

October 22 **Thomas Hagstrom**, Southern Methodist University
*Towards the Ultimate Solver for Wave Equations in the Time Domain*

October 29 **Kosuke Imai**, Princeton (Department of Politics)
*Statistical Analysis of List Experiments*

November 5 **Pengtao Yue**, Virginia Tech
*Diffuse Interface Simulations of Moving Contact Lines*

November 12 **Chun Liu**, Penn State
*Energetic Variational Approaches in the Modeling of Ionic Solutions and Ion Channels*

November 19 **Andrew Hicks**, Drexel University
*TBA*

December 3 **Leslie Greengard**, Courant Institute, NYU
*A New Formalism for Electromagnetic Scattering in Complex Geometry*

January 21 **Qiang Zhang**, City University of Hong Kong (visiting Robert Miura at NJIT)
*A Brief Review of Mathematical Finance and Its Recent Developments*

January 28 **Bob Eisenberg**, Rush University Medical Center
*Ions in Channels*

February 4 **Stanislaw Jarecki**, UC Irvine
*Efficient Protocols for Private Information Sharing*

February 11 **Guillaume Bal**, Columbia
*Inverse Elliptic Problems with Internal Controls and Applications to Hybrid Imaging*

February 18 **Don Schwendeman**, RPI
*Mathematical Models and Adaptive Numerical Methods for High-speed Reactive Flow*

February 25 **Ethan Akin**, CCNY
*Good Measures on Cantor Space*

March 4 **Marc Garbey**, University of Houston
*An Example of Computational Surgery: Multi-scale Modeling of Breast Conservation Therapy*

March 11 **Jay Tang**, Brown University
*Swimming Bacteria Meet Applied Math and Physics at Fluid Boundary*

March 25 **Mike Schatz**, Georgia Tech
*Characterizing Spatio-temporal Complexity in Fluid Flow using Computational Homology*

April 1 **Linda Smolka**, Bucknell
*Stability of a Planar-extensional Flow and an Axisymmetric Thin Film Flow*

April 8 **Alexander Nepomnyaschy**, Technion, Israel
*Front Propagation in Anomalous Diffusion-reaction Systems*

April 15 **Ronald Rosensweig**
*Fluid Mechanical Aspects of Magnetic Liquids*

April 29 **Carlos Chavez**, Arizona State University
*Epidemic Models for Influenza: From Single Outbreaks to Recurrence*

## Applied Statistics Seminar

September 09 **Gerhard Dikta**, Aachen University of Applied Sciences, Germany
*Probability of Damage of Electronic Systems due to Indirect Lightning Flashes*

September 16 **Kaifeng Lu**, Forest Laboratories, Inc.
*Specification of Covariance Structure in Longitudinal Data Analysis for Randomized Clinical Trials*

September 23 **Ohad Amit**, Senior Director, Oncology R&D, Statistics and Programming
*Graphical Approaches to the Analysis of Safety Data from Clinical Trials*

October 7 **G. Frank Liu**, Merck Research Laboratories
*On Statistical Analysis of Continuous Responses in Clinical Trials with Baseline Measurements*

October 14 **Bruce Levin**, Columbia University, Mailman School of Public Health
*Subset Selection in Comparative Selection Trials*

October 28 **Yongchao Ge**, Mount Sinai Medical School
*Making Statistical Inference on the Proportion of Positive Cells for the Flow Cytometry Data*

November 11 **Randall H. Rieger**, West Chester University, West Chester, PA
*Testing for Violations of the Homogeneity Needed for Conditional Logistic Regression*

November 18 **Marinela Capanu**, Memorial Sloan Kettering Cancer Center
*Simulation Study of Hierarchical Modeling for Estimating Cancer Risks of Individual Genetic Variants*

December 2 **Min-ge Xie**, Department of Statistics, Rutgers, the State University of New Jersey, Piscataway, NJ
*A General Framework for Combining Information & a Frequentist Approach to Incorporate Expert Opinions*

February 10 **Yuanjia Wang**, Mailman School of Public Health, Columbia University
*Flexible Semiparametric Analysis of Longitudinal Genetic Studies by Reduced Rank Smoothing*

February 17 **Haiyan Su**, Department of Mathematical Sciences, Montclair State University, Montclair, NJ
*Semi-parametric Hybrid Empirical Likelihood Inference for Two-sample Comparison With Censored Data*

February 24 **Zhiqiang Tan**, Department of Statistics, Rutgers University, Piscataway, NJ
*Understanding and Improving Propensity Score Methods*

March 10 **Qianxing Mo**, Research biostatistician, Department of Epidemiology and Biostatistics of Memorial Sloan-Kettering Cancer Center
*A Fully Bayesian Hidden Ising Model for ChIP-seq Data Analysis*

March 24 **Haiyan Xu**, Clinical Biostatistics, Johnson & Johnson Pharmaceutical Research & Development
*Parallel Gatekeeping Procedures*

March 31 **Sunil K. Dhar**, Department of Mathematical Sciences and the Center for Applied Mathematics and Statistics, New Jersey Institute of Technology
*Generalized Linear Model under the Inverse Sampling Scheme*

April 14 **Wenge Guo**, Department of Mathematical Sciences and the Center for Applied Mathematics and Statistics, New Jersey Institute of Technology
*Adaptive FWER and FDR Control under Block Dependence*

April 21 **Shuangge (Steven) Ma**, Yale School of Public Health
*Integrative Analysis of Cancer Genomic Data*

April 28 **Dirk F Moore**, Department of Biostatistics, UMDNJ School of Public Health and Biometrics Division, Cancer Institute of New Jersey
*What is the Best Way to Manage Prostate Cancer? Causal Inference using a Geographical Instrumental Variable with the SEER/Medicare Cohort*

## Mathematical Biology Seminar

September 14 **Andrea Barreiro**, Department of Mathematics, University of Washington
*Modeling Cooperative Activity in Neural Systems*

September 21 **Cristina Turner**, Department of Mathematics, FaMAF, Universidad Nacional de Cordoba
*Shape Optimization for Tumor Location*

September 28 **Gareth Russell**, Department of Biological Sciences & Department of Mathematical Sciences, NJIT
*Mathematical Ecology "Open Problems Forum": Modeling Home Ranges and Habitat Selection*

October 5 **Xinxian Huang**, Department of Mathematical Sciences, NJIT
*Using Phase Response Curves to Infer the Activity of Feed-back Neuronal Networks with Synaptic Depression*

October 12 **Gareth Russell**, Department of Biological Sciences & Department of Mathematical Sciences, NJIT
*Mathematical Ecology "Open Problems Forum": Modeling Animal Movement with Arbitrarily Complicated Constraints*

October 19 **Gemma Huguet**, Center for Neural Sciences, New York University
*A Model for Dynamical Switching during Tristable Perception of Visual Plaids*

October 26 **Dongwook Kim**, Department of Mathematical Sciences, NJIT
*The Effect of Periodic and Non-periodic Inputs on Firing Rate Resonance in A Stellate Cell Model*

November 2 **Alla Borisyuk**, Department of Mathematics, University of Utah
*Selectivity to Slowly Rising Stimuli in Frog Auditory Neurons*

November 23 **Hui Wu**, Department of Mathematical Sciences, NJIT
*Pattern Formation in Oscillatory Systems*

November 30 UBM Student Presentations:
**Sandhya Venkataraman & Enas Shehadeh**
*The Dynamic Instability of Microtubles: Vibrational Modes*

**Motolani Olarinre & Xavier Lee**
*Meta-population Model: Improving on the Inter-Patch Movement Rate Term for a more Realistic Model*

**Moustafa Moursy & Omar Meky**
*The Role of the Hyperpolarization-activated Current in Producing Stable Oscillations in the PD Pacemaker Cell*

January 18 — **Thounaojam Umeshkanta Singh**, School of Physical Sciences, Jawaharlal Nehru University, New Delhi, India
*Scenarios of Generalized Synchronization in Chaotically Driven Systems*

February 8 — **Horacio G. Rotstein**, Department of Mathematical Sciences, NJIT
*Subthreshold Resonance in a Stellate Cell Model. Part I*

February 15 — **Horacio G. Rotstein**, Department of Mathematical Sciences, NJIT
*Subthreshold Resonance in a Stellate Cell Model. Part II*

February 22 — **Horacio G. Rotstein**, Department of Mathematical Sciences, NJIT
*Discussion on Voltage Response Amplification due to Nonlinearities (and Maybe Time-scale Separation) in Neural Models*

March 8 — **Amit Bose**, Department of Mathematical Sciences, NJIT
*Dynamics on Random Graphs*

March 22 — **Alex Casti**, Center for Molecular and Behavioral Neuroscience, Rutgers University
*Thalamic Transformation of Retinal Input: Information Transfer and LGN Modeling*

March 29 — **Michiel Remme**, Center for Neural Sciences, New York University
*ITD sensitivity to naturalistic sounds in the superior olivary complex*

April 5 — **Michael Schwemmer**, Princeton Neuroscience Institute, Princeton University
*The Effects of Dendritic Properties on the Dynamics of Oscillatory Neurons*

April 12 — **Ivan Iossifov**, Cold Spring Harbor Lab
*Rare de novo Variants Associated with Autism Perturb a Large Network of Genes Involved in Formation and Function of Synapses*

April 25 — **Xinxian Huang**, Department of Mathematical Sciences, NJIT
*TBA*

## Fluid Mechanics Seminar

September 20 — **Xiaolin Li**, Stony Brook University
*Front Tracking and its Coupling with Convection Dominated Problems*

September 27 — **Ian Griffiths**, University of Oxford
*Mathematical Modelling of Adsorption Kinetics and Micellization in Surfactant Systems*

October 6 — **Arnaud Goullet**, NJIT
*Evolution of Large Amplitude Internal Solitary Waves using a Regularized Model*

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| October 11 | **Shravan Veerapaneni**, NYU/Courant<br>*Large-scale Simulations of Vesicles Suspended in 3D Viscous Flows* |
| October 18 | **Young Ju Lee**, Rutgers University<br>*Self-Sustaining Oscillations of the Falling Sphere Through the Johnson-Segalman Fluids* |
| October 25 | **Qiming Wang**, NJIT<br>*Capillary Breakup in Viscous Fluids: Surface-tension Driven Flow and the Effect of Surfactant or Electric Fields* |
| November 1 | **Daniel Attinger**, Columbia University<br>*Multiscale Engineering of Solid-liquid Interface* |
| November 8 | **Taehun Lee**, CCNY/Levich<br>*Unstructured Lattice Boltzmann Method for Single- and Two-phase Flows* |
| November 15 | **Raquel Perez-Castillejos**, NJIT<br>*Magnetic Fluids and Microfluidics: A Powerful Combination* |
| November 29 | **Javier Diez**, UNCPBA, Tandil, Argentina<br>*A Liquid Rivulet Placed across on an Inclined Plane: Its Stability* |
| December 6 | **Michael Higley**, NJIT<br>*Evolution of an Elastic Capsule in Two-dimensional Stokes Flow* |
| February 7 | **Pushpendra Singh**, NJIT<br>*Manipulation of Particles Trapped at Fluid-liquid Interfaces* |
| February 14 | **Kevin Connington**, CCNY<br>*Lattice Boltzmann Simulations of Particle Transport in Flexible Tubes via Peristalsis* |
| February 21 | **Tamar Shinar**, NYU<br>*Numerical Studies of Microtubule-based Motion in the Single-celled C. elegans Embryo* |
| February 28 | **Ashwin Vaidya**, Montclair State University<br>*Some Paradoxes in Fluid Mechanics* |
| March 7 | **Chang-Hwan Choi**, Stevens Institute of Technology<br>*Multi-Functional 3D Nanostructures: Design, Fabrication, and Applications* |
| March 21 | **Christopher Jacobs**, Columbia University<br>*Primary Cilia as Cellular Mechanosensors* |
| March 28 | **Parsa Zamankhan**, University of Michigan<br>*CFD Analysis of Free Surface Flow of Viscoplastic Materials in Human Airways* |
| April 4 | **Rolf Ryham**, Fordham University<br>*A Continuum Variational Approach to Vesicle Membrane Modeling* |
| April 11 | **Te-Sheng Lin**, NJIT<br>*Instabilities in Spreading Nematic Droplets and Hanging Newtonian Film Flow* |

April 18 **Margarita Staykova**, Princeton University
*Lipid Membranes under Forces: New Aspects of Membrane Behavior*

April 25 **Peichun Amy Tsai**, Princeton University
*Wetting Transition, Drop Impact, and Micro-Flows upon Hydrophobic Microstructures*

**Waves on Wednesdays Seminar**

September 9 **Nathan Gibson**, Oregon State University
*Polynomial Chaos Approach for Simulations in Dispersive Media*

September 9 **Vrushali Bokil**, Oregon State University
*Analysis of High Order Staggered FDTD Methods for Maxwell's Equations in Dispersive Media*

October 6 **Arnaud Goullet**, New Jersey Institute of Technology
*Evolution of Large Amplitude Internal Solitary Waves using a Regularized Model*

## V. PUBLICATIONS, PRESENTATIONS, AND REPORTS

### A. PUBLICATIONS

### JOURNAL PUBLICATIONS

**Shahriar Afkhami**

Numerical Investigation of Elongated Drops in a Microfluidic T-junction (with A. M. Leshansky and Y. Renardy), Physics of Fluids, Vol. 23, 022002, May 2011.

An Experimental and Numerical Investigation of the Dynamics of Microconfined Droplets in Systems with One Viscoelastic Phase (with R. Cardinaels, P. Moldenaers, and Y. Renardy), Journal of Non-Newtonian Fluid Mechanics, Vol. 166, pp. 52-62, 2011.

Deformation of a Hydrophobic Ferrofluid Droplet Suspended in a Viscous Medium under Uniform Magnetic Fields (with A. Tyler, Y. Renardy, M. Renardy, T. St. Pierre, R. Woodward, and J. S. Riffle), Journal of Fluid Mechanics, Vol. 663, pp. 358-384, 2010.

**Denis Blackmore**

Bifurcation and Chaos in Higher Dimensional Pioneer-climax Systems (with Y. Joshi), Int'l. Electronic J. Pure and Appl. Math., Vol. 1 (3), pp. 303-337, August 2010.

Integrability Analysis of Regular and Fractional Blackmore-Samulyak-Rosato Fields (with K. Urban and A. Rosato), Condensed Matter Phys., Vol. 13, 43403, pp. 1-7, December 2010.

**Victoria Booth**

Co-existent Activity Patterns in Inhibitory Neuronal Networks (with A. Bose), Journal of Theoretical Biology, Vol. 272, pp. 42-54, 2011.

Cellularly-driven Differences in Network Synchronization Capacity are Differentially Modulated by Firing Frequency (with C. Fink and M. Zochowski), PLOS Computational Biology, Vol. 7 (5), e1002062, 2011.

Spatial and Reversal Learning in the Morris Water Maze are Largely Resistant to 6 Hrs of REM Sleep Deprivation Following Training (with C.M. Walsh and G.R. Poe), Learn & Mem, Vol. 18 (7), pp. 422-34, 2011.

**Amitabha Bose**

Co-existent Activity Patterns in Inhibitory Neuronal Networks with Short-term Synaptic Depression (with V. Booth), J.Theor. Biol., Vol. 272, pp. 42-54, March 2011.

**Yassine Boubendir**

Dynamics of One- and Two-dimensional Fronts in a Bistable Equation with Delayed Feedback: Propagation Failure and Control Mechanisms (with V. Mendez and H.G. Rotstein), Phys. Rev. E Vol. 82, 036601, September 2010.

**Bruce Bukiet**

Modeling Perfect Games and No-Hitters in Baseball (with R. Sichel and U. Carl), Baseball Res. J., Vol. 40, (1), pp. 58-65, 2011.

Objectively Determining Major League Baseball's Most Valuable Players, Int'l. J. of Performance Analysis in Sport (with K. Fritz), Vol. 10 (2), pp. 152-169, August 2010.

**Daniel Bunker**

TRY – A Global Database of Plant Traits (with J. Kattge and ~100 additional authors), Global Change Biology, June 2011.

Purple Loosestrife Suppresses Plant Species Colonization Far More than Broad-leaved Cattail: Experimental Evidence with Plant Community Implications (with S.M. Hovick, C.J. Peterson, W.P. Carson), Journal of Ecology, Vol. 99, pp. 225-234, January 2011.

The Effect of Agricultural Diversity and Crop Choice on Functional Capacity Change in Grassland Conversions (with B.B. Lin, D.F.B. Flynn, M. Uriarte, S. Naeem), Journal of Applied Ecology, Vol. 48, pp. 609–618, 2011.

Functional Traits and the Growth-mortality Tradeoff in Tropical Trees (with S.J. Wright, K. Kitajima, N. Kraft, P. Reich, I. Wright, R. Condit, J. Dalling, S. Davies, S. Diaz, B. Engelbrecht, K. Harms, S. Hubbell, C. Marks, M. Ruiz-Jaen, C. Salvador, A. Zanne), Ecology, 91(12), January 2011.

Ecosystem Services for 2020 (with C. Perrings, S. Naeem, F. Ahrestani, P. Burkill, G. Canziana, T. Elmqvist, R. Ferrati, Z. Kawabata, J. Fuhrman, F. Jaksic, A. Kinzig, G. Mace, F. Milano, H. Mooney, A.-H. Prieur Richard, J. Tschirhart, W. Weisser), Science, Vol. 330 (6002), p. 324, October 2010.

Biodiversity Transcends Services Response (with C. Perrings, S. Naeem, F. Ahrestani, P. Burkill, G. Canziana, T. Elmqvist, R. Ferrati, Z. Kawabata, J. Fuhrman, F. Jaksic, A. Kinzig, G. Mace, F. Milano, H. Mooney, A.-H. Prieur Richard, J. Tschirhart, W. Weisser), Science, Vol. 330 (6002), p. 324, December 2010.

**Milena Chermisi**

A Symmetry Result for a General Class of Divergence Form PDEs in Fibered Media (with E. Valdinoci), Nonlinear Analysis, Theory, Methods and Applications, Ser. A, Vol. 73, pp. 695-703, 2010.

Multiwell Rigidity in Nonlinear Elasticity (with S. Conti), SIAM Journal on Mathematical Analysis Vol. 42, pp. 1986-2012, 2010.

**Wooyoung Choi**

A Numerical and Experimental Study on the Nonlinear Evolution of Long-crested Irregular Waves (with A. Goullet), Phys. of Fluids, Vol. 23, 016601, January 2011.

An Iterative Method to Solve a Regularized Model for Strongly Nonlinear Long Internal Waves (with A. Goullet and T.-C. Jo), J. Comp. Phys., Vol. 230, pp. 2021-2030, March, 2011.

**Linda Cummings**

Exponential Time Differencing Methods: Stability Analysis and Application to the Nonlinear Schrodinger Equation (with H.A. Ashi and P.C. Matthews), Int. J. Numerical Methods and

Applications, Vol. 4, pp. 99-128, December 2010.

Mathematical Model for Determining the Binding Constants between Immunoglobulins, Bivalent Ligands, and Monovalent Ligands (with E.T. Mack, R. Perez-Castillejos), Anal. Bioanal. Chem., Vol. 399, pp. 1641-1652, January 2011.

Modeling and Simulations of the Spreading and Destabilization of Nematic Droplets (with T.-S. Lin, L. Kondic), Phys. Fluids, Vol. 23, 043102, April 2011.

**Sunil K. Dhar**

Apoptosis in Severe, Compensated Pressure Overload Predominates in Non-Myocytes and is Related to the Hypertrophy but not Function, The American Journal of Physiology: Heart and Circulatory Physiology, (R. Gelpi, M. Park, S. Gao, S. K. Dhar, et al.), Vol. 300 (3), pp. H1062-H1068, March 2011.

Afterload Assessment with or without Central Venous Pressure: A Preliminary Clinical Comparison (with G. Atlas and J. Burger), Cardiovascular Engineering, Vol. 10 (04), pp. 246 - 252, December 2010.

Improvement of Cardiac Function by a Cardiac Myosin Activator in Conscious Dogs With Systolic Heart Failure (with Y.-T. Shen, F.I. Malik, X. Zhao, C. Depre, et al.), Circulation Heart Failure, Vol. 3, pp. 522-527, 2010.

**Javier A. Diez**

On the Breakup of Patterned Nanoscale Copper Rings into Droplets Via Pulsed Laser Induced Dewetting: Competing Liquid Phase Instability and Transport Mechanisms (with Y. Wu, J. D. Fowlkes, P. D. Rack, and L. Kondic), Langmuir, Vol. 26, 11972, 2010.

Self– Versus Directed– assembly of Nanoparticles via Pulsed Laser Induced Dewetting of Patterned Metal Films (with J. D. Fowlkes, L. Kondic, Y. Wu, and P. D. Rack), Nano Letters, Vol. 11, 2478, 2011.

**Thomas Erneux**

Induced Absorption Dynamics in Quantum Dot Based Waveguide Electroabsorbers (with T. Piwonski, J. Pulka, E. A. Viktorov, G. Huyet, R. J. Manning, J. Houlihan, and P. Mandel), Appl. Phys. Lett. Vol. 97, 121103, September 2010.

Analytical Approach to Modulation Properties of Quantum Dot Lasers (with K. Lüdge, E. Schöll, and E. Viktorov), J. Appl. Physics, Vol. 109, 103112, May 2011.

**Jorge Golowasch**

Pacemaker Neuron and Network Oscillations Depend on a Neuromodulator-Regulated Linear Current (with Sh. Zhao and F. Nadim), Frontiers in Behavioral Neuroscience, Vol. 4 (21), pp.1-9, 2010.

**Peter V. Gordon**

Local Kinetics of Morphogen Gradients (with C. Sample, A. Berezhkovskii, C. B. Muratov and S. Y. Shvartsman), Proc. Natl. Acad. Sci. USA, Vol. 108, (15), pp. 6157-6162, April 2011.

**Arnaud Goullet**

A Numerical and Experimental Study on the Nonlinear Evolution of Long-crested Irregular Waves

(with W. Choi), Physics of Fluids, Vol. 23, 016601, January 2011.

An Iterative Method to Solve a Regularized Model for Strongly Nonlinear Long Internal Waves (with W. Choi and T.C. Jo), Journal of Computational Physics, Vol. 230 (5), March 2011.

**Wenge Guo**

Procedures Controlling Generalized False Discovery Rate using Bivariate Distributions of the Null p-values (with Sanat Sarkar), Statistica Sinica, Vol. 20, pp. 1227-1238, July 2010.

**Claus Holzapfel**

Altered Vegetative Assemblage Trajectories within an Urban Brownfield (with F.J. Gallagher, I. Pechmann, and J. Grabosky), Environmental Pollution, Vol. 159, pp. 1159-66, February 2011.

**Huaxiong Huang**

Restricted Diffusion in a Cellular Medium:  A (1+1)-dimensional Model (with H. Huang and R.M. Miura), Bull. Math. Biol., Vol. 73, pp. 1682-1694, 2011.

A Thermal Elastic Model for Constrained Crystal Growth with Facets (with J.B. Wu and C.S. Bohun), J. Eng. Math., Vol. 69, pp. 71-90, January 2011.

Lifetime Ruin Minimization: Should Retirees Hedge Inflation or Just Worry about It? (with M.A. Milevsky), J. Pension Econ. Finance, Vol. 10, pp. 363-387, May 2011.

Spending Retirement on Planet Vulcan: The Impact of Longevity Risk Aversion on Optimal Withdrawal Rates (with M.A. Milevsky), Financial Analyst J., Vol. 67, pp. 45-58, March/Apr 2011.

Effect of Ocean Iron Fertilization on the Phytoplankton Biological Carbon Pump (with A. Pan and B. Pourziaei), Advan. Appl. Math. Mech., Vol. 3, pp. 52-64, January/February 2011.

Coarse Grained Molecular Dynamics Simulation of Interaction between Hemagglutinin Fusion Peptides and Lipid Bilayer Membranes (with N. Vaidya and S. Takagi), Advan. Appl. Math. Mech., Vol. 2, pp. 430-450, July/August 2010.

The Geometry and Dynamics of Binary Trees (with T. David, T. van Kempen, and P.L. Wilson), J. Math. Comput. Simulation, Vol. 81, pp. 1464-1481, March 2011.

**Shidong Jiang**

Incorporating the Havriliak-Negami Dielectric Model in the FD-TD Method (with M. F. Causley, P. G. Petropoulos), Journal of Computational Physics, Vol. 230, (10), pp. 3884-3899, May 2011.

**Lou Kondic**

Self– versus Directed– assembly of Nanoparticles via Pulsed Laser Induced Dewetting of Patterned Metal Films (with J.D. Fowlkes, J. Diez, Y. Wu, P. Rack), Nanoletters, Vol. 11, pp. 2478-2486, June 2011.

Modeling and Simulation of the Spreading and Destabilization of Small Nematic Droplets (with L. Cummings, T. Lin), Phys. Fluids, Vol. 23, 043102, pp. 1-10, March 2011.

Evolution of Droplets of Perfectly Wetting Liquid under the Influence of Thermocapillary Forces (with S. Mukhopadhyay, N. Murisic, R.P. Behringer), Phys. Rev. E, Vol 83, 046302, pp. 1-10, February 2011.

On the Breakup of Patterned Nanoscale Copper Rings into Droplets Via Pulsed Laser Induced Dewetting: Competing Liquid Phase Instability and Transport Mechanisms (with Y. Wu, J. Fowlkes, P. Rack J. Diez), Langmuir, Vol. 26, pp. 11972-11980, August 2010.

**Victor Matveev**

Calcium Cooperativity of Exocytosis as a Measure of Calcium Channel Domain Overlap (with A. Sherman and R. Bertram), Brain Research, Vol. 1398, pp. 126-138, June 2011.

N-type Calcium Channels Carry the Largest Current: Implications for Nanodomains and Transmitter Release (with A.M. Weber, F.K. Wong, A.R. Tufford, L.C. Schlichter, and E.F. Stanley), Nature Neuroscience, Vol. 13, pp. 1348-1350, October 2010.

**Jay N. Meegoda**

Solid Waste and Ecological Issues of Coal to Energy (with S. Gao, N.M.A. Al-Joulani, and L. Hu), ASCE Journal of Hazardous, Toxic, and Radioactive Waste Management, Vol. 15, (2), pp. 99-107, April 2011.

Microscopic Modeling of Air Migration during Air Sparging (with S. Gao and L.Hu), ASCE Journal of Hazardous, Toxic, and Radioactive Waste Management, Vol. 15, No. 2, pp. 70-79, April 2011.

Chrome Steel from Chromium Ore Processing Residue (with W. Kamolpornwijit), Advances in Geotechnical Engineering, ASCE Geotechnical Special Publication Vol. 211, pp. 1297-1306, 2011.

Performance of a Waste Cell in Cold Climate Operated As an Anaerobic Landfill Bioreactor (with C. A. Hunte, J.P.A. Hettiaratchi, and C.H. Hettiarachchi), Advances in Geotechnical Engineering, ASCE Geotechnical Special Publication Vol. 211, pp.1276-1286, 2011.

Production of Segmental Retaining Wall Units from Recycled Mixed Glass and Plastic, Advances in Geotechnical Engineering, ASCE Geotechnical Special Publication, Vol. 211, pp. 1335-1344, 2011.

Determination of Waste Properties from Settlement Behavior of a Full Scale Waste Cell Operated as a Landfill Bioreactor (with C.A. Hunte, J.P.A. Hettiaratchi, and C.H. Hettiarachchi), Advances in Geotechnical Engineering, ASCE Geotechnical Special Publication, Vol. 211, pp. 1404-1413, 2011.

Microscopic Research on Air Sparging I-Network Model Development (with S. Gao and L. Hu), Advances in Geotechnical Engineering, ASCE Geotechnical Special Publication, Vol. 211, pp. 4176-4185, 2011.

**Zoi-Heleni Michalopoulou**

A Particle Filtering Approach for Spatial Arrival Time Tracking in Ocean Acoustics (with R. Jain), Journal of the Acoustical Society of America, Vol. 29, (6), pp. EL236-EL241, June 2011.

RDX Detection with THz Spectroscopy in the following paginated issue of Journal of Infrared, Millimeter, and Terahertz Waves (with S. Mukherjee, Y. L. Hor, K. Su, Z. Liu, R. B. Barat, D. E. Gary and J. F. Federici), International Journal of Infrared, Millimeter, and Terahertz Waves, Vol. 31, (10), pp. 1171-1181, October 2010.

An Overview of Sequential Bayesian Filtering in Ocean Acoustics (with Caglar Yardim and Peter Gerstoft), IEEE Journal of Oceanic Engineering, Vol. 36, (1), pp. 71-89, January 2011.

**Robert M. Miura**

Restricted Diffusion in a Cellular Medium: A (1+1)-dimensional Model (with H. Huang and J.J. Wylie), Bull. Math. Biol., Vol. 73, pp. 1682-1694, 2011.

Exact and Approximate Traveling Waves of Reaction-diffusion Systems via a Variational Approach (with M.R. Rodrigo), Anal. Appl. (Singap.), Vol. 9, pp. 187-199, April 2011.

**Richard O. Moore**

A Path Integral Method for Coarse-graining Noise in Stochastic Differential Equations with Multiple Time Scales (with T. Schafer), Physica D, Vol. 240, pp. 89-97, January 2011.

Noise Bandwidth Dependence of Soliton Phase in Simulations of Stochastic Nonlinear Schrödinger Equations (with D. S. Cargill and C. J. McKinstrie), Opt. Lett., Vol. 36, pp. 1659-1661, May 2011.

**Cyrill Muratov**

Waves of Autocrine Signaling in Patterned Epithelia (with S. Y. Shvartsman), Math. Model. Nat. Phenom., Vol. 5, pp. 46-63, July 2010.

Droplet Phases in Non-local Ginzburg-Landau Models with Coulomb Repulsion in Two Dimensions, Commun. Math. Phys., Vol. 299, pp. 45–87, July 2010.

Cavitation-induced Ignition of Cryogenic Hydrogen-oxygen Fluids (with V. V. Osipov, E. Ponizovskaya-Devine, M. Foygel, and V. N. Smelyanskiy), Appl. Phys. Lett., Vol. 98, pp. 134102-1 -- 134102-3, March 2011.

Local Kinetics of Morphogen Gradients (with P. V. Gordon, C. Sample, A. M. Berezhkovskii and Stanislav Y. Shvartsman), Proc. Natl. Acad. Sci. USA, Vol. 108, pp. 6157-6162, April 2011.

**Farzan Nadim**

Differential Modulation of Synaptic Strength and Timing Regulate Synaptic Efficacy in a Motor Network (with B.R. Johnson, J.M. Brown, M.D. Kvarta, J.Y. Lu, L.R. Schneider and R.M. Harris-Warrick), Journal of Neurophysiology, Vol. 105, pp. 293-304, January 2011.

The Membrane Potential Waveform of Bursting Pacemaker Neurons is a Predictor of their Preferred Frequency and the Network Cycle Frequency (with H.-A. Tseng), Journal of Neuroscience, Vol. 30, pp. 10809-10819, August 2010.

Dopamine Modulates Ih in a Motor Axon (with A.W. Ballo, J.C. Keene, P.J. Troy, M.L. Goeritz, F. Nadim, and Bucher), Journal of Neuroscience, Vol. 30, pp. 8425-8434, July 2010.

**Peter G. Petropoulos**

Incorporating the Havriliak-Negami Dielectric Model in the FD-TD Method (with M. F. Causley and S. Jiang), Journal of Computational Physics, Vol. 230, pp. 3884-3899, May 2011.

**Anthony D. Rosato**

Tapping Dynamics of Granular Columns and Beyond (with D. Blackmore, X. Tricoche, K. Urban, V. Ratnaswamy), JOMMS, Vol. 6 (1-4), pp. 71-86, 2011.

Integrability Analysis of Regular and Fractional BSR Fields (with D. Blackmore, K. Urban), Journal of Condensed Matter Physics, Vol. 13 (4), 43403, pp. 1-7, 2010.

Microstructure Evolution in Tapped Granular Systems (with O. Dybenko, V. Ratnaswamy, L. Kondic), Phys. Rev. E, Vol. 81, 061301, 2010.

**Horacio G. Rotstein**

Dynamics of One- and Two-dimensional Fronts in a Bistable Equation with Delayed Feedback: Propagation Failure and Control Mechanisms (with Y. Boubendir and V. Mendez), Phys. Rev. E, Vol. 82, 036601, September 2010.

The Mechanism of Abrupt Transition between Theta and Hyper-excitable Spiking Activity in Medial Entorhinal Cortex Layer II Stellate Cells (with T. Kispersky and J. A. White), PLoS One, Vol. 5, e13697, 2010.

**Sundar Subramanian**

Multiple Imputations and the Missing Censoring Indicator Model, Journal of Multivariate Analysis, Vol. 102, pp. 105-117, January 2011.

**Ronald Sverdlove**

Corporate Credit Default Swap Liquidity and Its Implications for Corporate Bond Spreads (with R. Chen and F.J. Fabozzi), Journal of Fixed Income, Vol. 20, (2), pp. 31-57, 2010.

**Louis Tao**

A Numerical Solver for a Nonlinear Fokker-Planck Equation Representation of Neuronal Network Dynamics (with M.J. Carceras and J.A. Carrillo), J. Comput. Phys. Vol. 230, 1084, 2011.

Dimensionally-reduced Visual Cortical Network Model Predicts Network Response and Connects System- and Cellular-level Descriptions (with A.T. Sornborger), J. Comput. Neurosci., Vol. 28, pp. 91-106, 2010.

**Jonathan Wylie**

Critical Role of Friction for a Single Particle Falling through a Funnel (with Q. Zhang and Y. Fang), Phys. Rev. E, Vol. 83, 051303, 2011.

Deflection of a Dilute Stream of Particles (with Y.H. Deng and Q. Zhang), Phys. Rev. E, Vol 82, 011307, 2010.

Degenerate Orbit Transitions in a One-dimensional Inelastic Particle System (with R. Yang), Physical Review E, Vol. 82, 011302, 2010.

**Yuan-Nan Young**

Dynamics of a Compound Vesicle in Shear Flow (with S. Veerapaneni, P. Vlahovska and J. Blawzdziewicz), Phys. Rev. Lett., Vol. 106, 158103, April 2011.

Dynamics of a Non-spherical Microcapsule with Incompressible Interface in Shear Flow (with P. Vlahovska, G. Danker and C. Misbah), J. Fluid Mech., Vol. 678, pp. 221-247, April 2011.

## BOOKS AND BOOK CHAPTERS

### Manish Bhattacharjee

False Discovery Rates, Survival Analysis and Related Topics (with S.K. Dhar and S. Subramanian, eds.), Recent Advances in Biostatistics, World Scientific Press, March 2011.

### Denis Blackmore

Nonlinear Dynamical Systems of Mathematical Physics: Spectral and Symplectic Integrability Analysis (with A. Prykarpatsky and V. Samoylenko), World Scientific, Singapore, March 2011.

Recent Advances in Periodicity in Dynamical Systems (with C. Wang), Advances in Mathematical Research, Vol. 15, Nova Science Publ., NY, pp. 1- 47, June 2011.

### Sunil K. Dhar

False Discovery Rates, Survival Analysis and Related Topics (with M.B. Bhattacharjee and S. Subramanian, eds.), Recent Advances in Biostatistics, World Scientific Press, March 2011.

Book Review: Medical Statistics at a Glance, Third Edition, by A. Petrie and C. Sabin, Chichester, UK: Wiley-Blackwell, 2009, Journal of Biopharmaceutical Statistics, Vol. 20 (06), pp. 1223-1224, 2010.

### Sundar Subramanian

The Inverse Censoring Weighted Approach for Estimation of Survival Functions from Left and Right Censored Data (with P. Zhang), Recent Advances in Biostatistics, Vol. 4, pp. 191-206, March 2011.

## PROCEEDINGS PUBLICATIONS

### John Bechtold

Asymptotic Structure of Diffusion Flames at High Pressure (with D. Fong and C.K. Law), 7th US National Meeting of the Combustion Institute, Atlanta GA, Combustion Institute, March 2011.

Propagation of Confined Premixed Flames (with A.P. Kelley and C.K. Law), 7th US National Meeting of the Combustion Institute, Atlanta GA, Combustion Institute, March 2011.

### Manish Bhattacharjee

Warranty Servicing With a Brown-Proschan Repair Option (with R. Banerjee), Advanced Reliability Modeling IV, Proceedings of the 4th Asia-Pacific International Symposium on Advanced Reliability and Maintenance Modelling, McGraw Hill, pp. 33-40, 2010.

A Randomized Repair Strategy In Two Dimensional Warranties (with R. Banerjee), Proceedings of The Seventh International Conference On Mathematical Methods In Reliability Theory, Beijing, June 2011.

### Denis Blackmore

Dynamical Systems-Simulation-Visualization Approach to Tapping and Other Granular Flow

Phenomena: First Steps (with X. Tricoche and A. Rosato), Proc. NSF CMMI Grantees Conference, Atlanta, Georgia, 2011.

**Michael Booty**

Intermediate Template Magnetic Field Assisted Assembly (with R. Rivero, A.T. Fiory, and N.M. Ravindra), Advances in Electroceramic Materials II, Ceramic Transactions, Vol. 221, pp.245-251, August 2010.

**Wooyoung Choi**

Evolution of Nonlinear Surface Waves under the Effects of Wave Breaking and Wind Forcing (with Z. Tian and M. Perlin), Proceedings of the 28th Symposium on Naval Hydrodynamics, Pasadena, California, September 2010.

Refining an Eddy Viscosity Model for Two-dimensional Breaking Waves in Deep Water Experiments (with Z. Tian and M. Perlin), Proceedings of the 30th International Conference on Ocean, Offshore and Artic Engineering, Rotterdam, Netherlands, June 2011.

**Linda Cummings**

Direct Numerical Simulation of Ferrofluid Drops in a Cylindrical Microfluidic under the Influence of a Non-uniform Magnetic Field (with S. Afkhami, Y. Renardy, M. Renardy), Proceedings of 16th US National Congress of Theoretical and Applied Mechanics, State College, PA, July 2010.

**Javier A. Diez**

On the Breakup of Patterned Nanoscale Liquid Metal Rings (with L. Kondic, Y. Wu, J. D. Fowlkes, and P. D. Rack), Proceedings of the Eigth Euromech Fluid Mechanics Conference, Bad Reichenhall, Germany, pp. S8-9, September 2010.

Coating of a Cylindrical Fibre: Instability and Drop Formation (with A. G. Gonzalez, R. Gratton, D. Campana, and F. Saita), Bull. Amer. Phys. Soc., Vol. 55, (285), pp. 21-23, November 2010.

Self and Directed Assembly of Thin Metallic Films Exposed to Pulsed Laser Irradiation (with Y. Wu, J. Fowlkes, P. Rack, and L. Kondic), Bull. Amer. Phys. Soc., Vol. 56, (751), Dallas, TX, March 2011.

**Wenge Guo**

Adaptive Multiple Testing Procedures under Positive Dependence (with S. Sarkar and S. Peddada), In Recent Advances in Biostatistics: False Discovery Rates, Survival Analysis and Other Topics, edited by M. Bhattacharjee, S. Dhar, and S. Subramanian, Series in Biostatistics, Vol. 4, World Scientific, pp. 27-41, March 2011.

**Jay Kappraff**

The Sacred Cut, Proceedings of the Bridges: 2011 Conference, edited by C. Sequin, 2011.

**Jay N. Meegoda**

Retaining Wall Blocks from Recycled Mixed Glass and Plastic, International Symposium on Testing and Specification of Recycled Materials for Sustainable Geotechnical Construction, Baltimore, MD, February, 2011.

A Stochastic Framework for Sustainable Infrastructure-Application to Pipes and Culverts (with L. Abdel-Malek), Transportation Research Board, Washington DC, Paper TRB 11-2848, January

2011.

Microscopic Research on Air Sparging- Network Model Development (with S. Gao and L. Hu), International Second International Conference on Waste Engineering and Management, Shanghai, China, Xiao, Zhang, Cheung and Chu (Ed.), pp. 828-837, October 2010.

**Zoi-Heleni Michalopoulou**

Maximum a posteriori Modal Frequency and Amplitude Estimation for Geoacoustic Inversion, Proceedings of the European Conference in Underwater Acoustics, Istanbul, Turkey, pp. 1–4, July 2010.

**Anthony D. Rosato**

Destabilization of Pickering Emulsions using External Vibrations (with J. Cuadra and P. Singh), Proceedings of the 16th US National Congress on Theoretical and Applied Mechanics, State College, PA, June 2010.

Dynamical Systems-Simulation-Visualization Approach to Tapping and Other Granular Flow Phenomena: First Steps (with X. Tricoche and D. Blackmore), Proc. NSF CMMI Grantees Conference, Atlanta, Georgia, 2011.

## B. PRESENTATIONS

**Shahriar Afkhami**

May 2011: Institute of Geophysics, University of Lausanne, Lausanne, Switzerland
Pore-size Numerical Simulations

April 2011: Dept. of Mechanical Aerospace and Nuclear Engineering, Rensselaer Polytechnic Institute, Troy, NY
Simulating Microfluidic Flows

December 2010: Mechanical Engineering Dept., City College of City University of NY, NY
Drop Dynamics in Liquid-liquid and Liquid-liquid-solid Systems

November 2010: Dept. of Mathematics, Rutgers, New Brunswick
Direct Numerical Simulation of Confined Drops and Bubbles

March 2011: 16th International Conference on Finite Elements in Flow Problems, Munich, Germany
Droplet Deformation in Two-Liquid Systems

November 2010: American Physical Society, 63rd Annual Meeting of the Division of Fluid Dynamics, Long Beach, CA
1) Direct Numerical Simulation of Confined Drops and Bubbles at Low Capillary Numbers
2) Numerical Simulation of the Motion of Super Paramagnetic Nanoparticle Clusters in a Pressure-driven Channel Flow with an External Magnet

October 2010: The Society of Rheology 82nd Annual Meeting, Santa Fe, NM
Deformation of a Superparamagnetic Hydrophobic Ferrofluid Droplet in a Viscous Medium under Uniform Magnetic Fields

July 2010:  Annual meeting of the Canadian Applied and Industrial Mathematics Society, St. John's, Canada
Deformation of a Hydrophobic Ferrofluid Droplet Suspended in a Viscous Medium under Uniform Magnetic Fields

**John Bechtold**

July 2010:  SIAM Annual Meeting, Pittsburgh, PA
Asymptotic Structure of Diffusion Flames at High Pressure with Soret Transport

March 2011:  7th US National Technical meeting of the Combustion Institute, Atlanta, GA
1) Asymptotic Structure of Diffusion Flames at High Pressure with Soret Transport
2) Propagation of Confined Premixed Flames

**Denis Blackmore**

October 2010:  Texas Tech Mechanical Engineering/Mathematics Seminar, Texas Tech University, Lubbock, TX
Swept Volumes and Computational Topology

April 2011:  Mathematics Lecture Series, Wichita State University, Wichita, KS
New Applications of Infinite-dimensional Dynamics to Granular Flows

**Victoria Booth**

July 2010:  SIAM Life Sciences meeting, Pittsburgh, PA
Synaptic Depression Permits Co-existent Activity Patterns in Inhibitory Neuronal Networks

July 2010:  CNS*2010 Annual Computational Neuroscience Meeting, San Antonio, TX
Network Effects of Frequency Dependent Phase Response Curves

August 2010:  Annual University of Michigan – Michigan State University Circadian Clocks Meeting, Ann Arbor, MI
Modeling the Neuronal Interactions between Circadian and Sleep-wake Regulatory Systems

October 2010: Biopsychology seminar, University of Michigan, Ann Arbor, MI

November 2010: 40th Annual Meeting of the Society for Neuroscience, San Diego, CA
1) 6 Hours REM Sleep Restriction Does Not Affect Concurrent Spatial and Reversal Learning in the Morris Water Maze. 300.16
2) Network Effects of Frequency Dependent Phase Response Curves. 645.23
3) Modeling Sleep-wake Temporal Architecture in Multiple Species to Investigate Underlying Physiology of Behavioral State Regulation. 300.18.

May 2011:  SIAM Conference on Applications of Dynamical Systems, Snowbird, UT
Opening speaker and organizer of minisymposium on Modeling Dynamics of Sleep-Wake Regulation, Overview of Sleep-wake Regulation and Dynamics

**Michael Booty**

March 2011:  16th International Conference on Finite Elements in Flow Problems, Munich, Germany
A Hybrid Numerical Method for Interfacial Fluid Flow with Soluble Surfactant

**Amitabha Bose**

December 2010: Workshop on the Integration of Mathematics into Lower Division Science Courses for faculty at Hispanic Serving Institutes, Baltimore, MD
The Undergraduate Biology and Mathematics Program at NJIT

May 2011: SIAM Conference on Applications of Dynamical Systems, Snowbird, UT
Mechanisms for the control of REM sleep patterns

**Bruce Bukiet**

November 2010: NSTA 2010 Area Conference on Science Education, Baltimore, MD
A Collaborative Process to Create Simulations Demonstrating Mathematics and Science Concepts

**Yassine Boubendir**

November 2010: 2010 Fall AMS Central Section Meeting, Notre Dame, IN
Quasi-Optimal Convergence of Non Overlapping Domain Decomposition Method: the Helmholtz Equation.

February 2011: The Twentieth International Conference on Domain Decomposition Methods San Diego Supercomputer Center, La Jolla, CA
New Non-overlapping Domain Decomposition Algorithm for Helmholtz Equation

March 2011: Analysis and PDE Seminar, Department of Mathematics, U. of Delaware, DE
Past and New Non-overlapping Domain Decomposition Methods for the Helmholtz Equation

**Daniel Bunker**

June 2011: Plant Working Group Meeting, Google - Boulder, Boulder, CO
Ecological use Cases and Functional Trait Ontologies

May 2011: TraitNet RCN meeting: Designing TraitBank, Columbia University, New York, NY
TraitBank Meeting: Goals and Charge

February 2011: Phenotype RCN Annual Summit Meeting, National Evolutionary Synthesis Center, Durham, NC
TraitNet RCN: Foster the Curation, Discovery, and Sharing of Ecological Trait Data

December 2010: NSF Research Coordination Network Meeting, National Science Foundation, Arlington, VA
1) Interdisciplinary Collaborations - Challenges and Opportunities within TraitNet
2) RCN: TraitNet - Coordinating Trait-Based Ecological and Evolutionary Research

November 2010: Plant Ontology curators meeting, New York Botanical Garden, New York, NY
TraitNet Goals and Ontology Development

**Milena Chermisi**

March 2011: PDE seminar, Courant Institute of Mathematical Sciences, New York University, NY
Singular Perturbation Models in Phase Transitions for Second Order Materials

May 2011: Workshop on Macroscopic Modeling of Materials with Fine Structure, Carnegie Mellon University, Pittsburgh, PA
Singular Perturbation Models in Phase Transitions for Second Order Materials

April 2011: Applied Math Days, Rensselaer Polytechnic Institute, Troy, NY
Singular Perturbation Models in Second Order Phase Transitions

**Wooyoung Choi**

August 2010: The SIAM Conference on Nonlinear Waves and Coherent Structures, Philadelphia, PA
A Model for Energy Dissipation due to Wave Breaking

September 2010: 28th Symposium on Naval Hydrodynamics, Pasadena, CA
Evolution of Nonlinear Surface Waves under the Effects of Wave Breaking and Wind Forcing

December 2010: Seminar at the Pusan University, Pusan, Korea
Strongly Nonlinear Internal Waves in Density Stratified Oceans and their Satellite Images

March 2011: Seminar at the Kyushu University, Fukuoka, Japan
Large Amplitude Internal Waves in Density Stratified Oceans and their Satellite Images

April 2011: Minisymposium at the 7th IMACS International Conference on Nonlinear Evolution Equations and Wave Phenomena, Athens, GA
Instability of Large Amplitude Capillary Waves

June 2011: Seminar at the Pusan University, Pusan, Korea
Unsteady Hodograph Transformation and its Applications to Water Wave Problems

June 2011: Workshop on waves in fluids, III, Rio de Janeiro, Brazil
Instability of Large Amplitude Capillary Waves

June 2011: Seminar at the Pohang University of Science and Technology (POSTECH), Pohang, Korea
Mathematical Models for Large Amplitude Internal Solitary Waves- Nonlinearity, Ill-posedness, and Regularization

**Linda Cummings**

July 2010: Industrial Mathematics seminar, Centre de Recerca Matematica, Universitat Autonoma de Barcelona, Spain
Mathematical Modeling of Liquid Crystals

April 2011: Kent State University, Liquid Crystal Institute, Kent, OH
Towards an Optimal Model for a Bistable Nematic LCD

November 2010: University of Delaware Applied Math seminar, Newark, DE
Modeling Lipid Raft formation

November 2010: APS Division of Fluid Dynamics meeting, Long Beach, CA
Modeling Spreading of Liquid Crystal Drops

**Sunil K. Dhar**

March 2011: Statistics Seminar Series, Department of Mathematical Sciences and the Center for Applied Mathematics and Statistics, New Jersey Institute of Technology, Newark, NJ
Generalized Linear Model under the Inverse Sampling Scheme

August 2010: Biometrics Section, Joint Statistical Meeting 2010, Vancouver, BC
Optimizing a Testing Procedure Based on Kernel Density Estimation for Comparing Two Treatments

October 2010: American Society of Anesthesiology Annals Meeting in San Diego, CA
A Second Look at the Second Gas Effect

**Javier A. Diez**

October, 2010: 57th International American Vaccum Society Symposium, Albuquerque, NM
Self and Directed Assembly of Thin Metallic Films by Pulsed Laser Induced Dewetting

November 2010: XI Reunion sobre Recientes Avances en Fisica de Fluidos y sus Aplicaciones, Colonia del Sacramento, Uruguay
1) Ruptura de Filamentos Líquidos Rectos Sobre Substratos Inclinados con Mojabilidad Parcial
2) Ruptura de Anillos Liquidos Sobre Substratos Horizontales con Mojabilidad Parcial
3) Modelos para la Ruptura de Filamentos Liquidos sobre Substratos

November 2010: 63rd. Annual Meeting Division of Fluid Dynamics, American Physical Society (APS), Long Beach, CA
On the Breakup of Nanoscale Metalic Rings Melted via Laser Pulses

May 31-June 3: 55th International Conference on Electron, Ion, and Photon Beam Technology and Nanofabrication, Las Vegas, NV
The Directed Assembly of Metallic Nanoparticle Chains by Pulsed Laser Induced Dewetting and Nanolithography

**Thomas Erneux**

July 2010: 31st Annual Meeting of the Canadian Applied and Industrial Mathematical Society, St. John's NL, Canada
Delay Differential Equations in Action

November 2010: Journées DYCOEC, Synchronisation, Control & Bio-dynamics, Besançon, France
Coupled Optoelectronic Oscillators

January 2011: SPIE 2011 Photonics West, San Francisco, CA
The Dynamics of Optoelectronic Oscillators

April 2011: Universitat de les Illes Balears, Palma de Mallorca, Spain
Delay Differential Equations in Action

June 2011: Frontiers in Applied and Computational Mathematics, NJIT, Newark, NJ
Fronts and Pulses Controlled by Time-delayed Feedbacks

**Jorge Golowasch**

November 2010: 40th Society for Neuroscience Meeting, San Diego, CA
1) Intraneuronal Coregulated Expression of Ionic Currents in the Stomatogastric Ganglion of the Crab Cancer Borealis
2) The effects of the Ionic currents co-variation on the rhythmic activity patterns

August 2010: Ninth International Congress of Neuroethology, Salamanca, Spain
Pacemaker Neuron and Network Oscillations depend on a Neuromodulator-regulated Linear Current.

**Roy Goodman**

August 2011: SIAM Conference on Nonlinear Waves and Coherent Structures, Philadelphia, PA

Hopf Instabilities of Defect Modes

October 2011: Applied Mathematics Seminar, Tel Aviv University, Tel Aviv, Israel
Chaotic Scattering of Solitary Waves and Superballs

October 2011: PDE and Applied Math Seminar, Technion Israel Institute of Technology, Haifa, Israel
Chaotic Scattering of Solitary Waves and Superballs

November 2011: Applied Math Seminar, Weizmann Institute for the Advancement of Science, Rehovot, Israel
Chaotic Scattering of Solitary Waves and Superballs

December 2011: Solid State Institute Seminar, Department of Physics, Technion Israel Institute of Technology, Haifa, Israel
Oscillatory Instabilities and Complex Dynamics in a three-mode waveguide

**Peter Gordon**

October 2010: Mathematics Colloquium, Mississippi State University, Starkville, MS
Global Existence vs. Blow Up in Parabolic Systems. Gelfand-Barenblatt Problem for Porous Media.

October 2010: Mathematics Colloquium, Miami University, Oxford, OH
Global Existence vs. Blow Up in Parabolic Systems. Gelfand-Barenblatt Problem for Porous Media.

**Arnaud Goullet**

June 2011: Frontiers in Applied and Computational Mathematics, NJIT, Newark, NJ
Characterization of Two Dimensional Granular System under Isotropic Compression

June 2011: 2011 Interdisciplinary Summer School: University of Maryland College Park, MD
Granular Flows from Simulations to Astrophysical Application

**Wenge Guo**

June 2011: Summer Program Seminar, Department of Mathematical Sciences, New Jersey Institute of Technology, Newark, NJ
Two-stage BH Procedure for Controlling the FDR and its Application in Astrostatistics

April 2011: 2011 IISA COnference on Probability, Statistics, and Data Analysis, Raleigh, NC
Adaptive FWER and FDR Control under Block Dependence

April 2011: Statistics Seminar, Department of Mathematical Sciences, New Jersey Institute of Technology, Newark, NJ
Adaptive FWER and FDR Control under Block Dependence

**Michael Higley**

November 2010: APS Division of Fluid Dynamics, Long Beach, CA
Evolution of an Elastic Capsule in 2D Stokes Flow

June 2011: Frontiers in Applied and Computational Mathematics, NJIT, Newark, NJ
Tank-treading, Bursting and Cusping: Capsule Response at Large Deformation

**Claus Holzapfel**

March 2011: Ecological Society of America - Annual Mid-Atlantic Meeting, Montclair, NJ
1) Urban Green Spaces: Traps or Havens for Migratory Birds
2) Clonal Diversity and Resistance to Invasion in Remnant Salt Marsh Patches
3) Trophic Transfer of Heavy Metals and Avian Feeding Ecology in an Urban Brownfield
4) Biodiversity as a Goal? Semi-natural Assembly of Restored Upland Vegetation
5) The Relative Abundances of Native and Non-native Emydid Turtles across an Urban to Rural Habitat Gradient in Central New Jersey

November 2010: Partners in Environmental Technology - Technical Symposium & Workshop. Meeting DoD's Environmental Challenges, Washington, DC
Understanding and Combating the Fire-enhancing Impact of Non-native Annuals in Desert Scrub through the Tools of Population and Landscape Ecology

August 2010: Ecological Society of America, Pittsburgh, PA
Urban Restoration by Spontaneous Assembly: Are Wetland and Upland Wildlands Biodiversity Havens?

**David J. Horntrop**

July 2010: SIAM Annual Meeting, Pittsburgh, PA
1) Stochastic Simulation for Self-Organization in Materials
2) Variance Reduction for Numerical Simulation of Stochastic Differential Equations

**Huaxiong Huang**

June 2011: Progress Report for AIM SQuaRE, American Institute of Mathematics, Palo Alto, CA
Modeling Cortical Spreading Depression

August 2010: Report on Focussed Research Group, Banff International Research Station, Banff, Alberta, Canada
Focussed Research Group on Spreading Cortical Depression and Related Phenomena

July 2010: SIAM Annual Meeting, Pittsburgh, PA
Cellular-Network and Continuum Neuronal Models for Cortical Spreading Depression

July 2010: Report for AIM SQuaRE, American Institute of Mathematics, Palo Alto, CA
Modeling Cortical Spreading Depression

June 2011: Frontiers in Applied and Computational Mathematics, NJIT, Newark, NJ
A Neuronal Model for the Instigation and Propagation of Cortical Spreading Depression

June 2011: Fudan University Seminar, China
Fixed Grid Method for Problems with (Moving) Interfaces

**Shidong Jiang**

August 2010: IMA, University of Minnesota, MN
Hot Topics Workshop on "Integral Equation Methods, Fast Algorithms and Applications"
Second Kind Integral Equations for the First Kind Dirichlet Problem of the Biharmonic Equation in Three Dimensions

June 2011: Frontiers on Applied and Computational Mathematics, NJIT, Newark, NJ
Fast Algorithms for Generating Random Numbers with Certain Spatial Correlation

**Jay Kappraff**

August 2010: C:ADM conference sponsored by the American Cybernetics Society, RPI
A Course in the Mathematics of Design

**Lou Kondic**

June 2011: Aspen Center for Theoretical Physics Workshop on Fluctuations and Response in Granular Materials, Aspen, CO
Some Open Questions in Describing Dense Granular Matter

June 2011: Lorentz Center Workshop on Fluctuations and Response in Active Materials, Leiden, The Netherlands
Computational Homology Applied to Granular Media

June 2011: Interdisciplinary Summer School: Granular Flows: From Simulations to Astrophysical Application, College Park, MD
Discrete Element Simulations of Dense Granular Systems

June 2011: Frontiers in Applied and Computational Mathematics, NJIT, Newark, NJ
1) Liquid Crystal Instabilities
2) Microstructure Evolution in Dense Granular Systems
3) Characterization of Two Dimensional Granular System under Isotropic Compression

May 2011: Spring Eastern Sectional Meeting of American Mathematical Society, Worcester, MA
Modeling Spreading on Nematic Liquid Crystal Droplets

March 2011: American Physical Society Annual March Meeting, Dallas, TX
1) Topology of the Force Field in a Jammed Granular System Exposed to an Intruder
2) Self and Directed Assembly of Thin Metallic Films Exposed to Pulsed Laser Irradiation
3) Modeling Spreading of Nematic Droplets

November 2010: American Physical Society-Division of Fluid Dynamics Annual Meeting, Long Beach, CA
1) Thin Films: Instabilities, Waves, and Dewetting
2) On Influence of Microstructure on Granular Impact
3) Modeling Spreading of Liquid Crystal Drops
4) Evolution of Droplets of Perfectly Wetting Liquid under the Influence of Thermocapillary Forces
5) Granular Materials: On Topology of Force Chains
6) On the Breakup of Nanoscale Metal Rings Melted via Laser Pulses

September 2010: Eighth Euromech Fluid Mechanics Conference, Bad Reichenhall, Germany
On the Breakup of Patterned Nanoscale Liquid Metal Rings

September 2010: Colloquium at EMPA/ETH, Zurich, Switzerland
Mathematical Modeling in Materials Science: Two Case Studies

**Gregory A. Kriegsmann**

November 2010: Department of Engineering Science and Applied Mathematics, Northwestern University, Evanston, IL
Electric Discharge Sintering: A Mathematical Model

**Victor Matveev**

March 2011: Biocomplexity Seminar, Indiana University, Bloomington, IN
Modeling Calcium Sensitivity of Synaptic Response: How Many Calcium Channels Does It Take

to Release a Neurotransmitter Vesicle?

March 2010: Biophysical Society 55th Annual Meeting, Baltimore, MD
1) Effect of Spatial Organization of Presynaptic Calcium Channels on Calcium Current Cooperativity of Exocytosis
2) The Calcium Channel Single Channel Conductance Hierarchy is N>L>T at Physiological External Calcium: Implications for Presynaptic Transmitter Release Site Gating

**Zoi-Heleni Michalopoulou**

November 2010: Meeting of the Acoustical Society of America, Cancun, Mexico
1) Model-based Estimation and Uncertainty Characterization of Modal Arrival Times and Amplitudes in Ocean Acoustics
2) Gibbs Sampling for Modal Arrival Time and Amplitude Estimation from Time-frequency Representations of Acoustic Signals

March 2011: William Paterson University, Wayne, NJ
Applied Mathematics and Computational Science

May 2011: Meeting of the Acoustical Society of America, Seattle, WA
Tracking in Ocean Acoustics for Geoacoustic Inversion

**Robert M. Miura**

June 2011: Progress Report for AIM SQuaRE, American Institute of Mathematics, Palo Alto, CA
Modeling Cortical Spreading Depression

August 2010: Report on Focussed Research Group, Banff International Research Station, Banff, Alberta, Canada
Published on BIRS website: http://www.birs.ca/events/2010/focussed-research-groups/10frg116)
Focussed Research Group on Spreading Cortical Depression and Related Phenomena

July 2010: Canadian Applied and Industrial Mathematics Society and 19th Canadian Symposium on Fluid Dynamics, St. John's, Newfoundland, Canada
(Plenary Lecture) Mathematical Modeling with Applications to Biology and Medicine

July 2010: SIAM Annual Meeting, Pittsburgh, PA
Cellular-Network and Continuum Neuronal Models for Cortical Spreading Depression

July 2010: Report for AIM SQuaRE, American Institute of Mathematics, Palo Alto, CA
Modeling Cortical Spreading Depression

**Richard O. Moore**

July 2010: Applied and Computational Mathematics Seminar, IMPA, Rio de Janeiro, Brazil
Phase Fluctuations in Optical Solitons

August 2010: SIAM Conference on Nonlinear Waves and Coherent Structures, Philadelphia, PA
Traveling Waves in Thermally Driven Optical Parametric Oscillators

December 2010: ACMS Seminar, University of Notre Dame, Notre Dame, IN
Rare Events in Nonlinear Optics

January 2011: PDE/Applied Math Seminar, Drexel University, Philadelphia, PA
Rare Events in Nonlinear Optics

**Cyrill Muratov**

November 2010: Applied Mathematics Seminar, Department of Mathematics, University of Padua, Padua, Italy
Self-induced Stochastic Resonance: How New Non-random Behaviors can Arise from the Action of Noise

December, 2010: Materials Group Meeting, Courant Institute of Mathematical Sciences, New York, NY
Droplet Phases in Compositionally Asymmetric Diblock Copolymer Melts in Two Dimensions

March 2011: Workshop on Free Boundary Problems and Random Effects, Technical University of Dortmund, Germany
Droplet Phases in Compositionally Asymmetric Diblock Copolymer Melts in Two Dimensions

April 2011: German-American Kavli Frontiers of Science Symposium, NAS, Irvine, CA
Pattern Formation by Energy Minimization and More

May, 2011: Workshop on Ginzburg-Landau equations, Dislocations and Homogenization, Ile de Re, France
Droplet Phases in Compositionally Asymmetric Diblock Copolymer Melts in Two Dimensions

**Farzan Nadim**

July 2010: SIAM Life Sciences 10, Pittsburgh, PA
1) Synapses Showing a Preferred Frequency in a Reciprocally Inhibitory Neuronal Network
2) Using Feed-Forward Networks to Infer the Activity of Feed-Back Neuronal Networks

July 2010: Computational Neuroscience Meeting, San Antonio, TX
1) Using Feed-Forward Networks to Infer the Activity of Feed-Back Neuronal Networks
2) Synapses Showing a Preferred Frequency in a Reciprocally Inhibitory Neuronal Network

August 2010: Ninth International Congress of Neuroethology, Salamanca, Spain
Pacemaker Neuron and Network Oscillations Depend on a Neuromodulator-regulated Linear Current

November 2010: Society for Neuroscience Annual Meeting, San Diego, CA
1) Modeling a Reciprocally Inhibitory Neuronal Network Coupled with Synapses Showing a Preferred Frequency
2) The Frequency-dependent Response of Synapse in an Oscillatory Network
3) Different Neuromodulators Co-released from a Projection Neuron Affect the Synaptic Strength in the Target Network Depending on their Temporal Order
4) Dopamine Modulation of Ih Changes the Dependence of Conduction Velocity on Spike Frequency and History in a Stomatogastric Motor Axon

February 2011: Dynamical Systems Colloquium, Princeton University, Princeton, NJ
Preferred Frequencies of Synapses in a Central Pattern Generating Network

May 2011: SIAM Conference on Applications of Dynamical Systems, Snowbird, UT
Using Feed-forward Maps to Explore the Role of Synaptic Dynamics in a Reciprocally Inhibitory Network

**Peter G. Petropoulos**

July 2010: SIAM Annual Meeting, Pittsburgh, PA
A Numerical Method for Simulating EM Wave Propagation in Dielectrics that Exhibit Fractional Relaxation

**Anthony D. Rosato**

November 18, 2010: NJEdge.Net Conference 7.0, Somerset, NJ
Modeling and Simulation of Granular Materials

November, 2010: Naval Research Lab, Stennis Space Center, MS
Microstructure Evolution in Tapped Monodisperse Assemblies of Spheres via Discrete Element Simulations

July 2010: University of Salerno, Department of Civil Engineering, Italy
Microstructure Evolution in Tapped Monodisperse Assemblies of Spheres via Discrete Element Simulations

**Horacio G. Rotstein**

November 2010: VIth Annual Graduate Student Research Day. New Jersey Institute of Technology, Newark, NJ
The Effects of Periodic and Non-periodic Inputs on the Firing Frequency of Medial Entorhinal Cortex Layer II Stellate Cells Model

November 2010: Behavior and Neural Sciences Minisymposium, Rutgers University, Nov 8, 2010, Rutgers University, Newark, NJ
The Effects of Periodic and Non-periodic Inputs on the Firing Frequency of Medial Entorhinal Cortex Layer II Stellate Cells Model

February 2011: Mathematical Biology Seminar. New Jersey Institute of Technology, Newark, NJ
1) Subthreshold Resonance in a Stellate Cell Model. Part I
2) Subthreshold Resonance in a Stellate Cell Model. Part II
3) A Discussion on Voltage Response Amplification due to Nonlinearities (and maybe time-scale separation) in Neural Models

February 2011: Center for Neural Systems, New York University, Rinzel Group
Membrane Potential Resonance in a Ih/INap Biophysical Neuron Model: From Hyper-polarized to Threshold Voltage Regimes

March 2011: Department of Computer Science, University of Massachusetts, Amherst, MA
A Mechanism of Abrupt Transitions between Firing Frequency Regimes in Entorhinal Stellate Cells

April 2011: Center for Molecular and Behavioral Neuroscience, Rutgers University, Newark, NJ
Connectionist Computational Models

May 2011: Department of Mathematical Sciences, NJIT, Summer Faculty Seminar Series
Frequency Preference in Neural Systems

**Michael Siegel**

July 2010: Applied Mathematics Seminar, Imperial College, London, UK
1) A Hybrid Numerical Method for Fluid Interfaces with Soluble Surfactant
2) A Nonstiff Boundary Integral Method for Porous Media Flow with Surface Tension

July 2010: SIAM Annual Meeting, Pittsburgh, PA
A Nonstiff Boundary Integral Method for 3D Porous Media Flow with Surface Tension

August 2010: SIAM Conference on Nonlinear Waves and Coherent Structures, Philadelphia, PA
A Nonstiff Boundary Integral Method for Interfacial Flow with Surface Tension

January 2011: Applied Mathematics Seminar, Ohio State University, Columbus, OH
A Hybrid Numerical Method for Fluid Interfaces with Soluble Surfactant

February 2010: Applied Mathematics Seminar, SUNY, Stony Brook, NY
A Hybrid Numerical Method for Fluid Interfaces with Soluble Surfactant

April 2011: Applied Mathematics (Lunchtime) Seminar, City College of New York, New York, NY
A Hybrid Numerical Method for Fluid Interfaces with Soluble Surfactant

April 2011: Engineering Seminar, Brown University
A Hybrid Numerical Method for Fluid Interfaces with Soluble Surfactant

May 2011: NCTS Workshop on Fluid-Solid Interaction, Hsinchu, Taiwan
Numerical Computations of Interfacial Flow with Soluble Surfactant

**Ronald Sverdlove**

October 2010: Northeast Business and Economics Association Annual Meeting, Morristown, NJ
Mergers and Debt Seniority

**Louis Tao**

April 2011: Mathematical Neuroscience 2011, the 4th annual meeting of the UK Mathematical Neuroscience Network, Edinburgh, UK
Dimension Reduction of a Visual Cortical Model

October 2010: 10th China-India-Japan-Korea Joint Workshop on Neurobiology and Neuroinformatics, Kunming, China
Mapping Functional Connectivity with Larval Zebrafish Transgenic for a Ratiometric Calcium Indicator

**Qiming Wang**

July 2010: SIAM Annual Meeting, Pittsburgh, PA
Nonlinear Evolution of Electrified Threads and Annular Layers

June 2011: Frontiers in Applied and Computational Mathematics, NJIT, Newark, NJ
Numerical Simulations of Drop Dynamics with Soluble Surfactant

**Yuan-Nan Young**

August 2010: Fields Workshop on Fluid Motion, Toronto, Canada
Dynamics of a Semi-flexible Polar Filament in Stokes Flow

August 2010: SIAM Conference on Wave and Nonlinear Dynamics, Philadelphia, PA
Dynamics of a Polar Filament in Stokes Flow

October 2010: 47th Annual Technical Meeting of the Society of Engineering, Ames, IA
Dynamics of a Compound Vesicle in Linear Shear Flow

November 2010: APS Division of Fluid Dynamics, Long Beach, CA
Dynamics of a Compound Vesicle in Linear Shear Flow

March 2011: SIAM Conference on Computational Science and Engineering (CSE11), Reno, NV
Dynamics of the Primary Cilium in Linear Shear Flow

March 2011: APS Annual March Meeting, Dallas, TX
Dynamics of a Compound Vesicle in Linear Shear Flow

April 2011: Montclair State University, Montclair, NJ
Dynamics of the Primary Cilium in Linear Shear Flow

April 2011: Brown University, Providence, RI
Dynamics of the Primary Cilium in Linear Shear Flow

May 2011: SIAM Conference on Dynamical System, Snowbird, UT
Dynamics of the Primary Cilium in Linear Shear Flow

## C. TECHNICAL REPORTS

**REPORT 1011-1**: *Multiple Imputations and the Missing Censoring Indicator Model*
Sundar Subramanian

**REPORT 1011-2**: *Some Adjusted Marked Empirical Processes for Model Checking with Missing Binary Data*
Sundar Subramanian

**REPORT 1011-3**: *Warranty Servicing with a Brown-Proschan Repair Option*
Rudrani Banerjee and Manish C. Bhattacharjee

**REPORT 1011-4**: *Asymptotic Structure of Diffusion Flames at High Pressure*
D. Fong, J. K. Bechtold, and C. K. Law

**REPORT 1011-5**: *Inhibitory Feedback Promotes Stability in an Oscillatory Network*
F. Nadim, S. Zhao, L. Zhou, and A. Bose

**REPORT 1011-6**: *Peptide Neuromodulation of Synaptic Dynamics in an Oscillatory Network*
Shunbing Zhao, Amir Farzad Sheibanie, Myongkeun Oh, Pascale Rabbah, and Farzan Nadim

**REPORT 1011-7**: *Excitable Nodes on Random Graphs: Relating Dynamics to Network Structure*
Thounaojam Umeshkanta Singh, Kaustubh Manchanda, Ramakrishna Ramaswamy, and Amitabha Bose

**REPORT 1011-8**: *Self– versus Directed– assembly of Nanoparticles via Pulsed Laser Induced Dewetting of Patterned Metal Films*
J. D. Fowlkes, L. Kondic, J. Diez, Y. Wu, and P. D. Rack

**REPORT 1011-9**: *Evolution of Droplets of Perfectly Wetting Liquid under the Influence of Thermocapillary Forces*
Shomeek Mukhopadhyay, Nebojsa Murisic, Robert P. Behringer, and Lou Kondic

**REPORT 1011-10**: *Defect Modeling in Spreading Nematic Droplets*
T.-S. Lin, L. Kondic, and L. J. Cummings

**REPORT 1011-11**: *Modeling and Simulations of the Spreading and Destabilization of Nematic Droplets*
L.J. Cummings, T.-S. Lin, and L. Kondic

**REPORT 1011-12**: *Quasi-Optimal Convergence of Non-Overlapping Domain Decomposition Algorithm for the Helmholtz Equation*
Y. Boubendir, X. Antoiney, and C. Geuzaineets

**REPORT 1011-13**: *Second Kind Integral Equations for the First Kind Dirichlet Problem of the Biharmonic Equation in Three Dimensions*
Shidong Jiang, Bo Ren, Paul Tsuji, and Lexing Ying

**REPORT 1011-14:** *Caslav V. Stanojevic - A Renaissance Man*
Petronije Milojevic

## VI. EXTERNAL ACTIVITIES AND AWARDS

### A. FACULTY ACTIVITIES AND AWARDS

**Shahriar Afkhami**

Foundation Herbette, Visiting Researcher Grant and Invited Visiting Assistant Professor, University of Lausanne, 2011.

Visiting Assistant Professor, Dept. of Mathematics, Virginia Polytechnic Institute & State University.

Panel review, National Science Foundation CBET program.

Session Chair, Bubbles, APS-DFD Long Beach, California.

**Daljit S. Ahluwalia**

Member of Committee of Meeting and Conferences, AMS

**Denis Blackmore**

Associate Editor, Mechanics Research Communications, 2007 - present

Editorial Board, Atlantis/Springer Advanced Book Series, Studies in Mathematical Physics: Theory and Applications, 2011

Editorial Board, Journal of Nonlinear Mathematical Physics, 2010 - present

Editorial Board, Recent Patents in Space Technology, 2009 - present

Editorial Board, Differential Equations and Applications, 2008 - present

Editorial Board, Regular and Chaotic Dynamics, 2006 - present

Editorial Board, Mathematical Bulletin of the Shevchenko Scientific Society, 2005 - present

NSF Dynamical Systems Panels Career Award, December 2010 and March 2011

Listed in latest Who's Who in the World

**Victoria Booth**

Program Committee, Society for Industrial and Applied Mathematics, 2011-2014

Treasurer, Organization for Computational Neuroscience, 2011-2014

**Wooyoung Choi**

WCU Visiting professor, Korea Advanced Institute of Science and Technology. August 2010 - July 2011

**Linda Cummings**

Organizer of inaugural Mathematical Problems in Industry workshop at NJIT, June 2011.

Awarded an Oxford Centre for Collaborative Applied Mathematics (OCCAM) Visiting Fellowship.

**Javier Diez**

Councelor in the Superior Council of Universidad Nacional del Centro, 2010-2011)

**Jorge Golowasch**

Co-organizer of Dynamic Neural Networks: The Stomatogastric System. Satellite of the Society for Neuroscience Meeting, San Diego, CA, October 2010.

**Wenge Guo**

Editorial Board of the Journal of Biometrics and Biostatistics.

**Michael Higley**

SIAM travel award ICIAM 2011

**Huaxiong Huang**

Fields Institute Fellow, 2007 - Present.

Managing Editor, Math-in-Industry Case Studies Journal, Fields Institute.

Associate Editor, Editorial Board, Journal on Engineering Mathematics, Springer.

Associate Editor, Editorial Board, Advance in Applied Mathematics and Mechanics, Global Science.

Invited Member, Editorial Board, Journal of Hydrodynamics, Springer.

Member, Fields Institute Industrial Advisory Board, (2008 - Present).Regional Scientific Director, MITACS (2005 - Present).

Minisymposium Organizer, International Conference on Industrial and Applied Mathematics, Vancouver, British Columbia, Canada.

**Aridaman Jain**

Chair, American Society for Quality Writing Committee for An Attribute Chain Sampling Program: ANSI/ASQ S3.

Chair, American Society for Quality Writing Committee for An Attribute Skip-Lot Sampling Program: ANSI/ASQ S3.

**Lou Kondic**

Organizer, Aspen Center for Theoretical Physics Workshop, Fluctuations and Response in Granular Materials, May 23rd - June 10th, 2011.

**Gregory A. Kriegsmann**

Associate Editorialships:
IMA Journal of Applied Mathematics
European Journal of Applied Mathematics
Journal of Engineering Mathematics
Analysis and Applications

Visiting Professorships:
Visiting Professor of Engineering Science and Applied Mathematics, Northwestern University, Evanston, IL, September-August, 2010-2011.

Visiting Professor of Electrical Engineering, University of Pennsylvania, Philadelphia, PA, January-June, 2011.

**Jay N. Meegoda**

Editorial Board member: ASTM Geotechnical Testing Journal
Editorial Board member: Springer Journal on Waste and Biomass Valorization
Associate Editor: ASCE Practice Periodical of Hazardous, Toxic, and Radioactive Waste Management

**Robert M. Miura**

SIAM Fellow, SIAM, 2009 - Present.
AAAS Fellow, AAAS, 2005 - Present.
Fellow, Royal Society of Canada, 1995 - Present.

Chair, Board of Trustees, Mathematical Biosciences Institute, Ohio State University, Columbus, OH, 2008-2011.

Co-Editor-in-Chief, Analysis and Applications, World Scientific.

Member, SIAM Book Editorial Board.

Associate Editor, SIAM Journal on Applied Mathematics.

Member, Editorial Board, Canadian Applied Mathematics Quarterly.

Member, Editorial Board, SIAM Book Series on Monographs on Mathematical Modeling and Computation.

Member, William Benter Prize in Applied Mathematics Selection Committee, City University of Hong Kong, Kowloon, Hong Kong, 2009-2012.

Minisymposium Organizer, International Conference on Industrial and Applied Mathematics, Vancouver, British Columbia, Canada

Session Moderator, Blackwell-Tapia Conference, Mathematical Biosciences Institute, Columbus, OH, November 2010.

**Richard O. Moore**

June 2011: Minisymposium Chair, Frontiers in Applied and Computational Mathematics Conference, NJIT, Newark, NJ

June 2011: Co-organizer, Mathematical Problems in Industry Workshop, NJIT, Newark, NJ

June 2011: Local organizer, Graduate Student Mathematical Modeling Camp, NJIT, Newark, NJ

**Cyrill Muratov**

Associated Editor, Networks and Heterogeneous Media

**Farzan Nadim**

Review Editor, Journal of Neuroscience

Review Editor, Frontiers in Neural Circuits

Member, NIH Sensorimotor Integration Study Section

**Anthony D. Rosato**

Fulbright Senior Research Fellowship

Editor-in-Chief, Mechanics Research Communications

ASCE Engineering Mechanics Institute, Inelasticity Committee member

International Hoover Award Board, ASME representative

Committee on Publication Ethics (UK) - member

Elsevier Distinguished Lecture in Mechanics, organizer

**Horacio G. Rotstein**

Member of the Scientific Committee, 4th Argentine School of Mathematics and Biology, Cordoba, Argentina, August 2010.

Member of the Organizing Committee, Frontiers in Applied and Computational Mathematics, Newark, NJ, June 2011.

**Michael Siegel**

Member of Editorial Board, SIAM Journal of Applied Mathematics

Member of Organizing Committee, Conference on Frontiers in Applied and Computational Mathematics, NJIT, Newark, NJ, June 2011

**Sundar Subramanian**

Co-Editor of a research monograph entitled Recent Advances in Biostatistics: False Discovery, Survival Analysis and other topics, World Scientific Press.

**Ronald Sverdlove**

Discussant, Financial Management Association Annual Meeting, New York, New York, October 2010.

## B. CONFERENCE ON FRONTIERS IN APPLIED AND COMPUTATIONAL MATHEMATICS (FACM '11)

The Eighth Conference on Frontiers in Applied and Computational Mathematics (FACM ’11) at the New Jersey Institute of Technology was held on June 9-11 and was focused on wave propagation and applications to electromagnetics, optics, acoustics, fluid dynamics, and biology.

FACM ’11 was coordinated with the 26th Mathematical Problems in Industry Workshop, which was held for the first time at NJIT on June 13-17, immediately following FACM.

This year’s FACM conference was particularly noteworthy in that it celebrated the 25th anniversary of the Center for Applied Mathematics and Statistics (CAMS) at NJIT. Many of the department’s Ph.D. alumni attended a special dinner that was held on the first day of the conference to commemorate the anniversary of CAMS. Don Sebastian, Vice President for Research at NJIT, gave the keynote speech at the alumni dinner (photo right).


**Daljit S. Ahluwalia, Chair, Department of Mathematical Sciences and Director, Center for Applied Mathematics and Statistics**

**CSLA Dean Fadi Deek**

The conference featured 5 plenary talks, 35 minisymposium talks (many of which were given by up and coming junior faculty), and 19 contributed talks by postdocs and graduate students. The contributed talks were selected from a large number of applications, and were presented in the same sessions as the invited talks, giving these young researchers a chance to showcase their research results. In addition to the talks, there were 23 posters on a variety of research topics. A banquet was held on the second day of the meeting, with NJIT President Robert Altenkirch giving the dinner speech.

**NJIT President Robert Altenkirch**

(**from left) Naomi Leonard, George Papanicolaou, Jacob White, Joyce McLaughlin, Dean Fadi Deek, Provost Ian Gatley, President Robert Altenkirch, and Dr. Daljit S. Ahluwalia, Chair of DMS and Director of CAMS**

The plenary speakers for the conference were Oscar Bruno (California Institute of Technology), Joyce McLaughlin (RPI), George Papanicolaou (Stanford), Naomi Leonard (Princeton) and Jacob White (MIT). As in the past two conferences, there was a panel session on "Future Trends in Applied and Computational Mathematics". Papanicolaou, Leonard, McLaughlin, and Bill Kath (Northwestern) served as panelists, and Robert Miura was the moderator. The panel fielded questions on topics such as new and potentially fruitful areas for the application of mathematics, and on trends in applied mathematics education. Here are some examples of the questions and the answers from the panel:

*Question 1. Graduate programs in applied mathematics have evolved very slowly. If you were to design a program from scratch what would it look like? How would it differ from current programs?*

George: My answer is simple because we recently went through this exercise at Stanford. We have an Applied Math program in the Engineering School. It's called Computational Applied Mathematics. The program has attracted a large number of very good people in a short period time. The typical applicant has undergrad preparation in math or applied math and made the decision not to go into the traditional math department. They are looking for a broader

experience. Mathematics is the core of their intellectual pursuit but they do not want to be pushed into a program that has rigid requirements of qualifying examinations etc. The program is very rich and innovative. This program at Stanford is for a confident individual who is not afraid to move into a competitive environment. This is a very different atmosphere; the opportunity is there to move into new areas. There are huge opportunities as the students secure jobs and go into industry.

Bill: In light of on being on this panel a lot of places do analysis, computation and modeling, something that is becoming new over the last few years is large amounts of data. You can't teach students to handle all the different types but they should have familiarity and not be daunted by it. So much of what's going to happen in the next number years is going to involve these large data sets.

Naomi: At Princeton the Applied Math students do rotations with serious research in a field with one person and in another field with a different person. They will get the experience and then when they move to the higher level they choose among the things they have done. This gives a medical school approach where they have rotations and exposure.

Joyce: The students need to know the application area. In my area we interact with people in industry like GE and people in medical schools and they get to know the language and what's important to these individuals. So one way to effect this to have a research interdisciplinary group, where students work in these groups. In terms of designing a program, that kind of working group experience might be very valuable to try and work into the program. The other thing that is very useful for students is to obtain an internship. This helps them to get jobs later but to also appreciate the applied area.

*Question 2. This has to do with beginning researchers, especially postdocs and grad students. They struggle with a number of early career decisions and one such decision is to choose an area of research. How did you decide on your current primary area of research? (In fact this extends beyond early career because all of you have essentially worked in more than one area.)*

Joyce: I generally follow several different scientific areas just out of scientific interest. When something comes up that I feel that I have an expertise and there might be a high impact and I can get excited about it I may just move in that area.

Naomi: My training is in control theory. I was attracted to it for many reasons, the mathematics and the opportunities that are created for working on a variety of different systems so for me control theory is about feedback and dynamical systems. I've always moved around a little bit but recently began thinking about these problems on populations of animals... it's incredibly rewarding to take the mathematics that one has experience with and move into areas that are new to you.

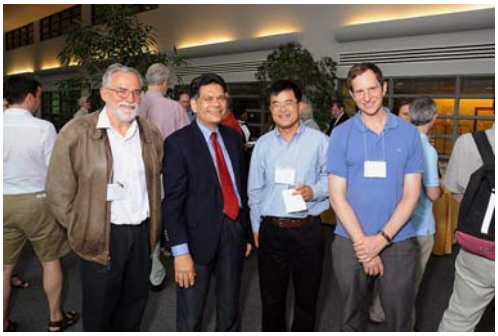
Bill: I remember what my advisor told me when I asked him this question a long time ago (Don Cohen at Cal Tech) figure out what the figure is going to be ten years from now and start working on it now and I think the answer is if you can really do that you would go into the financial markets instead.

George: I have a different perspective because I've been in this field more than 40 years. The most important thing is to do is to be open and be willing to change, willing to leave an accumulated experience in one area and move to another area. Be open and not get trapped in one area for too long in time. At Courant it was part of the culture, not to stay tied to one field, for example while at Courant I never taught the same class twice in a decade.

The organizing committee for this years conference was Daljit S. Ahluwalia (Chair), Yassine Boubendir, Margaret Cheney, Shidong Jiang, Horacio Rotstein, and Michael Siegel.

**Panel Session**

## FACM'11 Banquet



## C. MATHEMATICAL PROBLEMS IN INDUSTRY WORKSHOP

This year, for the first time, NJIT and the Department of Mathematical Sciences hosted the Mathematical Problems in Industry Workshop. The MPI Workshop is a week-long event that invites industrial researchers to present challenging problems encountered in their work to an assembled group of professors, postdoctoral researchers, and graduate students with experience in mathematical modeling, analysis, and computation. The week begins on Monday with the presentation of problems brought by the industrial participants and ends on Friday with the presentation of results obtained by the academic team. What transpires in between is an intense exploration of the problem from the formulation and modeling stages to analysis and computation in search of a solution. A written report is prepared by the academic team and presented to the industrial participants some months after the conclusion of the Workshop. The MPI Workshop rotates among a number of host institutions, including Rensselaer Polytechnic Institute, the University of Delaware, Worcester Polytechnic Institute, Olin College, and now NJIT.

The 27th Annual MPI Workshop was organized by Richard Moore and Linda Cummings and held in Cullimore Hall on NJIT campus from June 13 to 17, 2011. Research problems were presented by industrial participants from Alcatel-Lucent, Corning, Novartis, and Standard and Poor's to an audience consisting of 22 faculty, 6 postdocs, 37 graduate students, and one undergraduate student from universities across the United States, the United Kingdom, Ireland, and India.

NJIT also played host to the 8th Annual Graduate Student Mathematical Modeling Camp (see photo) the weekend prior to the MPI Workshop, June 11 and 12. The GSMM Camp, organized by Don Schwendeman from Rensselaer Polytechnic Institute, serves to introduce graduate students to the principles of industrial math by guiding them through problems that are designed by Camp mentors to be more tractable than the problems these graduate students will be tackling during the MPI Workshop.

Funding for both the 2011 MPI Workshop and the 2011 GSMM Camp was provided by the National Science Foundation.


8th Annual Graduate Student Mathematical Modeling Camp

## VII. FUNDED RESEARCH

### A. EXTERNALLY FUNDED RESEARCH

### CONTINUING FUNDED PROJECTS

***Conferences on Frontiers in Applied and Computational Mathematics (FACM) 2008-2010***
National Science Foundation: July 1, 2008 - June 30, 2011
Daljit S. Ahluwalia and Michael Siegel

***Statistical Data Analysis***
NJ Meadowlands Commission: November 1, 2006 - December 31, 2011
Daljit S. Ahluwalia and Aridaman Jain

***Nonlinear Dynamics of Flames with Applications at High Pressure***
National Science Foundation: July 1, 2008 - June 30, 2011
John Bechtold

***Fulbright Travel Award***
Amitabha Bose

***The Role of Short-term Synaptic Plasticity in Feedback Neuronal Networks***
National Science Foundation: September 2006 - August 2010
Amitabha Bose

***UBM: An Undergraduate Training Program in Biology and Mathematics at NJIT***
National Science Foundation: September 2004 - August 2010
Amitabha Bose, Jorge Golowasch, and Farzan Nadim

***Mobile Science Teaching Lab***
Hyde and Watson Foundation: May 2010 - May 2011
Bruce Bukiet and James Lipuma

***Expansion of Professional Development Workshop on Digital Learning Tools***
Roche: December 2009 - August 2011
Bruce Bukiet, Robert Friedman, Fadi Deek, and James Lipuma

***Encouraging High School Students to Pursue Degrees in Math and Science: Focus on skills and career opportunities for college math and science majors***
Roche: December 2009 - August 2011
Bruce Bukiet, Robert Friedman, Fadi Deek, and James Lipuma

***Mobile Science Teaching Lab***
Hyde and Watson: July 2009 - July 2010
Robert Friedman, Bruce Bukiet, Fadi Deek, and Eric Blitz

***Professional Development Workshop Employing Digital Learning Tools in Your Classroom: Using Probes, Sensors and Computer Learning Modules to Enhance Understanding of High School Mathematics and Science***
Roche: October 2009 - August 2011
Robert Friedman, Bruce Bukiet, Eric Blitz, Fadi Deek, and James Lipuma

***Computation and Communication: Promoting Research Integration in Science and Mathematics (C2PRISM)***
NSF DUE: March 2007 - August 2012
Fadi Deek, Robert Friedman, and Bruce Bukiet

***TECHS-NJ Teacher Education Collaboration for High-Need Schools - New Jersey***
National Science Foundation: August 2006 - August 2011
Bruce Bukiet, Arthur B. Powell (Rutgers-Newark), Ismael Calderon (Newark Museum), and Gayle Griffin (Newark Public Schools)

***Optimum Vessel Performance in Evolving Nonlinear Wave Fields***
Office of Naval Research: May 1, 2005 - April 30, 2011
Wooyoung Choi, Robert Beck, and Marc Perlin

***An Integrated Approach to Large Amplitude Internal Wave Dynamics and Their Surface Signatures***
Office of Naval Research: January 15, 2008 - December 31, 2010
Wooyoung Choi

***Modeling and Analysis of Nematic Liquid Crystals in Thin Geometries***
National Science Foundation: October 1, 2009 - September 30, 2012
Linda Cummings and Lou Kondic

***Computation and Communication: Promoting Research Integration in Science and Mathematics (C2PRISM)***
National Science Foundation: April 1, 2007 - March 31, 2012
Fadi Deek, Bruce Bukiet, and Robert Friedman

***Biostatiscal Analysis of Cell and Molecular Biology Experimental Data***
UMDNJ: July 01, 2009 - August 31, 2011
Sunil K Dhar

***Role of Neuromodulators and Activity in the Regulation of Ionic Currents and Neuronal Network Activity***
National Institute of Mental Health: March 31, 2009 – March 30, 2014
Jorge Golowasch

***Nonlinear Waves and Dynamical Systems***
National Science Foundation-Mathematical Sciences Division: July 1, 2008 - June 30, 2012
Roy Goodman

***Fluid Dynamics of Combustion***
US Israel Binational Science Foundation: October 1, 2009 - September 30, 2011
Peter Gordon

***Collaborative Research: Constructing New Multiple Testing Methods***
National Science Foundation: June 1, 2010 - May 31, 2013
Wenge Guo

***Integral-Equation-Based Fast Algorithms and Graph-Theoretic Methods for Large-Scale Simulations***
National Science Foundation, CCF Division: July 15, 2009 - June 30, 2013
Shidong Jiang

***Microstructure and Fluidization in Granular Media***
Department of Defense Basic and Applied Sciences Directorate: April 2010 - March 2015

Lou Kondic, Robert P. Behringer (Duke University), Corey O'Hern (Yale University), and Wolfgang Losert (University of Maryland)

***Computational Homology, Jamming, and Force Chains in Dense Granular Flows***
National Science Foundation: October 1, 2008 - September 30, 2012
Lou Kondic

***Processing of Ceramic Materials by Microwave and Ohmic Heating***
National Science Foundation: August 1, 2007 - August 1, 2011
Gregory A. Kriegsmann

***Calcium Dynamics in Exocytosis and Synaptic Facilitation***
National Science Foundation: August 1, 2008 - July 31, 2012
Victor Matveev

***UBM Group: Undergraduate Biology and Mathematics Training Program at NJIT***
National Science Foundation: September 1, 2009 - August 31, 2012
Victor Matveev, Gareth Russell, and Jorge Golowasch

***Efficient Inversion in Underwater Acoustics***
Office of Naval Research: January 1, 2008 - December 31, 2010
Zoi-Heleni Michalopoulou

***Inversion in Shallow Water Environments: An Uncertainty Study***
Office of Naval Research: February 1, 2007 - December 31, 2010
Zoi-Heleni Michalopoulou

***CSUMS: Computational Mathematics for Undergraduates in the Mathematical Sciences at NJIT***
National Science Foundation: January 1, 2007- December 31, 2010
Zoi-Heleni Michalopoulou, Roy Goodman, David J. Horntrop, and Michael Siegel

***Efficient Inversion in Underwater Acoustics with Iterative and Sequential Bayesian Approaches***
Office of Naval Research: January 1, 2010 - December 31, 2012
Zoi-Heleni Michalopoulou

***Stretching of Heated Threads***
National Science Foundation: August 15, 2007 – July 31, 2012
Robert M. Miura, Jonathan J. Wylie (Investigator), and Huaxiong Huang (Investigator)

***Collaborative Research: Analysis of Spatiotemporal Signal Processing in Developmental Patterning***
National Science Foundation: August 15, 2007 - July 31, 2010
Cyrill Muratov and Stanislav Shvartsman

***Winding Domain Walls in Thin Ferromagnetic Films***
National Science Foundation: September 1, 2009 - August 31, 2012
Cyrill Muratov

***Upper Stage Engine Uncontainable Failure Analysis***
NASA: January 1, 2010 - December 31, 2010
Cyrill Muratov

***Regulation of Neuronal Oscillation by Synaptic Dynamics***
National Institutes of Health: August 2006 - July 31, 2011
Farzan Nadim

***Interaction between Flow and Topography in Interfacial Electrohydrodynamics***
National Science Foundation-Mathematical Sciences Division: August 15, 2007 - July 31, 2010
Peter Petropoulos

***Rhythmic Oscillations in the Entorhino-Hippocampal System: Biophysics and Dynamics***
National Science Foundation: July 1, 2008 - June 30, 2011
Horacio G. Rotstein

***Collaborative Research: Numerics and Analysis of Singularities for the Euler Equations***
National Science Foundation: July 1, 2007 - June 30, 2011
Michael Siegel and Russel Caflisch

***Analysis and Numerical Computations of Free Boundaries in Fluid Dynamics: Surfactant Solubility and Elastic Fibers***
National Science Foundation - Division of Mathematical Sciences: July 1, 2007 - July 14, 2011
Michael Siegel, Michael Booty, and Yuan-Nan Young

***Numerical Methods and Analysis for Interfacial Fluid Flow with Soluble Surfactant***
National Science Foundation: July 15, 2010 - July 14, 2013
Michael Siegel, Michael Booty, and Yuan-Nan Young

***Direct Numerical Simulations of Elastic Filament Suspensions and Multi-Scale Modeling of Soft-Particle Suspensions***
National Science Foundation: September 1, 2009 - August 31, 2011
Yuan-Nan Young

**PROJECTS FUNDED DURING PRESENT FISCAL YEAR**

***Parallel Simulations of Drop Breakup in a MicroFluidic T-Junction***
National Computational Science Alliance Award, NSF-supported Consortium: April 13, 2011 - April 13, 2012
Shahriar Afkhami

***Conferences on Frontiers of Applied and Computational Mathematics, 2011-2013***
National Science Foundation: June 1, 20011 - June 30, 2014
Daljit S. Ahluwalia and Michael Siegel

***Collaborative Research: A Unified Dynamical Systems-Simulation-Visualization Approach to Modeling and Analyzing Granular Flow Phenomena***
National Science Foundation - CMMI Dynamical Systems Program:
September 1, 2010 - August 31, 2013
Denis Blackmore, Anthony Rosato, and Xavier Tricoche (Purdue)

**Hybrid Algorithms for Wave Propagation**
National Science Foundation: September 15, 2010 - August 31, 2013
Yassine Boubendir

***NJIT Science Education Workshops***
Novartis: January 1, 2011 - December 31, 2011
Bruce Bukiet and Roumiana Petrova

***Collaborative Research: Constructing New Multiple Testing Methods***
National Science Foundation: June 1, 2010 - May 31, 2013
Wenge Guo

***NSF/IFPRI Powder Flow Collaboratory***
National Science Foundation: September 1, 2010 - August 30, 2011
Lou Kondic

***Restricted Diffusion in Cellular Media: Application to Cortical Spreading Depression***
National Science Foundation: June 1, 2010 - May 31, 2013
Robert M. Miura, Huaxiong Huang, Jonathan J. Wylie

***Collaborative Research: Efficient surface-based numerical methods for 3D interfacial flow with surface tension***
National Science Foundation: October 1, 2010 - September 30, 2013
Michael Siegel

***Numerical methods and analysis for interfacial fluid flow with soluble surfactant***
National Science Foundation: October 1, 2010 - September 30, 2013
Michael Siegel, Michael Booty, and Yuan-Nan Young

**B. PROPOSED RESEARCH**

**PROJECTS PROPOSED DURING PRESENT FISCAL YEAR**

***Adaptive Computations of Interfacial Dynamics in Microfluidic Flows***
National Science Foundation: July 1, 2011 - June, 30 2014
Shahriar Afkhami

***Development and Implementation of Numerical Algorithms for Multi-scale Multi-phase Flows***
DOE Office of Science, Early Career Research Program 2010-2015
Shahriar Afkhami

***Dynamics of Multiphase Systems: Viscoelastic and Electrowetting Effects***
National Science Foundation: July 1, 2011 - June 30, 2014
Shahriar Afkhami and Linda Cummings

***Conferences on Frontiers of Applied and Computational Mathematics, 2011-2013***
National Science Foundation: June 1, 20011 - June 30, 2014
Daljit S. Ahluwalia and Michael Siegel

***New Mathematical Theories of Flames at High Pressure***
National Science Foundation: July 1, 2011 - June, 30 2014
John Bechtold

***Linear Conductance-based Mechanisms underlying Oscillations in Neuronal Networks***
National Science Foundation/National Institutes of Health: July 1, 2011 - June 30, 2014
Amitabha Bose, Jorge Golowasch, and Farzan Nadim

***FRG: Collaborative Research: Modeling Forcing and Dissipation in the Sea Surface Energy Balance with Application to Microwave Remote Sensing of the Sea Surface and Oceanography***
Wooyoung Choi
National Science Foundation: July 1, 2011 - June 30, 2014

***Propagation and Blow-up in Reaction-Diffusion Systems***
National Science Foundation: August 1, 2011 - July 31, 2014
Peter Gordon

***Spectral Methods for Stochastic Partial Differential Equations with Application to Materials***
National Science Foundation July 1, 2011 - June 30, 2014
David J. Horntrop

***Instabilities and Nano-assembly of Laser-irradiated Metallic Materials***
Department of Energy: July 1, 2011 - June 30, 2014
Lou Kondic

***Collaborative Research: Experimental and Computational Study of the Instabilities and Transport and Self Assembly of Nanoscale Metallic Thin Films and Nanostructures***
National Science Foundation: July 1, 2011 - June 30, 2014
Lou Kondic and Philip Rack (U. Tennessee)

***Inertial Effects on the Stretching of Viscous Fluid Filaments***
National Science Foundation: June 1, 2010 - May 31, 2013
Robert M. Miura, Jonathan J. Wylie, and Huaxiong Huang

***Collaborative Research: The MPI Workshop***
National Science Foundation: January 1, 2011 - December 31, 2013
Richard Moore and Linda Cummings

***Collaborative Research: Mathematical and Computational Methods for Stochastic Systems in Nonlinear Optics***
National Science Foundation: July 1, 2011 - June 30, 2014
Richard O. Moore and Tobias Schafer

***Collaborative Research: Dynamics of Morphogen Gradients***
National Science Foundation: July 01, 2011 - June 30, 2014
Cyrill Muratov, Peter Gordon, and Stanislav Shvartsman

***Temporal Fidelity of Axonal Action Potential Conduction and its Neuromodulation***
National Institutes of Health: September 1, 2011 – August 31, 2016
Dirk Bucher and Farzan Nadim

***Regulation of Neuronal Oscillations by Synaptic Dynamics***
National Institutes of Health: November 1, 2011 – October 31, 2016
Farzan Nadim

***Frequency Preference in Neural Systems: Biophysical and Dynamic Mechanisms***
National Science Foundation: July 1, 2011 - June 30, 2014
Horacio G. Rotstein

***Methods for Cumulative Incidence Estimation in Survival Analysis***
National Institutes of Health: April 2011 – March 2013
Sundar Subramanian (Consultants: Gerhard Dikta and Yanqing Sun)

***Model-based Simultaneous Confidence Bands for Survival Functions***
National Institutes of Health: July 2011 – June 2013
Sundar Subramanian (Consultant: Yanqing Sun)

***Collaborative Research: Rheology of Vesicle Suspensions***
National Science Foundation: Jan 1, 2012 - December 31, 2014
Yuan-Nan Young, Petia Vlahovska (Brown University), and Shravan Veerapaneni (New York University)

***Dynamics of a Vesicle as a Cell Mimic: Effects of Interior Structure, Cross-membrane Transport, and Interaction with Filaments***
National Science Foundation: September 1, 2011 - August 31, 2014
Yuan-Nan Young and Shravan Veerapaneni (New York University)

**CONTINUING PROJECTS — NOT THROUGH CAMS**

***Computational Study of Drop Deformation in Systems with Two Immiscible Liquids***
National Science Foundation - Division of Mathematical Sciences: June 30, 2009 - May 1, 2012
Yuriko Renardy, Pengtao Yue, and Shahriar Afkhami (Investigator)

***Mathematical Modeling of Circadian and Homeostatic Interaction***
Air Force Office of Scientific Research: February 1, 2008 – January 31, 2011
Victoria Booth, Daniel Forger, and Cecilia Diniz Behn

***RCN: TraitNet - Coordinating Trait-based Ecological and Evolutionary Research***
National Science Foundation, March 31, 2007 - March 31, 2012
Shahid Naeem and Daniel Bunker

***Inestabilidades en Flujos de Recubrimiento***
Agencia Nacional de Promocion de la Ciencia y la Tecnologia (ANPCyT, Argentina)(PICT 2498/06): June 2008-December 2011
Javier A. Diez

***Understanding and Combating the Fire-enhancing Impact of Non-native Annuals in Desert Scrub through the Tools of Population and Landscape Ecology***
Strategic Environmental Research and Development Program (SERDP)/DoD, 2010 -2014
Claus Holzapfel and Kirk Moloney

***Restoration Success Assessment / Community Ecology Research Project on the Formation of Plant Borders***
Department of Environmental Protection Grant, 2008-2010
Claus Holzapfel

***Temporal Dynamics and Molecular Ecology of Restored and Remnant Spartina patens High Marsh Communities in the NJ Meadowlands***
NJ Meadowlands Commission, MERI Fellow Program Grant, 2009/2010
Claus Holzapfel and Edward Kirby

***Modeling, Analysis and Computing for Problems from Industry***
Nature Science and Engineering Research Council (Canada): April 1, 2010 - March 31, 2015
Huaxiong Huang

***Focused Research Group on Cortical Spreading Depression and Related Phenomena (August 1-8, 2010)***
Banff International Research Station: September 2008-August 2010
Robert M. Miura and Huaxiong Huang

***SQuaRE on Modeling Cortical Spreading Depression***
American institute of Mathematics: November 2008 - June 2012
Robert M. Miura and Huaxiong Huang

***HHMI-NIBIB Interfaces Initiative - Graduate Training Program in Quantitative Neuroscience (with UMDNJ and Rutgers-Newark)***
Howard Hughes Medical Institute: January 1, 2006 - December 31, 2008 (No Cost Extension) (January 1, 2009 - December 31, 2010)
Robert M. Miura, Joshua Berlin (UMDNJ), and Ian Creese (Rutgers-Newark)

***Finsurance: Theory and Computation Mathematics of Information Technology and Complex Systems***
NCE (Canada) April 1, 2009 - Mar 31, 2012
T.S. Salisbury (PI), Core Investigators: H. Huang, S. Jaimungle, S. Lin, D. Charles, M. Morales

***Implementation of Maintenance Decision Support System in New Jersey***
US Department of Transportation/New Jersey Department of Transportation: July 2007- July 2011
Steven Chien and Jay Meegoda

***Modeling for Contaminant Removal by Air Sparging--A Theoretical Model and Centrifuge Validation***
National Natural Science Foundation of China: January 2009 - December 2011
Liming Hu and Jay Meegoda

***ADVANCE Institutional Transformation Award: More than the Sum of its Parts: Advancing Women at NJIT through Collaborative Research Networks***
National Science Foundation: September 1, 2006 - August 31, 2010
Lisa Axe, Sima Bagheri, Zoi-Heleni Michalopoulou, Piscilla Nelson, Nancy Steffen-Fluhr

***An Automated, Real-time Identification and Monitoring Instrument for Reef Fish Communities***
National Science Foundation July 1, 2007 - June 30, 2011
Gareth Russell

***Deflection of Granular Jets***
CERG (Hong Kong) 2008-20
Jonathan Wylie

**PROJECTS FUNDED DURING PRESENT FISCAL YEAR - NOT THROUGH CAMS**

***Investigación en Colaboracion Estudio Experimental y Computacional de Inestabilidades, Transporte y Auto-organizacion de Peliculas Metalicas Delgadas Nanoscopicas y Nanoestructuras***
Consejo Nacional de Investigaciones Cientificas y Tecnicas (CONICET-NSF): March 2010 - March 2012
Javier A. Diez

***Natural and Anthropogenic Impacts on Tibet Grassland***
Visiting Professorship for Senior International Scientist of the Chinese Academy of Science - 2010/11
Claus Holzapfel

***Workshop on Fluid Motion Driven by Immersed Structures***
Fields Institute: August 9-13, 2010
H. Huang, Z. Li, A. Layton, J. Stockie

***Fields-MITACS Industrial Problem-Solving Workshop (FMIPW)***
Fields Institute: August 16-20, 2010
C.S. Bohun, H. Huang, G. Lewis, R. Melnik, N. Nigam, S. Sivalogathan

***Drainage Identification, Analysis and Mapping Project***
US Department of Transportation/New Jersey Department of Transportation: January 2010-December 2011
Jay Meegoda

***Sustainable Sanitation for a Haitian Hospital***
US Environmental Protection Agency: August 2010 – August 2011
Jay Meegoda

***Snow Model Analysis***
US Department of Transportation/New Jersey Department of Transportation: May 2011-November 2012
Jay Meegoda

**PROPOSED PROJECTS - NOT THROUGH CAMS**

***Inestabilidades en Peliculas Liquidas Conformadas: Generacion de Gotas Submilimetricas y Nanometricas***
Agencia Nacional de Promocion de la Ciencia y la Tecnologia (ANPCyT, Argentina): June 2012 - June 2015
Javier A. Diez, Alejandro Gonzalez, Lou Kondic, Philip Rack

***Inestabilidades en Peliculas Liquidas Conformadas***
Consejo Nacional de Investigaciones Cientificas y Tecnicas: June 2012 - June 2015
Javier A. Diez, Alejandro Gonzalez, Lou Kondic, Philip Rack

***ENGAGE Mini Grant***
National Science Foundation Educational Grant as part of WEPAN Grant
September 1, 2011 - Dec. 31, 2012
Priscilla Nelson**,** Denis Blackmore, David Lubliner, and N.M. Ravindra

## VIII. COMMITTEE REPORTS AND ANNUAL LABORATORY REPORT

### A. COMPUTER FACILITIES

The Department of Mathematical Sciences (DMS) and Center for Applied Mathematics and Statistics (CAMS) at the New Jersey Institute of Technology operates an NSF funded 67-node Beowulf-class computer cluster for research in the mathematical sciences. Each compute-node of the cluster is composed of two 2.0 GHz, 64-bit processors (AMD Opteron CPU); the cluster includes a total of 256 GB of memory, mass storage devices, scientific software, and hardware for a high speed Myrinet network. The machine is dedicated to the support of research by faculty and graduate students in CAMS and DMS, and is used for projects which involve mathematical modeling and the development of computational techniques to study fundamental processes in physical science and biology.

This past year, a multi-core compute server (Gorgon) was added to the CAMS computational laboratory for fast serial computation, multi-core parallel computations, and applications requiring large memory. More recently, a second server (Stheno) was purchased and will be installed in fall 2011. Some specs on the new servers are as follows:

(i) Gorgon; a Microway system 1 Unit AMD Opteron Server with Dual Integrated Intel 82576 Gigabit Ethernet Ports:
Total one compute node
CPUs: 4 AMD Eight Core Opteron 6134 (32 total cores)
CPU Clock Speed: 2.3 GHz
Memory: 16 x 4GB DDR3 1333 MHz ECC/Registered Memory (64GB Total Memory)
Operating Sysytem: Scientific Linux 5

(ii) Stheno; a Microway system 2 Unit Xeon Twin Servers connected with InfiniScale IV - 8-port 40Gb/s InfiniBand Switch:
Total of 8 compute nodes with Dual Integrated Intel 82576 Gigabit Ethernet Ports
CPUs: 2 (servers) x 4 (compute nodes) x 2 Six Core Xeon E5649 (total of 96 cores)
CPU Clock Speed: 2.53 GHz
Memory: 96 x 4GB DDR3 1333 MHz ECC/Registered Memory (96GB per node - 768GB Total Memory)

Software: gnu - open64 - sun12 compilers, blacs, blas, fftpack, fftw2/3, s/lapack, mpi/mpich2, mpi/openmpi, openmpi, MATLAB Distributed Computing Server 16 pack and Parallel Computing Toolbox
Software (yet to be installed): Intel Compiler Suite Professional Edition for Linux, Intel Cluster Toolkit for Linux

### B. STATISTICAL CONSULTING LABORATORY REPORT

The Mathematical Sciences faculty serves the community as statistical consultants. Here are some examples of consulting activities.

Date: July – August 2010, Client: Francisco Artigas (New Jersey Meadowlands Commission – Environmental Research Institute)
Description: Analyzed the quality of water in Hackensack River at 12 monitoring stations during a

period of 16 years (1993 – 2008).
Consultant: Professor Aridaman Jain

Date: November - December 2010, Client: Francisco Artigas (New Jersey Meadowlands Commission – Environmental Research Institute)
Description: Conducted a statistical analysis of the data from organic composite for PCB and OCP as well as 9 metal concentrations in the sediments along the eastern side of the Secaucus High School (SHS) site of about 5 acres during 2007 - 2010.
Consultants: John Ponsiglione and Professor Aridaman Jain

Date: February – June 2011, Client: Francisco Artigas (New Jersey Meadowlands Commission – Environmental Research Institute)
Description: Conducted a statistical analysis of 3 years of data on 5 air pollutants to estimate the effects due to: (i) day, (ii) hour, (iii) month, (iv) season, (v) time, and (vi) weekday/weekend.
Consultants: John Ponsiglione, Gavin Lynch, and Professor Aridaman Jain

# IX. CURRENT AND COLLABORATIVE RESEARCH

## A. RESEARCH AREAS IN CAMS

### Mathematical Biology

Researchers in CAMS working on problems related to Mathematical Biology: Booth, Bose, Bukiet, Dhar, Georgieva, Golowasch, Holzapfel, Nadim, Matveev, Miura, Muratov, Perez, Rotstein, Russell, and Tao.

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

A primary focus of the Mathematical Biology group is in experimental, computational, and mathematical Neuroscience. The experimental research in neuroscience within CAMS is headed up by Jorge Golowasch and Farzan Nadim. Both researchers run labs in which they conduct experiments on various aspects of the crustacean stomatogastric nervous system (STNS). Various aspects of Computational and Mathematical neuroscience are being studied by Victor Matveev, Horacio Rotstein, Louis Tao, Amitabha Bose, and Robert Miura. Matveev studies mechanisms responsible for short-term synaptic plasticity. He is particularly interested in understanding the role of residual calcium in synaptic facilitation. Tao is interested primarily in the modeling and analysis of the dynamics of neuronal networks, with application to visual cortex and other large-scale cortical networks. He focuses on developing analytical techniques to study networks in simplified settings and on identifying possible biological functions of emergent network dynamics. Bose is interested in developing mathematical techniques to understand the role of short-term synaptic plasticity in producing multi-stable periodic solutions within neuronal networks. He is also interested in developing models for persistent localized activity in excitatory networks. Miura has worked extensively on modeling and analysis of models for electrical activity in excitable cells, including neurons and pancreatic beta-cells. He is currently working on mathematical models for spreading depression, a slowly propagating chemical wave in the cortex of various brain structures, which has been implicated in migraine with aura.

In the area of Developmental Biology, Cyrill Muratov is interested in developing models that describe the patterning events leading to the formation of dorsal appendages during Drosophila egg development. He studies a system of coupled reaction-diffusion equations driven by a localized input and characterizes the oocyte phenotype by the number of peaks in the signaling pattern. Gareth Russell studies complex ecological systems, including predictive models of wading bird species in the Everglades National Park.

## Fluid Dynamics

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

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

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

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

The fluid dynamics group in the Department of Mathematical Sciences at NJIT has an active research program covering interfacial fluid dynamics (Afkhami, Booty, Cummings, Huang, Kondic, Papageorgiou, Siegel, Vanden-Broeck), thin films (Cummings, Diez, Kondic), electrohydrodynamics (Papageorgiou, Petropoulos, Vanden-Broeck), hydrodynamic stability theory (Papageorgiou), sedimentation (Luke), granular flow (Kondic, Rosato) and combustion (Bechtold, Booty, Bukiet, Gordon). A particular focus for several of the faculty members (Afkhami, Booty, Choi, Cummings, Huang, Kondic, Papageorgiou, Siegel, Vanden-Broeck, Wang, Wylie, Young) is the study of free and moving boundary problems. These are particularly challenging problems in that partial differential equations have to be solved in a region which is not known in advance, but must be determined as part of the solution. A famous example is the Stefan problem for melting ice or freezing water, but also the dynamics of bubbles, jets, shock waves, flames, tumor growth, crack propagation and contact problems all can be classified under this heading. CAMS fluid dynamics researchers are also pursuing applications of their work in Biology and Nanotechnology.

## Wave Propagation

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

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

the following is a brief overview of the field and of their particular interests.

One field that has been affected very profoundly by the relatively new science of nonlinear waves is optical communications. Richard Moore is currently using perturbation theory and statistical techniques to develop efficient ways to characterize the effect of perturbations on solitons used for optical communications. Roy Goodman uses Hamiltonian mechanics and asymptotic methods to explore how light can be slowed, delayed, or "trapped"' by engineering defects in nonlinear periodic structures.

The treatment of transient electromagnetic signals such as those arising in signal analysis, spectroscopic applications, and the nondestructive testing of structures requires sophisticated numerical techniques that are stable, fast, and accurate, and that have reasonable memory requirements. Peter Petropoulos is conducting research on a variety of approaches that address these restrictions, including high-order finite difference schemes, boundary integral methods, and perfectly matched layers. Shidong Jiang investigates nonreflecting boundary conditions and scattering problems for acoustic and electromagnetic waves by open surfaces. He employs fast algorithms, including the fast multipole method, iterative solvers, and integral equation formulation of boundary value problems for such problems and for related large-scale problems in physics and engineering. Yassine Boubendir develops multi-scale methods, including domain decomposition methods, for the study of wave scattering.

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

Finally, the propagation of waves through materials is often influenced by parameters that depend on the waves in a way that requires fundamentally different physics. The microwave heating of ceramics or the passage of optical fields through photorefractive crystals, for instance, couples hyperbolic equations to parabolic equations governing the evolution of thermal profiles and chemical species. Gregory Kriegsmann and Richard Moore are investigating asymptotic and numerical methods to treat such coupled hyperbolic-parabolic systems.

## Dynamical Systems

Researchers in CAMS working on problems related to Dynamical Systems: Blackmore, Bose, Golowasch, Jiang, Kappraff, Kriegsmann, Matveev, Miura, Moore, Nadim, Papageorgiou, Rotstein, Siegel, Tao, and Young. Today's research in the theory and applications of dynamical systems all have their roots in the work of early innovators in differential equations and mathematical modeling.

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

Then in the 1960's, the face of dynamical systems research was dramatically altered by Smale and others with the introduction of a variety of techniques from differential topology that provided amazing new insights into the nature of chaotic dynamics. At about the same time, a dramatic

advance in research on infinite-dimensional Hamiltonian systems was occuring as a result of several extraordinary discoveries concerning integrability, solitons, and the inverse scattering transform made by the likes of Gardner, Greene, Kruskal, Lax, and our own Robert Miura. These remarkable breakthroughs established the foundations of what has come to be known as the modern theory of dynamical systems, and catalyzed an explosion of applied and fundamental research in nonlinear dynamics.

Dynamical systems research in CAMS has a decidedly applied focus, and is extremely active in a wide and diverse range of areas including mathematical biology, fluid dynamics, wave propagation, computational topology, nonlinear optics, and quantum field theory and its applications to such things as quantum computing. There are a significant number of researchers who employ techniques from nonlinear dynamics in their work, and a smaller but sizeable core group whose interests are centered around dynamical systems and their applications. This includes Denis Blackmore, who applies nonlinear dynamics to study the motion of vortices and vortex filaments in fluids and particles in granular flows, the chaotic evolution of biological populations, the computational topological nature of certain geometric objects, and quantum computing. He also does fundamental research in bifurcation theory, chaos theory, and algebraic and differential integrability analysis of infinite-dimensional Hamiltonian dynamical systems. Dynamical systems methods applied to nonlinear waves and optics is the focus of Roy Goodman's research. A key ingredient in his work is the development of methods for obtaining insights from finite-dimensional reductions of infinite-dimensional systems such as the nonlinear Schrodinger equation.

## Numerical Methods

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

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

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

Stochastic computation also receives a great deal of attention by CAMS researchers. Monte

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

## Statistics

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

Applied Probability and Statistics/Biostatistics is concerned with the study of processes in which uncertainty plays a significant role. In today's data driven environment, the utility and need for modeling and statistical analysis of uncertainty is assuming increasing importance in virtually every field of human interest. Typical examples are in the comparative study of DNA databases, evaluation of drug safety and effectiveness, design and analysis of modern communication protocols, stochastic models in finance, study of aging and performance analysis of components and complex systems.

While Applied Probability and Statistics/Biostatistics are driven by the need to solve applied problems, their progress and development comes from basic research and from their applications to solve specific problems arising in practice. This interplay of basic and applied research has benefited both. Real life applied problems have often posed new theoretical challenges which had to be solved by developing new methods (e.g., survival analysis and clinical trials). Conversely, theoretical ideas and methods which were developed in a specific applied context were later seen to be of much broader applicability (e.g., nonparametric aging ideas which owe their origins to research in stochastic modeling of reliability of physical systems were later seen as useful constructs in many other areas such as in the study of queuing systems, stochastic scheduling, branching processes as well as in modeling economic inequality). Biostatistics, an increasingly important area of statistics, focuses on developing new statistical methods, as well as applying existing techniques, to interpret data about the medical and life sciences. The importance of biostatistics stems from its wide use in the pharmaceutical and health-care industries, and in medical schools, e.g. in the area of cell biology and molecular medicine empirical survival distributions of mice in both placebo and treatment groups are typically compared to look for significant difference in new chemical treatments when compared with placebo.

The Statistical Consulting Laboratory (SCL), which operates under the umbrella of CAMS, provides data analysis and statistical modeling consulting services to the University community, as well as to external clients. Consulting on statistical and biostatistics problems channeled through the SCL, are provided by statistics faculty. The current coordinator of the SCL is Ari Jain.

The current research interests of the Statistics faculty are in the following broad and overlapping areas: applied probability models (Bhattacharjee, Dhar), Bayesian modeling (Bhattacharjee), bioinformatics and computational biology (Guo), bootstrap methods (Subramanian), censored time-to-event data analysis (Dhar, Subramanian), computational statistics (Guo, Subramanian), discrete multivariate distribution/reliability models and inverse sampling (Dhar), distribution theory and statistical inference (Bhattacharjee, Dhar, Subramanian), empirical processes (Dhar, Subramanian), high dimensional inference (Guo), minimum distance estimation (Dhar), multiple imputations methods (Subramanian), multiple testing (Guo), non-traditional applications of reliability theory (Bhattacharjee), orthogonal arrays in experimental designs (Dios), semiparametric estimation and inference (Dhar, Subramanian), statistical issues in clinical trials (Guo, Dhar), statistical theory of reliability and survival analysis (Bhattacharjee, Dhar,

Subramanian), stochastic orders and their applications (Bhattacharjee), and survey sampling (Jain).

Several CAMS members have active research programs in Biostatistics. This includes the application of non- and semi-parametric statistical inference and computational methods, such as the bootstrap, in biostatistics.

## B. RESEARCH DESCRIPTIONS

### Shahriar Afkhami

Shahriar Afkhami's research focuses on modeling flowing complex fluids including viscoelastic liquids, electro/magnetohydrodynamics, interfacial flows in porous media, dynamic contact lines, and microfluidics. Studies of existence of solutions, flow stability, asymptotic behavior, and singularities of such problems pose a great challenge. He uses numerical modeling for addressing some of these mathematical open questions and for understanding the underlying physical mechanisms of these phenomena. His current energy and environmental related projects involve large-scale 3D computations of drop dynamics and breakup in polymer processing, microfluidics, and electrowetting. Motivated by biomedical and pharmaceutical applications, he recently has been studying the deformation and motion of ferrofluid droplets in viscous media.

### 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.

### 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

Manish Bhattacharjee's research focus is on applied probability and associated problems of

statistical inference for such models. Prime areas of interest and work are aspects of Statistical Reliability Theory that have a common interface with engineering reliability and biostatistics (nonparametric survival models, proportional hazards, competing risks, censoring). Current ongoing research focuses on some aspects of mutual shape duality of hazard rates vs. mean remaining life and their implications for modeling.

**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 mathematical and computational neuroscience focusing on biophysical modeling of the electrical firing behavior of neurons and neuronal networks. Her collaborative and interdisciplinary research projects concentrate on quantitatively probing experimental hypotheses and providing experimentally-testable predictions. She is currently conducting modeling studies to investigate neural mechanisms promoting experimentally observed changes in hippocampal activity patterns that are associated with synaptic plasticity during waking and REM sleep, to study how pathologies at the neuronal level contribute to network-level dynamics in epilepsy, and to investigate the neurotransmitter interactions among brain stem neuronal nuclei that regulate wake and sleep states.

**Michael Booty**

Michael Booty's research interests are in mathematical modeling and analysis, by approximate or exact analytical techniques or by numerical methods. Much of his work is motivated by applications in fluid mechanics and combustion, with some electromagnetics. His studies on combustion have focused on time-dependent and multidimensional dynamics of propagating reaction waves in mixed and multiphase systems, prototype reaction-diffusion models, dynamics of fast reaction waves, and droplet burning. He has also studied conditions that minimize pollutant formation in the thermal oxidation of common materials, in collaboration with personnel of the Department of Chemistry and Environmental Science at NJIT. Current research interests include: studies on interfacial flows, surfactants, and membranes (with Michael Siegel and Yuan-Nan Young), thermal waves in microwave heating and processing (with Greg Kriegsmann), and studies of the interaction of flexible sails in potential flow (with Jean-Marc Vanden-Broeck, University College London).

**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.

**Yassine Boubendir**

Yassine Boubendir's general interests are in the numerical and the mathematical analysis of Partial Differential Equations. More specifically, he is interested in the design, implementation and analysis of numerical algorithms for problems of electromagnetic, acoustic and elastic wave propagation. In recent years, he introduced a new non-overlapping domain decomposition algorithm that combines a boundary element and finite element methods. In addition, he developed an appropriate krylov subspace method, at high frequency regime, in the context of multiple scattering situations. Currently, his research is devoted to the acceleration of the iterative methods corresponding to these two algorithms.

**Daniel Bunker**

Global change poses a strong challenge to ecologists, environmental scientists, and conservation biologists: even as our natural and managed ecosystems become more stressed by the forces of global change, humans require that these ecosystems produce both a greater quantity and a greater variety of ecosystem services. For instance, we may expect a forested ecosystem to produce timber, provide clean water, sequester carbon, support wildlife, and provide recreational opportunities, yet at the same time the forest community is being buffeted by climate change, invasive species, and land-use change. In order to ensure that our ecosystems provide the services society demands, we must be able to predict how ecological communities will respond to these global forces, and in turn how changes in community composition will affect ecosystem services. To develop this predictive framework, I employ a mix of observation, experimentation, modeling and synthesis, within a diverse array of biological communities.

**Bruce Bukiet**

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

**Milena Chermisi**

The main research activities of Milena Chermisi are focused on winding domain walls in thin film ferromagnets, and more specifically, on the effect of long-range forces in energy-driven pattern forming systems. In collaboration with Cyrill Muratov, she aim to study the existence, uniqueness, and qualitative properties, such as the monotonicity decay, of local minima of micromagnetic energy in thin uniaxial ferromagnetic films in the two-dimensional wall setting.

**Wooyoung Choi**

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

**Linda Cummings**

Linda Cummings works on a variety of physically-motivated free boundary problems, mostly fluid-dynamical in nature, many of which arise in industrial or biological applications. On the biological side her current work includes studies of fluid flow, nutrient transport and cell growth in tissue engineering applications; flow dynamics and bacterial biofilm formation in prosthetic devices such as urethral catheters and ureteric stents; and dynamics of lipids in cell membranes. Her current industrially-relevant projects include modeling and analysis of "bistable" nematic liquid crystal display devices; modeling of bubble dynamics in the manufacture of glass fibers; and the flow of thin liquid films (both Newtonian and non-Newtonian). She also works on classical low Reynolds number free boundary flows, such as Stokes flows and Hele-Shaw flows. Her mathematical approaches are wide-ranging, encompassing skills of mathematical modeling, discrete and continuum mechanics, complex analysis, and asymptotic and numerical methods.

**Fadi P. Deek**

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

**Sunil K. Dhar**

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

**Javier Diez**

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

**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.

**Thomas Erneux**

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

**Jorge Golowasch**

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

**Roy Goodman**

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

**Peter Gordon**

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

**Wenge Guo**

Wenge Guo's research interests include large-scale multiple testing, high-dimensional inference, bioinformatics, machine learning, and statistical methods for clinical trials. The new theories and methods he derived are mainly used for controlling the false discovery rate (FDR) and other

genereralized error rates in large-scale multiple testing. Their main applications are on bioinformatics and computational biology. His current research projects include estiamte and control of the FDR under dependence and development of new multiple testing methodologies for different biomedical areas such as microarray data analysis, design and analysis of clinical trials, and high throughput screening assay.

**Claus Holzapfel**

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

**David J. Horntrop**

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

**Huaxiong Huang**

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

**Shidong Jiang**

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

**Lou Kondic**

The research of Lou Kondic has concentrated on modeling and numerical simulations of two groups of physical systems: a) two fluid flows with emphasis on the interfacial dynamics, as well as free surface flows, and b) dynamics of granular systems. His studies of supersonic dynamics

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

**Gregory A. Kriegsmann**

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

**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.

**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 involve nonresonance and resonance problems with Fredholm and hyperbolic-like perturbations of singlevalued and multivalued nonlinear maps, and Hammerstein equations. He has widely applied these abstact theories to BVPs for (contingent) ordinary and elliptic PDEs, to periodic and BVPs for semilinear hyperbolic and parabolic equations and to nonlinear integral equations. His study of nonlinear and strongly nonlinear operator equations is concerned with the existence and the number of solutions of such equations involving condensing, monotone, and various types of approximation maps. His current research deals with Hammerstein equations and weakly inward A-proper and pseudo A-proper maps and applications to differential and integral equations.

**Robert M. Miura**

The research of Robert M. Miura covers several areas in mathematical physiology, especially in neuroscience. The techniques used are mathematical modelling, mathematical analysis, approximation methods, and numerical simulations. His research on excitable biological cells, including neurons, cardiac cells, and pancreatic beta-cells, is aimed at understanding ionic 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 recent studies on spreading cortical depression, and more generally, on intercellular communication via ion flows, include analysis and simulations of partial differential equation models of wave propagation in the brain, of spatially coupled discrete neurons, and of restricted diffusion.

**Richard O. Moore**

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

**Cyrill B. Muratov**

The main research direction of Cyrill B. Muratov is pattern formation, self-organization, and non-linear dynamics in systems described by coupled reaction-diffusion equations, with primary

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

**Farzan Nadim**

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

**Demetrios T. Papageorgiou**

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

**Manuel Perez**

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

**Peter G. Petropoulos**

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

**Anthony D. Rosato**

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

**Horacio G. Rotstein**

The research of Horacio G. Rotstein focuses mainly on the study of the biophysical and dynamic mechanisms underlying the generation of rhythmic oscillatory activity in the brain, particularly in the hippocampus and entorhinal cortex. Rhythmic oscillations at theta (8 - 12 Hz) and gamma (30 - 80 Hz) frequencies in these areas of the brain have been correlated with various forms of learning and memory. In addition, alteration in particular sorts of brain rhythmic oscillations have been shown to correlate with the existence and progression of a variety of neuropsychiatric conditions, including schizophrenia and dementia. Rhythms differ not only in their frequency range, but also in the underlying biophysical mechanisms by which they are generated. These mechanisms usually vary in different brain areas, and may operate at a single cell level or may involve the coherent activity of many cells and cell types in a network. The primary goal of my research is to uncover and understand the underlying biophysical and dynamic principles that govern the generation of rhythmic activity in the brain. As secondary goals I hope to understand the functional implications for brain functioning of the previous results, the relation between disruption of rhythmic activity and diseases of the nervous system, and the effects that changes at a subcellular level have on rhythms observed at the single cell and network levels.

**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.

**Sundar Subramanian**

The research of Sundar Subramanian focuses on non- and semi-parametric statistical inference for censored time-to-event-data analysis. His investigations involve study of the large sample behavior of estimators using techniques from counting processes and martingales, empirical processes, kernel estimation, and information bound theory. His interests on the computational side include bootstrap methods for model selection and bandwidth computation, and mis-specification studies using simulation. The procedures have strong theoretical basis and find applications in Biostatistics.

**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.

**Jean-Marc Vanden-Broeck**

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

**Yuan-Nan Young**

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

## C. COLLABORATIVE RESEARCH

**Shahriar Afkhami**

Sensing of Dynamic Ferrofluidic Oil/Water Systems in Porous Media, Amir Hiras (RPI).

Direct Pore-scale Numerical Simulations, Ivan Lunati (Institute of Geophysics, University of Lausanne).

Numerical Simulations and Asymptotic Modeling of Capillary Flow Focusing, Alex Leshansky (Technion - Israel Institute of Technology).

Deepwater Horizon Simulation, Daniel Fuster and Stephane Zaleski (Pierre and Marie Curie University), Stephane Popinet (National Institute of Water and Atmospheric Research).

Modeling of Viscoelastic Two-phase Flows, Yuriko Renardy and Michael Renardy (Virginia Tech).

**Roman I. Andrushkiw**

Malignancy in Tumors, E.M. Golubeva and D.A. Klyushin (Kyiv National Taras Shevchenko University) and N.V. Boroday (R.E.Kavetsky Institute of Experimental Pathology, Oncology and Radiobiology, Kyiv, Ukraine)

**John Bechtold**

New Theories of Flames at Elevated and High Pressures, C. K. Law (Princeton University)

Flame Flow Interactions and Flow Reversal, H. G. Im (University of Michigan)

**Denis Blackmore**

Dynamical Analysis of Granular Flows, A. Rosato (NJIT), X. Tricoche (Purdue), K. Urban (Stony Brook)

Integrability of Infinite-dimensional Hamiltonian Systems, A. Prykarpatsky (AGH-Krakow), N. Bogolubov (Moscow State) and V. Samoylenko (Lviv)

Dynamical Modeling and Analysis of Nonlinear Phenomena, Y. Joshi (Kingsborough) and A. Rahman (Delaware)

Regularity and Chaos in Vortex Dynamics, M. Brons (Technical University of Denmark), A. Goullet (NJIT), and B. Shashikanth (New Mexico State)

Indices for Detecting Periodicity in Hamiltonian Dynamical Systems, C. Wang (ECC) and X. Wang (Beijing University)

Emergency Scale Modeling and Analysis, E. Rohn (Ben Gurion University)

Computing Fractal Dimensions, A. Zaleski (NJIT)

**Amitabha Bose**

Dynamics on Random Graphs, Umeshkanta Singh, Kaustubh Manchanda and Ramakrishna Ramaswamy (Jawaharlal Nehru University)

Mathematical Models for Sleep/Wake Patterns, Rupesh Kumar and Birendra Nath Mallick (Jawaharlal Nehru University)

Assessing Role of Feedback in CPGs through Modeling and Experiments, Farzan Nadim, Xinxian Huang (NJIT) and Shunbing Zhao (Rutgers University)

**Wooyoung Choi**

Internal Wave Modeling, Roberto Camassa (University of North Carolina, Chapel Hill) and Taechang Jo (Inha University)

Instability of Capillary Waves, Roxana Tiron (Korea Advanced Institute of Science and Technology)

Nonlinear Surface Wave Experiments, Zhigang Tian (Korea Advanced Institute of Science and Technology)

**Javier A. Diez**

Self and Directed Assembly by Means of Engaging Natural, Liquid Phase Instablilities, Lou Kondic (NJIT), Alejandro G. Gonzalez (UNCPBA, Argentina), Philip D. Rack and Yueying Wu (University of Tennessee), Jason Fowlkes, Cliff McCold (ORNL).

**Roy Goodman**

Localized Modes in Optical Fibers with Nonlinearity Management, Gadi Fibich (Tel Aviv University) and Vered Rom-Kedar (Weizmann Institute).

Instabilities of nonlinear waves, Denis Blackmore (NJIT) and Jeremy Marzuola (North Carolina).

Chaotic Dynamics in Waveguides, Theoretical and Experimental, Alexander Szameit, Friedrich

Schiller University Jena (Germany).

**David J. Horntrop**

Packing of Granular Materials, A. Rosato (New Jersey Institute of Technology).

**Huaxiong Huang**

Stretching of Heated Viscous Threads, R.M. Miura (NJIT, NJ, USA) and J.J. Wylie (City University of Hong Kong, Hong Kong).

Modeling Cortical Spreading Depression, Including Discrete and Continuos Neuronal Networks, Effects of Neurovascular Tree, and Glutamate Waves, R.M. Miura (NJIT, NJ, USA), W. Yao (Fudan University, Shanghai, China), J.J. Wylie (City University of Hong Kong, Hong Kong), K.C. Brennan (UCLA, Los Angeles, USA), Josh Chang (UCLA, Los Angeles, USA).

**Shidong Jiang**

Second Kind Integral Equations for the First Kind Dirichlet Problem of the Biharmonic Equation in Three Dimensions, Paul Tsuji and Lexing Ying (University of Texas at Austin).

**Lou Kondic**

Dense Granular Systems and Topology, Robert Behringer (Duke University), Corey O'Hern (Yale University), Konstantin Mischaikow (Rutgers University).

Influence of Microstrocture on Impact of Dense Granular Matter, Robert Behringer (Duke University), Corey O'Hern (Yale University), Konstantin Mischaikow (Rutgers University).

Instabilities of Hanging Fluid Films, A. Filippov (Corning), Mario Cachile (U. Buenos Aires, Argentina).

Instabilities of Nano-scale Metal Structures, Philip Rack (U. Tennessee and Oak Ridge National Laboratory).

**Victor Matveev**

Cooperativity between Distinct Calcium Channels in Neurotransmitter Release, A. Sherman (National Institutes of Health) and R. Bertram (Florida State University).

Calcium Buffers and Calcium Transient Time-course at an Invertebrate Neuromuscular Junction, J.-W. Lin (Boston University).

Role of Short-term Synaptic Plasticity in Rhythmic Neural Network Activity, A. Bose and F. Nadim (NJIT).

Calcium Microdomains of Presynaptic Calcium Channels and Mechanisms of Synaptic Facilitation, E.F. Stanley (Toronto Western Research Institute).

**Robert M. Miura**

Stretching of Heated Viscous Threads, H. Huang (York University, Toronto, Canada) and J.J. Wylie (City University of Hong Kong, Hong Kong).

Modeling Cortical Spreading Depression, Including Discrete and Continuos Neuronal Networks, Effects of Neurovascular Tree, and Glutamate Waves, H. Huang (York University, Toronto, Canada), W. Yao (Fudan University, Shanghai, China), J.J. Wylie (City University of Hong Kong,

Hong Kong), K.C. Brennan (UCLA, Los Angeles, USA), Josh Chang (UCLA, Los Angeles, USA).

Discovery and Assessment of New Target Sites for Anti-HIV Therapies, N. Madras (York University, Toronto, Canada), C. Breward (University of Oxford, Oxford, UK), J. He_ernan (York University, Toronto, Canada), M.P. Soerensen (Tech. University of Denmark, Lyngby, Denmark), S, Qazi (Gustavus Adolphus College, St. Peter, MN, USA).

Exact and Approximate Traveling Waves of Reaction-Diffusion Systems Via a Variational Approach, M.R. Rodrigo (Instituto Tecnologico Autonomo de Mexico, Mexico City, Mexico).

Mathematical Modeling of CstF-77 Alternative Polyadenylation, Yiming Cheng (Neuchatel, Switzerland).

**Richard O. Moore**

Mathematical and Computational Methods for Stochastic Systems in Nonlinear Optics, Tobias Schafer (CUNY Staten Island).

**Cyrill Muratov**

Modeling and Computational Analysis of Cell Communication in Development, S. Y. Shvartsman (Princeton University).

Self-induced Stochastic Resonance Phenomena, Weinan E (Princeton University), Eric Vanden Eijnden (Courant Institute of Mathematical Sciences).

Pattern Formation in Micromagnetics, M. Chermisi (NJIT) and H. Knuepfer (Hausdorff Center, University of Bonn).

A Variational Approach to Traveling Waves and Propagation Phenomena for Ginzburg-Landau and Combustion Problems in Infinite Cylinders, M. Novaga (University of Pisa, Italy).

Strong Segregation Limit Energetics in Block Copolymer Systems, M. Novaga (University of Pisa, Italy), G. Orlandi (University of Verona, Italy), C. Garcia-Cervera (UCSB).

Structure and Simulations of Domain Walls in Thin Film Micromagnetics, V. Osipov (NASA Ames Research Center).

Modeling and Fault Prediction of Cryogenic Propellant Storage and Transfer in Microgravity, V. Osipov and V. Smelyanskiy (NASA Ames Research Center).

Non-classical Nucleation Droplets, Vitaly Moroz (Department of Mathematics, Swansea University, UK).

**Farzan Nadim**

Neuromodulation of Synaptic Dynamics, R.M. Harris-Warrick and B. Johnson (Cornell University).

Temporal Fidelity of Action Potential Conduction in Axons, D. Bucher (University of Florida).

**Anthony D. Rosato**

Disturbance Propagation in Periodic Granular Materials, F. Fraternali and V. Cianci (University of Salerno, Italy) and C. Dariao (California Institute of Technology).

Density Relaxation in Tapped Granular Systems, D. Horntrop (NJIT) and V. Ratnaswamy, PhD student (Cal-Tech).

**Horacio G. Rotstein**

Frequency Preference in Neurons and Neural Systems, Farzan Nadim (NJIT), Nancy Kopell (Boston University).

Neural Hyperexcitability in the Medial Entorhinal Cortex of the Brain, John White (University of Utah).

The Canard Phenomenon in Piecewise-linear Dynamical Systems and Its Role in Neural Network Dynamics, Steve Coombes (University of Nottingham).

Evolution of Fronts in Reaction Diffusion Systems with Global Inhibitory Feedback, Yassine Boubendir (New Jersey Institute of Technology).

**Michael Siegel**

A Nonstiff Boundary Integral Method for 3D Interfacial Flow, David Ambrose (Drexel), Svetlana Tlupova (U. Michigan).

Semi-Analytic Solutions for Elastic Capsules in 2D Flow, Michael Booty and Michael Higley (NJIT).

Numerical Methods and Analysis for Interfacial Fluid Flow with Soluble Surfactant, Michael Booty, Yuan Young, Qiming Wang, and Kuan Xu (NJIT).

Numerics and Analysis of Singularities for the Euler Equations, Russel Caflisch (UCLA).

**Yuan-Nan Young**

Dynamics of a Compound Vesicle in Shear Flow, Shravan Veerapaneni (New York University), Petia Vlahovska (Brown University), and Jerzy Blawzdziewicz (Texas Tech University).

Dynamics of a Non-spherical Microcapsule with Incompressible Interface in Shear Flow, P. Vlahovska (Brown University), G. Danker and C. Misbah (Universite Joseph Fourier and CNRS, France).

Modeling a Semi-flexible Filament in Cellular Stokes Flow using Regularized Stokeslets, Elizabeth L. Bouzarth and Anita T. Layton (Duke University).

## X. STUDENT ACTIVITIES

### A. UNDERGRADUATE ACTIVITIES

**Zoi-Heleni Michalopoulou, Director of Undergraduate Studies**

**Computational Science Training for Students in the Mathematical Sciences (CSUMS):**

Principal Investigator, Dr. Zoi-Heleni Michalopoulou

CSUMS is an NSF funded program that exposes undergraduate mathematical sciences students to research projects at the cusp of mathematics and scientific computing. The 2010 CSUMS cohort, that conducted research through May 2011, consisted of Todd Caskey, Nihal Dayal, Albi Kavo, Sean Kilroy, Namrata Patel, Matan Shavit, and Mandeep Singh. The faculty mentors were Horntrop, Moore, and Young. CSUMS students attended a series of seminars in which they learned about high performance computing, information literacy, numerical methods, and scientific document preparation. They also gained practical experience in problem-solving as well as presentation skills; frequent presentations of research projects were an important feature of the program.

**List of CSUMS presentations – July 1, 2010 to June 30, 2011:**

**SIAM Annual Meeting, Pittsburgh, PA, July 2010:**

- **High-Order Adaptive Methods for Drawing Parametric Curves,** Priyanka Shah and Casayndra Basarab, New Jersey Institute of Technology (CSUMS 2009 cohort).

- **Simulation of a Brownian Elastic Filament in Random Stokes Flow**, Steven Elliott, Karim Figueroa, Yuan-Nan Young (CSUMS 2009 cohort).

- **Variance Reduction for Numerical Simulation of Stochastic Differential Equations,** Sandeep Singh, Megha Billimoria, and David J. Horntrop, New Jersey Institute of Technology (poster, CSUMS 2009 cohort).

**Lecture presented at the CSUMS Research Conference, University of Saint Thomas in Saint Paul, MN, August 2010**

- **Variance reduction techniques for stochastic differential equations,** Albi Kavo, Mandeep Sing, Todd Caskey, David Horntrop (At this meeting, Kavo also served on a student panel. Horntrop represented the CSUMS mentors at this meeting and served on a panel as well.) (CSUMS 2010 cohort).

**Lecture presented at the NJIT Freshman Seminar, October 2010**

- **Research Opportunities in Mathematics at NJIT,** Namrata Patel and Tao Lin

## Capstone Laboratory Projects:

*Instabilities of Spreading Liquid Crystals*

Students: Paul Dupiano, Sean Naughton, Motolani Olarinre, Namrata Patel, Juan Pineda, Ivana Seric, Priyanka Shah, Mandeep Singh

Laboratory Assistant: Te-Sheng Lin Instructor: Lou Kondic

This project explored instabilities occurring during spreading of liquid crystals on solid surfaces and consisted of experimental, computational, and modeling component. The experimental group carried out table top experiments with 5CB liquid crystal in nematic phase spreading on horizontal and inclined substrates, with the idea of exploring the influence of complex liquid crystal rheology on the spreading behavior. The figures show some examples of intriguate patterns that were observed.

The computational and modeling groups have further developed existing theoretical models to model the spreading behavior. With the help of the assistant, nonlinear simulations of the spreading liquid crystal within the framework of an asymptotic method based on long-wave expansions were carried out.

This project evolved into a summer research project in which three of the students (Sean Naughton, Namrata Patel and Ivana Seric) participated. This project was supported by a Provost Research Fellowship awarded to S. Naughton.

The instructor acknowledges help by Prof. Linda Cummings and Peter Palffy-Muhoray (from the Liquid Crystal Institute, Kent State University). The project was in part supported by the NSF Grant No. DMS-0908158 (PI: L. Cummings, Co-PI: L. Kondic).

Figure 1: Flow down an incline.

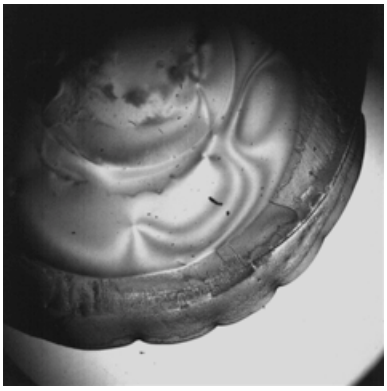


Figure 2: Horizontal spreading.

## UBM – Undergraduate Biology and Mathematics Training Program, 2010-11

Research Mentors: Victor Matveev, Gareth Russell, Jorge Golowasch, Camelia Prodan, and Jessica Ware (Rutgerts-Newark)

A group of six NJIT sophomore and junior students majoring in Math or Biology was interviewed and recruited in Fall 2010 to take part in the 2011 UBM Program: Ali Mustafa (Math/Physics), Amanee Mustafa (Biology), John Marin (Math), Sana Bendaoud (Biology), Kruti Shah (Biology), and Zhuo Jiang (Math).

As in the previous years, the Program started in the Spring semester (2011), with students taking the Mathematical Biology course (Math 373) taught by Prof. Daniel Bunker, along with a single-credit Undergraduate Research Seminar (Math 401). The Research Seminar involved one 1.5 hour meeting per week lead by the UBM program PI, Prof. Victor Matveev, and was aimed at educating the student participants in modeling techniques, with an emphasis on statistical methods, differential equations, stochastic simulation and MATLAB programming.

During Spring 2011 students also rotated through this year's host laboratories: the Evolutionary Biology and Phylogenetics laboratory of Dr. Jessica Ware (Rutgers-Newark), the Ecology laboratory of Dr. Gareth Russell (NJIT and Rutgers-Newark), and the Cell Biophysics laboratory of Dr. Camelia Prodan (NJIT). These rotations exposed the students for the first time to experimental research techniques, and gave them a selection of research projects to choose from.

Based on the preferences of the six UBM students, they were paired into three groups and assigned to one of the three participating laboratories. They started working on their research projects in May 2011, and will complete the active research phase of the program by early Fall 2011. The research projects are:

Lab: Dr. Jessica Ware
Students: John Marin (Math) and Sana Bendaoud (Biology)
*"Effect of nucleotide compositional bias among taxa on divergence time estimation"*

Lab: Dr. Gareth Russell
Students: Zhuo Jiang (Math) and Kruti Shah (Biology)
*"Scaling movement behavior from microscopic rules to habitat preference"*

Lab: Dr. Camelia Prodan
Students: Ali Mustafa (Math/Physics) and Amanee Mustafa (Biology)
*"Testing drug potency by single cell dielectric spectroscopy"*

Apart from the full-time research work, the summer phase of the UBM program involved two weekly group meetings attended by all students and their research mentors: one of the meetings was devoted to weekly presentation of research results, which helped to further develop students' presentation skills, while the second meeting, lead by V. Matveev, continued the training of mathematical and modeling topics, along with programming skills.

All UBM research activities are documented on the UBM Program webpage maintained by the program PI, V. Matveev: http://web.njit.edu/~matveev/UBM/

In addition to starting 2011 UBM program activities, this year also saw the conclusion of the year 2010 UBM program. The six students who had done their summer research in 2010 finalized their research projects and presented their research results in Fall 2010 Mathematical Biology seminar:

Lab: Dr. Jorge Golowasch
Students: Moustafa Abas Moursy and Omar Meky:
*"Role of Passive Leak Currents in Pacemaker Neuronal Activity"*

Lab: Dr. Gareth Russell
Students: Motolani Olarinre and Xavier Lee:
*"Tracking and Modeling Inter-Patch Organismal Movement with Chemotaxis"*

Lab: Dr. Camelia Prodan
Students: Sandhya Venkataraman and Enas Shehadeh
*"Models of Dynamic Instability in Microtubule Growth"*

Two of these groups presented their research results at regional and national research conferences (UBM student names are underlined); one of the presentations was published in abstract form in the Biophysical Journal:

1. 55th Annual Biophysical Society Meeting, March 2010, Baltimore, MD:
   Camelia Prodan, Emil V. Prodan, Sandhya Venkataraman, Enas Shehadeh
   "Dynamic Instability of Microtubules: The Role of Topological Phonon Modes"
   Biophysical Journal 100(3): 451(a)

2. New Jersey Space Grant Consortium Fellowship Meeting, 2011, New Brunswick, NJ
   Camelia Prodan, Emil V. Prodan, Sandhya Venkataraman, Enas Shehadeh
   "Dynamic Instability of Microtubules: The Role of Topological Phonon Modes"

3. Dana Knox Research Showcase, April 2011, NJIT (Bronze Medal in poster competition).
   Camelia Prodan, Emil V. Prodan, Sandhya Venkataraman, Enas Shehadeh
   "Dynamic Instability of Microtubules: The Role of Topological Phonon Modes"

4. UBM PI Meeting, March 2011, Fort Collins, CO
   Motolani Olarinre, Xavier Lee, Gareth Russell
   "Meta-population Dynamics via Chemotaxis"

Attesting to the success of the Program, most of the student participants continued their research involvement upon completion of the 2010 UBM Program:

1. Sandhya Venkataraman and Enas Shehadeh were awarded a NASA research fellowship to continue their work in the laboratory of Dr. Prodan
2. Omar Meky was accepted to take part in the 2011 Summer Research Training Program at the Mayo Clinic
3. Motolani Olarinre is involved in research project in the laboratory of Dr. Jorge Golowasch.

## Other Undergraduate Student Research Projects

Student: Utkarsh Raj (sophomore; Electrical Engineering major, Applied Math minor; GPA 3.82; Albert Dorman Honors scholar)
Project: Bistable nematic liquid crystal displays: electric field interactions
Supervisor: Linda Cummings
Funded by: CAMS

Summary: Nematic Liquid Crystal Display (LCD) devices rely on the ability of Nematic Liquid Crystals (NLCs) to rotate the plane of polarized light, to a degree that depends on the orientation of the molecules within the NLC. Therefore, when a layer of NLC is placed between crossed polarizers, the amount of light that passes through the sandwich depends on the molecular orientation. Controlling this orientation can create a sandwich of controllable brightness, forming

the basis for a `pixel' in an LCD. In conventional LCDs the molecular orientation is controlled by application of an electric field, but this is expensive in terms of power consumption. If instead surface effects at the sandwich's bounding surfaces can be harnessed to give two stable orientations for the NLC molecular orientation in the absence of an applied field - bistability - then the potential for a `zero power' display exists, with power needing to be applied only to switch from one state to the other when a change of contrast is required. This project focussed on modeling the sandwich with its two stable states, and specifically on the behavior of the NLC layer when an external field is applied to it to switch between stable states. While work has been done on existing models and the response to a uniform applied field, in reality the applied field interacts with the NLC layer and is inevitably nonuniform. This project derived a new model for the nonuniform field using calculus-of-variation approaches, and presented numerical solutions to the new model.

Student: Sean Naughton (junior; Applied Math major; GPA 3.82; Albert Dorman Honors scholar)
Project: Modeling and experiments on spreading films of nematic liquid crystal
Supervisor: Lou Kondic and Linda Cummings
Funded by: Provost's Summer Research program (hosted by CAMS/Capstone Lab)

Summary: When thin films or droplets of nematic liquid crystal (NLC) spread on a substrate, exotic fingering instabilities that would not be seen with Newtonian fluids can be observed. This project had three components: (i) laboratory experiments were carried out with flowing films of NLC to replicate these instabilities and capture them on film; (ii) computer simulations of new mathematical models for spreading thin films of NLC were done; and (iii) qualitative comparison was made between the experimental observations and the model simulations.

**Pi Mu Epsilon Induction Ceremony on April 20, 2011**

The NJIT Chapter of the Pi Mu Epsilon honor society inducted 13 new members (11 students and 2 faculty) this year.

Pi Mu Epsilon is a national mathematics honor society. It was founded at Syracuse University and incorporated at Albany, New York on May 25, 1914. The purpose of Pi Mu Epsilon is the promotion and recognition of mathematical scholarship among students in postsecondary institutions. It aims to do this by electing members on an honorary basis according to their proficiency in mathematics and by engaging in activities designed to promote the mathematical and scholarly development of its members.

## B. GRADUATE STUDENT RESEARCH PROGRAMS

### Michael Booty, Director of the Graduate Program

**<u>Ph.Ds Awarded August 2010</u>:**

**Kuan Xu**
Thesis: *Computational Methods for Two-Phase Flow with Soluble Surfactant*
Advisor: Michael Booty and Michael Siegel

**Qiyi Zhou**
Thesis: *A Numerical Study on the Propagation and Interaction of Strongly Nonlinear Solitary Waves*
Advisor: Wooyoung Choi

**Ph.Ds Awarded January 2011:**

**Hui Wu**
Thesis: *Pattern Formation in Oscillatory Systems*
Advisors: Horacio G. Rotstein and Louis Tao

**Ph.Ds Awarded May 2011:**

**Shuchi Agrawal**
Thesis: *Uniform Heating of Thin Ceramic Slabs in a Multimode Microwave Cavity*
Advisor: Gregory A. Kriegsmann

**Rudrani Banerjee**
Thesis: *Some Contributions to Modeling Usage Sensitive Warranty Servicing Strategies and Their Analyses*
Advisor: Manish C. Bhattacharjee

**Matthew Causley**
Thesis: *Asymptotic and Numerical Analysis of Time-dependent Wave Propagation in Dispersive Dielectric Media that Exhibit Fractional Relaxation*
Advisor: Peter Petropoulos

**Xinxian Huang**
Thesis: *Using Feed-forward Networks to Infer the Activity of Feedback Neuronal Networks*
Advisor: Amitabha Bose

**Matt Malej**
Thesis: *Numerical and Asymptotic Modeling of Evolving Nonlinear Ocean Surface Wave Fields*
Advisor: Wooyoung Choi

**Jacek Wrobel**
Thesis: *High-order Adaptive Method for Computing Invariant Manifolds of Maps*
Advisor: Roy Goodman

**Lianzhe Xu**
Thesis: *Markovian and Stochastic Differential Equation Based Approaches to Computer Virus Propagation Dynamics and Some Models For Survival Distributions*
Advisor: Manish C. Bhattacharjee

**Peixin Zhang**
Thesis: *Confidence Bands for Survival Functions under Semiparametric Random Censorship Models*
Advisor: Sundar Subramanian

**Publications, Presentations, and Conference Participation:**

**Rudrani Banerjee**

Presentations:

December 2010: 4th Asia-Pacific International Symposium on Advanced Reliability and Maintenance Modeling, Wellington, New Zealand, "Warranty Servicing with a Brown-Proschan Repair Option."

Posters:

Fall 2010: Graduate Research Day, Graduate Student Association, NJIT, Modeling and Analysis of Warranty Servicing Costs with a Randomized Repair Option.

Spring 2011: The Dana Knox Student Research Showcase, NJIT, Modeling and Analysis Of Warranty Servicing Costs With A Randomized Repair Option.

Scholarships/Awards/Honors:

1) Student Achievement Award, Graduate Student Association, NJIT, Spring 2011.
2) Student Award for Excellence in Research, Department of Mathematical Sciences, NJIT, December 2010
3) Nominated for Excellence in Teaching as a TA, Spring 2011

Publication:

CAMS Technical Report: (Report 1011-3) Warranty Servicing Strayegy with a Brown-Proschan repair option (joint with M. C. Bhattacharjee).

**Xiaoni Fang**

Posters:

April 2011: Dana Knox Research Showcase, New Jersey Institute of Technology, Newark, NJ
On Influence of Microstructure on Granular Impact

June 2011: International Fine Particles Research Institute Annual Meeting, Chapel Hill, NC
Modeling Hopper Flow

**Daniel Fong**

Proceedings Publications:

Asymptotic Structure of Diffusion Flames at High Pressure (with J.K. Bechtold and C.K. Law), 7th US National Meeting of the Combustion Institute, Atlanta GA, Combustion Institute, March, 2011.

Presentations:

July 2010: SIAM Annual Meeting, Pittsburgh, PA
Asymptotic Structure of Diffusion Flames at High Pressure with Soret Transport

March 2011:  7th US National Meeting of the Combustion Institute, Atlanta, GA
Asymptotic Structure of Diffusion Flames at High Pressure with Soret Transport

April 25, 2011:  Air Force Research Laboratory, Combustion Branch, Wright-Patterson Air Force Base, OH
Asymptotic Structure of Diffusion Flames at High Pressure

Honors and Awards

NASA New Jersey Space Grant Consortium Student Travel Support Grant, for presentation at the 7th US National Technical Meeting of the Combustion Institute, Atlanta, GA, March 2011

The Combustion Institute Student Travel Support Grant, for presentation at the 7th US National Technical Meeting of the Combustion Institute, Atlanta, GA, March 2011

Society for Industrial and Applied Mathematics Student Travel Award, For presentation at the SIAM Annual Meeting, Pittsburgh, PA, July, 2010.

Accepted into Princeton-CEFRC Summer Program on Combustion; 2010 and 2011 sessions.

Summer Internship; Air Force Research Laboratory (Wright-Patterson Air Force Base, Ohio), Propulsion Sciences Branch, June to August, 2011

**Te-Sheng Lin**

Publications:

Modeling and simulations of the spreading and destabilization of nematic droplets (with L. J. Cummings and L. Kondic), Phys. Fluid, 23, 043102, 2011.

Presentations:

August 2010: Universidad de Buenos Aires, Buenos Aires, Argentina
Contact line induced instabilities in two spreading problems: thin films flowing down inverted substrates and liquid crystal drops

August 2010: UNCPBA, Tandil, Argentina
Contact line induced instabilities in two spreading problems: thin films flowing down inverted substrates and liquid crystal drops

November 2010: APS Division of Fluid Dynamics Annual Meeting, Long Beach, CA
Thin films: instabilities, waves and dewetting

February 2011: Liquid Crystal Institute, Kent State University, OH
Instabilities in Newtonian films and nematic liquid crystal droplets

Posters:

November 2010: Graduate student research day, NJIT
Modeling and simulations of nematic droplets

November 2010: APS Division of Fluid Dynamics Annual Meeting, Long Beach, CA
Modeling spreading of liquid crystal drops

April 2011: The Dana Knox student research showcase, NJIT
Modeling spreading of nematic droplets

May 2011: Frontiers in Applied and Computational Mathematics, NJIT
Modeling spreading of nematic droplets

**Jacek Wrobel**

Presentations:

July 2010: SIAM Annual Meeting, Pittsburgh, PA
High-Order Bisection Method for Computing Invariant Manifolds of 2D Maps

May 2011: SIAM Conference on Applications of Dynamical Systems, Snowbird, UT
High-order Adaptive Methods For Computing Two-dimensional Invariant Manifolds of Maps

June 2011: Frontiers in Applied and Computational Mathematics, NJIT
High-order Adaptive Methods For Computing Two-dimensional Invariant Manifolds of Maps

**Lianzhe Xu**

Poster presentations:
1) Graduate Research Day, Graduate Student Association, NJIT; Fall 2010
2) The Dana Knox Student Research Showcase, NJIT; Spring 2011

## Graduate Student-Faculty Seminars

Co-sponsored by the Graduate Student Association Mathematical Sciences Group and the NJIT-SIAM Student Chapter

The aim of the seminars is to provide an opportunity for graduate students to present their research work to their peers and faculty, and for faculty to introduce graduate students to their area of research specialization. As such, it aims to promote the general level of awareness of research among the graduate student body.

The seminar series' website (http://math.njit.edu/seminars) lists recent seminar speakers with their titles and abstracts. Details of older seminars are archived at http://math.njit.edu/seminars/archive.php

July and August 2010

July 1 **Lou Kondic**, *Particulate Matter: Networks, Chains, Energies, and their Role in Signal Propagation*

July 6 **Daniel Fong**, *Asymptotic Structure of Diffusion Flames at High Pressure with Soret Transport*

July 8 **David Horntrop**, *Stochastic Simulation with Application to Materials*

July 13 **Peixin Zhang**, *Confidence Bands for Survival Functions Under Semiparametric Random Censorship Models*

July 15 **Michael Booty**, *Classical Aerofoil Theory and Variations on a Theme*

July 20 **Kuan Xu**, *The Evolution of a Two-Dimensional Cartesian Drop in an Imposed Linear Flow: The Influence of Surfactant and Surfactant Solubility*

July 22 **Yassine Boubendir**, TBA

July 27 **Jacek Wrobel**, *Adaptive Methods For Computing Invariant Manifolds of Maps*

July 29 **Shahriar Afkhami**, *The Motion and Deformation of Elongated Drops and Bubbles in a Microchannel*

August 3 **Xiaoni Fang**, *Molecular Dynamics Simulation of 2D Dry Granular Materials*

August 5 **Roy Goodman**, *What to Do with Your Numerical Simulations*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