CAMS

Center for Applied Mathematics and Statistics

ANNUAL REPORT
2014 – 2015

NJIT
New Jersey Institute of Technology

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I. FROM THE DIRECTOR

The Center for Applied Mathematics and Statistics (CAMS) is entering its 30th year as a vehicle for research in applied mathematics and statistics at NJIT. A significant birthday or milestone, perhaps, but we are not looking back. CAMS supports faculty research by organizing seminars and conferences and by facilitating group and interdisciplinary research proposals. We take particular pride in the undergraduate research that is supported by CAMS. NJIT Provost Fadi Deek 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. CAMS combined with faculty from the Department of Computer Science and researchers in industry to obtain a five year NSF 'EXTREEMS' grant, which began in September 2013 and is now in its second summer of engaging undergraduates in research. The grant will enable us to significantly enhance the exposure of undergraduate mathematical science students to topics in computational and data-enabled science and engineering.

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

- The oversight of twenty-nine continuing grants, from various agencies, and four newly awarded grants from NSF. CAMS receives substantial funding for graduate student and faculty research from sources such as the National Science Foundation, the Office of Naval Research, the Air Force Office of Scientific Research, NASA, the Department of Defense, other state and local agencies such as the NJ Meadowlands Commission, and private industry.

- Hosting of the 12th Frontiers in Applied and Computational Mathematics (FACM) conference. The two day meeting was attended by more than 140 participants, and focused on fluid dynamics, interpreted broadly to include wave propagation and numerical algorithms, and on applied and bio-statistics in big data. The meeting also included a focused minisymposium dedicated to recognizing Denis Blackmore's contributions to mathematical modeling of vortex dynamics, as well as his 70th birthday.

- Hosting of the Third Northeast Complex Fluids and Soft Matter Workshop (NCS3). The workshop series aims to bring together researchers who work on the science and engineering of complex fluids and soft matter, including polymers, granular materials, biomaterials, colloids, foams, and liquid crystals. The informal one-day workshops host a mix of invited talks, short presentations, and networking time for participants to exchange ideas and foster collaboration. Shahriar Afkhami and Yuan-Nan Young co-organized NCS3, which was held on January 16th, 2015, and was attended by more than 60 participants.

As always, the accomplishments of CAMS have been built with the support and dedication of many individuals. We are grateful to Fadi Deek, Provost and Senior Vice President of Academic Affairs, Jonathan Luke, Department of Mathematical Sciences Chair, and Atam Dhawan, Senior Vice President for Research, for encouraging CAMS through their strong support of scientific research. Finally, we thank President Joel Bloom, 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.

Michael Booty, Interim Director • Cyrill Muratov, 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 conference, "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 2014-2015

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Dr. Anne-Sophie Vanroyen	Modus Quantitative Advisors
Dr. Benjamin White	Exxon Research & Engineering

III. MEMBERS AND VISITORS

Department of Mathematical Sciences

Afkhami, Shahriar
Ahluwalia, Daljit S.
Bechtold, John
Blackmore, Denis
Booty, Michael
Bose, Amitabha
Boubendir, Yassine
Bukiet, Bruce
Bunker, Daniel
Choi, Wooyoung
Cummings, Linda
Deek, Fadi
Dhar, Sunil
Diekman, Casey
Dios, Rose
Froese, Brittany
Golowasch, Jorge
Goodman, Roy
Guo, Wenge
Horntrop, David
Jiang, Shidong
Johnson, Kenneth
Kappraff, Jay
Kondic, Lou
Kriegsmann, Gregory A.
Loh, Ji Meng
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
Shirokoff, David
Siegel, Michael
Subramanian, Sundar
Sverdlove, Ronald
Turc, Catalin
Wang, Antai
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 External Faculty Members

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 College London
Wylie, Jonathan	City University of Hong Kong

IV. COLLOQUIA AND SEMINARS

Applied Mathematics Colloquium/ Department of Mathematical Sciences Colloquium

September 5, **Kate Stebe**, University of Pennsylvania, *Energy Stored in Deformation Fields: Opportunities for Directed Assembly in Soft Matter*

September 12, **Paul A. Martin**, Colorado School of Mines, *Acoustic and Electric Faraday Cages*

September 19, **Fioralba Cakoni**, University of Delaware, *A Qualitative Approach to Inverse Scattering for Inhomogeneous Media: The Transmission Eigenvalue Problem*

September 26, **Li-Shi Luo**, Old Dominion University, *Kinetic Methods for CFD*

October 3, **Jianliang Qian**, Michigan State University, *Fast Huygens Sweeping Methods for Helmholtz Equations in Inhomogeneous Media in the High Frequency Regime*

October 10, **Yuriko Renardy**, Virginia Polytechnic Institute and State University, *A Viscoelastic Constitutive Model That Predicts Thixotropic Yield Stress Behavior for Large Relaxation Time*

October 17, **John Wettlaufer**, Yale University and the University of Oxford, *Sea Ice and Climate: A Model System in Stochastic Nonlinear Dynamics*

October 24, **Arthur Sherman**, National Institutes of Health, *Modeling the Causes and Cures of Diabetes*

October 31, **Irene Fonseca**, Carnegie Mellon University, *Variational Methods for Crystal Surface Instability*

November 7, **Yousef Saad**, University of Minnesota, *Multilevel Low-Rank Approximation Preconditioners*

November 14, **Peter Howell**, University of Oxford, *Deterministic and Stochastic Modelling of Lithiation/Delithiation in a Lithium-ion Battery Electrode*

November 21, **Margaret Beck**, Boston University, *Nonlinear Stability of Coherent Structures via Pointwise Estimates*

December 5, **Evelyn Sander**, George Mason University, *The Dynamics of Nucleation*

January 23, **David Amsallem**, Stanford University, *Accelerating PDE-Constrained Optimization Using Reduced-Order Models*

January 30, **Jinchao Xu**, Pennsylvania State University, *Stable Discretization and Robust Preconditioner for Some Multi-physics Models*
February 6, **Suncica Canic**, University of Houston, *Mathematical Methods for Cardiovascular Treatment*

February 13, **Hakima Bessaih**, University of Wyoming, *The Effect of Noise on Data Assimilation and Porous Media*

February 20, **Young Ju Lee**, Texas State University, *Non-local Three Species Model for Wormlike Micellar Fluids*

February 27, **Henry Abarbanel**, University of California, San Diego, *Statistical Physics of Data Assimilation*

March 6, **Irene Gamba**, University of Texas at Austin, *From Boltzmann Collisional Dynamics to the Landau Equation, Analysis and Numerics*

March 27, **Ian Griffiths**, University of Oxford, *Magnets and Zebra Pipes: Effective Ways of Purifying Water?*

April 10, **Chjan C. Lim**, Rensselaer Polytechnic Institute, *Solutions of Generalized (Ehrenfest's Dog Flea) Urn Models*

April 17, **Alex Mogilner**, NYU Courant, *Cell Motility as a Free Boundary Problem*

April 24, **Shawn Chester**, NJIT, *Multiphysics Mechanics of Polymeric Gels*

Applied Statistics Seminar

October 9, **Joseph Romano**, Stanford University, *Permutation Tests 101*

October 16, **Xiaoyu Jia**, Boehringer Ingelheim Pharmaceutical, *Two-stage likelihood Continual Reassessment Method for Phase I Clinical Trials*

October 22, **Min Qian**, Columbia University, *Constructing Dynamic Treatment Regimes Using Q-learning with L1-Regularization*

November 13, **Aiyi Liu**, National Institutes of Health, *Group Testing for Rare Diseases in the Presence of Misclassification*

November 20, **Xin (James) Li**, Georgetown University, *Advances in Methods on Enriched and Integrated Analysis for High-Throughput "-omics" Data*

November 27, **Jinfeng Xu**, New York University, title unknown

February 5, **Hammou Elbarmi**, The City University of New York, *Testing for Uniform Stochastic Ordering via Empirical Likelihood*

March 12, **MengLing Liu**, New York University School of Medicine, *Identification of Homogeneous and Heterogeneous Variables in Pooled Cohort Studies*

March 26, **Zhezhen Jin**, Columbia University, *Estimation and Inference with Semiparametric Models on Censored Data*

April 2, **Bin Zhu**, National Institutes of Health, *Locally Adaptive Bayes Nonparametric Regression via Nested Gaussian Processes*

April 9, **George Mytalas**, NJIT, *An Overview in K-out-of-N Reliability Systems With Queue and Exact Analysis of a Two Class K-out-of-N System with Repair*

April 16, **Yongzhao Shao**, PhD, New York University School of Medicine, *A Likelihood Ratio Test for Genome-wide Association Study Under Genetic Heterogeneity*

April 30, **Zhenzhen Xu**, Food and Drug Administration, *A Non-Parametric Maximum Likelihood Estimation Approach to Frailty Model*

Mathematical Biology Seminar

September 16, **Horacio Rotstein**, NJIT

October 14, **Dave Stanley**, Boston University, *Circadian Rhythms, Epilepsy and Synchrony: A Series of Computational and Experimental Investigations*

October 21, **Victor Matveev**, NJIT, *Modeling Cell Calcium Dynamics: Challenges and Open Problems*

October 28, **James Rankin**, New York University, *Perceptual Bistability in Auditory Learning*

November 4, **Xiaojun Yu**, Stevens Institute of Technology, *Tissue Engineering for Peripheral Nerve Regeneration*

November 11, **Hugh Piggins**, University of Manchester, *Extrinsic and Intrinsic Regulation of the Brain's Circadian Clock*

December 9, **Tim O'Leary**, Brandeis University

February 24, **Alla Borisyuk**, University of Utah, *Periodically Driven Noisy Neuronal Models: A Spectral Approach*

March 12, **Jason Graham**, University of Scranton, *Modeling Pathological Cartilage Inflammation*

March 24, **Roman Voronov**, NJIT, *Image-based Modeling for Bio-medicine and Beyond*

April 6, **Brad Peercy**, University of Maryland - Baltimore County, *Interplay of cAMP and Metabolism in Beta Cells*

April 21, **Antje Ihlefeld**, NJIT, *Hearing Loss and the Brain*

April 28, **Takanari Inoue**, Johns Hopkins University, *Synthetic Cell Biology: Deconstructing and Constructing Chemotaxis and Phagocytosis*

Fluid Mechanics and Waves Seminars

September 29, **Sebastian Furthauer**, New York University, *How Cells Tell Left from Right: Active Chiral Processes in Soft Biological Matter*

October 6, **Francesc Martinez**, Barcelona, *Mathematical Modelling of Special Solid-Liquid Phase Transitions*

October 20, **Mark Lyon**, University of New Hampshire, *Fourier Continuation and Accurate Approximation*

October 27, **Frederic Dias**, University College Dublin, *Extreme Waves: Their Observation and Their Generation*

November 3, **Jun Lai**, New York University, *A Fast Solver for Multi-Particle Scattering in a Layered Medium*

November 10, **Pierre-David Letourneau**, Columbia University, *Resolution and De-aliasing in Elastography*

November 17, **Emil Prodan**, Yeshiva, *C*-Algebras for Research and Discovery in Materials Science*

December 1, **Carlos Borges**, New York University, *Inverse Obstacle Scattering in Two Dimensions with Multiple Frequency Data and Multiple Angles of Incidence*

December 8, **Gilou Agbaglah**, Cornell University, *Impact of a Single Drop on the Same Liquid: Formation, Growth and Disintegration of Jets*

March 2, **Nawaf Bou-Rabee**, Rutgers Camden, *Continuous Time Random Walks for the Numerical Solution of Stochastic Differential Equations*

March 30, **Kamel Riahi**, NJIT, *A Robust Inversion Method for Quantitative 3D Shape Reconstruction from Coaxial Eddy-current Measurements*

April 6, **Anand Oza**, New York University - Courant, *A Trajectory Equation for Walking Droplets: Hydrodynamic Pilot-Wave Theory*

April 13, **Dong Zhou**, Temple University/ MIT, *High-order Methods for a Pressure Poisson Equation Reformulation of the Incompressible Navier-Stokes Equations*

April 20, **Lise-Marie Imbert-Gerard**, New York University - Courant, *Direct Scattering by Penetrable Media*

April 27, **Emilie Dressaire**, New York University - Polytechnic, *Interfacial Responses to Mechanical Forcings*

May 4, **Tony Gao**, *Modeling and Simulation in Complex Fluids: From Passive to Active Systems*

V. PUBLICATIONS, PRESENTATIONS, AND REPORTS

A. PUBLICATIONS

JOURNAL PUBLICATIONS

Shahriar Afkhami

Capillary Focusing Close to a Topographic Step: Shape and Instability of Confined Liquid Filaments (with M. Hein, L. Kondic, and R. Seemann), Microfluidics and Nanofluidics, DOI: 10.1007/s10404-014- 1481-0, September 2014.

Interfacial Instability of Thin Ferrofluid Films Under a Magnetic Field (with L. Kondic and I. Seric), Journal of Fluid Mechanics Rapids, Vol. 755 (9), DOI: 10.1017/jfm.2014.435, August 2014.

Denis Blackmore

Dark Equations and their Light Integrability (with A. Prykarpatsky), J. Nonlin. Math. Phys., Vol. 21 (2014), 407-428. September 2014.

Strange Attractors for Asymptotically Zero Maps (with Y. Joshi), Chaos, Solitons & Fractals, Vol. 68 (2014), 123-138. Nov. 2014.

Maxwell--Lorentz Electrodynamics Models Revisited via the Lagrangian Formalism and the Feynman Proper Time Paradigm (with N. Bogolubov (Jr.), A. Prykarpatsky), Mathematics, Vol. 3 (2015), 190 – 257; doi:10.3390/math 3020190. April 2015.

Yassine Boubendir

Regularized Combined Field Integral Equations for Acoustic Transmission Problems (with V. Dominquez Navarra, D. Levadoux Onera, and C. Turc), SIAM Journal on Applied Mathematics, Vol. 75 (3), DOI:10.1137/140964230, May 2015.

High-order Nyström Discretizations for the Solution of Integral Equation Formulations of Two-Dimensional Helmholtz Transmission Problems (with V. Dominquez and C. Turc), IMA Journal of Numerical Analysis, DOI: 10.1093/imanum/drv010, March 2015.

Integral Equations Requiring Small Numbers of Krylov-Subspace Iterations for Two-Dimensional Penetrable Scattering Problems (with O. Bruno, D. Levadoux Onera, and C. Turc), Applied Numerical Mathematics, Vol 95, DOI: 10.1016/j.apnum.2015.01.005, September 2015.

Bruce Bukiet

Deformations Experienced in the Human Skin, Adipose Tissues and Fascia in Osteopathic Manual Medicine (with H. Chaudhry, T. Findley, Z. Ji, A. Stecco), Journal of the American Osteopathic Association, Vol. 114 (10), pp. 780 - 787, October 2014.

Wooyoung Choi

An Explicit Data Assimilation Scheme for a Nonlinear Wave Prediction Model Based on a Pseudo-Spectral Method (with J. Kim and S. Yoon), IEEE Journal of Oceanic Engineering, Vol. PP (99), DOI: 10.1109/JOE.2015.2406471, March 2015.

High-Order Davies' Approximation for a Solitary Wave Solution in Packham's Complex Plane (with S. Murashige), SIAM Journal on Applied Mathematics, Vol. 75, pp. 189 - 208, DOI:10.1137/140980843, February 2015.

Elementary Stratified Flows with Stability at Low Richardson Number (with R. Barros), Physics of Fluids, Vol. 26, DOI: 10.1063/1.4904871, December 2014.

Linda Cummings

Transitions in Poiseuille Flow of Nematic Liquid Crystal (with T. Anderson, L. Kondic, and E. Mema), Vol. 75, pp. 15 - 21, DOI: 0.1016/j.ijnonlinmec.2015.04.010, October 2015, Available online May 2015.

Three-Dimensional Coating Flow of Nematic Liquid Crystal on an Inclined Substrate (with L. Kondic, M. Lam, and T.-S. Lin), European Journal of Applied Mathematics, DOI: 10.1017/S0956792515000091, April 2015.

Modeling Flow of Nematic Liquid Crystal Down an Incline (with L. Kondic, M. Lam, and T.-S. Lin), Journal of Engineering Mathematics, DOI: 10.1007/s10665-014-9697-2, November 2014.

Extensional Flow of Nematic Liquid Crystal with an Applied Electric Field (with J. Low and T. Myers), European Journal of Applied Mathematics, Vol. 25 (4), August 2014.

Electric Field Variations Within a Nematic Liquid Crystal Layer (with C. Cai, L. Kondic, and E. Mema), Physical Review E: Statistical, Nonlinear, and Soft Matter Physics, Vol. 90, July 2014.

Sunil Dhar

Transmission of Muscle Force to Fascia During Exercise (with H. Chaudhry and T. Findley), Journal of Bodywork and Movement Therapies, Vol. 19 (1), pp. 119-123, DOI: 10.1016/j.jbmt.2014.08.010, January 2015.

Pulsatile Aortic Pressure-Flow Analysis using Fractional Calculus for Minimally-Invasive Applications (with G. Atlas and J. Li), Journal of Biomedical Engineering and Biosciences, Vol. 1, pp. 1 - 7, December 2014.

Casey O. Diekman

Discovering Functional Neuronal Connectivity from Serial Patterns in Spike Train Data (with K. Dasgupta, V. Nair, and K.P. Unnikrishnan), Neural Computation, Vol. 26 (7), pp. 1263 - 1297, July 2014.

Thomas Erneux

The Goodwin Model Revisited: Hopf Bifurcation, Limit-Cycle, and Periodic Entrainment (with A. Woller and D. Gonze), Phys. Biol. Vol. 11, 045002, July 2014.

All-Optical Controlled Switching Between Time-Periodic Square-Waves in Diode Lasers with Delayed Feedbacks (with G. Friart, G. Verschaffelt, and J. Danckaert), Opt. Lett., Vol. 39, pp. 6098–6101, November 2014.

Self-Sustained Pulsations in a Quantum-Dot Laser (with E.A. Viktorov), Phys. Rev. E, Vol. 90, 052914, May 2014.

Multi-Rhythmicity in an Optoelectronic Oscillator with Large Delay (with L. Weicker, D.P. Rosin and D. J. Gauthier), Phys. Rev. E, Vol. 91, 012910, January 2015.

Synchronization of Tunable Asymmetric Square-Wave Pulses in Delay-Coupled Optoelectronic Oscillators (with J. Martinez-Llinas and P. Colet), Phys. Rev. E, Vol. 91, 032911, March 2015.

Analytical Stability Boundaries of an Injected Two-Polarization Semiconductor Laser (with G. Friart and A. Gavrielides), Phys. Rev. E, Vol. 91, 042918, April 2015 .

Un Eclairage Mathématique sur la Dynamique des Lasers (with P.-L. Buono), Acromath, Vol. 10, pp. 12-17, Winter- Spring Issue 2015.

Roy Goodman

A Mechanical Analog of the Two-Bounce Resonance of Solitary Waves: Modeling and Experiment (with M. Bellanich, C. Morrison, and A. Rahman), Chaos: An Interdisciplinary Journal of Nonlinear Science, Vol. 25, April 2015.

Dynamics of Vortex Dipoles in Anisotropic Bose-Einstein Condensates (with R. Carretero-González and P. Kevrekidis), SIAM Journal of Applied Dynamical Systems, Society for Industrial and Applied Mathematics, DOI: 10.1137/140992345, April 2015.

Self-Trapping and Josephson Tunneling Solutions to the Nonlinear Schrodinger / Gross-Pitaevskii Equation (with J. Marzuola and M. Weinstein), Discrete and Continuous Dynamical Systems--Series A, American Institute of Mathematical Sciences, Vol. 35 (1), pp. 225 - 246, January 2015.

Claus Holzapfel

Spatio-Temporal Impacts of Fire on Soil Nutrient Availability in Larrea Tridentata Shrublands of the Mojave Desert, USA (with Fuentes-Ramirez A., Schafer, J.L., Mudrak E., Schat M., Parag H.A. , Holzapfel C., Moloney K.), Geoderma, Vol. 259-260, pp. 126-133, 2015.

Assessing the Impact of Fire on the Spatial Distribution of Larrea Tridentata in the Sonoran Desert, USA (Fuentes-Ramirez A., Mudrak E., Caragea P., Holzapfel C. & Moloney K.), Oecologia, DOI: 10.1007/s00442-014-3214-1, 2015.

Middle-Eastern Plant Communities Tolerate Nine Years of Drought in a Multi-Site Climate Manipulation Experiment (with Tielbörger K. Bilton M.C., Metz J. , Kigel J., Holzapfel C., Lebrija-Trejos E., Konsens I., Parag H., Sternberg M.), Nature Communications, DOI: 10.1038/ncomms6102, 2014.

Predictive Modeling of Spatial Patterns of Soil Nutrients Related to Fertility Islands (Mudrak, E. L., Schafer, J.L., Fuentes-Ramirez, A., Holzapfel, C., Moloney, K. A.), Landscape Ecology, Vol. 29, pp. 491-505, 2014.

Wenge Guo

On Stepwise Control of Directional Errors Under Independence and Some Dependence (with J. Romano), Journal of Statistical Planning and Inference, Vol. 163, pp. 21 - 33, August 2015, Available online March 2015.

Shidong Jiang

Efficient Brownian Dynamics Simulation of DNA Molecules with Hydrodynamic Interactions in Linear Flows (with S.-P. Fu and Y.-N. Young), Physical Review E, Vol. 91, June 2015.

Fast and Accurate Evaluation of Nonlocal Coulomb and Dipole-Dipole Interactions via the Nonuniform FFT (with W. Bao and L. Greengard), SIAM Journal on Scientific Computing, Vol. 36 (5), pp. B777 - B794, October 2014.

The Solution of the Scalar Wave Equation in the Exterior of a Sphere (with L. Greengard and T. Hagstrom), Journal of Computational Physics, Vol. 274, pp. 191 - 207, October 2014.

Lou Kondic

Transitions in Poiseuille Flow of Nematic Liquid Crystal (with T. Anderson, L. Cummings, and E. Mema), Vol. 75, pp. 15 - 21, DOI: 0.1016/j.ijnonlinmec.2015.04.010, October 2015, Available online May 2015.

Instabilities of Nanoscale Patterned Metal Films (with N. Dong, J, Fowlkes, P. Rack, and Y. Wu), European Physical Journal - Special Topics (EPJ ST), Vol. 224, March 2015.

Three-Dimensional Coating Flow of Nematic Liquid Crystal on an Inclined Substrate (with L. Cummings, M. Lam, and T.-S. Lin), European Journal of Applied Mathematics, DOI: 10.1017/S0956792515000091, April 2015.

Nonlinear Force Propagation During Granular Impact (with R. Behringer, A. Clark, A. Petersen), Physical Review Letters, Vol. 114, February 2015.

Modeling Flow of Nematic Liquid Crystal Down an Incline (with L. Cummings, M. Lam, and T.-S. Lin), Journal of Engineering Mathematics, DOI: 10.1007/s10665-014-9697-2, November 2014.

Capillary Focusing Close to a Topographic Step: Shape and Instability of Confined Liquid Filaments (with S. Afkhami, M. Hein, and R. Seemann), Microfluidics and Nanofluidics, DOI: 10.1007/s10404-014- 1481-0, September 2014.

Interfacial Instability of Thin Ferrofluid Films Under a Magnetic Field (with S. Afkhami and I. Seric), Journal of Fluid Mechanics Rapids, Vol. 755 (9), DOI: 10.1017/jfm.2014.435, August 2014.

Quantifying Force Networks in Particulate Systems (with A. Goullet, M. Kramar, and K. Mischaikow), Physica D: Nonlinear Phenomena, Vol. 283, August 2014.

Electric Field Variations Within a Nematic Liquid Crystal Layer (with C. Cai, L. Cummings, and E. Mema), Physical Review E: Statistical, Nonlinear, and Soft Matter Physics, Vol. 90, July 2014.

Ji Meng Loh

Safety and Efficacy of a 100% Dimethicone Pediculocide in School-Age Children, BMC Pediatrics, Vol. 15, June 2015.

Variable Selection for Inhomogeneous Spatial Point Processes, Canadian Journal of Statistics, Vol. 43 (2), pp. 288 - 305, February 2015.

Mapping Contaminants Associated with Autism: A Public Health Pilot in New Jersey, Journal of Geographic Information System, Vol. 6, pp. 706 - 722, December 2014.

Some Properties of Generalized Fused Lasso and Its Applications to High Dimensional Data, Journal of the Korean Statistical Society, DOI: 10.1016/j.jkss.2014.10.002, October 2014.

A Masking Index for Quantifying Hidden Glitches, Knowledge and Information Systems: An International Journal (KAIS), DOI: 10.1007/s10115-014-0760-0, July 2014.

Victor Matveev

Reduced Endogenous Ca2+ Buffering Speeds Active Zone Ca2+ Signaling (with C. Baade, I. Delvendahl, S. Hallermann, L. Jablonski, and E. Neher), Proceedings or the National Academy of Sciences U.S.A., Vol. 112 (23), May 2015.

Eliza Michalopoulou

Sequential Filtering for Dispersion Tracking and Sediment Sound Speed Inversion (with A. Nattapol), Journal of the Acoustical Society of America, Vol. 136 (5), November 2014.

Cyrill Muratov

Orbital-Free Density Functional Theory of Out-of-Plane Charge Screening in Graphene (with J. Lu and V. Moroz), Journal of Nonlinear Science, DOI: 10.1007/s00332-015-9259-4, June 2015.

Mitigation of Solid Booster Ignition-Over-Pressure Wave by Water Aerosol Sprays (with H. Gafiichuk, M. Khasin, V. Osipov, V. Smelyanskiy, and M. Watson), Journal of Spacecraft and Rockets, Vol. 52, pp. 928 - 943, May 2015.

Energy Barriers for Bit-Encoding States Based on 360-Degree Domain Walls in Ultrathin Ferromagnetic Nanorings (with V. Osipov and E. Vanden-Eijnden), Journal of Applied Physics, Vol. 117, March 2015.

Front Propagation in Geometric and Phase Field Models of Stratified Media (with A. Cesaroni and M. Novaga), Archive for Rational Mechanics and Analysis, Vol. 216, pp 153 - 191, October 2014.

On an Isoperimetric Problem with a Competing Non-Local Term: Quantitative Results (with A. Zaleski), Annals of Global Analysis and Geometry, Vo. 47, pp 63 - 80, August 2014.

George Mytalas

An MX/G/1 Queueing System with Disasters and Repairs Under a Multiple Adapted Vacation Policy (with Michael A. Zazanis), Naval Research Logistics, Vol. 62 (3), April 2015.

Farzan Nadim

Neuromodulation of Neurons and Synapses, Current Opinion in Neurobiology, Vol. 29C, pp. 48 - 56, December 2014.

The Frequency Preference of Neurons and Synapses in a Recurrent Oscillatory Network (with D. Martinez and H. Tseng), Search Results The Journal of Neuroscience, Vol. 34, September 2014.

Frequency Preference in Two-Dimensional Neural Models: A Linear Analysis of the Interaction Between Resonant and Amplifying Currents (with H. Rotstein), Vol. 37, pp. 9 - 28, August 2014.

Peter Petropoulos

Nonlinear Dynamics and Wall Touch-Up in Unstably Stratified Multilayer Flows in Horizontal Channels under the Action of Electric Fields (with L. Barannyk, D. Papageorgiou, and J.-M. Vanden-Broeck), SIAM Journal on Applied Mathematics, Vol. 75 (1), pp. 92 - 113, January 2015.

Horacio Rotstein

Subthreshold Amplitude and Phase Resonance in Models of Quadratic Type: Nonlinear Effects Generated by the Interplay of Resonant and Amplifying Currents, Journal of Computational Neuroscience, Vol. 38 (2), pp. 325 - 354, April 2015.

Frequency Preference in Two-Dimensional Neural Models: A Linear Analysis of the Interaction Between Resonant and Amplifying Currents (with F. Nadim), Vol. 37, pp. 9 - 28, August 2014.

David Shirokoff

Sufficient Conditions for Global Minimality of Metastable States in a Class of Non-Convex Functionals: A Simple Approach Via Quadratic Lower Bounds (with R. Choksi and J.-C. Nave), Journal of Nonlinear Science, Springer, Vol. 25 (3), pp. 539-582, February 2015.

Sundarraman Subramanian

Simultaneous Confidence Bands for Cox Regression from Semiparametric Random Censorship (with S. Mondal), Lifetime Data Analysis, DOI: 10.1007/s10985-015-9323-2, February 2015.

Two-Sample Location-Scale Estimation from Semiparametric Random Censorship Models (with R. Bhattacharya), Journal of Multivariate Analysis, Vol. 132, pp. 25 - 38, August 2014.

Catalin Turc

Regularized Combined Field Integral Equations for Acoustic Transmission Problems (with Y. Boubendir, V. Dominquez Navarra, and D. Levadoux Onera), SIAM Journal on Applied Mathematics, Vol. 75 (3), DOI:10.1137/140964230, May 2015.

High-Order Nyström Discretizations for the Solution of Integral Equation Formulations of Two-Dimensional Helmholtz Transmission Problems (with Y. Boubendir and V. Dominquez), IMA Journal of Numerical Analysis, DOI: 10.1093/imanum/drv010, March 2015.

Integral Equations Requiring Small Numbers of Krylov-Subspace Iterations for Two-Dimensional Penetrable Scattering Problems (with Y. Boubendir, O. Bruno, and D. Levadoux Onera), Applied Numerical Mathematics, Vol 95, DOI: 10.1016/j.apnum.2015.01.005, September 2015.

Antai Wang

Increased Expression of Tumor Proliferation Genes in Hispanic Women with Early-Stage Breast Cancer (with E. Andreopoulou, K.D. Crew, A.M. Desai, H. Greenlee, D.L. Hershman, H. Hibshoosh, Z. Jin, K. Kalinsky, E.A. Lim, M. Maurer, J.A. Sparano, and Y. Tu), Cancer Investigation, Vol. 32, pp.439 - 444, September 2014.

The Identifiability of Competing Risks Models Induced by Bivariate Frailty Models (with K. Chandra, J. Sun, and R. Xu), Scandinavian Journal of Statistics, Theory and Applications, Vol. 42 (2), pp. 427 - 437, June 2015.

Yuan-Nan Young

Efficient Brownian Dynamics Simulation of DNA Molecules with Hydrodynamic Interactions in Linear Flows (with S.-P. Fu and S. Jiang), Physical Review E, Vol. 91, June 2015.

An Immersed Interface Method for Axisymmetric Electrohydrodynamic Simulations in Stokes Flow (with H. Nganguia), Communications in Computational Physics, April 2015.

Electrohydrodynamic Instability of a Capacitive Elastic Membrane (with M. Miksis), Physics of Fluids, Vol. 27 (2), February 2015.

A Hybrid Immersed Boundary and Immersed Interface Method for Electrohydrodynamic Simulations (with W.-F. Hu and M.-C. Lai), Journal of Computational Physics, Vol. 282, pp. 47 - 61, November 2014.

BOOKS AND BOOK CHAPTERS

Wenge Guo

Stepdown Procedures Controlling a Generalized False Discovery Rate (with Sanat Sarkar). Statistical Paradigms: Recent Advances and Reconciliations. Edited by A. Basu, A. SenGupta, and T. Samanta. Statistical Science and Interdisciplinary Research, Vol. 14, pp. 53 - 70. World Scientific, November 2014.

Jay Kappraff

A Participatory Approach to Modern Geometry. World Scientific, September 2014.

Yuan-Nan Young

Multiscale Modeling of Primary Cilia (with L.C. Espinha, A.M. Nguyen, and C.R. Jacobs). In Multiscale Modeling in Biomechanics and Mechanobiology. Edited by S. De, W. Hwang, and E. Kuhl, pp. 87 - 110. Springer, October 2014.

Dynamics of a Primary Cilium in Time-Periodic Flows. In Contemporary Mathematics, Vol. 628, Biological Fluid Dynamics: Modeling, Computations, and Applications. Edited by A. Layton and S. Olson. American Mathematical Society, July 2014.

PROCEEDINGS PUBLICATIONS

Denis Blackmore

Overview of the Unified Localizable Emergency Scale and Its Practical Use (with E. Rohn), 5th International Disaster and Risk Conference (IDRC), Davos, Switzerland, August 2014.

Linda Cummings

Asymptotic Model for Three Dimensional Coating Flow of Nematic Liquid Crystal on an Inclined Substrate (with L. Kondic, M. Lam, and T.-S. Lin), Bulletin of the American Physical Society, Vol. 60, March 2015.

Substrate Induced Gliding for a Nematic Liquid Crystal Layer (with L. Cummings and E. Mema), Bulletin of the American Physical Society, Vol. 60, March 2015.

Free Surface Dynamics of Nematic Liquid Crystal (with L. Kondic, M. Lam, and T.-S. Lin), Bulletin of the American Physical Society, Vol. 59, November 2014.

Sunil Dhar

A Preliminary Fractional Calculus Model of the Aortic Pressure Flow Relationship During Systole (with G. Atlas), Proceedings of ICBES's 14th International Conference on Biomedical Engineering and Systems, August 2014.

Lou Kondic

Asymptotic Model for Three Dimensional Coating Flow of Nematic Liquid Crystal on an Inclined Substrate (with L. Cummings, M. Lam, and T.-S. Lin), Bulletin of the American Physical Society, Vol. 60, March 2015.

Substrate Induced Gliding for a Nematic Liquid Crystal Layer (with L. Cummings and E. Mema), Bulletin of the American Physical Society, Vol. 60, March 2015.

Free Surface Dynamics of Nematic Liquid Crystal (with L. Cummings, M. Lam, and T.-S. Lin), Bulletin of the American Physical Society, Vol. 59, November 2014.

Ji Meng Loh

Empirical Glitch Explanations, 20th ACM SIGKDD Conference on Knowledge Discovery and Data Mining, August 2014.

B. PRESENTATIONS

Shahriar Afkhami

July 2014: 7th International Summer Research Symposium, NJIT, Newark, NJ
Mathematical Modeling of Magnetic Particles in Blood Flow Applied to Magnetic Drug Targeting

July 2014: The Eleventh International Conference for Mesoscopic Methods in Engineering and Science (ICMMES), City College of New York, New York, NY
A Volume-of-Fluid Method for Simulating Fluid/Fluid Interfaces in Contact with Solid Boundaries

Denis Blackmore

August 8, 2014: ASCE Engineering Mechanics Institute 2014 Conference, Hamilton, Ontario, Canada. (presented by my coauthor A. Rosato, with L. Zuo) (invited)
Dilation Contraction Characteristics of a Tapped Granular Column

November 8, 2014: American Mathematical Society Sectional Conference Fall 2014, University of North Carolina, Greensboro, NC. (presented by my coauthor Aminur Rahman)
Further Analysis of Discrete Dynamical Models of the RS Flip-Flop Circuit (invited)

April 2, 2015: Session on Mathematical Modeling and Physical Dynamics of Solitary Waves: From Continuum Mechanics to Field Theories, Ninth IMACS International Conference on Nonlinear Evolution Equations and Wave Phenomena: Computation and Theory, University of Georgia, Athens Georgia. (presented by my coauthor A. Rosato, with D. Horntrop, H. Wu, L. Zuo)
A Simulation and Dynamical Model Study of Waves in 1D Granular Tapping Flows (invited)

May 18, 2015: Minisymposium on Reduced Dynamical Models and Their Applications, SIAM Conference on Applications of Dynamical Systems, Snowbird Resort, Utah
Reduced Models for Granular and Ecological Dynamics

May 18, 2015: Minisymposium on Reduced Dynamical Models and Their Applications, SIAM Conference on Applications of Dynamical Systems, Snowbird Resort, Utah. (presented by my coauthor, Aminur Rahman)
A Scheme for Modeling and Analyzing the Dynamics of Logical Circuits (invited)

May 19, 2015: Minisymposium on Reduced Dynamical Models and Their Applications, SIAM Conference on Applications of Dynamical Systems, Snowbird Resort, Utah. (presented by my coauthor, Hao Wu)
A Novel Semidiscrete Scheme for a Reduced Continuum Flow Model (invited)

May 21, 2015: Center for Nonlinear Studies Seminar, Los Alamos National Laboratory, Los Alamos, NM. (presented by my coauthor Aminur Rahman)
A Scheme for Modeling and Analyzing the Dynamics of Logical Circuits (invited)

June 17, 2015: Dr. Masao Satake Memorial Symposium on Granular Mechanics, Engineering Mechanics International Conference, Stanford University, CA. (presented by my coauthor A. Rosato, with D. Horntrop, H. Wu, L. Zuo)
Overview of Continuum and Discrete Modeling of a Tapped Column (invited)

June 24, 2015 NJIT Graduate Student Seminar, New Jersey Institute of Technology, Newark, NJ. (presented by my coauthor Aminur Rahman)
Neimark-Sacker Bifurcation and Evidence of Chaos in a Discrete Dynamical Model of Walkers

June 5, 2015: Frontiers in Applied and Computational Mathematics (FACM'15), NJIT. (presented by my coauthor A. Rahman)
A Scheme for Modeling and Analyzing the Dynamics of Logical Circuits (Poster)

Michael Booty

April 2015: Computational Complex Analysis for Free Surface Flows and Other Applications, ACCA-UK, London, England
Conformal Mapping Techniques Applied to Interfacial Flow Computations

January 2015: Modern Applications of Complex Variables: Modeling, Theory, and Computation, Banff International Research Station, Banff, Canada
Conformal Mapping Techniques Applied to Interfacial Flow with Soluble Surfactant

Amitabha Bose

June 2015: FACM, NJIT, Newark, NJ
Synchronization Mechanisms in Genetic Oscillator Networks

Bruce Bukiet

July 2014: Toyota-UD Applied Math Initiative, University of Delaware, Newark, DE
Mathematical Modeling of Baseball

July 2014: NJIT Summer Visit Day July 18 and July 25, NJIT, Newark, NJ
Skills Gained in Earning a Degree in NJIT's College of Science and Liberal Arts and Related Career Opportunities

July 2014: Real World Connections, NJIT, Newark, NJ
Math and Statistics in the Real World

Daniel Bunker

August 2014: Ecological Society of America Annual Meeting, Ecological Society of America, Sacramento, CA
Deer Exclosure Impacts on Bee Communities in Northeastern Temperate Forests

Wooyoung Choi

April 2015: Shanghai Jiao Tong University, China
A Theoretical and Experimental Study of Evolving Nonlinear Ocean Waves

April 2015: Seoul National University, Korea
A Combined Theoretical and Experimental Approach to Nonlinear Waves. Part 1. Why and When Do We Need Nonlinearity?

April 2015: Seoul National University, Korea
A Combined Theoretical and Experimental Approach to Nonlinear Waves. Part 2. How Well Can We Describe the Evolution of Nonlinear Ocean Waves?

March 2015: University of Limerick, Ireland
Highly Nonlinear Wave Motions in the Ocean - How Accurately Can Simple Mathematical Models Describe Them?

March 2015: University of Bath, UK
Rayleigh Expansion for Long Waves and its Application to Large Amplitude Internal Waves

March 2015: Loughborough University, UK
Rayleigh Expansion for Long Waves and its Application to Large Amplitude Internal Waves

February 2015: National Institute of Mathematical Sciences, Daejeon, Korea
Connecting the Dots Between Asymptotic Models for Water Waves: from Shallow to Deep Water

December 2014: Workshop on Nonlinear Water Waves, University of of Ibaraki, Mito, Japan
Asymptotic Models Based on Unsteady Stokes and Rayleigh Expansions

September 2014: The First SJTU-U. Tokyo-KAIST Symposium, KAIST, Jeju, Korea
Generalization of Unsteady Stokes Expansion to Wave-Body Interaction Problems

August 2014: National Congress on Fluids Engineering, Korea
Unsteady Stokes Expansion and its Generalization to Wave-Body Interaction Problems

Linda Cummings

March 2015: Morphogenesis, Universite Paris VII (Diderot), Paris, France
Instabilities in Downslope Flow of Nematic Liquid Crystals

March 2015: APS March Meeting, NSF, San Antonio, TX
Asymptotic Model for Three Dimensional Coating Flow of Nematic Liquid Crystal on an Inclined Substrate

March 2015: APS March Meeting, NSF, San Antonio, TX
Electric Field Variation Within a Nematic Liquid Crystal Layer

March 2015: APS March Meeting, NSF, San Antonio, TX
Substrate Induced Gliding for a Nematic Liquid Crystal Layer

March 2015: First International Workshop of ACCA-UK/JP, Imperial College London, London, England
Analysis of Complex Flows: Interacting Instabilities in Downslope Flow of Nematic Liquid Crystal

November 2014: APS DFD Meeting, NSF, San Francisco, CA
Free Surface Dynamics of Nematic Liquid Crystal

November 2014: APS DFD Meeting, NSF, San Francisco, CA
Influence of Particle Shape on Properties of Force Networks in Particulate Systems

November 2014: University of Pennsylvania Seminar, University of Pennsylvania, Philadelphia, PA
Free Surface Instabilities in Nematic Liquid Crystal flow

July 2014: 7th Conference of the International Marangoni Association, IMA/NSF, Vienna, Austria
Instabilities of Liquid Crystal Films

Sunil Dhar

August 2014: International Conference on Biomedical Engineering and Systems, Prague, Czech Republic
A Preliminary Fractional Calculus Model of the Aortic Pressure Flow Relationship during Systole

Casey O. Diekman

June 2015: Penn Sleep-Chronobiology Research Retreat, University of Pennsylvania, Philadelphia, PA
Modeling Circadian Rhythmicity of Cardiac Arrhythmias

June 2015: Biophysics Seminar, University of California, San Diego, San Diego, CA
Multi-Level Organization of the Mammalian Circadian Clock

June 2015: FACM, NJIT, Newark, NJ
Synchronization Mechanisms in Genetic Oscillator Networks

May 2015: Computational Neuroscience Seminar, Brandeis University, Waltham, MA
Multi-level Organization of the Mammalian Circadian Clock

April 2015: Chaos Seminar (MATH 491), NJIT, Newark, NJ
Irregular Activity Arises as a Natural Consequence of Synaptic Inhibition

April 2015: DMS Graduate Seminar (Math 791), NJIT, Newark, NJ
Mathematical Modeling of Circadian Clocks and Binocular Rivalry

November 2014: Society for Neuroscience Annual Meeting, SFN, Washington, D.C.
Eupnea, Tachypnea, and Autoresuscitation in a Closed-Loop Respiratory Control Model

November 2014: Society for Neuroscience Annual Meeting, SFN, Washington, D.C.
Irregular and Uncorrelated Activity Can Arise as a Natural Consequence of Synaptic Inhibition

October 2014: Department of Mechanical and Industrial Engineering Seminar, NJIT, Newark, NJ
Mathematical Modeling of Circadian Clocks and Binocular Rivalry

October 2014: Clocks Club of New England, UMASS Medical School, Worcester, MA
Modeling Circadian Transcription of Ion Channels and Cardiac Arrythmogenesis

October 2014: Department of Mathematics Seminar, University of Scranton, Scranton, PA
Mathematical Modeling of Circadian Clocks and Binocular Rivalry

July 2014: Society for Mathematical Biology Annual Meeting, SMB, Osaka, Japan
Modeling Circadian Transcription of Ion Channels and Cardiac Arrythmogenesis

July 2014: Sapporo Symposium on Biological Rhythms, Hokkaido University, Sapporo, Japan
Modeling Circadian Transcription of Ion Channels and Cardiac Arrythmogenesis

July 2014: SIAM Annual Meeting, SIAM, Chicago, IL
Network Symmetry and Binocular Rivalry Experiments

Thomas Erneux

July 2014: Workshop on "Delay Differential and Difference Equations", Veszprém, Hungary
Delay Differential Equations in Action

August 2014: International Conference on Control of Self-Organizing Nonlinear Systems, Rostock-Warrnemünde, Germany
Controlled Switching Between Time-Periodic Square-Waves

September 2014: Four Lectures at the Autumn School on Laser Dynamics, Szeged, Hungary

October 2014: ITMO University, St Petersburg, Russian Federation
(i) Dynamical Effects in Nonlinear Systems with Feedback: Basic Concepts
(ii) Dynamical Effects in Laser Systems with Optical Feedback: Examples and Applications

May 2015: photonics@be Doctoral School, Ootsduinkerke Belgium
New Trends on Optical Feedback in Photonics
May 2015: Delay Differential Equations in the Physical Sciences and Engineering, The Fields Institute, Toronto, Canada
Time Delay, Excitability, and Multi-Rhythmicity

Roy Goodman

June 2015: International Conference on Mathematics of Nonlinearity in Neural and Physical Science, NYU Shanghai, Shanghai, China
Some Nearly Finite-Dimensional Hamiltonian Dynamics in NLS-Like Systems

August 2014: SIAM Conference on Nonlinear Waves and Coherent Structures, SIAM, Cambridge, UK
Periodic and Relative Periodic Solutions in a Multiple Waveguide System

Wenge Guo

March 2015: ENAR 2015 Spring Meeting, ENAR, Miami, FL
Fallback Type FDR Controlling Procedures for Testing a Priori Ordered Hypotheses

November 2014: 2014 IMPACT Symposium III, Durham, NC
Improving Holm's Procedure Using Pairwise Dependencies

September 2014: Biostatistics Seminar, New York University Langone Medical Center, New York, NY
On Procedures Controlling the False Discovery Rate for Testing Hierarchically Ordered Hypotheses

August 2014: 2014 Joint Statistical Meetings, Boston, MA
Testing of Hierarchically Structured Families of Hypotheses with Multidimensional Directional Decisions

Claus Holzapfel

June 2014: Evenari Symposium, Sde Boqer, Israel (invited keynote):
Novel Plant Communities in Arid Lands: the Role of Climate Change and Annual Plant Invasion

David Horntrop

July 2014: SIAM Annual Meeting, SIAM, Chicago, IL
Variance Reduction in the Simulation of Stochastic Differential Equations

July 2014: SIAM Annual Meeting, SIAM, Chicago, IL
Research and Training in Computational and Data-Enabled Science and Engineering for Undergraduates in the Mathematical Sciences at NJIT

Shidong Jiang

November 2014: 67th Annual Meeting of the APS Division of Fluid Dynamics, American Physical Society, San Francisco, CA
A Fast Multipole Method and a Metropolis Method for Coarse-grained Brownian Dynamics Simulations of a DNA with Hydrodynamic Interactions

Lou Kondic

May 2015: DARPA Dynamics, Geometry and Big Data Sets Workshop, Washington, D.C.
Statics and Dynamics of Granular Force Networks

March 2015: Morphogenesis, Universite Paris VII (Diderot), Paris, France
Instabilities in Downslope Flow of Nematic Liquid Crystals

March 2015: APS March Meeting, NSF, San Antonio, TX
Asymptotic Model for Three Dimensional Coating Flow of Nematic Liquid Crystal on an Inclined Substrate

March 2015: APS March Meeting, NSF, San Antonio, TX
Electric Field Variation Within a Nematic Liquid Crystal Layer

March 2015: APS March Meeting, NSF, San Antonio, TX
High Speed Impacts on a Granular Material

March 2015: APS March Meeting, NSF, San Antonio, TX
Percolation and Jamming Transitions in Particulate Systems With and Without Cohesion

March 2015: APS March Meeting, NSF, San Antonio, TX
Scaling of Force Networks for Compressed Particulate Systems,

March 2015: APS March Meeting, NSF, San Antonio, TX
Substrate Induced Gliding for a Nematic Liquid Crystal Layer

March 2015: Colloquium, University Carlos III, Madrid Spain
Films, Rings and Rivulets: Instabilities of Liquid Metals on Nanoscale

March 2015: First International Workshop of ACCA-UK/JP, Imperial College London, London, England
Analysis of Complex Flows: Interacting Instabilities in Downslope Flow of Nematic Liquid Crystal

November 2014: APS DFD Meeting, NSF, San Francisco, CA
Free Surface Dynamics of Nematic Liquid Crystal

November 2014: APS DFD Meeting, NSF, San Francisco, CA
Granular Impact at High Mach Number
November 2014: APS DFD Meeting, NSF, San Francisco, CA
Influence of Particle Shape on Properties of Force Networks in Particulate Systems

November 2014: APS DFD Meeting, NSF, San Francisco, CA
Instabilities of Structured Metal Films on Nanoscale

November 2014: University of Pennsylvania Seminar, University of Pennsylvania, Philadelphia, PA
Free Surface Instabilities in Nematic Liquid Crystal flow

October 2014: Northeastern Granular Materials Workshop, Yale University, New Haven, CT
Mechanical Response of Granular Matter Exposed to Impact

August 2014: PASI on Frontiers in Particulate Media: From Fundamentals to Applications, NSF, La Plata, Argentina
Evolution of Force Networks in Granular Media

August 2014: PASI on Frontiers in Particulate Media: From Fundamentals to Applications, NSF, La Plata, Argentina
Structure of Contact and Force Networks in Dense Granular Matter: From Percolation to Persistence

July 2014: 8th European Nonlinear Dynamics Conference, Euromech, Vienna, Austria
Asymptotic Models for Liquid Crystal Films

July 2014: 7th Conference of the International Marangoni Association, IMA/NSF, Vienna, Austria
Asymptotic Models for Liquid Crystal Films

July 2014: 7th Conference of the International Marangoni Association, IMA/NSF, Vienna, Austria
Instabilities of Liquid Crystal Films

Ji Meng Loh

August 2014: Joint Statistical Meeting, American Statistical Association, Boston, MA
A Masking Index for Quantifying Hidden Data Glitches

July 2014: 3rd Asia Pacific Rim Meeting, Institute of Mathematical Statistics, Taiwan
Bayesian Estimation of the Intensity of Inhomogeneous Point Patterns

Victor Matveev

June 2015: FACM, NJIT, Newark, NJ
Extension of Rapid Buffering Approximation to Calcium Buffers with Multiple Binding Sites

May 2015: Neurizons 2015, Göttingen, Germany
Reduced Endogenous Ca2+ Buffering Speeds Active Zone Ca2+ Signaling
February 2015: Biophysical Society 59th Annual Meeting, Baltimore, MD
Extension of Rapid Buffering Approximation to Calcium Buffers with Multiple Bonding Sites

October 2014: Mathematical Biology Seminar, NJIT, Newark, NJ
Modeling Cell Ca2+ Dynamics: Challenges and Open Problems

August 2014: Gordon Research Conference on Synaptic Transmission, Waterville Valley, NH
Presynaptic Calcium Dynamics at Cerebellar Mossy Fiber Boutons

Eliza Michalopoulou

October 2014: Meeting of the Acoustical Society of America, Acoustical Society of America, Indianapolis, IN
Particle filtering for robust modal identification and sediment sound speed estimation

May 2015: Meeting of the Acoustical Society of America, Acoustical Society of America, Pittsburgh, PA
Direct Inversion for Sediment Sound Speed in Ocean Acoustics

March 2015: ONR Peer Review Workshop, Slidell, MS
Inversion in Ocean Acoustics

Richard Moore

August 2014: SIAM Conference on Nonlinear Waves and Coherent Structures, University of Cambridge, Cambridge, UK
Localized Solutions and Travelling Waves in a Nonlocal Parametrically Forced Nonlinear Schrodinger Equation

Cyrill Muratov

April 2015: Materials Working Group Seminar, Courant Institute of Mathematical Sciences, New York, NY
1-D Domain Walls in Thin-Film Ferromagnets

April 2015: PDE Seminar, University of Connecticut, Storrs, CT
On Shape of Charged Drops

March 2015: Applied Math Seminar, Bristol University, Bristol, UK
Low density phases in a uniformly charged liquid

February 2015: Applied Mathematics Colloquium, Courant Institute of Mathematical Sciences, New York, NY
Low Density Phases in a Uniformly Charged Liquid

February 2015: Kinken Theory Seminar, Institute for Materials Research, Tohoku University, Sendai, Japan
Winding Domain Walls in Thin Ferromagnetic Films

January 2015: Kyushu Symposium on PDEs, Kyushu University, Fukuoka, Japan
Asymptotic Properties of Ground States of a Semilinear Elliptic Problem with a Vanishing Parameter

January 2015: Workshop on Recent Trends in Traveling Waves, Tokyo University, Tokyo, Japan
Multiplicity of Supercritical Fronts for Reaction-Diffusion Equations in Cylinders

December 2014: Analysis Seminar, Courant Institute of Mathematical Sciences, New York, NY
Orbital-Free Density Functional Theory of Out-of-Plane Charge Screening in Graphene

October 2014: 59th Annual Magnetism and Magnetic Materials, NSF, Honolulu, HI
Energy Barriers for Bit-Encoding States Based on 360-Degree Domain Walls in Ultrathin Ferromagnetic Nanorings

October 2014: Conference on Nonlinearity, Transport, Physics, and Patterns, Fields Institute, Toronto, Canada
Low Density Phases in a Uniformly Charged Liquid

September 2014: Workshop on Homogenization and Random Phenomenon, Mittag-Leffler Institute, Stockholm, Sweden
Front Propagation in Geometric and Phase Field Models of Stratified Media

August 2014: Oberseminar in Analysis, Max Planck Institute for Mathematics in the Sciences, Leipzig, Germany
Front Propagation in Geometric and Phase Field Models of Stratified Media

August 2014: Workshop on Micromagnetics: Analysis and Applications, University of Heidelberg, Heidelberg, Germany
Winding Domain Walls in thin Ferromagnetic Films

July 2014: 10th AIMS Conference on Dynamical Systems, Differential Equations and Applications, NSF, Madrid, Spain
Threshold Phenomena for Symmetric Decreasing Solutions of Reaction-Diffusion Equations

George Mytalas

June 2015: CRS/INFORMS, INFORMS, Canada
An M/G/1 Queue System with Delayed Feedback and Server Vacations

November 2014: 18th INFORMS Annual meeting Conference, INFORMS, San Francisco, CA
An M/G/1 Queue System Subject to Disasters and Server Breakdowns

August 2014: First European Conference on Queueing Theory, Gent, Belgium
An M/G/1 Queueing Model with a Gated Service and Impatient Customers

Horacio Rotstein

June 2015: FACM, NJIT, Newark, NJ
Synchronization Mechanisms in Genetic Oscillator Networks

David Shirokoff

June 2015: CAIMS Conference, Waterloo, Ontario
A Fourier Penalty Method for Partial Differential Equations on Irregular Domains

April 2015: University Colloquium at University of Delaware, Newark, DE
High Order Penalty Methods: a Fourier Approach to Solving PDE's on Irregular Domains

March 2015: SIAM CSE 2015, Salt Lake City, UT
High-Order Fourier-Penalty Methods for PDEs on Irregular Domains

February 2015: NJIT Faculty Research Showcase, NJIT, Newark, NJ
Navigating Energy Landscapes

September 2014: Faculty Seminar for Graduate Students, NJIT, Newark, NJ
Computational Mathematics with a Focus on Three Open Problems

Michael Siegel

May 2015: Recent Advances in Applied and Computational Mathematics, Huazhong University of Science and Technology, Wuhan, China
Analysis and Computations of the Initial Value Problem for Hydroelastic Waves

April 2015: Computational Complex Analysis for Free Surface Flows and Other Applications, ACCA-UK, London, England
Conformal Mapping Techniques Applied to Interfacial Flow Computations

January 2015: Modern Applications of Complex Variables: Modeling, Theory, and Computation, Banff International Research Station, Banff, Canada
Ill-Posedness of a Truncated Series Model for Water Waves via Complex Analysis

January 2015: Modern Applications of Complex Variables: Modeling, Theory, and Computation, Banff International Research Station, Banff, Canada
Conformal Mapping Techniques Applied to Interfacial Flow with Soluble Surfactant

October 2014: Numerical Analysis Seminar, University of Delaware, Newark, DE
Analysis and Computations of the Initial Value Problem for Hydroelastic Waves

August 2014: SIAM Conference on Nonlinear Waves and Coherent Structures, Cambridge, UK
Analysis and Computations of the Initial Value Problem for Hydroelastic Waves

July 2014: SIAM Annual Meeting: Minisymposium on Dynamics of Biological Membranes, SIAM, Chicago, IL
A Numerical Method for Induced-Charge Electrokinetic Flow with Deformable Interfaces

July 2014: SIAM Annual Meeting: Minisymposium on Recent Advances in Interfacial Dynamics and its Applications, SIAM, Chicago, IL
An Overlapping Patch Boundary Integral Method for Dynamic Interface Problems

Sundarraman Subramanian

April 2015: New York University School of Medicine, New York, NY
Simultaneous Confidence Bands for Survival Functions in Cox Regression Framework

August 2014: Joint Statistical Meetings, American Statistical Association, Boston, MA
Simultaneous Confidence Bands from Two-Sample Censored Data

August 2014: Joint Statistical Meetings, American Statistical Association, Boston, MA
Two-Sample Location-Scale Estimation from Semiparametric Random Censorship Models

August 2014: Joint Statistical Meetings, American Statistical Association, Boston, MA
Model-Assisted Cox Regression, Part II: Simultaneous Confidence Bands

Ronald Sverdlove

September 2014: Conference on Globalization, Bubbles, and Too Big to Fail, Leir Center for Financial Bubble Research, Ridgefield, Connecticut
Globalization and the Growth in Derivatives Markets and Global Financial Interconnectedness

Catalin Turc

September 2014: Applied Mathematics Seminar, Auburn University, Auburn, AL
Well-Conditioned Boundary Integral Equation Formulations for the Solution of High-Frequency Electromagnetic Scattering Problems

July 2014: 10th AIMS Conference on Dynamical Systems, Differential Equations and Applications, NS, Madrid, Spain
Well-Conditioned Boundary Integral Equation Formulations for the Solution of High-Frequency Electromagnetic Scattering Problems

Antai Wang

December 2014: TIES 2014 Education Technology Conference, Guangzhou University and Chinese Society of Environmental and Resources Statistics, Guangzhou, China
The Identifiability of Dependent Competing Risks Models Induced by Bivariate Frailty Models

November 2014: NYU School of Medicine, New York, NY
The Identifiability of Competing Risks Models Induced by Bivariate Frailty Models

August 2014: 2014 JSM, American Statistical Association, Boston, MA
The Identifiability of Dependent Competing Risks Models Induced by Bivariate Frailty Models

July 2014: 2014 ICSA China Statistics Conference, Academy of Applied Statistical Science (AASS) at ECNU, Shanghai, China
Properties of the Marginal Survival Functions for Dependent Censored Data under an Assumed Archimedean Copula

Yuan-Nan Young

June 2015: 4th Northeast Complex Fluids and Soft Matter Workshop, Stony Brook University, Stony Brook University, Long Island, NY
Hydrodynamics of a Lipid Bilayer Membrane: Fluid Dynamics in Cell Biology

December 2014: SCPDE (Scientific Computing and Partial Differential Equations) 2014, Department of Mathematics, Hong Kong Baptist University, Hong Kong
An Immersed Interface Method for Axisymmetric Electrohydrodynamic Simulations in Stokes Flow

November 2014: 67th Annual Meeting of the APS Division of Fluid Dynamics, American Physical Society, San Francisco, CA
Electrohydrodynamic Instability of a Capacitive Elastic Incompressible Membrane

November 2014: 67th Annual Meeting of the APS Division of Fluid Dynamics, American Physical Society, San Francisco, CA
A Fast Multipole Method and a Metropolis Method for Coarse-grained Brownian Dynamics Simulations of a DNA with Hydrodynamic Interactions

November 2014: 67th Annual Meeting of the APS Division of Fluid Dynamics, American Physical Society, San Francisco, CA
Coupling a Mechanosensitive Channel with a Vesicle under Shear Flow

November 2014: 67th Annual Meeting of the APS Division of Fluid Dynamics, American Physical Society, San Francisco, CA
Immersed Interface Method for Drop Electrohydrodynamics

July 2014: Workshop on Transport of Ionic Particles in Biological Environments, Fields Institute, Toronto, Canada
Modeling the Electro-Hydrodynamics of a Leaky Lipid Bilayer Membrane: Continuum vs. Coarse-Grained Modeling

July 2014: Workshop on Cerebral Blood Flow (CBF) and Models of Neurovascular Coupling, Fields Institute, Toronto, Canada
Mechanical Coupling Between Cell Membrane and a Transmembrane Protein

Joseph Zaleski

June 2015: Penn Sleep-Chronobiology Research Retreat, University of Pennsylvania, Philadelphia, PA
Modeling Circadian Rhythmicity of Cardiac Arrhythmias

C. TECHNICAL REPORTS

REPORT 1415-1: *An $M^X/G/1$ Queueing System with Disasters and Repairs under a Multiple Adapted Vacation Policy*
G.C. Mytalas, M.A. Zazanis

REPORT 1415-2: *Dynamics of Vortex Dipoles in Anisotropic Bose-Einstein Condensates*
R.H. Goodman, P.G. Kevrekidis, R. Carretero-Gonzalez

REPORT 1415-3: *Convergence of a Boundary Integral Method for 3D Interfacial Darcy Flow with Surface Tension*
M. Siegel, D.M. Ambrose

REPORT 1415-4: *A Hybrid Numerical Method for Interfacial Flow with Soluble Surfactant and its Application to an Experiment in Microfluidic Tipstreaming*
M.R. Booty, M. Siegel, S.L. Anna

REPORT 1415-5: *Semiparametric Simultaneous Confidence Bands for the Difference of Survival Functions Using Empirical Likelihood*
N. Ahmed, S. Subramanian

REPORT 1415-6: *Single-Index Model for Inhomogeneous Spatial Point Processes*
Y. Fang, J.M. Loh

REPORT 1415-7: *Bandwidth Selection for Estimating the Two-Point Correlation Function of a Spatial Point Pattern Using AMSE*
W. Jang, J.M. Loh

REPORT 1415-8: *Fast Food and Liquor Store Density, Co-Tenancy, and Turnover: Vice Store Operations in Chicago, 1995-2008*
N.O. Kwate, J.M. Loh

REPORT 1415-9: *Mathematical Model of Cardiovascular and Metabolic Responses to Umbilical Cord Occlusions in Fetal Sheep*
Q. Wang, N. Gold, M.G. Frasch, H. Huang, M. Thiriet, S. Wang

REPORT 1415-10: *Debye Potentials for the Time Dependent Maxwell Equations*
L. Greengard, T. Hagstrom, S. Jiang

REPORT 1415-11: *Computing the Ground State and Dynamics of the Nonlinear Schrodinger Equation with Nonlocal Interactions via the Nonuniform FFT*
W. Bao, S. Jiang, Q. Tang, Y. Zhang

REPORT 1415-12: *On the Integral Equation Derived from the Linearized BGK Equation for the Steady Couette Flow*
S. Jiang, L.-S. Luo

REPORT 1415-13: *Bifurcation Analysis of Gilet's Walking Droplet Model*
A. Rahman, D. Blackmore

REPORT 1415-14: *Dynamical Modeling and Analysis of RS Flip-Flop Circuits*
A. Rahman, D. Blackmore

REPORT 1415-15: *On the Dimension of the Set of (Positive) Solutions of Nonlinear Equations with Applications*
P. S. Milojevic

VI. EXTERNAL ACTIVITIES AND AWARDS

A. FACULTY ACTIVITIES AND AWARDS

Shahriar Afkhami

Panel review member for grants: National Science Foundation Graduate Research Fellowship Program, ACS Petroleum Research Fund

FACM 2015 Organizing Committee, co-chair

Ph.D. Advisor: Kyle Mahady, Ivana Seric, Valeria Barra

Denis Blackmore

Associate Editor, Mechanics Research Communications (2007 -)

Editorial Board, Editorial Board of the Universal Journal of Physics and Application (2015 -)

Editorial Board, Atlantis/Springer Advanced Book Series: Studies in Mathematical Physics: Theory and Applications (Editor-in-Chief, Norbert Euler), (2011 -)

Editorial Board, Journal of Nonlinear Mathematical Physics (2010 -)

Editorial Board, Recent Patents in Space Technology (2009 -)

Editorial Board, Differential Equations and Applications (2008 -)

Editorial Board, Regular and Chaotic Dynamics (2006 -)

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

Served on one NSF panel and reviewed proposal for Swiss National Science Foundation

Reviewed 30 journal paper manuscripts and two advanced mathematics books.

Co-organized Minisymposium on Reduced Dynamical System and Their Applications at the SIAM Conference on Applications of Dynamical Systems, Snowbird Resort, Utah, May 17-21, 2015.

MAA (New Jersey Section) Award for Distinguished College or University Teaching of Mathematics, January, 2015.

Linda Cummings

Organizing Committee, 31st Annual MPI (Mathematical Problems in Industry) workshop, University of Delaware, June 2015

FACM 2015 Organizing Committee, member

Editorial Advisory Board, Quarterly Journal of Mechanics & Applied Mathematics

Associate Editor, IMA Journal of Applied Mathematics (2011 - present)

Casey O. Diekman

Institute partner meeting representative: Mathematical Biosciences Institute, Ohio State University, Columbus, OH, February 2014

Javier Diez

Vice-director of "Centro de Investigaciones en Fìsica e Ingenierìa del Centro de la Provincia de Buenos Aires (CIFICEN)" (Research Center of CONICET and UNCPBA)

Director of "Instituto de Fìsica Arroyo Seco (IFAS)" (Research Center of Facultad de Ciencias Exactas, UNCPBA)

Wenge Guo

Editorial Board of PLOS ONE

Editorial Board of the Journal of Biometrics and Biostatistics

Editorial Board of Calcutta Statistical Association Bulletin

Zoi-Heleni Michalopoulou

Associate Editor, Journal of the Acoustical Society of America

Horacio Rotstein

Program Committee Member, International Neural Network Society & IEEE Computational Intelligence

Guest Editor, Chaos, an Interdisciplinary Journal of Nonlinear Science, "Focus Issue on Rhythms and Dynamic Transitions in Neurological Disease: Modeling, Computation and Experiment" (with T. Kaper and M. Kramer)

Richard O. Moore

2014-2015: Advisor, SIAM Student Chapter at NJIT

Organizing Committee, 31st Annual MPI (Mathematical Problems in Industry) workshop, University of Delaware, June 2015

Cyrill Muratov

Associate Editor, Networks and Heterogeneous Media

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 2015

B. FACM 2015 CONFERENCE: FRONTIERS IN APPLIED AND COMPUTATIONAL MATHEMATICS

The twelfth conference on Frontiers in Applied and Computational Mathematics (FACM 2015) was held at the New Jersey Institute of Technology on June 5-6. This year it had two main focus areas, one on mathematics applied to problems in fluid dynamics, including fluids that are active, biological, or complex, flocking and swarming, numerical algorithms, and waves in fluids and media. The second focus area was on applied statistics and biostatistics, particularly as regards the emerging area of big data.

This year's FACM conference included a special minisymposium in honor of Denis Blackmore's contributions to vortex dynamics, which was organized by Stefan Llewellyn Smith of UCSD. The timing was fortuitous, coinciding with Denis's 70th Birthday (many happy returns, Denis). Morten Brons, who is a long term colleague and coauthor of work on vortex dynamics with Denis, visited from the Technical University of Denmark to contribute to the minisymposium.

The conference had over 140 total participants, and featured 92 minisymposium talks, many of which were given by junior faculty who are among the best of young researchers in the mathematical sciences. Contributed talks by postdocs and graduate students were also selected from a large number of applications and were presented in the same sessions as the invited talks, thereby giving them a chance to showcase their research results. In addition to the talks, there were 29 posters on a variety of research topics.

The plenary speakers and talks for the conference were given by:

- Jean-Luc Thiffeault, of the University of Wisconsin - Madison, on "*Particle Fluctuations Induced by Microswimmers".*
- Anne Juel, of the University of Manchester, on *"Interfacial Instabilities on the Pore Scale".*
- Randall J. LeVeque, of the University of Washington - Seattle, on *"Numerical Methods for Tsunami Modeling and Hazard Assessment".*
- Xiao-Li Meng, of Harvard University, on *"Is it a Computing Algorithm or a Statistical Procedure: Can You Tell or Do You Care?".*

The organizing committee for this year's conference was Shahriar Afkhami (Co-Chair), Yuan-Nan Young (Co-Chair), Linda Cummings, Lou Kondic, Ji Meng Loh, Jonathan Luke, Michael Siegel, Stefan Llewellyn Smith (External Organizer, UCSD).

Introductory Remarks by Atam P. Dhawan, Vice Provost for Research

Welcome Remarks by Jonathan Luke, DMS Chair

Michael Siegel, CAMS Director

Group Photo, FACM'15

VII. FUNDED RESEARCH

A. EXTERNALLY FUNDED RESEARCH

CONTINUING FUNDED PROJECTS

A New Computational Method for Viscoelastic Two-phase Flows
National Science Foundation, Division of Mathematical Sciences, Computational Mathematics: September 1, 2013 - August 31, 2016
Shahriar Afkhami

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, 2014
Denis Blackmore (PI at NJIT), Anthony Rosato (Co-PI at NJIT), Xavier Tricoche (PI at Purdue)

Numerical Methods and Analysis for Interfacial Fluid Flow with Soluble Surfactant
National Science Foundation - Division of Mathematical Sciences: October 1, 2010 - September 30, 2014
Michael Booty (Co-PI), Michael Siegel (PI), Yuan-Nan Young (Co-PI)

Linear Conductance-Based Mechanisms Underlying Oscillations in Neuronal Networks
National Science Foundation: October 1, 2011 - September 30, 2015
Amit Bose

Efficient Methods for Electromagnetic and Acoustic Problems
National Science Foundation: July 15, 2013 - June 30, 2016
Yassine Boubendir

Hybrid Algorithms for Wave Propagation
National Science Foundation: September 15, 2010 - August 31, 2014
Yassine Boubendir

Collaborative Research: Expanding Links with Industry Through Collaborative Research and Education in Applied Mathematics
National Science Foundation - Division of Mathematical Sciences: April 1, 2013 - March 31, 2016
Linda Cummings (PI), Richard Moore (Co-PI)

Modeling and Analysis of Nematic Films: Flow-Substrate Interactions
National Science Foundation - Division of Mathematical Sciences: August 1, 2012 - July 31, 2015
Linda Cummings (PI), Lou Kondic (Co-PI)

Collaborative Research: The MPI workshop and GSMM Camp
National Science Foundation - Division of Mathematical Sciences: March 1, 2012 - Feb 28, 2015
Linda Cummings

Applications of Complex Variables: Modeling, Theory & Computation
Banff International Research Station: September 2013 - January 2015
Linda Cummings, Stefan Llewellyn-Smith (UCSD), Paul Martin (Colorado School of Mines), Bartosz Protas (McMaster University)

Collaborative Research: New Directions for Research on Some Large-Scale Multiple Testing Problems
National Science Foundation: July 15, 2013 - June 30, 2016
Wenge Guo

Experimental and Computational Study of the Instabilities, Transport, and Self-Assembly of Nanoscale Metallic Thin Films and Nanostructures
National Science Foundation: September 1, 2012 - August 31, 2015
Lou Kondic

CREATIV: Nonlinear Data Reduction Applied to Dense Granular Media
National Science Foundation: September 15, 2012 - August 31, 2015
Lou Kondic, Konstantin Mischaikow (Rutgers), and Robert Behringer (Duke)

Pan-American Advanced Study Institute (PASI) Conference on Frontiers in Particulate Media: From Fundamentals to Applications
National Science Foundation: January 1, 2013 - December 31, 2014
Lou Kondic and Robert Behringer (Duke)

Microstructure, Fluidization and Control of Penetrator Trajectories in Granular Media
Department of Defense Basic and Applied Sciences Directorate, April 16, 2010 - September 30, 2014
Lou Kondic, Robert P. Behringer (Duke University), Corey O'Hern (Yale University), and Wolfgang Losert (University of Maryland)

Efficient Inversion in Ocean Acoustics with Iterative, Sequential, and Analytical Methods
Office of Naval Research: January 1, 2013 - December 31, 2015
Zoi-Heleni Michalopoulou

Collaborative Research: Mathematical and Computational Methods for Stochastic Systems in Nonlinear Optics
National Science Foundation: September 1, 2011 - August 31, 2015
Richard O. Moore

Winding Domain Walls in Thin Ferromagnetic Films
National Science Foundation: September 1, 2009 - August 31, 2014
Cyrill Muratov

Collaborative Research: Dynamics of Morphogen Gradients
National Science Foundation: October 1, 2011 - September 30, 2015
Cyrill Muratov

Deterministic and Stochastic Magnetization Dynamics in Thin Ferromagnetic Films and Devices
National Science Foundation: July 1, 2013 - June 30, 2016
Cyrill Muratov

Modeling and Numerical Study of Explosive Boiling in Well-Wetting Fluids Under Microgravity
University Space Research Association (NASA): April 1, 2014 - August 31, 2014
Cyrill Muratov

Mechanisms of Frequency Preference in Neurons and Networks: Biophysics and Dynamics
National Science Foundation: September 1, 2013 - August 31, 2016
Horacio Rotstein

Collaborative Research: Efficient Surface-Based Numerical Methods for 3D Interfacial Flow with Surface Tension
National Science Foundation: October 1, 2010 - September 30, 2014
Michael Siegel (PI), David Ambrose (Drexel, Co-PI)

Efficient Integral Equation Solvers for Large-Scale Frequency Domain Electromagnetic Scattering Problems
NSF Applied Mathematics: September 1, 2013 - August 31, 2016
Catalin Turc

MIMO Radar Clutter Modeling Phase II, STTR Phase II
Air Force Office Scientific Research: February 1, 2014 - January 31, 2016
Catalin Turc (Co-PI, with MathSys Inc.), STTR Phase II,

Analysis of Survival Data using Copula Models
National Science Foundation: July 1, 2013 – June 30, 2015
Antai Wang (PI)

Mathematical and Experimental Study of Lipid Bilayer Shape and Dynamics Mediated by Surfactants and Proteins
National Science Foundation-Mathematical Sciences Division: September 15, 2012 - August 31, 2015
Yuan-Nan Young (PI)

CONTINUING FUNDED TRAINING PROGRAMS

INTERDISCIPLINARY UNDERGRADUATE PROGRAM IN NANOTECHNOLOGY AT NJIT: Linking K-12 Through Graduate Education via Nanotechnology
National Science Foundation: January 1, 2014 - December 31, 2015
Zoi-Heleni Michalopoulou, Raquel Perez-Castillejos, John Carpinelli, Haim Grebel, and Somenath Mitra

EXTREEMS-QED: Research and Training in Computational and Data-Enabled Science and Engineering for Undergraduates in the Mathematical Sciences at NJIT
National Science Foundation: September 1, 2013 - August 31, 2018
Michael Siegel, David Horntrop, Ji Meng Loh, Zoi-Heleni Michalopoulou, and Marvin Nakayama

PROJECTS FUNDED DURING THE PRESENT ACADEMIC/FISCAL YEAR

Provost Undergraduate Summer Research Award: NJIT. Dynamics of Logical Circuits (with Ian Jordan).
June - July, 2015.
Denis Blackmore

McNair Scholar Program: Dynamical System Analysis of a One-dimensional Walking Droplet Model (with Leila Wooten). June - July, 2015.
Denis Blackmore

Modeling Circadian Clock Mechanisms from Synapse to Gene
National Science Foundation: July 1, 2014 - June 30, 2017
Casey Diekman

Mathematics of Biological Timekeeping
Simons Foundation: September 1, 2014 - August 31, 2019
Casey Diekman

Collaborative Research: Efficient High-Order Parallel Algorithms for Large-Scale Photonics Simulation
National Science Foundation: August 15, 2014 - July 31, 2017
Shidong Jiang

Numerical Methods and Analysis for Electrokinetic Flow with Deformable Interfaces
National Science Foundation: August 1, 2014 - July 31, 2017
Michael Booty (Co-PI), Michael Siegel (PI), Yuan-Nan Young (Co-PI)

CAMS MEMBER EXTERNALLY FUNDED PROJECTS -- NOT THROUGH CAMS

Neurocomputational Properties of Mammalian Clock and Non-Clock Neurons
Burroughs Wellcome Fund: January 1, 2013 - December 31, 2014
Casey Diekman

Inestabilidades en Peliculas Liquidas Conformadas: Formacion de Gotas Submilimetricas y Nanometricas
Consejo Nacional de Investigaciones Cientificas y Tecnicas (CONICET, Argentina): July 2013 - July 2015
Javier Diez

Formación de Patrones por Inestabilidad de Películas Líquidas Hasta Escalas Nanométricas
Agencia Nacional de Promoción de la Ciencia y la Tecnología (ANPCyT, Argentina): July 2013 - July 2015
Javier Diez

B. PROPOSED RESEARCH

PROJECTS PROPOSED DURING PRESENT FISCAL YEAR

Electromagnetic Field Shaping of Liquid Lenses
National Science Foundation-EPMD: July 1, 2015 - June 30, 2018
Shahriar Afkhami

Non-Overlapping Finite Element Simulations of Turbulent Flows Around Rotating Wind Turbines
National Science Foundation: July 1, 2015 - June 30, 2018
Yassine Boubendir

GOALI: New Mathematical Models for Membrane Filters
National Science Foundation: July 1, 2015 - June 30, 2018
Linda Cummings (PI), Lou Kondic (Co-PI)

Multisensory Integration by Circadian Clocks
Army Research Office: September 1, 2015 - August 31, 2018
Casey Diekman

REU Supplement to: Modeling Circadian Clock Mechanisms from Synapse to Gene
National Science Foundation: July 1, 2015 - June 30, 2016
Casey Diekman (Co-PI)

Collaborative Research: Computations, Modeling and Experiments of Self and Directed Assembly of Nanoscale Liquid Metal Systems
National Science Foundation: July 1, 2015 - June 30, 2018
Lou Kondic (Pi), Shahriar Afkhami (Co-PI)

Collaborative Research: Computational and Data-Enabled Science and Engineering
National Science Foundation: July 1, 2015 - June 30, 2019
Lou Kondic

Single Index Modeling and Dimension Reduction for Spatial Point Patterns
National Security Administration: July 1, 2015 - June 30, 2017
Ji-Meng Loh

Studying New York City's Fast Food Environment Using New Statistical Methods for Spatial Point Patterns
National Institutes of Health: July 1, 2015 - June 30, 2018
Ji-Meg Loh

New Methods for Modeling Inhomogeneous Spatial Point Patterns with an Application to Public Health
National Science Foundation: July 1, 2015 - June 30, 2018
Ji-Meng Loh

New Approaches to Analyzing Gene Expression Data with Application to Uterine Leiomyoma
National Science Foundation: July 1, 2015 - June 30, 2018
Ji-Meng Loh (PI), Antai Wang (Co-PI), Wenige Guo (Co-PI)

Formula for Maximum Standard Deviation
American Society for Testing and Materials E29.01 Subcommittee on Sieves
Ji-Meng Loh

Spatial Analysis of Neighborhood Changes and Health
National Institutes of Health: July 1, 2015 - June 30, 2017
Ji-Meng Loh

Spatial Analysis of Stop and Frisk Patterns
National Institutes of Health: July 1, 2015 - June 30, 2017
Ji-Meng Loh

NRT-DESE Collaborative Research and Teaching in Core Statistical, Mathematics and Computing Competencies
National Science Foundation: July 1, 2015 - June 30, 2019
Ji-Meng Loh

Cell Calcium Dynamics
National Science Foundation: July 1, 2015 - June 30, 2018
Victor Matveev

Collaborative Research: Optimal Control and Assimilation in Uncertain Flows
National Science Foundation - CMMI(SDC): July 1, 2015 - June 30, 2018
Richard Moore

A Spectral Mass Gauging Concept for Large-Scale Cryogenic Propellant Tanks
National Aeronautics and Space Administration: July 1, 2015 - February 29, 2016
Cyrill Muratov

Oscillatory Patterns in Networks of Relaxation Oscillators: Interplay of the Dynamic Properties of Nodes and Connectivity
National Science Foundation: July 1, 2015 - June 30, 2018
Horacio Rotstein

Fourier Penalty Methods for Irregular Domains and Interface Problems
National Science Foundation: July 1, 2015 - June 30, 2018
David Shirokoff

Penalty Methods and Computational Material Science
Simons Foundation
David Shirokoff

Conferences on Frontiers in Applied and Computational Mathematics 2015-2017
National Science Foundation: July 1, 2015 - June 30, 2018
Michael Siegel

Accurate and Efficient Boundary Integral Methods
National Science Foundation: July 1, 2015 - June 30, 2018
Michael Siegel (PI), David Ambrose (Co-PI)

Innovative Physics-Based Modeling Tool for Application to Passive Radio Frequency Identification System on Rotorcraft
Air Force Office of Scientific Research: July 1, 2015 - June 30, 2018
Catalin Turc

New Strategies to Analyze Survival Data Using Frailty Models and Nonparametric Methods
National Security Administration: July 1, 2015 - June 30, 2017
Antai Wang

New Strategies to Analyze Survival Data Using Frailty Models and Nonparametric Methods
National Science Foundation: July 1, 2015 - June 30, 2018
Antai Wang (PI), Sundarraman Subramanian (Co-PI)

New Strategies to Analyze Survival Data Using Frailty Models and Nonparametric Methods
National Institutes of Health: July 1, 2015 - June 30, 2017
Antai Wang

New Approaches to Analyzing Genomic Data with Application to Uterine Leiomyoma
National Institutes of Health: July 1, 2015 - June 30, 2018
Antai Wang (PI), Ji-Meng Loh (Co-PI), Wenge Guo (Co-PI)

Biological Membranes in Electrolytes: Electrokinetic Effects on Membrane Properties, Dynamics and Transport
National Science Foundation-CBET: July 1, 2015 - June 30, 2018
Yuan-Nan Young

Collaborative Research: Mechanics and Mechanobiology of the Primary Cillium and its Role in Cellular Mechanotransduction
National Science Foundation: July 1, 2015 - June 30, 2018
Yuan-Nan Young

EarthCube 1A: Collaborative Proposal
National Science Foundation: October 1, 2015 - October 1, 2017
Yuan-Nan Young

VIII. COMMITTEE REPORTS AND ANNUAL LABORATORY REPORT

A. COMPUTER FACILITIES

High quality facilities supporting numerical computation are essential for the Department of Mathematical Sciences (DMS) and the Center for Applied Mathematics and Statistics (CAMS) at NJIT to fulfill their educational and research missions. Thus DMS and CAMS, with the help of SCREMS, CSUMS, UBM, and MRI grants from the NSF, together with the generous support of NJIT, have maintained the CAMS Math Computation Laboratory (CMCL) for the research needs of their members since 1989.

Computational support provided by CMCL takes the form of the workstations and desktop PC's that are made available in faculty, postdoctoral associate, and student offices, which are networked, plus other more major, shared facilities of the CMCL.

The current major computational facilities of the CMCL consist of two clusters, "Gorgon" and "Stheno".

DMS has expanded its Stheno cluster in a sequence of stages since its first server, Stheno-1, became operational in November 2011. In the year covered by this report, department funds were used to purchase two IBM iDataPlex dx360 servers in June 2015. This cluster is intended to be used to test (or debug) and run MPI (message-passing interface) codes.

Specific details of this year's expansion of the Stheno cluster, for the technically-minded, are as follows:

* Server 1, Stheno-5, has: 1 node with 2 NVIDIA Tesla K20 GPUs. The node has 2 CPUs (Intel Xeon E5-2660 processors, 2.2 GHz, 25 MB cache, 1866MH), each with 10 cores, making a total of 20 CPU cores. RAM total is 128 GB (DDR3, 1866MHz, LP RDIMM). Each of the two GPUs has 2668 cores, with a maximum rate of 3950 Gflops, and 6GB of RAM. The networking technology is 10GigE (i.e., 10 Gigabit) Ethernet, and node interconnect is Intel QDR InfiniBand. The server's local disk storage is 500GB (IBM).

* Server 2, Stheno-4, has: 2 nodes, each with two 6-core CPUs (Intel Xeon E5-2630 processors, 2.3GHz, 15MB cache, 1333MH), making a total of 24 CPU cores. The networking technology is 10GigE Ethernet, and node interconnect is Intel QDR InfiniBand. RAM total is 256 GB (DDR3, 1333MHz, LP RDIMM). The server's local disk storage is 1TB (IBM).

Stheno-3 and Stheno-5 are the two servers of the cluster that contain GPUs. These are currently CUDA (compute unified device architecture) capable, and are intended for general-purpose computation on GPU-accelerated computing nodes.

The successive upgrades from Stheno-1 to Stheno-5 bring the current Stheno cluster totals to 32 nodes and 392 CPU cores, with 3.84 TB of RAM, and 9.872 TB local disk storage.

Since 2010, DMS also has its own "Gorgon" cluster, which is intended for jobs that require large memory, and for parallel computations that use OpenMP, i.e., the Open Multi-Processing application programming interface. Like Stheno, Gorgon has been expanded in stages since it first became operational. Gorgon is now a 32 core system, with AMD Opteron 6134 processors running at 2.3 GHz, and a total of 64GB of shared memory.

The two clusters are maintained by NJIT's Academic and Research Computing Systems (ARCS) group, which is headed by Dr. David Perel as Director of ARCS.

In the broader domain, beyond DMS and CAMS, NJIT began in 1998 to make a commitment to support the scientific and engineering computing that is essential to research work across the campus by providing all faculty members and graduate students access to centralized servers for research purposes. The main NJIT cluster is "Kong", which recently received a substantial upgrade as part of a significant donation of computer equipment to NJIT from Linode. Linode is a Linux-based cloud hosting company based in Galloway, New Jersey.

* The upgrade, Kong-7, was completed in May 2015, and consists of 314 nodes, each with two 4-core CPUs (Intel Xeon L5520 processors, 2.27GHz). RAM total is 20.096TB. Manufacturer is Supermicro.

The Kong cluster now has a total of 359 nodes, 2812 CPUs, 22.704TB of RAM, and a disk storage of 318.8TB. Processors are all AMD Opteron or Intel Xeon models, with speeds from 2.2GHz to 2.8GHz. It also features two 2-GPU nodes (NVIDIA Tesla K20x) with 20 CPU cores per node. Each GPU has 2688 cores, with a peak performance double precision rate of 1.31Tflops, and 6GB of RAM.

B. STATISTICAL CONSULTING LABORATORY REPORT (July 2014 - June 2015)

The Statistical Consulting Lab serves the NJIT community and various external organizations as clients. It aims to offer high quality statistical consulting for the purposes of promoting research, collaboration, and statistical education. Here are some examples of consulting activities in the past year:

Throughout the year, Ji Meng Loh met with NJIT graduate students to discuss statistical issues related to their research projects. Examples include Poisson distributions for the rain attenuation of THz electromagnetic waves, analysis of variance for repeated measures for longitudinal biological data, and machine learning methods for data mining and bioinformatics.

Consulting activities with external organizations include:

Date: March 2015
Client: Ken Beyer (ASTM Standards Committee for Sieves)
Description: Derive thresholds for quality control of sieves based on new standards.
Consultants: Ji Meng Loh and PhD student Yalin Zhu.

Date: January 2015
Client: Francisco Artigas (New Jersey Meadowlands Commission - Environmental Research Institute)
Description: Analysis of water velocity, turbidity, and depth data collected from 7 NJ creeks. Consultant: Ji Meng Loh.

Date: July 2014
Client: Francisco Artigas (New Jersey Meadowlands Commission - Environmental Research Institute)
Description: Analysis of Mercury data
Consultant: Ji Meng Loh

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, Diekman, Golowasch, Holzapfel, Nadim, Matveev, Miura, Muratov, Perez, Rotstein, Russell, Siegel, Tao, and Young.

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, Huang, Jiang, Kondic, Luke, Papageorgiou, Petropoulos, Rosato, Shirokoff, 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, asymptotic 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, and Vanden-Broeck), thin films (Cummings, Diez, and Kondic), electrohydrodynamics (Papageorgiou, Petropoulos, and Vanden-Broeck), hydrodynamic stability theory (Papageorgiou), sedimentation (Luke), granular flow (Kondic and Rosato) and combustion (Bechtold, Booty, and Bukiet). A particular focus for several of the faculty members (Afkhami, Booty, Choi, Cummings, Huang, Kondic, Papageorgiou, Siegel, Vanden-Broeck, Wang, Wylie, and 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, Petropoulos, and Turc.

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 and Catalin Turc develop multi-scale and efficient 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 occurring 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, Boubendir, Bukiet, Choi, Goodman, Horntrop, Jiang, Kondic, Luke, Matveev, Michalopoulou, Moore, Muratov, Papageorgiou, Petropoulos, Rosato, Shirokoff, Siegel, Tao, Turc, 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: Dhar, Dios, Guo, Johnson, Loh, Subramanian, and Wang.

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 Ji Meng Loh.

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

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 computational and mathematical modeling of real-life engineering phenomena including biomedical systems, polymers and plastics, microfluidics, and nanomaterials. His current research thrusts include studies of existence of solutions, flow stability, asymptotic behavior, and singularities of complex flow problems. Currently, he is working on 3D computations of drop dynamics and breakup in polymer processing, microfluidics, and electrowetting. Motivated by biomedical and pharmaceutical applications, Shahriar Afkhami has been studying the dynamics of magnetic particles in a blood flow for drug delivery applications. His current materials related projects involve directed assembly of metallic nanostructures.

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.

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 nonpremixed 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.

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 50 dynamical systems (PDEs), particle dynamics, phyllotaxis, virtual reality systems, vortex dynamics, and weak shock waves.

Victoria Booth

Victoria Booth is interested in applying mathematical modeling techniques to further our understanding of the brain. Her research focuses on different spatial and temporal scales of brain function, from single neuron spiking, to activity of large-scale spiking neuron networks, to networks of interacting neuronal populations. The consistent theme of her research is to utilize mathematical modeling to understand the physiological

mechanisms generating experimentally observed neural activity, thus providing the neuroscience community with quantitative support of experimental hypotheses and a rigorous theoretical framework for exploring and developing experimentally-testable predictions. Mathematically, understanding the mechanisms generating specific model behaviors requires complete analysis of stable and unstable solutions to the nonlinear ordinary differential equations of the model system. For this analysis, she utilizes numerical simulations and analysis techniques from dynamical systems, singular perturbation theory and bifurcation theory.

Currently, her research activities are primarily concentrated in two major directions: construction and analysis of mathematical models of the sleep-wake regulatory network and investigation of the interactions of single neuron properties and network structure on spatio-temporal activity patterns in large-scale spiking neuron network models.

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, including heat transfer, chemical, and electromagnetic effects. His studies on combustion have focused on time-dependent and multidimensional dynamics of 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 faculty of the Department of Chemistry and Environmental Science at NJIT. Current research interests include: studies on interfacial flows with surfactants, elastic membranes, and electrostatic fields (with Michael Siegel and Yuan-Nan Young), and thermal waves in microwave heating and processing (with Greg Kriegsmann).

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.

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-PI.

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 wide and varied experience in statistical consulting.

Casey Diekman

Casey Diekman uses a combination of mathematical modeling, numerical simulation, and dynamical systems analysis to gain insight into biological systems. He is currently focused on creating a mathematical framework to understand how dynamic changes in gene expression affect the electrical properties of neurons and ultimately animal behavior. Circadian (~24-hour) rhythms offer one of the clearest examples of the interplay between these different levels of organization, with rhythmic gene expression leading to daily rhythms in neural activity, physiology and behavior. Diekman develops mathematical models of the master circadian clock in the mammalian brain. These models and the mathematical theory associated with them have led to counterintuitive predictions that have since been validated experimentally by his collaborators. The primary goal of his research program in mathematical biology is to uncover mechanisms underlying biological timekeeping, neuronal rhythm generation, and the disruption of rhythmicity associated with certain pathological conditions including sleep disorders, Alzheimer's disease, breathing problems, and ischemic stroke.

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 differential 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. Another area of application is the interaction of vortices in Bose-Einstein condensates.

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 generalized error rates in large-scale multiple testing. Their main applications are on bioinformatics and computational biology. His current research projects include estimate 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.

Ji Meng Loh

Ji Meng Loh's primary research interest is in spatial statistics, in particular the analysis of spatial point patterns. He has developed methods for bootstrap of spatial data, anomaly detection and assessing data quality. Ji Meng has worked on statistical applications in many fields including cosmology, public health, fMRI analysis and telecommunication.

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. Micromechanic 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 single valued and multivalued nonlinear maps, and Hammerstein equations. He has widely applied these abstract 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 techniques, 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 electrophysiological 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.

David Shirokoff

David Shirokoff's research focuses on two main areas. (i) Numerical methods for fluid dynamics in the presence of irregular boundaries and interfaces, and (ii) Numerical methods for the simulation and characterization of materials governed by energy driven pattern formation. In the first area, his developments include

reformulations of the Navier-Stokes equations as pressure-Poisson systems for improved accuracy and efficiency in fluid dynamics computations, and active high order penalty methods as a means to improve the accuracy and efficiency of Fourier based methods that are used to solve PDEs on irregular geometries. In the second area, of computational materials science, his interests focus on designing new numerical techniques to characterize the underlying energy landscape. The techniques rely on replacing a complicated energy with a simpler, convex one, which can then be minimized using tools from optimization theory to systematically obtain low energy states for use in thermodynamic simulations.

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.

Ronald Sverdlove

Ronald Sverdlove's research interests are in the areas of corporate finance, fixed income securities, and the overlap of the two. In the fixed income area, he studies the Credit Default Swap (CDS) market and its relations to the bond and stock markets. He uses price data in all three markets to determine the effectiveness of models for predicting future prices. In corporate finance, he studies how corporations make decisions about various aspects of their financing, in particular the seniority level of newly issued bonds. A second corporate decision is the relative importance of using "soft" or "hard" information in deciding on investments to be made. Hard information consists of those things that can be objectively measured in a reproducible way, while soft information is more subjective and often based on personal relationships. Different kinds of institutions make different choices between the two. Current work considers contracts that corporations offer to creators of intellectual property for the purchase of that property and the reasons for the existence of contingent payments in those contracts. A third type of corporate decision is particularly relevant in the financial industry, where institutions must decide how to structure themselves according to the regulations that will apply to each possible structure. Current work involves modeling the process by which a financial institution makes the decision whether or not to become a regulated bank, trading off the ability to offer deposit insurance to customers against the reduced amount of risk and leverage that can be used by an unregulated institution. Techniques of game theory are used to analyze many of these decisions involving negotiations between two or more institutions.

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.

Catalin Turc

Catalin Turc's research interests belong to the broad area of computational electromagnetics and acoustics. The main goal is the design and implementation of numerical methods that can be used for efficient simulation of electromagnetic and acoustic wave interactions with complex material structures. During the past few years, he has worked on a variety of problems related to fast, high-order frequency domain integral equation methods for acoustic and electromagnetic scattering problems in domains with complex material and geometrical features. He has developed analytical and computational tools that enable solutions for problems of fundamental significance involving applications such as electromagnetic interference and compatibility (electronic circuits), dielectric/magnetic coated conductors, composite metamaterials (photonic crystals and negative index materials), and solar cells.

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.

Antai Wang

Antai Wang's research mainly focuses on survival data analysis, high dimensional data analysis and cancer data analysis. Currently his research goal is to develop new strategies to model dependent censored data or multivariate survival data using frailty models, copula models and nonparametric methods. For high dimensional data, Antai develops new methodologies to conduct variable selections for longitudinal data based on a Procrustes criterion which is used to extract data information while keeping the original data structure. The new research strategies are important and useful for correlated survival data analysis and microarray data analysis in medical research.

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

Liquid Metal on Surfaces, Lou Kondic (NJIT) and Philip Rack (Univ. Tennessee)

Dynamics of Ferrofluidic Systems, Amir Hiras (RPI)

Shape and Instability of Confined Liquid Filaments, Lou Kondic (NJIT) and Ralf Seemann (Saarland University)

Moving Contact Line Problems, Stephane Zaleski (UPMC Paris 6)

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

Denis Blackmore

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

Magnetic Reconnection, K. Urban (NJIT)

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 - Especially Strange Attractors and Logic Circuits, Y. Joshi (Kingsborough) and A. Rahman (NJIT)

Dynamics of a forced van der Pol equation, J. Tavantzis (NJIT Emeritus)

4D vortex dynamics, B. Shashikanth (New Mexico State)

Michael Booty

Numerical Methods and Analysis for Interfacial Fluid Flow with Surfactant, and Electrokinetic Flow for Deformable Interfaces, Michael Siegel (NJIT), Yuan-Nan Young (NJIT), Qiming Wang (York University, Ontario, Canada), and Jacek Wrobel (Tulane).

Magnetic Field Assisted Assembly for the Manufacture of Integrated Circuits, Anthony.T. Fiory (Physics, NJIT) and N.M. Ravindra (Physics, NJIT).

Sunil Dhar

Optimal Scheduling for Controlling Prostate Cancer under Intermittent Androgen Suppression, with: Hans R. Chaudhry (Biomedical Engineering, NJIT), Bruce Bukiet (Mathematical Sciences, NJIT), Zhiming Ji (Mechanical

and Industrial Engineering, NJIT), Nan Guo (Biological Sciences, Rutgers Newark), and Thomas W. Findley (Physical Medicine and Rehabilitation, Rutgers New Jersey Medical School)

Evaluation of Epidural Catheters among Various Brands in the Presence of a Control Group, with: Antonio Gonzalez (Anesthesiology, Rutgers New Jersey Medical School), Rebecca Scholl (Anesthesiology, Rutgers New Jersey Medical School), Robert Horvath (Materials Science and Engineering, Rutgers University, New Brunswick), Nubyra Ahmed (Mathematical Sciences, NJIT), and Vanny Le (Anesthesiology, Rutgers New Jersey Medical School)

Casey O. Diekman

Dynamics of the Mammalian Circadian Clock, M. Belle and H. Piggins (University of Manchester)

Roy Goodman

Interaction of Vortices in Bose-Einstein Condensates, Panayotis Kevrekidis (Massachusetts) and Ricard Carretero (San Diego State)

Instability and Dynamics of Nonlinear Waves, Jeremy Marzuola (North Carolina) and Michael Weinstein (Columbia)

Wenge Guo

New Directions for Research on Some Large-Scale Multiple Testing Problems, Sanat Sarkar (Temple University)

The Control of Directional Errors in Stepwise Procedures under Dependence, Joseph Romano (Stanford University)

Control of the False Discovery Rate in Statistical Process Control, Jun Li (University of California, Riverside)

Multiple Testing Procedures for Multiple Pairwise Comparisons in Genomic Studies, Shyamal Peddada (National Institute of Environmental Health Sciences)

David J. Horntrop

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

Shidong Jiang

Fast and Accurate Evaluation of Nonlocal Coulomb and Dipole-Dipole Interactions via the Nonuniform FFT, L. Greengard (Courant Institute, New York University) and W. Bao (National University of Singapore)

The Solution of the Scalar Wave Equation in the Exterior of a Sphere, L. Greengard (Courant Institute, New York University) and T. Hagstrom (Southern Methodist University)

On the Integral Equation Derived from the Linearized BGK Equation for the Steady Couette Flow, L. Luo (Old Dominion University)

Lou Kondic

Dense Granular Systems and Topology, Robert Behringer (Duke University), Konstantin Mischaikow (Rutgers University)

Breakup of Finite Fluid Films and Rivulets, Javier Diez, Alejandro Gonzalez (UNCPBA, Argentina)

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

Ji Meng Loh

Iterative Cleaning of Data. Laure Berti-Equille (Qatar Computing Research Institute) and Tamraparni Dasu (AT&T Labs)

Sampling Design for Spatial Data. Zhengyuan Zhu (Iowa State University) and Chunyip Yau (Chinese University of Hong Kong)

Health impact of NYC Stop-and-Frisk. Naa-Oyo Kwate (Rutgers University)

Single-Index Modeling for Spatial Point Processes. Yixin Fang (New York University)

Bandwidth Selection for Correlation Estimation in Spatial Point Processes. Woncheol Jang (Seoul National University, South Korea)

Victor Matveev

Dynamics of Neurotransmitter Release in Mammalian Cerebellar Synapses, S. Hallermann (Carl-Ludwig Institute for Physiology, Leipzig University, Germany)

Dynamics of Calcium-Controlled Insulin Release in Pancreatic Beta-Cells, M.-G. Pedersen (University of Padova, Italy) and A. Sherman (NIH)

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

Zoi-Heleni Michalopoulou

Passive Fathometer Processing for Reflector Tracking, Peter Gerstoft and Caglar Yardim (Scripps Institution of Oceanography, UCSD)

Signal Propagation in Dispersive Waveguides, Leon Cohen (Hunter College, CUNY)

Richard O. Moore

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

Data Assimilation with Directed Observations, Damon MacDougall (University of Texas) Christopher K. R. T. Jones (University of North Carolina)

Cyrill Muratov

Modeling and Analysis of Morphogen Dynamics, P. V. Gordon (University of Akron) and S. Y. Shvartsman (Princeton University).

Pattern Formation in Micromagnetics, G. Chaves (NJIT) and H. Knuepfer (University of Heidelberg, Germany).

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

Geometric Variational Problems for Systems with Competing Short-Range and Long-Range Interactions, H. Knuepfer (University of Heidelberg, Germany) and M. Novaga (University of Pisa, Italy)

Modeling the Behavior of Cryogenic Fluids in the Context of Rocket Propulsion, V. Osipov and V. Smelyanskiy (NASA Ames Research Center).

Ground States for Classical and Quantum Systems, Jianfeng Lu (Courant Institute for Mathematical Sciences) and Vitaly Moroz (Department of Mathematics, Swansea University, UK).

Horacio Rotstein

Frequency Preference in Neuron and Neuronal Networks, Farzan Nadim (NJIT), Nancy Kopell (Boston University), John White (University of Utah), Gyorgy Buzsaki (NYU Medical School)

Dynamics of Networks of Relaxation Oscillators, Irving Epstein (Brandeis University)

Effect of Ionic Conductance Correlations on Neuronal Network Activity, Jorge Golowasch (NJIT)

David Shirokoff

High Order Accuracy Solutions to the Navier-Stokes Equations via Pressure Poisson Reformulations and Related Time Stepping Issues. Benjamin Seibold (Temple University), Dong Zhou (Temple University), and Ruben Rosales (MIT)

Fourier Methods for the Solution of Partial Differential Equations on Irregular (Smooth) Domains by Active Penalty Methods. Ryan Galagusz (McGill University) and Jean-Christophe Nave (McGill University)

Sharp interface numerical methods for material structures with non-local energies. Cyrill Muratov (NJIT)

Michael Siegel

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

Efficient Surface-Based Numerical Methods for 3D Interfacial Flow with Surface Tension. David Ambrose (Drexel), Carlo Fazioli (Drexel)

Antai Wang

Survival Analysis Methods Applied to Optimal Scheduling for Controlling Prostate Cancer under Intermittent Androgen Suppression, with: Hans R. Chaudhry (Biomedical Engineering, NJIT) and Thomas W. Findley (Physical Medicine and Rehabilitation, Rutgers New Jersey Medical School)

Yuan-Nan Young

Mechanical Coupling Between a Mechano-Sensitive Channel (Mscl) and Membrane Dynamics, on Shun Pak and Howard Stone (Princeton University), Shravan Veerapaneni (University of Michigan)

Temperature-Controlled Growth of Nano Rods, Sangwoo Shin and Howard Stone (Princeton University)

Electrically Actuated Swimmer, Shravan Veerapaneni (University of Michigan) and Petia Vlahovska (Brown University)

X. STUDENT ACTIVITIES

A. UNDERGRADUATE ACTIVITIES

Zoi-Heleni Michalopoulou, Director of Undergraduate Studies

Report on Undergraduate Studies

The undergraduate program of the Department of Mathematical Sciences was very active during the past academic year and enjoyed many successes.

One of its highlights has been the NSF-funded EXTREEMS program, which began in September 2013 and has now entered its second year and taken in its second student cohort. The PI is Michael Siegel and the Program Director is David Horntrop. Students in each year's cohort begin their research projects in January and complete them in December of the same year. The seven students of the first cohort began their research projects in January 2014 under the guidance of Shidong Jiang, Eliza Michalopoulou, and Richard Moore. The students were Jake Brusca, Shan Fung, Daniel Meldrim, Jacob Moorman, Armando Rosa, Fremy Santana, and Thomas Tu. The second cohort, which began conducting research in January 2015, consists of nine students: Andres Alban, Hardik Darji, Atsuki Imamuram, Joseph Ballardo, Jonathan Dougherty, Nilanjan Haldar, Josef Mohrenweiser, Michael Rivera, and William Ruys. Their research mentors are Casey Diekman, David Horntrop, Bill Morokoff (industry mentor, from Standard & Poor's Financial Services), and Marvin Nakayama (Computer Science Department, NJIT).

From the first EXTREEMS cohort, Jacob Moorman presented his research on "Target Tracking in the Ocean" at the SIAM Conference on Computational Science and Engineering in March 2015. Jacob Moorman, together with Jake Brusca and Shan Fung, each presented their research in poster format at the NJIT Undergraduate Research Showcase in July 2014 as well.

Many additional students have been involved in research since July 2014, and they have presented and published their work. Of these, for example, Timothy Barnes attended an REU at Purdue University in the summer of 2014, and Angelo Taranto is currently pursuing an REU in summer 2015 at the Miami University, Ohio. Joseph Zaleski completed his project on "Mathematical Modeling of Daily Rhythms and Cardiac Arrhythmias" under the guidance of Casey Diekman, and he will soon be starting his doctoral studies at RPI.

Several students in the Mathematics of Finance and Actuarial Science concentration are currently pursuing internships. MetLife and the various service arms of Prudential Financial are frequent destinations for these, but some students intern at consulting firms. Recent examples include Mercer Consulting, Oliver Wyman Actuarial Consulting, and Advisors Capital Management. Other destinations for recent internships include Bank of America, TIAA-CREF, and the United Health Group. This year, Anna Jezewska was the recipient of a CAMAR Actuarial Scholarship. The Casualty Actuaries of the Mid-Atlantic Region - CAMAR - scholarship is awarded on a competitive basis to two students each year among nominated candidates from the seven undergraduate actuarial programs that are situated in the New Jersey-Philadelphia area. About ten students passed actuarial exams in the past year.

This year's Pi Mu Epsilon Induction Ceremony took place on April 24, 2015. The inductees were Timothy Barnes, Lucas Lamb, Jacob Moorman, Erich Nething, Fremy Santana, Christopher Skwarko, Thomas Tu, and Wilbur Vale.

Many students who graduate from our program continue either to enter graduate programs at other prestigious institutions or find gainful employment. In the latter group, many find employment in the finance and actuarial science industry, often within the New York metropolitan area.

Students at the April 2015 Pi Mu Epsilon Induction Ceremony

B. GRADUATE PROGRAMS

Overview by Linda Cummings, Director of the Graduate Program

The graduate programs of the Department of Mathematical Sciences continue to build on their recent successes. In addition to the ongoing success of our four MS programs, in Applied Mathematics, Applied Statistics, Biostatistics, and Mathematical & Computational Finance, our PhD program continues to attract high-caliber students who carry out cutting-edge research with our faculty.

Our PhD students have an impressive collective record of presenting their research, thereby gaining exposure on a national and international stage. Each year we send our students to high-profile international meetings such as the APS meetings, SIAM meetings, and meetings of the Acoustical Society of America, where their work brings credit to the department and NJIT. In addition, almost all of our students present posters or talks at the annual Frontiers in Applied and Computational Mathematics conference, which is described in Section VIB of this report. The PhD students organize their own summer seminar series, in which each research-active student makes a presentation. The department also hosts an active SIAM Student Chapter, with Richard Moore as its Faculty Advisor.

Our PhD students are strongly encouraged to publish their work in quality peer-reviewed journals, and most have two papers or sometimes more accepted for publication by the time of their graduation. A full list of our students' accomplishments in conference presentations and peer-reviewed publications follows.

Our graduates continue to succeed in their careers post-NJIT, with recent non-academic destinations for our PhD graduates including Google, HSBC, Oak Ridge National Laboratory, and Merck.

PhDs Awarded in the Period Covered by the Report

Ahmed, Nubyra
Thesis: Methods for two-sample comparisons from censored time-to-event data (May 2015)
Advisor: Sundarraman Subramanian

Grandhi, Anjana
Thesis: Multiple testing procedures for complex structured hypotheses and directional decisions (May 2015)
Advisors: Wenge Guo, Ji-Meng Loh

Midura, Dawid
Thesis: Efficient domain decomposition algorithms for the solution of the Helmholtz equation (August 2014)
Advisor: Yassine Boubendir

Mondal, Shoubhik
Thesis: Confidence bands for survival curves using model assisted cox regression (August 2014)
Advisor: Sundarraman Subramanian

Varfolomiyev, Oleksiy
Thesis: An efficient boundary integral method for stiff fluid interface problems (May 2015)
Advisors: Michael Siegel, Michael Booty

NJIT graduate students, from left to right, Szu-Pei Fu, Ivana Seric, Kyle Mahady, Valeria Barra, and Ensela Mema, at the NCS3 Workshop, NJIT January 2015

Publications, Presentations, & Conferences (not including FACM Participation)

Valeria Barra

Poster Presentations

October 2014: GSA Graduate Students Research Day, NJIT
Interfacial Instability of Thin Viscoelastic Liquid Films (with Shahriar Afkhami)

March 2015: SIAM Computational Science and Engineering meeting, in Salt Lake City, UT
Numerical Study of Thin Viscoelastic Films on Substrates (with Shahriar Afkhami)

Conference Participation

March 2015: SIAM Computational Science and Engineering meeting, in Salt Lake City, UT
SIAM Students Days, Student Representative for SIAM Student Chapter at NJIT

Lenka Kovalcinova

Presentations

January 2015: The 3rd Northeast Complex Fluids and Soft Matter Workshop (NCS3), NJIT
Scaling of Force Networks for Compressed Particulate Systems

March 2015: APS March Meeting, San Antonio
Scaling of Force Networks for Compressed Particulate Systems

April 2015: Dana Knox Research Showcase, NJIT (poster award, 3rd place)
Percolation in Compressed Particulate Systems

June 2015: The 4th Northeast Complex Fluids and Soft Matter Workshop (NCS4), Stony Brook
Scaling of Force Networks for Compressed Particulate Systems

Michael Lam

Publications

Three-Dimensional Coating Flow of Nematic Liquid Crystal on an Inclined Substrate (M. A. Lam, T.-S. Lin, L. J. Cummings, and L. Kondic), European Journal of Applied Mathematics, DOI: 10.1017/S0956792515000091, April 2015.

Modeling Flow of Nematic Liquid Crystal Down an Incline (M. A. Lam, T.-S. Lin, L. J. Cummings, and L. Kondic), Journal of Engineering Mathematics, DOI: 10.1007/s10665-014-9697-2, November 2014.

Poster Presentation

April 2015: Dana Knox Research Showcase, NJIT

Three-dimensional flow of nematic liquid crystal on an incline (M. A. Lam, L. J. Cummings, and L. Kondic)

Ensela Mema

Publications

Electric field variations within a nematic liquid crystal layer (Cummings, L. J., Mema, E., Cai, C., Kondic, L.), Physical Review E - Statistical, Nonlinear, and Soft Matter Physics, Vol. 90 (1), July 2014.

Transitions in Poiseuille flow of nematic liquid crystal (Anderson, T.G., Mema, E., Kondic, L., Cummings, L.J.), International Journal of Nonlinear Mechanics, Vol. 75, pp. 15 - 21, January 2015.

Poster Presentations

March 2015: APS March Meeting, San Antonio, Texas
Electric field variation within a nematic liquid crystal layer
(Cummings, L. J., Mema, E., Cai, C., Kondic, L.)

April 2015: Dana Knox Research Showcase, NJIT
Substrate induced gliding for a nematic liquid crystal layer
(Mema, E., Cummings, L. J., Kondic, L.)

Presentation

March 2015: APS March Meeting, San Antonio, Texas
Substrate induced gliding for a nematic liquid crystal layer
(Mema, E., Cummings, L. J., Kondic, L.)

Workshop Presentations

April 2015: Applied Math Days at Rensselaer Polytechnic Institute
Substrate induced gliding for a nematic liquid crystal layer (Mema E., Cummings, L. J., Kondic, L.)

January 2015: NCS3, Northeast Complex Fluids and Soft Matter Workshop, NJIT
Substrate induced gliding for a nematic liquid crystal layer (Mema E., Cummings, L. J., Kondic, L.)

Matthew Moye

Workshop Presentation

June 2015: Journal Club presentation.
Introduction to data assimilation and synopsis of research article
Dynamical estimation of neuron and network properties I: Variational methods by Toth et al.

Aminur Rahman

Publication

A Mechanical Analog of the Two-Bounce Resonance of Solitary Waves: Modeling and Experiment (with M. Bellanich, R. Goodman, and C. Morrison), Chaos: An Interdisciplinary Journal of Nonlinear Science, Vol. 25, April 2015.

Invited Presentations

May 2015: A Scheme for Modeling and Analyzing the Dynamics of Logical Circuits. Center for nonlinear studies seminar. Los Alamos National Laboratory, Los Alamos, NM.

May 2015: A Scheme for Modeling and Analyzing the Dynamics of Logical Circuits. SIAM Dynamical Systems 2015. Snowbird, UT.

March 2015: A Mechanical Analog and Discrete Modeling of the n-bounce Resonance of Solitary Waves. AMS Spring Sectional 2015. Georgetown University, Washington DC.

November 2014: Further Analysis of Discrete Dynamical Models of the RS flip-flop Circuit. AMS Fall Sectional 2014. University of North Carolina - Greensboro, Greensboro, NC.

Pejman Sanaei

Presentations

June 2015: Mathematical Problems in Industry (MPI), MPI Fellow's presentation, University of Delaware
Mathematical Modeling of Membrane Filtration

June 2015: The 4th Northeast Complex Fluids and Soft Matter Workshop (NCS4), SUNY Stony Brook
Flow and Fouling in a Pleated Membrane Filter

November 2014: 67th Annual Meeting of the American Physical Society Division of Fluid Dynamics, San Francisco, CA
Simplified Model for Flow and Fouling of a Pleated Membrane Filter

Poster Presentations

April 2015: Dana Knox Student Research Showcase, NJIT
Flow and Fouling in a Pleated Membrane Filter

April 2015: Applied Math Days at Rensselaer Polytechnic Institute
Effect of Filter Membrane Morphology on Separation Efficiency

January 2015: The 3rd Northeast Complex Fluids and Soft Matter Workshop (NCS3) at NJIT
Effect of Filter Membrane Morphology on Separation Efficiency

Ivana Seric

Publication

Interfacial Instability of Thin Ferrofluid Films Under a Magnetic Field (with S. Afkhami and L. Kondic), Journal of Fluid Mechanics Rapids, Vol. 755 (9), DOI: 10.1017/jfm.2014.435, August 2014.

Presentation

November 2014: 67th Annual Meeting of the American Physical Society Division of Fluid Dynamics, San Francisco, CA
Volume of fluid simulations of liquefied metal nanofilms with Marangoni effects (with K. Mahady, S. Afkhami, and L. Kondic)

January 2015: The 3rd Northeast Complex Fluids and Soft Matter Workshop (NCS3), NJIT
Interfacial Instability of Thin Ferrofluid Films Under a Magnetic Field (with S. Afkhami, and L. Kondic)

Graduate Student Poster Presentations at FACM 2015

Zeynep Akcay, currently at Queensborough Community College, CUNY. *Creation of Bistable Phase Locking Solutions in Recurrent Neuronal Networks Through Short-Term Synaptic Depression*.

Valeria Barra. *Numerical Study of Thin Viscoelastic Films on Substrates.*

Rui Cao. *A Hybrid Numerical Method for Electro-Osmotic Flow with Deformable Interfaces.*

Michael Lam. *Saffman-Taylor Instability of Complex Fluids in a Hele-Shaw Cell.*

Randolph Leiser. *Effects of Coupling on Beta Cells and Relaxation Oscillators.*

Haiyang Qi. *Numerical Methods for Two-Dimensional Helmholtz Transmission Problems.*
Aminur Rahman. *A Scheme for Modeling and Analyzing the Dynamics of Logical Circuits.*

Oleksiy Varfolomiyev. *An Efficient Boundary Integral Method for Stiff Fluid Interface Problems.*

MPI Workshop 2015

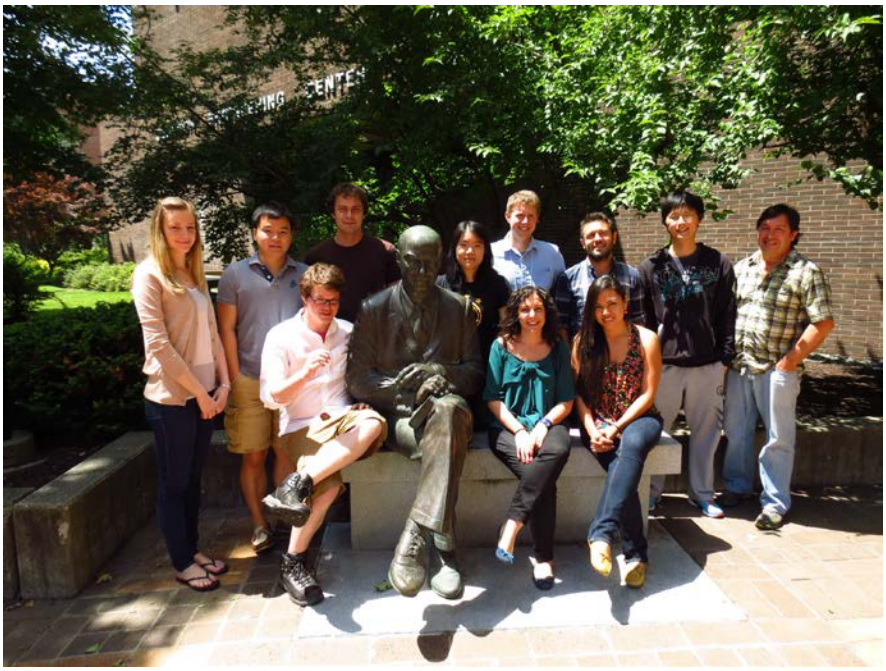
The following students participated in the Mathematical Problems in Industry workshop, MPI 2015, which was held at the University of Delaware from June 22 to June 26:

Mahdi Bandegi, Valeria Barra, Andrew DeStefan, Matthew Moye, Aminur Rahman, Pejman Sanaei, and Ivana Seric.

Linda Cummings and Richard Moore were both members of the organizing committee for the event.

Graduate Student Mathematical Modeling Camp, June 2015

Mahdi Bandegi and Matt Moye attended the Twelfth Annual GSMMC, which was held at Rensselaer Polytechnic Institute, June 16-19, and is associated with the MPI Workshop.



Graduate students (not all from NJIT) at
the Graduate Student Mathematical Modeling Camp, RPI June 2015

Graduate Student Honors and Awards

Valeria Barra: Best Poster Award, GSA Graduate Student Research Day, NJIT, October 30, 2014.

Lenka Kovalcinova: Graduate Presentation Award, Dana Knox Research Showcase, NJIT

Aminur Rahman: (i) Travel award from the Society for Industrial and Applied Mathematics (SIAM) to attend and participate in the SIAM Conference on Applications of Dynamical Systems 2015. (ii) Travel grant from Graduate Student Association and Department of Mathematical Sciences NJIT to attend the AMS Fall 2014 Sectional Conference, University of North Carolina - Greensboro, NC.

Pejman Sanaei: (i) Mathematical Problems in Industry (MPI) Fellowship for extended post-workshop study during summer 2014. (ii) Travel award from the American Physical Society to attend the 67th Annual DFD Meeting, San Francisco, November 2014.

Ivana Seric: Dr. Ahluwalia Fellowship for Graduate Study in Mathematical Sciences. (ii) CSLA Award for Outstanding Graduate Student.

PhD Summer Program Activities

Summer Program Seminars

Summer 2014, July 1 to August 15, in chronological order:

Tuesday talks by faculty were given by: Eliza Michalopoulou, Roy Goodman, Michael Siegel, Michael Booty, and Victor Matveev.

Thursday talks by graduate students were given by: Casayndra Basarab, Emel Khan, Xieyang Jia, Haiyang Qi, Valeria Barra, Pejman Sanaei, Anjana Grandhi, Aminur Rahman, Rianka Bhattacharya, Ensela Mema, Ivana Seric, Michael Pedneault, Rui Cao, and Randolph Leiser.

Summer 2015, June 1 to June 30, in chronological order:

Thursday talks by graduate students, beginning June 11, were given by:

June 11: Aminur Rahman "Neimark-Sacker Bifurcation in a Discrete Dynamical Model of Walkers", and Pejman Sanaei "Mathematical Modeling of Membrane Filtration".

June 18: Valeria Barra "Numerical Simulations for Interfacial Instabilities of Thin Viscoelastic Liquid Films", and Lenka Kovalcinova "Sheared Granular Systems".

June 25: Haiyang Qi "Multi-Trace Formulations of Two-Dimensional Helmholtz Transmission Problems of Multi-domain".

Soccer Match, May 2015,
Mathematical sciences graduate students and faculty versus undergraduates

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