CAMS

Center for Applied Mathematics and Statistics

ANNUAL REPORT

2022 – 2023

July 1, 2022 – June 30, 2023

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 37th year as a vehicle for research in applied mathematics and statistics at NJIT. CAMS supports faculty research by organizing colloquia, seminars and conferences and by facilitating group and interdisciplinary research proposals. We take particular pride in the research achievements of our members, which have been featured in numerous postings on the university news site and other news outlets.

Highlights and significant achievements in this past year, include:

- The successful hosting of our annual conference on ``Frontiers in Applied and Computational Mathematics'' (FACM '23), May 26-27 at NJIT. The conference theme was ``New trends in computational wave propagation and imaging.'' There were 25 invited talks and 35 poster presentations given by participants from all over the world. CAMS thanks NSF for their generous support of the meeting.
- NJIT's hosting of the first annual meeting of the NJ, NY, PA chapter of SIAM (Society for Industrial and Applied Mathematics), with over 300 participants. We thank DMS and CAMS member Roy Goodman for initiating the chapter and spearheading this exciting meeting, as well as SIAM, The NJIT Provost's Office, NJIT College of Science and Liberal Arts, NJIT Department of Mathematical Sciences, and NSF for support.
- The awarding of five major grants by funding agencies including NSF, ONR, and others.
- The oversight of an additional thirty continuing grants from various agencies. CAMS receives substantial funding for graduate student and faculty research from sources such as the National Science Foundation, Simons Foundation, U.S. Navy, NASA, and other state and local agencies along with private industry.

As always, the accomplishments of CAMS have been built with the support and dedication of many individuals. We are grateful to Atam Dhawan, Interim Provost and Senior Vice President of Academic Affairs and Senior Vice President for Research, and Eliza Michalopoulou, Department of Mathematical Sciences Chair, for encouraging CAMS through their strong support of scientific research. We thank President Teik Lim for supporting CAMS and its mission. We look forward to working with new Provost John Pelesko in the upcoming year, as well as to the significant contribution of CAMS to the university's strategic priorities.

Michael Siegel, Director • David Shirokoff, 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.

III. MEMBERS AND VISITORS

Department of Mathematical Sciences

Afkhami, Shahriar
Ahluwalia, Daljit S.
Askham, Travis
Bechtold, John
Booty, Michael
Bose, Amitabha
Boubendir, Yassine
Bukiet, Bruce
Bunker, Daniel
Choi, Wooyoung
Cummings, Linda
Deek, Fadi
Dhar, Sunil
Diekman, Casey
Frederick, Christina
Golowasch, Jorge
Goodman, Roy
Guo, Wenge
Hamfeldt, Brittany
Horntrop, David
Horwitz, Kenneth
Jaquette, Jonathan
Johnson, Kenneth
Jin, Chong
Kappraff, Jay
Kondic, Lou
Loh, Ji Meng
Luke, Jonathan
Lushi, Enkeleida
Matveev, Victor
MacLaurin, James
Michalopoulou, Zoi-Heleni
Milojevic, Petronije
Nadim, Farzan
Nguyen, Thi-Phong
Oza, Anand
Petropoulos, Peter
Russell, Gareth
Shang, Zuofeng
Shirokoff, David
Siegel, Michael
Subramanian, Sundarraman
Turc, Catalin
Wang, Antai
Wicke, Kristina
Young, Yuan-Nan

CAMS External Faculty Members from New Jersey Institute of Technology

Ahmadpoor, Fatemeh	Department of Mechanical & Industrial Engineering
Bunker, Daniel	Federated Department of Biological Sciences
Deek, Fadi	Office of the Provost
Dias, Cristiano	Department of Physics
Dytso, Alex	Department of Electrical & Computer Engineering
Farokhirad, Samaneh	Department of Mechanical & Industrial Engineering
Flammang, Brooke	Federated Department of Biological Sciences
Garnier, Simon	Federated Department of Biological Sciences
Ghosh, Arnob	Department of Electrical & Computer Engineering
Golowasch, Jorge P.	Federated Department of Biological Sciences
Gor, Gennady	Department of Chemical & Materials Engineering
Holzapfel, Claus	Federated Department of Biological Sciences (RU)
Koutis, Yiannis	Department of Computer Science
Marras, Simone	Department of Mechanical & Industrial Engineering
Meegoda, Jay N.	Department of Civil & Environmental Engineering
Musialski, Przemyslaw	Department of Computer Science
Nadim, Farzan	Federated Department of Biological Sciences
Rosato, Anthony	Department of Mechanical Engineering
Rotstein, Horacio	Federated Department of Biological Sciences
Russell, Gareth	Federated Department of Biological Sciences
Shakib, Farnaz	Department of Chemistry & Environmental Science
Tafuni, Angelo	School of Applied Engineering & Technology
Voronov, Roman	Department of Chemical & Materials Engineering
Wang, Haimin	Department of Physics

Xu, Pan	Department of of Computer Science

CAMS External Faculty Members

Booth, Victoria	University of Michigan, Ann Arbor
Cirillo, Michelle	University of Delaware
Diez, Javier	University Nacional del Centro, Tandil, Argentina
Erneux, Thomas	Université Libre de Bruxelles, Belgium
Huang, Huaxiong	York University, Toronto, Canada
Mema, Ensela	Kean University
Moore, Richard	SIAM, Philadelphia
Pak, On Shun	Santa Clara University
Papageorgiou, Demetrios	Imperial College, London
Pugnaloni, Luis	University of La Pampa, Argentina
Roychoudhury, Satrajit	Pfizer
Sachs, Jeffrey	Merck
Sanei, Pejman,	New York Institute of Technology
Tao, Louis	Peking University, China
Vanden-Broeck, Jean-Marc	University of East Anglia, Norwich, England
Wang, Qiming	Scotiabank, Canada
Wylie, Jonathan	City University of Hong Kong

IV. COLLOQUIA AND SEMINARS

Applied Mathematics Colloquium/ Department of Mathematical Sciences Colloquium

September 9, **Helen Wilson**, University College London
Mathematical Modelling of Suspensions

September 16, **Wooyoung Choi**, New Jersey Institute of Technology
New Directions and Challenges in Modeling Nonlinear Waves in Shallow Water

September 23, **Jean-Luc Thiffeault,** University of Wisconsin Madison
Shake Your Hips: An Active Particle with a Fluctuating Propulsion Force

September 30, **Saleh Tanveer**, Ohio State University
Study of a Reduced Model for Two Fluid Shear Flow

October 7, **Shuwen Lou**, Loyola University Chicago
A Model of Distorted Brownian Motion with Varying Dimension

October 14, **Yue Yu**, Lehigh University
Learning Nonlocal Operators for Heterogeneous Material Modeling

October 21, **Marcus Roper**, UCLA
Dead Spots and Short Circuits: Optimization in the Microcirculation

October 28, **Gerard Ben Arous**, Courant Institute
High-Dimensional Limit Theorems for Stochastic Gradient Descent: Effective Dynamics and Critical Scaling

November 4, **Amin Doostmohammadi**, Niels Bohr Institute
Active Matter: Flow, Topology, and Control

November 11, **Javier Gomez Serrano**, Brown University
Self-Similar Blow up Profiles for Fluids via Physics-Informed Neural Networks

November 18, **James Kelly**, U.S. Naval Research Lab
Fractional Partial Differential Equations: Boundary Conditions and Duality

December 2, **Javier Diez**, CIFICEN-CONICET-CICPBA, Instituto de Física Arroyo Seco, Universidad Nacional del Centro de la Provincia de Buenos Aires
Dependence of Surface Tension and Hamaker Constant on Concentration

December 9, **Stephanie Chaillat-Loseille**, ENSTA Paris - UMA Laboratoire POems
Fast Boundary Element Methods to Simulate Underwater Explosions and their Interactions with Submarines

January 20, **Raghav Venkatraman**, New York University
The Robustness of ENZ Device

January 27, **Jonathan Jaquette**, Boston University
Exploring Global Dynamics and Blowup in Some Nonlinear PDEs

February 3, **Ehud Yariv**, Israel Institute of Technology
Flows About Superhydrophobic Surfaces

February 10, **Sophie Ramananarivo**, LadHyX, Ecole Polytechnique
Can We Tailor the Behavior of Flexible Sheets in Flows by Adding Cuts or Folds?

February 17, **Paul Milewski**, University of Bath
Embedded Solitary Internal Waves

February 24, **Arik Yochelis**, Ben-Gurion University of the Negev
From Intracellular Actin Waves to Mechanism and Back: How Pattern Formation Theory Aids Biological Understanding and Applications

March 3, **Igor Belykh**, Georgia State University
Modelling and Predicting Crowd-induced Bridge Instabilities

March 10, **David Shirokoff**, New Jersey Institute of Technology
Overcoming Order Reduction in Runge-Kutta Methods via Weak Stage Order: Theory and Order Barriers

March 24, **Malena Espanol**, Arizona State University
Computational Methods for Solving Inverse Problems in Imaging

March 31, **Dejan Slepcev**, Carnegie Mellon University
Variational Problems on Random Structures: Analysis and Applications to Data Science

April 14, **Jeffrey Sachs**, Merck
Applying Math to Help Improve and Extend Life: Examples from Industry

April 21, **Gwynn Elfring**, University of British Columbia
Active Matter in Inhomogeneous Environments

April 28, **Kasso Okoudjou**, Tufts University
Optimal Point Distributions on the $d-$dimensional Unit Sphere

Applied Statistics Seminar

September 15, **Haipeng Xing**, Stony Brook University University
Statistical Surveillance of Structural Breaks in Credit Rating Dynamics

December 1, **Yuan Huang**, Yale School of Public Health
Subgroups and Multiple Changepoints Detection of Natural Disease History for Huntington's Disease

December 15, **Chong Jin**, New Jersey Institute of Technology
Integrating Multi-Omics Summary Data Using a Mendelian Randomization Framework

February 16, **Wujuan Zhong**, Merck
fastGWA-GE: A Fast and Powerful Linear Mixed Model Approach for Genotype-environment Interaction Tests in Large-scale GWAS

March 2, **Tian Tian**, Children's Hospital of Philadelphia
Model-based Deep Learning Approaches for Analyses of Single-cell and Spatial Genomics Data

March 23, **Ruiyi Yang**, Princeton University
Optimization on Manifolds via Graph Gaussian Processes

April 13, **Reuben Adatorwovor**, University of Kentucky
A Flexible Copula Model for Bivariate Survival with Dependent Censoring: An Application in Prostate Cancer Data

April 27, **Jiaoyang Huang**, University of Pennsylvania
Efficient Derivative-free Bayesian Inference for Large-Scale Inverse Problems

Mathematical Biology Seminar

September 14, **Joon Ha**, Howard University
A Reduced-Mathematical Model Derived by Data, Not Mathematical Methods Enhances Diabetes Research

September 28, **Megan Owen**, Lehman College, CUNY
Continuous Phylogenetic Tree Space: Algorithms and Applications

October 5, **Katherine St. John**, Hunter College, CUNY
Analyzing Phylogenetic Treespace

November 2, **Daniel Gomez**, University of Pennsylvania
Spike Solutions to the Singularly Perturbed Fractional Gierer-Meinhardt System

November 3, **Nicholas Battista**, The College of New Jersey
Exploring the Sensitivity of Jellyfish Locomotion to Variations in Scale, Frequency, and Duty Cycle

November 9, **Mareike Fischer**, University of Greifswald
How Far is My Network From Being Edge-Based? Proximity Measures for Edge-Basedness of Unrooted Phylogenetic Networks

November 30, **Xinxin Du**, Flatiron Institute
Modeling Epithelial Tissue as a 3D, Self-Sculpting, Viscoelastic Slab with Active Surfaces

February 8, **Albane Thiery**, University of Pennsylvania
Microswimmers Navigating Complex Fluids

February 22, **Yariv Aizenbud**, Yale University
Recovering Tree Models via Spectral Graph Theory

March 8, **Nessy Tania**, Quantitative Systems Pharmacology, Pfizer Worldwide Research, Development, and Medical
Shaping Your Own Career as a Mathematical Biologist

April 12, **Zhangli Peng**, University of Illinois in Chicago
Multiscale Modeling of Structures of the Cell and Beyond

April 18, **Tomer Weiss**, Informatics, New Jersey Institute of Technology
Simulating Multi-Agent Dynamics for Physical and Virtual Worlds

May 3, **Ruby Kim**, University of Michigan
Mathematical Modeling of the Molecular Clock and the Dopaminergic System

Fluid Mechanics and Waves Seminars

September 12, **Jose Alvarado**, University of Texas at Austin
Elastoviscous Effects of Soft, Passive Hair Beds

September 26, **Dan Fortunato**, Flatiron Institute
A High-Order Fast Direct Solver for Surface PDEs

October 10, **Fruzsina Agocs**, Flatiron Institute
A Fast and Arbitrarily High-Order Solver for Highly Oscillatory ODEs

October 31, **Yassine Tissaoui**, New Jersey Institute of Technology
Efficient Lower-Atmospheric Simulations Using Unstructured Grids and Spectral Elements: Added Complexity and Possible Solutions Featuring Non-Column Based Rain

November 7, **Amir Sagiv**, Columbia University
Floquet Hamiltonians - Effective Gaps and Resonant Decay

December 5, **Aminur Rahman**, University of Washington
Bouncing Droplets as a Damped-Driven System

February 6, **Pedro Jordan**, U.S. Naval Research Laboratory
Nonlinear Acoustics: Fundamental Concepts and Shock Applications

February 20, **Fredrik Fryklund**, New York University
An Integral Equation Method for the Advection-Diffusion Equation on Time-Dependent Domains in the Plan

March 6, **Pablo Ravazzoli**, The Center for Research in Physics and Engineering of the Center of the Province of Buenos Aires (CIFICEN)
Equilibrium Solutions of 3 and 4 Phase Systems

April 3, **Zewen Shen**, University of Toronto
Is Polynomial Interpolation in the Monomial Basis Unstable?

April 17, **Heather Wilber**, University of Texas Austin
Hierarchical Solvers for Special Linear Systems

May 1, **Rodolfo Brandão Macena Lira**, Princeton University
Elastic Filaments in Low-Reynolds-Number Flows

V. PUBLICATIONS, PRESENTATIONS, AND REPORTS

A. PUBLICATIONS

Journal Publications

Amitabha Bose

Dynamic Models for Musical Rhythm Perception and Coordination (with E. Large, J.C. Kim, J. Cannon, J. Pazdera, L. Trainor, and J. Rinzel), *Frontiers in Computational Neuroscience,* Vol 17, May 17, 2023.

Beyond the Limits of Circadian Entrainment: Non-24-hour Sleep-wake Disorder, Shift Work, and Social Jet Lag (with C. Diekman), *Journal of Theoretical Biology,* Vol 545, pp. 111148, July, 2022.

Entrainment Within Hierarchical Circadian Networks (with G. Liao), *Mathematical Biosciences,* Vol 351, pp.108883, July 27, 2022.

Yassine Boubendir

New Optimized Robin--Robin Domain Decomposition Methods Using Krylov Solvers for the Stokes--Darcy System, *SIAM Journal on Scientific Computing,* Vol 44, Issue 4, pp. 27, August, 2022.

Bruce Bukiet

The Effectiveness of Using Near-peer Role Models and Mentoring: A Phenomenological Reflection on STEM for Success (with C. E. Y. Leon and J. M. Lipuma), *Journal of Engineering Research,* Vol 3, Issue 18, pp. 7, June 2023.

Wooyoung Choi

High-order Strongly Nonlinear Long Wave Approximation and Solitary Wave Solution – CORRIGENDUM, *Journal of Fluid Mechanics*, Vol 952, pp. E2: 1-2, December 2022.

High-order Strongly Nonlinear Long Wave Approximation and Solitary Wave Part 2. Internal Waves, *Journal of Fluid Mechanics,* Vol 952, pp. A41: 1-29, December 1, 2022.

High-order Strongly Nonlinear Long Wave Approximation and Solitary Wave Solution, *Journal of Fluid Mechanics,* Vol 945, pp. A15: 1-38, July 2022.

Linda Cummings

Flow Through Pore-size Graded Membrane Pore Network (with B. Gu and L. Kondic), *Phys. Rev. Fluids*, Vol 8, pp. 44502, March 1, 2023.

Fadi Deek

The Converged Learning Model: Melding the Physical and Virtual Environments for Teaching and Learning Before, During, and After the Pandemic (with R. Collins), *Journal of Higher Education Theory and Practice*, Vol 23, No 7, May 2023.

Stock Broad-Index Trend Patterns Learning Via Domain Knowledge Informed Generative Network (with J. Gu and G. Wang), *International Journal of Artificial Intelligence and Applications*, Vol 14, No 2, March 2023.

Sampling Technique for Fourier Convolution Theorem Based k-space Filtering (with C. Ciulla, I. Xhaferri, E. Muzhaqi, D. Veljanovski, U. Shikoska, and F. Risteski), *Applied Research*, Vol 2, No 3, February 2023.

ADPP: A Novel Anomaly Detection and Privacy-Preserving Framework using Blockchain and Neural Networks in Tokenomics (with W. Yao, J. Gu, W. Du, and G. Wang), *International Journal of Artificial Intelligence and Applications*, Vol 13, No 6, November 2022.

Casey Diekman

Beyond the Limits of Circadian Entrainment: Non-24-hour Sleep-wake Disorder, Shift Work, and Social Jet Lag (with A. Bose), *Journal of Theoretical Biology,* Vol 545, pp. 111148, July 2022.

Christina Frederick

On the Frame Set of the Second-order B-spline (with A. G. Atindehou, K. Okoudjou, and Y. E. Kouagou), *Applied and Computational Harmonic Analysis,* September 2022.

Seabed Classification and Source Localization with Gaussian Processes and Machine Learning, (with Z. H. Michalopoulou), *JASA Express Letters,* Vol 2, Issue 8, August 8, 2022.

Roy Goodman

Apodizer Design to Efficiently Couple Light into a Fiber Bragg Grating (with J. Adriazola), *SIAM Journal on Applied Mathematics,* Vol 83, Issue 3, pp. 1126-1145, June 6, 2023.

Efficient Manipulation of Bose-Einstein Condensates in a Double-Well Potential1 (with J. Adriazola and P. G. Kevrekidis), *Communications in Nonlinear Science and Numerical Simulation,* Vol 122, pp. 107219, March 2023.

Transition to Instability of the Leapfrogging Vortex Quartet, (with B. M. Behring), *Mechanics Research Communications,* Vol 128, pp. 104068, February 2023.

Wenge Guo

A Hierarchical Testing Procedure for Three Arm Non-inferiority Trials (with S. Ghosh), *Computational Statistics & Data Analysis,* Vol 174, pp. 107521, October 2022.

Brittany Hamfeldt

A Convergent Quadrature Based Method for the Monge-Amp\`ere Equation (with J. Brusca), *SIAM Journal on Scientific Computing,* Vol 45, Issue 3, pp. A1097-A1124, 2023.

On the Reduction in Accuracy of Finite Difference Schemes on Manifolds Without Boundary (with A. Turnquist), *IMA Journal of Numerical Analysis,* July 2023.

Lou Kondic

Stochastic Methods for Slip Prediction in a Sheared Granular System (with P. Bretz and M. Kramar), *Physical Review E,* Vol 107, pp. 54901, May 1, 2023.

Flow Through Pore-size Graded Membrane Pore Network (with B. Gu and L. J. Cummings), *Phys. Rev. Fluids,* Vol 8, pp. 44502, March 1, 2023.

Ji Meng Loh

Nonparametric Inference for Symbolic Data Using Kernel Methods (with W. Jang and H. Park), *Journal of Nonparametric Statistics,* January 2023.

A Latent State Space Model for Estimating Brain Dynamics from Electroencephalogram (EEG) Data (with Q. Wang, X. He, and Y. Wang), *Biometrics,* September 19, 2022.

James MacLaurin

Stochastic Rotating Waves (with G. Zucal and C. Kuehn), *Stochastic Dynamics*, December 2022.

Stochastic Oscillators in Biology: Introduction to the Special Issue (with J.M. Fellous, P. Thomas, and B. Lindner), *Biological Cybernetics,* Vol 116, 2022.

Victor Matveev

Close Agreement Between Deterministic vs. Stochastic Modeling of First-passage Time to Vesicle Fusion, *Biophysical Journal,* November 8, 2022.

Zoi-Heleni Michalopoulou

Adaptive Genetic Algorithm-based Particle Herding Scheme for Mitigating Particle Impoverishment (with C. Kuptametee and N. Aunsri), *Measurement (Elsevier)*, June 2023.

Inversion in an Uncertain Ocean Using Gaussian Processes (with P. Gerstoft), *Journal of the Acoustical Society of America*, pp. 1600-1611, March 2023.

Seabed Classification and Source Localization with Gaussian Processes and Machine Learning (with C. A. Frederick), *JASA Express Letters,* Vol 2, Issue 8, August 8, 2022.

Thi-Phong Nguyen

Direct Sampling Methods for Isotropic and Anisotropic Scatterers with Point Source Measurements (with I. Harris and D.L. Nguyen), *Inverse Problems and Imaging,*Vol 16, Issue 5, pp. 1137-1162, October 2022.

Cyrill Muratov

Mathematics of Thin Structures (with J.-F. Babadjian, G. Di Fratta, I. Fonseca, G. Francfort, and M. Lewicka), *Quart. Appl. Math.,* September 2022.

Forced and Spontaneous Symmetry Breaking in Cell Polarization (with P. W. Miller, D. Fortunato, L. Greengard, and S. Shvartsman), *Nature Comput. Sci.,* August 2022.

A Micromagnetic Theory of Skyrmion Lifetime in Ultrathin Ferromagnetic Films (with A. Bernand-Mantel and V. V. Slastikov), *Proc. Natl. Acad. Sci. USA,* Vol 199, pp. E2122237119, July 2022.

Anand Oza

Generalization of Waving-plate Theory to Multiple Interacting Swimmers (with P. J. Baddoo, N. J. Moore, and D. G. Crowdy), *Communications on Pure and Applied Mathematics,* July 7, 2023.

Zuofeng Shang

Distributed Adaptive Nearest Neighbor Classifier: Algorithm and Theory (with R. Liu and G. Xu), *Statistics and Computing,* June 2023.

Deep Neural Network Classifier for Multi-dimensional Functional Data (with S. Wang and G. Cao), *Scandinavian Journal of Statistics,* March 2023.

Optimal Classification for Functional Data (with S. Wang, G. Cao, and J. Liu),*Statistica Sinica,* October 2022.

Solar Flare Index Prediction Using SDO/HMI Vector Magnetic Data Products with Statistical and Machine Learning Methods (with H. Zhang, Q. Li, Y. Yang, J. Ju, J. Wang, and H. Wang), *The Astrophysical Journal Supplement,* September 2022.

A Likelihood-ratio Type Test for Stochastic Block Models with Bounded Degrees (with M. Yuan and Y. Feng), *Journal of Statistical Planning and Inference*, July 2022.

David Shirokoff

Design of DIRK schemes with high weak stage order (with A. Biswas, D. Ketcheson, and B. Seibold), *Communications in Applied Mathematics and Computational Science*, Vol 18, No 1, pp 1-28, May 2023.

Michael Siegel

Convergence of the Boundary Integral Method for Interfacial Stokes Flow (with D. M. Ambrose and K. Zhang), *Mathematics of Computation*, Vol 92, pp. 695-748, March 2023.

Jeffery's Paradox for the Rotation of a Single 'Stick–slip' Cylinder (with E. Yariv), *Mechanics Research Communications,* Vol 131, p. 104154, June 2023.

Sundar Subramanian

Model Checks for Two-sample Location and Scale (with A. Javidialsaadi and S. Mondal), *Journal of Nonparametric Statistics/Taylor and Francis,* August 4, 2023.

Simultaneous Confidence Bands for Survival Functions from Twice Censorship, *Statistics and Probability Letters/Elsevier,* Vol 186, pp. 109494, July, 2022.

Antai Wang

The Analysis of Semi-competing Risks Data Using Archimedean Copula Models (with Y. Zhang, J. Wu, and Z. Guo), *Statistica Neerlandica,* pp. 1-17, June 1, 2023.

The Identifiability of Copula Models for Dependent Competing Risks Data with Exponentially Distributed Margins, *Statistica Sinica*, pp. 1-19, January 2023.

Kristina Wicke

How Far is My Network from Being Edge-based? Proximity Measures for Edge-basedness of Unrooted Phylogenetic Networks (with M. Fischer and T. N. Hamann), *Discrete Applied Mathematics,* Vol 337, pp. 1-18, May, 2023.

Phylogenetic Diversity Rankings in the Face of Extinctions: The Robustness of the Fair Proportion Index (with M. Fischer and A. Francis), *Systematic Biology,* Vol 72, Issue 3, pp. 606-615, May, 2023.

Effects of Discordance Between Species and Gene Trees on Phylogenetic Diversity Conservation (with M. Fischer and L. Kubatko), *Journal of Mathematical Biology,* Vol 86, Issue 1, pp. 1-34, January, 2023.

Yuan-Nan Young

Effects of Tunable Hydrophobicity on the Collective Hydrodynamics of Janus Particles Under Flows (with S. P. Fu, R. Ryham, and B. Quaife), *Physical Review Fluids,* Vol 8, pp. 50501, May 11, 2023.

From Electrodiffusion Theory to the Electrohydrodynamics of Leaky Dielectrics Through the Weak Electrolyte Limit – CORRIGENDUM (with P. Marthaler, A. Class, and Y. Mori), *Journal of Fluid Mechanics,* Vol 962, pp. E1, May 9, 2023.

Influence of Surface Viscosities on the Electrodeformation of a Prolate Viscous Drop (with H. Nganguia, D. Das, and O. Pak), *Soft Matter,* Vol 19, pp. 776, December 23, 2022.

Comparison of Four Boundary Conditions for the Fluid-hydrogel Interface, (with Z. Xu, J. Zhang, P. Yu, and J. Feng), *Physical Review Fluids,* Vol 7, Issue 9, pp. 93301, September 2022.

Effects of Tunable Hydrophobicity on the Collective Hydrodynamics of Janus Particles Under Flows (with S. P. Fu, R. Ryham, and B. Quaife), *Physical Review Fluids*, May 2023.

Conference Publications and Abstracts

Bruce Bukiet

The Effectiveness of Using Near-peer Role Models and Mentoring: A Phenomenological Reflection on STEM for Success (with C. Leon and J. M. Lipuma), *Academic Journals*, p.p 4, June 2023.

Fadi Deek

Prediction with Time-Series Mixer for the S&P500 Index (with J. Ye, J. Gu, A. Dash, and G. Wang), *IEEE 39th International Conference on Data Engineering Workshops (ICDEW),* pp. 20-27, 2023.

Toward Designing Innovation Learning Experiences: Examining Engagement and Affective Traits Based on Learner and Course Characteristics (with R. Collins), *Proceedings of the 56th Hawaii International Conference on System Sciences (HICSS),* pp. 4755-4764, 2023.

On the Use of a Novel Converged Learning Model as an Agile Method for Teaching and Learning Before, During, and After the Pandemic (with R. Collins). *8th e-Learning Excellence Awards 2022: An Anthology of Case Histories, The 21st European Conference on e-Learning (ECEL)*, pp. 35-47, 2022.

Lou Kondic

Colloidal Phase Transitions Under Microgravity (with Q. Lei, B. Khusid, A. Hollingsworth, P. M. Chaikin, W. Meyer, and A. Reich), *The Center for the Advancement of Science in Space*, Inc., Issue 1, Abstract: 118, November 2022.

Phase Transitions in Colloidal Suspensions of Spheres and Ellipsoids Under Microgravity (with Q. Lei, B. Khusid, A. Hollingsworth, P. M. Chaikin, W. Meyer, and A. Reich), *American Society for Gravitational and Space Research (ASGSR)*, Issue 1, Abstract: 13, November 2022.

James MacLaurin

Stochastic Oscillations in Biology, *American Physical Society*, 2022.

Zoi-Heleni Michalopoulou

Direction-of-arrival Estimation Using Gaussian Process Interpolation (with I. Khurjekar, P. Gerstoft, and C. Mecklenbrauker), *Proceedings of ICASSP 2023 (IEEE)*, pp. 1-5, 2023.

Theoretical and Experimental Multi-Sensor Signal Detection in Time Spreading Distortion Underwater Channels (with R. Rashid, E. Zhang, A. Abdi, Z.H. Michalopoulou), *IEEE Proceedings of Oceans 2022*, October 2022.

Zuofeng Shang

Core Matrix Regression and Prediction with Regularization (with D. Zhou, A. Uddiin, C. Sylla, and D. Yu), 291-299, November 2, 2022.

Temporal Bipartite Graph Neural Networks for Bond Prediction (with D. Zhou, A. Uddiin, X. Tao, and D. Yu), 308-316, November 2, 2022

Core Matrix Regression and Prediction with Regularization (with D. Zhou, A. Uddiin, C. Sylla, and D. Yu), *ICAIF'22: 3rd ACM International Conference on AI in Finance*, October 2022.

Temporal Bipartite Graph Neural Networks for Bond Prediction, (with D. Zhou, A. Uddiin, X. Tao, and D. Yu), *ICAIF'22: 3rd ACM International Conference on AI in Finance*, October 2022.

Temporal Bipartite Graph Neural Networks for Predicting Financial Time Series with Irregular Intervals, (with D. Zhou, A. Uddiin, X. Tao, and D. Yu), *ICDM/SSTDM 2022: 17th International Workshop on Spatial and Spatiotemporal Data Mining*, October 2022.

Michael Siegel

Vortex Sheet Simulations of Interacting Flapping Plates, (M. Nitsche and A. Oza), *American Physical Society*, November 2022.

Manuscript

Chong Jin

CD147 Mediates Epidermal Malignant Transformation Through the RSK2/AP-1 Pathway (with Y. Guo, T. Xiao, J. Li, A. Guo, Li. Lei, Q. Long, X. Zhang, J. Su, M. Yin, H. Liu, C. Chen, Z. Zhou, S. Zhu, J. Tao, S. Hu, X. Chen, and C. Peng), *Journal of Experimental & Clinical Cancer Research*, Vol 41, Issue 1, p.p 1-21, December 2022.

Research Report

Bruce Bukiet

2022 Inaugural Annual Report STEM for Success (with J. M. Lipuma and C. Leon), p.p 18, April 2023.

Software

Travis Askham

Inverse-obstacl-scattering-2d (with M. Rachh, J. Hoskins, and C. Borges), August 2022.

Victor Matveev

Calcium Calculator (CalC) Modeling Software, release 7.10.2, October 14, 2022.

B. PRESENTATIONS

Travis Askham

July 22, 2022 : SIAM Annual Meeting 2022, SIAM, Virtual
“A Periodic Fast Multipole Method”

Michael Booty

April 5, 2023 : International Conference on Multiphase Flow 2023, Kobe, Japan
“Electrokinetic Flow About a Drop”

Amitabha Bose

June 15, 2023: Mathematical and Computational Biology ICERM, Providence, Rhode Island
“Understanding the Limits of Entrainment of Circadian Oscillator Models Using One-Dimensional Maps”

May 16, 2023: SIAM Conference on the Applications of Dynamical Systems, SIAM, Portland, Oregon
“Strategies for Multi-Season Eradication of the Coffee Berry Borer”

February 27, 2023: Math Biology Seminar University of Iowa, Virtual
“Understanding the Limits of Entrainment of Circadian Oscillator Models Using One-Dimensional Maps”

December 8, 2022: Math Club Seminar East Lake High School Sammamish, WA, Virtual
“Mathematical Models for Biological Applications”

Bruce Bukiet

January 12, 2023: SHPE High Tech High School, Lincroft, NJ, Virtual
“Study and Research in Mathematical Sciences”

Wooyoung Choi

May 16, 2023: Workshop on Waves and Free Surface Flows: The Next Twenty Years, International Center for Mathematical Sciences, Edinburgh, UK
“Stability of Finite-Amplitude Interfacial Periodic Waves”

November 29, 2022: Applied Mathematics Seminar, University College London, London, UK
“High-order Long Wave Approximation and Solitary Wave Solution in Shallow Water”

September 16, 2022: Math Colloquium, NJIT, Newark, NJ
“New Directions and Challenges in Modeling Nonlinear Waves in Shallow Water”

July 2022: Workshop on Modulation Theory and Dispersive Shock Waves, Isaac Newton Institute University of Cambridge, UK
“Modulation of short surface waves by long internal waves”

July 2022: Workshop on New Directions in Water Waves, University of Bath, UK

“High-order Long Wave Approximation and Solitary Waves”

Linda Cummings

February 1, 2023: SIAM Conference on Computational Science and Engineering, SIAM, Amsterdam, Netherlands
“Asymptotic Modeling for Evolving Liquid Crystal Films”

August 31, 2022: Mathematical Modelling of Fluid Mechanics Seminar Series, Queensland University of Technology, Virtual
“Asymptotic Thermal Modeling of Droplet Assembly in Nanoscale Molten Metal Films”

July, 2022: Journal of Engineering Mathematics Webinar Series, Journal of Engineering Mathematics (Springer), Virtual
“Asymptotic Thermal Modeling of Droplet Assembly in Nanoscale Molten Metal Films”

Casey Diekman

December 2, 2022: Mathematical Biology Seminar, Duke University Durham, North Carolina, Virtual
“Data Assimilation and Dynamical Systems Analysis of Circadian Rhythmicity and Entrainment”

September 27, 2022: DMC (Data, Mathematical, and Computational Sciences) Lecture Series, Ramapo College of New Jersey, Ramapo, New Jersey
“Data Assimilation and Dynamical Systems Analysis of Circadian Rhythmicity and Entrainment”

Fadi Deek

June 2023: University of Tennessee Graduate School of Medicine, Department of Oral and Maxillofacial Surgery Resident/Fellow Graduation, Knoxville, TN
“Natural Intelligence, Artificial Intelligence, Superintelligence—What do we Really need to Lead and Succeed”

Javier Diez

November 1, 2022: American Physical Society Division of Fluid Mechanics Annual Meeting, APS Indianapolis, IN
“Thin Films Dewetting with Phase Separation: Dependence of Surface Tension and Hamaker Constant on Concentration”

Christina Frederick

December 2022: Meeting of the Acoustical Society of America, ASA, Nashville, TN
“Seabed Classification and Source Localization with Gaussian Processes and Machine Learning”

September 2022 : Oklahoma University Mathematics Colloquium, Norman, OK
“An invitation to Gabor Analysis and the Frame Set Problem”

September 2022: SIAM Central States Section Annual Meeting, OSU, Stillwater, OK
“Machine Learning Techniques for Inverse Problems in Sonar Imaging”

Roy Goodman

July 2022: Coherent Structures: Current Developments and Future Challenges, Lorentz Center, Leiden, Netherlands
“Optimal Control of Dispersive Waves”

Brittany Hamfeldt

May 27, 2023: Frontiers in Applied and Computational Mathematics, NJIT, Newark, NJ
“Reflector Antenna Design via Optimal Transport on the Sphere”

Kenneth Horwitz

August 2022: 16th International Conference on Mathematics Education for the Future Project, Cambridge University, UK
“Using Professional Development to Change the Teaching Culture in an Urban School District”

Chong Jin

June 2023: ICSA 2023, ICSA, Ann Arbor, Michigan
“Integrating Multi-omics Summary Data Using a Mendelian Randomization Framework”

April 2023: NJ ACTS
“Integrating Multi-omics Summary Data Using Mendelian Randomization”

October 4, 2022: Biostat Seminar Series Division of Biostatistics, Department of Biostatistics, Epidemiology and Informatics University of Pennsylvania Perelman School of Medicine Blockley, Philadelphia, PA
“Integrating multi-omics Summary Data Using a Mendelian Randomization Framework”

October 3, 2022: Faculty Research Talks, NJIT, Newark NJ
“Integrating Multi-omics Summary Data Using a Mendelian Randomization Framework”

Lou Kondic

June 28,2023: Seminar, Twente University, Enschede, Netherlands
“Including Thermal Effects in Modeling Flow of Thin Fluid Films”

May 1, 2023: Seminar, University Nacional del Pampa Santa Rosa, Argentina
“Computing Force Networks in Dense Particulate Systems”

March 1, 2023: Seminar, Technion Haifa, Israel
“Computing Dynamics of Thin Fluid Films Including thermal effects”

March 1, 2023: Seminar, Rutgers University New Brunswick, NJ
“Computing Force Networks in Dense Particulate Systems”

February 1, 2023: Seminar, Munster University, Munster, Germany
“Thin Fluid Films: From Liquid Crystals to Liquid Metals”

February 1, 2023: SIAM Conference on Computational Science and Engineering, SIAM, Amsterdam, The Netherlands
“Modeling and Computing Thin Film Flows: New Frontiers and Challenges”

October 1, 2022: Controlling Structure Formation in Soft Materials, University Mainz, Germany
“Effects of Spatially-varying Substrate Anchoring on Instabilities and Dewetting of Thin Nematic Liquid Crystal Films”

September 15, 2022: Physics Colloquium University Ljubljana, Ljubljana, Slovenia
“Instabilities and Dewetting of Thin Nematic Liquid Crystal Films”

August 1, 2022: 9th International Symposium on Bifurcation and Instabilities in Fluid Dynamics (BIFD), University Groningen, Groningen, The Netherlands
“Dielectrowetting of a Thin Nematic Liquid Crystal Layer”

August 1, 2022: 9th International Symposium on Bifurcation and Instabilities in Fluid Dynamics (BIFD), University Groningen Groningen, The Netherlands
“Instabilities and Dewetting of Liquid Crystal Films”

July 10, 2022: Seminar, Friedrich-Alexander Erlangen-Nürnberg University, Erlangen, Germany
“Computing Force Networks in Particulate Systems”

July 5, 2022: European Solid Mechanics Conference, Euromech, Galway, Ireland
“Computing and Quantifying Force Networks in Experiments and Simulations”

Ji Meng Loh

August 7, 2022: Joint Statistical Meeting American Statistical Association, Washington DC
“Parameter Estimation and Inference of Spatial Autoregressive Model by Stochastic Gradient Descent”

Victor Matveev

April 27, 2023: Henrique von Gersdorff Laboratory Seminar, Oregon Health & Science University Vollum Institute, Portland, OR
“Fundamentals of Parameter Estimation: Likelihood Ratios, MCMC and Beyond”

April 25, 2023: Vollum Institute Seminar Series Vollum Institute, Oregon Health & Science University Vollum Institute, OHSU, Portland, OR
“Comparison Between Deterministic and Stochastic Simulations of Calcium-dependent Vesicle Exocytosis”

March 20, 2023: Applied Mathematics Seminar, University of Pittsburgh, Pittsburgh, PA
“Accuracy of Deterministic vs. Stochastic Modeling of Calcium-Dependent Vesicle Release”

July 13, 2022: Annual Meeting of the Society for Industrial and Applied Mathematics - Life Sciences (SIAM-LS 2022), SIAM, Pittsburgh, PA
“Novel Closed-form Approximations of Stationary Single-channel Ca2+ “Nanodomains””

Ensela Mema

March 1, 2023: APS March Meeting, APS, Las Vegas, AZ
“Evolution of a Two-layer Film with Large Viscosity Ratio”

Zoi-Heleni Michalopoulou

June 2023: Underwater Acoustics Measurements and Exhibition, Kalamata, Greece
“Machine Learning Techniques for Source Ranging and Sediment Classification in the Ocean”

May 2023: Meeting of the Acoustical Society of America, AS,A Chicago, IL
“Waveform Modeling with Gaussian Processes for Inversion in Ocean Acoustics”

February 2023: Workshop on the SBCEX 22 Experiment, ONR, La Jolla, CA
“Field Predictions and Virtual Arrays for SBCEX 22 Analysis and Inversion”

December 2022: Meeting of the Acoustical Society of America, ASA, Nashville, TN
“Tracking in ocean acoustics: Insights from the work of Lisa Zurk”

December 2022: Meeting of the Acoustical Society of America, ASA, Nashville, TN
“Seabed Classification and Source Localization with Gaussian Processes and Machine Learning”

Cyrill Muratov

October 2022: Turing's Chemical Basis of Morphogenesis at 70, Flatiron Institute, New York, NY
”Understanding Turing Pattern Initiation: A Multiscale Approach”

Padma Natarajan

April 4, 2023: ITE Donuts and Discussion ITE, NJIT, Newark, NJ
“Collaborative Tool(s) to Promote Student Engagement and Learning”

Thi Phong Nguyen

June 8, 2023: Faculty and Student Summer Talks 2023, NJIT, Newark, NJ
“Inverse Scattering Problems and Application to the Maging of Local Defects in Periodic Media”

March 18, 2023: AMS 2023 Spring Southeastern Sectional Meeting, Georgia Institute of Technology, Atlanta, GA
“Differential Imaging Method and the related Interior Transmission Eigenvalues Problem for Local Defects in Anisotropic Periodic Media”

March 9, 2023: Seminar on Applied Mathematics, Kansas State University, Online
“Sampling Methods for Inverse Scattering Problems in Complex Media”

November 14, 2022: Faculty Research Talk, NJIT, Newark, NJ
“Direct and Inverse Scattering Problems in Locally Perturbed Periodic Media”

October 28, 2022: New Ideas in Computational Inverse Problems, Banff, Alberta, Canada

“Differential Sampling Method in Inverse Scattering Problems”

October 1, 2022: The 7th Annual Meeting of SIAM Central States Section, Oklahoma State University, Stillwater, OK
“A Direct Approach for Inverse Source Problems in Photoacoustic Tomography”

August 17, 2022: International Conference on Differential Equations and Applications, Institute of Mathematics, Hanoi, Vietnam
“Imaging of Fractures in Elastic Media”

Anand Oza

May 15, 2023: Conference on Applications of Dynamical Systems (DS23), Society for Industrial and Applied Mathematics (SIAM), Portland, OR
“Invariant Measures of Walking Droplets in Hydrodynamic Pilot-wave Theory”

February 27, 2023: Conference on Computational Science and Engineering (CSE23), Society for Industrial and Applied Mathematics (SIAM), Amsterdam, Netherlands
“Data-driven continuum Modeling of Active Nematics via Sparse Identification of Nonlinear Dynamics”

Zuofeng Shang

December 2022: CMStatistics 2022, King's College London, London, UK
“Semiparametric Efficiency in Deep Instrumental Variable Models”

August 2022, 2022: Workshop on Statistical Network Analysis and Beyond, New York University, New York City, NY
“Variational Nonparametric Testing in Functional Stochastic Block Model”

David Shirokoff

June 12, 2023: CAIMS/SCMAI Annual Meeting, Canadian Applied and Industrial Mathematics Society (CAIMS), University of New Brunswick, June 12-15, 2023
“Preconditioning and Linearly Implicit Time Integration for the Dispersive Shallow Water Equation”

April 1, 2023: American Mathematics Society 2023 Spring Eastern Sectional Meeting, American Mathematics Society (AMS), Virtual
“Entropy of an Autonomous PDE arising as the Mean-field Limit of a Spin Glass System”

March 10, 2023: NJIT Applied Mathematics Colloquium, NJIT, Newark, NJ
“Overcoming Order Reduction in Runge-Kutta Methods via Weak Stage Order: Theory and Order Barriers”

March 2, 2023: SIAM Conference on Computational Science and Engineering (CSE23), SIAM, RAI Convention Center, Amsterdam, Netherlands
“Weak Stage Order Theory and Order Barriers for Runge-Kutta Methods”

September 21, 2022: Temple University Applied Mathematics and Scientific Computing Seminar, Temple University, Philadelphia, PA

“Efficient Time Integration Approaches for the Dispersive Shallow Water Equations”

September 1, 2022: Carnegie Mellon University Center for Nonlinear Analysis Seminar, Carnegie Mellon, University Pittsburgh, PA
“Overcoming Order Reduction in Runge-Kutta Methods via Weak Stage Order: Theory and Order Barriers”

July 25, 2022: SciCADE 2022: The International Conference on Scientific Computation and Differential Equations, University of Reykjavik Reykjavik, Iceland
“Weak Stage Order Theory and Order Barriers”

Michael Siegel

June 2023: The 13th AIMS Conference on Dynamical Systems, Differential Equations and Applications, American Institute of Mathematical Sciences (AIMS), Wilmington, NC
“Finite-time Singularity Formation in the Generalized Constantin-Lax- Majda Equation”

May 2023: Waves and Free Surface Flows: the Next Twenty Years, International Center for Mathematical Sciences, Bayes Center, Edinburgh, UK
“Finite-time Singularity Formation in the Generalized Constantin-Lax- Majda Equation”

February 2023: SIAM Computational Science and Engineering Meeting, SIAM, Amsterdam, The Netherlands
“Fluid-solid Interaction motivated by the Lotus Leaf”

December 2022: Applied Mathematics Colloquium, University of Colorado, Colorado Springs. University of Colorado, Colorado Springs, CO
“Finite-time Singularity Formation in the Generalized Constantin-Lax- Majda Equation”

July 2022: SIAM Annual Meeting Society for Industrial and Applied Mathematics, Pittsburgh, PA
“A Fast and Accurate Boundary Integral Method for Superhydrophobic Flow Computations”

Sundarraman Subramanian

August 9, 2022: Joint Statistical Meetings, American Statistical Association, Washington DC
“Simultaneous Confidence Bands for Survival Functions from Twice Censorship”

Kristina Wicke

June 2023: MCEB (Mathematical and Computational Evolutionary Biology) 2023, Institute D'études Scientifiques De Cargèse, Corsica, France
“Effects of Discordance Between Species and Gene Trees on Phylogenetic Diversity Conservation”

June 2023: Oberseminar Diskrete Mathematik – Geometrie und Optimierung Goethe, University Frankfurt, Frankfurt, Germany
“Mathematical Approaches to Biodiversity Conservation: Some Recent Developments and Challenges in Phylogenetic Diversity Research”

February 2023: Villanova Mathematics Colloquium, University of Villanova, Villanova, PA

“Mathematical Approaches to Biodiversity Conservation: Some Recent Developments and Challenges in Phylogenetic Diversity Research”

January 2023: Joint Mathematics Meetings - AMS Special Session on Trees in Many Contexts, Boston, MA
“Links Between Trees and Biodiversity Conservation: Some Recent Developments and Challenges in Phylogenetic Diversity Research”

December 2022: NJIT Biology Colloquium, New Jersey Institute of Technology, Newark, NJ
“Mathematical Approaches to Biodiversity Conservation: Some Recent Developments and Challenges in Phylogenetic Diversity Research”

August 2022: Emerging Mathematical Frontiers in Molecular Evolution, Institut Mittag-Leffler, Djursholm, Sweden
“Effects of Discordance Between Species and Gene Trees on Phylogenetic Diversity Conservation”

Yuan-Nan Young

June 2, 2023: The 13th AIMS Conference on Dynamical Systems, Differential Equations and Applications, Wilmington, North Carolina
“A Model for Microtubule-Mediated Deformation of a Cellular Nucleus”

February 23, 2023: Applied Math Seminar, University of Delaware, Newark, DE
“From Centrosome to Primary Cilium”

November 22, 2022: 75th Annual American Physical Society/Division of Fluid Dynamics, Indianapolis, Indiana
“Collective Dynamics of Squirmers with Hydrophobicity”

July 29, 2022: UT Austin Physics Seminar, University of Texas at Austin, Austin, TX
“The Many Behaviors of Deformable Active Droplets”

July 13, 2022: SIAM/Annual Meeting/Life Sciences 2022, SIAM, Pittsburgh, PA
“Microtubule-Mediated Deformation of Cell Nucleus with Permeability”

VI. EXTERNAL ACTIVITIES AND AWARDS

A. FACULTY ACTIVITIES

Linda J. Cummings

Associate Editor of IMA Journal of Applied Mathematics, Institute of Mathematics and its Applications, London, July 2011 - Current

Shidong Jiang

Editorial Board, Journal of Scientific Computing, 2020 - Current

Lou Kondic

Fellow, American Physical Society

Associate Editor, Crystals, 2021 - Current

Associate Editor, Nanomaterials, 2021 - Current

Associate Editor, Journal of Engineering Mathematics, 2020 - Current

Associate Editor, Papers in Physics, 2019 - Current

Simone Marras

Associate Editor, Quarterly Journal of the Royal Meteorological Society, 2018 - Current

Topical Editor, Geoscientific Model Development, Copernicus EGU, 2014 - Current

Luis Pugnaloni

Managing Editor, Papers in Physics, 2009 - Current

Zoi-Heleni Michalopoulou

Associate Editor, Journal of the Acoustical Society of America

Associate Editor, IEEE Journal of Oceanic Engineering

Michael Siegel

Associate Editor, Journal of Engineering Mathematics

B. FACULTY AWARDS

Christina Frederick

Women in Acoustics Young Investigator Travel Award, Acoustical Society of America, November 2022
Summer Faculty Fellow, Office of Naval Research, December 2022
Lou Kondic

Da Vinci Fellowship, Twente University, July 2022

Ji Meng Loh

CSLA Award for Excellence in Undergraduate Education, CSLA, NJIT, May 2023

Anand Oza

CSLA Excellence in Graduate Education Award, CSLA, NJIT, May 2023

C. FACM 2023 CONFERENCE: FRONTIERS IN APPLIED AND COMPUTATIONAL MATHEMATICS

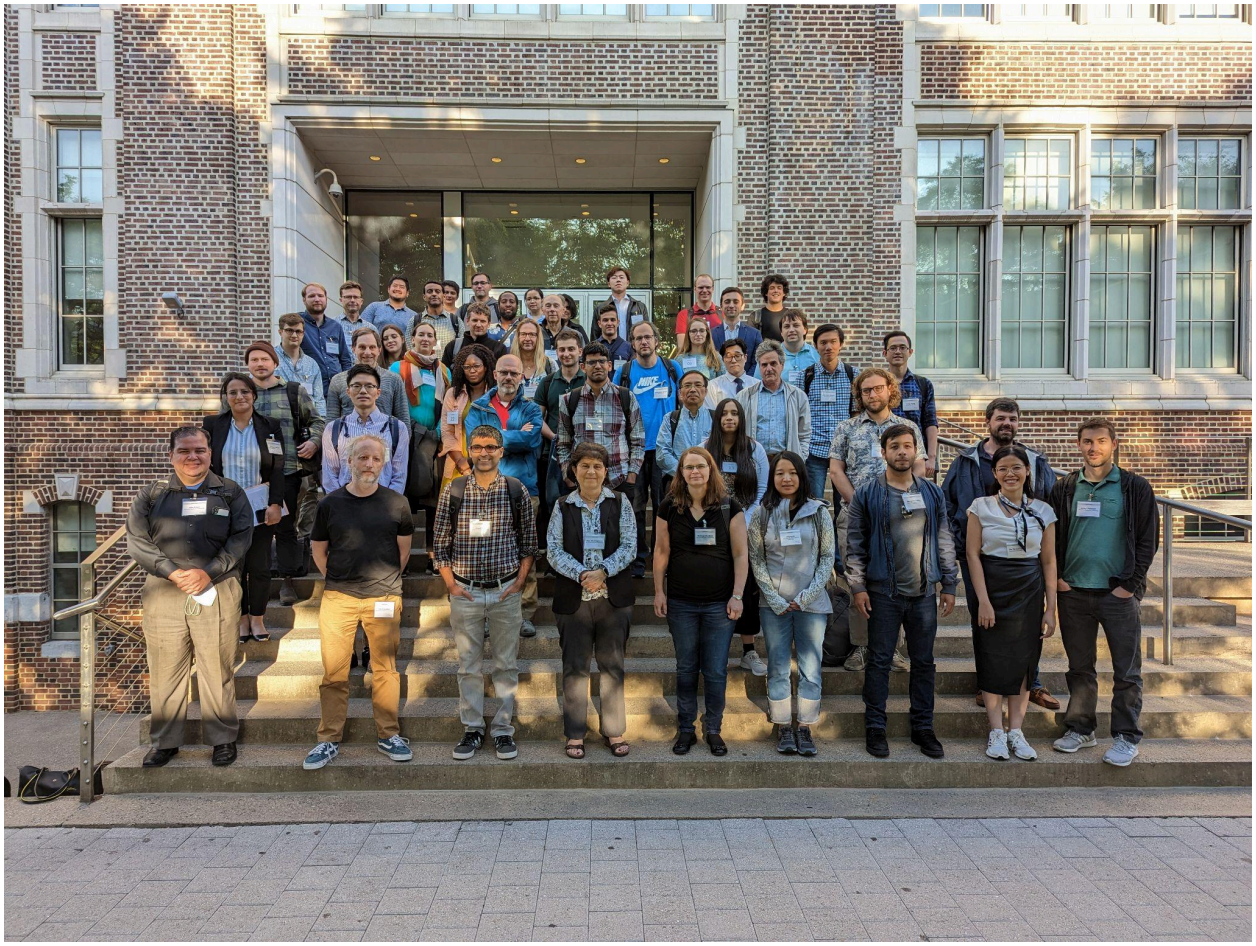
The Center for Applied Mathematics and Statistics and Department of Mathematical Sciences welcomed over 100 participants to the conference

``Frontiers in Applied and Computational Mathematics'' (FACM ‘23) held on May 26-27 at NJIT. The FACM 2023 conference theme was ``New trends in computational wave propagation and imaging,'' and focussed on several problem areas that have either been established as areas of major significance in applied mathematics, or as emerging research fields with exceptional potential. In particular, this 18th conference in the FACM meeting series was devoted to promising recent research in the areas of (1) inverse problems and imaging, (2) integral equation and high-frequency methods, (3) optimal transport in optical design, and (4) applications of machine learning in PDE's and inverse problems. Minisymposia were held in each of these problem areas. Plenary talks were given by Nilima Nigam (Simon Fraser), Nathan Kutz (University of Washington), Euan Spence (University of Bath) and Cristian Gutierrez (Temple).

Overall there were 25 invited talks and 35 poster presenters. Other activities included a reception and a panel discussion on “Emerging methods and open problems in computational wave propagation and imaging.” The conference series brought together mathematicians, statisticians, scientists, and engineers to present their research in an environment that promotes significant interaction and cross-fertilization among the participants.

The FACM ’23 Organizing Committee consisted of Michael Siegel (NJIT), Yassine Boubendir (NJIT), Travis Askham (NJIT), Christina Frederick (NJIT), Brittany Froese-Hamfeldt (NJIT), Bamdad Hosseini (U. Washington), Zoi-Heleni Michalopoulou (NJIT), Thi-Phong Nguyen (NJIT), David Shirokoff (NJIT), Yunan Yang (ETH/Cornell).

The organizers thank NSF for their generous support of the conference.



FACM 2023 Group Photo

VII. FUNDED RESEARCH

A. EXTERNALLY FUNDED RESEARCH

Continuing Funded Projects

Collaborative Research: Novel Microlocal-Analysis and Domain-Decomposition Based Fast Algorithms for Elastic Wave Modeling and Inversion in Variable Media
National Science Foundation: August 1, 2020 - March 31, 2024
Yassine Boubendir

NSF INCLUDES DDLP: Leadership and iSTEAM for Females in Elementary school (LiFE): An Integrated Approach to Increase the Number of Women Pursuing Careers in STEM
National Science Foundation: April 1, 2018 - August 31, 2021
Bruce Bukiet

Nonlinear Resonant Wave Interactions in Density-Stratified Flows
National Science Foundation: September 1, 2021 - August 31, 2024
Wooyoung Choi

Liquid Crystal Films Across Scales: Dewetting & Dielectrowetting
National Science Foundation: September 1, 2018 - August 31, 2023
Linda Cummings (PI), Lou Kondic (Co-PI)

GOALI: Predicting Performance & Fouling of Membrane Filters
National Science Foundation: September 1, 2016 - August 31, 2022
Linda Cummings (PI), Lou Kondic (Co-PI)

CAREER: Neuronal Data Assimilation Tools and Models for Understanding Circadian Rhythms
National Science Foundation: July 1, 2016 - September 30, 2022
Casey Diekman

Strategies, algorithms, and analysis for autonomous mobile sensor deployment
US Dept. Of Navy: August 20, 2021 - August 19, 2024
Christina A. Frederick

CAREER: Generated Jacobian Equations in Geometric Optics and Optimal Transport
National Science Foundation: July 1, 2018 - June 30, 2023
Brittany Hamfeldt

Development of a graduate course on granular matter
Ministry of Education, Argentina: April 1, 2022 - October 1, 2022
Lou Kondic

Phase Separation of Two-Fluid Mixtures using Surface Acoustic Waves: Developing Basic Principles in a Quest for Enhanced Water Recovery

US- Israel Binational Science Foundation: October 1, 2021 - September 30, 2025
Lou Kondic

Active Oil-Water Separation Using Surface Chemistry and Acoustowetting
American Chemical Society: August 1, 2021 - August 31, 2023
Lou Kondic

Stick-Slip Dynamics and Failure in Granular Materials
Duke University: July 15, 2018 – July 31, 2022
Lou Kondic

Scalable Inference of quantile Regression for Large-Scale Health Care Data
National Institutes of Health: May 15, 2019 – April 30, 2024
Ji Meng Loh

Modeling and Simulations of Problems in Active Matter
The Simons Foundation: September 1, 2019 - August 31, 2024
Enkeleida Lushi

Collaboration in Mathematical Biology
The Simons Foundation: September 1, 2020 - August 31, 2025
James Maclaurin

Collaborative Research: Understanding the Turbulent Dynamics of Convective Bursts and Tropical Cyclone Intensification Using Large Eddy Simulation and High Order Numerics
National Science Foundation: August 1, 2021 - July 31, 2024
Simone Marras

Supplement Collaborative Research: Understanding the Turbulent Dynamics of Convective Bursts and Tropical Cyclone Intensification Using Large Eddy Simulation and High Order Numerics
National Science Foundation REU: August 1, 2021 - July 31, 2024
Simone Marras

Conference on Frontiers in Applied and Computational Mathematics
National Science Foundation: May 1, 2022 – April 30, 2023
Victor Matveev (PI), Amitabha Bose (Co-PI)

Geoacoustic Inversion in Shallow Water - Analytic and Optimization Methods
U.S. Navy: Office of Naval Research: March 1, 2020 - February 28, 2024
Zoi-Heleni Michalopoulou

Coherent Structures in Nanomagnetism
National Science Foundation: July 1, 2019 - June 30, 2023
Cyrill Muratov

Modeling and Simulation of Interacting Wings: Collective Dynamics in Inertial Fluid Flows
National Science Foundation:July 15, 2021 - June 30, 2024
Anand U. Oza

Phase Transitions in Colloid-Polymer Mixtures in Microgravity
NASA: November 5, 2019 - November 3, 2023
Anand Oza

Wave-Coupled Active Matter
Simons Foundation: September 1, 2018 - August 31, 2023
Anand Oza

US-Israel Research Proposal: Network Resonance: Spiking Mechanisms and Behavioral Implications
National Science Foundation: September 15, 2016 - August 31, 2022
Horacio Rotstein

CDS&E: Collaborative Research: Scalable Nonparametric Learning for Massive Data with Statistical Guarantees
National Science Foundation: August 1, 2019 - July 31, 2023
Zuofeng Shang

Collaborative Research: Euler-Based Time-Stepping with Optimal Stability and Accuracy for Partial Differential Equations
National Science Foundation: August 15, 2020 - July 31, 2024
David Shirokoff

Collaborative Research: Overcoming Order Reduction and Stability Restrictions in High-Order Time-Stepping
National Science Foundation: August 1, 2017 - July 31, 2022
David Shirokoff

Flows about Grooved Superhydrophobic Surfaces
US- Israel Binational Science Foundation: October 1, 2021 - September 30, 2025
Michael Siegel

Numerical Methods and Analysis for Interfacial Flow with Ionic Fluids and Surfactants
National Science Foundation: August 1, 2019 - July 31, 2023
Michael Siegel

Optimized Domain Decomposition Methods for Wave Propagation in Complex Media
National Science Foundation: September 1, 2019 - August 31, 2022
Catalin Turc

Efficient Solutions of Wave Propagation Problems in Multi-Layered, Multiple Scattering Media
National Science Foundation: September 1, 2016 - August 31, 2022
Catalin Turc

Collaborative Research: Mathematical, Numerical, and Experimental Investigation of Flow Sensing by the Primary Cilium
National Science Foundation: August 1, 2020 - July 31, 2024
Yuan-Nan Young

Collaborative Research: Theoretical, Computational, and Experimental Investigations on the Interaction Between a Lipid Bilayer Membrane and a Solid Substrate or Particle
National Science Foundation: September 1, 2016 - August 31, 2022
Yuan-Nan Young

Projects Funded During the Present Academic/ Fiscal Year

GOALI: Network models for membrane
National Science Foundation: August 15, 2022 - July 31, 2025
Linda Cummings (PI), Lou Kondic (Co-PI)

GOALI: Merging Deep Learning and Mechanistic Modeling to Analyze the Electrophysiology of Circadian Clock Neurons, Aging, Cardiac Arrhythmias, and Alzheimer's Disease
National Science Foundation: July 15, 2022 - June 30, 2025
Casey Diekman

Dynamics and scattering of vortices
National Science Foundation: August 15, 2022 - July 31, 2025
Roy Goodman

Advancing Analysis of Multi-omics Data in Alzheimer's Disease Research
Trustees Of The University of Pennsylvania: April 1, 2023 - March 31, 2024
Chong Jin

Geoacoustic inversion in shallow water - stochastic and machine learning approaches
U.S. Navy: Office of Naval Research: April 1, 2023 - March 31, 2026
Zoi-Heleni Michalopoulou

B. PROPOSED RESEARCH

Projects Proposed During Present Fiscal Year

Travis L. Askham

Collaborative Research: Elements: A Fast, Accurate, and Easy-to-Use Integral Equation Toolbox
National Science Foundation, December 16, 2022

Yassine Boubendir

Stable and efficient high frequency iterative methods for wave propagation
National Science Foundation, November 29, 2022

Casey O. Diekman

IBM PhD Fellowship Program - Michael Luo
IBM, March 3, 2023

Christina A. Frederick

Collaborative Research: New perspectives from applied and computational time-frequency analysis
National Science Foundation, May 19, 2023

Multiscale inverse scattering problems in ocean acoustics
National Science Foundation, November 30, 2022

Roy H. Goodman

Conference: First SIAM New York/New Jersey/Pennsylvania Section Conference
National Science Foundation, February 17, 2023

Dynamics and scattering of vortices and vortex rings
National Science Foundation, July 20, 2022

Brittany D. Hamfeldt

Approximation of transport maps from local and non-local Monge-Ampere equations
National Science Foundation, November 21, 2022

Efficient iterative numerical methods for the solution of fully nonlinear elliptic equations
National Science Foundation, November 10, 2022

David J. Horntrop

REU Site: Summer Explorations in Applied Mathematical Sciences at NJIT (SEAMS-NJIT)

National Science Foundation, September 6, 2022

Chong Jin

Advancing Analysis of Multi-omics Data in Alzheimer's Disease Research
Trustees Of The University of Pennsylvania, April 17, 2023

Statistical learning methods for multi-omics data
Sage Bionetworks, March 14, 2023

Lou Kondic

Acoustofluidic Delivery, Propulsion, and Agitation of Catalytic Particles in Thin Films on Non-Porous and in Porous Media for Decontamination
Regents of the University of California, April 28, 2023

Modeling and simulation of phase separation and thermal effects in nanoscale free surface films, with application to liquid alloys
National Science Foundation, November 15, 2022

Collaborative Research: CDS&E Analysis of dense suspension dynamics via network methods
National Science Foundation, October 17, 2022

Enkeleida Lushi

Fast simulations of micro-swimmers in complex confinement
National Science Foundation, December 1, 2022

James N. MacLaurin

Noise Induced Patterns and Waves
National Science Foundation, November 15, 2022

Zoi-Heleni Michalopoulou

Detection, Localization, and Classification of Underwater Munitions: Integrating Multi-modality Physics-informed Learning via Meta-Analysis
US Dept of Defense, March 9, 2023

Geoacoustic inversion in shallow water - stochastic and machine learning approaches
US Dept. Of Navy, December 20, 2022

Thi Phong Nguyen

New Imaging Method for inverse scattering problems in complex inhomogeneous media
National Science Foundation, November 15, 2022

Anand U Oza

CAREER: Waves and memory in active matter
National Science Foundation, July 27, 2022

Zuofeng Shang

CDS&E: Optimal Nonparametric Inference Based on Deep Neural Network for Massive Quantized Data
National Science Foundation, September 15, 2022

David G. Shirokoff

Collaborative Research: Accuracy-Preserving Robust Time-Stepping Methods for Fluid Problems
National Science Foundation, March 14, 2023

Michael S. Siegel

International Conference on Multiscale Modeling and Simulation Based on Physics and Data
US Dept. Of Navy, November 21, 2022

Conference on Frontiers in Applied and Computational Mathematics (FACM-2023): New trends in wave propagation and imagine
National Science Foundation, September 26, 2022

Catalin C. Turc

Density Interpolation Methods for high-order discretizations of electromagnetic and elastic integral operators
National Science Foundation, November 14, 2022

Antai Wang

Analysis of dependent censored data using copula models
US NIH, February 27, 2023

Analysis of dependent censored data using copula models
National Science Foundation, December 15, 2022

Kristina Wicke

Exploring phylogenetic trees and networks and their applications
The Simons Foundation, January 10, 2023

Collaborative Research: Translating Combinatorial Encodings into Practical Network Inference
National Science Foundation, December 14, 2022

Yuan-Nan Young

Collaborative research: Self-organization modeled by moving domain elliptic PDEs
National Science Foundation, March 14, 2023

VIII. COMMITTEE REPORTS AND ANNUAL LABORATORY REPORT

A. COMPUTER FACILITIES

Computing Equipment

Access to high performance computing (HPC) resources is 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 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 for the proposers consists of the workstations and desktop PC's that are networked and available to investigators in their offices, plus other more major, shared facilities of the CMCL.

Shared HPC resources at NJIT and within the CMCL are anticipated to change significantly in the coming year when a new system, called Wulver, will come online and older systems will be retired. This transition has not yet occurred and the current HPC resources are described in detail below.

The DMS has expanded its "Stheno" cluster in stages since its first server became operational in 2011. The cluster is intended to be used to test, debug, and run message-passing interface (MPI) codes. It now has 30 nodes and 368 cores, 3,840 GB of RAM, and 9,872 GB of local disk storage. Two servers of the cluster contain GPU's, which now total 6, with a total of 32 GB of GPU RAM. The GPU's are currently CUDA capable and are intended for general purpose computation on GPU-accelerated computing nodes.

The DMS also has its "Gorgon" cluster, which has been expanded sequentially since it became operational in 2010. This cluster is intended for jobs that require large memory, and for parallel computations that use the OpenMP application programming interface. It is now a 32 core system, with AMD Opteron 6134 processors running at 2.3 GHz, and a total of 64 GB of shared memory.

Recognizing the need to support the scientific and engineering computing that is essential to research efforts across the campus, NJIT provides all faculty, postdocs, and graduate students access to centralized computing servers for research purposes. The current general computing cluster provided by NJIT is called Lochness. Lochness utilizes a shared infrastructure model with public, private, and Stheno nodes supported.

All computational facilities are maintained by the Academic and Research Computing Systems (ARCS) group, headed by its director, David Perel.

Current resources (DMS only and general access) are summarized in the table below (provided by ARCS):

Category	**Lochness**	**Stheno**	**Gorgon**
Nodes	206	32	1
Total CPU cores	24780	392	32
Total RAM, GB	58767	3840	64
Total GPU cores	78932	15320	-

Total GUP RAM, BG	386	32	-
Total Local disk, GB	210944	9872	-
Type	Cluster	Cluster	SMP
AFS Client	Yes	Yes	Yes
Access	General	Restricted (DMS)	Restricted (DMS)

B. STATISTICAL CONSULTING LABORATORY REPORT

July 2022 - June 2023

The Statistical Consulting Lab serves the NJIT community and external organizations and aims to offer high quality statistical consulting for the purposes of promoting research, collaboration, and statistical education.

Ji Meng Loh, together with PhD student Chhavi Tyagi worked with Mr Ken Beyer from ASTM from June 2022 to March 2023 to study the normality of sieve opening measurements to evaluate whether to update ASTM E11 quality control standards.

Ji Meng Loh met with Asst Professor Martin Kellog (Computer Science) in January 2023 to discuss methods for meta analysis in support of a NSF grant submission to study understandability of source code by humans.

The SCL also provided consulting support to graduate students in their research:

1. Ji Meng Loh met with PhD student Dahlia Musa (Information Systems) in March 2023 to discuss statistical methods to analyze data on measurements of wounds as they healed. The project aims to compare experts and non-experts in their use of guided and non-guided software to examine the trend in measurements of a wound as it heals.

2. Ji Meng Loh met with Masters student Dahlia Mansour (Biology) in March 2023 to discuss methods to process and analyze data collected from temperature sensors placed under and away from trees.

IX. CURRENT AND COLLABORATIVE RESEARCH

A. RESEARCH AREAS IN CAMS

Mathematical Biology

Researchers in CAMS working on problems related to Mathematical Biology: Booth, Bose, Bunker, Diekman, Flammang, Garnier, Golowasch, Holzapfel, Lushi, MacLaurin, Matveev, Nadim, Rotstein, Russell, Sachs, Wicke, and Young.

Mathematical Biology broadly refers to the branch of mathematics that is devoted to the theoretical study of biological processes and the development of novel mathematical tools to understand these processes. Recently, there has been quite a bit of emphasis on the intersection of mathematics with developmental biology, neurophysiology, systems biology, and genomics. Moreover, mathematicians are applying their modeling and analytical skills to the study of various diseases, such as diabetes, Parkinson's disease, schizophrenia, 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, stochastic differential equations, fluid dynamics, mechanics, parameter estimation, and statistics, to name only a few. Researchers in Mathematical Biology at NJIT have strong interdisciplinary research programs that involve, in most cases, active collaborations with experimentalists at the NJIT and Rutgers campuses, and other universities both in the US and abroad.

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. Various aspects of Computational and Mathematical neuroscience are being studied by Victor Matveev, Horacio G. Rotstein, Casey Diekman, Amitabha Bose and James MacLaurin. Matveev uses analytical and computational techniques to study intracellular calcium signals controlling synaptic neurotransmitter release, endocrine hormone release and other physiological processes. He is particularly interested in the dynamics of calcium diffusion and buffering underlying changes in synaptic transmission strength termed synaptic plasticity. Rotstein is interested in understanding the mechanisms of generation of neuronal rhythmic oscillations in various areas of the brain (e.g., hippocampus, entorhinal cortex, neocortex, prefrontal cortex, striatum, olfactory bulb) and how this results from the cooperative activity of the dynamic and biophysical properties of the participating neurons, the synaptic connectivity and the network topology. A primary focus of this research is the study of the effects that single cell and network resonances (emergent properties resulting from the interaction between neurons/networks and oscillatory inputs) affect the generation of network oscillations. Diekman creates multiscale models of the circadian (~24-hour) clock to understand the interaction of membrane excitability and daily rhythms in gene expression and behavior. He is also developing data assimilation techniques for parameterizing conductance-based models, and new methods for analyzing how circadian oscillators entrain to environmental cycles. Bose is interested in developing mathematical and dynamical systems techniques to understand neuronal networks. In particular, he is interested in developing models for beat perception in the context of music and for circadian oscillations. James MacLaurin studies many aspects of neuroscience, including the effect of white noise on waves and patterns, derivation of population-density equations to describe the collective behavior of large ensembles of neurons, and techniques for the phase reduction of noisy irregular oscillations.

Another focus of CAMS members is in the area of computational and applied ecology as well as evolution. Dan Bunker is interested in how natural ecosystems cope with the ever increasing stresses placed on them by the forces of global change. Claus Holzapfel is interested in the creation of novel communities that consist of species that never occurred together, but are now being created through fast paced human impact. Gareth Russell studies complex ecological systems, including predictive models of wading bird species in the Everglades National Park. Kristina Wicke works in phylogenetics and is interested in the estimation and mathematical properties of evolutionary trees and networks.

In the area of biological fluid-structure interactions, Young has focused on the biomechanics of primary cilium, a cellular antenna that bends under a fluid flow around the cell. Young has also investigated the force from lipid (FFL) paradigm by constructing a continuum model for the activation of a non-selective mechanosensitive channel reconstituted in a vesicle under fluid stress. Lushi and other CAMS members work on the modeling and simulation of active matter.

Finally, external member Jeffrey Sachs uses pharmacometrics for vaccine discovery and development.

Fluid Dynamics and Material Science

Researchers in CAMS working on problems related to Fluid Dynamics and Material Science: Afkhami, Ahmadpoor, Askham, Bechtold, Booty, Bukiet, Choi, Cummings, Dias, Diez, Farokhirad, Gor, Huang, Jiang, Kondic, Luke, Lushi, Marras, Meegoda, Mema, Oza, Pak, Papageorgiou, Petropoulos, Rosato, Sanei, Shirokoff, Shakib, Siegel, Tafuni, Vanden-Broeck, Voronov, Wang H., Wang Q., Wylie, and Young.

A large group of members within the Department of Mathematical Sciences (DMS) and Center for Applied Mathematics and Statistics (CAMS) have research interests in fluid dynamics and Material Science. 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 gasses. 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, including data science

The fluid dynamics group in the Department of Mathematical Sciences at NJIT has an active research program covering interfacial fluid dynamics, thin films, electrohydrodynamics, hydrodynamic stability theory, sedimentation, climate science, granular flow and combustion. A particular focus for several of the faculty members is the study of free and moving boundary problems. These are particularly challenging problems in that partial differential equations have to be solved in a region which is not known in advance, but must be determined as part of the solution. A famous example is the Stefan problem for melting ice or freezing water, but also the dynamics of bubbles, jets, shock waves, flames, tumor growth, crack propagation and contact problems all can be classified under this heading. CAMS fluid dynamics researchers are also pursuing applications of their work in Biology and Nanotechnology. In particular, there is an active research program in active matter. This and other topics in complex fluids is the focus of a complex fluids and soft matter working group, headed by Anand Oza.

There are also various research activities in material science. This includes molecular dynamics, variational methods, thin film materials, gels and soft matter, and data science methods.

Wave Propagation

Researchers in CAMS working on problems related to Wave Propagation: Ahluwalia, Askham, Booty, Boubendir, Choi, Erneux, Frederick, Goodman, Jiang, Michalopoulou, Moore, Nguyen, 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.

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 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. Thi-Phong Nguyen studies inverse problems applied to the non-destructive testing of materials.

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. In particular, Zoi-Heleni Michalopoulou and Christina Frederick work on developing powerful new algorithms for inverse problems in acoustics. Their research brings forward state-of-the-art techniques, including machine learning, to these challenging problems.

Numerical Methods

Researchers in CAMS working on problems related to Numerical Methods: Afkhami, Askham Boubendir, Bukiet, Choi, Dias, Dytso, Frederick, Goodman, Hamfeldt, Horntrop, Jiang, Kondic, Koutis, Luke, Lushi, Matveev, Michalopoulou, Moore, Musialski, Muratov, Nguyen, Papageorgiou, Petropoulos, Rosato, Shirokoff, Siegel, Shang, Tao, Turc, Xu and Young.

Given the rapidly increasing computing power and capacity 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 actively 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 high-performance clusters..

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; hybrid methods are being developed and refined in order to achieve high order 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. Efficient and consistent coarse-grain algorithms are designed to simulate the dynamics of DNA molecules and lipid bilayer membranes in viscous flows. 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. Recently, there has been significant research efforts by CAMS members on emergency methods in data science. Focus areas include statistical learning and applications of data science in acoustics, solar physics, and fluids.

Statistics

Researchers in CAMS working on problems in Applied Probability and Statistics: Dhar, Guo, Jin, Loh, Roychoudhury, Shang, 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 (Fang, Jin, Guo), bootstrap methods (Subramanian), censored time-to-event data analysis (Dhar and Subramanian), computational statistics (Fang, 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 (Fang, Guo, Loh, and Wang), machine learning and data mining (Fang), minimum distance estimation (Dhar), multiple imputations methods (Subramanian), multiple testing (Guo), semiparametric estimation and inference (Dhar and Subramanian), spatial statistics and spatial point patterns (Loh), statistical genomics/genetics and RNA-seq methods (Jin), 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.

X. STUDENT ACTIVITIES

A. UNDERGRADUATE ACTIVITIES

Report on Undergraduate Studies
David J. Horntrop, Associate Chair for Undergraduate Studies

The undergraduate program of the Department of Mathematical Sciences continued to be very active during the past academic year.

In addition to their studies in our rigorous academic programs, many of our undergraduates also engaged in research. In addition to participating in the Provost's Summer Undergraduate Research Program, many students have engaged in research by working with individual professors and by participating in REU programs such as the RIPS program at UCLA.

Many of our students have industrial internships during the summer, particularly, but not exclusively, students in the Mathematics of Finance and Actuarial Science concentration. Each summer a number of students have internships at MetLife and Prudential Financial while some students intern at consulting firms such as Mercer Consulting and Oliver Wyman Actuarial Consulting. Companies such as Movado Group, Chubb, Aon, Google, Facebook, and BNY-Mellon also employ our students as summer interns.

Our students have also received many honors and awards during the past year and have also found success on their actuarial examinations with more than 12 passed during the year. The department itself was honored by having its Mathematics of Finance and Actuarial Science program ranked fifth nationally in a study commissioned by SafecoInsurance.com.

Many students who graduate from our program continue either to enter graduate programs at other prestigious institutions or find gainful employment. Examples of graduate schools recently attended by our undergraduates include UTexas-Austin, UCLA, CalTech, RPI, Columbia, Northwestern, and the University of Delaware. Examples of employers of our recent graduates include MetLife, Prudential Financial, Chubb, NYLife, Aon, Buck Consultants, Trillium Management, J.P.Morgan Chase & Co., and Willis Towers Watson.

Project 1: Computational Topology Methods Applied to Particulate Systems

Instructor: Lou Kondic

Lab Assistant: Joseph D'Addesa

Participating Students: Anay Bhat, Zhaoshu Cao, Brandon Coutinho, Mike Jeong, Michelle Vanadia

This Capstone project focuses on the analysis of the structure and interparticle interaction in the experiments carried out by the instructor's collaborators in 2022 at U. Stuttgart, Germany, using XRCT (X-ray computed tomography) (PNAS 120, 2219999 (2023)). The experiments focus on the mechanical response of glass-rubber particle systems, with the goal of understanding how the addition of rubber particles modifies this response. Participating students analyzed the data using two types of approaches emerging from persistent homology. The first approach is based only on the geometry of packings and quantifies this geometry using so-called alpha-complexes. The second approach considers particle interactions (quantified by their distance) in addition to the geometry. The outcome of the topology-based approaches was compared to experimentally measured mechanical properties, and suggestions for future experiments were formulated. The web page illustrating the results can be found at http://cfsm.njit.edu/capstone.

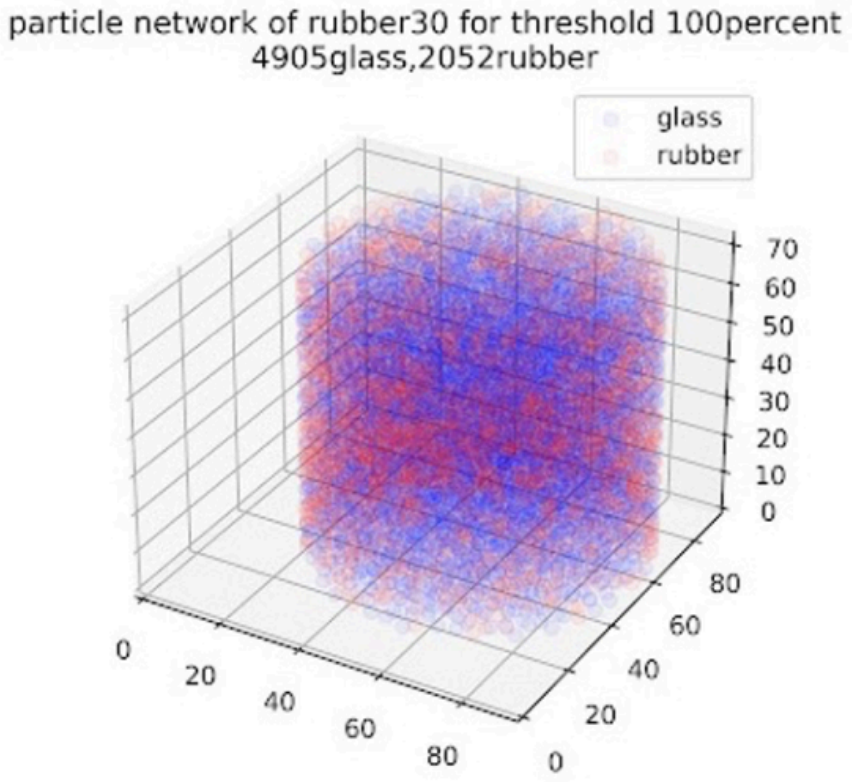


Figure 1. Experimental image showing the glass (blue) and rubber (red) particles.

This project is supported in part by the NSF Grant No. DMS - 2201627.

Project 2: Computational Topology Methods Applied to Pore-based Filters

Instructor: Lou Kondic

Lab Assistant: Joseph D'Addesa

Participating Students: Omar Benavente, Skender Capani, Carlos Espana, Linus Garcia

This Capstone project focuses on the application of computational topology to the networks formulated by our current PhD candidate Matt Illingworth (in collaboration with our former student Binan Gu). Such networks (see Figure 1) are used as a proxy for filters used in applications. The focus of the project is on computing topological measures describing the geometry of the pore networks. The students have carried out such computations and have also learned about the basics of computational topology. The resulting measures quantifying the geometry of the networks are then compared to the filtration performance. The web page illustrating the results can be found at http://cfsm.njit.edu/capstone.

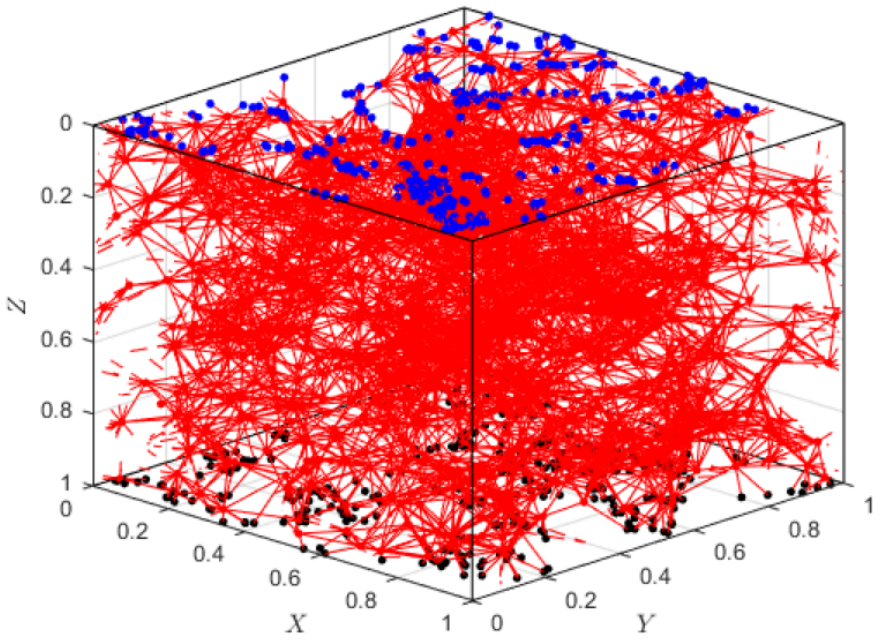


Figure 2. Example of a network used for computations (from J. Membrane Sci. 657 120668 (2022)).

This project is supported in part by the NSF Grant No. DMS - 2201627.

Project 3: Modeling Frosting Utilizing Monte Carlo Simulations

Instructor: Lou Kondic

Lab Assistant: Joseph D'Addesa

Participating Students: Itay Bachar, Nalby Kadkoui, Ryan McCann, Yousef Sayes, Amritha Venigalla

This Capstone project focuses on modeling frosting on microstructured substrates in experiments carried out by instructors' collaborators at the Max-Planck Institute of Polymer Science in Mainz, Germany. Based on the experimental results and helped by direct communication with the researchers involved in carrying out these experiments, the students formulated Monte Carlo-based simulations of the frosting process, focusing in particular on the correlation of the outcome of the results (such as the fractal dimension of the emerging patterns) between the experiments and simulations. The web page illustrating the results can be found at http://cfsm.njit.edu/capstone.

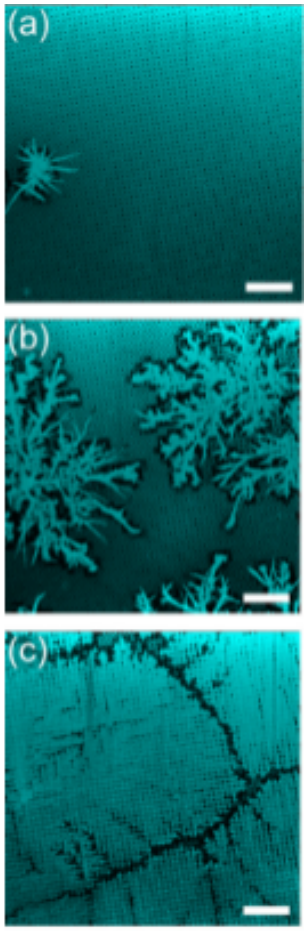


Figure 3. Experimental image of frost spreading in experiments carried out with different humidities. From Phys. Rev. E 104, 044901 (2021).

Project 1: Dynamical modeling of pyramidal neuron excitability using deep learning

Instructor: Casey Diekman

Lab Assistant: Soheil Saghafi

Participating Students: Luc Brancheau, Sam Granovsky, Heonjun Miller, and Patrick Wu

The action potentials (APs) generated by pyramidal neurons are important for many cognitive processes. The goal of this project was to infer biophysical parameters (in particular, the maximal ionic conductances) underlying pyramidal neuron excitability based on AP recordings provided by Jorge Golowasch (Federated Department of Biological Sciences, NJIT & Rutgers-Newark). First, we defined several features to capture the properties of pyramidal neuron APs, such as AP width and height. Next, we created a training dataset by simulating a biophysical ODE model of pyramidal neurons with millions of random parameter sets and calculating the AP features. Then, we used a conditional Generative Adversarial Networks (cGAN) to learn the mapping between feature space and parameter space. Finally, we calculated AP features from the experimental data and passed them to the trained cGAN to obtain parameter values consistent with the data. This allowed us to infer the distribution of maximal ionic conductances in these cells and demonstrated that cGANs are a powerful deep learning approach for developing biophysical models of pyramidal neurons.

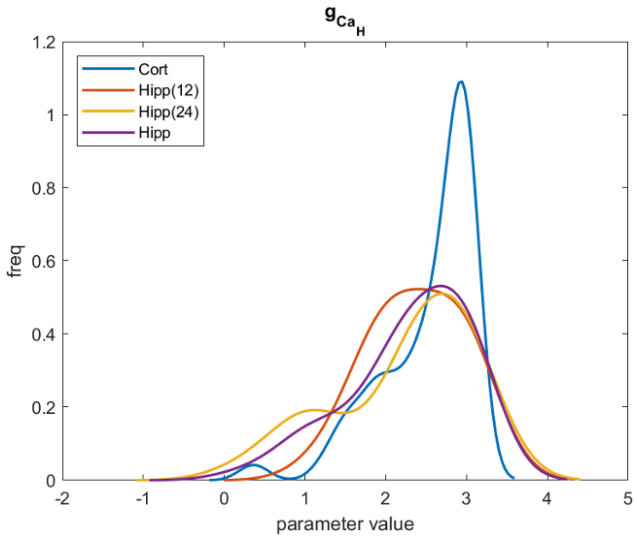


Figure 4. Kernel density estimate plot showing the distribution of the maximal conductance of the high-voltage activated calcium channel (gCaH) for pyramidal neurons in the cortex (blue curve) and hippocampus (red, yellow, and purple curves) inferred using the trained cGAN.

This project is supported in part by the National Science Foundation grant No. 2152115.

Project 2: Dynamical Modeling of Cardiac Excitability Using Deep Learning

Instructor: Casey Diekman

Lab Assistant: Soheil Saghafi

Participating Students: Kale Alvarez, Matt Cassini, Marissah McNeil, and Moises Ramos

Sudden Cardiac Arrest (SCA) causes around 13% of all deaths in the US and occurs when the electrical system of the heart malfunctions. SCA is more likely to occur in the morning than at other times of day. In this project we sought to understand cardiac excitability and its relation to these daily (circadian) rhythms in SCA using ODE and PDE models of ventricular cardiomyocytes and published human ECG data. First, we defined several features to capture the properties of ECGs, such as the RT interval (i.e., the amount of time between the peak of the R wave and offset of the T wave in an ECG signal). Next, we created a training dataset by simulating a 1D cable of cardiac tissue with thousands of random parameter sets and calculating the pseudo-ECG features. In these simulations, the sodium conductance parameter was biased to be higher at night than during the day, and the L-type calcium conductance parameter was biased to be higher during the day than at night. Then, we used a conditional Generative Adversarial Network (cGAN) to learn the mapping between feature space and parameter space. Finally, we passed to the trained cGAN a target set of features from the daytime simulations and a target set of features from the nighttime simulations. In each case, the cGAN returned parameter sets with distributions consistent with the known biases used to generate the target data. This demonstrates the ability of cGAN to infer complex parameter distributions from simulated ECG features. Our next step would be to pass features extracted from the human ECG recordings made during the day and at night, and then compare the parameters inferred in each case to get insight into the ionic conductance changes that potentially underlie daily rhythms in SCA.

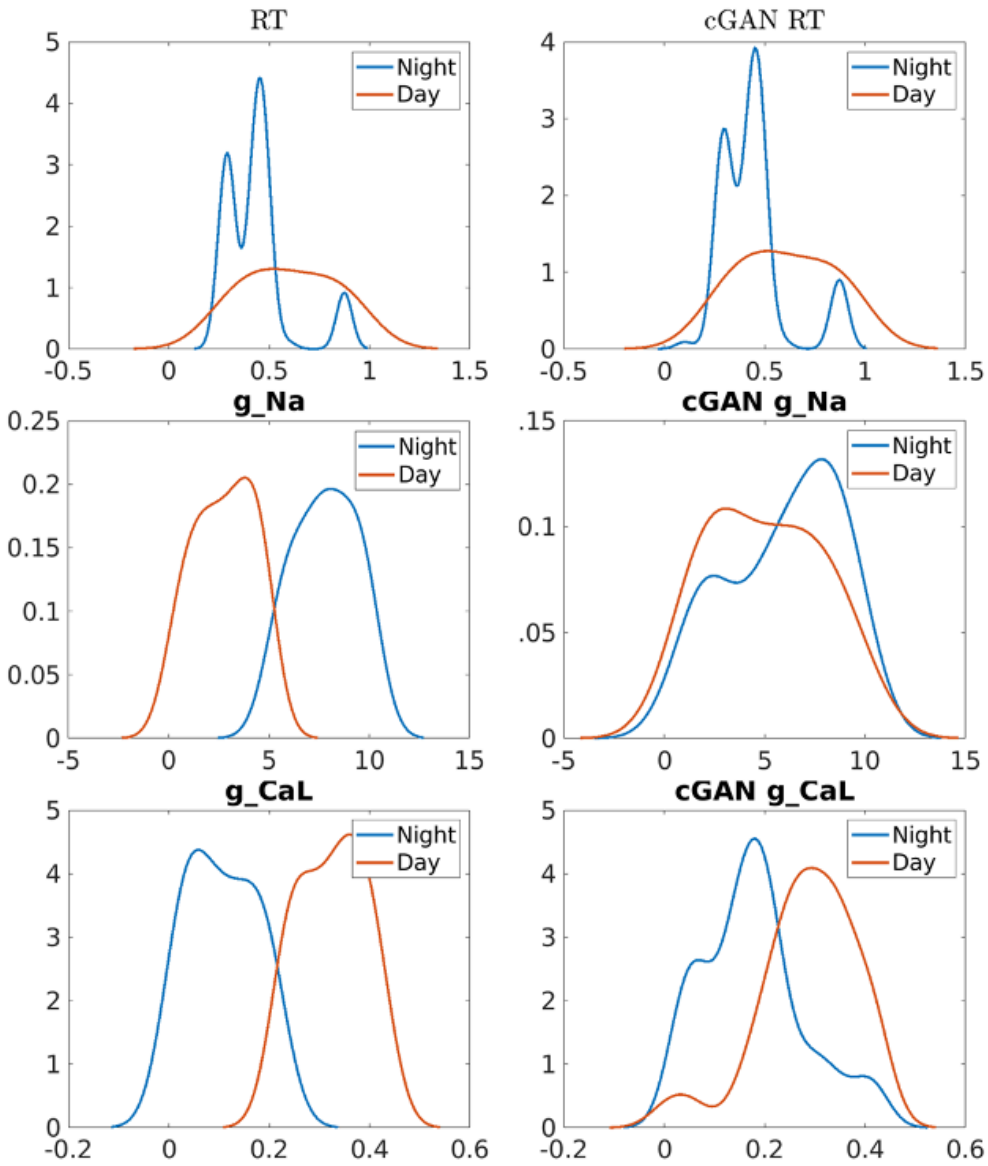


Figure 5. Top left: Kernel density estimate plots showing the distributions of an ECG feature (RT interval) that was presented to the trained cGAN as a daytime target (red curve) and a nighttime target (blue curve). Top right: Distributions of that ECG feature when the parameter sets generated by the cGAN in response to the targets are passed through the mechanistic model. Middle left: Distributions of the maximal sodium conductance parameter (g_Na) used in simulations to produce the target datasets. Middle right: Distributions of the maximal sodium conductance parameter (g_Na) inferred by the cGAN in response to the targets. Bottom left: Distributions of the maximal L-type calcium conductance parameter (g_CaL) used in simulations to produce the target datasets. Bottom right: Distributions of the maximal sodium conductance parameter (g_CaL) inferred by the cGAN in response to the targets.

This project is supported in part by the National Science Foundation grant No. 2152115.

Project 3: Simulating the Effect of Acoustic Waves on Ballistic Trajectories

Instructor: Casey Diekman

Lab Assistant: Soheil Saghafi

Participating Students: Rishik Danda, Jose Da Silva, Grace Leverett, Emily McNamara, and Tomas Poventud

We created a model to simulate the effect of pressure (wind and sound) on a ballistic object and to determine the pressure imparted on a moving object by acoustic waves. For simplicity, our simulation utilized supersonic ballistics and considered acoustic waves to be 2D sine waves. The purpose of the project was to determine what intensity of sound would be required to alter the trajectory of a moving bullet by approximately 6 inches, or 10 centimeters. The model was determined using the 1D pressure function, the distance formula, the angular frequency of the wave (200Hz), and the initial offset of the ballistic. Based on the implementation of our model in MATLAB, we determined that with the selected frequency and desired trajectory deviation, a sound level of 255 decibels would be required. When we increased the selected frequency to be above that of human speech, the results changed only slightly. We also conducted physical experiments using a 3D-printed bullet suspended by a string. We found that 2.4 mph wind from a fan moved the bullet by 6 cm, whereas 85 dB sound from a speaker did not move the bullet by a measurable amount.

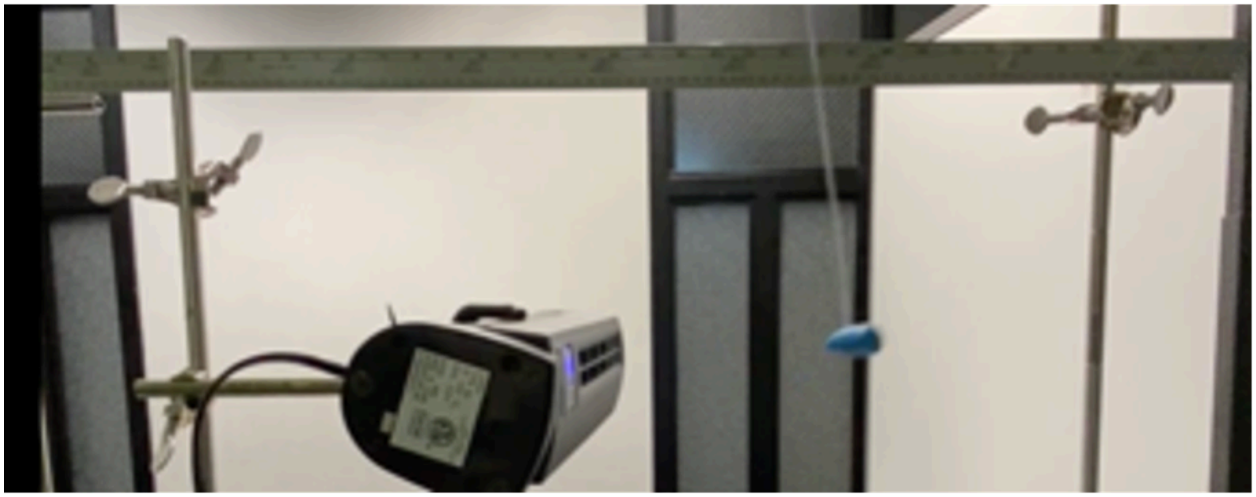


Figure 6. Setup for physical experiments testing how much wind speed produced by a fan can move a 3D-printed bullet suspended by a string.

B. GRADUATE PROGRAMS

Graduate Activities Report
Roy Goodman, Associate Chair for Graduate Studies

This was a banner year for the Department of Mathematical Sciences graduate program. We had a high yield on our offers of graduate admissions, culminating in an incoming class of 8 Ph.D. students in Applied Mathematics and Applied Statistics, plus one student in Data Science. The new students have diverse backgrounds from undergraduate and master's programs in mathematics (pure and applied), engineering, and statistics. Several current students secured summer internships at government labs and local pharmaceutical companies. The Ph.D. program in Data Science (Statistics track) is up and running: its first student started in the fall, and another will join in the spring.

The Department of Mathematical Sciences takes great pride in the quality of its graduate programs. In addition to master's programs in Applied Mathematics, Applied Statistics, Biostatistics, and Data Science (Statistics track), our Ph.D. program continues to attract high-caliber students who work closely with faculty to conduct original research in applied and computational mathematics and statistics. We have recently introduced graduate certificates in Applied Statistics, Biostatistics, and Data Science. Each graduate certificate provides its students with a four-course set of specialized training that can be used to enhance an existing career or to explore advanced material before enrolling in a master's program.

Our doctoral students have an impressive collective record of presenting and publishing their research. Each year, they earn invaluable experience and recognition for their accomplishments at high-profile meetings organized by SIAM, the APS, and other international scientific organizations. Almost all our students also present posters at our annual Frontiers in Applied and Computational Mathematics conference. Most of our students have at least one high-quality publication accepted by graduation, essential for success in today's job market.

Our doctoral students are very engaged in departmental activities, and they regularly organize tea-time as well as academic, career-oriented, and social events under the banner of the NJIT SIAM Chapter, such as a student-organized seminar series in machine learning in addition to the usual graduate student seminar series that runs over the summer (see below). Our students have had much recent success finding internships in governmental research facilities such as the Johns Hopkins Applied Physics Laboratory and at private companies, including Emergent Holdings, Sage Therapeutics, and Biogen.

Ultimately, the offers our students receive after graduation best indicate our programs' health. New positions secured by our graduates in the past two years include an NSF postdoctoral fellowship at Southern Methodist University, postdocs at Emory University, Wayne State University, and Sandía National Laboratory, and a statistics position at Regeneron Pharmaceuticals. Several recent graduates have obtained exciting positions in data science. This year, a former student gave a presentation on his path to becoming a data scientist and a colloquium speaker from a pharmaceutical company held an employment workshop for the students.

PhDs Awarded in the Period Covered by the Report

Yasser Almoteri
Bacterial Motion and Spread in Porous Environments
Advisor: Enkeleida Lushi

Lauren Barnes
Fluid Dynamics of Interacting Particles: Bouncing Droplets and Colloid-Polymer Mixtures
Advisor: Anand Oza

Rituparna Basak
Application of Computational Topology to Particulate Systems in Intermittent Flow Regime
Advisor: Lou Kondic

Subhrasish Chakraborty
Topics on Asymmetric Classification
Advisor: Wenge Guo

Binan Gu
Stochastic Modeling of Flows in Membrane Pore Networks
Advisors: Linda Cummings and Lou Kondic

Yuexin Liu
Low-Reynolds-Number Locomotion via Deep Reinforcement Learning
Advisor: Yuan-Nan Young

Connor Robertson
Continuum Modeling of Active Nematics via Data-Driven Equation Discovery
Advisors: Travis Askham and Anand Oza

Soheil Saghafi
Deep Hybrid Modeling of Neuronal Dynamics Using Generative Adversarial Networks
Advisor: Casey Diekman

Tadanaga Takahashi
Domain Decomposition Methods for Linear and Non-Linear Elliptic Problems
Advisor: Yassine Boubendir

Hewei Zhang
Exploring the Complementarity of Statistical and Machine Learning Techniques for Scientific Prediction
Advisor: Zuofeng Shang

Publications, Presentations, & Conferences

***Not Including DMS Summer Student Talks**

Lauren Barnes

Talks and Posters

The Role of Concentration-dependent Viscosity on the Dynamics of Colloid-polymer Mixtures, Conference on Frontiers in Applied & Computational Mathematics (FACM), May 26, 2023, NJIT, Newark, NJ

The Role of Concentration-dependent Viscosity on the Dynamics of Colloid-polymer Mixtures, American Society for Gravitational and Space Research Meeting American Society for Gravitational and Space Research, November 12, 2022, Houston, TX

The Role of Concentration-dependent Viscosity on the Dynamics of Colloid-polymer Mixtures, ASGSR Conference NASA, November 1, 2022, Houston, TX

The Role of Concentration-dependent Viscosity on the Dynamics of Colloid-polymer Mixtures, Conference on Frontiers in Applied & Computational Mathematics (FACM), May 26, 2023, NJIT Newark,

The Role of Concentration-dependent Viscosity on the Dynamics of Colloid-polymer Mixtures, American Society for Gravitational and Space Research Meeting American Society for Gravitational and Space Research, November 12,2022, Houston, TX

The Role of Concentration-dependent Viscosity on the Dynamics of Colloid-polymer Mixtures, SGSR Conference NASA, November 1, 2022, Houston, TX

Austin Juhl

Conference and Workshop Attendance

SIAM Conference on Computational Science and Engineering (CSE23)
February 28, 2023, Amsterdam, The Netherlands

Talks and Posters

Certifying Stability in Runge-Kutta Methods Via Semidefinite Programming
2023 SIAM RAI Convention Center, February 26 - March 3, Amsterdam, Netherlands

Justin Maruthanal

Conference and Workshop Attendance

Frontiers in Applied and Computational Mathematics (FACM 2023) at the New Jersey Institute of Technology, May 26-27, 2023, Newark NJ.

David Mazowiecki

Talks and Posters

Numerical Simulation of Particles Undergoing Quincke Rotation (poster),
Frontiers in Applied and Computational Mathematics,
May 26-27, 2023, New Jersey Institute of Technology, Newark, NJ.

Jose Pabon

Talks and Posters

Reduced-order Models of Hydrodynamically Interacting Flapping Airfoils,
Frontiers in Applied and Computational Mathematics (FACM 2023)
New Jersey Institute of Technology, May 26-27, 2023, Newark NJ.

Reduced-order Models of Hydrodynamically Interacting Flapping Airfoils,
Conference on Computational Science and Engineering (CSE23) Society for Industrial and Applied Mathematics (SIAM), February 27, 2023, Amsterdam, Netherlands

Connor Robertson

Talks and Posters

Data-driven Continuum Modeling of Active Nematics via Sparse Identification of Nonlinear Dynamics,
75th Annual Meeting of the American Physical Society Division of Fluid Dynamics American Physical Society, November 22, 2022, Indianapolis, IN

Chhavi Tyagi

Talks and Posters

Tree-based Conformal Prediction Approaches for Multi-label Classification
Conference on Advances in Multiple Testing, Temple University, June 1, 2023, Philadelphia, PA,

Kosuke Sugita

Publications

Impacts of Nanobubbles in Pore Water on Heavy Metal Pollutant Release from Contaminated Soil Columns (with Y. Zhang, Z. Song, S. Xue, and W. Zhang) *Nanomaterials*, Vol 13(10), 1671, (2023)

Posters

Scattering Matrix Computations for Integrated Photonics (poster),
Frontiers in Applied and Computational Mathematics
May 26-27, 2023, New Jersey Institute of Technology, Newark, NJ.

Conference and Workshop Attendance

SIAM Conference on Computational Science and Engineering (SIAM CSE23) at RAI Congress Centre, February 26 - March 3, 2023, Amsterdam, The Netherlands.

Frontiers in Applied and Computational Mathematics (FACM 2023) at the New Jersey Institute of Technology, May 26-27, 2023, Newark NJ.

Student Talks - Summer 2023

Thursday, June 6, **Samantha Evans**
A Fast Mesh-Free Boundary Integral Method for Two Phase Flow with Soluble Surfactant

Monday, June 12, **Lauren Barnes**
The Role of Concentration-dependent Viscosity on the Dynamics of Colloid-polymer Mixtures

Monday, June 12, **Jose Pabon**
Reduced-order Models of Hydrodynamically Interacting Flapping Airfoils

Thursday, June 22, **Souaad Lazergui**t
High Frequency Asymptotic Expansion of the Helmholtz Equation Solutions Using Neumann to Dirichlet and Robin to Dirichlet Operators

Thursday, June 23, **Nicholas Dubicki**
A Micromagnetic Study of Skyrmions in Ferromagnetic Thin Film Bilayers

Monday, June 26, **Moshe Silverstein**
Calcium Signaling: Stochastic Models, Large Deviation Theory, and Statistical Analysis

Monday, June 26, **David Mazowiecki**
Numerical Simulation of Particles Undergoing Quincke Rotation

Wednesday, July 5, **Connor Greene**
Efficient Points for Polynomial Interpolation on the Unit Interval

Thursday, July 6, **Kosuke Sugita**
Numerical Methods for the Monge-Ampère equation and Optimal Transport

Monday, July 10, **Rituparna Basak**
Application of Computational Topology to Particulate Systems in Intermittent Flow Regime

Monday, July 10, **Philip Zaleski**
Convergence Rates for Stochastic Gradient Descent Markov Operators

Thursday, July 13, **Joseph D'Addesa**
Phase Separation of Two-Fluid Mixtures using Surface Acoustic Waves

Thursday, July 13, **Nicholas Harty**
Time-Domain Multiple Scattering Using Convolution Quadrature

Thursday, July 13, **Michael Luo**
Modeling SCN Neuron Dynamics

Monday, July 17, **Mark Fasano**
Forced Phase Separation in a Closed Cell

Monday, July 17, **Zhiwen Wang**
Intensity Estimation in Spatial Analysis

Thursday, July 20, **Zheng Zhang**
Consistent Estimation of the Number of Communities in Nonuniform Hypergraph Model

Thursday, July 20, **Justin Maruthanal**
Oscillations of the Mitotic Spindle in C. Elegans During Asymmetric Cell Division

Thursday, July 20, **Atul Anurag**
Generalization of Leapfrogging Orbits of Point Vortices

Monday, July 21, **Patrick Grice**
Detecting Unexploded Ordnances

Monday, July 21, **Nastaran Rezaei**
Interfacial Instability of Two-Layer Flows of Newtonian Liquids

Monday, July 21, **Andrew White**
Effect of Calcium Buffer Properties on Cell Calcium Dynamics

Monday, July 21, **Prianka Bose**
Analyzing Son Clave Rhythmic Patterns

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