CAMS

Center for Applied Mathematics and Statistics

ANNUAL REPORT

2000-2001

NJIT
New Jersey Institute of Technology

TABLE OF CONTENTS

I. FROM THE DIRECTOR

As documented in this report, 2000-2001 was another solid year of accomplishment for CAMS and its members. These pages show that CAMS members are active scientists engaged in exciting interdisciplinary research. Twenty-three externally funded projects, sixty-two journal publications, thirty-four proceedings papers, eighty-four conference and seminar presentations testify to the productivity of CAMS members and the soundness of the CAMS research infrastructure. This report also shows that CAMS members are educators and mentors dedicated to helping students, both undergraduate and graduate, to grow and achieve their full potential. The four Ph.D. students completing in the past year represent the fruit of the efforts of CAMS members and the research environment that CAMS fosters. This past year saw the first student enrolled in the recently established Applied Statistics track of the Doctoral Program in the Mathematical Sciences. Particularly representative of the many contributions of CAMS and its members to undergraduate education is the CAPSTONE course which gives seniors an opportunity to see first hand the integration of theoretical, numerical and experimental methods in science. Graduate students have been working under difficult conditions due to space limitations; the new construction beginning this summer gives hope that this situation will soon be resolved. Finally, this report reveals the dedication of CAMS members to service. This dedication is seen in various community activities and most prominently in the CAMS Committees to maintain the CAMS research infrastructure.

CAMS basic research infrastructure remained healthy in 2000-2001. The growth and maturation of various disciplines within CAMS prompted the reorganization of the CAMS/Math seminars into two colloquia--one in Applied Mathematics and the other in Applied Statistics. Both colloquia continue to maintain the high standards that have distinguished the CAMS seminar series for so long. An important milestone in area of research funding for 2000-2001 was the receipt of a significant grant from the National Institutes of Health. This NIH grant, the first received through CAMS, is a powerful indication of the continuing growth and maturation of biomathematics in CAMS. Interactions with graduate students in the CAMS Reading Room appear to be increasing; CAMS will continue to encourage this trend. In addition to a significant proposal to NSF to enhance our scientific computing efforts, CAMS substantially upgrade the computing facilities for gradate students. CAMS is grateful to David Ullman, Associate Provost for Information Services and Technology, David Perel, Director of Engineering Computing, and their staff for the assistance and support they provided on this project.

The accomplishments of CAMS are built on the efforts and support of many individuals. CAMS is grateful to President Saul Fenster for the vision that has created an environment where the aspirations of CAMS are espoused and appreciated. Provost William Van Buskirk, Acting Dean of CSLA, and Donald Sebastian, Vice President for Research and Development, have encouraged CAMS through their strong support of scientific research. CAMS is very appreciative of the deep commitment of Gregory A. Kriegsmann, Foundation Chair in Applied Mathematics, whose generous supply of resources, advice, and energy have been instrumental in our ongoing success.

Daljit S. Ahluwalia, Director **Jonathan Luke, Associate Director**

II. MISSION STATEMENT

The Center for Applied Mathematics and Statistics (CAMS) was established in 1986 to promote research in the mathematical sciences at the New Jersey Institute of Technology. Members of the Department of Mathematical Sciences naturally form the core of CAMS membership, but the importance of mathematics for science and technology has made CAMS an interdisciplinary organization. The formal structure of CAMS consists of the Director, Associate Director, and various committees. But the essential nature of the organization is that of a voluntary association of individual researchers of many disciplines joined in a collegial collaboration to enhance mathematical work at NJIT.

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

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

III. MEMBERSHIP AND VISITORS

Department of Mathematical Sciences

Ahluwalia, Daljit S.
Andrushkiw, Roman
Bechtold, John
Bhattacharjee, Manish
Blackmore, Denis
Booth, Victoria
Booty, Michael
Bose, Amit
Bukiet, Bruce
Chaudhry, Hans
Crunk, Steven
Dhar, Sunil
Dios, Rose
Elmer, Christopher
Goldberg, Vladislav
Goldman, Daniel
Kappraff, Jay
Kondic, Lou
Kriegsmann, Gregory A.
Lott, Dawn
Luke, Jonathan
Michalopoulou, Zoi-Helen
Milojevic, Petronije
Nadim, Farzan
Papageorgiou, Demetrios
Perez, Manuel
Petropoulos, Peter G.
Ray, Bonnie
Siegel, Michael
Stickler, David
Tavantzis, John
Tilley, Burt

Visiting Members

Balaji, Srinivasan
Chen, Jerry
Georgieva, Anna
Muratov, Cyrill
Vanden-Broeck, Jean-Marc
Walker, Stuart
Yefet, Amir

Department of Biomedical Engineering

Michael Lacker

Department of Mechanical Engineering

Aubry, Nadine
Rosato, Anthony

Department of Civil and Environmental Engineering

Meegoda, Jay N.

Department of Computer and Information Science

Recce, Michael

CAMS Research Professors

Erneux, Thomas

Long and Short-Term Visitors

Chopra, D.V.	Wichita State University, Kansas
Diez, Javier	Universidad Nacional del Centro de la Provincia de Buenos Aires, Argentina
Dzamonja, Mirna	University of East Anglia, Norwich, England
Lychagin, Valery	University of Tromso, Norway

IV. SEMINARS AND COLLOQUIA

Applied Mathematics Colloquium

September 8 **Anna Georgieva,** Mathematical Sciences Department, New Jersey Institute of Technology

"A Distributed-Parameter Model for Formaldehyde Uptake and Disposition in the Rat Nasal Lining"

September 15 **Valery Lychagin,** Institute of Mathematical and Physical Sciences, University of Tromso, Norway

"Quantization and Symmetry"

September 22 **Marcelo Magnasco,** Laboratory of Mathematical Physics, Rockefeller University

"Essential Nonlinearities in Hearing"

September 29 **Kresimir Josic,** Department of Mathematics, Boston University

"Synchronization and phase locking in chaotic systems"

October 6 **Joel Koplik,** Levich Institute, City College of New York

"Molecular Fluid Mechanics"

October 13 **Omar Knio,** Department of Mechanical Engineering, John Hopkins University

"Mathematical Modeling and Numerical Simulation of Slender Vortices"

October 18 **Denis Blackmore,** Mathematics Department NJIT

"A Hamiltonian Approach to Obstacle - Vortex Filament Dynamics"

October 20 **George Karniadakis,** Division of Applied Mathematics, Brown University

"Spectral methods on unstructured grids: Algorithms and Applications"

October 27 **Patrick Miller,** Department of Mathematics, Stevens Institute of Technology

"Transport in Two-Dimensional Ocean Models: A Dynamical Systems Approach"

November 3 **Hsueh-Chia Chang,** Department of Chemical Engineering, University of Notre Dame, visiting Princeton University

"Fast-Igniting Catalytic Converters"

November 8 **Panayotis Kevrekidis,** Department of Physics, Rutgers University

"Dynamics and Interactions of Coherent Structures in Hamiltonian Nonlinear PDE's and DDE's"

November 10 **John Pelesko,** Department of Mathematics, Georgia Institute of Technology

"Mathematical Modeling of Electrostatic MEMS Devices"

November 15 **Michael Lacker,** Biomedical Engineering and Mathematics, New Jersey Institute of Technology

"Using Mathematics to Solve Problems in Biomechanics and Physiology"

November 17 **Michael Lacker,** Biomedical Engineering and Mathematics, New Jersey Institute of Technology

"Models in Physiology where Non-Local Interaction Produces Symmetry Breaking Solutions"

November 22 **Dan Joseph,** Department of Aerospace Engineering and Mechanics University of Minnesota Minneapolis

"Lift Correlations from Direct Numerical Simulation of Solid-Liquid Flow"

December 1 **Ilya Timofeyev,** Courant Institute of Mathematical Sciences

"Stochastic Modeling of Small Scales with applications to Climate Models"

December 6 **Dr. Suresh Goyal,** Lucent Technologies

"The Mechanics of Impact"

December 8 **Gregory A. Kriegsmann,** Department of Mathematical Sciences, New Jersey Institute of Technology

"Scattering by Large Resonant Cavity Structures"

December 15 **Robert M. Miura,** Department of Mathematics, University of British Columbia

"Applications of Excitable Cell Models"

December 19 **Paul F. Batcho,** Department of Chemistry and Courant Institute of Mathematical Sciences New York University and the Howard Hughes Medical Institute New York, NY

"Applied and Computational Mathematics for Chemistry and Biology: New Results and Discussion"

January 16 **Dimitri D. Vaynblat,** Applied Mathematics Department, California Institute of Technology, Pasadena, CA

"Shock-Induced Martensitic Phase Transitions in Solids"

January 19 **Mette Olufsen,** Department of Mathematics, Boston University, Boston, Massachusetts

"New Roles for the Gamma Rhythm: Population Tuning and Preprocessing for the Beta Rhythm"

January 23 **Chris Wiggins**, Courant Institute of Mathematical Sciences, New York University, New York

"Biomathematical Modeling of Polymer Dynamics"

January 26 **Zhong-Hui Duan,** Department of Mathematics, The University of Michigan, Ann Arbor, MI

"Adaptive Treecodes for Computing Nonbonded Interactions in Molecular Simulations"

January 31 **Guillaume Bal,** Department of Mathematics, University of Chicago, Chicago, Illinois

"Particle Transport Through Scattering Regions with Non-scattering Clear Layers and Inclusions"

February 2 **Michael Weinstein,** Fundamental Mathematics Research Department, Bell Labs - Lucent Technologies

"Nonlinear Propagation of Light in Periodic Structures"

February 7 **Jacob Rubinstein,** Department of Mathematics, Technion-Israel Institute of Technology, Haifa, Israel

"Phase Transitions in Mesoscopic Superconductors"

February 9 **Javier A. Diez,** Instituto de Fisica Arroyo Seco Universidad Nacional del Centro de la Provincia de Buenos Aires, Tandil, Argentina

"The Crumbling of a Viscous Prism With an Inclined Free Surface"

February 14 **Florian A. Potra,** Department of Mathematics and Statistics, University of Maryland, Baltimore, MD

"Computer Simulation of Multi-body Systems with Contacts and Friction"

February 16 **Leonid A. Kunyansky,** Applied & Computational Mathematics, California Institute of Technology, Pasadena, CA

"Fast, High-Order Solution of Surface Scattering Problems"

February 21 **Gino Biondini,** Department of Applied Mathematics and Engineering Sciences, Northwestern University, Evanston, IL

"Nonlinear Waves, Solitons and Optical Fiber Communications"

February 23 **Richard Kleeman,** Courant Institute of Mathematical Sciences

"Measure of Predictability in Dynamical Systems with Applications to Geophysical Phenomenon"

February 28 **Chjan C. Lim,** Department of Mathematical Sciences, Rensselaer Polytechnic Institute, Troy, NY

"A Microscopic Derivation of the Energy Density Spectra for 2d Turbulence and Exact Solutions of Kraichnan's Energy-Enstrophy Theory - Applications to Venus' Super-Rotation"

March 2 **Steve Childress,** Courant Institute of Mathematical Sciences

"Stalking the Wild Antarctic Pteropod: A Preliminary Report of Observations of Bimodal Swimming at Intermediate Reynolds Numbers"

March 7 **Tak Shing Lo,** Courant Institute of Mathematical Sciences, New York University, New York, NY

"Phase Field Modeling of Microstructural Pattern Formation in Peritectic Alloys"

March 9 **Xu-Dong Liu,** Department of Mathematics, University of California, Santa Barbara

"Positive Schemes for Multi-Dimensional System of Convention Laws"

March 23 **Louis Fishman,** Naval Research Laboratory, Stennis Space Center, MS and Department of Physics, University of New Orleans, LA

"Phase Space and Path Integral Methods in Multidimensional Wave Propagation"

March 26 **Snezhana Abarzhi,** Department of Applied Mathematics & Statistics, State University of New York at Stony Brook

"Nonlinear Evolution of Unstable Fluid Interface"

March 30 **David J. Horntrop,** Department of Mathematics & Statistics University of Massachusetts, Amherst, MA

"Mesoscopic Simulation for Pattern Formation"

April 6 **Daniel D. Szyld,** Department of Mathematics, Temple University Philadelphia, PA

"Algebraic Theory of Schwarz Methods for Domain Decomposition"

April 20 **Arthur Sherman,** National Institute of Health

"The Phantom Burster Model for Pancreatic Beta-Cells"

April 27 **Stephanos Venakides,** Department of Mathematics, Duke University, Durham, NC

"BEM Calculation of Scattering by Photonic Crystal Structures With and Without Defects"

June 6 **Ravi Samtaney**, Graduate Aeronautical Laboratories and Applied Mathematics, California Institute of Technology, Pasadena, CA

"The Virtual Test Facility: A Distributed Computing Environment to Simulate the Dynamic Response of Materials"

June 13 **Dharam V. Chopra**, Wichita State University, Kansas

"Investigations on the Number of Constraints of Some Combinatorial Arrays"

June 25 **B.V. Rathish Kumar**, Department of Mathematics, IIT Kanpur, India and Advanced Computing Centre, Saitama, Japan

"A Parallel 3D Unsteady Flow Computation in a Doubly Constricted Vessel"

Statistics Colloquim

September 13 **Bonnie K. Ray,** New Jersey Institute of Technology Mathematical Sciences Department

"Bayesian Methods for Change-point Detection in Long-range Dependent Processes"

September 27 **Nancy L. Jackson,** New Jersey Institute of Technology Graduate Program in Environmental Policy Studies

"Classification of a Developed Coastal Barrier"

October 11 **Marshall Joffe,** Biostatistics, University of Pennsylvania

"A Case-Control Follow-up Study for Disease-Specific Mortality"

October 25 **Phil Everson,** Department of Mathematics, Swarthmore College

"Bayesian inference for Hierarchical Data"

November 15 **Sunil Dhar,** Department of Mathematical Sciences and Center for Applied Mathematics and Statistics, NJIT

"The Small Sample Robust Minimum Distance Estimators of Shift"

November 29 **Bing Li** (Joint work with R. Dennis Cook), Dept. of Statistics, Pennsylvania State *University*

"Dimension Reduction of Conditional Mean in Regression"

January 31 **Susan Hodge,** Department of Psychiatry and Biostatistics, Columbia University

"Stoppage: A Potential Problem for Genetic Analysis of Severe, Early-Onset Diseases"

March 1 **Daniel F. Heitjan,** Mailman School of Public Health, Columbia University

"Assessing Sensitivity to Nonignorability"

April 18 **Scott Vander Wiel,** Statistics Research, Bell labs, Lucent Technologies, Murray Hill, NJ

"Thinking Statistically About Optimization - A Bayesian Quasi-Newton Method"

April 25 **Georg Ch. Pflug,** University of Vienna, Austria

"Shape Restricted, Nonparametric Regression"

V. CAMS MEMBER PUBLICATIONS, PRESENTATIONS, AND REPORTS

A. PUBLICATIONS

JOURNAL PUBLICATIONS

Roman Andrushkiw

Computer-Aided Differential Diagnosis of Breast Cancer and Fibroadenomatosis Based on Malignancy Associated Changes in Buccal Epithelium, (with Y. Petunin, D. Klyushin, K. Ganiana, N. Boroday), Automedica, Vol. 19, pp. 135-164, 2001.

Srinivasan Balaji

Multiplicative Ergodicity and large deviations for an irreducible Markov chain, (with Sean P. Meyn), Stochastic Processes and their Applications, Vol. 90, pp. 123-144, 2000.

Closure properties of uniform convergence of empirical means and PAC learnability under a family of probability measures, (with M. Vidyasagar and B. Hammer), Systems & Control Letters, Vol 42, pp. 151-157, 2001.

Manish Bhattacharjee

Preservation results for Life Distributions based on comparisons with Asymptotic Remaining Life under Replacements, (with A.M. Abouammoh, A.N. Ahmed & A.M. Barry), J. Appl. Probab., V.37, pp. 999-1009, 2000.

Denis Blackmore

Singularity Theory Approach to Swept Volumes, (with R. Samulyak and M. Leu), International Journal of Shape Modeling, Vol. 6, pp. 105-129, 2000.

On Swept Volume Formulations: Implicit Surfaces, (with K. Abdel-Malek and J. Yang), Computer-Aided Design, Vol. 33, pp. 113-121, 2001.

Hamiltonian Structure for Vortex Filament Flows, (with O. Knio), ZAMM, Vol. 81 S, pp. 161-165, 2001.

Generalized formulation for strip yielding model with variable cohesion and its analytical solutions, (with W. Wang and CTT Hsu), International Journal of Solids and Structures, Vol. 37, pp. 7533-7546, 2000.

Victoria Booth

Hippocampal place cells and the generation of temporal codes, (with Amitabha Bose and Michael Recce), Neurocomputing, Vol. 32-33, pp. 225-234, 2000.

A temporal mechanism for generating phase precession of hippocampal place cells, (with Amitabha Bose and Michael Recce), Journal of Computational Neuroscience, Vol. 9, pp. 5-30, 2000.

Regulating firing rate of networks of pyramidal cells, (with Amitabha Bose) Neurocomputing, Vol. 38-40, pp. 497-504, 2001.

Amit Bose

A temporal mechanism for generating the phase precession of hippocampal place cells, (with V. Booth and M. Recce) Journal of Computational Neuroscience, Vol. 9, pp. 5-30, 2000.

Phase precession and phase locking of hippocampal pyramidal cells, (with M. Recce), Hippocampus, Vol. 11, pp. 204-215, 2001.

Role of synaptic delay in organizing the behavior of networks of self-inhibiting neurons, (with S. Kunec) Physical Review E, Vol. 63, pp. 1908-1913, 2001.

Regulating firing rate of networks of pyramidal cells, (with V. Booth) Neurocomputing, Vol. 38-40, pp. 497-504, 2001.

Control of network output by synaptic depression, (with Y. Manor and F. Nadim) Neurocomputing, Vol. 38-40, pp. 781-787, 2001.

Synchrony and frequency regulation by synaptic delay in networks of self-inhibiting neurons, (with S. Kunec) Neurocomputing, Vol. 38-40, 505-513.

Hippocampal place cells and the generation of temporal codes, (with Victoria Booth and Michael Recce), Neurocomputing, Vol. 32-33, pp. 225-234, 2000.

Large Amplitude Solutions of Spatially Non-homogeneous, Non-local Reaction Diffusion Equations, (with G. A. Kriegsmann), Methods and Applications of Analysis, Vol.7, pp. 295-312, 2000.

Hans Chaudhry

Optimal Patterns for Suturing Wounds of Complex Shapes to Foster Healing, (with Dawn Lott), Journal of Biomechanics, Vol. 34, pp. 51-58, 2001.

Sunil Dhar

Performance Status of Health Care Facilities Changes with Risk Adjustment of Hemoglobin A_{1c}, (with Quanwu Zhang and Leonard Pogach) *Diabetes Care Journal*, Vol. 23, pp. 919-927, 2000.

Rose Dios

On bi-level orthogonal arrays of strength four, (with D.V. Chopra), Congressus Numerantium, Vol. 144, pp. 183-188, 2000.

Some investigations on orthogonal arrays, (with D.V. Chopra), Journal of Combinatorial Mathematics and Combinatorial Computing, Vol.36, pp. 193-200, 2001.

Christopher Elmer

Traveling Wave Solutions for Bistable Differential-Difference Equations with Periodic Diffusion, (with E.S. Van Vleck), SIAM Journal of Applied Mathematics, Vol. 61, pp. 1648-1679, 2001.

Thomas Erneux

The pulse shape of a passively Q-switched microchip laser, (with P. Peterson and A. Gavrielides), European Physical Journal D, Vol. 10, pp. 423-431, 2000.

Bifurcation to mixed external cavity mode solutions for semiconductor lasers subject to optical feedback, (with F. Rogister, A. Gavrielides, and V. Kovanis), Optics Communications, Vol. 183, pp. 467-477, 2000.

Hopf bifurcation subject to a large delay in a laser system, (with D. Pieroux, A. Gavrielides, and V. Kovanis), SIAM J. on Appl. Math., Vol. 61, pp. 966-982, 2000.

Nearly vertical Hopf bifurcation for a passively Q-switched microchip laser, (with G. Kozyreff), Journal of Statistical Physics, Vol. 101, pp. 543-552, 2000.

Stability and bifurcations of periodically modulated injected diode lasers, (with M. Nizette, A. Gavrielides, and V. Kovanis), Phys. Rev. E, Vol. 63, pp. 6212-6221, 2001.

Synchronisation through bursting oscillations for two coupled lasers, (with I. Susa, A. Barsella, C. Lepers, D. Dangoisse and P. Glorieux), Phys. Review A 63, pp. 3815-3821, 2001.

Interacting pairs of periodic solutions lead to tori in lasers subject to delayed feedback, (with D. Pieroux, T. Luzyanina and K. Engelborghs), Phys. Rev. E, Vol. 63, pp. 6211-6222, 2001.

Anna Georgieva

1:2 Resonance Mediated Transmission Band Gap Opening in 1-d Nonlinear Periodic Medium, (with T. Kriecherbauer and S. Venakides), SIAM Journal of Applied Mathematics, Vol. 61, pp. 1802-1815, 2001.

Vladislav V. Goldberg

A classification and examples of four-dimensional nonisoclinic three-webs, Webs and Quasigroups, Vol. 2001, pp. 24-62, 2001.

Solution of Belousov's problem (with M. A. Akivis), Discussiones Mathematicae - General Algebra and Applications, Vol. 21, pp. 1-7, 2001.

Daniel Goldman

A computational of study of the effect of capillary network anastomoses and tortuosity on oxygen transport, (with A. Popel), Journal of Theoretical Biology, Vol. 206, pp. 181-194, 2000.

A computational study of the effect of vasomotion on oxygen transport from capillary networks, (with A. Popel), Journal of Theoretical Biology, Vol. 209, pp. 189-199, 2001.

Jay Kappraff

Polygons and Chaos, (with G. W. Adamson), Bridges: 2001 White Plains (Md): Gilliland Press (2001).

A Secret of Ancient Geometry, In Geometry at Work edited by C.Gorini. Mathematics Association of America Geometry MAA Notes No. 53 (2000).

A Fresh Look at Number, (with G. W. Adamson), Visual Mathematics (an electronic journal, www.members.tripod.com/vismath) Vol. 2, No. 3, Fall 2000.

The Arithmetic of Nicomachus of Gerasa and its Applications to Systems of Proportion, Nexus Network Journal (an electronic journal, www.nexusjournal.com) Vol. 4, No. 3, October 2000.

Lou Kondic

Contact line instabilities of thin liquid films, (with J. Diez), Physical Review Letters, Vol. 86, pp. 632-635, 2001.

Global models for moving contact lines, (with J. A. Diez and A. L. Bertozzi), Physical Review E, Vol. 63, pp. 0112081-01120813, 2001.

Pattern formation in non-Newtonian Hele-Shaw flow, (with P. Fast, M. J. Shelley, and P. Palffy-Muhoray), Physics of Fluids, Vol. 13, pp. 1191-1212, May 2001.

Gregory A. Kriegsmann

Pattern Formation in Microwave Heated Ceramics Cylinders and Slabs, I.M.A. Journal on Applied Mathematics, Vol. 66, pp. 1-32, 2001.

Microwave Joining of Two Long Hollow Tubes: An Asymptotic Theory and Numerical Simulations, (with J.H.C. Luke), Journal of Engineering Mathematics, Vol. 39, pp. 63-78, 2001.

Large Amplitude Solutions of Spatially Non-homogeneous, Non-local Reaction Diffusion Equations, (with A. Bose), Methods and Applications of Analysis, Vol.7, pp. 295-312, 2000.

Dawn Lott

Optimal patterns for suturing wounds of complex shapes to foster healing, (with Hans R. Chaudhry), Journal of Biomechanics, Vol 34, pp. 51-58, 2001.

Jonathan Luke

Microwave joining of two long hollow tubes: an asymptotic theory and numerical simulations, (with Gregory A. Kriegsmann), Journal of Engineering Mathematics, Vol. 39, pp. 63-78, 2001.

Jay N. Meegoda

Ultrasound to Decontaminate Metals in Dredged Sediments, (with R. Perera), Journal of Hazardous Materials Vol. 59, pp. 1-17, 2001.

Construction use of Vitrified Chromium Contaminated Soils, (with G. Charleston and W. Kamolpornwijit), ASCE Practice Periodical of Hazardous, Toxic, and Radioactive Waste Management, Vol. 4, pp. 89-98, 2000.

Zoi-Heleni Michalopoulou

Matched impulse response processing for shallow water localization and geoacoustic inversion, Journal of the Acoustical Society of America, Vol. 108, pp. 2082-2090, 2000.

Petronije Milojevic

Existence and the number of solutions of nonresonant semilinear equations and applications to boundary value problems, Mathematical and Computer Modelling, Vol. 32, pp. 1395-1416, 2000.

Cyrill Muratov

A quantitative approximation scheme for the traveling wave solutions in the Hodgkin-Huxley model, Biophysical Journal, Vol. 79, pp. 2893-2901, 2000.

Static spike autosolitons in the Gray-Scott model, (with V. V. Osipov), Journal of Physics A: Mathematical and General, Vol. 33, pp. 8893-8916, 2000.

Farzan Nadim

The Role of Short-term Synaptic Dynamics in Motor Control, (with Yair Manor), Current Opinion in Neurobiology, Vol. 10, pp. 683-690, 2000.

Neurons and Neural Networks: Computational Models, (with Yair Manor), Encyclopedia of Life Sciences, 2000.

Control of network output by synaptic depression, (with Yair Manor and Amitabha Bose) Neurocomputing, Vol. 38-40, pp. 781-787, 2001.

Demetrios Papageorgiou

The modulational stability of Taylor vortices in a curved channel, (with A.H. Dando and P. Hall), SIAM Journal of Applied Mathematics, Vol. 60, pp. 1543-1564.

Temporal instability of compound jets and threads, (with A. Chauhan, C. Maldarelli and D.S. Rumschitzky), Journal of Fluid Mechanics, Vol. 420, pp. 1-25.

Peter G. Petropoulos

Numerical Dispersion and Absorbing Boundary Conditions, International Journal of Numerical Modelling: Devices, Circuits and Fields, Vol. 13, pp. 483-498, 2000.

A Staggered Fourth-Order Accurate Explicit Finite Difference Scheme for the Time-Domain Maxwell's Equations, (with A. Yefet), Journal of Computational Physics, Vol. 168, pp. 286-315, 2001.

Bonnie Ray

Spatio-temporal variability of US Summer PDSI-SST teleconnections during the 20th century, (with Rajagopalan, B., Cook, E., Lall, U.), Journal of Climate, Vol. 13, pp. 4244-4255, 2000.

Michael Recce

Path integration following temporal lobectomy in humans, (with Worsley CL, Spiers HJ, Marley J, Polkey CE and Morris RG), Neuropsychologia, Vol. 39, pp. 452-464, 2001.

Hippocampal place cells and the generation of temporal codes, (with Victoria Booth and Amitabha Bose), Neurocomputing, Vol. 32-33, pp. 225-234, 2000.

A temporal mechanism for generating phase precession of hippocampal place cells, (with Victoria Booth and Amitabha Bose), Journal of Computational Neuroscience, Vol. 9, pp. 5-30, 2000.

Phase precession and phase locking of hippocampal pyramidal cells, (with Amitabha Bose), Hippocampus, Vol. 11, pp. 204-215, 2001.

Anthony Rosato

Microstructure Evolution in Compacted Granular Beds, (with D. Yacoub), Powder Technol., Vol. 109, pp. 255-261, 2000.

John Tavantzis

Viscoelastic Effects on the Stability of Thin-Film Parallel Flow in Lubrication Applications, (with Harnoy, A. and Shridhar, L.), FED-Vol. 252, Rheology and Fluid Mechanics of Nonlinear Materials, ASME, Vol. 252, pp. 49-54, 2000.

Burt Tilley

Unsteady Stokes Flow near an oscillating, heated contact line, (with S. H. Davis and S. G. Bankoff), J. Fluid Mech., Vol. 430, pp. 1-24, 2001.

Amir Yefet

A Staggered Fourth-Order Accurate Explicit Finite Difference Scheme for the Time-Domain Maxwell's Equations, (with P. Petropoulos), Journal of Computational Physics, Vol. 168, pp. 286-315, 2001.

PROCEEDINGS PUBLICATIONS

Manish Bhattacharjee

A Unified Framework for modeling and analysis of Repairable Systems, Perspectives in Statistical Sciences (Proceedings of 3rd International Symposium on Probability & Statistics, Calcutta University), Oxford University Press, ISBN 019-565366-1, pp. 58-74, 2000.

Aging with Laplace Order conserving Survival under Perfect Repairs, (with S.K. Basu), Advances on Methodological and Applied Aspects of Probability and Statistics (Proceedings of IISA Conference, McMaster University), Gordon and Breach Science Publishers, pp. 425-440, 2001.

Denis Blackmore

Dynamics of a two species oscillating particle system, (with R. Samulyak, A. Rosato and R. Dave), Segregation in Granular Flows, A. Rosato and D. Blackmore (eds.), Kluwer, Dordrecht, pp. 255-268, Proceedings of IUTAM Symposium, Cape May, 1999.

Fractionation and segregation of suspended particles using acoustic and flow fields, (with N. Aboobaker and J. Meegoda), Proceedings of the 32nd Mid-Atlantic Industrial and Hazardous Waste Conference, Technomic, pp. 659-668, 2000, Boston, 1999.

Closed form swept volume of implicit surfaces, (with K. Abdel-Malek and J. Yang), Proceedings of the 26th ASME Design Automation Conference, 2001, pp. 231-239, Johns Hopkins University, 2000.

Victoria Booth

Neural mechanisms for generating temporal and rate codes, (with Amitabha Bose), 9th Annual Computational Neuroscience Meeting, pp. 20, Brugge, Belgium, 2000.

A simple biophysical model for generating hippocampal phase precession, (with Amitabha Bose and Michael Recce), 30th Annual Meeting of the Society for Neuroscience, Vol. 26, pp. 266.11, New Orleans, 2000.

Hans Chaudhry

Mathematical Analysis of Heart Reduction Surgery, (with B. Bukiet and A. Ritter), International Union of Theoretical and Applied Mechanics, Chicago, August-September, 2000, Technical Report, 950, 14:04, NBO2.

Residual Stresses in Oscillating Thoracic Arteries Increase Blood Flow, (with B. Bukiet and A. Ritter), International Union of Theoretical and Applied Mechanics, Chicago, August-September, 2000, Technical Report, 950, 08-00-IB1.

Mathematical Analysis of Heart Reduction Surgery, (with B. Bukiet, R. Arora, T. Regan and A. Ritter), Journal of Federation of American Societies of Experimental Biology (FASEB) Vol.15, No.5, 891.14 Experimental Biology Conference, Orlando, Florida, 2001.

Thomas Erneux

Asymptotic methods applied to semiconductor laser models, in Physics and Simulations of Optoelectronic Devices VIII, R. Binder, P. Blood, M. Osinski, Eds., Proc. SPIE 3944 (2000), 588-601.

Phase-locked modulations of optically-injected laser diodes, (with A. Gavrielides, V. Kovanis, and M. Nizette), in Physics and Simulations of Optoelectronic Devices VIII, R. Binder, P. Blood, M. Osinski, Eds., Proc. SPIE 3944 (2000), 627-638.

Multiple time scale analysis of lasers, in "Fundamental Issues of Nonlinear Laser Dynamics", B. Krauskopf and D. Lenstra, Eds., AIP Conf. Proceedings 548 (2000), 54-65.

Vladislav V. Goldberg

Continuity of generations: Calapso's family of geometers, Atti del Congresso Internazionale in honour of Pasquale Calapso, Messina, Italy, pp. 159-190, November 2000.

Lightlike hypersurfaces on a four-dimensional manifold endowed with a pseudoconformal structure of signature (2,2) (with M. A. Akivis), Atti del Congresso Internazionale in honour of Pasquale Calapso, Messina, Italy, pp. 13-40, November 2000.

Gregory A. Kriegsmann

Microwave-enhanced CVI Processing: A Moving Interface Model, (with Burt Tilley), Proceedings of the Second World Congress on Microwave Processing, Orlando, FL., 2000, Microwave Processing IV, Ceramic Transactions III, 2001.

Microwave Joining of Two Long Hollow Ceramic Tubes: A Combined Asymptotic and Numerical Analysis, (with Jonathan Luke), Proceedings of the Second World Congress on Microwave Processing, Orlando, FL., 2000, Microwave Processing IV, Ceramic Transactions III, 2001.

Dawn Lott

A two-dimensional numerical approach to the quasilinear wave equation governing antiplane shearing of nonlinearly elastic bodies, (with Stuart S. Antman and William G. Szymczak), 33rd Solid Mechanics Conference, Institute of Fundamental Technological Research Center of Mechanics and Information Technology and Polish Academy of Sciences, Zakopane, Poland, pp. 269-270, 2000.

Jonathan Luke

Microwave Joining of Two Long Hollow Ceramic Tubes: A Combined Asymptotic and Numerical Analysis, (with Gregory A. Kriegsmann), Microwaves: Theory and Application in Materials processing V, Vol.3, pp. 27-34, Orlando, 2001.

Jay N. Meegoda

Material Information Management System, (with C. Tang), Computer Methods and Applications in Geomechanics Dasai et al. (eds), Balkema, Rotterdam, pp. 665-668, January 2001.

Analysis of Fractionation of Sediments caused by an Acoustic Field, (with N. Aboobaker and D. Blackmore), Proceedings of International Conference on Computer Methods and Advances in

Geomechanics, edited by Desai et al., (eds), Balkema, Rotterdam, Vol. 1, January 2001, pp. 775-780.

Physical Mechanisms of Colloidal Silica Grouting in Remediation of Chromium Contaminated Soils, (with N. Yossapol), Proceedings of the 33rd Mid-Atlantic Industrial and Hazardous Waste Conference, Edt N. Assaf-Anid, NYC, NY, June 18-20, pp. 19-28.

Zoi-Heleni Michalopoulou

Inivited paper: *Fast matching methods for inversion with underwater sound* (with Xiaoqun Ma, Michele Picarelli, and Urmi Ghosh-Dastidar), Proceedings of Oceans 2000, pp. 647-651, Rhode Island, September 2000.

A possible relationship between waveguide properties and bandwidth utilization in humpback whales (with Eduardo Mercado III and L. Neil Frazer) Proceedings of Oceans 2000, pp. 1746-1750, Rhode Island, September 2000.

Model based time delay processing for underwater source localization and tracking (with Xiaoqun Ma) Proceedings of the Fifth European Conference on Underwater Acoustics, pp. 1019-1024, Lyon, France, July 2000.

Farzan Nadim

Synaptic Depression Promotes Bistability in an Excitatory-Inhibitory Network, (with Yair Manor and Amitabha Bose), Society for Neuroscience Abstracts 711.2, Vol. 26, pp. 1902, 2000.

When Two Depressing Synapses are Better Than One, (with Yair Manor), Society for Neuroscience Abstracts 748.4, Vol. 26, pp. 1999, 2000.

Shifting the Locus of Control Between Fast and Slow Rhythms in a Network Model, (with Akira Mamiya, Jordan Hague, Michael P. Nusbaum and Yair Manor), Society for Neuroscience Abstracts 163.5, Vol. 26, pp. 449, 2000.

Flexibility in Intercircuit Interactions Influences Motor Pattern Generation, (with Debbie Wood, Michael P. Nusbaum and Yair Manor), Society for Neuroscience Abstracts, Vol. 26, pp. 449, 2000.

Peter G. Petropoulos

A Fourth-Order FD-TD Scheme for Electromagnetics, (with A. Yefet), Fifth International Conference on Mathematical and Numerical Aspects of Wave Propagation, pp. 883-887, Santiago de Compostella, Spain, 2000.

Anthony Rosato

Books/Book Chapters:

Segregation in Granular Flows, eds. A. D. Rosato and D. L. Blackmore, Kluwer Academic Publishers, Dordrecht, The Netherlands (2000).

“An Overview of Particle Technology”, The Expanding World of Chemical Engineering, 2nd edition (eds: S. Furusaki, J. Garside, L.-S. Fan), Intl. Publishers Direct, Singapore (2000).

Michael Siegel

Cusp formation and tip-streaming instabilities for time-evolving interfaces in two-dimensional Stokes flow, IUTAM Symposium on Nonlinear Waves in Multi-Phase Flow, South Bend, Indiana, pp. 139-148, 2000.

Burt Tilley

Microwave-enhanced CVI Processing: A Moving Interface Model, (with Gregory A. Kriegsmann), Proceedings of the Second World Congress on Microwave Processing, Orlando, FL., 2000, Microwave Processing IV, Ceramic Transactions III, 2001.

B. PRESENTATIONS

Roman Andrushkiw

July 2000: Third World Congress of Nonlinear Analysts, Catania, Italy
A Variational Method for Eigenvalue Problems Nonlinearly Dependent on the Spectral Parameter

Nadine Aubry

July 2000: 2000 SIAM Annual Meeting, Rio Grande, Puerto Rico
Closed-loop Wake Flow Control Based on a Reduced Model

September 2000: ICTAM 2000, Chicago, IL
Electro-magnetic feedback control of wake flows

November 2000: 53rd Annual Meeting of the Division of Fluid Dynamics, American Physical Society, Washington, DC
1) Electro-magnetic Feedback Control of Wake Flows
2) Optimal Feedback Control of Cylinder Vortex Shedding with Lorentz Force
3) Numerical Simulations of Flowing Suspensions Subjected to Dielectrophoresis in Various Geometries

October 2000: Navy Presentation, Washington, DC
Defense Initiative for Smart Processing (DISP)

John Bechtold

November 2000: APS Division of Fluid Dynamics, Washington DC
Onset of Instabilities in Spherically Expanding Flames

February 2001: University of Hawaii, College of Engineering, Honolulu HI
Dynamics of Near-Stoichiometric Premixed Flames

Manish Bhattacharjee

March 2001: Delhi, India
Conference /colloquium: colloquium given during professional short visit
Indian Statistical Institute - Delhi Campus
New preservation results for Geometric Compounds and Applications

March 2001: Bangalore, India
Conference /colloquium: colloquium given during professional short visit
Indian Institute of Science, Bangalore
Discrete Convex Ordered Lifetimes: Characterization,Stochastic Equivalence and Applications

March 2001: Calcutta, India
Conference/colloquium : colloquium given during professional short visit
Indian Statistical Institute - Calcutta
New preservation results for Geometric Compounds and Applications

March 2001: Calcutta, India
Syposium on stochastic modeling (invited speaker)
Calcutta University
Shape duality of hazard rate and mean remaing life functions

March 2001: Calcutta, India
Conference/colloquium: colloquium given during professional short visit
O.R. Society of India, Calcutta Chapter
Choosing between two used items, the poor man's dilemma

Denis Blackmore

September 2000: ECCOMAS 2000, Barcelona, Spain
Hamiltonian Formulation of the Interaction between a Vortex Ring and a Sphere

October 2000: Joint Mechanical Engineering/Mathematical Sciences Symposium, NJIT
A Hamiltonian Approach to Vortex Filament Dynamics

February 2001: GAMM 2001, Zurich, Switzerland
Higher Order Conditions for Weak Shocks: Modified Prandtl Relation

Victoria Booth

July 2000: 9th Annual Computational Neuroscience Meeting, Brugge, Belgium
Neural Mechanisms for Generating Temporal and Rate Codes

November 2000: 30th Annual Meeting of the Society for Neuroscience, New Orleans, Louisiana
A Simple Biophysical Model for Generating Hippocampal Phase Precession

April 2001: Conference in Celebration of Smith College Alumnae Mathematicians, Northampton, Massachusetts
Modeling Pyramidal Neuron Firing in the Hippocampus

May 2001: 6th SIAM Conference on Applications of Dynamical Systems, Snowbird, Utah
Neural mechanisms for generating rate and temporal codes in networks of CA3 pyramidal cells

Michael Booty

November 2000: AICHE Annual Meeting, Los Angeles
Tip streaming instabilities for slender axisymmetric bubbles with surfactant: an asymptotic approach (with Michael Siegel)

Amit Bose

January 2001: 34th Annual Winter Brain Conference, Steamboat Springs, Colorado
Phase precession and phase locking of hippocampal place cells

March 2001: Department of Applied Mathematics Student Seminar, Columbia University, New York
Mathematics and neurobiology

Bruce Bukiet

August 2000: 20th International Congress of Theoretical and Applied Mechanics, Chicago
Residual stresses in oscillating thoracic arteries increase blood flow

Jerry Chen

May 2001: 6th SIAM Conference on Applications of Dynamical Systems, Snowbird, Utah
Twisted Chaos in Discrete Population Models

Sunil Dhar

November 15, 2000: Statistics Colloquium presented by the Department of Mathematical Sciences and The Center for Applied Mathematics and Statistics, NJIT
The Small Sample Robust Minimum Distance Estimators of Shift

Rose Dios

October 2000: Midwest Conference on Combinatorics, Computing and Cryptography, Wichita State University
On orthogonal arrays of strength four
On the existence of balanced arrays of strength five

Christopher Elmer

November 2000: Ellis B. Stouffer Colloquium, Department of Mathematics, University of Kansas
An Introduction to Traveling Wave Solutions of Spatially Discrete Bistable Reaction-Diffusion Equations

April 2001: Center for Dynamical Systems and Nonlinear Studies Colloquium, School of Mathematics, Georgia Institute of Technology
The Effect of Discretization on Traveling Wave Solutions

Thomas Erneux

September 2000: CLEO-IQEC 2000, Nice, France
1) Isolated period 3 and 2 coexisting bifurcation orbits in diode lasers subject to optical injection: experiments and theory
2) Bifurcation connection between external cavity modes in asemiconductor laser exhibiting low frequency fluctuations
3) Super and sub-critical Hopf bifurcation leading to chaos: theory and experiments
4) Phase equations for periodically driven injected lasers
5) Intensity rate equations to describe polarisation switching in vertical-surface-emitting lasers
6) Eckhaus instabilities induced by nonuniformities: a laser example

September 2000: AFOSR Workshop on Nonlinear Optics, Tucson, Arizona
1) Mixed external cavity mode regimes for semiconductor lasers subject to optical feedback
2) Locking properties of simultaneously electronically modulated and optically injected diode lasers

September 2000: Arizona State University, Phoenix, AZ
Bifurcation studies of semiconductor lasers subject to delayed feedback

October 2000: Workshop on “front propagation in periodic media”, Leiden, The Nethelands
Propagation failure in bistable and excitable systems

November 2000: Université Libre de Bruxelles, Service de Métrologie Nucléaire
Lasers à semi-conducteurs, feedback optique, bifurcations

January 2001: SPIE conference on Physics and Simulations of Optoelectronic Devices IX, San Jose, CA
1) Stochastic polarization dynamics in vertical-cavity surface-emitting lasers described by simple rate equations
2) Generation of pulsating intensities in external-cavity diode lasers

April 2001: Brussels, Belgium
Organisation of the meeting "From gamma-ray optics to semiconductor laser dynamics"

May 2001: SIAM Conference on Dynamical Systems, Snowbird, UT
Organization of the session called "delay differential equations and their applications in nonlinear optics"

Anna Georgieva

February 2001: Applied Mathematics Seminar, Duke University, Durham NC
Higher Dimensional Resonances in Nonlinear Discrete Periodic Medium

May 2001: Sixth SIAM Conference on Applications of Dynamical Systems, Snowbird, Utah
Stability Properties of System Modeling Gas Uptake in the Nasal Passages

Vladislav V. Goldberg

June 2001, Laptev's Readings, Moscow State University, Moscow, Russia
On the structure of varieties with degenerate Gauss mappings

Lou Kondic

June 2001: First International Workshop on Nanocapilarity and Wetting of Heterogenous Surfaces and Porous Solids, Princeton
Thin Film Flows on Heterogeneous Surfaces

April 2001: Department of Physics, Carnegie Mellon University, Pittsburgh
Contact line instabilities of thin liquid films

February 2001: Department of Mathematics, North Carolina State University, Raleigh
Contact line instabilities of thin liquid films

November 2000: AiChe 2000 Annual Meeting, Los Angeles
Contact line instabilities of thin liquid films

August 2000: International Congress of Theoretical and Applied Mechanics, Chicago
Nonlinear dynamics of thin film flows

July 2000: IUTAM Symposium on Free Surface Flows, Birmingham, United Kingdom
Instabilities in the flow of thin liquid films

Gregory A. Kriegsmann

March 2001: Department of Mathematics, W.P.I.
Electromagnetic Propagation in Porous Periodic media.

June 2001: 2001 Mechanics and Materials Conference, University of San Diego
Electromagnetic Propagation in Porous Periodic media.

Dawn Lott

July 2000: Society for Industrial and Applied Mathematics, Rio Del Mar, Puerto Rico
A numerical technique for optimal patterns of suturing wounds of complex shapes to foster healing

September 2000: 33rd Solid Mechanics Conference, Zakopane, Poland
A two-dimensional numerical approach to the quasilinear wave equation governing antiplane shearing of nonlinearly elastic bodies

April 2001: Department of Mechanical Engineering, NJIT, Newark, NJ
Optimal patterns of wound suture to maximize strength, foster healing and minimize scar

Jonathan Luke

January 2001, AFOSR Electromagnetics Workshop, San Antonio
Finite-Difference Modeling of Energy Transport and Deposition in Dispersive Dielectrics

Jay N. Meegoda

August 2000: National Cheng Kung University, Department of Civil Engineering, Tainan, TAIWAN,
Micromechanical Modeling of Asphalt Concrete

Cyrill Muratov

October 2000: Applied Mathematics Colloquium, Rensellaer Polytechnic Institute, Troy, NY
Instabilities and formation of complex domain patterns in reaction-diffusion systems

November 2000: Applied Mathematics Colloquium, University of Massachusetts, Amherst, MA
Instabilities and formation of complex domain patterns in reaction-diffusion systems

April 2001: Nonlinear Dynamics Seminar, Department of Mathematics, Princeton University, Princeton, NJ
Testing a Hypothesis in Developmental Biology: Modeling and Computational Analysis of Autocrine Loops in Drosophila Oogenesis

Farzan Nadim

July 2000: Computational Neuroscience 2000, Belgium
1) Control of network output by synaptic depression
2) Synaptic depression is used to switch between distinct oscillatory states in circuits with recurrent inhibition

November 2000: Society for Neuroscience Annual Meeting, New Orleans
1) Synaptic Depression Promotes Bistability in an Excitatory-Inhibitory Network
2) When Two Depressing Synapses are Better Than One
3) Shifting the Locus of Control Between Fast and Slow Rhythms in a Network Model
4) Flexibility in Intercircuit Interactions Influences Motor Pattern Generation

April 2001: East Coast Nerve Net, Woods Hole, MA
1) Slow it for a pull, speed it for a push
2) A gap between two neurons: trying to understand their coupling

May 2001: Frontiers in Neuroscience (Invited Talk), Emory University, Atlanta
The role of depressing synapses in frequency regulation of rhythmic networks

Demetrios Papageorgiou

July 2000: Centre International des Sciences Méchaniques
Invited Lecture Series on ``*Interfacial phenomena, the Marangoni effect, instability, waves and convective flows*''., Udine, Italy.

October 2000: Department of Mathematics and Statistics, Birmingham University, England.
On the motion of bubbles in surfactant solutions

November 2000: Department of Mathematics, Imperial College of Science, Technology and Medicine, England.
Stability of liquid jets

January 2001: Institute for Mathematics and its Applications, University of Minnesota. Invited participant of the IMA ``Hot Topics'' workshop on the ``Analysis and Modeling of Industrial Jetting Processes''.
Stability of electrified liquid sheets.

January 2001: Department of Mathematics, University College London, England.
On the motion of bubbles in surfactant solutions

February 2001: The British Petroleum Institute, Cambridge University, England.
On the motion of bubbles in surfactant solutions

February 2001: Department of Applied Mathematics and Theoretical Physics (DAMTP), Cambridge University.
On the motion of bubbles in surfactant solutions

February 2001: Department of Mathematics, Manchester University.
On the motion of bubbles in surfactant solutions.
April 2001: British Applied Mathematics Colloquium, University of Reading.
Dynamics and rupture of planar electrified fluid sheets

May 2001: Oxford Centre of Industrial and Applied Mathematics (OCIAM), Mathematical Institute, Oxford University, England.
Chaotic solutions of a class of Navier-Stokes solutions.

Peter G. Petropoulos

July 2000: 5th SIAM Conference on Mathematical and Numerical Methods in Wave Propagation, Santiago de Compostela, Spain
A Fourth-Order FDTD Scheme for Electromagnetics

September 2000: 1st SIAM Conference on Computational Science & Engineering, Washington DC
A Fourth-Order Staggered Grid Finite Difference Method for Computational Electromagnetics

January 2001: AFOSR Annual Electromagnetics Workshop, San Antonio, TX
Subgridding a Fourth-Order Staggered Scheme for Maxwell's Equations

Bonnie Ray

February 2001: Mathematical Sciences Seminar Series, University of Arkansas, Fayetteville, AR
Identifying Structural Change in Long-range Dependent Processes

April 2001: Mathematical Sciences Seminar Series, IBM T.J. Watson Research Center, Yorktown Hts, NY
Identifying Common Long-range Dependence in Vector Time Series

June 2001: U.S.-Japan Joint Seminar on Statistical Time Series, Kyoto, Japan
Testing and modeling multivariate nonlinear time series using nonparametric methods

Anthony Rosato

An Overview of Vibration-Induced Size Segregation of Granular Materials, International Symposium NEPTIS-9 on Solids Flow Mechanisms and Their Applications, Jan. 7-9, 2001, Kyoto, Japan. (Invited lecture and session chair).

Michael Siegel

July 2000: IUTAM Symposium on Free Surface Flows, Birmingham, UK
Cusp formation and tipstreaming instabilities for time-evolving interfaces in Stokes flow

September 2000: Applied and Computational Mathematics Seminar, University of Minnesota
Tipstreaming in two dimensional and axisymmetric Stokes bubbles

September 2000: Applied Mathematics Seminar, University of California, Irvine
Tipstreaming in two dimensional and axisymmetric Stokes bubbles

November 2000: AICHE Annual Meeting, Los Angeles
Tip streaming instabilities for slender axisymmetric bubbles with surfactant: an asymptotic approach (with Michael Booty)

January 2001: IMA Hot Topics Workshop on Analysis and Modeling of Industrial Jetting Processes, Minneapolis
Tip streaming instabilities for slender axisymmetric bubbles with surfactant: an asymptotic approach

May 2001: SIAM Dynamical Systems Conference, Minisymposium on Hele-Shaw Flow
Small surface tension limit for Hele-Shaw fingers and bubbles with anisotropy

Burt Tilley

November 2000: APS Division of Fluid Dynamics, Washington, DC
Spatial stability of two-layer flows in inclined channels

January 2001: IMA Workshop on the Analysis and Modeling of Industrial Jetting Processes, Minneapolis, MN
Dynamics and rupture of planar electrified sheets

June 2001: Annual Technical Meeting of the Society for Engineering Science, San Diego, CA
Dynamics and rupture of planar electrified sheets

C. CAMS TECHNICAL REPORTS

REPORT 0001-1: S. Kunec and A. Bose
The role of synaptic delay in organizing the behavior of networks of self-inhibiting neurons

REPORT 0001-2: S. Dhar and D. Chen
The small sample robust minimum distance estimators of shift in the two-sample location models

REPORT 0001-3: V. V. Goldberg
A classification and examples of four-dimensional nonisoclinic three-webs

REPORT 0001-4: M. A. Akivis and V. V. Goldberg
Local equivalence of Sacksteder and Bourgain hypersurfaces

REPORT 0001-5: M. A. Akivis and V. V. Goldberg
On the structure of submanifolds with degenerate Gauss maps

REPORT 0001-6: V. V. Goldberg
Goursat's (n+1)-webs

REPORT 0001-7: V. V. Goldberg
Multidimensional (n+1)-webs with reducible subwebs

REPORT 0001-8: A. Bose, Y. Manor and F. Nadim
Bistable oscillations arising from synaptic depression

REPORT 0001-9: V. Booth and A. Bose
Neural mechanisms for generating rate and temporal codes in model CA3 pyramidal cells

REPORT 0001-10 R. I. Andrushkiw and V. V. Slastikov
A variational method for eigenvalue problems nonlinearly dependent on the spectral parameter

REPORT 0001-11: D. Blackmore, J. Chen, J. Perez & M. Savescu
Dynamical properties of discrete Lotka-Voltera equations

REPORT 0001-12: V. Booth and A. Bose
Regulating firing rate of networks of pyramidal cells

REPORT 0001-13: W. B. Fairley, A. Izemann and S. Crunk
Combining incomplete information from independent assessment surveys for estimating masonry deterioration

REPORT 0001-14: A. Bose and S. Kunec
Synchrony and frequency regulation by synaptic delay in networks of self-inhibiting neurons

REPORT 0001-15: F. Nadim, Y. Manor and A. Bose
Control of network output by synaptic depression

REPORT 0001-16: F. Nadim and Y. Manor
Neurons and neural networks: computational models

REPORT 0001-17: Y. Manor and F. Nadim
Frequency regulation demonstrated by coupling a model and a biological neuron

REPORT 0001-18: G. A. Kriegsmann
Electromagnetic propagation in periodic translationally invariant media

REPORT 0001-19: B. S. Tilley, P. G. Petropoulos and D. T. Papageorgiou
Dynamics and rupture of planar electrified liquid sheets

REPORT 0001-20: L. Kondic and J. Diez
Pattern formation in a gravity driven flow of thin films: Constant flux flow

REPORT 0001-21: Yu. I. Petunin, D. A. Klyushin, R. I. Andrushkiw, K. P. Ganina and N. V. Boroday
Computer-aided pattern recognition method for cytogenetic diagnosis of breast cancer and fibroadenomatosis

REPORT 0001-22: D. Stickler
Membrane Equilibrium Equations

REPORT 0001-23: C. B. Muratov and Weinan E
Theory of phase separation kinetics in polymer-liquid crystal systems

REPORT 0001-24: G. A. Kriegsmann and J. H. C. Luke
Microwave joining of two long hollow ceramic tubes: a combined asymptotic and numerical analysis

REPORT 0001-25: G. A. Kriegsmann and J. H. C. Luke
Microwave joining of two long hollow tubes: an asymptotic theory and numerical simulations

REPORT 0001-26: A. Chakrabarti, M. S. Rao and D. S. Ahluwalia
Surface water waves involving a vertical barrier in the presence of an ice-cover

REPORT 0001-27: H. R. Chaudhry, B. Bukiet, R. Arora, T. Regan and A. B. Ritter
A mathematical analysis of heart reduction surgery

REPORT 0001-28: S. Y. Shvartsman, C. B. Muratov and D. A. Lauffenburger
Testing a hypothesis in developmental biology: modeling and computational analysis of autocrine loops in Drosophila oogenesis

REPORT 0001-29: Y. Manor and F. Nadim
A role for depressing synapses in frequency regulation

REPORT 0001-30: M. A. Akivis and V. V. Goldberg
Solution of Belousov's Problem

REPORT 0001-31: J. Chen and D. Blackmore
On the Exponentially Self-Regulating Population Model

REPORT 0001-32: P. G. Petropoulos
Approximating the Surface Impedance of a Homogeneous Lossy Half-Space: An Example of "Dialable" Accuracy

REPORT 0001-33: X. Ma and Z-H. Michalopoulou
Inversion in an Uncertain Environment Using Linearization and Ray Path Arrivals

VI. CAMS MEMBER EXTERNAL ACTIVITIES AND AWARDS

Daljit S. Ahluwalia

Member, United States National Committee/Theoretical and Applied Mechanics, National Research Council.

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

Nadine Aubry

Information Technology Research (ITR) Proposal Panel, National Science Foundation (NSF), Member, June 14-15, 2000.

Manish Bhattacharjee

Consultant: Legislative Apportionment Commission, Majority Leader and Senator John O. Bennett and the members of the Legislative Apportionment Commission, District 12, Monmouth County, New Jersey (with Professor Sunil Dhar, Mathematical Sciences Department, NJIT)

Denis Blackmore

Invited speaker at the Twelfth International Colloquium on Differential Equations, Plovdiv, Bulgaria, August 2001

Invited speaker at the Multi-Hamiltonian Structures: Geometric and Algebraic Aspects Conference, Bedlewo, Poland, August 2001

Certificate for McNair Program Mentoring

Victoria Booth

Elected to Program Committee of the Annual Computational Neuroscience Meeting, 2001-2003.

Member of Advisory Board for the Mathematics Department of Passaic County Community College, Paterson, NJ, 1999-present.

Amitabha Bose

Co-organizer of a minisymposium entitled "Multiple Rhythms and Switch Mechanisms in Neuronal Networks" for the 6th SIAM Conference on Applications of Dynamical Systems, May 2001, Snowbird, UT

Bruce Bukiet

Editorial Board member for SIAM Journal on Scientific Computing.

Sunil Dhar

Consultant: Legislative Apportionment Commission, Majority Leader and Senator John O. Bennett and the members of the Legislative Apportionment Commission, District 12, Monmouth County, New Jersey (with Professor Manish Bhattacharjee, Mathematical Sciences Department, NJIT)

Rose Dios

Named NJIT Master Teacher.

Anna Georgieva

Visiting Scientist, Duke University, August 2000
Speaker for Project Advance at Duke University, February 2001

Vladislav V. Goldberg

Honored on the occasion of his 65th birthday and the completion of four decades of his career as a scholar by “Webs and Quasigroups”, pp. 7-23, December 2000.

Review of the book "Modern differential geometry of curves and surfaces with Mathematica", second edition, by A. Gray, CRC Press, Boca Raton, FL, 1998, Mathematical Reviews 2000i:53001, 2000.

Review of the book "Smooth quasigroups and loops" by L. Sabinin, Kluwer Academic Publishers, Dordrecht, 1999, Mathematical Reviews 2001e:20069, 2001

Gregory A. Kriegsmann

Editor in Chief, SIAM Journal of Applied Mathematics
Editorial Board Member, Wave Motion
Editorial Board Member, IMA Journal on Applied Mathematics
Editorial Board Member, Journal of Engineering Mathematics
Editorial Board Member, Applications of Analysis
Board of Directors Member, Society of Engineering Sciences

Dawn Lott

Department of Mathematical Sciences Undergraduate Teaching Award, NJIT, 1999-2000

Certificate of Appreciation, The McNair Achievement Program, NJIT, September 2000

Mathematical Association of America, Vice Chair for Speakers, New Jersey Section (MAA-NJ)

Association for Women in Mathematics (AWM), Nominating Committee Member, Graduate Student Mentor

Enhancing Diversity of Graduate Education (EDGE), Advisory Board Member

Jay N. Meegoda

Published: *Ultrasound to Decontaminate Dredged Sediments*, Final Report to the National Science Foundation, Submitted by the New Jersey Institute of Technology, Newark, 119 pages, July 2000

Editorial Board member, ASTM Geotechnical Testing Journal
Associate Editor, ASCE Practice Periodical of Hazardous, Toxic, and Radioactive Waste Management
Guest editor, Journal of Hazardous Materials, special issue on Contaminated Dredged Sediments

Chairperson of Geotechnical Group for the ASCE North Jersey Section.

Best Practice Paper Award, 2001, Environmental Multimedia Council of the Environmental and Water Resources Institute (EWRI) of American Society of Civil Engineers (ASCE).

ASCE North Jersey Branch Educator of the Year Award, 2001.

Petronije Milojevic

Editorial Board member, Communications on Applied Nonlinear Analysis
Editorial Board member, Facta Universitatis
Editorial Board member, Mathematica Moravica

Farzan Nadim

Faculty member, Stomatogastric Nervous System Cycle, Neural Systems and Behavior Course, Marine Biological Laboratory, Woods Hole, MA.

Peter G. Petropoulos

Guest Editor of a special issue of the International Journal of Numerical Modelling: Devices, Circuits and Fields titled ``Absorbing Boundary Conditions for Computational Electromagnetics''. The special issue appeared as Vol. 13, issue #4, September-October 2000.

Organizer and Chairperson of the mini-symposium on Computational Electromagnetics for the 21st Century at the 1st SIAM Conference on Computational Science & Engineering, Washington DC, September 2001.

Bonnie Ray

Associate Editor, Journal of Computational and Graphical Statistics
Associate Editor, The American Statistician
Associate Editor, International Journal of Forecasting
Associate Editor, Journal of Business and Economic Statistics
ASA Committee on Statisticians in Defense and National Security
Faculty Affiliate, Statistical Sciences Division, Los Alamos National Laboratory

Anthony Rosato

Elected Fellow of the American Society of Mechanical Engineers (Elected: October 2000)

Associate Editor, Mechanics Research Communications, Elsevier

VII. FUNDED RESEARCH

A. EXTERNALLY FUNDED RESEARCH

CONTINUING FUNDED PROJECTS

1. Mathematical Models of Premixed Flames

National Science Foundation, Division of Mathematical Sciences: July 1998 – June 2001
John Bechtold

2. *Neural Mechanisms for Generating Temporal Coding*

National Science Foundation: August 1, 1999 - July 31, 2002
Amitabha Bose
Victoria Booth
Michael Recce

3. *Reactive Models for Front-Tracking Simulations*

Batelle: April, 1998 - May 2001
John Starkenberg
Bruce Bukiet

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

National Science Foundation: August 1, 1999 – July 31, 2002
Thomas Erneux

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

Department of Energy: July 1, 2000 - June 30, 2003
Gregory A. Kriegsmann

6. *Microwave Processing of Ceramic Materials*

National Science Foundation: July 1, 2000-June 30, 2003
Gregory A. Kriegsmann

7. *Scattering by Large and Complex Structures*

AFOSR: February 1, 1996 - November 30, 2000
Gregory A. Kriegsmann
Jonathan H. C. Luke
Cheryl V. Hile

8. *Gravity and Granular Materials*

NASA: March 1, 2000-October 30, 2003
Lou Kondic
Robert Behringer, Duke University

9. *Computation of High Gradient Phenomena in Solid Mechanics*

National Science Foundation: July 1, 1998-June 30, 2001
Dawn Alisha Lott

10. *Scientific Computing Research Environments for the Mathematical Sciences*

National Science Foundation: July 1, 1998-June 30, 2000
Jonathan Luke
Zoi-Heleni Michalopoulou
Dawn A. Lott-Crumpler
Demetrios T. Papageorgiou
Michael Siegel

11. *Efficient shallow water matched field inversion*

ONR, January 1, 2000-December 31, 2001
Zoi-Heleni Michalopoulou

12. Graduate Traineeship Award: *Efficient inversion methods in underwater acoustics*

ONR: October 1, 1999-September 30, 2002
Zoi-Heleni Michalopoulou
Xiaoqun Ma

13. *Sloan Research Fellowship*

Alfred P. Sloan Foundation: September 1, 1999-August 31, 2001
Farzan Nadim

14. *Hydrodynamics of bubble motion and oscillatory flows*

National Science Foundation: July 1, 2000 - June 30, 2003
Demetrios T. Papageorgiou

15. *Numerical Modeling and Analysis of Transient Electromagnetic Wave Propagation and Scattering*

Air Force Office of Scientific Research: October 1, 1998-November 31, 2001
Peter G. Petropoulos

16. *Computationally Intensive Methods for Time Series Analysis with Environmental and Economic Applications*

National Science Foundation: July 1, 1996 - June 30, 2001
Bonnie K. Ray

17. *Assessment of Climatic and Human Activities on Shoreline Change*

NJ Sea Grant Development Funding Program: March 2000 - February 2001
Bonnie K. Ray
Nancy L. Jackson

18. *Surfactant effects in viscous fingering*

National Science Foundation: July 1, 1997--June 30, 2001
Michael Siegel

19. *Free boundary problems in volatile multi-fluid flows*

National Science Foundation: July 1, 1999 - June 30, 2002
Burt S. Tilley

PROJECTS FUNDED DURING PRESENT ACADEMIC YEAR

1. Graduate Traineeship Award: *Detection and Localization in the ocean in the presence of coherence loss mechanisms*

ONR: October 1, 2000-September 30, 2003
Zoi-Heleni Michalopoulou
Urmi Ghosh-Dastidar

2. *Synaptic Dynamics*

National Science Foundation: September 1, 2000-August 31, 2001
Farzan Nadim

3. *Regulation of Neuronal Oscillations by Synaptic Dynamics*

National Institute of Mental Health: December 1, 2000-November 30, 2005
Farzan Nadim

4. *Analysis and Numerical computations of moving boundaries in fluid dynamics and materials science*

National Science Foundation: July 1, 2001--June 30. 2004
Michael Siegel

B. PROPOSED RESEARCH

PROJECTS PROPOSED DURING PRESENT ACADEMIC YEAR

1. *Simulation Model in Tissue Freezing*

National Research Council: January 2001 – December 31, 2002
Roman Andrushkiw

2. *Dynamics of Premixed Flames: Effects of Mixture Strength and Radiation*

National Science Foundation: July 1, 2001 – June 30, 2004
John Bechtold

3. *Scientific Computing Research Environments for the Mathematical Sciences*

National Science Foundation: July 1, 2001 – June 30, 2003
Jonathan Luke
Lou Kondic
Victoria Booth
Amitabha Bose
Christopher Elmer
Daniel Goldman
Farzan Nadim
Burt Tilley

4. *Analysis and Computation of Vortex Filament Dynamics and Kinematics*

National Science Foundation: Sept. 1, 2001 - Aug. 31, 2004
Denis Blackmore
Omar Knio

5. *Method for Constructing Reduced Submanifolds for Analysis of the Dynamic Wave Processes in the Earth's Crust*

National Research Council: June 1, 2001 - July 31, 2002
Denis Blackmore
Mykola Prytula
Yuriy Starodub

6. *Advanced Virtual Environments for Modeling of Freeform Solids*

National Science Foundation: Aug. 1, 2001 - July 31, 2004
Ming Leu
Denis Blackmore

7. *Development of a Biocomplexity Research Program for the Analysis of Ecosystem Structure and Dynamics in Urban Salt Marshes*

National Science Foundation: Oct. 1, 2001 - Sept. 30, 2002
Michael Levandowsky
Gaboury Benoit
Denis Blackmore
Max Haggblom

8. *Scientific Computing Research Environments for the Mathematical Sciences: Research in Applied Statistics*

National Science Foundation: September, 2001-August, 2003
Bonnie K. Ray
Steven Crunk
Sunil K. Dhar
Rose Dios

9. *Modeling of Airlfow and Gas Uptake in the Human Nasal Passages*

National Science Foundation: July 1, 2001-June 30, 2004
Anna Georgieva

10. *Web Geometry Approach to Analysis of Solutions of the Maxwell-Einstein Equations*

    National Science Foundation: July 1, 2001-June 30, 2004
    Vladislav V. Goldberg
    Valentin Lychagin

11. *An experiment-based computational study of blood flow and transport during sepsis*

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

12. *Interface dynamics and pattern formation in thin liquid film flows*

    National Science Foundation: July 1, 2001-June 30, 2004
    Lou Kondic

13. *Instabilities in the flow of thin liquid films*

    National Science Foundation: January 1, 2002-December 31, 2004
    Lou Kondic

14. *Optimal Patterns of Wound Closure to Maximize Strength, Foster Healing and Minimize Scar*

    U. S. Army Medical Research and Material Command: July 1, 2001 – June 30, 2003
    Dawn Alisha Lott
    Hans R. Chaudhry
    K.G.Swan
    A,B.Ritter

15. *Optimal Patterns for Wound Closure to Maximize Strength, Foster Healing and Minimize Scar*

    Office of Naval Research: October 1, 2001 – September 30, 2003
    Dawn Alisha Lott
    Hans R. Chaudhry

16. *Spiking Excitable Systems*

    National Science Foundation: July 1, 2001-June 30, 2004
    C. B. Muratov

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

    AFOSR: December 1, 2001 – November 30, 2004
    Peter G. Petropoulos

18. *Analyzing Massive Numbers of Noisy Time Series*

    National Science Foundation GOALI Program: July 2001-June 2004
    Bonnie K. Ray
    Daryl Pregibon (AT&T Labs Research)
    Chris Volinsky (AT&T Labs Research)

19. *Quantitative Assessment of Natural and Human System Interaction on Shoreline Change*

NOAA, NJ Sea Grant: September, 2002-August, 2004
Bonnie K. Ray
Nancy L. Jackson (Humanities and Social Sciences, NJIT)

20. *Interfacial and Three-Dimensional Free Surface Flows*

National Science Foundation: July 1, 2001 – June 30, 2004
Jean-Marc Vanden-Broeck

C. EXTERNALLY FUNDED PROJECTS -- NOT THROUGH CAMS

1. *Micro-Air jet for controlling dusty flows*

Kleissler Company: On going collaboration
Nadine Aubry

2. *Electro-Separation for On-line Monitoring and Cleaning of In-Service Fluids in Shipboard Equipment*

Office of Naval Research (ONR): March 15, 1999 - January 31, 2001
Nadine Aubry
Boris Khusid

3. *Testing of Composite Materials*

Honeywell Inc.: February 1, 2001 - January 31, 2001
Nadine Aubry
Pushpendra Singh

4. *Ultra-Filtration of In-Service Fluids*

Office of Naval Research (ONR): May 1, 2001 - April 31, 2003
Nadine Aubry
Boris Khusid

5. *Laboratory for Electro-Hydrodynamics*

W. M. Keck Foundation: January 2000 - January 2005
Nadine Aubry
Boris Khusid

6. New Jersey Center for Micro-Flow Control
New Jersey Commission on Science and Technology (NJCST): December 1, 2000 – November 30, 2005

Nadine Aubry
Ernest Geskin
Dittmar Hahn
Boris Khusid
Somenath Mitra
Pushpendra Singh

7. Software and Digital Systems Safety (SDSS) project; Federal Aviation Administration
SDSS Task: Safety Engineering in Software (7/01-6/02)
Manish Bhattacharjee (This is a part of a NJIT white paper submitted by NJIT to FAA)

8. *Experimental Mathematics, Science and Communications Program*

Victoria Foundation: January 1, 2000 - December 31, 2001
Rose Dios
Howard Kimmel

9. *Transportation Information and Decision Engineering*

New Jersey Commission on Science and Technology: May 1998 – December 2000
John Tavantzis (Investigator)

10. *Laboratory Information Management System*

New Jersey Department of Transportation/US Department of Transportation:
April 2000 - December 2001
J. N. Meegoda
C. Tang

11. *Investigation of Subsurface Contamination and Effectiveness of Remediation Technologies Using Geotechnical Centrifuge Techniques*

Research Grant Council of Hong Kong: January 2000 - December 2001
I. M. C. Lo
J. N. Meegoda

12. *Research, Development, Demonstration and Validation of Intelligent Systems for Conveyance and Storage Infrastructure*

U.S. Army Environmental Center: May 2001- April 2002
T. Juliano
J. Meegoda

13. *Correlation of Surface Texture, Segregation, and Measurement of Air Voids*

New Jersey Department of Transportation: January-December 2001
J. Meegoda
G. Rowe

VIII. CAMS COMMITTEE AND LABORATORY ANNUAL REPORTS

A. READING ROOM

Reading Room Report by Chris Elmer and Dan Goldman

During this academic year, the CAMS reading room continued to function as a place where faculty members, as well as graduate students, could interact in an informal setting. To this end, afternoon teas were once again organized, this time by C. Elmer and D. Goldman. The tea hour was held twice weekly (Tuesday and Friday) and was well attended by CAMS members, particularly on Fridays when the seminar speaker was usually present. In addition to the organizers, the teas were supported in various ways by a number of Mathematical Sciences and CAMS faculty.

During this year, two improvements were made to enhance the utility of the reading room. First, the hours were expanded so that faculty and graduate students could meet at their convenience throughout the day. Second, upon our request the computer committee installed a Sun Sparc 5 computer in the reading room so that faculty, graduate students, and visitors could read email and perform other tasks in a relaxed and convenient setting. It is hoped that the attendance at the afternoon teas will continue to increase and that the improvements described above will lead to greater utilization of this space.

B. CAMS COMMITTEE REPORTS

SEMINAR COMMITTEE REPORT

Colloquium Committee Report by Anna Georgieva

The 2000-01 colloquium series of the Department of Mathematical Sciences was a very successful and popular event. The lectures, delivered by well-known mathematicians and physicists from academia and industry, covered a variety of fields like mathematical biology, dynamical systems, fluid dynamics, climate and ocean modeling, scientific computing and numerical methods, nonlinear optics among others. Four of the seminars were held jointly with the Department of Mechanical Engineering at NJIT. A separate Wednesday seminar series featured talks in the areas of statistics and biostatistics.

PUBLICATIONS COMMITTEE REPORT by Peter Petropoulos

The annual duties of the Publications Committee include overseeing the production, advertisement, and distribution of Technical Reports produced by CAMS members, and the production of the Center's Annual Report. The efforts of the Committee are aided by the Departmental Administrative Assistant (S. Sutton).

This year the committee continued maintaining/updating the web pages created two years ago for the purpose of making the titles/abstracts of the CAMS Technical Reports available to a wide Internet audience. Thirty two (32) CAMS Technical Reports were produced this year; the figure represents an increasing trend.

Under the supervision of Prof. C. Muratov, the committee and the student helpers completed a set of Web pages that display examples of DMS/CAMS member research activities.

RESEARCH COMMITTEE REPORT by Denis Blackmore

In the fall semester of 2000, the efforts of the Committee were centered on helping faculty members of the Department of Mathematical Sciences submit research proposals to external funding agencies such as the NSF, AFOSR, ARO, DOE and ONR. The proposals were reviewed and suggestions were made to improve them. Advice was given on the NSF Fastlane submission process and the procedure for proposal submission through the Office of Sponsored Programs at NJIT. Partly as a result of our efforts, the Department faculty managed to submit about a dozen proposals to the National Science Foundationand other funding agencies.

The Committee was actively involved in the spring of 2001 in helping our newer faculty members with the preparation of NJIT - SBR proposals. We read and critiqued the proposals, and helped the applicants prepare their budgets. Six proposals were submitted.

C. LABORATORY ANNUAL REPORTS

COMPUTER COMMITTEE REPORT by Peter Petropoulos

The Computer Committee includes L. Kondic (faculty member) and I. Giouvanos (DMS Systems Manager). Its tasks are to:

a) ensure smooth operations of existing common and individual computational resources within DMS/CAMS,

b) plan for the distribution of computer resources among DMS/CAMS faculty and graduate students who require them for research- and course-related purposes,

c) assure software maintenance is regularly performed,

d) plan the growth of computer resources in order to support the expansion of existing faculty activities into computationally-intensive research areas and accommodate new faculty,

e) reconfigure existing systems in response to new equipment acquired as a result of the above task.

This year the committee began the implementation of a plan to centralize graduate student computing under a common file system (AFS) managed by the University. For this purpose 22 Ultra Spark 5 SUN workstations (each with 256 MB of RAM) were procured from the University to replace the multitude of computing platforms and operating systems previously used by graduate students in their numerically intensive courses and in their thesis-related research activities.

An additional 4 Ultra Spark 5 SUN workstations (each with 256 MB of RAM) were obtained to replace the four aging Silicon Graphics workstations currently in use in the CAPSTONE Laboratory.

The above effort released a large number of computing platforms (10 Silicon Graphics and Intel-CPU Linux workstations; some two-processor and one four-processor systems). This has allowed the committee to plan and begin executing the integration of the DMS/CAMS common research computing platforms under a common filesystem in a way that will allow new common systems to be simply "hooked-up" at future dates.

Also, under the same filesystem and within a new computing platform, the committee is planning the centralization of e-mail and Web-related DMS services that are complementary to similar University-provided services.

Throughout the year the committee has responded to a large number of emergencies involving aging common computing facilities and individual faculty computers. This has contributed a sense of urgency for the successful completion of the work described above.

STATISTICAL CONSULTING LAB COMMITTEE by Sunil Dhar

STATISTICAL CONSULTING LABORATORY
Sunil K. Dhar, Director

The Statistical Consulting lab was involved with providing service to the NJIT community and outside.

Date: October 4, 2000
Client: Cathy Yuhas, M.S. student NJIT, Environmental Science, working under Dr. Weis, Rutgers Biology Program
Description: with initial consultation in modeling.
Consultant: Sunil K. Dhar

Date: January, 2001
Client: Nazhat Aboobaker, PhD student, Civil and Environmental Engineering Department, NJIT working under Professor Meegoda.
Description: Compared various Smoothers via Splus
Consultant: Sunil K. Dhar

Date: February, 2001
Client: Amit Numunkar, PhD student, Electric Engineering, advisor Professor Atam Dhawan, NJIT
Description: helped with SAS on AFS.
Consultant: Sunil K. Dhar

Date: February, 2001
Clients: Dr Mauro Tonolla, University of Geneva, Switzerland and Professor Dittmar Hahn, Microbial Ecology, Dept. of Chemical Engineering, Chemistry and Environmental Science, NJIT
Description: Computed the standard error of Biomass: the product of two estimators
Consultant: Sunil K. Dhar

Date: April 8, 2001
Clients: Mr. Jaidev Talwar, TECHNOVATIONS, Randolph, NJ 07869
Description: Compare various PTUF grades and recommend the right PTUF grade (on going)
Consultant: Sheng Zhang (Supervisor: Sunil K. Dhar)

Date: May 7, 2001
Clients: Sheldon Lipke, P.E. Superintendent of Plant Operations and Paul Cavanagh, P.E. Passaic Valley Sewerage Commissioners, Newark, NJ 07105
Description: Evaluating regression methodology (on going)
Consultant: Sunil K. Dhar and Manish Bhattacharjee

IX. RESEARCH WITHIN CAMS

A. CURRENT RESEARCH ACTIVITIES

Daljit S. Ahluwalia

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

Roman Andrushkiw

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

Srinivasan Balaji

The research of Srinivasan Balaji is broadly in the area of Probability, in particular, Stochastic processes with special emphasis on the stability and asymptotics of diffusions. His studies mainly concern with recurrence, transience and positive recurrence of reflecting diffusions in domains such as Quadrant or Orthant and passage time moments for Multidimensional diffusions. His studies in the area of Markov Chains cover the topics such as Multiplicative ergodicity, Poisson equation and Large deviation of empirical measures. His research on Computational Learning theory concerns with PAC learnability under a family of probability measures. His current projects include the analysis of duality between failure rate and mean residual life of Lifetime distributions, role of sticky diffusions in Default risk modeling, and possible applications of Markov chain Monte Carlo methods to Finance.

John Bechtold

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

Manish Bhattacharjee

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

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

Denis Blackmore

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

Victoria Booth

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

Michael Booty

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

Amitabha Bose

The research of Amitabha Bose focuses on the area of dynamical systems and their applications to non-linear waves and mathematical neurophysiology. His work on non-linear waves involves proving existence and stability of pulse solutions to non-local reaction diffusion equations arising in microwave heating applications. His studies in neurophysiology include modeling sleep rhythms in the thalamocortical system, phase precession of hippocampal place cells and the development of rigorous mathematical techniques to analyze such problems. His current projects include modeling synaptic depression in the gastric mill system of crustaceans, ripple wave

formation in the rat hippocampus and firing rate and phase based changes in multi-compartment pyramidal cells.

Bruce Bukiet

Bruce Bukiet's research is concerned with mathematical modeling of a variety of processes. In the area of detonation dynamics, work with Dr. John Starkenberg of Army Research Laboratory in Aberdeen, Maryland has been concerned with modeling the behavior of detonation waves using a discrete mixture equation of state. Using this model, one can study the build up of a detonation wave induced by a shock wave. The front tracking method for gas dynamics is being extended to handle the problem of a flyer plate impacting on an explosive material. In the area of biomechanics, work has continued on the study of residual stresses and stresses in the heart, with Prof. Hans Chaudhry of NJIT. Recent work has focused on understanding whether heart reduction surgery should be beneficial to patients with dilated cardiomyopathy. In addition, work has begun on modeling of flow in the lungs in an effort to understand treatment options for those with spinal injuries.

Hans Chaudhry

The research of Hans Chaudhry has mainly focused on the modeling and analysis of physical and physiological problems in continuum mechanics, especially solid mechanics incorporating large elastic deformations. His studies in large elastic deformations cover stress and strain analysis in cardiovascular system, human skin and low back dysfunction. He and his collaborators from NJIT have recently given a sound mathematical analysis of heart reduction surgery in patients suffering from myocardial cardiomyopathy. In-vivo comparisons of his results on dogs are being investigated by a team of doctors from UMDNJ. He along with his other collaborators from NJIT have also discovered the optimal patterns of suturing wounds of complex shapes to maximize strength, foster healing and minimize scars by employing finite element techniques. These results are also being investigated by experts in the surgery department of UMDNJ.

Sunil K. Dhar

The research of Sunil K. Dhar has been focusing on modeling and inference. Specifically, his research involves developing robust and efficient minimum distance estimators. Among the distance estimators studied by him are the L2-Distance type, under the following: AR [k] process, linear models, the additive effects outliers model, and the two-sample location problem. Another such estimators are the functional least squares minimum distance estimators researched in the additive effects outliers model. He derives sufficient conditions for the existence of L2 type minimum distance estimators. In the process, developing significant optimization tool, for the general class of sums of absolute multivariate linear functionals, which work even when linear programming methods fail. Here, he also covers the topics of computations of minimum distance estimators. His new extended negative multinomial distribution has applications to linear, log-linear and logit models. His studies in multivariate reliability involve deriving new discrete lifetime distributions such as the multivariate geometric and the discrete analog of Freund's model. He demonstrates fitting these new models with real data sets. Other discrete models developed by him use the binary sequence order k and are called the models of order k. This sequence was itself extensively studied by getting its likelihood function and developing probability bounds on its finite sum. His interest in statistical consulting has lead him to compute various models such as mixed models for the performance status of health care facilities changes with risk adjustment of hemoglobin A1c, logistic regression for longitudinal assessment of neuropsychological functioning, psychiatric status, disability and employment status in chronic fatigue syndrome (CFS) and other such projects. Currently, he is involved in advancing the research in minimum distance estimators.

Christopher E. Elmer

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

Vladislav V. Goldberg

The research of Vladislav V. Goldberg is in the field of differential geometry: projective differential geometry, conformal differential geometry, and the theory of webs. In the first field, he studies submanifolds with degenerate Gauss maps in a multidimensional projective space, in the second one, he studies the theory of lightlike submanifolds, and in the third one, his studies concern the local theory of webs and the algebraic aspects of this theory. His current project include an investigation of the structure of submanifolds with degenerate Gauss maps, construction of invariant normalizations of lightlike submanifolds, finding a classification of multidimensional four-webs, and solving Belousov's problem of existence of reducible and irreducible n-quasigroups.

Daniel Goldman

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

Lou Kondic

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

Gregory A. Kriegsmann

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

Dawn A. Lott

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

Jonathan H. C. Luke

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

Zoi-Heleni Michalopoulou

The research of Zoi-Heleni Michalopoulou focuses on inverse prolems in underwater acoustics for estimation of parameters such as source location and physical properties of the propagation medium. The research involves numerical modeling of sound propagation and the development of signal processing methods for the estimation process. Current projects include time delay estimation from received time series for use in inversion, multiple source localization, and inversion in the presence of coherence loss mechanisms.

Petronije Milojevic

The research of P.S. Milojevic is focused on studying semilinear and (strongly) nonlinear operator equations using a combination of topological, approximation and variational methods and applications to ordinary and partial differential equations. He has developed various fixed point results for condensing and A-proper maps. His studies of semilinear operator equations with monotone and (pseudo) A-proper maps involves nonresonance and resonance problems with Fredholm and hyperbolic like perturbations of singlevalued and multivalued nonlinear maps, and Hammerstein equations. He has widely applied these abstact theories to BVP's for (contingent)

ordinary and elliptic PDE's, to periodic and BVP's for semilinear hyperbolic and parabolic equations and to nonlinear integral equations. His study of nonlinear and strongly nonlinear operator equations is concerned with the existence and the number of solutions of such equations involving condensing, monotone and various types of approximable maps. His current research deals with Hammerstein equations and weakly inward A-proper and pseudo A-proper maps and applications to differential and integral equations.

Cyrill B. Muratov

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

Farzan Nadim

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

Demetrios T. Papageorgiou

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

Peter G. Petropoulos

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

exact absorbing boundary conditions, and the development of fourth-order accurate schemes in the presence of curved boundaries.

Michael Siegel

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

David Stickler

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

Burt Tilley

The research of Burt S. Tilley has focused on the modeling and analysis of free boundary problems that arise in multi-fluid/media applications. Models of these phenomena are derived by taking advantage of the disparate space and time scales through a systematic asymptotic analysis, and then numerical methods are used to simulate the dynamics. Examples include the stability and pattern formation of the interface between two immiscible, incompressible viscous fluids in an inclined channel, heat transfer due to the fluid motion of a contact line on an oscillating, heated substrate, stability and nonlinear evolution of a thin inviscid liquid dielectric sheet in the presence of an axial electric field, and microwave-enhanced chemical vapor infiltration. Current projects, in addition to extensions of the above work, include the evolution of critical layers in countercurrent two-layer flows, nonlinear elastic/fluid interactions, and a nonlinear description of transitions to slugging in core-annular flows.

B. SELECTED RESEARCH RESULTS

Amitabha Bose and Farzan Nadim (with Yair Manor)

Anna Georgieva

Daniel Goldman

Lou Kondic

Gregory A. Kriegsmann

Jonathan Luke

Zoi-Heleni Michalopoulou

Cyrill Muratov

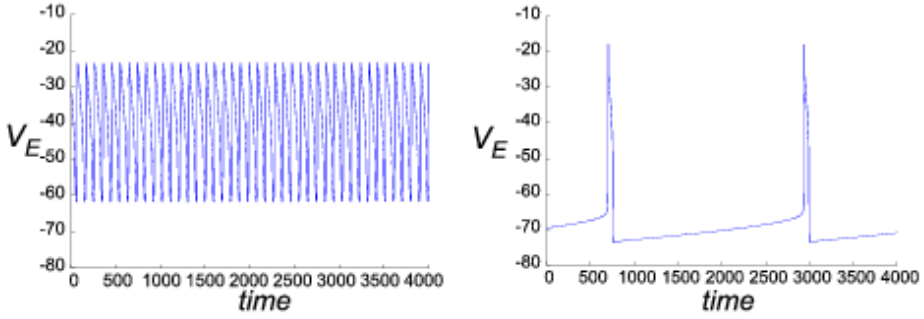
Demetrios T. Papageorgiou

Amir Yefet and Peter G. Petropoulos

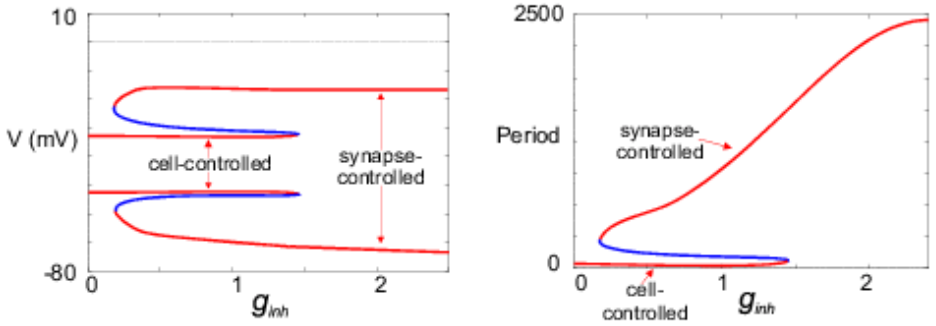
Synaptic Depression Promotes Bistability in a Neuronal Network
Amitabha Bose and Farzan Nadim (with Yair Manor)

Synaptic depression is a common form of short-term plasticity in the central nervous system. We show how a 2-cell network of excitatory and inhibitory neurons with a single depressing synapse can display two very different stable periodic orbits. The existence of these orbits is primarily dictated by the maximal conductance g_{inh} of the depressing synapse. For g_{inh} small, the orbit is a short-period solution controlled by the intrinsic properties of the neurons. For g_{inh} large, the solution is a long-period orbit controlled by the strength and time constants of the depressing synapse. In an intermediate range of g_{inh} values, both stable periodic solutions exist simultaneously.

Oscillations happen in 2 distinct modes:



The transition between the 2 oscillation modes can be seen in the bifurcation diagram.



Anna Georgieva

Knowledge of airflow patterns in the human nasal cavity is important for a more complete understanding of various biological and functional aspects of the entire respiratory tract since the nasal passages absorb those materials from the air prior to their delivery to the lungs. We investigate the effect of cyclic breathing on airflow patterns and formaldehyde uptake using computational fluid dynamics simulations in an anatomically-correct computer reconstruction of the human nasal passages. We model cyclic breathing by the time-dependent Navier-Stokes equations for airflow, using finite element method at physiological breathing rates, with the appropriate periodic boundary condition (breathing frequency at rest is chosen to be 15) at the nostrils.

The first figure shows the steady-state velocity vector field at representative cross-sections of the human nose at flow rate 15 L/min. Nostril is to the right; the direction of the main flow is from right to left. The two other figures show the velocity profiles at 1 second of the cyclic breathing cycle for flow rate of 0.365 L/min at two different cross-sections of the human nasal geometry.

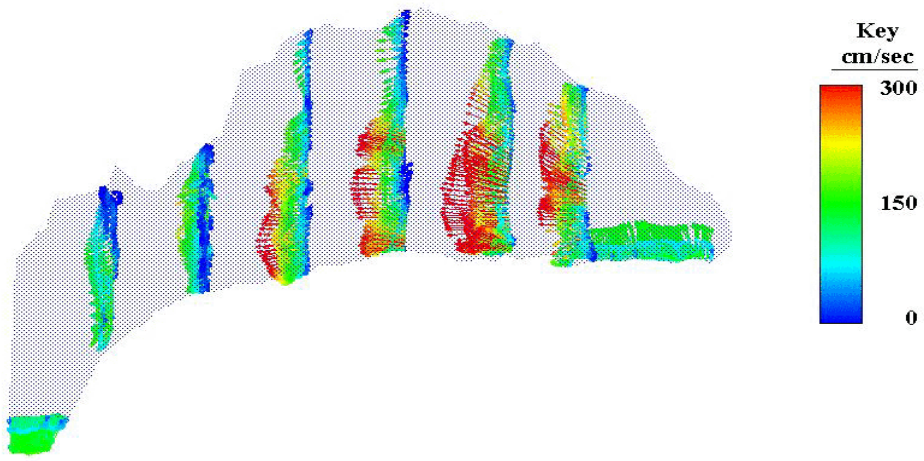
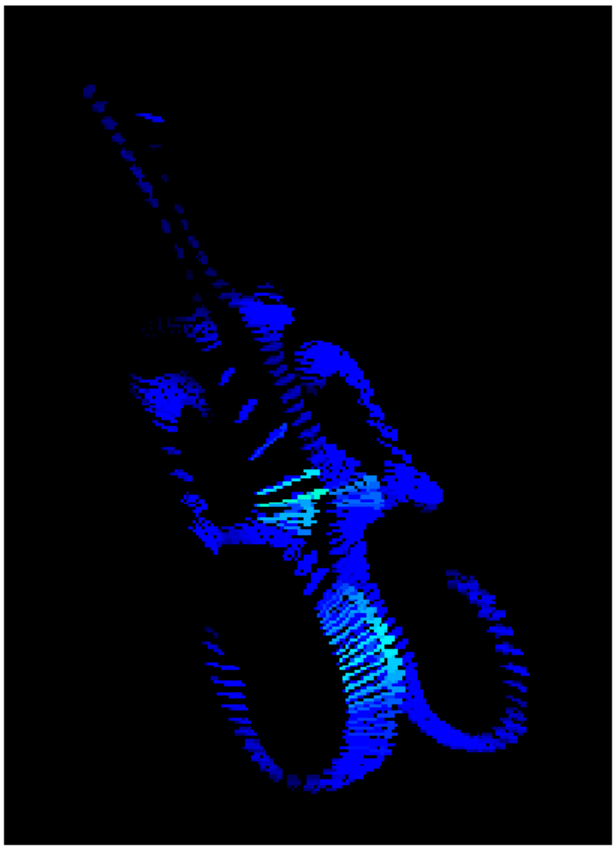


Fig. 1

Fig. 2



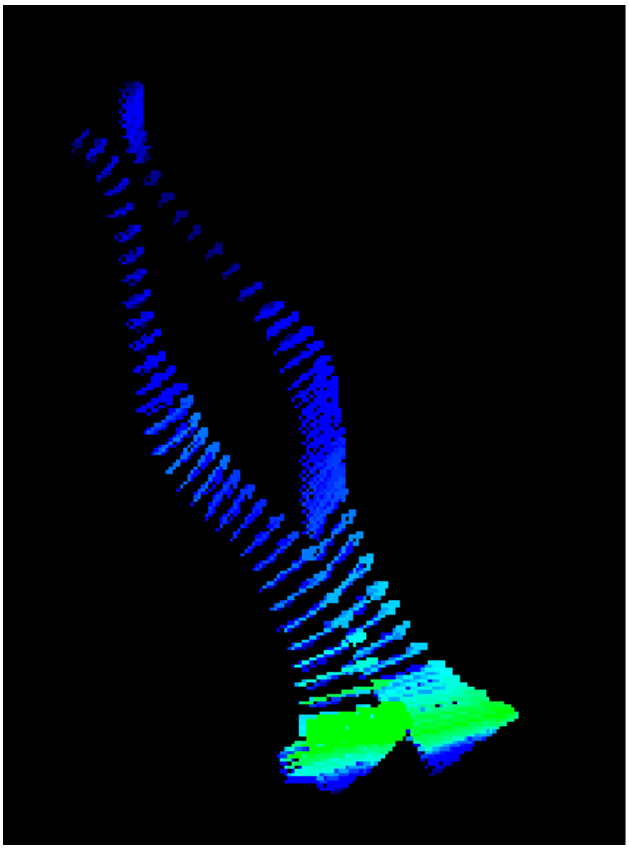
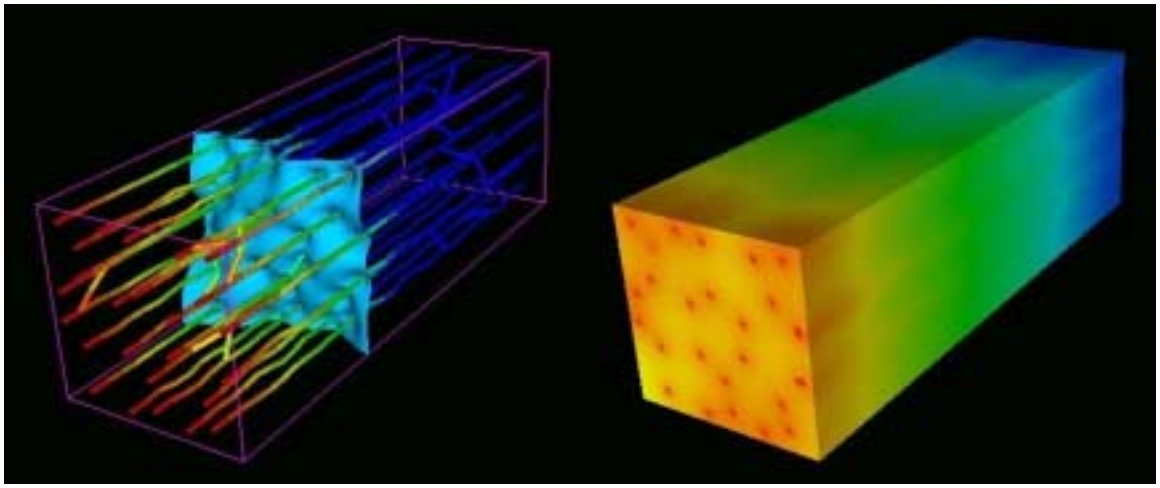


Fig. 3

Daniel Goldman

Simulations of the partial differential equations describing time-dependent oxygen transport in the microcirculation. At left, blood flow resumes in a transiently ischemic capillary network and oxygen concentrations begin to rise (from blue to red). The isosurface shown represents an oxygen partial pressure in the surrounding tissue of 10 Torr. At right, the oxygen distribution in the tissue reaches the normal steady state in which oxygen supply exactly matches metabolic demand.



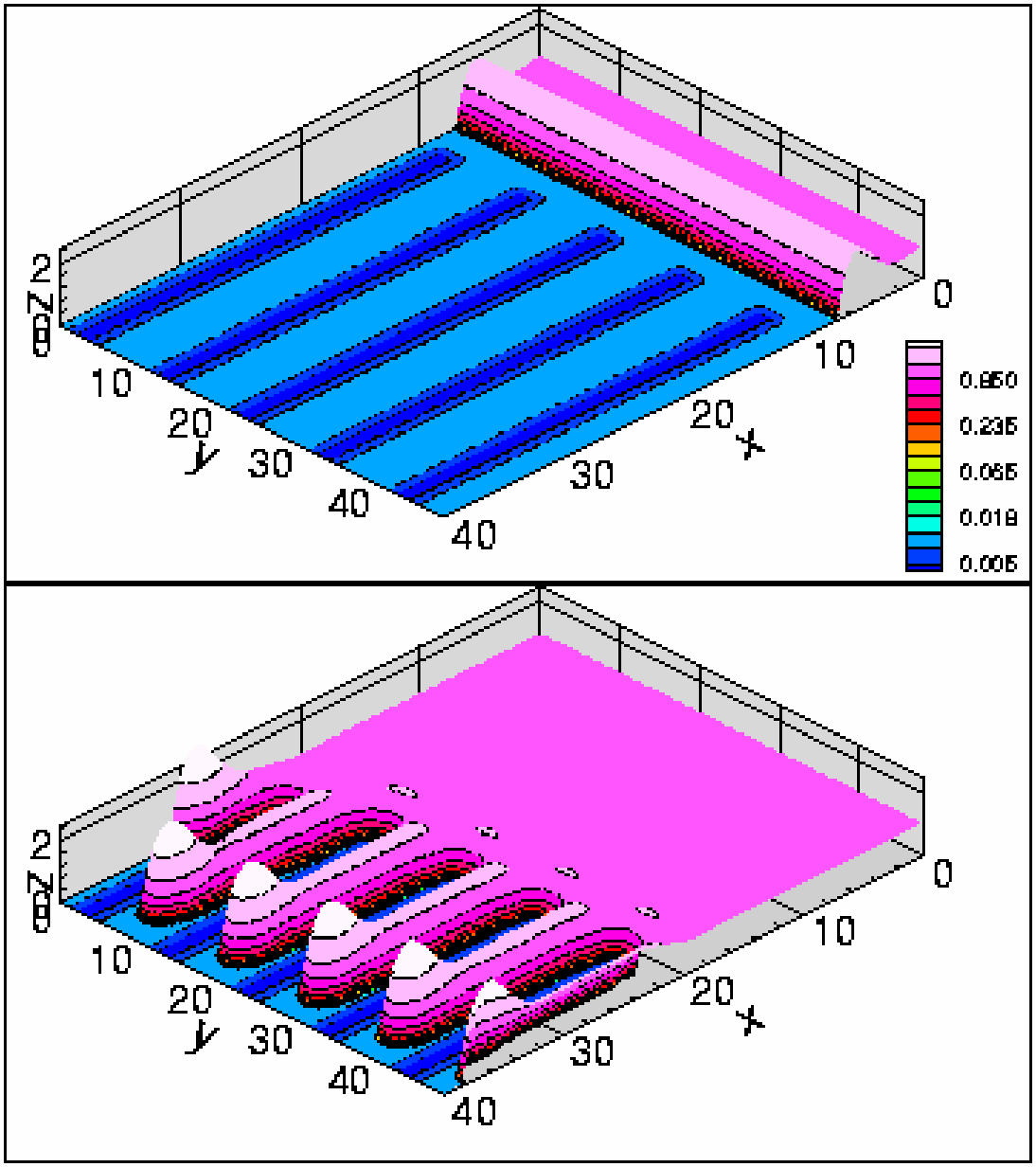
Lou Kondic

Instabilities in the flow of thin liquid films

As thin liquid films flow down an inclined plane, an instability develops due to the destabilizing effect of gravity. Typically, this instability leads to the formation of either triangular or finger-like patterns (Diez and Kondic, Phys. Rev. Lett. vol. 86, pp. 632 (2001)). In technological applications, this effect is often undesirable, since it may lead to partial or uneven surface coverage.

Some applications (such as microchip production) do require, however, partial substrate coverage. In our current work, we explore how the instability mechanism can be used to produce, in a controllable manner, a surface that is partially wetted. To achieve this goal, we perturb the surface by a series of channel-like structures. Figure 1 shows one example of our computational results, obtained by performing fully nonlinear time dependent simulations of the equations governing the dynamics. In this figure, light/dark blue corresponds to the regions of "easy/difficult" flow, respectively. The liquid film naturally chooses easy regions and produces regularly spaced patterns. In our computations, we currently explore how various characteristics of the imposed perturbations (such as their width, distance, etc.) influence this process.

Kondic (continued)



Flow over stripped surface. Color scheme represents the fluid height.

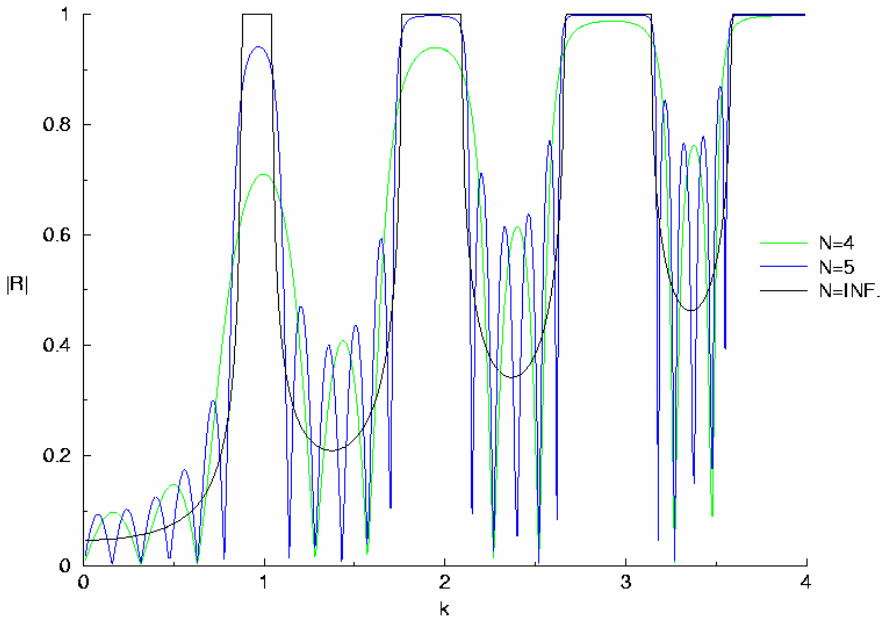
Gregory A. Kriegsmann

Scattering Matrix Analysis of Simple Photonic Band Gap Structures

Photonic band gap materials have received considerable study over the past several years because of their use in fabricating frequency selective structures. These are used in the construction of optical and microwave filters.

We have recently analyzed and studied the scattering and transmission of waves through simple two-dimensional photonic structures, including a Fabry-Perot resonator. Our method of attack employed scattering matrix theory. Assuming normal incidence, single mode propagation, and sufficient inter-element spacing in the direction of propagation, the mathematical structure of this complicated scattering problem was shown to hinge on the roots of a quadratic equation.

In the figure below we have plotted the magnitude of the reflection coefficient as a function of the wave number k. The photonic structure for this example is composed of N parallel columns of periodically arrange metallic strips. Intervals of k where |R| ~ 1 correspond to "stop bands"; for these frequencies the wave does not penetrate into the structure. It is apparent from the figure that these stop bands are well formed for N > 4 and k>1. In the "pass bands" the magnitude of the reflection coefficient oscillates rapidly with increasing N; its average approximating the N = infinity case. Indeed the introduction of loss into the system smoothes out these wiggles yielding intervals where |R| < 1/2.



Jonathan Luke: Gravity Driven Flow in a Fluid of Variable Density with Application to Sedimentation Theory

For an initially quiescent fluid with constant density, applying a uniform gravitational field produces no currents. The situation in a fluid of variable density is quite different. Convection currents are produced unless the density gradient everywhere points in the direction of gravity, that is, unless the fluid is stably stratified. Thus, variations in the fluid density generally produce variations in the fluid velocity. In the low Reynolds number limit, the mathematical structure of the relationship between the velocity and the density simplifies: The velocity is given by the convolution of a simple but singular kernel with the density. This relationship gives a precise description of dynamics that are easily understood at an intuitive level. "Bubbles" (regions in the fluid where the density is less than the surrounding fluid) tend to rise, and "blobs" (regions in the fluid where the density is greater than the surrounding fluid) tend to sink.

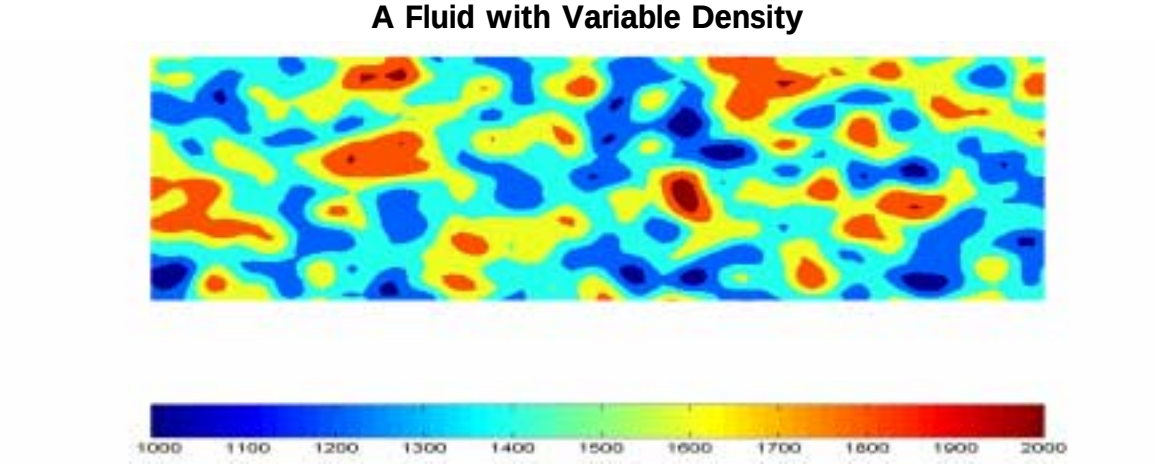


Figure: Flow driven by bubbles (blue) and "blobs" (red).

Because a suspension can be considered to be an effective fluid at length scales much larger than then mean nearest neighbor distance, the formula relating the density to the velocity has direct application to analysis of velocity fluctuations in a suspension. For an unbounded, random suspension with particles distributed according to the "well-stirred distribution" the velocity fluctuations (measured by the variance of the velocity) are infinite. This rigorous analysis does not agree with experimental results and thus appears paradoxical.

The dynamics of the problem provide a plausible resolution of this paradox. In a stably stratified suspension, "bubbles" and "blobs" rise and sink to their own levels. That is, density fluctuations diminish in time through the natural dynamics of the suspension. A quantitative analysis shows that for an initially "well-stirred" suspension the velocity fluctuations are proportional $t^{-1/2}$ where t is the time since the random suspension was initially prepared. Thus, at $t=0$ the infinite velocity variance is recovered in agreement with the theory for "well-stirred" suspensions, and for $t>0$ a finite variance is found agreeing with experimental results.

Zoi-Heleni Michalopoulou

We developed a linearization inversion method for parameter estimation in underwater acoustics. The method provided a linear approximation to the complex problem of source localization and sound speed and bottom depth estimation in problems involving sound propagation in the ocean. The linear system we constructed related arrival times of distinct rays and travel time derivatives and was solved with least squares and regularization. The estimates were accurate, and the estimation process was very efficient. Figure 1 shows scatter plots created from estimates of source range and bottom depth from (a) least squares and (b) regularization. Both sets show estimates of range close to 700~m and water column depth close to 200~m (which are the correct values of the unknown parameters). The spread of the estimation is reduced in the regularization results.

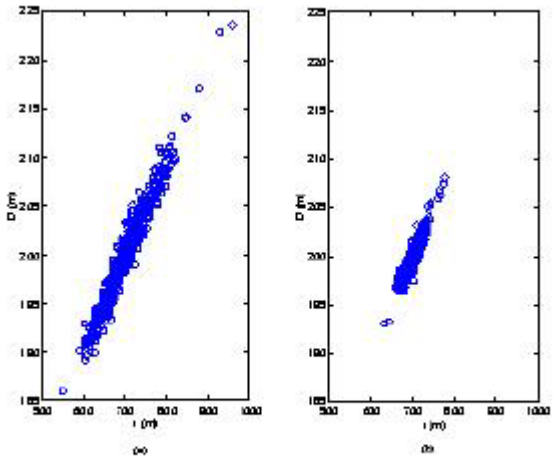
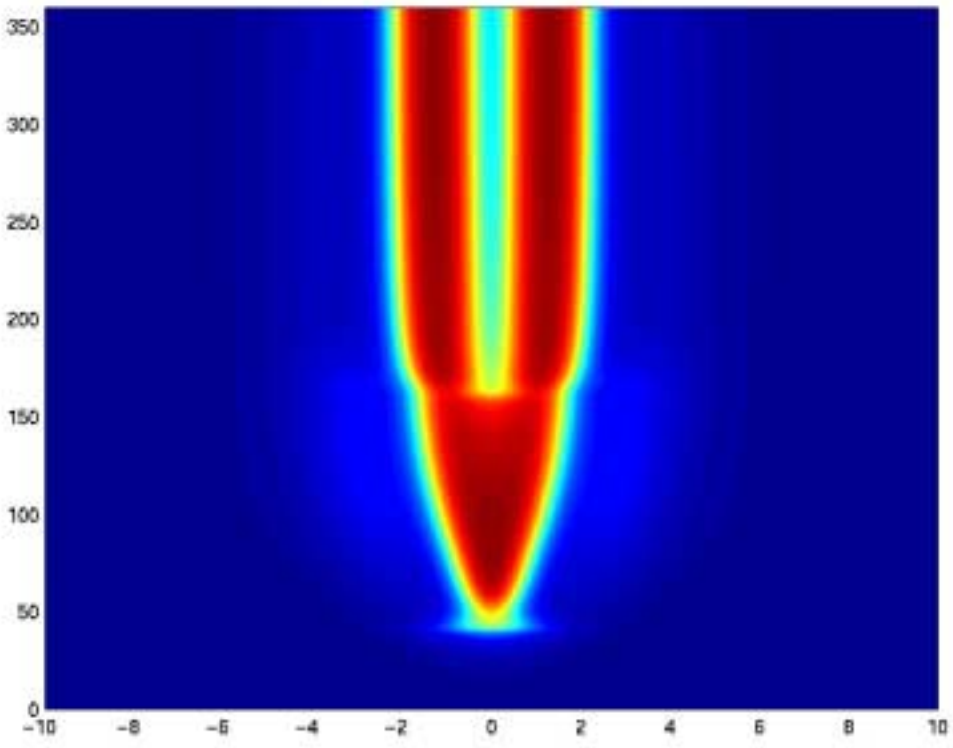


Figure 1: Monte Carlo simulations for source range and bottom depth inversion: (a) scatter plots using least squares method; (b) scatter plots using regularization.

Cyrill Muratov

Twin peaks patterning the Drosophila egg

The picture shows the evolution of a transient signaling pattern during the formation of a pair of respiratory appendages in the egg of the fruitfly Drosophila. The colorcode shows the concentration of the ligand of the Epidermal Growth Factor Receptor called Spitz, which specifies the formation of the appendages, in the cross-section of the egg as a function of time. One can see that the signaling pattern consisting of only one peak initially forms in the center of the system as a result of the stimulation of the Spitz-secreting follicle cells by the oocyte. In the second stage, however, the signaling pattern splits into two peaks as a result of the cooperative action of the positive and negative autocrine feedback loops.



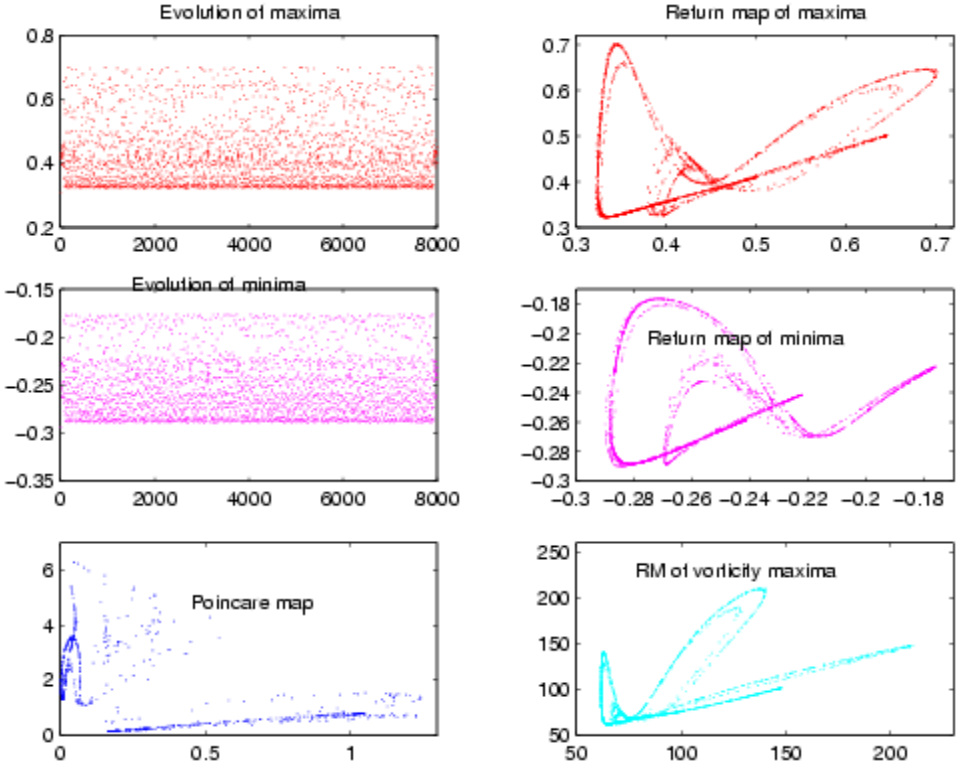
Demetrios T. Papageorgiou

Title: Chaotic flows inside pulsating circular pipes: Exact Navier-Stokes solutions

We consider the flow in a pulsating circular pipe which contains a viscous incompressible fluid. Such flows are of relevance to biological as well as technological applications. In dimensionless variables, the pipe radius is given by $r = 1 + \Delta \cos t$ where $0 < \Delta < 1$ is the oscillation amplitude. In addition, the flow is characterized by a Reynolds number

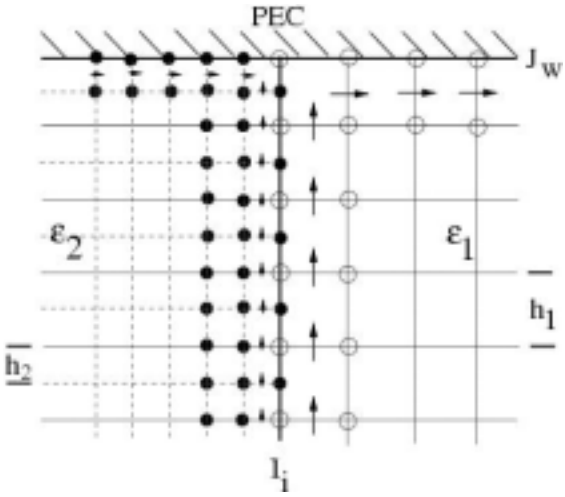
$R = \dfrac{a^2 \omega}{\nu}$ where a is the mean pipe radius, ω is the frequency of oscillation and ν is the fluid's kinematic viscosity. A class of exact Navier-Stokes solutions exists which is of stagnation point form, that is the axial velocity depends linearly on the axial coordinate and the radial velocity is independent of it. This local solution (expected to be valid in a long vessel) leads to a system that depends on time and the radial coordinate alone; the system is nonlinear and is periodically forced. We have computed solutions for different amplitudes and Reynolds numbers using a streamfunction-vorticity formulation designed to give good stability at high Reynolds numbers.

Results are presented for a representative case having $\Delta = 0.3$ and $R = 1000$. (At low values of R the flow locks into the forcing frequency; low Reynolds number solutions are easily found by regular perturbation.) Our main concern is in following bifurcations in the solution and in particular following different routes to chaotic or other aperiodic dynamics. The Figures show chaotic solutions presented as follows: A point at a fixed distance from the pipe axis is taken and the evolution of the streamfunction (this is proportional to the radial velocity at the given point) is stored. From this signal, the local maxima and minima at their respective times of occurrence are noted. These mimick maps extracted out of the infinite-dimensional dynamical system and provide information about the dynamics. Such results are given in the top four Figures; the flow is chaotic and as is evident from the return maps there is a high degree of folding and self-similarity which is typical of strange attractors. Additional evidence of this is given in the Poincare section (constructed by defining a three-dimensional vector from the flow field at three distinct points in the pipe) and the return map of the maxima of the wall vorticity.

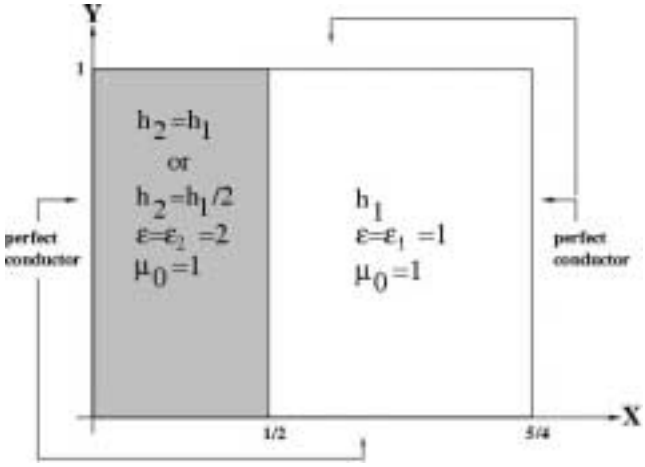


Amir Yefet and Peter G. Petropoulos

Many modern technology applications involve the propagation and scattering of transient electromagnetic signals, e.g., electronic on-chip interconnects, non-destructive testing of concrete structures, and aircraft radar signature analysis. This is a challenge for numerical modelers as the relevant mathematical problem to be solved generally exhibits disparate spatial (e.g., dielectric inhomogeneities with both small- and large-scale features) and time (e.g., dispersive media) scales. Thus far, Yee's Finite-Difference Time-Domain (FD-TD)algorithm has provided the best second-order accurate non-dissipative direct solution of the time-domain Maxwell equations on a staggered grid. As all finite difference schemes, the Yee scheme is dispersive and anisotropic, and for large-scale problems, or for problems requiring long-time integration of Maxwell's equations, errors from dispersion and anisotropy quickly accumulate and become significant unless a fine discretization is used This leads to prohibitive memory requirements, and high computational cost when addressing real-world problems. Methods with a higher convergence rate are needed. We have previously derived and analysed appropriate fourth-order accurate extrapolation and one-sided difference operators in order to complete a model fourth-order scheme near metal boundaries and dielectric interfaces. Here we show some of our recent efforts to appropriately adapt our interpolation/extrapolation and one-sided difference operators to incorporate a 2X spatial mesh refinement capability in our fourth-order method which is itself fourth-order accurate; special care is required near the intersection of the dielectric interface and the PEC boundary. In computations we have observed long-time stability.

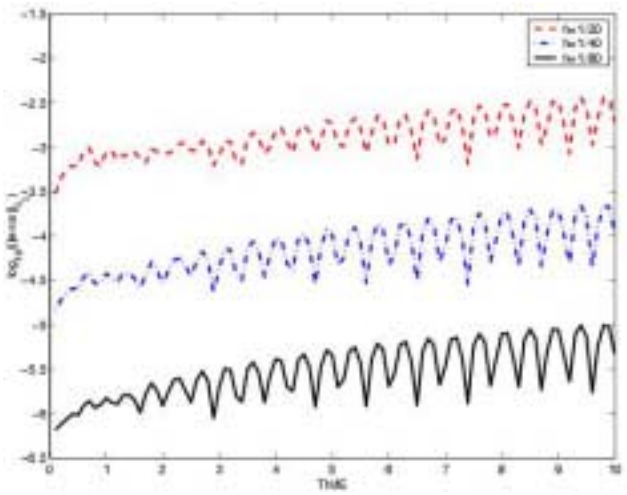


Schematic of the nodal structure across the mesh refinement interface



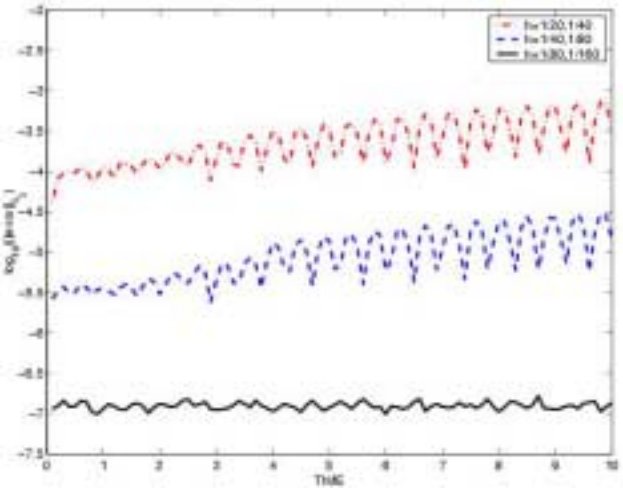
Computational domain

Yefet and Petropoulos (continued)



No mesh refinement

With mesh refinement



C. COLLABORATIVE RESEARCH

Roman Andrushkiw

Pattern Recognition of Malignancy-Associated DNA Changes in the Pathology of the Thyroid and Mammary Glands, Y. Petunin, D. Klyushin (Kyiv Shevchenko Natl. University), and K. Ganina, N. Boroday (Institute of Experimental Pathology, Oncology and Radiology of the Natl. Academy of Sciences of Ukraine)

Srinivasan Balaji

Risk sensitive control of general Markov chains and their application to Portfolio management, Tomasz Bielecki (Northeastern Illinois University).

Default Risk modelling and sticky diffusions, Federico Marchetti (Politechnico di Milano, Milan, Italy)

Optimal trading under minimal assumptions, John F. Price (Univ. of New South Wales, Australia)

John Bechtold

Flame/flow interactions in premixed combustion, M. Matalon (Northwestern University)

Radiation-driven flows, P. Ronney (University of Southern California)

Manish Bhattacharjee

New preservation results for Geometric Compounds and Applications, S. Ravi, R. vasudeva, N.R. Mohan (University of Mysore)

On the HNBRUE closure problem under convolutions, S. Ravi, R. vasudeva, N.R. Mohan (University of Mysore)

Shape duality of hazard rate and mean remaing life functions, S. Balaji (NJIT)

Denis Blackmore

Proposal: *Development of Advanced Automated Manufacturing Software,* ICAM: Sept. 1, 2001 - Aug. 31, 2002, with M. Leu (University of Missouri - Rolla).

Vortex dynamics and kinematics, O. Knio (Johns Hopkins), C. Lim (RPI), P. Newton (UC - Davis), J. Tavantzis (NJIT) and L. Ting (Courant Institute)

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

Analysis of shock wave flows, L. Ting (Courant Institute)

Integrability of infinite-dimensional dynamical systems, A. Prykarpatsky (Ukranian Academy of Sciences - Lviv), A. Samoilenko (University of Kiev)and R. Samulyak (Stony Brook and Brookhaven Laboratories)

Acoustically induced separation and segregation of particulates, N. Aboobaker (NJDOT) and J. Meegoda (NJIT)

Dynamical systems based development of automated manufacturing algorithms, K. Abdel-Malek (University of Iowa), K. Joy (UC - Davis), M. Leu (University of Missouri - Rolla) and J. Yang (University of Iowa)

Analysis of Earth's crust dynamics, M. Prytula (Lviv University) and Y. Starodub (Ukrainian Academy of Sciences - Lviv)

Biocomplexity and dynamics of ecosystems, M. Levandowsky (Pace University), G. Benoit (Yale), M. Haggblom (Rutgers University) and O. Anderson (Columbia University)

Fractal modeling and analysis of engineering surfaces, G. Zhou (Drexel University)

Victoria Booth

Phase Maintenance of the Pyloric Rhythm, Yair Manor (Ben-Gurion University, Beer-Sheva, Israel)

Amitabha Bose

Switches and bistability arising from synaptic depression, Farzan Nadim (NJIT), Yair Manor (Ben-Gurion University, Israel)

Bruce Bukiet

Proposal: *Mathematical Analysis of Heart Reduction Surgery,* with H. Chaudhry (Department of Mathematical Sciences and Center for Applied Mathematics and Statistics, NJIT, Newark); A.Ritter, A. Arora, T.Regan and A. Khorasani (all from UMDNJ, Newark).

Modeling Explosive Initiation, John Starkenberg (Army Research Lab, Aberdeen, Maryland)

Hans Chaudhry

Proposal: Mathematical Analysis of Heart Reduction Surgery, with B. Bukiet (Department of Mathematical Sciences and Center for Applied Mathematics and Statistics, NJIT, Newark); A.Ritter, A. Arora, T.Regan and A. Khorasani (all from UMDNJ, Newark)

Optimal Patterns for Suturing Wounds of Complex Shapes to Maximize Strength, Foster Healing and Minimize Scars (D.A. Lott Crumpler, NJIT; K.G.Swan and A.B. Ritter both from UMDNJ, Newark)

Mathematical Modeling to Evaluate Low Back Dysfunction (with T. Findley, J.Mertz, M.Warner all private Clinical Consultants and R. Patraju, a student from Biomedical Engineering, NJIT, Newark)

Sunil Dhar

The standard error of Biomass: the product of two estimators, Dr Mauro Tonolla, University of Geneva, Switzerland and Professor Dittmar Hahn, Microbial Ecology, Dept. of Chemical Engineering, Chemistry and Environmental Science, NJIT (February, 2001)

Comparing various smoothers, Professor Meegoda and Ph.D. student Nazhat Aboobaker, Civil and Environmental Engineering Department, NJIT (January, 2001)

Christopher Elmer

The effect of discretization on traveling wave solutions of bistable partial differential equations, E.S. Van Vleck (Colorado School of Mines)

COLDLY - A collocation based boundary value solver for mixed type delay equations, K.A. Abell (University of Sussex, Brighton, U.K.), A.R. Humphries (University of Sussex, Brighton, U.K.), and E.S. Van Vleck (Colorado School of Mines)

A variant of Newton's method for the computation of traveling waves of bistable differential-difference equations, E.S. Van Vleck (Colorado School of Mines)

Anna Georgieva

Modeling of airflow in the upper respiratory tract, J. Kimbell and P. Schlosser (CIIT Centers for Health Research)

Nonlinear Waves in Periodic Medium, T. Kriecherbauer (U. Munich) and S. Venakides (Duke University)

Daniel Goldman

Modeling transport in the rat EDL microcirculation during sepsis, C. Ellis and R. Bateman (University of Western Ontario, Canada)

Modeling oxygen transport in the rat EDL microcirculation under normal conditions, C. Ellis, R. Bateman (University of Western Ontario, Canada) and A. Popel (Johns Hopkins University)

Modeling oxygen transport by capillaries and capillary networks in the presence of hemoglobin-based blood substitutes, A. Popel, A. Vadapalli, and N. Tsoukias (Johns Hopkins University)

Lou Kondic

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

Discrete modeling of granular materials, R. Berhinger (Duke University)

Gregory A. Kriegsmann

Microwave Power Requirements in Joining SiC Cylinders, R. Bruce (F&M Technologies, Fairfax, VA) and R. Silberglitt (Rand, Arlington, VA)

Electromagnetic Propagation in Porous Periodic Structures, I. D. Abrahams (Manchester, UK).

TM Scattering by a Strip: The On Surface Radiation Condition Revisited, P. D. Smith (Dundee, UK).

Dawn Lott

Application of quantitative image analysis to studying calcium diffusional processes in heart muscle cells, John Tavantzis (NJIT) and Joshua Berlin (UMDNJ)

Cyrill Muratov

Modeling and computational analysis of pattern formation in development, S. Y. Shvartsman (MIT)

Kinetics of polymer-liquid crystal systems, W. E (Princeton University)

Spike autosolitons in the Gray-Scott model, V. V. Osipov (CSIC, Laboratorio de Fisica de Sistemas Pequenos y Nanotecnologia, Madrid, Spain)

Farzan Nadim

Proposal: *The Pyloric Model Group: Functional Analysis of a Complex, Distributed Biological Neural Network,* National Science Foundation: May 1, 2001-April 30, 2006, with Scott Hooper, Ron Harris-Warrick, Jorge Golowasch, Eve Marder, Michael P. Nusbaum.

Regulation of Neuronal Oscillations by Synaptic Dynamics, Yair Manor (Ben-Gurion University, Beer-Sheva, Israel).

Configuration of Circuit Dynamics by Modulatory Fibers, Michael P. Nusbaum (University of Pennsylvania Medical School, Philadelphia, PA), Yair Manor (Ben-Gurion University, Beer-Sheva, Israel).

Demetrios T. Papageorgiou

Research collaboration with Professor Charles Maldarelli, Levich Institute, City College of New York. Work on theoretical and experimental aspects of bubble motion in surfactant solutions. Co-mentored a Ph.D. (Dr R. Palaparthi) student in Chemical Engineering at CCNY. Thesis defended and currently employed at Oric Inc., Denver, Colorado.

Research collaboration with Professor Philip Hall, Imperial College of Science, Technology and Medicine. Work on chaotic motions and instabilities of high-speed flows. Jointly supervising a doctoral student and a postdoctoral researcher.
Hydrodynamics of bubbles in surfactant solutions, C. Maldarelli (Levich Institute, City College of New York).

Chaotic motions in oscillatory flows, P. Hall (Imperial College, London).

Instabilities of sheared suspensions, R. Mauri (University of Pisa, Italy).

Chaotic dynamics of dissipative/dispersive systems, Y. Smyrlis (University of Cyprus).

Bonnie K. Ray

Proposal: *Effects of Diesel Exposure on Exacerbation of Pediatric Asthma,* Health Effects Institute: September, 2001-August, 2004, with Clifford P. Weisel (UMDNJ-RWJMS), Stanley H. Weiss (UMDNJ-NJMS), Leonard Bielory (UMDNJ-NJMS), Natalie Freeman (Rutgers-New Brunswick), Barbara Turpin (UMDNJ-NJMS), Amy Davidow (UMDNJ-NJMS), David Hom (UMDNJ-NJMS).

Bayesian change-point estimation for long-range dependent processes, R. Tsay (University of Chicago)

The local Whittle estimator of long memory stochastic volatility, C. Hurvich (New York University)

Modeling nonlinear time series (graduate text), J. De Gooijer (University of Amsterdam)

Michael Siegel

Singular effects of surface tension in the dynamics of two-finger competition in Hele-Shaw flow, E. Paune and J. Casademunt (Univ. of Barcelona, Spain)

Small surface tension limit for Hele-Shaw fingers and bubbles with anisotropy, Mark Kunka (Caltech) and Saleh Tanveer (Ohio State).

Volume of fluid method for free surfaces with surfactant, A. James and J. Lowengrub (University of Minnesota).

Burt Tilley

Two-layer flows in inclined channels, L. Kondic (NJIT), J. Diez (University del Centro, Pinto, Argentina)

Microwave-enhanced CVI processing, G. A. Kriegsmann (NJIT), J. Binner (Loughborough University, England)

Evolution of Holmboe waves in two-layer flows, P. Huerre (Ecole Polytechnique)

Fluid/elastic instabilities, J.-M. Vanden-Broeck (University of East Anglia, England)

X. STUDENT ACTIVITIES

A. CAMS ACADEMIC YEAR RESEARCH PROGRAM FOR GRADUATE STUDENTS

Dr. Michael Booty, Director of the Graduate Program

Ph.D.'s Awarded:

Jerry Chen
January 2001 – Advisor: Dr. Denis Blackmore
Thesis: *"Dynamical Properties of Discrete Lotka-Volterra Equations"*
(Currently a Visiting Assistant Professor at the University of Delaware.)

Adrienne James
May 2001 – Advisor: Dr. Michael Recce
Thesis: *"A Dynamical Model of the Distributed Interaction of Intracellular Signals"*

Xiaoqun Ma
May 2001 – Advisor: Dr. Zoi-Heleni Michalopoulou
Thesis: *"Efficient Inversion Methods in Underwater Acoustics"*
(Currently a Mathematician at Watermark Corporation, Princeton, NJ.)

Stuart Walker
May 2001 – Advisor: Dr. Gregory A. Kriegsmann
Thesis: *"Multi-Mode Cavity Effects on the Microwave Heating of A Ceramic Slab"*

Report of the Ph.D. Qualifying Exam Committee by Denis Blackmore

(D. Blackmore, Chair)

During this year we gave Ph.D. Qualifying exams in August 2000, January 2001, and May 2001. Exams in Analysis and Linear Algebra/Numerical Methods were given in August. In January, exams in Applied Mathematics and Linear Algebra/Numerical Methods were given. The exam in Applied Mathematics was given in May.

In August, one of the two students taking the Analysis exam earned an A, while two of the three students who took the Linear Algebra/Numerical Methods exam received A's.

One student took, and earned a grade of B, on the Applied Mathematics exam in January. The only student taking the Linear Algebra/Numerical Methods exam received a grade of A.

Three students took the Applied Mathematics exam in May and two of them earned A's.

Presentations:

Conference and Workshop Participation:

Lyudmyla Barannyk: Contributed talk at the APS 53rd Annual Meeting of the Division of Fluid Dynamics, Washington DC, November 2000.
``The effect of surface tension on strongly nonlinear interfacial waves in a channel."
With Demetrios Papageorgiou.

Urmi Ghosh-Dastidar: Poster presentation at the SIAM Annual Meeting, Puerto Rico, July 2000. ``Inverse problems in underwater acoustics in the presence of internal gravity waves."

Lyudmyla Barannyk, Said Kas-Danouche, and Knograt Savettaseranee participated in the Rensselaer Polytechnic Institute `Mathematical Problems in Industry' Workshop, June 4-8, 2001.

Steven Kunec:
1) Poster presentation. Rutgers-UMDNJ-NJIT Integrated Neuroscience Minisymposium, October 2000. Aidekman Center for molecular and behavioral neuroscience.

2) Poster presentation. SIAM Conference on Dynamical Systems. May 19th-24th, 2001 at Snowbird, Utah. ``The role of synaptic delay in organizing synchronous behavior in networks of self-inhibiting neurons."

Xiaoyun Sun: Contributed talk at the APS 53rd Annual Meeting of the Division of Fluid Dynamics, Washington DC, November 2000. ``Optimal feedback control of cylinder vortex shedding by Lorentz force." With Nadine Aubry.

Publications:

S. Kunec and A. Bose. ``Role of synaptic delay in organizing the behavior of networks of self-inhibiting neurons." Physical Review E, 63, 0219081-13.

A. Bose and S. Kunec. ``Synchrony and frequency regulation by synaptic delay in networks of self-inhibiting neurons." Neurocomputing, 2001, 38-40, pp 505-513.

Z.H. Michalopoulou, X. Ma, M. Picarelli and U. Ghosh-Dastidar. ``Fast Matching methods for inversion with underwater sound." Proceedings of Oceans 2000 MTS/IEEE Conference, September 2000.

X. Ma and Z.H. Michalopoulou. ``Model based time delay processing for underwater source localization and tracking." Proceedings of the Fifth European Conference on Underwater Acoustic, ECUA 2000. Lyons, France, July 2000.

I. Zorych. Informativity of Bayes experiment in making decision problems for countable parametric space. Cybernetics and System Analysis, 2001.

Graduate Student Achievements:

Urmi Ghosh-Dastidar was awarded an Office of Naval Research grant: Three-year Graduate Traineeship Award, *"Detection and Localization in the ocean in the presence of coherence loss mechanisms"*.

Xiaoqun Ma is in his second year of support from his Office of Naval Research grant, *"Efficient shallow water matched field inversion"*

B. CAMS SUMMER RESEARCH PROGRAM FOR GRADUATE STUDENTS

2000:

As with previous years, a Summer Research Program was offered for the Mathematical Sciences Ph.D. students. The program started on May 17 and lasted for 12 weeks.
The faculty in charge of this summer program were Professors **Demetrios Papageorgiou**, **Denis Blackmore** and **Cyrill Muratov**.

In addition to individual research projects, students participated in a summer seminar series. Two seminars were given each week. One of the weekly seminars was given by a faculty member on fundamental areas of applied mathematics, such as mathematical biology, fluid dynamics, electromagnetics, underwater acoustics, wave propagation, and combustion. The second seminar was given by a graduate student on their specific area of research. Each seminar was followed by an informal discussion. The seminar series helped spark interesting dialogues between students and faculty, as well as supplement each student's growing knowledge of applied mathematics.

In addition to presenting, students were asked to compose a brief, scientific report about the work they accomplished during the summer.

Below is a list of the seminars given during the CAMS Summer Research Program 2000:

Faculty Seminars:

Peter Petropoulos, "Computational Methods for Electromagnetic Wave Propagation Problems -- Parts 1 and 2"
Denis Blackmore, "The Dynamics of Vortex Ring Interactions"
Victoria Booth, "Hippocampal Place Cells and Neural Code"
Farzan Nadim, "Central Pattern Generation in the Nervous System"
Lou Kondic, "Flow of Thin Films -- Parts 1 and 2"
Dawn A. Lott and Hans Raj Chaudhry, "Biomechanics of Human Skin: Determining Optimal Pattern of Suturing Wounds -- Finite Element and Analytical Methods -- Parts 1 and 2"
Gregory A. Kriegsmann, "Problems in Wave Propagation -- Parts 1 and 2"
Michael Siegel, "Moving Boundary Problems in Fluid Mechanics"
Srinivasan Balaji, “Statistical Aspects of Learning Theory: Applications to Control and Neural Networks”

Student Seminars:

Ray Addabbo, "Hydrodynamic and Diffusive Instabilities in Near Stoichiometric Flames"
Xiaoqun Ma, "Estimation of Sound Speed Profile Using a Linear Inversion Model"
Eliana Antoniou, "Dynamics of Near Stoichiometric Flames"
Stuart Walker, "Microwave Heating of a Ceramic Slab"
Knograt Savettaseranee, "Fluid Flow in a Tangential Electric Field"

Adrienne James, "Cell Behavior as a Dynamic Attractor in the Intracellular Signaling System"
Hoa K. Tran, "Transport of Electromagnetic Energy"
Said Kas-Danouche, "Interfacial Hydrodynamics of Annular Films"
Steve Kunec, "The Dynamics of Two Self-inhibiting, Inhibitory Coupled Neurons"
Lyudmyla Barannyk, "Strongly Non-Linear Interfacial Waves with Surface Tension"
Xiaoyun Sun, "Vortex Shedding Control of Two Dimensional Unsteady Flow"
Valery Lukyanov, "On Solving the Helmholtz Equation with Higher Order Boundary Conditions"

Summer course in Scientific Computing for the first-year graduate students

Participants: H. Coskun, C. Epstein, V. Lukyanov, R. Search, T. Segin, M. Sun.

The purpose of this short course is to familiarize the first-year graduate students with the numerical methods of solving partial differential equations and some relevant programming practices. It emphasizes both practical and applied aspects of a model problem. The students solve for the distribution of heat inside an electric circuit module with heat-generating parts as a function of time as the circuit is turned on. The application question is whether the proposed circuit design will overheat or not. To answer this question, the students solve the Poisson

equation describing the distribution of temperature inside the module using finite differences with the successive overrelaxation method or conjugate gradient method, and fast fourier transform. Then they compare the efficiency and convergence of these ietrative methods as applied to this particular problem. The students also learn how to visualize their results on modern workstations, and how to typeset their reports using LaTeX.

2001:

This year we were again fortunate in being able to offer a summer program for students on the doctoral program. In addition to providing welcome stipend for students to pursue their studies over the summer, various more or less formal activities were organized to provide a focus for the students' development in research. This year the program organizers were **Michael Booty**, Director of the Graduate Program, and **Jonathan Luke**, Associate Chairperson.

The program ran for twelve weeks, from May 21 to August 10, and supported a total of twenty two students with each choosing the duration of their participation on the program. Two seminars were scheduled each week, of which one was given by a more advanced graduate student and one was given by a faculty member. The more advanced graduate students, i.e., those who had completed their qualifying exams, had the opportunity to pursue research unimpeded by other regular commitments such as classes and teaching.

Students at an earlier stage in the doctoral program took a class in real and complex analysis, which was given by Denis Blackmore, and were assigned to computational projects organized by Lou Kondic. The analysis class built on fundamental skills and fully prepared students for qualifying exams in the Fall. The computational projects were intended for students who are at the stage between their first and second semester of graduate level numerical methods. As in the past, we have found that the projects provide an invaluable opportunity to improve practical skills such as code writing, compiling, and running, as well as an opportunity to consolidate understanding of concepts and theory taught in class.

Faculty provided office hours for tutoring in individual subject areas and informal discussions on research interests. These were organized as follows: Denis Blackmore, Analysis; Lou Kondic, Numerical Methods; Linear Algebra, Cyrill Muratov; Statistics, Manish Bhattacharjee; Jonathan Luke and Michael Booty, miscellaneous.

Below is a list of the seminars given during the CAMS Summer Research Program 2001:

Faculty Seminars:

Christopher Elmer, `An introduction to traveling wave solutions of functional differential equations.'
Srinivasan Balaji, `On some interesting features of Brownian sample paths.'
Michael Booty, `Freely propagating premixed flames as traveling waves, and their relation to solutions of Fisher's equation.'
Gregory Kriegsmann, `Scattering Matrix Analysis of Simple Photonic Structures.'
Cyrill Muratov, `Pattern formation in non-equilibrium systems.'
Jonathan Luke, `A paradox in sedimentation.'
Dawn Lott, `Two problems in biomechanics.'
Victoria Booth, `Modeling pyramidal neuron firing in the Hippocampus.'
Daniel Goldman, `Modeling flow and transport in the microcirculation.'
Burt Tilley, `Problems in volatile multi-fluid flows.'
Amit Bose, `A possible wave structure for a Bose-Einstein condensate.'
Farzan Nadim, `Oscillations in the nervous system.'

Student Seminars:

Eliana Antoniou. `A new theory of premixed flames in near toichiometric mixtures.'
Steven Kunec, `A model of sharp wave-associated ripple generation in the CA1 region of the Hippocampus.'
Michele Picarelli, `Fast and efficient methods in shallow-water acoustics.'
Said Kas-Danouche, `The influence of surfactant on drop dynamics.'
Urmi Ghosh-Dastidar, `An efficient method for signal detection in the presence of internal gravity waves.'
Xiaoyun Sun, `Optimal control of vortex shedding from a circular cylinder.'
Knograt Savettaseranee, `The influence of an electric field on stabilization of a thin viscous liquid film.'
Lyudmyla Barannyk, `New solitary waves in two-fluid flows and their connection to elliptic integrals.'
Ivan Zorych, `Statistical Regularities and Indifferent Uncertainty.'
Arnaud Goullet, `The problem of stirring advection.'
Hoa Tran, `More on electromagnetic energy.'
Graduate Students, `Presentation of Computational Summer Projects.'

C. CAPSTONE LABORATORY PROJECTS

Student Project: Instabilities in the flow of thin liquid films

Advisor: Professor Lou Kondic

Students: Jeremy P. Carlo, Pritam O. Dodeja, Jeffrey Fernandez, Rupen Patel, Mark Timonera, Rafal Turek

Graduate Student Assistant: Hoa Tran

The experiment is performed on a platform with a sheet of glass placed at an angle, shown in a Figure 1. Then a viscous fluid is released, the fluid front becomes unstable and forms fingers or triangles, depending on inclination angle (small angle, triangles, large angle, fingers). This kind of instability is relevant in many technological applications involving coating, such as microchip production. Theoretical modeling of this problem uses lubrication approximation to reduce Navier-Stokes equations to a single diffusion-like equation for the liquid thickness.

In the class project one group of students was responsible for theoretical calculations, performing the experiment and recording the results on a digital video camera. A second group focused on modeling and numerical simulation of the fluid flow. A third and fourth groups were responsible for data extraction from the video, sorting the data and extracting relevant data from the images for comparison with the theoretical predictions respectively. The students' results were presented in a Special Applied Math Seminar on May 04, 2001.

(a) ***(b)***

Figure 1: (a) The design model, and (b) actual working prototype.

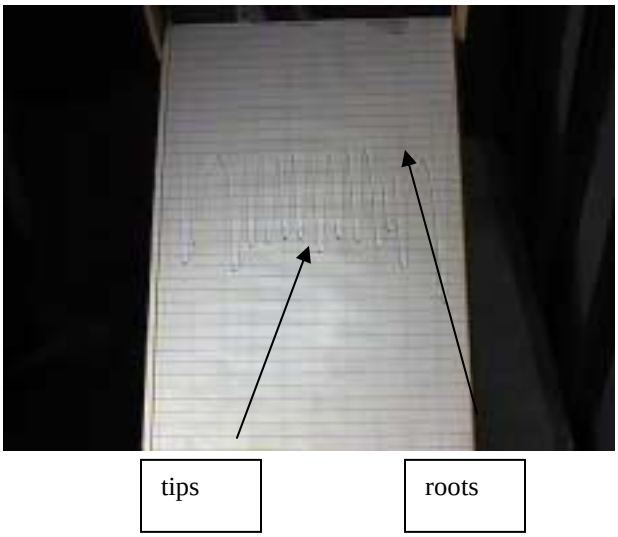
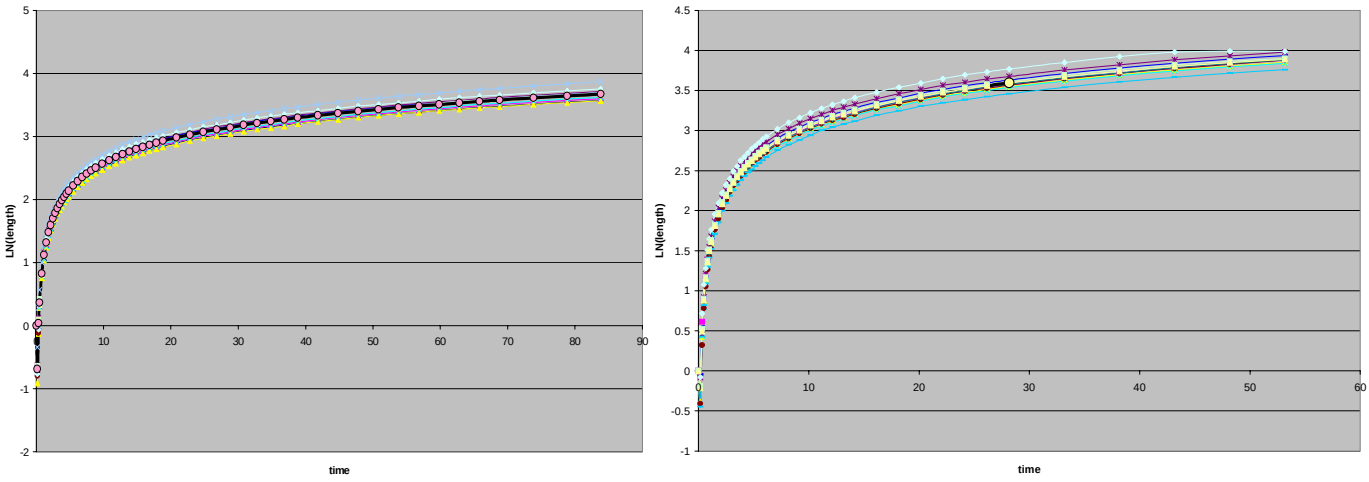


Figure 2: A sample of an image extracted from the video. Each of these images is automatically time stamped for easier data sorting and extracting information.



(a) ***(b)***

Figure 3: Lin-log plot of the pattern length when 50 cSt silicone oil flowed at 30° (a) and 60° (b) angle, as a function of time. These two plots show that the length of the fingers/triangles grows exponentially for early times, as predicted by linear stability theory.

Student Project: Mathematical Modeling of the Pyloric Network

Students: Ruchika Chandok, Trishauna Cockburn, John Demonteverde and Mital Smart

Advisor: Dr. Victoria Booth

Graduate Student Assistant: Steven Kunec

The students in the neuronal modeling section of the Capstone course constructed a minimal mathematical model of the Pyloric neuronal network located in the crab (cancer borealis) digestive tract. The Pyloric network consists of three groups of neurons: the AB/PD cells, the LP motoneuron and the PY motoneuron. These neurons generate and modulate the rhythmic muscle contractions that control the movement of the pylorus, the passage at the lower end of the stomach that opens up into the small intestine. These neurons fire action potentials in a repetitive cycle during which the AB/PD cells fire first followed by the LP cell and then the PY cell.

The students modeled the pyloric network using the generic Morris-Lecar neuronal model for each of the three cell types and synaptically coupled the cells based on the synaptic architecture of the biological network (Fig 1.). The students found that the synaptic architecture was not sufficient to generate the biological three-phase, firing pattern of the pyloric rhythm. When all cells had similar properties, the network could fire in three different stable rhythms: the biological rhythm, a reverse rhythm and a synchronous rhythm in which LP and PY fire together. The students analyzed the generation and stability of these rhythms using phase-plane techniques (Figs. 2 and 3).

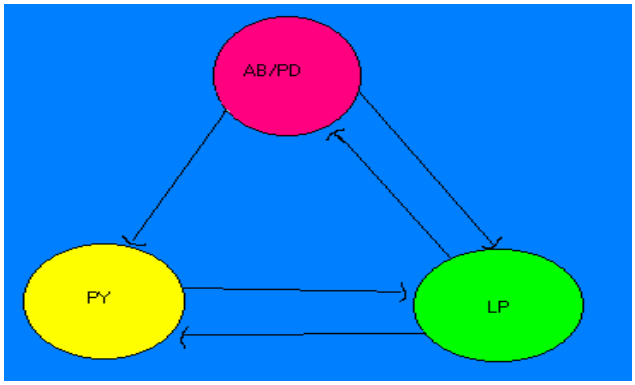


Fig1. Architecture of the Pyloric Network

The students consulted Dr. Farzan Nadim who conducts experiments on the pyloric network to determine what was needed in their minimal model to robustly generate the biological rhythm. Based on these discussions, the students made the LP and PY neurons fire more rapid action potentials than the AB/PD cell and added an additional transient, potassium current, called the A current, to the PY cell. This A current had the effect of slowing down the initiation of action potentials in the PY cell, allowing for LP to fire before PY as in the biological rhythm.

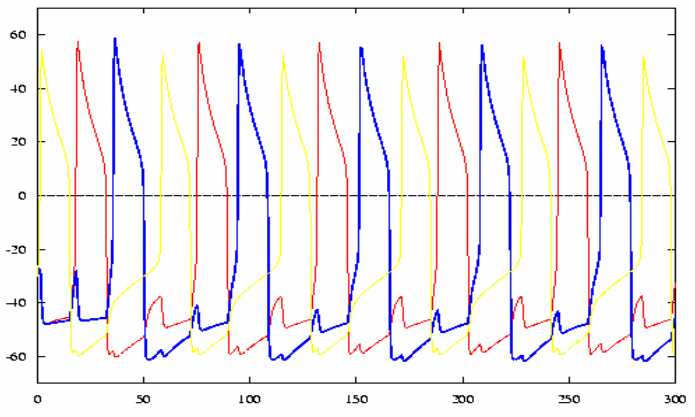


Fig. 2: Simulated biological pyloric rhythm

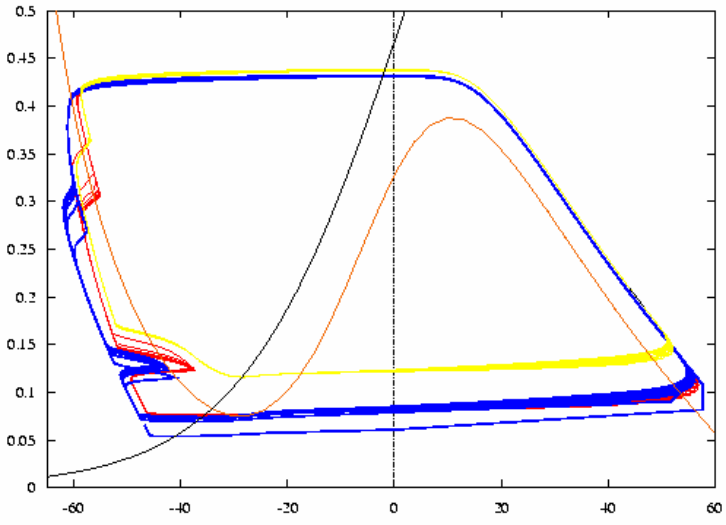


Fig. 3: Trajectories plotted in the phase plane

D. UNDERGRADUATE ACTIVITIES

Dr. Amitabha Bose, Director of Undergraduate Studies

Academic Achievements

Jeremy Carlo ('01) was one of 7 co-Valedictorians for the NJIT class of 2001. He received National Defense Science and Engineering Graduate Fellowship, which provides full tuition and a stipend of ~$20,000 for three years. Will begin graduate school at Columbia University in the Fall of 2001, in the Department of Physics.

Jeremy Carlo ('01), **Niral Gandhi** and **Tsezar Seman** attended the Moravian College Undergraduate Mathematics Conference in Spring 2001. Carlo gave an oral presentation. Professor Lott supervised the event.

Francisco Lindo ('01) is attending Montclair State University in pursuit of a Masters in Teaching in Mathematics.

Mital Smart ('01) was admitted to Montclair State University to pursue a Masters in Teaching in Mathematics, Fall 2001.

Rafal Turek ('01), **Trishauna Cockburn** ('01) and **Ruchika Chandhok** are BS/MS students who will enter the MS program in Applied Mathematics at NJIT in Fall 2001.

Pritam Dodeja ('01) has been admitted into the Masters program in Computer Science at NJIT

The following graduates of the Applied Mathematics program are currently pursuing doctoral studies: **Steven Arturo** ('00): NJIT, **Brandy Rapatski** ('98): U. of Maryland, **Hoa Tran** ('98): NJIT, **Shirley Yap** ('99): U. of Pennsylvania.

Pi Mu Epsilon Honor Society

Pi Mu Epsilon - The New Jersey Kappa Chapter inducted 7 new members on May 2, 2001: **Geoffrey Cox, Michal Czajka, Anuj Daftari, Niral Gandhi, Miao Li, Aleksandr Livshits** and **Sarabjit Singh**.

Scholarships Awarded

The Department awarded 4 merit-based scholarships for AY 2000-20001. They were:

Ahluwalia Award : **Rafal Turek** ('01)
Mathematical Sciences Award: **Afsaneh Taheresifat**
Actuarial Sciences Award: **Bobby Hancock** ('01)
Gary Thomas Award: **Lihong Zhang**

Undergraduate Professional Achievements

Bobby Hancock ('01) works for Metlife Insurance Company.
Erik Bole ('01) works for IDT.
Jeffrey Fernandez ('01) has accepted a position as a Financial Analyst with the Interet Corporation
Tsezer Seman: internship at Lucent Technologies, Summer 2001
Danis Qadri: internship at Globix, Summer 2001

CAMS

Center for Applied Mathematics and Statistics
Department of Mathematical Sciences
606 Cullimore Hall
University Heights
Newark, NJ 07102
(973) 596-5782
fax (973) 596-6467