CAMS

Center for Applied Mathematics and Statistics

ANNUAL REPORT

1998-1999

TABLE OF CONTENTS

I. FROM THE DIRECTOR

The core mission of CAMS is to promote and sustain research in the mathematical sciences at NJIT. CAMS seeks to foster a stimulating scientific environment where each member can reach their full potential. Our goals are not modest. We hope to nurture significant scientific developments and to participate in the training of a new generation of scientific leaders. Of course, such high aspirations require consistent, careful and patient efforts at developing all aspects of the research environment.

Opportunities abound for CAMS and its members. The challenge is to sustain and develop our well-established and highly regarded research infrastructure as we simultaneously advance in new directions. In the past year our infrastructure has been strengthened. The CAMS/Math Seminar Series has continued to garner much deserved recognition for its first-rate science and wide-range of speakers. The CAMS Computational Laboratory was upgraded with its first multiprocessor compute server as well as substantial improvements networking, printing, backup and support software. Our efforts to encourage research funding have met with substantial success including a number of first-time grant recipients; these results strengthen our confidence that we are laying a solid foundation for the future. The CAMS Summer Research Program continues to provide a rich scientific environment for graduate students to perform research in collaboration with CAMS members. A major renovation of the CAMS Reading Room has

provided us with a facility for social and research interactions that fully reflects the seriousness and dedication of our efforts to reach our ambitions. This short list is representative of the general progress we have made in research infrastructure.

Challenges remain. The continuing inadequacies of the office and computing resources for graduate student researchers must be overcome. The rapid advance and increasing importance of biomathematics in CAMS provoke us to update our understanding of the unity of the mathematical sciences. Our just-begun exploration of financial mathematics will further challenge this understanding. The recent hardware and software upgrades of our laboratories must be molded into a coherent computing environment supporting research. The obvious talents and dedicated efforts of the CAMS membership give us an overwhelming confidence that these challenges will be met.

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 and Dean John Poate 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 the committees on research, seminars, computation, publications, and statistical consulting. 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. 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 Lott-Crumpler, Dawn

Bechtold, John Luke, Jonathan

Bhattacharjee, Manish Michalopoulou, Zoi-Heleni

Blackmore, Denis Milojevic, Petronije

Booth, Victoria Nadim, Farzan

Booty, Michael Papageorgiou, Demetrios

Bose, Amit Perez, Manuel

Bukiet, Bruce Petropoulos, Peter

Crato, Nuno Porter, Michael

Dhar, Sunil Ray, Bonnie

Dios, Rose Siegel, Michael

Goldberg, Vladislav Stickler, David

Hile, Cheryl Tavantzis, John

Kriegsmann, Gregory Tilley, Burt

Lacker, Michael

Visiting Members

Chaudhry, Hans Gilchrist, John

Jorge, Maria Carmen Luo, Laihan

Yefet, Amir

Department of Mechanical Engineering

Aubry, Nadine Rosato, Anthony

Dave, Rajesh

Department of Civil and Environmental Engineering

Meegoda, Jay N.

Department of Computer and Information Science

Recce, Michael

CAMS Research Professors

Erneux, Thomas Findley, Thomas

Long and Short-Term Visitors

Abrahams, David University of Manchester, UK

Chopra , D.V. Wichita State University, Kansas

Feher, Lambert Forschungszentrum Karlsruhe – ITP, Germany

Smith, Paul Dundee University, UK

IV. SEMINARS

1998-99 Seminar Series

September 4 **V. V. Goldberg**, Department of Mathematical Sciences, New Jersey Institute of Technology. *"Conformal Rigidity of Hypersurfaces"*

September 11 **Mike Shelley**, Courant Institute of Mathematical Sciences. *"Modelling of the Visual Cortex"*

September 18 **Dipak K. Dey**, Department Of Statistics, University of Connecticut, Storrs. *"A New Skew Link Model for Dichotomous Quantal Response Model"*

September 22 **David Abrahams**, Beyer Professor of Applied Mathematics, University of Manchester. *"Matrix Weiner-Hopf Factorization with Applications in Fluids and Solid Mechanics"*

September 25 **David A. Edwards**, Department Of Mathematical Sciences, University of Delaware. *"Transport Effects in Surface-Volume Biochemical Reactions"*

October 2 **Thomas Erneux**, Free University of Brussels, Nonlinear Optics Group.

"Semiconductor Laser Instabilities"

October 9 **Jerry Ramage**, AT&T Labs. *"Applied Research on Behavior at AT&T Labs"*

October 16 **Tim Lewis**, Courant Institute of Mathematical Sciences and the

Center for Neural Science, New York University, New York, New York.

"Mechanisms of Cardiac Defibrillation"

October 23 **Moshe Matalon**, Department of Applied Math and Engineering Science,

Northwestern University.

"The Structure, Extinction and Stability Properties of Diffusion Flames"

October 30 **Mark Hansen**, Bell Laboratories.

"Strategies for Spline Adaptation in Extended Linear Modeling"

November 6 **Philip Blythe**, Lehigh University. *"Ignition Problems in the Newtonian Limit"*

November 13 **Jerry Bona**, Department of Mathematics, University of Texas, Austin.

"Solitons, Singularities, and Sand Bars"

November 20 **David Rindskopf**, Educational Psychology, CUNY Graduate Center, New York.

"Applications of Multilevel Modeling and Empirical Bayes Estimation in Social

Research"

November 24 **Paul Smith**, Dundee University,United Kingdom.

"Matrix Wiener-Hopf Factorization with Applications in Fluid and Solid

Mechanics"

January 14 **Jie Li**, Department of Mathematics, Virginia Tech, Blacksburg, VA.

"Simulation of Two-Fluid Flows at Low Reynolds Numbers"

January 22 **Lou Kondic**, Department of Mathematics and Center for Nonlinear and

Complex Systems, Duke University, Durham, NC.

"Computations of Bubble Dynamics and Single Bubble Sonoluminescence"

January 29 **Qing Nie**, Department of Mathematics, University of Chicago, Chicago, IL.

"Interface Dynamics in Microstructure Evolution"

February 3 **Steven Crunk**, Department of Statistics, Wharton School of Business,

University of Pennsylvania. *"Autoregressive Time Series: Bias, Variances, and Tapering"*

February 5 **Harji I. Patel**, Pfizer Incorporation, New York, NY.

"Analysis of Count Data from a Clinical Trial"

February 10 **Curtis Tatsuoka**, Department of Statistics and Applied Probability, University

of California, Santa Barbara. *"Sequential Classification on Partially Ordered Sets"*

February 12 **Judy Miller**, Department of Mathematics, Georgetown University,

Washington, DC. *"Evans functions, solitary wave stability, and a coupled KdV*

system"

February 17 **Guillermo Goldsztein**, Department of Applied Mathematics, California

Institute of Technology, Pasadena.

"Collapse and Rebound of a Gas Bubble: Asymptotic Expansions and

Applications"

February 19 **Danielle Carr**, Department of Mathematics, Bryn Mawr College, Bryn Mawr,

Pennsylvania. *"Modeling Anguilliform using Immersed Boundary Method"*

February 22 **Yunling Du**, Department of Statistics, Pennsylvania State University, University Park, PA. *"A Fully Nonparametric ANCOVA Method for Censored Data"*

February 24 **Hector Ceniceros**, Department of Applied Mathematics, California Institute of Technology, Pasadena. *"Pattern Formation in Interface Problems: Physical Selection versus Noise Effect"*

February 26 **Wei Lang**, Department of Biostatistics, University of Pittsburgh, PA. *"Application of Copula to Repeated Measurements Data"*

March 1 **Hojin Moon**, Department of Applied Mathematics and Statistics, State University of NY at Stony Brook. *"Testing of Time to Onset of Occult Tumors by Attributing Tumor Lethality in the Absence of Cause-of-Death Information"*

March 3 **Tingchuan Wang**, Department of Statistics, Rutgers University, New Brunswick, NJ. *"Dynamic Graphical Methodology for Multivariate Response Surface"*

March 5 **Cyrill Muratov**, Courant Institute of Mathematical Sciences, New York University. *"One-Dimensional Spike Autosolitons in a Reaction-Diffusion Model"*

March 12 **Nancy Kopell**, Department of Mathematics, Boston University, Massachusetts. *"Dynamical Systems of the Nervous System"*

March 24 **David Halpern**, Department of Mathematics, University of Alabama, Tuscaloosa. *"Oscillatory Shear Stress Induced Stabilization of Thin Film Instabilites*"

March 26 **Jim Yorke**, Department of Mathematics and the Institute of Physical Sciences and Technology, University of Maryland **(Joint Seminar with Mathematics Department, Rutgers-Newark).** *"How Do We Find Out What a Dynamical*

System is Doing?"

April 9 **Jan Achenbach**, Center for Quality Engineering and Failure Prevention,

Northwestern University, Evanston, Illinois. *"Integration of modeling and acoustic microscopy measurement for multiple layered coatings"*

April 16 **S.I. Hariharan**, Department of Mathematics, University of Akron, Ohio.

"Solidification: Sharp-Interface Models and Phase-Field Methods"

April 21 **Charles R. Doering**, Department of Mathematics, University of Michigan, Ann

Arbor. *"Laminar and Turbulent Energy Dissipation in a Shear Boundary Layer with Suction"*

April 21 **Howard Brenner,** William Henry Dow Professor of Chemical Engineering,

MIT, Cambridge, MA **(Joint Seminar with Mechanical Engineering Dept.)**

"Enhanced Heat- and Mass-Transport Rates Induced by Laminar Chaos in

Creeping Flow Systems"

April 28 **Peter Simpkins**, Bell Laboratories, Lucent Technologies, Murray Hill, NJ

(Joint Seminar with Chemical Engineering, Chemistry, and

Environmental Sciences Department), *"Emulsions, Coating and Tip*

Streaming"

April 30 **Bill Morokoff**, Goldman Sachs, New York, New York.

(Joint seminar with Stevens Institute, Department of Mathematics)

"Applications of Brownian Motion to Option Pricing and Risk"

May 5 **Roger Traub,** Professor of Mathematical Neuroscience, Department of

Neurophysiology, The University of Birmingham, Birmingham, England.

"Non-synaptic mechanisms of high-frequency (>100 Hz) oscillations in the

hippocampus"

V. CAMS MEMBER PUBLICATIONS, PRESENTATIONS, AND REPORTS

A. PUBLICATIONS

JOURNAL PUBLICATIONS

Daljit S. Ahluwalia

Advection-Diffusion Around A Curved Obstacle, (with Joseph B. Keller and Charles Knessl), Journal of Mathematical Physics, Vol. 39, No. 7, pp. 3694-3707, July 1998.

Nadine Aubry

Simulation and identification of organized structures in flows, Fluid Mechanics and its applications, Vol. 52, Kluwer Academic Publishers, Dordrecht, The Netherlands (1999) (ed. with J. N. Sorensen and E. J. Hopfinger).

Space-time structure of the flow in a cylindrical cavity with a rotating lid, in Simulation and Identification of Organized Structures in Flows (with E. Christensen and J. N. Sorensen), Kluwer Academic Publishers, Dordrecht, The Netherlands (1999).

Bifurcations in a planar propagating flame as the size of the domain increases, (with M. Rahibe and G. I. Sivashinsky), Applied Numerical Mathematics Vol. 31, No. 1, pp. 103-115, 1999.

John Bechtold

Weakly Stretched Premixed Flames in Oscillating Flows, (with Z. Huang and M. Matalon), Combust. Theory and Modeling, Vol. 2, pp.115-133, 1998.

Manish Bhattacharjee

Exponentiality within class-L and Stochastic Equivalence of Laplace Ordered Survival Times, Prob. in Eng. & Info. Sci., Vol. 13, pp. 201-207, 1999.

Denis Blackmore

A New Fractal Model for Anisotropic Surfaces , (with G. Zhou), Int. J. Mach. Tools Manufact., Vol. 38, pp. 551-557, 1998.

*Fractal Analysis of Height Distributions of Anisotropic Rough Surfaces, (*with G. Zhou), Fractals, Vol. 6, pp. 43-58, 1998.

New Mathematical Models for Particle Flow Dynamics, (with R. Samulyak and A. Rosato), J. Nonlin. Math. Phys., Vol. 6, pp. 198-221, 1999.

Trimming Swept Volumes, (with R. Samulyak and M.C. Leu), Computer-Aided Design, Vol. 31, pp. 215-223, 1999.

Phyllotaxis as a Dynamical System: A Study in Number, Symmetry in Plants, (with J. Kappraff, and G. Adamson), R. Jean and D. Barabe (eds.), World Scientific, Singapore, pp. 409-458, 1998.

Algebraic Integrability of Nonlinear Dynamical Systems on Manifolds, collaborated with authors on chapter five (with A. Prykarpatsky and I. Mykytiuk), Kluwer, Dordrecht, pp. 314-402, 1998.

Michael Booty

Cellulose and Polystyrene, (with B.I. Park, J.W. Bozzelli, M.J. Bernhard, K. Mesuere, C.A. Pettigrew, J.C. Shi, and S.L. Simonich). Environmental Science and Technology, Vol. 33, No. 15, pp. 2550-2556, 1999.

Amit Bose

Stability of Localized Structures in Non-Local Reaction-Diffusion Equations, (co-author Gregory Kriegsmann), Methods and Applications of Analysis, Vol. 5, No. 4, 351-366, 1998.

Bruce Bukiet

Optimal Patterns for Suturing Wounds, (with H. R. Chaudhry, A. B. Ritter, T. Findley and N. Guzelsu),

Journal of Biomechanics, Vol. 31, pp. 653-662, 1998.

Hans Chaudhry

Optimal Patterns for Suturing Wounds, (with B.Bukiet, M.Siegel,T.Findley, A.Ritter and N.Guzelsu),

Journal of Biomechanics, Vol. 31, pp. 653-662, 1998.

Letter to the Editor:*Theoretical Study of the Stress Dependent Remodeling on Arterial Geometry*

Under Hypertensive Conditions, by Alexander Rachev, Journal of Biomechanics, Vol. 32, No. 5, pp. 551-551, 1999.

Sunil K. Dhar

Data Analysis with Discrete Analog of Freund's Model, Journal Applied Statistical Science, Vol. 7, pp. 169-183, 1998.

Rose Dios

Contributions to the Existence of Balanced Arrays of Strength Six", (with D. Chopra), Journal of Combinatorics, Information and System Sciences, Vol. 23, pp. 345-350, 1998.

A Low-Tech, Hands-on Approach to Teaching Sorting Algorithms to Working Students, (with J. Gellar), Computers and Education, Vol. 31, pp. 89-103, 1998.

Vladislav V. Goldberg

The Darboux Mapping of Canal Hypersurfaces, (with M. A. Akivis), Beitraege zur Algebra und Geometrie, Vol. 39, No. 2, pp. 396-411, 1998.

Lightlike Hypersurfaces in the de Sitter Space, (with M. A. Akivis), Acta Applicandae Mathematicae, Vol. 53, No. 2, pp. 297-328, 1998.

Semiintegrable Almost Grassmann Structures, (with M. A. Akivis), Differential Geometry and Applications, Vol. 10, No. 3, pp. 257-294, 1999.

Review of the book "Differentialgeometrie" (in German) by V. Wuensch, Mathematik fuer Ingenieure und Naturwissenschaftlers, B. G. Teubner Verlaggesellschaft mbH, Mathematical Reviews 98g:53001, 1998.

Gregory A. Kriegsmann

Microwave-Induced Combustion: A One-Dimensional Model, (with J. K. Bechtold and M. R. Booty), Journal of Combustion Modeling and Theory, Vol. 2, No. 1, pp. 57-80, 1998.

A Hybrid Numerical Method for Loaded Highly Resonant Single Mode Cavities, (with C. Hile), Journal of Computational Physics, Vol. 142, pp. 506-520, 1998.

The Flanged Waveguide Antenna: Discrete Reciprocity and Conservation, Wave Motion, Vol. 29, pp. 81-95, 1999.

Stability of Localized Structures in Non-Local Reaction Diffusion Equations, (with A. Bose), Methods and Applications of Analysis, Vol. 5, No. 4, pp. 351-366, 1999.

Jonathan Luke

A Finite Difference Method for Dispersive Linear Waves with Applications to Simulating Microwave Pulses in Water, J. Comput. Physics, Vol. 148, pp. 199-226, 1999.

Laihan Luo

The Generalized KdV Equation in a Quarter Plane, (with Jerry Bona), in Contemporary Mathematics, Vol. 221, (J.R. Dorroh, G.R. Goldstein, J.G. Goldstein and M. Tom, eds.), American Mathematical Society; Providence, RI, pp. 59-125, 1999.

Jay N. Meegoda

Remediation of Chromium Contaminated Soils--A Bench Scale Investigation, (with W. Kamolpornwijit, D. A. Vaccari, A. S. Ezeldin, B. A. Noval, R. T. Mueller, and S. Santora), ASCE Practice Periodical of Hazardous, Toxic, and Radioactive Waste Management, Vol. 3, No.3, pp. 124-131, July 1999.

Stabilization/Solidification of Contaminated Soils with Asphalt Emulsions, ASCE Practice Periodical of Hazardous, Toxic, and Radioactive Waste Management, Vol. 3, No. 1, pp. 46-55, January 1999.

Compaction Characteristics of Contaminated Soils-Reuse as a Road Base Material, Recycled Materials in Geotechnical Applications, (with Bin Chen, Samiddha D. Gunasekera and Philip Pederson), ASCE Geotechnical Special Publication No. 79, (C. Vipulanandan and David J. Elton, Eds.), ISBN: 0-7844-0387-2, pp. 195-209, 1998.

Construction Use of Abandoned Soils, (with H. Y. Shan), Journal of Hazardous Materials, Vol. 56, pp. 133-145, 1998.

Petronije Milojevic

Nonresonant Semilinear Equations and Applications to Boundary Value Problems in Analysis of Divergence, Control and Management of Divergent Processes, (W.O. Bray, C. V. Stanojevic eds.), Applied and Numerical Harmonic Analysis, pp. 379-402, Birkhauser, Boston, 1999.

Existence and the Number of Solutions of Nonresonant Semilinear Equations and Applications to BVP's, Advanced Topics in Nonlinear Operator Theory, J. Math. and Computer Modelling, pp. 33, 1999.

Farzan Nadim

Frequency Control of a Slow Oscillatory Network by a Fast Rhythmic Input: Pyloric to Gastric Mill Interactions in the Crab Stomatogastric, (with E. Marder, Y. Manor, M.

Bartos, and M.P. Nusbaum), Annals New York Acad. Sci. Vol. 860, pp. 226-238, 1998.

Network Oscillations Generated by Balancing Graded Asymmetric Reciprocal Inhibition in Passive Neurons, (with Y. Manor, S. Epstein, J. Ritt, E. Marder, and N. Kopell), J. Neuroscience, Vol. 19, No. 7, pp. 2765-2779, 1999.

Demetrius Papageorgiou

Study of Jet Breakup Using One-Dimensional Models of the Euler Equations, (with O. Orellana), SIAM J. Applied Math., Vol. 59, No.1, pp. 286-317, 1998.

Chaos in a Class of Exact Solutions of the Navier-Stokes Equations, (with P. Hall), J. Fluid Mech., Vol. 393, pp. 59-87, 1999.

On the Effects of Generalized Dispersion on Dissipative Dynamical Systems, (with Y.S. Smyrlis), Appl. Math. Lett., Vol. 11, No. 6, pp. 93-99, 1998.

Increased Mobility of a Surfactant Retarded Bubble at High Bulk Concentrations, (with Y. Wang and C. Maldarelli), J. Fluid Mech., vol. 390, pp. 251-270, 1998.

Peter Petropoulos

Plane-Wave Analysis and Comparison of Split-Field, Biaxial and Uniaxial PML Methods as ABCs for Pseudospectral Electromagnetic Wave Simulations in Curvilinear Coordinates, (with B. Yang), J. Computational Physics, Vol. 146, pp. 747-774, 1998.

On the Termination of the Perfectly Matched Layer with Local Absorbing Boundary Conditions, J. Computational Physics, Vol. 143, pp. 665-673, 1998.

A Reflectionless Sponge Layer Absorbing Boundary Condition for the Solution of Maxwell's Equations with High-Order Staggered Finite Difference Schemes, (with L. Zhao and A.C. Cangellaris), J. Computational Physics, Vol. 139, pp. 184-208, 1998.

Bonnie Ray

Forecasting Exchange Rates Using TSMARS, (with J. De Gooijer and H. Krager), International Journal of Money and Finance, Vol. 17, pp. 513-534, 1998.

John Tavantzis

Analytical Solutions of Openings Formed by Intersection of a Cylindrical Shell and an Oblique Nozzle Under Internal Pressure, (with H. Cai, B. Sun, B. Koplick), ASME Journal of Pressure Vessel Technology, vol. 121, pp. 170-175, 1999.

Michael Siegel

Optimal Patterns for Suturing Wounds, (with H. R. Chaudhry, B. Bukiet, T. Findley, A. B. Ritter, and N. Guzelsu), Journal of Biomechanics, Vol. 31, pp. 653-662, 1998.

Featured Review of *Geometry of Singularities for the Steady Boussinesq Equations*, Mathematical Reviews, MR 98f:35121, 1998.

Amir Yefet

Construction of Three Dimensional Solution for the Maxwell's Equations, (with E. Turkel), NASA/CR-1998-208954, ICASE Interim Report No. 34, 1998.

*Bounded Errors Schemes for the Wave Equation on Complex Domains, (*with S. Abarbanel and A. Ditkowski), ICASE report No. 98-50, 1998.

PROCEEDINGS PUBLICATIONS

Roman I. Andrushkiw

Mathematical Background of the Computer-Aided Cytogenetic Method of Diagnosis of Breast Cancer, (with Yu. I. Petunin, D.A. Kljushin, and M. Yu. Savkina). Proceedings of the XIII Summer School of Biometrics, pp. 203-215, 1998.

John Bechtold

Effects of Stroichiometry on Stretched Premixed Flames, (with M. Matalon), Proceedings of the Joint Meeting of the United States Sections of the Combustion Institute, Washington, DC, pp. 813-816, March 1999.

Manish Bhattacharjee

Dynamic Programming, Renewal Functions and Perfect vs. Minimal Repair Comparisons, Frontiers in Reliability, (A.P. Basu, et. al., eds.), World Scientific Press, pp. 63-70, 1998.

TTT-transform Characterization of the NBRUE property and Tests of Exponentiality, (with P.K. Sen), Frontiers in Reliability, (A.P. Basu, et. al., eds.), World Scientific Press, pp. 71-82, 1998.

Denis Blackmore

On the Lax Solution to a Hamilton-Jacobi Equation and Its Generalizations. Part 1, (with A. Prykarpatsky), Proc. Int. Conf. on PDEs, Praha, pp. 234-232, 1998.

Deformed Swept Volume Analysis of NC Machining with Cutter Deflection, (with M.C. Leu and B. Maiteh), Proc. SSM'98 Conf., Auburn Hills, pp. 105-117, 1998.

Quasi-optimal Paths in Automated Assembly, Proc. Int. Conf. On Quality Manufacturing, Stellenbosch, S. A., pp. 23-27, 1999.

Bruce Bukiet

Solving Curved Detonation Riemann Problems, appearing in Shock Compression of Condensed Matter – 1997. Proceedings of the American Physical Society Topical Conference, Amherst, Massachusetts, July 27 - Aug. 1, 1997, Elsevier-North Holland, July, 1998.

Vladislav V. Goldberg

On the Theory of Almost Grassmann Structures (with M. A. Akivis), Proceedings of the International Conference on Differential Geometry (Eotvos University, Budapest, 1996), Kluwer Academic Publishers, pp. 1-37, 1998.

Jay N. Meegoda

Ultrasound to Decontaminate Dredged Sediments, Proceedings of the Thirtieth Mid-Atlantic Industrial and Hazardous Waste Conference, (R. P. S. Suri and G. L. Christensen, eds.), Technomic Publishers, July 1998, Villanova, PA, pp. 163-166.

Eliza Michalopoulou

Active Source Detection in a Dispersive Multiple-Reflection Environment, Proceedings of the International Conference of Acoustics, Speech, and Signal Processing, Phoenix, Arizona, March 1999.

An Efficient Implementation of Broadband Matched Field Processing for A Known Source Spectrum,

Proceedings of the Fourth European Conference on Underwater Acoustics, Rome, vol. 1, pp. 45--50, September 1998.

Global Optimization in Matched Field Inversion, (co-author:P. Gerstoft), Proceedings of the Fourth European Conference on Underwater Acoustics, Rome, vol. 1, pp. 27--32,

September 1998.

Farzan Nadim

A Synapse Acting as a Switch: A Role for Synaptic Depression of Graded Synapses, (with Y. Manor, N. Kopell, and E. Marder), Annals of Biomedical Engineering, Vol 26, Supplement 1, 1998.

A Novel Mechanism of Network Oscillation Based on Asymmetric Reciprocal Inhibition, (with S. Epstein, J. Ritt, Y. Manor, E. Marder, and N. Kopell), Soc. Neuroscience Abstracts Vol. 24, pp.1892, 1998.

Dynamic Regulation of Motor Pattern Generation via Disinhibition and Neuromodulation, (with Y. Manor, M. Bartos, E. Marder, and M. Nusbaum), Soc. Neuroscience Abstracts Vol. 24, pp.1892, 1998.

The Role of Depression of a Graded Synapse in an Oscillating Network of Neurons, (with Y. Manor, N. Kopell, L.F. Abbott, and E. Marder), Soc. Neuroscience Abstracts Vol. 24, pp. 1670, 1998.

Peter Petropoulos

Well-posed Perfectly Matched Layers for the Numerical Solution of Maxwell's Equations in Rectangular, Cylindrical, and Spherical Coordinates, Proceedings of the Fourth SIAM International Conference on Mathematical and Numerical Aspects of Wave Propagation, pp. 567-569, 1998.

Michael Porter

*Hyperthermia therapy using phase conjugation, (*with P. Roux, H.C. Song, and W. Kuperman), J. Acoust. Soc. Am., Vol. 105(2), Pt. 2 (1999).

Influence de l'environnement sur la propagation acoustique par petits fonds: la campagne de tomographie acoustique INTIMATE96, (with Y. Stephan, X. Demoulin, T. Folegot, S. Jesus, and E. Coelho), Numero 18, EPSHOM/CMO/OCA/NP report, Oct. 12, 1998.

Internal tide acoustic tomography: reliability of the normal modes expansion as a possible basis for solving the inverse problem (with O.C. Rodreguez, S. Jesus, Y. Stephan, X. Demoulin, and E. Coelho), Proceedings of the Fourth European Conference on Underwater Acoustics, Sept. 21-25,

Rome, Italy, 1998.

Single-phone source tracking in a variable environment, (with S.M. Jesus, Y. Stephan, E. Coelho, X. Demoulin, (invited), Proceedings of the Fourth European Conference on Underwater Acoustics, Sept. 21-25, Rome, Italy, 1998.

Broadband source localization with a single hydrophone, (with S.M. Jesus, Y. Stephan, E. Coelho, X. Demoulin), Proceedings of Oceans '98, Sept. 28- Oct. 1, Nice, France 1998.

*Application of phase conjugation to hyperthermia therapy, (*with Philippe Roux, Hee Chun Song, and W.A. Kuperman, to appear. Proceedings of 24th International Symposium on Acoustical Imaging, Ed. Hua Lee, Sept. 23-26, Univ. of California at Santa Barbara, Plenum Press, 1998.

*Hyperthermia therapy using acoustic phase conjugation, (*with Philippe Roux, Hee Chun Song, and W.A. Kuperman), to appear, Proceedings of the First International Symposium on Physics in Signal and Image Processing, January 18-19, Paris, France, 1999.

Using the echo pattern to range a sound source, (with S.M. Jesus, Y. Stephan, E. Coelho, X. Demoulin), to appear, Proceedings of the First International Symposium on Physics in Signal and Image Processing, January 18-19, Paris, France, 1999.

Tumor treatment by time-reversal acoustics, (with P. Roux, H. Song, and W. Kuperman), (invited), International Conference on Acoustics, Speech, and Signal Processing (ICASSP) Proceedings, 1999.

Nonlinear soliton interaction with acoustic signals: Focusing effects, (with O. Rodriguez, S. Jesus, Y. Stephan, X. Demoulin, and E. Coelho), Proceedings of the Third International Conference on Theoretical and Computational Acoustics, Trieste, Italy, 1999.

Bonnie Ray:

Testing for nonlinearity in a vector time series, (with J. Harvil), Proceedings of the Statistical Computing Section, 1998 Joint Statistical Meetings.

B. PRESENTATIONS

Nadine Aubry

August 1998: Workshop on Applications of DNS/LES to geophysical and Industrial Flows, Istanbul, Turkey (Invited)

Hierarchical order in wall-bounded shear turbulence

November 1998: 51st Annual Meeting of the Division of Fluid Dynamics (APS), Philadelphia, Pennsylvania

Control of vortex breakdown in a rotating flow: Numerical Simulation

Active feedback control of vortex shedding past a cylinder based on a low dimensional model

One dimensional approach to the flow structures in a cavity

July 1999: Department of the Navy, Arlington, VA

Flow control for fast hydrofoils

John Bechtold

July 1998: Twenty-Seventh International Symposium on Combustion, Boulder, CO

Effects of Stoichiometry on Stretched Premixed Flames

November 1998: Annual Meeting of The American Physical Society, Division of Fluid Dynamics, Philadelphia, PA

Effects of Preferential Diffusion on a Flame in a Strained Flow Field

March 1999: Joint Meeting of the United States Sections of the Combustion Institute, Washington, DC

Effects of Stoichiometry on Stretched Premixed Flames

Manish Bhattacharjee

October 1998: IISA Annual Meeting, McMaster University, Hamilton, Ontario, Canada

Modeling Repairable Systems

Denis Blackmore

January 1999: Int. Conf. on Quality Manufacturing, Stellenbosch, South Africa, Invited

Quasi-optimal Paths in Automated Assembly

March 1999: Johns Hopkins University (Invited)

Regular and Chaotic Motions of Coaxial Vortex Rings

April 1999: Annual GAMM Conf., Metz, France (Invited)

Transition From Quasiperiodicity to Chaos for Three Coaxial Vortex Rings

May 1999: Third Int. Conf. on Dynamic Systems and Applic., Atlanta, GA (Invited)

Chaos in Granular Flows

June 1999: IUTAM Conf. on Segregation in Granular Flow, Cape May, NJ, Co-organizer of conference

Dynamics of a Two Species Granular Flow

Victoria Booth

April 1999: Opening symposium for the Center for Computational Biology and Bioengineering, NJIT

Hippocampal place cells and the generation of temporal codes

January 1999: Bi-Co Mathematics Colloquium, Bryn Mawr College

Modeling bistable firing behavior in vertebrate motoneurons

July 1998: Poster presentation, CNS*98, Seventh Annual Computational Neuroscience Meeting, Santa Barbara

Dendritic plateau potentials in models of bistable motoneurons: Biophysical implications investigated using genetic algorithms

Michael Booty

August 1998: 27th International Symposium on Combustion, Boulder, CO, Contributed poster

February 1999: Department of Mechanical and Aerospace Engineering, Lehigh University, Bethlehem, PA. Invited seminar

March 1999: First Joint Meeting of the U.S. Sections of the Combustion Institute, Washington DC. Contributed talks and poster

May 1999: 18th International Conference on Incineration and Thermal Treatment Technologies, Orlando, FL. Contributed talk

Amit Bose

September 1998: Conference on Waves and Continuation Methods in Biology, Pittsburgh, PA

A temporal mechanism for control of the phase precession of hippocampal place cells

October 1998: CMBN Neuroscience Day, Rutgers University, Newark, NJ

A temporal mechanism for control of the phase precession of hippocampal place cells

October 1998: Mathematics Colloquium, Georgetown University

Non-local reaction diffusion equations

May 1999: 5th SIAM Conference on Dynamical Systems, Snowbird, UT

Non-local reaction-diffusion equations for microwave heating applications

Bruce Bukiet

May 1999*:* Association of Math Teachers of New Jersey, Regional Conference, College of New Jersey

Why Study Math

Hans Chaudhry

March 1999: Annual Research Day, UMDNJ, Stratford, NJ

Adaptation of Passive Left Ventricle in Diastolic Dysfunction

April 1999: Opening Symposium, Center for Computational Biology and Bioengineering, NJIT, Newark

Stress Analysis in the Cardiovascular System and Skin

Nuno Crato

August 99: Joint Statistical Meetings, Dallas, TX

On the behavior of Tanaka's test in the presence of fractionally integrated models

Heavy tails in randomized search algorithms

Sunil K. Dhar

October 1998: International Indian Statistical Association, International conference 1998, McMaster University, Hamilton, Canada

Data Analysis with discrete analog of Freund's model

Vladislav V. Goldberg

September 1998: NJIT Mathematics Department Seminar, 1-hour talk

Conformal Rigidity of Hypersurfaces

October 1998: International Congress in Honour of Pasquale Calapso, University of Messina, Messina, Italy; 1-hour invited plenary lecture

Continuity of Generations: Calapso's Family of Geometers (Pasquale, Renato, and Maria Teresa).

Lightlike Hypersurfaces on a Manifold Endowed with a Pseudoconformal Structure of Index (2, 2)

March 1999: The Eighth International Conference in Geometry, University of Haifa, Israel; 1-hour invited plenary lecture

Webs, Local Quasigroups, and Local Algebras

Gregory A. Kriegsmann

June 1998: Fourth International Conference on Mathematical and Numerical Aspects of Wave Propagation, Golden, CO

Scattering from Large Resonant Structures

February 1999: Department of Mathematics, RPI, Troy, NY

Microwave Heating of Materials: A Mathematical Overview

April 1999: Department of Electrical Engineering, IIT, Chicago, IL

Microwave Heating of Materials: A Mathematical and Physical Overview

Dawn Lott-Crumpler

September 1998: Minorities and Applied Mathematics Connections to Industry and National Laboratories, Berkeley CA

The quasilinear wave equations governing antiplane axisymmetric shearing

October 1998: Bryn Mawr University, Bryn Mawr, PA

The formation and properties of shear bands

October 1998: St. Joseph's University, Philadelphia, PA

The formation and properties of shear bands

Jonathan Luke

January 1999: AFOSR Electromagnetics Workshop, San Antonio, TX

A Finite-Difference Method for Dispersive Waves in Inhomogeneous Materials

May 1999*:* 1999 SIAM Annual Meeting, Atlanta, GA

A High-Order Finite-Difference Method of Linear Hyperbolic Systems

Eliza Michalopoulou

September 1998*:* Proceedings of the Fourth European Conference on Underwater Acoustics,

Rome, Italy

An efficient implementation of broadband matched field processing for a known source spectrum

Global optimization in matched field inversion

October 1998: 136th Meeting of the Acoustical Society of America, Journal of the Acoustical Society of America, vol. 104, no. 3, part 2, pp. 1739, Norfolk

Coherent and incoherent shallow water matched field inversion

March 1999: Rennselaer Polytechnic Institute (Invited)

Temporally and spatially coherent underwater sound inversion for target localization and geoacoustic inversion

May 1999: Fourth International Conference on Theoretical and Computational Acoustics, Trieste, Italy

Objective Function selection for shallow water geoacoustic inversion

May 1999, Herakleion, Greece

Impulse response estimation for inversion and source localization

Petronije Milojevic

January 1999: Nonlinear Differential Equations Conference, the University of Miami, Coral Gables, FL

Existence and the number of solutions of nonresonant semilinear equations and applications

to BVP's

Farzan Nadim

July 1998: Computational Neuroscience Meeting, Santa Barbara, CA.

October 1998: Biomedical Engineering Society Annual Meeting, Cleveland, OH.

November 1998: Society for Neuroscience Annual Meeting, Los Angeles, CA.

April 1999: East Coast Nerve Net, Woods Hole, MA.

April 1999: Center for Computational Biology and Bioengineering Opening Symposium, NJIT, Newark, NJ.

April 1999: Center for Molecular and Cellular Neuroscience, Rutgers University, Newark, NJ.

Demetrius Papageorgiou

June 1998. American Chemical Society, Colloid and Interface Science Symposium. Penn State. *Surfactant control of wake formation at the back end of a rising bubble at order one Reynolds numbers*

November 1998: Annual Meeting of the American Institute of Chemical Engineers, Miami, FL

Chaos in a class of exact solutions of the Navier-Stokes equations

Experimental manifestation of absolute instability in a single jet

Particle concentration instability in Couette flows of concentrated suspensions

November 1998: American Physical Society, 51st Annual Meeting of the Division of Fluid Dynamics

Chaos in a class of exact solutions of the Navier-Stokes equations

On the effects of generalized dispersion on dissipative dynamical systems with applications to core-annular flows

Peter Petropoulos

June 1998: Presentation at Workshop in Honor of Prof. V. Ryaben'kii, International Conference on Spectral and High Order Methods, Israel (Invited)

Reflectionless Sponge Layers as ABCs for the Numerical Solution of Maxwell's Equations

January 1999: AFOSR Annual Electromagnetics Workshop, San Antonio, TX (Invited)

Numerical Dispersion and Absorbing Boundary Conditions

April 1999: Division of Scientific Computing, Lucent Technologies, NJ (Invited)

Reflectionless Sponge Layers for Computational Electromagnetics

Michael Porter

1999: Third International Conference on Theoretical and Computational Acoustics, Trieste, Italy

Assessment of 3D effects in the Key West experiment (Invited)

Ray and beam shift in the time-domain

1999: 137th Meeting of the Acoustical Society of America/2nd Convention of the European Acoustics Association, Berlin, Germany

Hyperthermia therapy using phase conjugation

Bonnie Ray

March 1999: Symposium in Honor of Peter Lewis, Naval Postgraduate School, Monterey, CA (Invited)

Modeling nonlinear periodic time series using TSMARS

August, 1998: European Meeting of Statisticians, Vilnius, LT (Invited)

Identification and estimation of common long-range dependence in a vector process

August,1998: Workshop on Nonlinear and Nonstationary Signal Processing of Environmental Time Series, Newton Institute, Cambridge, UK

Nonparametric estimation of vector climate series

Michael Siegel

March 1999: Applied Math Seminar, Ohio State University

Cusp formation for evolving bubbles in 2-D Stokes flow: the effect of variable surface tension

August 1998: Hele-Shaw Flow Centennial Meeting, Oxford, England

Singularity formation for evolving bubbles with non-constant surface tension in 2-D Stokes flow

February 1999: Computational and Applied Math Seminar, SUNY Stony Brook

Effects of small surface tension in free surface flow

November 1998: APS Division of Fluid Dynamics Annual Meeting, Philadelphia, PA

Cusp formation for evolving bubbles in 2-D Stokes flow: the effect of variable surface tension

July 1998: Mini-Symposium on High Resolution and Robust Interface Methods and Applications, SIAM Annual Meeting, Toronto, Canada

Influence of surfactant in bubble dynamics for slow viscous flow

Burt Tilley

November 1998: American Physical Society-Division of Fluid Dynamics Annual Meeting, Philadelphia, PA

Potential flow instabilities in a thin fluid sheet

Oblique two-fluid stagnation point flow.

April 1999: Department of Mathematical Sciences, University of Delaware, Newark, DE

Potential flow instabilities in a thin fluid sheet

April 1999: Department of Mathematical Sciences, University of Massachusetts-Lowell, Lowell, MA

Potential flow instabilities in a thin fluid sheet

Amir Yefet

May 1999: Informal Seminar on Wave Propagation, NJIT

Construction Of Fourth Order Accurate Implicit Scheme for Maxwell's Equations.

May 1999: Brown University

Construction of Fourth Order Accurate Compact Schemes For Maxwell's Equations. Brown University.

January 1999: AFOSR Workshop on Electromagnetics*,* San Antonio, TX

On the Construction of a High Order Difference Scheme for Complex Domains in a Cartesian Grid

C. CAMS REPORTS

1. **M.A. Akivis and V.V. Goldberg**

   The Geometry of Lightlike Hypersurfaces of the De Sitter Space

2. **Amitabha Bose**

   A Geometric Approach to Singularly Perturbed Non-Local Reaction Diffusion Equations

3. **Michael Siegel**

   Cusp Formation for Evolving Bubbles in 2-D Stokes Flow: The Effect of Variable Surface Tension

4. **Peter G. Petropoulos**

   Reflectionless Sponge Layers as Absorbing Boundary Conditions for the Numerical Solution of Maxwell's Equations in Rectangular, Cylindrical and Spherical Coordinates

5. **Baolin Yang and Peter G. Petropoulos**

   Plane-Wave Analysis and Comparison of the Split-Field, Biaxial and Uniaxial PML ABC Methods for Pseudospectral Electromagnetic Wave Simulations in Curvilinear Coordinates

6. **Nuno Crato and Leslie Dowling-DaCosta**

On the Behavior of Some Estimators for the Index of Stability

9899-7 Peter G. Petropoulos

Numerical Dispersion and Absorbing Boundary Conditions

8. **P.S. Milojevic**

   Nonresident Semilinear Equations and Applications to Boundary Value Problems

9. **Amitabha Bose, Victoria Booth, and Michael Recce**

   A Mechanism for Temporal Control of the Phase Precession of Hippocampal Place Cells

10. **Dimitri Alexandrou, Zoi-Heleni Michalopoulou, and Dimitris Pantzartzis**

Slope Effects in Sidescan Bathymetry

11. **J. Abbott, A. Bose, J. Haus, T. Witelski, and S. Zabrenski**

    Measurement of Modal Power in Optical Fibers

12. **A. Yefet and E. Turkel**

    Construction of Three Dimensional Solutions for the Maxwell Equations

13. **H.R. Chaudhry, B. Bukiet, M. Siegel, T. Findley, A.B. Ritter, and N. Guzelsu**

    Adaptation of Passive Rat Left Ventricle in Diastolic Dysfunction

14. **J.K. Bechtold and M. Matalon**

    Effects of Stoichiometry on Stretched Premixed Flames

15. **V. Booth**

    A Genetic Algorithm Study on the Influence of Dendritic Plateau Potentials on Bistable Spiking in Motoneurons

16. **A. Yefet**

    Stability of the Numerical Boundary Conditions Imposed by the Ty(2,4) Scheme

17. **A. Yefet**

    Numerical δ Function

18. **F. Nadim, Y. Manor, N. Kopell, and E. Marder**

    Synaptic Depression Creates a Switch That Controls the Frequency of an Oscillatory Circuit

19. **A. Akivis and V. Goldberg**

Differential Geometry of Webs

9899-20 S. Abarbanel, A. Chertock, and A. Yefet

Strict Stability of High-Order Compact Implicit Finite-Difference Schemes--The Role of Boundary Conditions for Hyperbolic PDEs

21. **Zoi-Heleni Michalopoulou**

Matched-Impulse-Response Processing for Shallow Water Localization and Geoacoustics Inversion

22. **P.S. Milojevic**

    Existence and the Number of Solutions of Nonresonant Semilinear Equations and Application to Boundary Value Problems

23. **Jonathan H.C. Luke**

    Stability of Some Green's-Function-Based Methods Applied to Nondispersive Linear Wave Equations

24. ***Amit Bose, Nancy Kopell, and David Terman***

    Almost-Synchronous Solutions for Networks of Neurons Coupled by Excitation

25. **Gregory A. Kriegsmann**

    Pattern Formation in Microwave Heated Ceramics: Cylinders and Slabs

26. **Vladislav V. Goldberg**

    A Classification and Examples of Four-Dimensional Isoclinic Three-Webs

27. ***M.A. Akivis and V.V. Goldberg***

    Lightlike Hypersurfaces on Manifolds Endowed with A Conformal Structure of Lorentzian Signature

28. **Vladislav V. Goldberg**

    Continuity of Generations: Calapso's Family of Geometers (Pasquale, Renato, and Maria Teresa)

29. **Maks A. Akivis and Vladislav V. Goldberg**

Lightlike Hypersurfaces on A Four-Dimensional Manifold Endowed with A Pseudoconformal Structure of Signature (2,2)

VI. CAMS MEMBER EXTERNAL ACTIVITIES AND AWARDS

A. FACULTY

Daljit S. Ahluwalia

Member, United States National Committee/Theoretical and Applied Mechanics, National Research Council, 1995-99.

Editorship, Mathematical Sciences Research Hot-Line International Journal, 1999 onward.

Nadine Aubry

Member, Prize Committee, American Physical Society, Division of Fluid Dynamics.

Member, Organizing Committee, 1998, American Physical Society Meeting/Division of Fluid Dynamics in Philadelphia, PA.

Chairperson, Session on Reacting Flows and Vortex Flows, 1998, American Physical Society Meeting/Division of Fluid Dynamics in Philadelphia, PA.

Organizer and chairperson, Turbulence symposium at the 1998 American Institute of Chemical Engineers (AIChE) meeting in Miami.

Victoria Booth

Member, Department of Mathematics Advisory Council, Passaic County Community College

Bruce Bukiet

Associate Editor, SIAM Journal on Scientific Computing

Vladislav V. Goldberg

Editorial Board, Journal Webs and Quasigroups, Tver State University, Russia

Gregory A. Kriegsmann

Editor-in-Chief, SIAM Journal on Applied Mathematics

Editorial Board, Journal of Engineering Mathematics

Editorial Board, IMA Journal on Applied Mathematics

Editorial Board, Journal of Analysis and Applications

Petronije Milojevic

Editorial Board, Communications on Applied Nonlinear Analysis

Editorial Board, Facta Universitatis

Demetrius Papageorgiou

Associate Editor, SIAM Journal on Applied Mathematics

Burt S. Tilley:

Session Chair in the Viscous Flows 2 Section of the American Physical Society – Division of Fluid Dynamics Annual Meeting, Philadelphia, PA, November 1998

B. STUDENTS

Undergraduate Activities and Achievements

1. Our petition to found a chapter of Pi Mu Epsilon (a national math honors society) at NJIT has been unanimously approved. An initiation ceremony took place in Spring 99, and 12 students were inducted as charter members.

Pictured left to right: Dr. Daljit S. Ahluwalia (Chairperson and Director of CAMS), Prof. Burt S. Tilley, Robin Tanenbaum, Mathew Detlet, Dorota Moscicka, Brandy Rapatski, Robert Gloria, Daniel Stier, Jose Henriques, Hoa Tran, Michelle DeBonis, Dr. Eileen Poiani (Installing Officer, Vice President of St. Peter's College), Prof. Amitabha Bose, Maria Barrios, Prof. John Bechtold (Director of Undergraduate Studies), and Dr. John Poate (Dean of CSLA).

2. One of our students, Robin Tanenbaum, was the Class of '99 valedictorian. She was honored at Commencement for being the only student in this year's graduating class to achieve straight "A"'s throughout her college career.

3. One of our students, Michelle DeBonis, was the Class of '98 valedictorian.

4. Michelle DeBonis participated at the Mathematical Modelling workshop held during summer 1998 at RPI.

5. Six of our students participated in the Research Experience for Undergraduates (REU) program in Summer 1998.

- Michelle DeBonis: NJIT, Fluid Dynamics
- Robert Gloria: NJIT, Fluid Dynamics
- Steven Arturo: Montana State, Cellular Automata
- Ivory Kilpatrick: Rutgers-Newark, Math Biology
- Shirley Yap: Indiana, Dynamical Systems

- Dorotka Moscicka: NASA-NJIT, Student Launch Program

5. Two mathematics undergraduate students presented research papers at Moravian College Math Conference:

- Steven Arturo: Cellular Automata: Computer Modeling of Microbes on a Glass Surface
- Shirley Yap: Dynamics of Three-Piece Piecewise Linear Maps

7. Steven Arturo and Gem Patel participated in 13th Annual COMAP Applied Math Modeling Contest.

8. Undergraduate Students in demand:

- Shirley Yap, University of Pennsylvania, Mathematics, Ph.D. Program
- Dorotka Moscicka, Lucent Technologies
- Robin Tanenbaum, IBM
- Ivory Kilpatrick, Rutgers-Newark, Bio-medical Engineering, M.S. Program
- Hoa Tran, NJIT, Applied Mathematics, Ph.D. Program

9. Shirley Yap was awarded the National Physical Sciences Consortium (NPSC) Fellowship for Mathematics in 1999.

10. James Mawe and Dorota Moscicka received the Labh K. and Santokh S. Ahluwalia Award for 1999.

VII. CENTER FUNDING ACTIVITIES

A. EXTERNALLY FUNDED RESEARCH

CONTINUING FUNDED PROJECTS

1. Study of the Aerodynamics Through Fans

Allied-Signal Inc.: April 1, 1998–December 1, 1999

Nadine Aubry

Pushpendra Singh

2. Applications of Differential Equations to Automated Manufacturing

National Science Foundation: September 1995-August 1999

Denis Blackmore

3. A Dendritic Origin of Bistability and of Motoneuron Firing Patterns

National Science Foundation, Division of Integrative Biology and Neuroscience

September 1997-August 1999

Victoria Booth

4. Reactive Models for Front-Tracking Simulations

Army Research Lab through Batelle: April 1998-November 1999

Bruce Bukiet

5. Student Launch Program

NASA: June 1997 - December 1999

Bruce Bukiet

6. Mathematical Sciences: Asymptotic and Singular Perturbation Methods for Bifurcation

Problems with Applications

National Science Foundation: August 1996-July 1999

Thomas Erneux

7. Mathematical Sciences: Microwave Processing of Ceramic Materials

National Science Foundation: July 1996-June 1999

Gregory A. Kriegsmann

8. Applied Mathematical Problems in Microwave Processing of Ceramic Materials

Department of Energy, Office of Scientific Computing: 1994-2000

Gregory A. Kriegsmann

9. Computational Problems in Modern Electromagnetics

Air Force Office of Scientific Research: 1995-2000

Gregory A. Kriegsmann

Jonathan Luke

Cheryl Hile

10. Scattering by Large and Complex Structures

Air Force Office of Scientific Research: February 1996-January 2001

Gregory A. Kriegsmann

Jonathan Luke

Cheryl Hile

11. Ocean Acoustics and Signal Processing for Robust Detection and Estimation

Office of Naval Research: June 1997-May 2000

Eliza Michalopoulou

12. Surface Tension Driven Flows

National Science Foundation, Division of Mathematical Sciences: July 1997-June 2000

Demetrius Papageorgiou

13. CAREER Development Award: Computationally Intensive Methods for Time Series Analysis with Environmental and Economic Applications

National Science Foundation: July 1996-June 2000

Bonnie Ray

14. Surfactant Effects in Viscous Fingering

National Science Foundation: July 1997-June 2000

Michael Siegel

PROJECTS FUNDED DURING PRESENT ACADEMIC YEAR

1. Mathematical Models of Premixed Flames

National Science Foundation: July 1998-June 2001

John Bechtold

2. Funding for IUTAM Conferences on Segregation in Granular Flow

National Science Foundation: February 1999-June 1999

Denis Blackmore

Anthony Rosato

3. Computational Electromagnetic Methods in Nonlinear Optics and Microwave Material Processing

National Science Foundation: August 1998-July 2001

Cheryl Hile

4. Computation of High Gradient Phenomena in Solid Mechanics

National Science Foundation, Division of Applied Mathematics: July 1998-June 2001

Dawn A. Lott-Crumpler

5. Scientific Computing Research Environments for the Mathematical Sciences

National Science Foundation: July 1998-July 2000

Jonathan Luke

Zoi-Heleni Michalopoulou

Dawn A Lott-Crumpler

Demetrius T. Papageorgiou

Michael Siegel

6. Numerical Modeling and Analysis of Transient Electromagnetic Wave Propagation and Scattering

Air Force Office of Scientific Research: November 1998-October 2001

Peter Petropoulos

7. Shallow Water Detection

Office of Naval Research: March 1999-September 2000.

Michael Porter

B. PROPOSED RESEARCH

PROJECTS PROPOSED DURING PRESENT ACADEMIC YEAR

1. Center for Flow Prediction and Control in Manufacturing Process

New Jersey Commission on Science & Technology

Nadine Aubry

John Bechtold

Denis Blackmore

Michael Booty

Bruce Buckiet

Ernest Geskin

Boris Khusid

Jonathan Luke

Demetrius Papageorgiou

Anthony Rosato

Michael Siegel

Pushpendra Singh

Burt Tilley

D. Watts

Chao Zhu

2. State-of-the-Art Fluid Mechanics Facilities for Advanced Processing

National Science Foundation – Major Research Instrumention

Nadine Aubry

Denis Blackmore

Ernest Geskin

Boris Khusid

Anthony Rosato

Pushpendra Singh

Burt Tilley

Chao Zhu

3. Laboratory for Electro-Hydrodynamics of Suspensions

Keck Foundation

Nadine Aubry

Boris Khusid

4. Smart Hydrofoils for Fast Ships

Naval Sea Systems Command

Nadine Aubry

Boris Khusid

5. Virtual Environment Enterprise: Environmental Justice Metrics for Hazardous Nonpoint Sources

National Science Foundation

Manish Bhattacharjee

Marcus Healey (HSMRC, NJIT)

Michael Bieber (Computer & Info. Sci.)

6. Change Dynamics in Contemporary Urban Environments

National Science Foundation, Urban Research Initiative

Manish Bhattacharjee

David Hawk (School of Architecture and School of Management)

Stanley Reisman (Electrical Engineering)

Methi Wecharatana (Civil and Environmental Engineering)

Rose Dios

David Rothenberg (Humanities and Social Sciences)

7. Analysis and Simulation of Granular Flow in Vibrating Beds and Hoppers

National Science Foundation

Denis Blackmore

Anthony Rosato

8. Neural Mechanisms for Generating Temporal Coding

National Science Foundation

Amit Bose

Victoria Booth

Michael Recce

9. *Mathematical Analysis of Stress Distribution and Adaptation of Aortic Aneurysm and Stenotic Arterial Walls Under Altered Loading Conditions*

National Science Foundation

Hans Chaudhry

Michael Siegel

A. Ritter (UMDNJ)

10. Identifying Long Memory Stationarity

National Science Foundation

Nuno Crato

11. Asymptotic and Singular Perturbation Methods for Bifurcation Problems with Applications

National Science Foundation

Thomas Erneux

12. Graphics and Visualization Facilities

NJIT CIS Department

Vladislav V. Goldberg

13. Microwave Processing of Ceramic Materials

National Science Foundation: Mathematical Sciences

Gregory A. Kriegsmann

14. The Interaction Between Fast and Slow Oscillatory Circuits

The Klingenstein Fund

Farzan Nadim

15. Regulation of Neuronal Oscillation by Synaptic Dynamics

National Science Foundation

Farzan Nadim

16. Regulation of Neuronal Oscillation by Synaptic Dynamics

NIH

Farzan Nadim

17. Transition in Turbine/Compressor Flows

Air Force Office of Scientific Research

Demetrius Papageorgiou

18. Broadband Inversion in Shallow Water

Office of Naval Research

Michael Porter

19. On Heat and Mass Transfer From A Vertically Hanging Film

Petroleum Research Fund

Burt Tilley

20. State of the Art Fluid Mechanics Facilities for Advanced Processing and Manufacturing

National Science Foundation Major Research Instrumentation Program

Nadine Aubry

Burt Tilley

21. Measurement of Stretch by Light Reflection in Biological Soft Tissue

National Science Foundation

N.Guzelsu

Hans Chaudhry

J.Federici

Thomas Findley

22. Center for Flow Prediction

New Jersey Commission on Science and Technology R & D Excellence Program

Nadine Aubry

Burt Tilley

23. Free Boundary Problems in Volatile Multi-Fluid Flows

National Science Foundation: July 1999-June 2002

Burt S. Tilley

C. EXTERNALLY FUNDED PROJECTS -- NOT THROUGH CAMS

1. Electro-Separation for On-Line Monitoring and Cleaning of In Service Fluids

Office of Naval Research: March 1999-March 2001

Nadine Aubry

Boris Khusid

2. Study of An Air Jet for Controlling Dusty Flows

Kleissler Company: January 1999-September 1999

Nadine Aubry

Boris Khusid

3. Analysis of Granular Flow Dynamics

NJCST: June 1998-August 1998

Denis Blackmore

4. *Studies on thermal oxidation of polymers using a bench-scale continuous feed reactor under conditions relevant to municipal incineration*

Procter & Gamble Company: February 1998-January 1999

Michael Booty

Joseph Bozzelli (Chemical Engineering)

5. Pre-College Experimental Math

Victoria Foundation: January 1998-December 1999

Rose Dios

Howard Kimmel, Pre-College Program

Exxon Corporation: January 1998-December 1999

Rose Dios

Howard Kimmel, Pre-College Program

6. Diabetes Data Analysis Using Generalized Mixed Models Via SAS

Diabetes Association of America

Sunil Dhar

5. *Travel support*

University of Messina: October 12-14, 1998

Vladislav V. Goldberg

8. Developing and Testing Probabilistic Forecast Models of Drought in the US

National Science Foundation/NOAA: August 1997-July 1999

(Funded through Lamont-Doherty Earth Observatory, Columbia University)

Bonnie Ray

Ed Cook

Upmanu Lall

Balaji Rajagopalan

9. TIDE: Transportation Informatics and Decision Engineering Center

New Jersey Department of Transportation: January 1999-Jan. 2000

John Tavantzis

10. Ultrasound to Decontaminate Dredged Sediments

National Science Foundation: May 1997- May 2000

Jay N. Meegoda

VIII. CAMS COMMITTEE AND LABORATORY ANNUAL REPORTS

A. READING ROOM by Jonathan Luke

The CAMS Reading Room houses a small collection of research texts and provides space for research meetings and the CAMS/Math teas. With generous support from CAMS members, CAMS undertook a major renovation of this essential space in the past year. The resulting facility is ideally suited to its purposes and fully reflects the seriousness and pride that CAMS takes in its research activities.

On June 15, 1999, Saul Fenster, President of NJIT, dedicated the renovated reading room in a ribbon cutting ceremony attended by many senior university officials including Provost William Van Buskirk, Senior Vice President Henry Mauermeyer, and Dean John Poate. These officials congratulated CAMS on their accomplishment and cited this facility as upholding the high standards to which they believe all NJIT centers and departments should aspire.

President Fenster cuts the ribbon in a ceremony rededicating the CAMS Reading Room. From left to right:

John Poate (Dean of the College of Science and Liberal Arts), Saul Fenster (NJIT President), Daljit S. Ahluwalia (CAMS Director), and William Van Buskirk (NJIT Provost).

B. CAMS COMMITTEE REPORTS

PUBLICATIONS COMMITTEE REPORT by Peter Petropoulos

The annual duties of the Publications Committee include 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 Computer Systems Administrator (R. Giouvanos) and by the Departmental Administrative Assistant (S. Sutton).

A major undertaking this year was the revision of the contents and appearance of the CAMS Annual Report. The assistance of Ms. Sutton was invaluable in this endeavor, as were the suggestions provided by Professors Luke and Ahluwalia.

Also, this year the Publications Committee contributed towards efforts in the Mathematical & Statistical Sciences Department to achieve a paper-less office. Additionally, for the purpose of advertising the research done within the CAMS to a wider audience, the Committee created a new web-page that contains the titles and abstracts of papers submitted in the CAMS Report Series by individual members. This web-page will be maintained by the Committee each year.

Towards the paper-less office, the Committee created (aided by the Computer Committee) a set of web-forms through which individual CAMS members enter their contributions towards the CAMS Annual Report. These web-forms are username/password protected and can be accessed throughout the academic year so that CAMS members can keep their entries up to date.

RESEARCH COMMITTEE REPORT by Denis Blackmore

In the Fall semester of 1998, our activities were centered on helping faculty members of the Department of Mathematical Sciences submit research proposals to external funding agencies. We proofread and critiqued proposals, gave advice on where and how to submit the proposals and explained (where necessary) the procedure for proposal submission through the Office of Sponsored Programs at NJIT. The proposals submitted by our faculty were of very high quality and many of them were funded.

The Committee was actively involved in the Spring of 1999 in aiding our newer faculty members in the preparation of NJIT - SBR proposals. Our efforts and especially those of the newer faculty were very successful - virtually all the proposals were funded.

C. LABORATORY ANNUAL REPORTS

Computer Committee Report for AY 1998-99 by Eliza Michalopoulou

The members of the computer committee for AY 1998-1999 were Dawn Lott-Crumpler, Eliza Michalopoulou (Chair), Burt Tilley, and Irene Giouvanos (the CAMS/Mathematical Sciences Systems Manager). The student assistant administrators were Mr. Pandurang Kamat and Mr. Poorna Bhimavarapu.

During the academic year, the computer committee oversaw the successful completion of the new wiring of the 5th and 6th floors in Cullimore. The new wiring gave us the

opportunity to connect to a faster, more reliable network. In addition, the committee investigated and proposed the purchase of a computational server and a sophisticated back-up system. The recommended equipment was purchased in the Spring of 1999. The new, four-processor server is already available for scientific computation and the back-up system is in the installation process.

During the Spring of 1999, new PCs were delivered to many faculty of the Department of Mathematical Sciences. The new computers were installed in faculty offices and were connected to the network. Also, new software with symbolic manipulation capabilities was installed on the CAMS workstations. The new software complements the scientific packages already available on our systems and is operational on our fastest computers. Furthermore, several departmental computers and software were upgraded, whereas outdated equipment was retired.

Report of the Statistical Consulting Lab Committee by Sunil Dhar

SCL computing facilities is housed in "Statistics Lab" in Cullimore 311 starting January 1999. The projects that earned funds are:

1. Standing agreement with Rutgers School of Nursing, Newark, for need-based statistical consulting

services provided by SCL to their faculty and graduate students for their research.

a. Statistical Analysis of Research Data. Client: Dr. N. Eller. Service provided by Dr. Bhattacharjee and Dr. R. Dios.
b. Statistical Analysis of Data sets based upon study about recovery from cancer. Client Ph.D. student Ellyn Matthews. Service provided by Dr. R. Dios.

1. Three day training course on Design and Analysis of Experiment (using JMP software) for PurePac,

   Pharmaceutical Company, by Dr. R. Dios and Dr. M. C. Bhattacharjee, April 14, 21, and 29, 1999.

2. Evaluation of Medical Decision-Making software MEDICALWARE to teach students. Client Gururajan

   Rao. Part of Ph.D. student's dissertation at Graduate School of Management, Rutgers, Newark.

   Helped with questionnaire design, comparisons for two teaching methods via multivariate hypothesis

   tests. Dr. S. Dhar. (start date 3/29/99 - on going).

3. Comparing actual versus calculated diffusion coefficients. Clients Dr. Raghu, CEE, NJIT and S.

   Chirputkar, Ph.D. student, CEE, NJIT. Service provided by Dr. M. C. Bhattacharjee.

4. Veterans Affairs Medical Center, East Orange and the Department of Neuroscience to analyze diabetes data. Data management and merging performed for data sources from various VA centers, using generalized mixed and repeated measure models via SAS, EXCEL (Summer 1998, on going) Service provided by Dr. S. Dhar.
5. Evaluation of Medical Decision-Making software MEDICALWARE to teach students. Part of Ph.D.

student's dissertation at UMDNJ. Statistical help provided by Professor Dhar.

D. CAPSTONE LABORATORY

Advisor: Michael Siegel

Students: Elene Bouloubasis, Hiren Gajipara, Robert Gloria, Ivory Kilpatrick, Jessica Mahon,

Dorota Moscicka, Shirley Yap

The NSF Capstone Lab (supported by a NSF ILI grant) houses Silicon Graphics workstations and equipment for physical experiments. These items are used by undergraduate students for research projects in the Capstone course in applied mathematics and statistics.

During the academic year 1998-1999, the students worked on the project ``Experiments and numerical simulation of fluid flow in a Hele-Shaw cell'', under the direction of Prof. Siegel and Teaching Assistant Michelle DeBonis. A Hele-Shaw cell consists of two closely space glass plates, with a viscous fluid occupying the gap between the plates. When a less viscous fluid such as air is injected into the viscous fluid (say, through a hole in one of the plates) an interesting fingering pattern develops on the interface. G. I. Taylor realized in 1956 that the equations governing flow in a Hele-Shaw cell are analogous to those governing flow in porous media, and therefore the cell could serve as a simple

apparatus to study flow instabilities arising in the oil industry.

In the class project, one group of students performed the experiment and recorded the results on video and digital cameras. The images were subsequently digitized for analysis. A second group focused

on modelling and numerical simulation of the interfacial flow. Some samples of the students' work are shown in the accompanying figures. The first set of panels show images taken from an experiment in which air is injected into sweetened condensed milk. The view is from the top of the cell, with the injection hole visible just above the origin of the axes. The second set of panels show colored water injected into condensed milk. Finally, the third figure shows the result of a numerical simulation, which clearly captures the salient features of the fingering phenomenon. The students' results were presented in a Special Applied Math Seminar on May 14.

I.

II.

III.

IX. ANNUAL RESEARCH WITHIN CAMS

A. SELECTED RESEARCH ACTIVITIES

John Bechtold:

In the past academic year, my research has been in the area of mathematical modeling of combustion phenomena. More specifically, I have derived several new models of premixed flame propagation through a variety of flow conditions. Of particular interest are those conditions typical of turbulent flows, such

as unsteadiness, nonuniform flow, and thermal and concentration gradients. The models have been used to investigate flame-flow interactions in simple geometries to gain insights into turbulent reacting flows.

Manish C. Bhattacharjee:

Basic Research: on Applied Probability and related staistical inference problems. Specific work includes research on modeling weak notions of aging with reference to repair achemes such as replacement/ perfect repairs.

Victoria Booth:

My research interests are in the mathematical and biophysical modeling of the electrical firing behavior of neurons. Models are developed based on electrophysiological data of the neurons and on anatomical data of the neuron networks. The goal of analysis of model results is to provide quantitative support of experimental hypotheses and to yield quantitative predictions of experimentally-testable behaviors.

Currently, I am implementing parameter optimization by genetic algorithm to motoneuron models previously developed in collaboration with John Rinzel (NYU) and Ole Kiehn (University of Copenhagen) to investigate the dependence on dendritic conductances for the generation of experimentally observed bistable firing patterns. In a separate collaboration with Amitabha Bose and Michael Recce (NJIT), I am developing network models of the CA3 region of the hippocampus to investigate neural mechansims for the generation of the phenomenon of place cell phase precession and for the suggested role of the region

in spatial memory. Model development is based on Michael Recce's experimental recordings from the hippocampus of freely moving rats. Model results are analyzed using phase plane methods and geometric singular perturbation techniques as well as numerical simulation. Predictions from model results are experimentally tested, leading to a close and immediate integration of theoretical and experimental techniques to understand the observed neural behavior.

Denis Blackmore:

Research projects on applications of dynamical systems to automated manufacturing, analysis of the dynamics of vortex rings in an ideal fluid, modeling and analysis of granular flows, fractal analysis of engineering surfaces, modeling and analysis of biological systems, existence and uniqueness theorems for partial differential equations, harmonic mappings between manifolds, and versal deformations of infinite-dimensional dynamical systems.

Bruce Bukiet:

During this year,I continued working on detonation dynamics with Army Research Lab. This work focuses on enabling a front tracking computational code to employ discrete

mixture equations of state to study detonation initiation. I also continued work on mathematical biology concerning stresses in the heart and the NASA Student Launch program.

Hans R. Chaudhry:

Professor Hans Chaudhry, along with his team from NJIT (Dr. B. Bukiet, Dr. M. Siegel, Dr. J. Federici and Dr. D. Lott-Crumpler) and UMDNJ (Dr. T. Findley, Dr. A. Ritter, and Dr. N. Guzelsu), made contribution to Biomechanics by analyzing stresses and strains in the cardiocvascular system and skin using the methods of non-linear elasticity. He focused his research mostly on the role of residual stresses in heart muscle and arteries and investigating the optimal patterns for suturing wounds in surgical procedure.

Nuno Crato:

Research on the time series models for the stochastic volatility of financial time series, namely stocks and commodity futures. Research on the distribution of computing costs associated with backtrack search algorithms.

Vladislav V. Goldberg:

I was working on open problems of conformal differential geometry (lightlike hypersurfaces and their applications), projective differential geometry (structure of tangentially degenerate submanifolds),

and web geometry (classification of 4-dimensional webs).

Gregory A. Kriegsmann:

Professor Kriegsmann's research activities for the year remain focused in two areas of wave propagation. In the first, he continues to develop asymptotic and numerical methods to quantitatively describe microwave heating processes that arise in the sintering, joining, and fabrication of ceramics. In the second, he continues to develop hybrid numerical methods for describing the scattering of electromagnetic waves from large resonant structures, such as jet engine ducts.

Dawn Lott-Crumpler:

My research for the Academic Year 1998-1999 spans three topics: One focus of my research has been the development and implementation of effective numerical methods for the solutions of quasilinear partial differential equations governing large motions of nonlinearly elastic, elastoplastic and viscoplastic materials. In particular, I utilize Adaptive Chebyshev Pseudo-spectral methods for the computation of shear bands in viscoplastic materials. Secondly, I have been studying the behavior of antiplane motions in one and two dimensions of nonlinearly elastoplastic materials. In particular, I am utilizing an efficient numerical scheme based on finite-difference approximations and inspired by numerical methods from gas dynamics in order to study antiplane motions of elastic materials. In addition, my research is also devoted to the study of optimal patterns of suturing for wound closures of arbitrary configuration. For this project, I utilize finite element methods which are suited for problems with irregular boundaries, i.e. wounds.

Laihan Luo:

Study the behavior of solutions for some nonlinear, dispersive wave equations with dissipation. Study the initial- and boundary-value problems for a generalized Korteweg-de Vries equation. Study rigorously

on the solvability for the asymptotic linearization of acoustic wave equations and some other asymptotically integrable systems. Research on a moving boundary-value problem for the Black-Scholes equation in mathematical finance by the PDE technique.

Eliza Michalopoulou:

My research focus during 1998/99 was on shallow water source localization and environmental inversion. The goal was the development of computationally efficient coherent time-domain methods. Very encouraging results in localization and bathymetry were obtained by applying a modified model-based matched-filter to data collected during the SwellEX-96 experiment.

Farzan Nadim:

Set up neurophysiology laboratory for experimental work on the crustacean stomatogastric nervous system. Modeled a switch generated by synaptic depression in a recurrent inhibitory neuronal network. Continued the investigation of the interaction between multiple neuronal network rhythms generated by modulatory command neurons.

Demetrius Papageorgiou:

Work continued on the dynamics of bubbles in surfactant solutions and in particular the control of their mobility using high bulk concentrations of surface active agents. We have made important strides both theoretically and experimentally and are now in a position to make direct comparisons. The experimental work is carried out in the lab of Professor Maldarelli of the Levich Institute of CCNY - I am co-mentoring a PhD student there. We have also completed work on a class of exact Navier-Stokes solutions and in

particular their complicated chaotic dynamics. These flows arise in many situations including lubricated bearings and blood flow in collapsible tubes. A third project is the instability and resulting topological singularities found in free surface flows when surface tension is important. We have been studying

surfactant effects (with Prof. Siegel), collapse of fluid sheets (with Prof. Tilley and Dr. Samulyak) and breakup of compound liquid jets. Work has also begun in the effects of electric fields on such flows (with Prof. Petropoulos).

Peter Petropoulos:

This year I concentrated on the analysis of the effect of numerical dispersion on the performance of absorbing boundary conditions and reflectionless sponge layers used to truncate computational domains

in which Maxwell's equations are solved numerically. With Dr. Yefet we have been studying explicit fourth-order schemes in complex domains. Also, a collaborative project with Professor Papageorgiou was started in which we derived the evolution equations describing the fluid velocity and interfacial deflection of a thin fluid sheet stressed by an axial electric field. These equations constitute an initial boundary-value problem and will be solved numerically using a Chebyshev pseudo-spectral method.

Bonnie K. Ray:

My research has concentrated on two areas: 1) long-range dependent models for stochastic volatility processes and 2) methods for modeling nonlinear vector time series. Application areas include climatology and finance. Currently, I have six papers related to these topics either submitted or under

revision for journals.

Burt Tilley:

Current research projects include the stability and pattern formation of interfacial instabilities in a thin fluid sheet (co-workers D.T. Papageorgiou and R. V. Samulyak), in which we derived a simple set of evolution equations describing the fluid velocity and interfacial deflection of a thin fluid sheet. We were able to

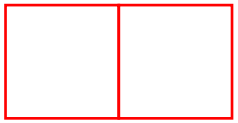
show that for spatially periodic boundary conditions, counterpropagating waves appear with noncommensurate wavespeeds: solutions are quasi-periodic in time. We also found a critical flow amplitude above which the sheet will rupture, the dependence of this criterion to wavelength, and independence of similarity exponents to initial conditions in this regime. Other activities include the solution of unsteady Stokes flow of a wedge on an oscillating heated plate (collaborators are S.H. Davis and S. G. Bankoff) in which evaporation, disequilibrium, and Marangoni stresses are important. Independent work was begun on the effect of adverse shear on a coating fluid layer.

Amir Yefet:

In this academic year Peter Petropoulos and I were working on fourth order explicit scheme for Maxwell's equations. Recently we wrote the first draft of a paper discussing this new scheme.

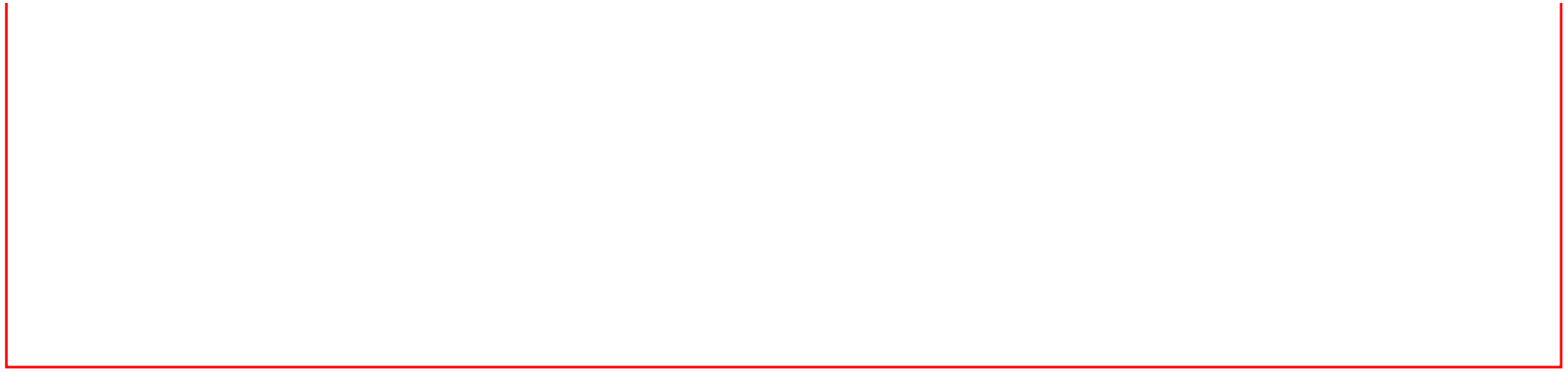
B. SELECTED RESEARCH RESULTS

Burt S. Tilley



Singularity formation in fluid flows is of interest since these events can be used to enhance performance in engineering applications. Consider the flow of an incompressible, irrotational, inviscid fluid sheet shown in the upper figure. We have derived a simple set of coupled partial differential equations, valid for long-wavelength disturbances, which describe the evolution of the varicose interface deflection $S(x,t)$ and the axial velocity $u(x,t)$: $S_t + (uS)_x = 0$, $u_t + u\,u_x = S_{xxx}$, in which the effects of inertia and surface tension are both important. We show that this system does not possess solitary wave solutions. From the asymptotic approach, these equations describe rupture ($S \approx 0$ locally) provided that spatial gradients remain bounded. From a similarity property of these equations, and some numerical investigations, we are able to describe the general behavior for rupture. For initial velocity amplitudes u_o sufficiently large, or for wavelengths L sufficiently long, the interface ruptures according to the similarity scales found in Pugh & Shelley (1998). Otherwise, the solutions remain bounded, and are in general quasi-periodic in time and spatially periodic. We further find the class of initial conditions for which travelling waves are the solutions. This work was done in collaboration with D. T. Papageorgiou and R. V. Samulyak.

Michael Siegel



This figure illustrates tip-streaming instabilities for a nearly cusped fluid interface in an external strain flow. When a photographic film or optical fiber is pulled through a liquid coating bath at high speeds, a cusped surface is created at the liquid/air interface. In figure (a), a perturbation (curve A) to the steady cusped interface relaxes back to the cusped profile (curve B). Beyond a critical pulling speed, the same perturbation leads to a tip-streaming instability (Figure (b)). The figures show that the steady cusped interface is unstable at high pulling speeds, leading to degradation of the coating. Since standard numerical methods have difficulty dealing with interfaces that are near cusping or pinching, new methods had to be devised to compute these solutions.

Peter Petropoulos and Amir Yefet

Engineers who use computational electromagnetics codes have objected to fourth-order accurate schemes as a replacement of the industry workhorse second-order accurate Yee scheme because of a) difficulty in implementing absorbing boundaries due to the extended spatial stencil, b) lack of an approach to model heterogeneous dielectrics while maintaining the order of accuracy of the scheme. The first

objection was addressed by us in JCP, v. 139, pp. 184-208 (1998). With analysis and numerical experiments (metal box in which there are layers of dielectrics) we have shown that the obvious treatment

(dashed line above) of dielectric interfaces results in a loss of at least two orders of global accuracy for an explicit staggered fourth-order scheme. A new treatment restores the fourth-order convergence globally (dash-dot line above) and improves the error level in comparison to the Yee scheme (solid line above). This work, done jointly by Amir Yefet and Peter G. Petropoulos, addresses the second (and final) objection to high-order schemes, and paves the way towards full acceptance of fourth-order schemes for engineering computations.

Michael Booty

Temperature disturbance T_1 and pressure disturbance p_1 as functions of lagrangian distance ψ and time t in the 'induction domain' ahead of a deflagration with small Mach number in a category $M=O(\varepsilon)$. The mathematical model developed for this set-up and the interpretation of its solution are described below.

Flamelet models of combustion, also referred to as reaction-sheet models, are derived in the limit of small inverse activation energy $\varepsilon \downarrow 0$ to describe the dynamics of a flame in a combustible gas mixture. In this limit, effects of chemical activity are small or negligible except within a spatially narrow region, which is the flame or flamelet. Asymptotic analysis of the governing (reactive Navier-Stokes) equations is used to replace the flame by a surface of discontinuity across which a rationally derived set of jump conditions must be satisfied by the flow field to either side. These jump conditions can be appended to the traditional equations of inert gasdynamics and reactive acoustics in much the same way that the Rankine-Hugoniot jump conditions are appended to the Euler equations to describe the evolution of a shock wave. However, the form taken by the jump conditions varies with the flame speed, or propagation Mach number M, and how this is scaled on the inverse activation energy ε.

To date, flamelet models have been used to describe the slowest category of premixed flames, which are referred to as diffusional-thermal flames and have propagation Mach number M to activation energy ε scaling $M = O(\varepsilon \exp(-1/2T_b))$, where $T_b \approx 6$ is the ratio of ambient absolute temperatures ahead and behind the flame. In the work described here, a new flamelet model was derived for the next fastest category of flames, for which the M to ε scaling is $M=O(\varepsilon)$. The model was then adapted in an attempt to describe the phenomenon of deflagration to detonation transition, whereby a low-speed flame or deflagration evolves and accelerates to become a high-speed wave or detonation, as is widely observed in simple experiments and applications.

In this adaptation, the flow field immediately ahead of the flame is described by small-amplitude disturbances (T_1 , p_1 , u_1) in temperature, pressure, and gas velocity about a uniform basic state with temperature near the flame's critical ignition temperature. Even in the absence of the flame, gas in this state will ultimately develop directly into a supersonic, weak detonation wave at some nondimensional time $t \approx 1$. Flow disturbances in this region are governed by the semilinear hyperbolic system of reactive acoustics, or ′ induction domain' equations. The gas temperature is presumed to be raised to a level near the flame's ignition temperature by a shock wave, which precedes the induction domain and flame, being driven by a piston that moves into the gas from a location immediately behind the flame.

The model reduces to an initial boundary value problem for the induction domain equations, which requires numerical solution. Initial data is given describing a quiescent state ahead of the shock wave, and an initial temperature profile in the induction domain just ahead of the flame. Boundary data is given describing (1) reflection and transmission of disturbances at the preceding shock wave, and (2) data on a path immediately ahead of the flame, which follows from the flamelet jump conditions and describes transmission and reflection of disturbances across the flame and piston pair.

Booty (continued)

The figures above show temperature and pressure disturbances T_1 (ψ , t) and p_1 (ψ , t) in the induction domain for a typical evolution pattern of the flow field, where ψ is a lagrangian distance coordinate measured from the piston. The curve of intersection of the disturbance surfaces with the flame path ψ =0 is found to have a turning point singularity at a time near t=0.005. This singularity type propagates into the induction domain along the characteristic entering the domain from the flame path at the critical instant. Note that the critical instant occurs at a far earlier time than would spontaneous development of a weak detonation in absence of the flame. The computations show that as the critical instant is approached the flame speed remains finite while its acceleration becomes unbounded, with the event emitting a well-defined disturbance into the flow field ahead of the flame. Computations have not yet been taken beyond the critical event but a hypothesis suggested by the experimentally observed phenomenon of 'galloping flames' is that the flame will slow after the event - before the process, qualitatively, repeats itself.

Eliza Michalopoulou

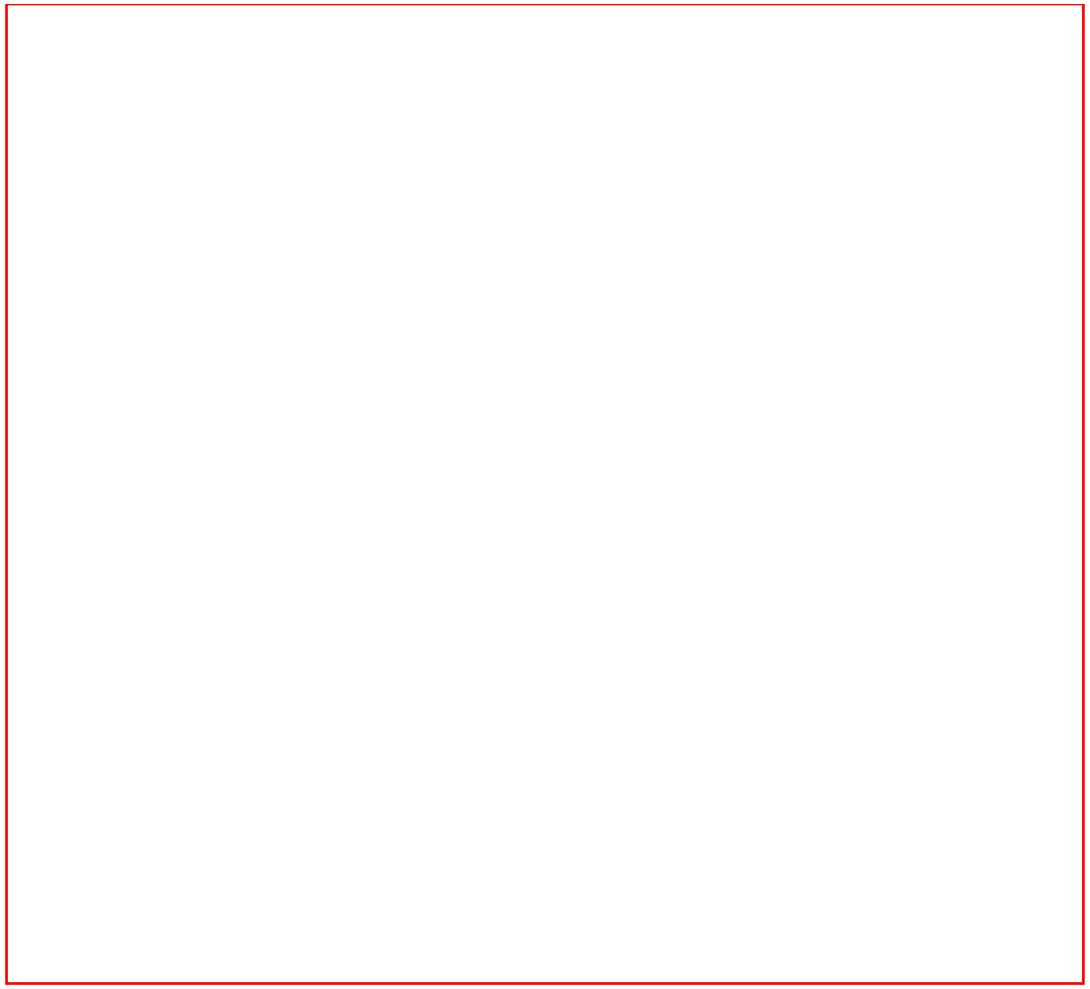
Incoherent Bartlett MFP

Matched Impulse Response Processing

Figure 1: Ambiguity surfaces computed with the incoherent Bartlett processor (top) and the matched-impulse response processor (bottom).

We showed that broadband source localization for a known source sequence can be achieved accurately and efficiently by extracting the impulse response of the ocean and cross-correlating it to replicas of the ocean impulse response. Figure 1 shows range-depth localization results for data collected during the SWellEX-96 experiment. The top plot illustrates the conventional, incoherent Bartlett ambiguity surface and the bottom plot shows the matched-impulse response ambiguity surface. The incoherent Bartlett surface shows a high level of uncertainty, whereas the matched-impulse response surface has a relatively "clean" peak at a range of 9.3 km and depth of 58 m (the correct source position is at 8.6 km in range and 56 m in depth). For the replica calculation for both incoherent and impulse response methods, the environment was assumed to be range independent, ignoring, thus, the bathymetric changes between source and receiver. The incoherent Bartlett processor is affected by the error between assumed and true bathymetry giving wrong localization results, whereas the matched-impulse response processor is robust, leading to a good source estimate with only a shift in source range as a result of the environmental mismatch.

John Bechtold



The response of a premixed flame in stagnation point flow with an imposed oscillating strain rate has been analyzed. This configuration is considered a prototype for a laminar flamelet, and it is therefore applicable to turbulent flames. The sequence of figures above illustrates our theoretical prediction that a region of reverse flow can temporarily appear immediately ahead of the flame during part of each cycle. Figure 1 shows streamlines of a flow impinging against a wall at x=0. A planar flame located at x=D separates the fresh mixture from the burned region. As the gas is burned it becomes less dense and streamlines are deflected, causing the incoming flow to be displaced a distance, a (see the dashed line). During part of each cycle, the magnitude of displacement can exceed the flame standoff distance as shown in Figures 3 and 4. This gives rise to a region of reverse flow and a stagnation plane develops upstream.

Gregory A. Kriegsmann

Pattern Formation in a Microwave Heated Ceramic Slab

The heating of a ceramic slab in a resonant TE_{103} cavity is a highly nonlinear process which is described by Maxwell's equation and the heat equation. Assuming that the slab is thin and that the Biot number is

small, we have derived a two- dimensional reaction diffusion equation which models the heating process. The equation contains a nonhomogeneous source term which corresponds to the modal structure of the cavity and a functional which takes into account the detuning of the cavity by the heated slab.

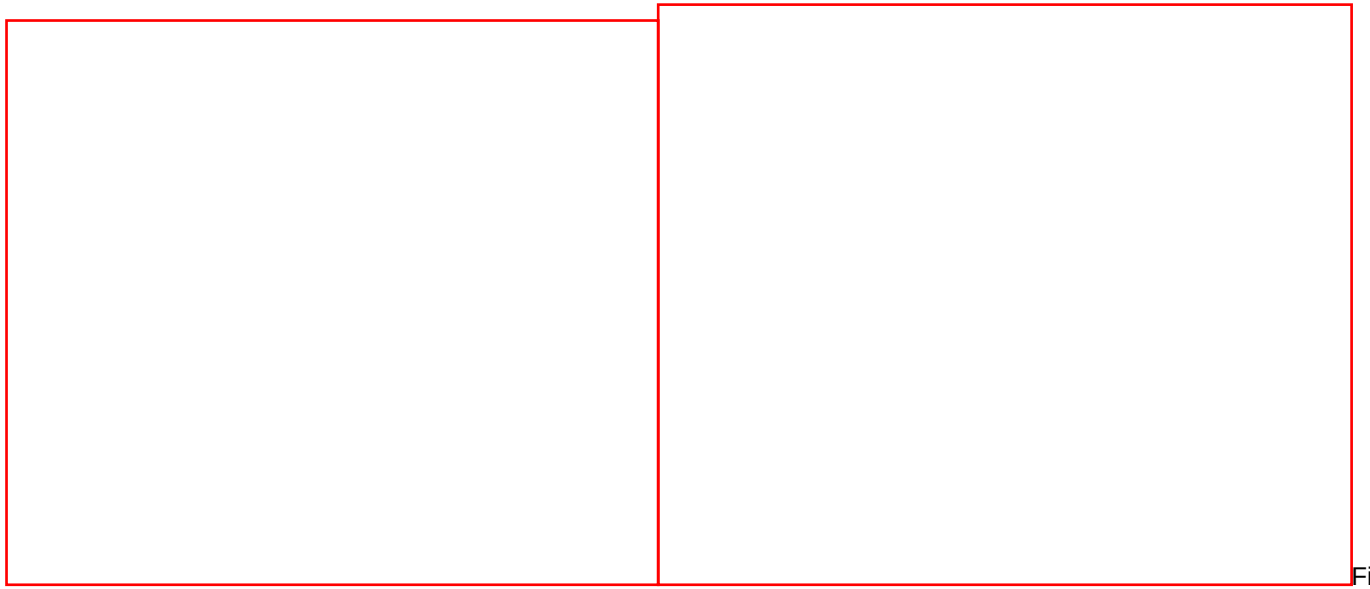


Figure 1 shows the face of the slab for a given incident power level P_1; the stripe- like pattern is indicative of the underlying modal structure which preferentially heats the center. Figure 2 shows the face of the same slab when the power is slightly increased to $P_2 > P_1$; a thermal instability has changed the stripe Into an oval spot. This has been seen experimentally. Finally, if the power is increased further, then the oval spot focuses and the heating becomes much more localized as shown in Figure 3. Such a scenario would result in a hole burned in the middle of the slab.

Demetrius Papageorgiou

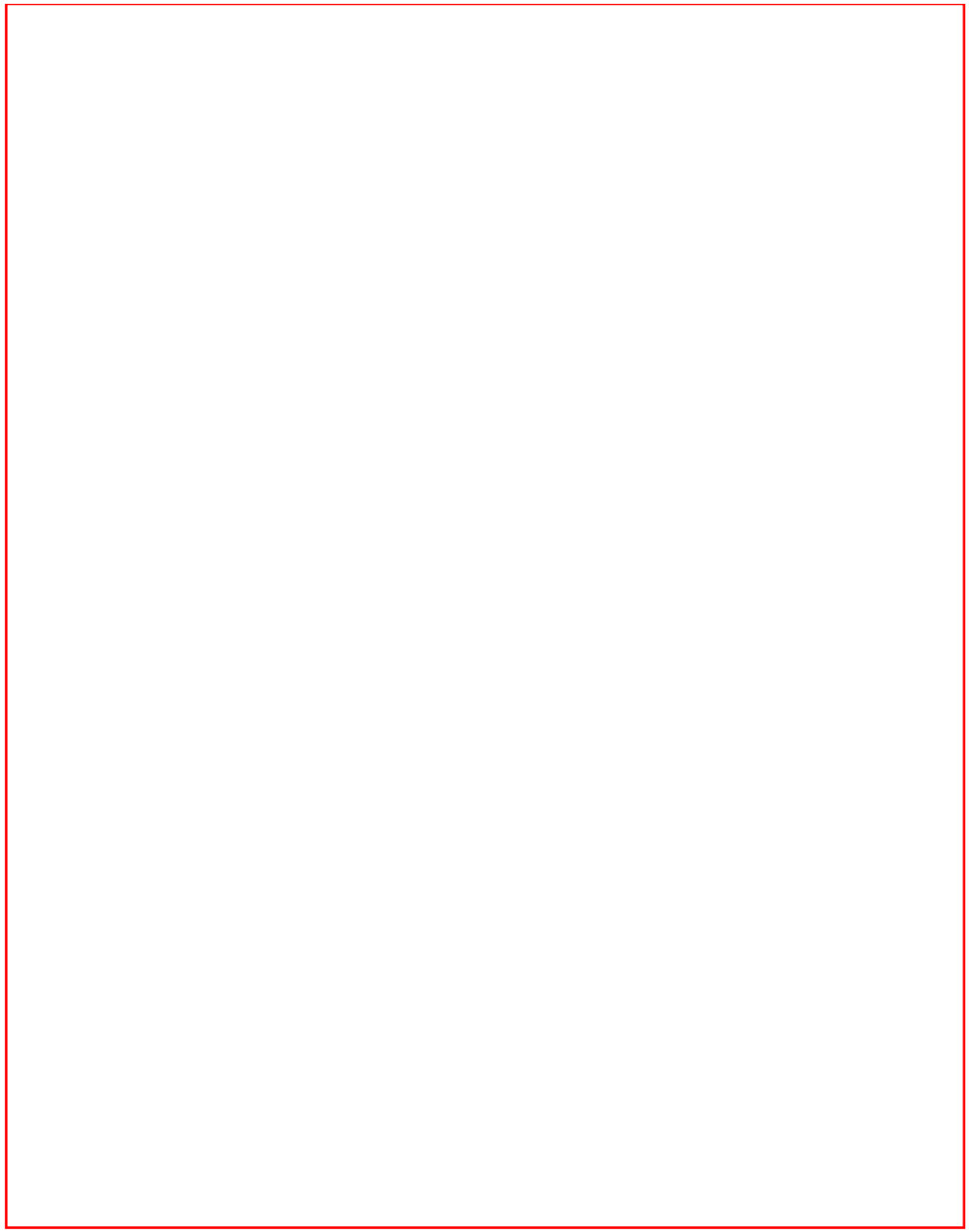


Figure 1: Flow around bubble at order one Reynolds numbers for a fixed surfactant concentration and a fixed Peclet of 100.

This Figure shows numerical results for the steady flow around a rising gas bubble in a viscous fluid containing soluble surfactants. The Navier-Stokes equations have been solved numerically and the streamlines of the steady flow are shown at different increasing Reynolds numbers. The presence of surfactants causes a wake to form at the back end (the flow is from left to right in a frame fixed in the bubble) - note that in the absence of surfactants there is no separation and no wakes if the bubble remains spherical. From Wang, Papageorgiou and Maldarelli (1999). (See also, *A Theoretical Study of Bubble Motion In Surfactant Solutions*, Yanping Wang, Ph.D. Thesis, Department of

Mathematical Sciences, New Jersey Institute of Technology (1998).)

Papageorgiou (continued)

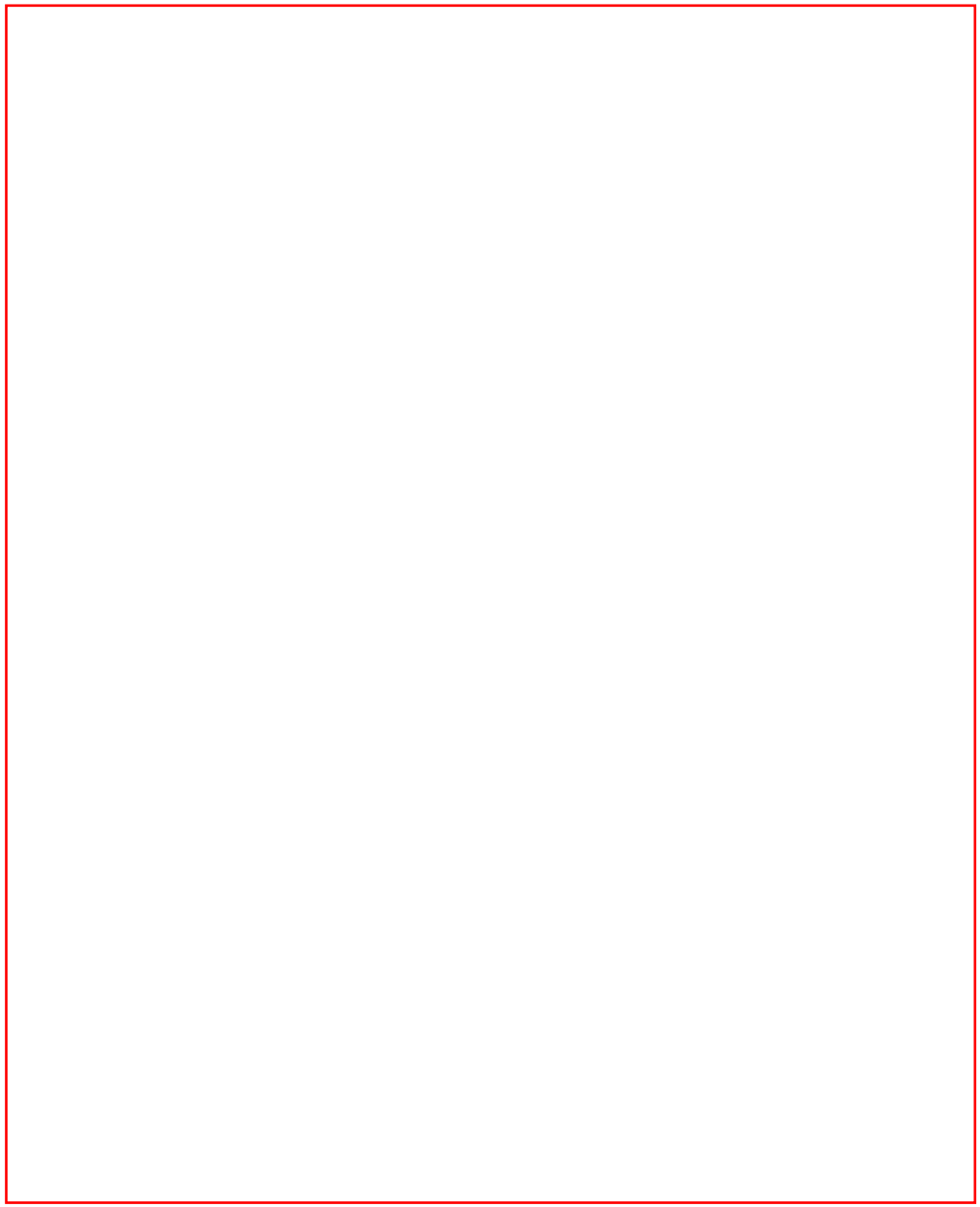


Figure 2: Flow around bubble at a Reynolds number of 100 and a Peclet number of 200. *k* represents the surfactant concentration.

This Figure shows numerical results for the steady flow around a rising gas bubble in a viscous fluid containing soluble surfactants. The Navier-Stokes equations have been

solved numerically and the streamlines of the steady flow are shown at different increasing surfactant concentrations. The Reynolds number is fixed at 100 and the Peclet number is 200. In the absence of surfactants a wake forms at the back end (see the smaller values of *k*). As the surfactant concentration increases the interfacial mobility increases and the wake is removed - the bubble remobilizes. These computations show that the wake size can be controlled by using appropriate surfactants and opens a way of mass transfer enhancement. From Wang, Papageorgiou and Maldarelli (1999). (See also, *A Theoretical Study of Bubble Motion In Surfactant Solutions*, Yanping Wang, PhD Thesis, Department of Mathematical Sciences, New Jersey Institute of Technology (1998).)

Amit Bose, Victoria Booth, and Michael Recce

Spatial navigation in freely moving rats

Voltage traces of neurons from a model of region CA3 of the hippocampus of a rat moving through the place field of the pyramidal cell (P) are shown. The traces are consistent with two experimentally verified results. First, as the rat runs in a known environment, the pyramidal cell fires in a spatially specific location (Heavy Bar). Here running velocity is constant, so the horizontal axis represents both space and time. Second, the firing of the pyramidal cell precesses relative to the pacemaker input T (dotted lines) during passage through the place field. The model makes the novel prediction that some interneurons (I2) may also precess in the place field while others (I1) will not. Full details of these results are contained in Bose, Booth and Recce, CAMS Report 9899-9, which is to appear in the Journal of Computational Neuroscience.

Farzan Nadim

Rhythmic patterns generated in the central nervous system control a variety of behaviors. These include walking, swimming, ingestion and digestion of food and heartbeat. One of the important questions in this area of Neurosciences is the relative contribution of synaptic dynamics to the generation of rhythmic patterns. My collaborators and I are addressing this question by combining modeling and experiments on the crustacean stomatogastric nervous system. Our recent mathematical modeling studies show that use-dependent depression, a well-known dynamical property of synapses, can create a switch between two modes of oscillations in a network involving recurrent inhibitory synapses (Nadim et al., 1999; Fig. 1). We have begun a set of experiments to test the feasibility of such a switch mechanism in the biological network. In this set of experiments we are replacing the biological synapse with an artificial synapse using a computer-

to-biological real-time interface (Fig. 2).

H. R. Chaudhry, B. Bukiet, M. Siegel, T. Findley, A. B. Ritter, and N. Guzelsu

Optimal Patterns for Suturing Wounds

We have developed a mathematical model for computing stresses in sutured human skin wounds.

The model uses the incremental law of elasticity and elastic constants valid for *in vivo* orthotropic skin.

We have applied the model to compute the principal stress and displacements resulting from suturing small elliptical and circular wounds in a large flat sheet of skin, in order to determine the optimal suturing patterns. We have observed that the average stress index for a circular wound sutured toward the center is almost double that of a wound sutured perpendicular to a diameter. Thus, the latter type of suturing pattern is preferable. Similarly, suturing an elliptical wound perpendicular to its major axis produces

a lower average stress index than a circular wound of the same area. Finally, we have found that the optimal ratio of semi-major to semi-minor axis of an elliptical wound is near 3 (for abdominal wounds), i.e., this ratio produces the most uniform stresses along the wound edges, where wound healing is the lowest. This agrees with common medical practice. Since high stresses have adverse effects on healing and blood flow, this work, depicting regions of high stresses, may be used along with other biological factors to help predict regions of slower healing in sutured wounds.

The figure below shows the principal stresses at the precursor points, i.e., before suturing, through the first quadrant of the skin sheet with an elliptical wound when the wound is sutured perpendicular to the major axis. Note that the stress is highest at the end of the major axis. This work has appeared in Journal of Biomechanics, Vol. 31, 1998, pp. 653-662.

Nadine Aubry

It is well-known that at early stages an impulsively started flow past a circular cylinder consists of twin vortices which are images of one another through the mid-plane. While the twin vortices are stable for Reynolds numbers below the critical Reynolds number value (Rec ~ 48), they become unstable above the critical Reynolds number. At Re > Rec, the flow keeps its symmetric recirculating bubble structure for a short time, undergoes a symmetry breaking instability, and develops into a Karman vortex street. Vortex shedding is associated with a strong oscillating transverse force (lift force) on the body that cause flow induced vibrations and can damage the body. We have concentrated our efforts into modeling the instability and controlling vortex sheeding first through the model, and second through numerical simulations dealing with the full Navier-Stokes equations.

Our modeling effort is based on Foppl's low (four) dimensional, potential flow model. We have carried out the stability analysis of a steady bubble of vortices in the model, and found two asymmetric modes, a stable one and an unstable one. We have then shown by numerical simulation how the instability properties of the model qualitatively mimic those of the real flow. We have then controlled the instability in the model by inserting two small vorticity sources which can suppress vortex shedding in the real flow (see Figure 1).

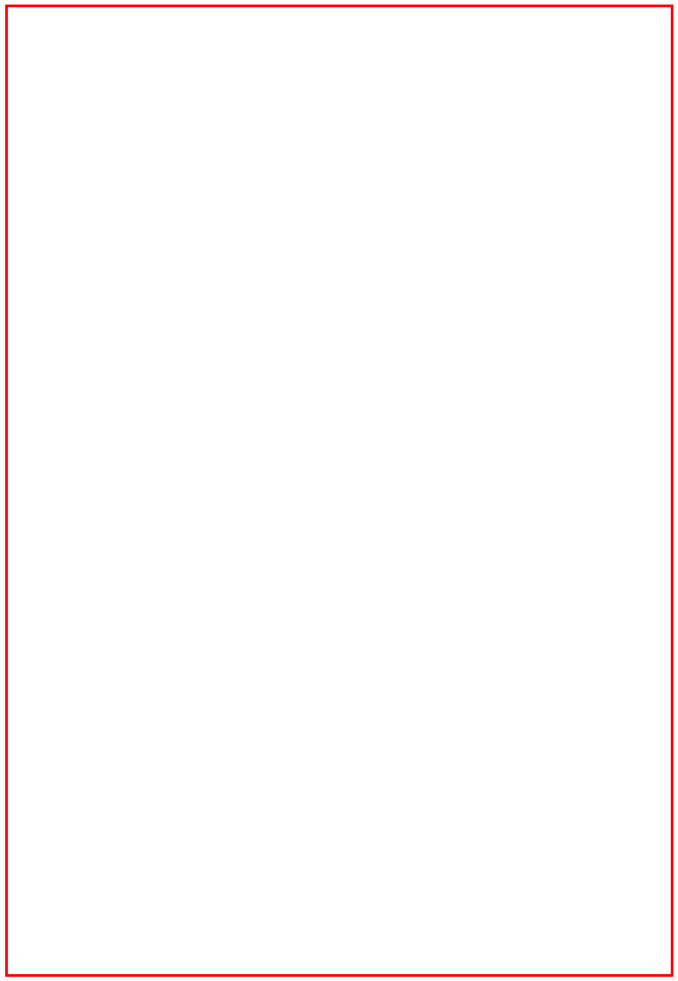


Figure 1. Visualization of the flow past a circular cylinder obtained from numerical simulation dealing with the full Navier-Stokes equations. At time t = 350.01, we have inserted two small sources of vorticity in the flow which, at later times, destabilize the Karman vortex street and bring the flow to a symmetric steady state with no lift force on the body

(from S. Tang and N. Aubry, *Journal of Fluids and Structures*, in press).

Aubry (continued)

We have also shown that similar results can be obtained through the application of electro-magnetic forces to the flow (Figure 2). Figure 2 shows the flow past a circular cylinder obtained from numerical simulations at

Re = 200, without control, with control by means of a relatively small electro-magnetic force (flow control I), with control by means of a larger electro-magnetic force (flow control II). In both cases, vortex shedding is suppressed and the lift force on the body becomes zero. The flow-structure interaction computations from modified Navier-Stokes equations were also performed, showing that vortex shedding can be suppressed and the lift can vanish even if the body is free to move under the action of the flow (Figure 3).

Figure 2. Flow visualization (showing streamlines) resulting from our numerical simulation of the flow past a fixed circular cylinder subjected to external electro-magnetic forces at Re = 200: flow without control, flow subjected to a relatively small electro-magnetic force, flow subjected to a larger electromagnetic force (from Z. Chen's Ph.D. doctoral dissertation, NJIT, in preparation).

Aubry (continued)

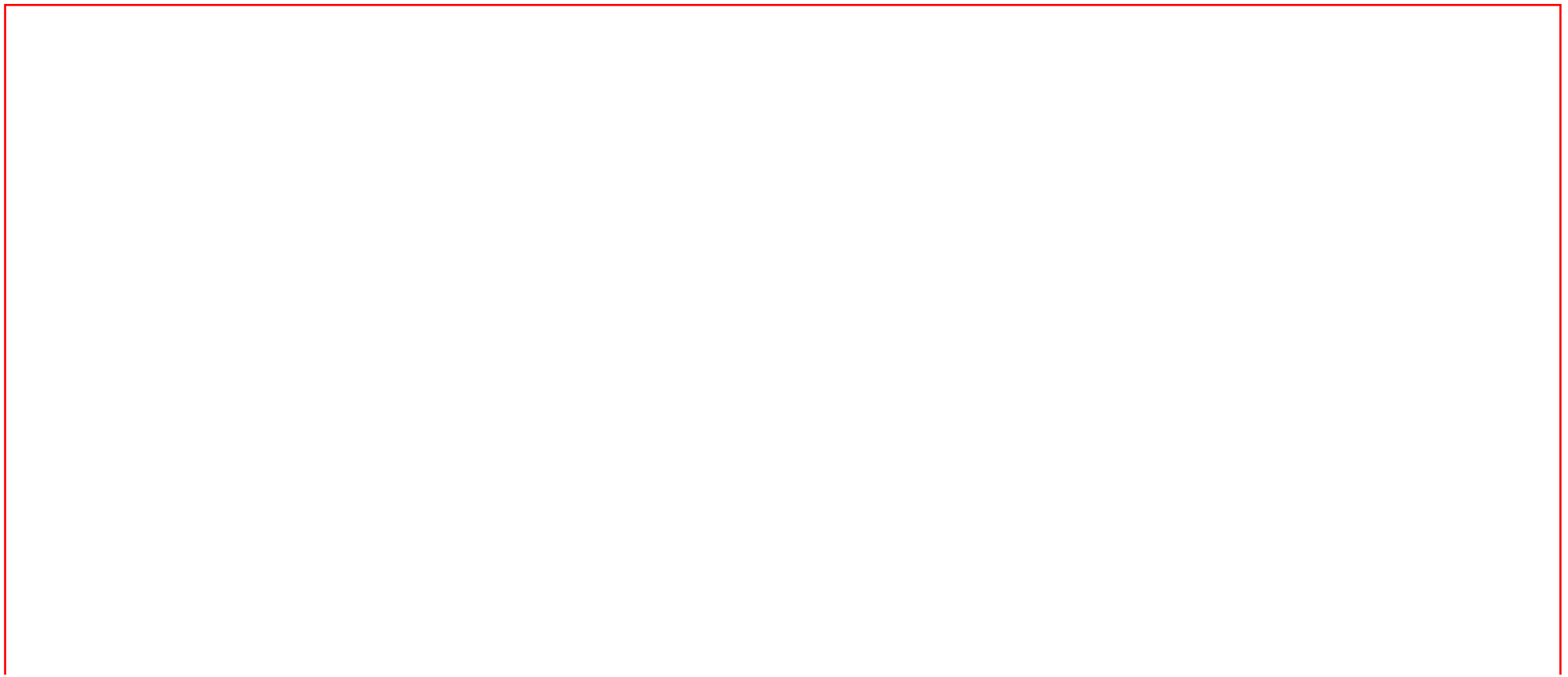


Figure 3. This figure is similar to Figure 2, except that flow-structure interactions are now simulated, allowing for the displacement of the body under the influence of the flow, at every time step (from Z. Chen's Ph.D. doctoral dissertation, NJIT, in preparation).

C. COLLABORATIVE RESEARCH

Denis Blackmore:

Dynamics of Vortex Rings and Filaments, D. Blackmore, L. Ting (Courant Institute), and O. Knio (Courant Institute)

Amit Bose:

Dynamics of Networks of Neurons, Amitabha Bose, Nancy Kopell (Boston University), David Terman (Ohio State University)

Dawn Lott-Crumpler:

Numerical Methods for the Quasilinear Wave Equations: Antiplane Shearing of Nonlinearly Elastic Bodies, Dawn A. Lott-Crumpler, Stuart S. Antman and William G. Szymczak

Laihan Luo:

Long Time Behavior of Solutions of Some General Nonlinear, Dispersive Wave Equations, with J. Bona, Department of Mathematics and Texas Institute for Computational and Applied Mathematics, The University of Texas, Austin, TX 78712 USA and with A.S. Fokas, Department of Mathematics, Imperial College, 180 Queen's Gate, London, SW7 2BZ UK

Initial- and Boundary-Value Problems for Some Nonlinear Wave Equations, with J. Bona in Department of Mathematics and Texas Institute for Computational and Applied Mathematics, The University of Texas, Austin, TX 78712

Solvability for Some Asymptotically Integrable Systems, with A.S. Fokas, Department of Mathematics, Imperial College, 180 Queen's Gate, London, SW7 2BZ UK

Demetrius Papageorgiou:

Dynamics of Bubbles in Surfactant Solutions. C. Maldarelli, City College of New York.

Chaotic Dynamics in Forced Navier-Stokes Flows. P. Hall, Imperial College of Science, Technology and Medicine, London.

Peter Petropoulos:

Numerical Dispersion in Numerical Solutions of Electromagnetic Integral Equations, G. Pelekanos, Southern Illinois University.

Comparison of Exact ABC's and Reflectionless Sponge Layers in Spherical Coordinates, N. Kantartzis, University of Thessaloniki, Greece.

Bonnie Ray:

Performance Analysis for Large-scale Multi-response Simulations, Los Alamos National Laboratory, ongoing collaboration with Statistical Sciences Group.

D. CAMS ACADEMIC YEAR RESEARCH PROGRAM FOR STUDENTS

Ph.D.'s Awarded:

Zili Huang

May 1999 - Advisor: Dr. Bechtold

Thesis Title, "Flame dynamics in unsteady strained flows."

Roman Samulyak

May 1999 - Advisor: Dr. Blackmore

Thesis Title, "Dynamical systems associated with particle flow models:Theory and numerical methods."

Yanping Wang

Jan. 1999 - Advisor: Dr. Papageorgiou

Thesis Title, "Theoretical study of bubble motion and remobilization in surfactant solutions."

Presentations:

John Gilchrist

Invited as featured speaker at 2nd Student Conference, Florida State University, 1998. Winner of Student Paper Award.

Xiaoqun Ma

A linearization approach to source localization in an uncertain environment. SIAM Annual Meeting, Atlanta, Georgia, May 1999.

Objective function selection for shallow water geoacoustic inversion. Conference on Theoretical and Computational Acoustics, Trieste, Italy, May 1999.

Inpulse response estimation for inversion and source localization. Workshop on inverse problems, Greece, May 1999.

Matched arrival processing for efficient inversion in underwater acoustics. Oceans '99 NTS/IEEE Conference and Exhibition Seattle, Washington, Sept 1999.

Michele Picarelli

Coherent and incoherent shallow water matched field inversion. Invited Paper, 136th Meeting of the Acoustical Society of America, Norfolk, October 1998.

Roman V. Samulyak

Granular flows in hoppers and in vibrating beds: Mathematical models, numerical solutions and computer simulations. AIChE 1998 Annual Meeting, November 15-20, Miami Beach, Florida.

Dynamical systems associated with particle flow models: Theory and numerical methods. Applied Mathematics and Statistics Department Seminar, State University of New York at Stony Brook, March 17, 1999, Stony Brook, NY.

Dynamical systems for granular flows and related problems of fluid mechanics. Center for Nonlinear and Complex Systems Seminar, Duke University, March 30, 1999, Durham, NC.

A class of exact finite-dimensional reductions of infinite-dimensional dynamical systems: theory and applications. Arizona Center for Mathematical Sciences seminar, University of Arizona, Tucson, AZ. April 19, 1999

E. CAMS SUMMER RESEARCH PROGRAM FOR STUDENTS

1998

The CAMS Summer Research Program is designed to involve graduate students in the research efforts of CAMS members. With the guidance of faculty advisors, students conduct summer research projects

commensurate with mathematical and scientific abilities. Students present these projects in the weekly Graduate Student Seminar. In 1998, the Graduate Student Seminar was organized by Prof. Michael

Booty. Prof. Amit Bose and Prof. Petronije Milojevic assisted those students who were preparing for qualifying exams. Students also took Math 691, "Stochastic Processes with Applications," which was offered by Prof. Sunil Dhar.

Listed below are details of the weekly seminars.

ZiLi Huang, "Flame Dynamics In Unsteady Strained Flows"

Yanping Wang, "Dynamics of A Spherical Bubble Rising in Surfactant Solution"

Juan Gomez, "Studies of Droplet Burning"

Fu Li, "Microwave Assisted Combustions"

Raymond Addabbo, "Expanding Spherical Flames"

Eliana Antoniou, "Ignition of A Combustible Solid"

Xiaoqun Ma, "Linearization of the Inverse Problem for Underwater Acoustics"

Michelle Picarelli, "Problems in Underwater Acoustics"

Prof. Amit Bose, "Non-Local Equations for Microwave Heating Applications"

Roman Samulyak, "Finite Dimensional Reduction of Nonlinear Dynamical Systems: Theory, Numerical

Methods, and Applications to Granular Flow"

Stuart Walker, "Multi-Mode Excitation of a Resonant Cavity"

Urmi Ghosh-Dastidar, "Microwave Heated Ceramics: A One-Dimensional Model"

1999

Following the success of previous CAMS Summer Research programs, a Summer program was also offered for Mathematical Sciences Ph.D. students in 1999. The program started on May 17 and was of three months duration. The faculty in charge of the summer program were Professors

Bechtold, Luke, and Papageorgiou. Besides the individual research projects that many of the students are working on, there were two seminars given each week. Of the two weekly seminars one was given by a faculty member on fundamental areas of applied mathematics (the areas covered were fluid dynamics, electromagnetics, wave propagation, optimization problems and mathematical biology). The second weekly seminar was given by a graduate student on the specific research they are conducting. Each graduate student made a presentation which was followed by informal discussions.

These seminars, besides their intrinsic instructive nature, served as a focal point for lively discussions between faculty and students on current and future research resulting from the various projects.

In addition, each student completed a brief scientific report of the work accomplished during the program.

Listed below are details of the weekly seminars.

Faculty Workshops:

Michael Siegel, "Introduction to Fluid Dynamics"

John Bechtold, "Introduction to Combustion"

Burt Tilley, "Problems in Hydrodynamic Stability"

John Tavantzis, "Mathematical Tools in Transportation Problems"

Jonathan Luke and Gregory A. Kriegsmann, "Electromagnetic Waves"

David Stickler and Daljit S. Ahluwalia, "Introduction to Wave Propagation"

Hans R. Chaudhry, "Introduction to Bio-Mechanics"

Farzan Nadim, "Introduction to Mathematical Neuroscience"

Dharam Chopra, "Contributions to Orthogonal Arrays"

Student Seminars:

Xiaoqun Ma, "A Linearization Approach to Source Localization in An Uncertain Environment"

Stuart Walker, "Single and Multi Mode Cavities"

Fu Li, "Control of Vortex Shedding Behind A Circular Cylinder"

Juan Gomez, "Burke Schumann Diffusion Flames"

Raymond Addabbo, "Stability of Laminar Flames"

Urmi Ghosh-Dastidar, "Correlation Loss Factors in Underwater Signal Processing"

Eliana Antoniou, "Near Stoichiometric Flames"

Knograt Savettaseranee, "Stability of Liquid Jets"

Said Kas-Danouche, "Interfacial Hydrodynamics of Annular Films"

Jerry Chen, "Analysis of Discrete Dynamical System Models for Interacting Species—Competition Model"

Lyudmyla Barannyk, "Symmetry Reducation and Invariant Solutions of Equations of Mathematical

Physics"

Adrienne James, "Synoptic Changes"

Stephen Kunec, "The Method of Averaging: Perturbation Techniques for Dynamical Systems"