1988 SIAM Annual Meeting
JULY 11–15, 1988
Hyatt Regency Hotel, Minneapolis, Minnesota

And Short Course on Nonlinear Dynamics, Chaos, and Bifurcations
JULY 10, 1988

CONFERENCE THEMES
Computational Science
Chaotic Behavior and Nonlinear Systems
Computer Science
Signal Processing
Nonlinear Fluid Dynamics
Graph Theory
Image Compression
Parallel Processing
Materials Science
Numerical Analysis
Computer Impact on Mathematics
Mathematics of the Biological and Medical Sciences
Wave Propagation
Dynamical Systems and Fractals
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ORGANIZING COMMITTEE

Donald G. Saari, Chair
Northwestern University

Joseph W. Jerome
Northwestern University

Willard Miller, Jr.
University of Minnesota

Francis Sullivan
National Bureau of Standards

James A. Yorke
University of Maryland

LATE CONTRIBUTIONS

SIAM will accept late contributed presentations and poster presentations for this meeting. To make a contribution, please call or write for an abstract form to: Conference Coordinator, SIAM, 117 S. 17th Street, 14th Floor, Philadelphia, PA 19103. Telephone: (215) 564-2929. Contributions must be received by May 25th, in order to appear in the final program. SIAM will consider contributions until June 21st, but those received after May 25th, will be listed in an addendum to the final program based on the availability of both time and space.

SHORT COURSE

Short Course on Nonlinear Dynamics, Chaos, and Bifurcation
July 10, 1989
Hyatt Regency Hotel
Nicolete D-2

Scientists are now realizing that nonlinear dynamics has a wide variety of strange phenomena that are broadly applicable in virtually all realms of science. This series of tutorial lectures, presented by John Guckenheimer of Cornell University and James Yorke of the University of Maryland, will introduce some of these typical dynamical features and show their application to selected systems. The emphasis will be on bifurcation—how asymptotic behavior of trajectories changes as parameters are varied in the definition of the system—and chaos—the occurrence of trajectories whose asymptotic behavior is aperiodic. The types of attractors which occur in systems: fixed, periodic, quasi-periodic, and chaotic will be described. The fractal structure of chaotic attractors and ways of quantifying it will be introduced. Bifurcation scenarios that portray the typical way that these attractors change will be discussed. Attention will be drawn to the routes to chaos, regular dynamics becomes chaotic, and to crises, bifurcations that signal dramatic changes in the basins of attraction. The role of symmetry in bifurcation theory will be introduced and discussed in relation to dynamical systems derived from partial differential equations.

There will be six hours of presentation plus discussion.

PROGRAM

9:00 AM  Elementary Bifurcations of Dynamical Systems
          John Guckenheimer

10:30 AM  Coffee and Discussion

11:00 AM  Chaotic Dynamics
          James A. Yorke

12:30 PM  Lunch and Discussion

2:00 PM  Routes to Chaos
          John Guckenheimer

3:30 PM  Coffee and Discussion

4:00 PM  Fractal Dimension and Attractors
          James A. Yorke

5:30 PM  Discussion

6:00 PM  Adjournment

Registration Fees*

<table>
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<tr>
<th></th>
<th>SIAM Member</th>
<th>Non Member</th>
<th>Student</th>
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<tr>
<td>Advance</td>
<td>$ 95</td>
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<tr>
<td>On-Site</td>
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<td>$75</td>
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*Registration Fee for the Short Course includes preprints, coffee, and lunch.

Attendees should pre-register for the short course, as on-site registration cannot be guaranteed. Preprints of the lecture materials will be distributed upon check-in at the registration desk.

SPECIAL SESSIONS

THE JOHN VON NEUMANN LECTURE

Wednesday, July 13/2:00 PM
Chair: C. W. Gear
University of Illinois, Urbana-Champaign
Business and Pleasure with Stiff Differential Equations

Stiff initial value problems for ODE’s are characterized by numerical instabilities that prevent the use of an explicit method with a step size that is commensurate with the global behavior of the solution. Typical examples are systems that describe simultaneous processes with widely differing time constants where some rapidly changing components tend to blend quickly with slower ones. Chemical kinetics offer many examples of this kind. But there are others, such as, for example, ODE systems that result when an initial value problem for a PDE is discretized in space. Singular perturbation problems also lead to stiff ODE’s. The search for accurate numerical methods with adequate stability properties leads to rather pleasant questions in classical analysis. In the 1960’s the first general methods for stiff problems were developed and applied to problems that had defied solution by traditional methods. In these methods, the step size could sometime be increased successfully by several powers of 10, but at every step an algebraic system has to be solved by a modified Newton method that demands much storage and requires lots of computing time.

The speaker will address recent efforts in the search for alternative iterative techniques and describe the progress that has been made in finding various shortcuts that exploit the properties of systems found in important classes of applications.

Germund G. Dahlquist
Royal Institute of Technology
Stockholm, Sweden

ICEMAP Session

Monday, July 11/2:00 PM
Chair: Judith Sunley
National Science Foundation

ICEMAP (the Interagency Committee for Extramural Mathematics Programs) is a group that provides loose coordination of Federal funding for research in the mathematical sciences at academic institutions. This session is designed to inform attendees about the nature of support available (including anticipated budgets for the several agencies and types of awards for which one can compete); scientific areas of emphasis; and plans for the future. Questions from the audience are encouraged, particularly those concerned with issues relevant to the community as a whole. Representatives of the agencies will be available to talk with individuals about their particular concerns at various times during this meeting.

PROGRAM DESIGN: TOM JACKSON
CENTENNIAL LECTURES

America celebrates 100 years of U.S. mathematics with a program of lectures designed to highlight a century of American mathematics inspired by real world problems.

Centennial Lecture 1
Tuesday, July 13/2:00 PM
Applied Mathematics and Scientific Computing: Pioneers, Puzzles, Prospects

During the past century, there have been remarkable developments in both applied mathematics and scientific computing, many of which were stimulated by seminal work of American mathematicians. The rapid development of large-scale digital computing over the past half century owes its genesis in large part to the work of mathematicians. The parallel development of numerical analysis and asymptotic methods, as well as their applications to continuum dynamics problems, have opened new vistas for science. All of these developments have had a profound impact on both the applied mathematics community in the United States industry, other disciplines, and society. The role of key individuals, including von Neumann, Gibbs, von Kármán, Courant, and others, cannot be underestimated.

In this talk we shall trace some of the significant advances made in applied mathematical analysis, computational algorithms and computer design through the past century. We shall look at the crucial role played by several key pioneers in the development of these fields and see how they developed new approaches and techniques to solve the problems which faced them. The range of challenging puzzles presented by the diverse branches of applied mathematics and scientific computing in our own time will be described, and an attempt will be made to forecast the kinds of developments that will play an increasing role in the future.

Steven A. Orszag
Princeton University

Centennial Lecture 2
Wednesday, July 13/9:00 AM
The Emergence of Numerical Optimization

The mathematics problem area using up most of the world’s computer time, according to a statement made by Lovasz in 1985, is numerical optimization. Business, industry, the space program — all depend heavily on mathematical models from linear programming, nonlinear programming, and control theory.

Continuous numerical optimization is an active, exciting, and large part of today’s world of engineering and scientific computing. It affects our lives in many diverse ways. The speaker will trace the historical development of numerical optimization and identify what we consider to be ideas and significant contributions. Our thesis will be that while the bulk of activity in numerical optimization has occurred in the wake of solving the introduction of the simplex algorithm in the late 1940s, many of our contemporary tools, including the Karmarkar projective scaling transformation, have roots in the classical calculus of variations.

This close tie particularly bolters the theme of “100 years of American Mathematics,” since in the first part of the century, American mathematicians contributed significantly to the theory of the calculus of variations, while in the last 30 years or so, American mathematics has played a major role in numerical optimization.

Richard Tapia
Rice University

PRIZE PRESENTATIONS

Wednesday, July 13/3:00 PM
The George B. Dantzig Prize

The prize is awarded jointly by the Mathematical Programming Society (MPS) and SIAM. It is awarded for original work which by its breadth and scope constitutes an outstanding contribution to the field of mathematical programming.

The Dantzig Prize is awarded every three years and, while normally presented at the international Symposium of MPS, it will be awarded for the first time at a SIAM meeting.

The Richard C. DiPrima Prize

The Richard C. DiPrima Prize was established in 1986 to commemorate a former president of SIAM who also served for many years as a member of the SIAM Council and Board of Trustees, as Vice President for Programs, and as a dedicated and committed member.

The prize is awarded to a young scientist who has done outstanding research in applied mathematics and who has completed his/her doctoral dissertation and completed all other requirements for his/her doctorate during the period running from three years prior to the award date. This will be the first award of this prize which is scheduled to be given every even year.

Mathematical Contest in Modeling

The SIAM-cosponsored Fourth Mathematical Contest in Modeling was held in February, with teams of three undergraduates devoting a weekend to modeling either of two applied problems. From among the teams judged outstanding, two SIAM graders selected one for a SIAM Award in special recognition of the quality of the team’s solution. This award thus honors three students for excellence in collaborative mathematical modeling.

1988 SIAM ANNUAL BUSINESS MEETING

The annual business meeting of SIAM will be held on Wednesday, July 13th, at 3:30 PM in Nicotet Ballroom C-1.

This annual meeting is held for YOU, the members of SIAM, to afford you the opportunity to meet face-to-face with the officers you have elected to serve you. You will be apprised of SIAM’s financial status, hear about our past successes, and be asked to participate in the future direction of our society.

The meeting will benefit all of us. We urge you to attend.
INVITED PRESENTATIONS

Monday, July 118:30 AM
Invited Presentation 1
Chaos, Strange Attractors, and Fractal Basin Boundaries in Nonlinear Dynamics
Even relatively simple deterministic systems can behave in an apparently unpredictable, erratic manner. This type of behavior is one of the attributes of chaotic dynamics. Within the last decade there has been an explosion of interest, and major developments have taken place in the field. Examples of areas where chaotic dynamics have been applied have included the scientific outlook include meteorology, ecology, fluid mechanics, chemistry, physics, engineering, economics, to name just a few. The common element in all of these fields is that chaos is expected to develop whenever nonlinearity plays a role. Since nonlinearity is inherent in so much of science and technology, an understanding of chaos is essential.

The speaker will present a review of the field of chaotic dynamics of dissipative systems, including recent developments. Topics to be covered include strange attractors, homoclinic orbits, and the role chaos plays in the study of the system parameter, universality, fractal basin boundaries and their effect on predictability, and applications to physical systems.

Cesare Grebogi
University of Maryland, College Park

Tuesday, July 12 8:30 AM
Invited Presentation 3
Stability Analysis in Free Boundary Problems in Materials Science
For several decades, there has been an ever-intensifying interest by physical scientists and applied mathematicians in certain free boundary problems that arise in the context of materials science. These problems generally arise in the context of phase transformations and are generalizations of the classical Stefan problem, which one seeks to describe the position of the free, isothermal boundary that separates a pure crystal from its melt during solidification. In these generalized problems, the free boundary is no longer isothermal but, instead, has a temperature that depends on its local curvature (capillary effect due to surface tension). Moreover, for alloys, both thermal and solutal fields govern the process. Such problems are intrinsically two- or three-dimensional, and the shape of the boundary (not just its position) is paramount. From linear perturbation theory, it is known that such shapes are subject to instabilities, so-called morphological instabilities.

The speaker will discuss the manner in which both analytical and numerical techniques have been used to deepen an understanding of both steady-state and time-dependent shapes that occur in the nonlinear regime subsequent to morphological instability.

Robert F. Sekerka
Carnegie Mellon University

Thursday, July 14 8:30 AM
Invited Presentation 5
Grand Challenges to Computational Science
Over the last four hundred years, scientists have learned how to design powerful scientific instruments like the microscope and telescope and to use them to make startling discoveries many orders of magnitude beyond the reach of the naked eye. The supercomputer is a new kind of scientific instrument with which the most spectacular discovery still lies very much in the future. Much attention is focused now on how to complete the design of this new scientific instrument and learn how to use it so that scientific breakthroughs are achieved. An area of very major importance for supercomputing is algorithm development enabling the limited computational capability of today's supercomputers to generate accurate and reliable results for scientific problems of great complexity. Breakthroughs in traditional numerical analysis areas like linear matrix operations, are not enough and collaborations between numerical analysts, and other mathematicians and scientists, will be needed to resolve the algorithmic bottlenecks. The speaker will discuss a number of scientific "grand challenge" areas where supercomputer in future will produce results fully as astonishing as the most powerful microscopes and telescopes once these algorithmic and other bottlenecks are resolved.

Kenneth G. Wilson
Cornell University

Solutions and Nonlinear Waves in Optics
Nonlinear optics is a relatively new subject because nontrivial interaction between light and matter requires large intensities over relatively narrow bands of frequency. This talk will survey the Maxwell-Bloch equations, the equations of motion for light-matter dynamics, and introduces some of the exciting new developments connected with nonlinear wave propagation in fibers and waveguides, Sheel's laws in nonlinear dielectrics, optical bistability in ring and Fabry-Perot cavities, Raman and Brillouin scattering, four-wave mixing, phase conjugation, multmode and soliton lasers. One or two models will be discussed in detail. A key message is that optics provides a rich source of stimulating problems for the applied mathematician, problems that are intellectually challenging, theoretically promising and, above all, problems that display the fascinating behavior of nonlinear partial differential and difference equations.

Alan Newell
University of Arizona

Wednesday, July 13 8:30 AM
Invited Presentation 2
The Mathematical Theory of the Crystallographic Phase Problem
The X-ray analysis of crystal structure may be viewed as a two-dimensional problem in which the three-dimensional structure of a crystal is to be reconstructed from the results of an X-ray diffraction experiment. The intensities of the scattered beams which can be measured in such an experiment is essentially the squared modulus of the Fourier coefficients associated to the triple-periodic electron density distribution in the crystal. Unfortunately the corresponding phases cannot be measured, yet they must be restored by some means before the desired picture of the crystal structure can be obtained by Fourier synthesis. This constitutes the "Phase Problem" of X-ray crystallography.

Because of the extreme practical importance of its solution, the Phase Problem has been of constant attack for over half a century, but there is still no generally applicable method for solving it. Its recalcitrant nature derives from the fact that it is mathematically indeterminate unless sufficient chemical information is brought to bear on its solution to constrain it down to a reasonably unique answer, while the content of this chemical information cannot be adequately captured by any of the well-developed instruments of mathematics. The various techniques available at present to circumvent it all have their limitations, and are a constant source of difficulties.

The speaker will review the mathematical aspects of the theory of the Phase Problem aimed at providing a new solution strategy. He will also examine the computational requirements of present and foreseeable developments in this field, and in particular the design of superfast Fourier transform algorithms optimally adapted to crystallographic symmetry groups.

Gerard Bricogne
L.U.R.E. (Synchrotron Radiation Laboratory) University of Paris, France
**MEETING HIGHLIGHTS**

### MINISYMPOSIA

1. **Mathematical Aspects of Computational Image Analysis**
   Donald E. McClure, Brown University

2. **Mathematical Models of Phase Transition and Growth Phenomena In Statistical Physics and Materials Science**
   Francis Sullivan, National Bureau of Standards

3. **Mathematical Epidemiology**
   Carl P. Simon, University of Michigan, Ann Arbor

4. **Chaotic Dynamics and Fractals**
   Michael F. Barnsley, Georgia Institute of Technology

5. **Combinatorial Optimization**
   Clyde Monma, Bell Communications Research

6. **Performance Evaluation and Benchmarking**
   Jack J. Dongarra, Argonne National Laboratory

7. **Material Science and Applied Mathematics**
   H. T. Rao, Northeastern University

8. **How The Computer Will Influence Mathematics**
   Richard McGehee, University of Minnesota, Minneapolis

9. **Mathematical Models Of Phase Transition And Growth Phenomena In Statistical Physics And Material Science**
   Geoffrey McFadden, National Bureau of Standards

10. **Computational Methods For Nonlinear Reaction, Diffusion, Convection Systems Of Partial Differential Equations**
    Joseph Jerome, Northwestern University

11. **Waves In Elastic-Plastic Solids**
    John A. Trangenstein, Lawrence Livermore National Laboratory

12. **New Directions For The Shannon Sampling Theorem**
    Gilbert G. Walter, University of Wisconsin, Milwaukee

13. **Numerical Grid Generation; Mathematical Aspects**
    Stanly Steinberg, University of New Mexico

14. **Nonlinear Oscillations and Excitability In Cell Physiology**
    John Rinzel, National Institutes of Health

15. **Mathematics and Applications of Inverse Problems and Imaging**
    Mostafa Kaveh, University of Minnesota, Minneapolis

16. **Computer Aided Proofs In Analysis**
    Kenneth R. Meyer, University of Cincinnati

17. (Title and chair to be announced in final program)

18. **1988 Mathematical Contest In Modeling, Including SIAM-Award Winners**
    James Daniel, University of Texas, Austin

19. **Expander Graphs And Their Applications**
    Joel Friedman, Princeton University

20. **Parallel Processing, Distributed Computing And Economics**
    Stanley Reiter, Northwestern University

21. **p and h-p Versions Of Finite Element Methods In Computational Solid Mechanics**
    Soren Jensen, University of Maryland, Baltimore County

22. **Splitting Methods In Wave Propagation Problems**
    Robert J. Krueger, Iowa State University

23. **Zero-Crossings and Nonuniform Sampling Of Signals And Systems**
    Farokh Marvasti, Illinois Institute of Technology

24. **Numerical Grid Generation; Mathematical Aspects**
    Jose E. Castillo, San Diego State University

25. **Spectral Methods In Computational Fluid Mechanics**
    Soren Jensen, University of Maryland, Baltimore County

26. **Theoretical, Experimental, and Computational Aspects of Viscous, Free-Surface Flows**
    W. G. Pritchard, Pennsylvania State University

27. **Association Schemes**
    Dennis W. Stanton, University of Minnesota, Minneapolis

28. **Applications Of Asymptotic Techniques To Stochastic Processes**
    James McKenna, AT&T Bell Laboratories

29. **Bringing MASYSY1 Into The Mainstream Of Applied Mathematics**
    Richard Petti, Symbolics, Inc.

30. **Numerical Device And Process Modelling For VLSI Systems**
    William M. Coughran, Jr., AT&T Bell Laboratories

31. **Algorithms For The Algebraic Eigenvalue Problem On Parallel Architectures**
    Patricia J. Eberlein, SUNY Buffalo

32. **Theory And Computational Of Defects In Continuous Media**
    David Kinderlehrer, University of Minnesota, Minneapolis

33. (Title and chair to be announced in final program)

### SPECIAL EVENTS

**Welcoming Reception**
Sunday, July 10, 8:00 PM–10:00 PM
Niccollet D1-D2
Cash bar

**Beer Party**
Monday, July 11, 8:00 PM–8:00 PM
Exhibit Hall
The beer party will consist of pizza, baked potato skins with choice of toppings, beer and assorted sodas.
Cost $15.00

**Buffet Dinner and Mississippi River Boat Cruise**
Wednesday, July 13, 6:30 PM–9:30 PM
Boon Island, Minneapolis, MN
Enjoy a relaxing river cruise and buffet dinner aboard the Anson Northrup River Boat. The old fashion side wheeler will cruise through the locks of St. Anthony’s Falls and down the Mississippi River between the twin cities of St. Paul and Minneapolis. We will also cruise by the Old Showboat Landing at the University of Minnesota and the wood cliffs along the river banks. Between 6:30 PM and 7:30 PM enjoy a cocktail at one of the two full service bars on board the Anson Northrup where you can purchase the cocktail of your choice. At 7:30 PM we will be seated for a buffet dinner consisting of both baked bread of chicken and prime filet mignon, assorted salads, vegetables, baked potato and an assortment of desserts. There will also be red and white wine served with dinner. Buses will leave the hotel lobby at 5:45 PM.
Cost $28.00

### PREPRINTS TABLE

SIAM has reserved a table in the book exhibit area for those attendees who wish to share new results or ideas with other participants at the meeting. We encourage you to bring copies of your work to the meeting and make them available to those who may be interested. No advertisements or promotions, please.
**Saturday, July 9/PM**
5:00 PM/Nicollet Promenade
Registration opens for Short Course
9:00 PM/Nicollet Promenade
Registration closes

**Sunday, July 10/AM**
8:00 AM/Nicollet Promenade
Registration opens for Short Course
9:00 AM/Nicollet D-2
Elementary Bifurcations of Dynamical Systems
John Guckenheimer
Cornell University
10:30 AM/Nicollet D-1
Coffee
11:00 AM/Nicollet D-2
Chaotic Dynamics
James A. Yorke
University of Maryland, College Park

**Monday, July 11/AM**
7:15 AM/Nicollet Promenade
Registration opens
8:15 AM/Nicollet C-1
Opening Remarks
8:30 AM/Nicollet C-1
Invited Presentations 1 and 2
Chair: Donald S. Scarf
Northwestern University
8:30 AM
Chaos, Strange Attractors, and Fractal Basin Boundaries in Nonlinear Dynamics
Celso Grebogi
University of Maryland, College Park
9:15 AM
The Mathematical Theory of the Crystallographic Phase Problem
Gerard Bricogne
University of Paris, France
10:00 AM/Exhibit Hall
Coffee
10:30 AM
CONCURRENT SESSIONS

**MINISYMPOSIUM 1/Nicollet D-2**
Mathematical Aspects of Computational Image Analysis
Chair: Donald E. McClure
Brown University

**MINISYMPOSIUM 2/Nicollet C-1**
Mathematical Models of Phase Transition and Growth Phenomena in Statistical Physics and Materials Science 1
Chair: Francis Sullivan
National Bureau of Standards

**MINISYMPOSIUM 3/Nicollet D-3**
Mathematical Epidemiology
Chair: Carl S. Simon
University of Michigan, Ann Arbor

**CONTRIBUTED PRESENTATIONS 1/Greenway B**
Theory of Partial Differential Equations
Contributed Presentations 1/Greenway B
Finite Element Techniques
Contributed Presentations 3/Nicollet D-1
Optimization and Control

**Sunday, July 10/PM**
12:30 PM/Nicollet B-1 and C-1
Lunch
2:00 PM/Nicollet D-2
Routes to Chaos
John Guckenheimer
Cornell University
3:30 PM/Nicollet D-1
Coffee
4:00 PM/Nicollet D-2
Fractal Dimensions and Attractors
James A. Yorke
University of Maryland, College Park
5:30 PM/Nicollet D-2
Discussion
6:00 PM/Exhibit Hall
Registration opens for Meeting
6:00 PM/Nicollet D-1 and D-2
Welcoming Reception
9:00 PM/Nicollet Promenade
Registration closes

**Monday, July 11/PM**
12:30 PM
Lunch
2:00 PM/Nicollet C-1
ICEMAP Session (the Interagency Committee for Extramural Mathematics Programs)
Chair: Judith S. Sunley
National Science Foundation
3:00 PM/Exhibit Hall
Coffee
3:30 PM
CONCURRENT SESSIONS

**MINISYMPOSIUM 4/Nicollet D-3**
Chaotic Dynamics and Fractals
Chair: Michael Barnsley
Georgia Institute of Technology

**MINISYMPOSIUM 5/Nicollet D-2**
Combinatorial Optimization
(Sponsored by the SIAM Activity Group on Discrete Mathematics)
Chair: Clyde Monma
Bell Communications Research

**MINISYMPOSIUM 6/Nicollet C-1**
Performance Evaluation and Benchmarking
(Sponsored by the SIAM Activity Group on Supercomputing)
Chair: Jack Dongarra
Argonne National Laboratory

**MINISYMPOSIUM 7/Nicollet D-1**
Materials Science and Applied Mathematics
Chair: R. Tao
Northeastern University

**CONTRIBUTED PRESENTATIONS 4/Greenway C**
Analysis 1

**CONTRIBUTED PRESENTATIONS 5/Greenway A**
Matrices and Linear Algebra

**CONTRIBUTED PRESENTATIONS 6/Greenway B**
Mathematics in Medicine
6:00 PM/Exhibit Hall
Bear Party
<table>
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<tr>
<th>Tuesday, July 12/AM</th>
<th>Tuesday, July 12/PM</th>
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<tr>
<td>8:30 AM/Nicollet C-1 Invited Presentations 3 and 4 Chair: Francis Sullivan National Bureau of Standards</td>
<td>12:30 PM Lunch</td>
<td>9:00 AM/Nicollet C-1 Centennial Lecture 2 The Emergence of Numerical Optimization Richard Tapia Rice University</td>
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<tr>
<td>8:30 AM Stability Analysis in Free Boundary Problems in Materials Science Robert F. Sekara Carnegie Mellon University</td>
<td>2:00 PM/Nicollet C-1 Centennial Lecture 1 Applied Mathematics and Scientific Computing: Pioneers, Puzzles, Prospects Steven Orszag Princeton University</td>
<td>10:00 AM/Exhibit Hall Coffee</td>
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<td>9:15 AM 3d Nonlinear Waves in Excitable Media—Modeling the Heart Muscle Arthur T. Winfree University of Arizona</td>
<td>3:00 PM/Nicollet C-1 Lunch</td>
<td>10:30 AM CONCURRENT SESSIONS</td>
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<td>10:00 AM/Exhibit Hall Coffee</td>
<td>3:30 PM CONCURRENT SESSIONS</td>
<td>Minisymposium 18/Nicollet D-3 Mathematics and Applications of Inverse Problems and Imaging Chair: Mostafa Kaveh University of Minnesota, Minneapolis</td>
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<td>10:30 AM CONCURRENT SESSIONS</td>
<td>Minisymposium 11/Nicollet C-1 Waves in Elastic-Plastic Solids Chair: John A. Trangenstein Lawrence Livermore National Laboratory</td>
<td>Minisymposium 16/Nicollet C-1 Computer Aided Proofs in Analysis Chair: Kenneth R. Meyer University of Cincinnati</td>
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<td>Minisymposium 8/Nicollet D-2 How the Computer will Influence Mathematics Chair: Richard McGehee University of Minnesota, Minneapolis</td>
<td>Minisymposium 12/Nicollet D-2 New Directions for the Shannon Sampling Theorem Chair: Gilbert G. Walter University of Wisconsin, Milwaukee</td>
<td>Minisymposium 17/Nicollet D-2 (Title and chair to be announced in final program)</td>
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<td>Minisymposium 9/Nicollet C-1 Mathematical Models of Phase Transition and Growth Phenomena in Statistical Physics and Materials Science 2 Chair: Geoffrey McFadden National Bureau of Standards</td>
<td>Minisymposium 13/Nicollet D-3 Numerical Grid Generation: Mathematical Aspects 1 Chair: Stanley Steinberg University of New Mexico</td>
<td>Minisymposium 18/Nicollet D-1 1988 Mathematical Contest in Modeling, Including SIAM Award Winners (Sponsored by the SIAM Vice President for College and University Activities) Chair: James Daniel University of Texas, Austin</td>
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<td>Minisymposium 10/Nicollet D-3 Computational Methods for Nonlinear Reaction, Diffusion, Convection Systems of Partial Differential Equations Chair: Joseph Jerome Northwestern University</td>
<td>Minisymposium 14/Nicollet D-1 Nonlinear Oscillations and Excitability in Cell Physiology Chair: John Rinzel National Institutes of Health</td>
<td>Contributed Presentations 12/Greenway B General Session</td>
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<td>Contributed Presentations 7/Greenway A Materials Science</td>
<td>Contributed Presentations 10/Greenway B Analysis 2</td>
<td>Contributed Presentations 13/Greenway A Mathematics in Biology</td>
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<td>Contributed Presentations 8/Nicollet D-1 Signal Processing and Data Analysis</td>
<td>Contributed Presentations 11/Greenway A Parallel Algorithms</td>
<td>Poster Session 1/Exhibit Hall</td>
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<td>Contributed Presentations 9/Greenway B Free Surface Problems</td>
<td>Poster Session 2/Exhibit Hall</td>
<td>Wednesday, July 13/PM</td>
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<td>12:30 PM Lunch</td>
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<td>2:00 PM/Nicollet C-1 The John von Neumann Lecture Business and Pleasure with Stiff Differential Equations Germandt G. Dehliqulat Royal Institute of Technology, Sweden</td>
<td>2:00 PM/Nicollet C-1 Prize Presentations The George B. Dantzig Prize The Richard C. DiPrima Prize The 1988 Mathematical Contest in Modeling Award</td>
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<td>3:30 PM/Nicollet C-1 1988 SIAM Business Meeting</td>
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<td>5:30 PM/New Hall Lobby Buses leave for Mississippi River Boat Cruise and Dinner</td>
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### Thursday, July 14/AM

- **8:30 AM** | **Nicollet C-1**  
  *Invited Presentations 5 and 6*  
  Chair: Willard Miller, Jr.  
  University of Minnesota

- **8:30 AM** | **Grand Challenges to Computational Sciences**  
  Kenneth G. Wilson  
  Cornell University

- **9:15 AM** | **Solitons and Nonlinear Waves in Optics**  
  Alan Newell  
  University of Arizona

- **10:00 AM** | **Exhibit Hall**  
  Coffee

### Thursday, July 14/PM

- **12:30 PM** | **Lunch**

- **2:00 PM** | **CONCURRENT SESSIONS**  
  *Minisymposium 10/Nicollet D-3*  
  Expander Graphs and Their Applications  
  Chair: Joel Friedman  
  Princeton University

- **3:00 PM** | **Exhibit Hall**  
  Coffee

### Friday, July 15/AM

- **8:30 AM** | **Nicollet C-1**  
  *Invited Presentations 7 and 8*  
  Chair: Joseph W. Jerome  
  Northwestern University

- **8:30 AM** | **Mathematical Problems Associated with the Elasticity of Fluids**  
  Daniel Joseph  
  University of Minnesota, Minneapolis

- **9:15 AM** | **Adaptive Computational Methods**  
  James G. Glimm  
  Courant Institute of Mathematical Sciences  
  New York University

### Friday, July 15/PM

- **12:30 PM** | **Lunch**

- **2:00 PM** | **CONCURRENT SESSIONS**  
  *Minisymposium 3/Nicollet D-2*  
  Numerical Device and Process Modeling for VLSI Systems  
  Chair: William M. Coughran, Jr.  
  AT&T Bell Laboratories

- **4:00 PM** | **Meeting Adjourns**
MINISYMPOSIA

Monday, July 11/10:30 AM
Minisymposium 1/Nicollet D-2

MATHMATICAL ASPECTS OF COMPUTATIONAL IMAGE ANALYSIS

The goals of computer methods for analyzing digital pictures range from "low level" image processing (for example, image restoration) to "high level" problems such as scene analysis and computer vision (for example, invariant recognition of objects). Increasingly, the methods and algorithms for performing these analyses are guided by mathematical concepts and models. Recently, connectionist models (neural networks) and Markov random fields have been prominent in this context. In return, the problems of image processing and computer vision are stimulating the development of new mathematics, for example, to better understand the behavior of algorithms for global optimization of objective functions on very high-dimensional domains. In this minisymposium, we will highlight selected interactions between mathematics and applications to image analysis.

Organizer: Donald E. McClure
Brown University

A Relational Approach to Object Recognition
Elie Bienenstock
Université Paris-Sud, France

Asymptotic Behavior of Simulated Annealing
Chi-Ruey Hwang
Academia Sinica, Taiwan

Recursive Stochastic Minimization Algorithms
Sanjoy K. Mitter, Massachusetts Institute of Technology, and Saul B. Gelfand, Purdue University, West Lafayette

Monday, July 11/10:30 AM
Minisymposium 2/Nicollet C-1

MATHMATICAL MODELS OF PHASE TRANSITION AND GROWTH PHENOMENA IN STATISTICAL PHYSICS AND MATHEMATICAL SCIENCES — I

Phase transition and growth phenomena occur in many real-world applications, including alloy solidification and domain separation. Associated mathematical problems are often modeled by stochastic processes and phase transitions. Among the recent results is the remarkable discovery that the same growth law is obtained from several seemingly completely different mathematical models. This minisymposium will include a discussion of various approaches and the relations among them. There will also be reports of recent theoretical and computational work on related problems.

Organizers: Francis Sullivan (Chair) and Geoffrey McFadden, National Bureau of Standards, Gaithersburg, MD

Monte Carlo Study of Spinodal Decomposition in the Two-Dimensional Kinetic Ising Model
Jacques Amar
National Bureau of Standards, Gaithersburg, MD

Domain Growth and Remnant Magnetization
Decay in Spin Glasses
David Hughes
AT&T Bell Laboratories

Numerical Simulation of Morphological Development During Ostwald Ripening
Geoffrey McFadden
National Bureau of Standards, Gaithersburg, MD

Ostwald Ripening in Systems Which Transform by the Transport of Heat and Mass
Peter W. Voorhees
Northwestern University

Stress Corrosion
William C. Johnson
Carnegie-Mellon University

Monday, July 11/10:30 AM
Minisymposium 3/Nicollet D-3

MATHMATICAL EPIDEMOLOGY

Mathematical models of the dynamics of the spread of disease have led to a better understanding of how biological and sociological mechanisms influence disease spread, to more effective comparisons among communicable diseases, to the performance of theoretical experiments in an area where actual experiments are not possible for ethical and practical reasons, and to the prediction of the relative merits of different control methods. In some cases, mathematical models have led to successful immunization strategies. On the other hand, as the speakers in this session will show, the models in epidemiology have led to interesting mathematical problems and results in stability, periodicity, structure, and chaotic behavior of dynamical systems.

Organizer: Carl P. Simon
University of Michigan, Ann Arbor

Dynamic Models in Mathematics and Economics
(To be presented by the Organizer)

Periodicity in Epidemiological Models
Herbert W. Hethcote, University of Iowa, Iowa City, and A. Ghosh, Cornell University

Delays and Age Structure in Models of the Spread of AIDS
Kenneth L. Cooke
Pomona College

The Case for Chaos in Childhood Epidemics
William M. Schaffer, and G. L. Truty, University of Arizona, Tucson

Monday, July 11/10:30 AM
Minisymposium 4/Nicollet D-3

CHAOTIC DYNAMICS AND FRACTALS

Randomness, chaotic dynamics, and fractal geometry are related to one another. The relationship between these leads to new mathematical tools for analyzing experimental data and to new parallel algorithms for the analysis and computation of images.

Organizer: Michael F. Barnsley
Georgia Institute of Technology

Mixing Computer Images which are Generated from Orbits of 2-D Markov Chains
Marc A. Berger
The Weizmann Institute of Science

Thermodynamic Formalism for Fully Turbulent Flows
Katsapalli Sreenivasan
Yale University

Sufficiency as Statistical Symmetry
Perai Dieonis
The Science Centre, Cambridge, MA

Recurrent Iterated Function Systems
Michael F. Barnsley and John Eton, Georgia Institute of Technology

Monday, July 11/13:30 PM
Minisymposium 5/Nicollet D-2

COMBINATORIAL OPTIMIZATION
(organized by the SIAM Activity Group on Discrete Mathematics)

In recent years there have been several exciting new developments in the area of combinatorial optimization which bring to bear the tools of mathematics, computer science and operations research. The talks in this session focus on three such areas: (1) New methods for solving linear programming problems; (2) Polyhedral combinatorics for solving large-scale combinatorial problems; and (3) Combining mathematical programming approaches and computational geometry to solve new optimization problems.

Organizer: Clyde Monna
Bell Communications Research

On Maximum Flows in Polyhedral Domains
Joseph S. B. Mitchell
Cornell University

Solving Large O-1 Linear Programming Problems: Some Recent Results
Karla L. Hoffman
George Mason University

A Primal-Dual Interior Point Method for Linear Programming
(To be presented by the Organizer)

The Nonlinear Geometry of Linear Programming
David Baver
Columbia University

Monday, July 11/13:30 PM
Minisymposium 6/Nicollet C-1

PERFORMANCE EVALUATION AND BENCHMARKING
(organized by the SIAM Activity Group on Supercomputing)

Computing power is now a crucial part of many facets of research and engineering. From desktop workstations to supercomputers, scientists rely on computers for their everyday work. But measuring the performance of those computers is an imprecise art at best. The performance of a computer is a function of many interrelated quantities. There is no single approach to evaluation that addresses the requirements of all the communities involved in computer measurement. There is no universal metric of value. This minisymposium will examine the topic of performance evaluation and benchmarking.

Organizer: Jack J. Dongarra
Argonne National Laboratory

Computing Performance in Resource Limited Environments
Kirk Jordan
Exon Research and Engineering Company

Measuring Performance of Parallel Computers
Francis Sullivan
National Bureau of Standards, Gaithersburg, MD

Supercomputer Performance Evaluation
Joanne Martin
IBM Corporation

The Livermore Fortran Kernels Test
Frank McMahon
Lawrence Livermore National Laboratory
MINISYMPOSIA

Monday, July 11/3:30 PM
Minisymposium 7/Nicollet D-1

MATERIALS SCIENCE AND APPLIED MATHEMATICS

This minisymposium offers a survey of recent advances in material sciences as they pertain to applied mathematics. Computer simulations have produced a tremendous impact on material science research. Two speakers will discuss this aspect and present their research results from computer simulation in this field. Meanwhile, people are still looking for analytical solution of physical models. One speaker will discuss his new model and his mathematical techniques. There is a general belief that non-relativistic quantum mechanics is sufficient in material science. However, the recent study of new materials, magneto crystals, shows that only relativistic quantum electrodynamics can explain them. One speaker will discuss this issue for us.

Organizer: R. Tao
Northeastern University

Polarization of Charge Density Waves
J. B. Sokoloff, Northeastern University; and
I. Webman, IBM Bergen Scientific Centre, Norway

Thermal Properties of Fractals
To be presented by the Organizer

Energetics of a Discrete Interface
Qiwei Zhang
Courant Institute of Mathematical Sciences, New York University

Quantum Electrodynamic Aspects of Magneto-Electric Crystals
A. Widom, and Y. Srivastava, Northeastern University

Tuesday, July 12/10:30 AM
Minisymposium 8/Nicollet D-2

HOW THE COMPUTER WILL INFLUENCE MATHEMATICS

Computers are profoundly influencing the ways in which some mathematicians are doing mathematics. Numerical simulations of differential equations have traditionally been the major use of computers in mathematical investigations, but the situation is changing. The use of algebraic manipulators is spreading rapidly. The future promises computer-assisted proofs of theorems; indeed, the early stages have been with us for some time. This minisymposium brings together mathematicians from diverse fields who will describe how they use the computer in their research.

Organizer: Richard McGehee
University of Minnesota, Minneapolis

Minimal Surfaces
Frederick Almgren
Princeton University

(title to be announced)
Dennis Hejhal
University of Minnesota, Minneapolis

Solving Ordinary Differential Equations Symbolically by Computer
Dieter Schmidt
University of Cincinnati

Answering Open Questions with an Automated Reasoning System
Larry Wos
Argonne National Laboratory

Tuesday, July 12/10:30 AM
Minisymposium 9/Nicollet C-1

MATHMATICAL MODELS OF PHASE TRANSITION AND GROWTH PHENOMENA IN STATISTICAL PHYSICS AND MATERIALS SCIENCE—II

Phase transition and growth phenomena occur in many real-world applications, including alloy solidification and domain separation. Associated mathematical problems provide fascinating instances of successful modeling using Monte Carlo Methods and nonlinear PDE's, and of the use of large-scale computations to gain new insights into physical and mathematical questions. Among recent results is the remarkable discovery that the same growth law is obtained from several seemingly completely different mathematical and computational models. This minisymposium will include a discussion of various approaches and the relations among them. There will also be reports of recent theoretical and computational work on related problems.

Organizers: Geoffrey McFadden (Chair) and Francis Sullivan, National Bureau of Standards, Gaithersburg, MD

Field Theory for Growth Kinetics
Gene F. Mazenko
The University of Chicago

Domain Growth in Both the Kinetic Ising and Continuum Langevin Models
J. D. Gunton
Temple University

Scaling in Ordering at Surfaces: Prospects for Experimental Observation
Ted Einstein
University of Maryland, College Park

A General Geometric Model of Coarsening: Mathematical Development—I
Steven Marsh
Rensselaer Polytechnic Institute

A General Geometric Model of Coarsening: Mathematical Development—II
Daniel Zwilinger
The MITRE Corporation, Bedford, MA

Models for Two Solution Crystal Growth Problems
Joseph Fehribach
University of Alabama, Huntsville

Tuesday, July 12/10:30 AM
Minisymposium 10/Nicollet D-3

COMPUTATIONAL METHODS FOR NONLINEAR REACTION, DIFFUSION, CONVECTION SYSTEMS OF PARTIAL DIFFERENTIAL EQUATIONS

Models of biodegradation, petroleum reservoir recovery, and semiconductor simulation are included among the many physical and biological models leading to reaction/diffusion/convection systems of partial differential equations. These systems are characterized by a potential equation for the ambient force field, and conservation equations for the carrier concentrations. Such systems emerge as highly convective, and require numerical methods which reflect this. In recent years, algorithms based on mixed finite element methods, approximate characteristic methods, and Newton/continuation calculus have been introduced. Some of these models and ideas will be discussed in this minisymposium.

Organizer: Joseph Jerome
Northwestern University

Simulation of Flow in Naturally Fractured Reservoirs
Jim Douglas, Jr.
Purdue University

(Titles to be announced)
Joseph Jerome, Northwestern University; and Mary F. Wheeler, Rice University

Tuesday, July 12/10:30 AM
Minisymposium 11/Nicollet C-1

WAVES IN ELASTIC-PLASTIC SOLIDS

The study of waves in elastic-plastic solids is important in a number of applications, such as flow of granular materials, high-speed impact of metals and the design of structures threatened by earthquakes. Plastic yielding leads to a discontinuity of the momentum flux derivative that introduces discontinuities into the characteristic wave structure. Because these discontinuities lead to a variety of very interesting physical effects, the speakers in this minisymposium will present several views of the subject. One of them will discuss conditions under which the flow of granular materials becomes ill-posed, this phenomenon is often associated with shear-banding. Another speaker will present models of the dependence of stress on the strain rate during high-speed loading in metals. Since the solution of Riemann problems is an important step in several numerical methods (such as the random choice method front-tracking and Godunov's method), one of the talks will discuss an analysis of the Riemann problem for von Mises plasticity in metals. The fourth speaker will discuss a characteristic analysis of finite deformation in hypoplastic-plastic solids with thermal effects, in order to apply the higher-order Godunov method, together with an approximate Riemann problem solver.

Organizer: John A. Trangenstein
Lawrence Livermore National Laboratory

Ill-Posedness in the Critical State Theory for Granular Media
E. Bruce Pitman
New Jersey Institute of Technology

Shock Wave Plasticity: Theory and Experimental Results
Davis Loel Tonsa
Los Alamos National Laboratory

The Riemann Problem for Elastic-Plastic Solids
James E. Hammerberg, and Charles H. Neil, Los Alamos National Laboratory

Characteristic Structure of Finite Deformation in Elastic-Plastic Solids
To be presented by the Organizer
Tuesday, July 12/3:30 PM
Minisymposium 12/Nicollet D-2

NEW DIRECTIONS FOR THE SHANNON SAMPLING THEOREM
The original Shannon sampling theorem enables one to recover a (a) band limited signal with finite energy from its values on the integers. A number of extensions have been introduced. These include (i) versions of the theorem applicable to bandlimited signals with infinite energy, (ii) versions with irregular sampling points, (iii) versions with several time like variables, (iv) versions appropriate for signals which are not bandlimited, and (v) stochastic version. In this minisymposium we hope to present a sampling of recent discoveries in these areas.

Organizers: Gilbert G. Walter (Chair), University of Wisconsin, Milwaukee; and Ahmed Zayed, California Polytechnic State University

Prediction Formulas Based on Samples of Bandlimited Signal and Its Derivative
Dale H. Mattox, Medical College of Georgia, Augusta, Georgia
Santa Clara University

Lagrange-Interpolation Associated With Kramer’s and Shannon’s Sampling Theorems
A. Zayed, California Polytechnic State University; G. Hinsen and P. Butzer, Technischen Hochschule Aachen, W. Germany

Nonuniform Sampling Expansions of Two-Dimensional Bandlimited Signals
P. Butzer, and G. Hinsen, Technischen Hochschule Aachen, W. Germany

A Sampling Theorem for Jacobi Transforms
Gilbert G. Walter
University of Wisconsin, Milwaukee

Tuesday, July 12/3:30 PM
Minisymposium 14/Nicollet D-1

NONLINEAR OSCILLATIONS AND EXCITABILITY IN CELL PHYSIOLOGY
Electrical activity plays an important role in the physiological function of various biological cells (neurons, muscle cells, secretory cells...). Such activity frequently involves nonlinear dissipative phenomena, which may be oscillatory, e.g., the cyclic signaling by nerve networks to stimulate muscles for locomotion, or excitable as in the generation of individual nerve impulses for supertreshold conditions. The physiological function often requires the coordination or recruitment of many cells and thereby entails coupling and propagation mechanisms. The mathematical models involve nonlinear ordinary and partial differential equations. These speakers will describe the models from a biophysical vantage point, indicate some of the interesting mathematical problems and techniques which arise, and illustrate the valuable role which modeling has played in understanding how the electrical activity is generated, coordinated, and propagated.

Organizer: John Rinzel
National Institutes of Health

Emergence of Bursting Oscillations in Coupled Insulin-Secreting Cells
Arthur Sherman and John Rinzel, National Institutes of Health; and Joel Keizer, University of California, Davis

Coupled Neural Oscillators
G. Bard Ermentrout
University of Pittsburgh

Slow Passage Through a Hopf Bifurcation: A Memory Effect and Its Dependence on Fluctuations
Steven M. Bader
National Institutes of Health

Behavior of Models of Myelinated Axons
Jonathan Bell
SUNY, Buffalo

Wednesday, July 13/10:30 AM
Minisymposium 15/Nicollet D-2

1989 MATHEMATICAL CONTEST IN MODELING, INCLUDING SIAM-AWARD WINNERS
(Sponsored by the SIAM Vice President for College and University Activities)

SIAM co-sponsors the annual Mathematical Contest in Modeling (MCM), in which teams of three undergraduates develop a mathematical model of an applied problem; teams may devote an entire weekend to the problem, the model, and its analysis, using computers and libraries.

Two SIAM graders selected a SIAM-Award winning team to present its solution in this minisymposium; other excellent solutions will be presented, along with information on the contest itself.

This minisymposium provides an opportunity for SIAM members to recognize outstanding future applied mathematicians and to learn how to stimulate student participation on the MCM at their own institution.

Organizer: James Daniel
University of Texas, Austin

An Introduction to the Mathematical Contest in Modeling
Ben Fusaro
U.S. Military Academy, and Salisbury State College

Solution to a Contest Problem
SIAM Award Winning Teams (3 to be selected)
### MINISYMPOSIA

**Thursday, July 14/10:30 AM**  
**MINISYMPOSIUM 19/Nicollet D-3**  
**EXPANDER GRAPHS AND THEIR APPLICATIONS**  
(Sponsored by the SIAM Activity Group on Discrete Mathematics)

Expander graphs, roughly speaking, are graphs which, for every subset of vertices, A, of a given size, the size of the set of neighbors of A is at least a constant factor greater than A’s. Expansion is useful, for example, to prevent congestion in a communication network. Networks whose underlying graph is an expander can be used for efficient packet routing or telephone communication. Expanders are of theoretical interest because no explicit constructions of optimal expanders are known. One can give (non-explicit) counting arguments to prove the existence of graphs of fixed degree with a certain amount of expansion, but the best known explicit constructions are not known to have as good expansion factors.

Organizer: Joel Friedman  
Princeton University

**Expanders: An Overview**  
(To be presented by the Organizer)

**Quasi-Random Graphs**  
Fan R. K. Chung  
Bell Communications Research

**The Second Eigenvalue of Random Regular Graphs**  
André Broder  
D.E.C. Systems Research Center, Palo Alto

**Eigenvalues and Graph Bisection Problems**  
Ravi Kannan  
Rutgers University

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**Thursday, July 14/10:30 AM**  
**MINISYMPOSIUM 20/Nicollet D-2**  
**PARALLEL PROCESSING, DISTRIBUTED COMPUTING AND ECONOMICS**

Efficient allocation of resources among economic agents requires coordinated action (organizational performance) and depends on information initially dispersed among the agents. The problem is analogous to one of distributed computing, with "agents" = "processors", "initial information" = "distributed data", and "coordinated action" = "value of the function to be computed". Relations between organizational performance, time of computation, and amount of communication required are explored in this minisymposium. Several of the speakers will discuss tradeoffs between the number of (discrete) variables communicated and the accuracy of the computation of the desired action, when the problem is to verify in a decentralized way that a proposed action is the desired one. Other speakers will present study dynamic computational processes for finding desired actions and the study tradeoffs between communication requirements and the time of computations, in one case, and issues of convergence and stability in another.

Organizer: Stanley Reiter  
Northwestern University

**Message Capacity Requirements for Approximate Parallel Verification**  
Leopold Horvitz, University of Minnesota, Minneapolis; and T. Marschak, University of California, Berkeley

**Decentralized Stochastic Adjustment Processes**  
James P. Jordon  
University of Minnesota, Minneapolis

**Economic Organization and Distributed Computing**  
(Due to be presented by the Organizer)

**Computational Complexity and Economics**  
Daniel J. Kleinman  
Massachusetts Institute of Technology

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**Thursday, July 14/10:30 AM**  
**MINISYMPOSIUM 21/Nicollet C-1**  
**p and h-p VERSIONS OF FINITE ELEMENT METHODS IN COMPUTATIONAL SOLID MECHANICS**

The focus of this minisymposium will be extension procedures of the finite element method as applied to solid mechanics. With the p-version the mesh is fixed and higher accuracy is achieved by increasing the polynomial degree p. The h-p version allows in addition mesh refinement. This is the first of two minisymposia on this subject. The second minisymposium is entitled: “Spectral Methods in Computational Fluid Mechanics.”

The four speakers will present the latest advances in this very active field, citing numerous collaborations between researchers in mathematics, engineering, and industry. Both theoretical and computational aspects will be touched.

Organizer: Soren Jensen  
University of Maryland, Baltimore County

**Mathematics of the h-p Version of the Finite Element Method**  
Ivo Babuska  
University of Maryland, College Park

**Industrial Experience with the p-Version of the Finite Element Method**  
Barba A. Szabo  
Washington University, St. Louis

**PROBE-3D Analysis of Solid Structures by the p-Version of the FEM**  
D. A. Dunavant, and Joseph L. Baudrash, Nostic Technologies, St. Louis, MO

**Reliability, Accuracy and Computational Efficiency of a Self-Adaptive Finite Element Scheme for Solution of Problems in Three-Dimensional Elastomechanics**  
Borje Andersson, Urban Falk and Anders Gustavsson, The Aeronautical Research Institute of Sweden

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**Thursday, July 14/3:30 PM**  
**MINISYMPOSIUM 22/Nicollet D-1**  
**SPLITTING METHODS IN WAVE PROPAGATION PROBLEMS**

Wave splitting techniques are being used increasingly as a method for studying propagation and inverse problems. The technique amounts to the introduction of a new basis for the problem such that the dynamics are re-expressed in terms of quantities which are readily observed or controlled, or quantities which are of more fundamental interest or more easily computed than the field variables themselves. In any given problem there may be several appropriate choices of splittings depending on the motivation for studying the problem. In this minisymposium, a number of different wave splitting philosophies and techniques will be presented. These techniques will be applied to vector and/or multidimensional direct and inverse scattering problems, as well as problems involving the exact or approximate determination of fields in a medium.

Organizers: Robert J. Krueger (Chair), Iowa State University; and Vaughan H. Weston, Purdue University, West Lafayette

**Splitting Methods for Wave Equations**  
James Corones  
Iowa State University

**Phase Space Factorization and Functional Integral Methods in Direct and Inverse Scattering**  
Louise Fishman  
Colorado School of Mines

**Splitting and Parabolic Approximation Methods for Surface Water Wave Propagation**  
Vijay G. Panchang  
University of Maine, Orono

**Wave Splitting and Inverse Scattering for the Wave Equation in IR3**  
Vaughan H. Weston  
Purdue University, West Lafayette

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**Thursday, July 14/3:30 PM**  
**MINISYMPOSIUM 23/Nicollet D-3**  
**ZERO-CROSINGS AND NONUNIFORM SAMPLING OF SIGNALS AND SYSTEMS**

This minisymposium offers a survey of zero-crossings and nonuniform sampling of signals and systems with emphasis on the synergy of the two for developing theorems and reconstruction methods. Recent developments in the analysis of single and multidimensional signals, and theorems related to zero-crossings and nonuniform samples will be discussed. Other topics will be spectral estimation, and partial information that can be derived from zero-crossings of one and two-dimensional signals. Related topics, such as reconstruction of two-dimensional signals from a finite number of nonuniform samples by minimizing maximum mean squared error, and some iterative techniques will be discussed by the organizer.

Organizer: Farohk Marvasti  
Illinois Institute of Technology

**Multiple Level Crossings and Reconstruction Schemes for Multi-Dimensional Signals**  
Avida Zaqouh, and Allen Oppenheim, Massachusetts Institute of Technology

**Higher Order Crossings (HOC) Processes**  
Benjamin Kedem  
University of Maryland, College Park

**Time-Sequential Sampling of Time-Varying Multidimensional Signals with an Application to Motion Estimation**  
Jan P. Allebach, and Mohammed Rahgozar, Purdue University, West Lafayette

**Reconstruction of Two-Dimensional Signals From Nonuniform Samples**  
(Due to be presented by the Organizer)
**MINISYMPOSIUM**

**Thursday, July 14/3:30 PM**

**Minisymposium 24/Niccolet D-2**

**NUMERICAL GRID GENERATION; MATHEMATICAL — II**

Numerical grid generation is one of the most important aspects in the numerical solution of partial differential equations on irregular geometries. This topic is of considerable interest to anyone involved in the numerical modeling of complex phenomena, particularly those interested in numerical fluid dynamics. The speakers will address some of the aspects of these methods in order to obtain a better understanding of how they work and what their limitations are.

Organizers: Jose E. Castillo (Chair), San Diego State University, and Stanley Steinberg, University of New Mexico

**Grid Generation on Curves and Surfaces**

Stanley Steinberg, University of New Mexico, and Patrick J. Roache, Eddydynamic Research Associate

**Harmonic Maps in Grid Generation**

Arkady Dvinsky, Creare Incorporated, Hanover, NH

**Variational Surface Grid Generation**

J. Saltzman, Los Alamos National Laboratory

**Surface Grid Generation and Differential Geometry**

Z. U. A. Wara, Mississippi State University

**Friday, July 15/10:30 AM**

**Minisymposium 26/Niccolet D-2**

**THEORETICAL, EXPERIMENTAL, AND COMPUTATIONAL ASPECTS OF VISCOUS, FREE-SURFACE FLOWS**

Scientific issues centering on viscous free-surface flows arise in many contexts, including laying of emulsion on film, aspect of oil recovery, and the design of dies for the extrusion of materials, to mention only a few. The subject has been strongly influenced by experimental work which has led to the discovery of unexpected phenomena, some of which will be featured. Theoretical and experimental aspects of numerical simulation of such flows will also be discussed. These computations are an important tool which relates both to the experimental situations and to analytical discovery. The study of the mathematical problems thrown up by this class of flows is in its infancy, but some results for a simple flow arising in one of the experiments will also be presented.

Organizers: W. G. Pritchard (Chair) and J. L. Bona, Pennsylvania State University

**A Technique for Determining the Boundary Conditions at the Intersection of a Free Surface with a Solid Wall**

E. B. Dussan, Schlumberger-Doll Research Center; E. Ramá, University of Pennsylvania; and G. Geroff, Schlumberger-Doll Research Center

**Computational and Experimental Comparisons of a Perturbed Poiseville-Nusselt Flow**

Simon J. Tavenor, Pennsylvania State University

**Free Boundary Problem for Perturbation of Poiseville-Nusselt Flow**

Frederick A. Berger, Pennsylvania State University

**Stability of Coating Flows**

K. N. Chaudhury and L. E. Scriven, University of Minnesota, Minneapolis

**Analysis of Numerical Methods for Flow with a Free Boundary**

Ridgway Scott, Pennsylvania State University

**Experiments on the Flow of Two Immiscible Liquids**

Daniel J. Joseph, University of Minnesota, Minneapolis

**Saturday, July 15/10:30 AM**

**Minisymposium 28/Niccolet C-1**

**APPLICATIONS OF ASYMPTOTIC TECHNIQUES TO STOCHASTIC PROBLEMS**

For many stochastic models, exact analytic solutions are either impossible to obtain or are extremely difficult to evaluate. In some cases the quantities of interest can be characterized as the solutions of boundary value problems governed by differential or difference equations. Often highly accurate approximate solutions to such problems can be obtained by the use of asymptotic techniques.

Many queueing systems can be characterized by a parameter, that lies between zero and one. Approximate solutions can be obtained when this parameter is either near zero or one. When the parameter is near one the resulting approximation is referred to as the diffusion approximation. Although correction terms to the leading order term are generally unknown, in some situations higher order terms can be obtained.

Recently useful and important approximate solutions have been obtained by very different techniques when the parameter is near zero. New results in this area will be presented. Finally, there are models for which exact solutions exist. Such solutions are extremely difficult to evaluate when some of the parameters become large, but special techniques have proved useful in this case.

Organizers: James McKenna (Chair), AT&T Bell Laboratories; and Bernard J. Matkowsky, Northwestern University

**Applications of Singular Perturbation Techniques in Queueing Theory**

Bernard J. Matkowsky, Northwestern University

**Light Traffic Expansions for Analysis, Design, and Control of Queueing Systems**

Martin I. Reiman, AT&T Bell Laboratories

**Some Topics in Diffusion Approximations**

Charles Knessl, University of Illinois, Chicago

**A New Tree Algorithm for the Calculation of the Partition Function of Some Large Closed Product-Form Queueing Networks**

James McKenna, AT&T Bell Laboratories

**Character Tables of Association Schemes**

Eichi Bannai, Ohio State University, Columbus

**Orthogonal Polynomials of Classical Association Schemes**

(To be presented by the Organizer)

**S-Transitive and Distance Transitive Graphs**

Richard Weiss, Tufts University

**Friday, July 15/10:30 AM**

**Minisymposium 28/Niccolet C-1**
MINISYMPOSIAS

Friday, July 15/10:30 AM
Minisymposium 29/Nicollet D-3

BRINGING MACSYMA INTO THE MAINSTREAM OF APPLIED MATHEMATICS

Just as computers revolutionized numerical analysis, they are now revolutionizing symbolic mathematics, yielding enormous increases in speed, accuracy and modeling power. Improved software technology, plus plunging hardware costs, are thrusting the technology into the mainstream of applied mathematics. After over 150 man-years of development effort, MACSYMA is being extended in new directions, to make it the core of an integrated mathematical computation system. The purpose of this minisymposium is to present the recent progress of MACSYMA toward this goal, and to discuss future directions and user needs.

Organizer: Richard Petti
Symbolics, Inc.

Focusing MACSYMA Development on User Needs
(To be presented by the Organizer)

Recent and Proposed Symbolic Mathematics Enhancements to MACSYMA
Jeffrey P. Golden
Symbolics, Inc.

Implementation of Perturbation Methods for ODEs in MACSYMA
Jonathan L. Len
Symbolics, Inc.

Interfacing MACSYMA With Other Languages
Dan Nguyen
Symbolics, Inc.

Friday, July 15/2:00 PM
Minisymposium 31/Nicollet C-1

ALGORITHMS FOR THE ALGEBRAIC EIGENVALUE PROBLEM ON PARALLEL ARCHITECTURES

The solution of very large matrix eigenvalue problems is recognized to be of major importance in many applications. The speakers will explore the behavior of algorithms for large eigenproblems in a multiprocessing environment. The focus will be on solutions which yield a complete set of eigenvalues and eigenvectors.

Development of various implementation of parallel algorithms is described, and the behavior and comparison of OF-based and Jacobi-like algorithms are presented. Experimental timings, costs, and speedups are given.

Special emphasis is given to the general problem and to the non-symmetric problem since they arise very often in applications such as control theory and signal processing.

Organizers: Patricia J. Eberlein (Chair), SUNY at Buffalo; and Haeusen Park, University of Minnesota, Minneapolis

Finding Eigenvalues and Eigenvectors of Unsymmetric Matrices Using a Distributed-Memory Multiprocessor
G. A. Geist, Oak Ridge National Laboratory; and G. J. Davis, Georgia State University

Parallel Solution of the Eigenproblem on a Hypercube
Daniel Boley, and Robert Maier, University of Minnesota, Minneapolis

Jacobi-Like Algorithms for Non-Symmetric Eigenproblems on Hypercube
Patricia J. Eberlein, SUNY at Buffalo; and Haeusen Park, University of Minnesota, Minneapolis

Friday, July 15/2:00 PM
Minisymposium 33/Nicollet D-1

NUMERICAL DEVICE AND PROCESS MODELING FOR VLSI SYSTEMS

The partial differential equations associated with process and device models arising from VLSI systems are quite difficult to solve. Moreover, the usual drift-diffusion model has recently received competition from more detailed alternatives such as the hydrodynamic mode. In this minisymposium, both the fluid-diffusion and hydrodynamic models will be discussed and a variety of numerical algorithms ranging from new discretization methods to linear and nonlinear iterative methods for solving the discretized problems will be presented. Some open problems in simulating VLSI systems will be described.

Organizer: William M. Coughran, Jr.
AT&T Bell Laboratories

Hyperbolic Waves in the Hydrodynamic Model for Semiconductor Device Simulation
Carl L. Gardner
Duke University

Some Theoretical Aspects of the Discretization of the Semiconductor Equations
Thomas Kerkhoven
University of Illinois, Urbana

Some Computational Aspects of Short Device Simulation
F. Oden and L. Rehny, IBM T. J. Watson Research Center

Numerical Aspects of Process and Device Modeling
R. K. Smith and R. Bank, AT&T Bell Laboratories

Friday, July 15/2:00 PM
Minisymposium 30/Nicollet D-2

THEORY AND COMPUTATION OF DEFECTS IN CONTINUOUS MEDIA

The formation of defect structures and the phase transitions experienced by many materials exemplify the large and dramatic changes in behavior whose control and prediction is assisted by nonlinear theory. Recent work has emphasized the development and implementation of computational methods in conjunction with theory. Sophisticated analyses of nonconvex, constrained, and three-dimensional problems have led to significant advances in the understanding of defect structures in liquid crystals, crystals, and other materials.

The speakers will attempt to give an assessment of developments expected in the near future.

Organizers: David Kinderlehrer (Chair), and Mitchell Luskin, University of Minnesota, Minneapolis

A Nonconvex Variational Problem Related to Change of Phase
Patricia Bauman, and Daniel Phillips, Purdue University, West Lafayette

Fractional Step Methods for Liquid Crystal Problem
Robert Cohen
University of Minnesota, Minneapolis

Relaxation Methods for Liquid Crystal Problems
San-Yih Lin
University of Minnesota, Minneapolis

Parametrized Measures: A Guide to Applications
José P. Matos
University of Minnesota, Minneapolis; and Lisbon Technical University
Monday, July 11/10:30 AM
Contributed Presentations 1/Greenway A

THEORY OF PARTIAL DIFFERENTIAL EQUATIONS

The Number of "Effective Modes" and the Collapsing Tendency of Solutions of the Spherically-Symmetric Nonlinear Schrödinger Equation
Bhimsen K. Shivamoggi and Ram N. Mohapatra, University of Central Florida

Mean Flow - Harmonic Interaction and Hydrodynamic Stability
Kwok Wing Chow, Washington State University

Galerkin Methods for a Singularly Perturbed Hyperbolic Problem with Nonlocal Nonlinearity
Benjamin F. Esham, Jr. and Elizabeth Greenwell Yank, Virginia Commonwealth University

Numerical A Posteriori Proof for the Existence of Some Nonlinear Elliptic Partial Differential Equations
A. Bamberger, Institut Français du Pétrole and Maitre de Recherche a l'École Polytechnique, France

Uniqueness of Recovery of a Discontinuous Conductivity Coefficient
Victor Isakov, Cornell University

Numerical Hyperbolic Conservation Systems in Extended Kinetic Theory
Vincio C. Boffi, University of Bologna, Italy

Monday, July 11/10:30 AM
Contributed Presentations 2/Greenway A

FINITE ELEMENT TECHNIQUES

Exact Non-Reflecting Boundary Conditions
Joseph B. Keller and Dan Givoli, Stanford University

The Local Projection $p^2-p^1$ - Discontinuous-Galerkin Finite Element Method for Scalar Conservation Laws
Guy Chavent, INRIA and Universite Paris-Dauphine, France, and Bernardo Cockburn, University of Minnesota, Minneapolis

A Locally Refined Rectangular Grid Finite Element Method for Arbitrary Geometries. (Part I)
Robin G. Melvin and David P. Young, Boeing Computer Services; John E. Bussolati and Forrester T. Johnson, Boeing Advanced Systems Company; and Satish S. Samant, Boeing Commercial Airplane Company, Seattle

A Locally Refined Rectangular Grid Finite Element Method for Arbitrary Geometries. (Part II)
David P. Young and Robin G. Melvin, Boeing Computer Services; John E. Bussolati and Forrester T. Johnson, Boeing Advanced Systems Company; and Satish S. Samant, Boeing Commercial Airplane Company, Seattle

TVB Runge-Kutta Local Projection Discontinuous Galerkin Finite Element Method for Conservation Laws: One Dimensional Systems
Bernardo Cockburn and San-Yih Lin, University of Minnesota, Minneapolis, and Chi-Wang Shu, Brown University

Divergence Stability of the p-Version of the Finite Element Method for Stokes Equations
S. Jensen, University of Maryland, Baltimore; and M. Vogelius, University of Maryland, College Park

Monday, July 11/10:30 AM
Contributed Presentations 3/Nicollet D-1

OPTIMIZATION AND CONTROL

A New Utility Function Approach to Search Path Design
Edgar A. Cohen, Jr. and John W. Wingate, Naval Surface Warfare Center, Silver Spring

A Numerical Comparison of Optimization Softwares in IMSL, Harwell and NAG Libraries
D. Le, Australian National Science and Technology Organisation, Australia

Sequential Quadratic Programming in Function Spaces
C.T. Kelley and S.J. Wright, North Carolina State University, Raleigh

Towards The Optimal Rendez-Vou of Space Craft: An Application for Telecommunication Systems
M. El-Arabaty, Cairo, Egypt

New Investigations for Modern Pursuit-Evasion Games and Extended Applications
M. El-Arabaty, Cairo, Egypt

L1 Solution of Large-Scale Overdetermined Systems of Linear Equations

Trust Region Algorithms using Inexact Function and Gradient Information
Richard G. Carter, ICASE-NASA Langley Research Center

A Quadratic Programming Implementation for Small Active Set Problems
Paul D. Frank and Michael Healy, Boeing Computer Services, Seattle

Controllability and Spectral Results for a Structurally Damped Euler-Bernoulli Beam
Scott W. Hansen, University of Wisconsin, Madison

Monday, July 11/10:30 AM
Contributed Presentations 4/Greenway C

ANALYSIS 1

A General Theory of Local Lyapunov Exponents
Alp Eden, Indiana University, Bloomington

Composite Functions and Their Taylor Series
Bruce Jeffrey Leyman, Leyman Engineering, West Richland

Nonatomic Neutral Functional Differential Equations as Semigroups on Product Spaces
Janos Turi, Worcester Polytechnic Institute

On Non-Linear Hodge Theory and Applications to Electro- and Magneto-Statics and Gas Dynamics
Rainer H. Picard, University of Wisconsin, Milwaukee

On Balance of Mass Flow with Applications to Simulated Annealing
Tzu-Shuh Chang and Yunhegyow Chow, Academia Sinica, R.O.C.

Invariant Manifold Theorems For the Navier Stokes Equations
S.S. Sritharan, University of Southern California

Distributed Computational Methods
Avin Lin, Temple University

Some Existence Results for Flows of Viscoelastic Fluids with Differential Constitutive Equations
Colette Guillope and Jean-Claude Saut, Universite Paris-Sud and C.N.R.S., France

Monday, July 11/3:30 PM
Contributed Presentations 5/Greenway A

MATRICES AND LINEAR ALGEBRA

Displacement Ranks for Group Matrices
Paul D. Gader, University of Wisconsin, Oshkosh

On the Distinction Between Preconditioning and Reducing the Condition Number
Hillel Tal-Ezer, Brown University

Precision Control and Exception Handling
Thomas E. Hull, University of Toronto, Canada

VLSI Architecture for Toeplitz Principal Component Extractor
Muralidharan Swaminathan and Lokesh Datta, Wright State University, Dayton

Numerical Composition of Centrohermitian Matrices
Lokesh Datta, Wright State University, Dayton

Conditions for Optimality of Performance Indices Defined over the Matrix Spaces
Dan Ionescu, University of Ottawa, Canada

Monday, July 11/3:30 PM
Contributed Presentations 6/Greenway B

MATHMATICS IN MEDICINE

Mathematical Implications of Two Multistage Models of Cancer Induction
Michael Gaffney, Pfizer, New York; and Bernard Altshuler, New York University Medical Center

Solution of a Model of the Mammalian Kidney Using Interactive Continuation: Role of Atrial Natriuretic Factor (ANF) on Urine Formation
Raymond Mebi and Mark A. Knepper, National Institutes of Health

A Mathematical Model of an Electromechanically Coupled Porous Elastic Medium Driven by an Applied Electric Current
Jeffrey R. Sache, University of Tokyo; and Alan J. Goddinsky, Massachusetts Institute of Technology

Modeling Thought Processes in a Brain by Klein-Gordon Equation
Syamala D. Vashishthali, Bell Communications Research, Inc., Piscataway, NJ

Stability Analysis of a Mathematical Model of the Respiratory Control System
Janos Turi and Frederick M. Bennett, Worcester Polytechnic Institute

A Kinetic Model of T-Lymphocyte Interactions with the Human Immune Deficiency (AIDS) Virus (HIV)
John E. Perchier, Richard I. Shrager, James J. Bailey and William L. Jackson, National Institutes of Health

Flow of Red Blood Cells in Capillaries with Near Minimal Diameters
D. Halpern and T.W. Seckm, University of Arizona

Special Notice to Contributed Presentation Authors and Chairman of Contributed Presentation Sessions:
Fifteen minutes are allowed for each contributed presentation. Presenters are requested to spend a maximum of 12 minutes for their presentation, and 3 minutes for questions and answers.

Please note:
For presentations with more than one author, an underline is used to denote the author who will present the paper.
CONTRIBUTED PRESENTATIONS

Tuesday, July 12/10:30 AM
Contributed Presentations 7/Greenway A

MATERIALS SCIENCE

Conservative Configuration Dependent Forces
Dawn Fisher, James Madison University

A Decoupled Approach for the Simulation of Visco-Elastic Fluid Flows
Andre Fortin, Ecole Polytechnique de Montreal, Canada; and Michel Fortin, Univeriste Level, Canada

A Numerical Investigation of Oscillatory Motion in the Zone Refining of Liquid Si
Joseph S. Wilkowski, Manhattan College, Riverdale, and Nicholas D. Kazarzin, SUNY, Buffalo

Modeling the Rayleigh-Taylor Response of Elastic-Plastic Solids
Allen C. Robinson, Sandia National Laboratories, Albuquerque

Exact Numerical Solution of the Reimann Problem for Solids
Charles H. Nell, Los Alamos National Laboratory

Reconstruction of Continuous Material Interfaces from Volume Fraction Data
Gary A. Dills, Los Alamos National Laboratory

On Entropy Generation in Viscous Shear Flows
Joseph C. Kliwicki and John J. McGrath, Michigan State University

Design and Retrofitting of Aluminum Reduction Cells by Numerical Modelling
Essam Eidn Khalil, Cairo University, Egypt

Tuesday, July 12/10:30 AM
Contributed Presentations 8/Nicollet D-1

SIGNAL PROCESSING AND DATA ANALYSIS

The Problem of Interfering Filters
Farokh Marvasti and Llu Chuande, Illinois Institute of Technology

A Two Term Recursion to Generate a Sampled Sinewave and Other Signal Processing Techniques
Budrow Swartzendruber, Department of Defense, Fort George G. Meade

A Recursive Filtering Algorithm for Stochastically Moving Measurement Nodes
C.N. Shen and YeoBing Chen, Renault Polytechnic Institute

Radon Transform Over Finite Fields and its Application to Signal Processing
Izidor Gertner, Technion - Israel Institute of Technology

Compressed Planetary and Lunar Ephemeris
Peter C. Kammeyer, U.S. Naval Observatory, Washington, DC

The Application of a Prolate Spheroidal Function Approximation to Multi-Resolution Pyramid Generation
Todd R. Reed, University of Minnesota, Minneapolis

Convexity for Box Splines
Thomas A. Grandine, Boeing Computer Services Company, Seattle

Tuesday, July 12/10:30 AM
Contributed Presentations 9/Greenway B

FREE SURFACE PROBLEMS

Free Streamline Flows Past Polygonal Obstacles with Double Spiral Vortices
Piero Bassanini, University of Roma, “La Sapienza”, Italy; and Alan Serot, Wichita State University

Comparison of Techniques for Solution of a Free Surface Problem
John E. Molyneux and Fred G. Daddi, Widener University

Numerical Solution of Parabolic Free Boundary Value Problems
Fritz Keinert, University of Utah

Mechanics of Liquid-liquid Contact
H. Oguz and A. Prosperetti, Johns Hopkins University

Solution of a Stefan Problem by Reduction to a Parabolic Inverse Problem
Barbara Bikans and Igor Melnyshchek, San Jose State University

Analytical and Numerical Studies of Liquid Curtains
J.J. Ramos, Carnegie-Mellon University

On the Boundary Integral Formulation of Free Surface Problems
Greig Tryggvason, University of Michigan, Ann Arbor

Tuesday, July 12/12:30 PM
Contributed Presentations 10/Greenway B

ANALYSIS 2

Certain Integrals of Products of Ultraspherical Functions
Mirl J. Shah, Kent State University, Warren

Following Envelopes of Symmetry-Breaking Bifurcation Points
John H. Bool, Lawrence Livermore National Laboratory

Minimal Representation of Singular System of Differential Equations
Pradeep Misra, Wright State University, Dayton

Solution of Boundary Value Problems by Multi-Dimensional Laplace Transformation Method
R.S. Dahya, Iowa State University

On the Theory of N-Dimensional Laplace Transform and its Application to Boundary Value Problems
Joyvati Deb Nath, University of Wisconsin, River Falls; and Rajbir S. Dahya, Iowa State University

The Initial Value Problem for Fractional Order Differential Equations with Constant Coefficients
Ronald L. Berger, Air Force Institute of Technology

The Computation of Centralizer of Subgroup in the Symmetric Semigroup and an Application
Guangzhou Zhou, University of Arkansas, Fayetteville

Z Transforms in Pseudo Banach Algebras
C.R. Giardina, Mahwah, NJ

Tuesday, July 12/3:30 PM
Contributed Presentations 11/Greenway A

PARALLEL ALGORITHMS

On Parallelization of a Conjugate Gradient Minimization Method
D. Li, Australian Nuclear Science and Technology Organisation, Australia

Parallel Algorithms for Nonlinear Least-Squares Problems
Rodrigo Fontecilla, University of Maryland, College Park

A Parallel Algorithm for Computing the Bidiagonalization of a Rectangular Matrix
Bruce W. Suter, Peng Chai and Charles R. Katholi, University of Alabama, Birmingham

Use of the LR Algorithm to Triagonalize a General Matrix
David S. Watkins and Wenyi Wang, Washington State University

Parallel Implementation of a Block Skyline Solver
Jim Armstrong, CONVEX Computer Corporation, Richardson

A Parallel Algorithm for Computing the L-D-Lt Decomposition of a Symmetric Nonnegative Definite Matrix
Priti Krishnakumar and Bruce W. Suter, University of Alabama, Birmingham

Wednesday, July 13/10:30 AM
Contributed Presentations 12/Greenway B

GENERAL SESSION

Relations and Computability
Lere Shakhunie, Matra Software International, West Germany

Discrete Geometries
Fred B. Holt, Boeing Electronics Company, Seattle

Verification Vision as a Nonlinear Least Squares Problem
Robert R. Goldberg, Queens College of CUNY

The Measure of Complexity in Cellular Automata
Rui M. Dill, CERN, Switzerland

Discipline Related Writing Requirement at Saint Mary’s College
Donald E. Miller, Saint Mary’s College, Notre Dame, IN

Wednesday, July 13/10:30 AM
Contributed Presentations 13/Greenway A

MATHEMATICS IN BIOLOGY

A Comparison of Dispersal Strategies for Survival of Spatially Heterogeneous Populations
Douglas P. Hardin, Peter Takacs and Glenn F. Webb, Vanderbilt University, Nashville

Critical Patch Size for Discrete Reaction Diffusion Models
Linda J.S. Allen, Texas Tech University, Lubbock

Order Reduction of Higher Order Nonlinear Difference Equations
Weijiang Zhang, Northeastern University

A Numerical Method for the Estimation of Variable Time Delays with Applications to Biology
Katherine A. Murphy, University of North Carolina, Chapel Hill

Population Dynamics With Age Dependence and Diffusion: Localization
Gaston E. Hernandez, University of Iowa

Thursday, July 14/10:30 AM
Contributed Presentations 14/Greenway A

FLUID FLOW AND HEAT TRANSFER 1

Numerical Study of the Stability and the Transition of Pipe Flow, Using a Two-Point Boundary Value Method
Gerardo A. Acha, Universidad Central de Venezuela

A Probabilistic Model of the Apparent Radiance of a Rough Sea
Richard G. Priest and Ira B. Schwartz, Naval Research Laboratory, Washington, DC

A Fast Solver for Potential Flow in Channels
Leslie Greengard, Yale University

Numerical Solution to a Problem in the Flow of a Viscoelastic Fluid between Rotating Cylinders
Bruce A. Drew, Minneapolis Doralawami

Ramkrishna, Purdue University; and Leon Levine, Leon Levine Associates, Plymouth, MN

Asymptotic Analysis of Volterra Integral Equations: Application to Heat Transfer
D. Glenn Lasseigne, Old Dominion University

The Effects of Compressibility on a Non-orthogonal, Stagnation-point Flow Impinging on a Hot or Cold Isothermal Plate
D. Glenn Lasseigne, Old Dominion University
CONTRIBUTED PRESENTATIONS

Thursday, July 14/10:30 AM
Contribution Presentations 15/Greenway B

REACTION-DIFFUSION AND HEAT CONDUCTION
Fast Reaction, Slow Diffusion, and Flow by Curvature
Jacob Rubinstein, Peter Sternberg and Joseph B. Keller, Stanford University

ECE Versus DISP Electrochemical Competition
Susan Cole and Joseph W. Wilder, Rensselaer Polytechnic Institute

Diffusional/Thermal Instability of a Solid Propellant Flame
Stephen B. Margolis, Sandia National Laboratories; and Forman A. Williams, Princeton University

Detonation Shock Dynamics: Shock-State Dependent Rates
John B. Bardsley, University of California, Santa Barbara; and D. Scott Stewart, University of Illinois, Urbana

Homogenisation Results for Non Linear Heat Conduction Equation in Heterogeneous Media
Michael Artola, Centre d’Etudes Scientifiques de Techniques d’Aquitaine and Universite De Bordeaux 1, France

Inverted Bifurcation Model of Discrete Roll Transitions in Thermal Convection
J.R. Leith, University of New Mexico

Thursday, July 14/10:30 AM
Contribution Presentations 16/Nicollet D-1

WAVE PROPAGATION I

Interfacial Waves Theory for dendritic structure of Needle Crystal
Jian-Jun Xu, USRA/NASA at Marshall Space Flight Center

Free Boundary Conditions of Arbitrary Polygonal Topography in a 2-D Explicit Elastic Finite-Difference Scheme
Ron-Song Jih, Texas A&M University; and Richard Haberman, Southern Methodist University

Evolution Equations for Interfacial Waves in Liquid Crystals
H.C. Morris, Y.K. Kowk and L. Lam, San Jose State University

Time-Dependent Solutions to Nonlinear Wave-Condition Problems in Elasticity
I.S. Goldberg, St Mary’s University, San Antonio; and R.T. Folk, Lehigh University, Bethlehem, PA

Spectral Boundary Integral Method for Gravity-Capillary Waves
William W. Schultz and Jin Huh, University of Michigan, Ann Arbor

Thursday, July 14/3:30 PM
Contribution Presentations 17/Greenway A

NUMERICAL ANALYSIS (ALGEBRA)

Two Parallel Iterative Schemes
Jerard M. Barry, and John P. Pollard, Australian Nuclear Science and Technology Organisation, Australia; and Eugene L. Wachspress, University of Tennessee, Knoxville

Use of Dominated Functions to Find a Bounded Domain Containing all the Roots of a Nonlinear Function
Xingren Ying and I. Norman Katz, Washington University, St. Louis

Rapidly Convergent Hybrid Algorithms for Finding a Zero of a Function
Dalciido Moraes Claudio, Universidade do Rio Grande do Sul, Brazil

On an Equidistant Collocation Method
Natalia Sternberg, Clark University

Solving Multiple Triadiagonal Systems on the Cyber 205
Ronald F. Boisvert, National Bureau of Standards, Gaithersburg

Thursday, July 14/3:30 PM
Contribution Presentations 18/Greenway B

DYNAMICAL SYSTEMS AND CHAOS

Subharmonic Control of the Birth and Death of Chaotic Attractors
Ira B. Schwartz, US Naval Research Laboratory, Washington, DC

Amplitude Modulated Chaos in Harmonically Excited Mechanical Systems
Anil K. Bajaj and Joseph M. Johnson, Purdue University, West Lafayette

Numerical Computation and Continuation of Invariant Manifolds Connecting Fixed Points
Eusebius J. Doedel, California Institute of Technology; and Concordia University, Canada; and Nam S. Kolve, University of Alabama, Huntsville

One-Degree of Freedom Motion Induced by Modeled Vortex Sheddng
Leslie A. Yates, NASA Ames Research Center; and Ayun Ural, US Army Aviation Research and Technology Activity, Michael Stadz and Gary T. Chapman, NASA Ames Research Center

Diffusion Induced Bifurcation of Traveling Waves From Standing Waves in an Excitable Medium
Jack D. Dockery, Utah State University

Irreducible Forms, Invariants and Stability for a System Describing Second Harmonic and/or Subharmonic Generation in a Medium with Quadratic and Cubic Nonlinearities
Partha P. Banerjee, Syracuse University; Frank Verheest, State University of Ghent, Belgium; and Willy Hereman, University of Wisconsin, Madison

Painlevé Analysis, Integrability and Particular Solutions to Fifth Order Dispersive Evolution Equations
Willy Hereman, University of Wisconsin, Madison; Partha P. Banerjee, Syracuse University; and Frank Verheest, State University of Ghent, Belgium

Instabilities, Nonlinear Modes, and Low-Dimensional Chaos in the Dynamics of a Forced Elastic Rod: Experiments and Theory
J.P. Guckenbach and J.C. Moon, Cornell University

Thursday, July 14/3:30 PM
Contribution Presentations 19/Greenway C

MECHANICS, OPTICS, ELECTROMAGNETISM

Unilateral Contact Between a Square Plate and an Elastic Layer
J.P. Dempsey and H. Li, Clarkson University

Losses for Vector Solutions of Infrared Whistling-Gallery Waveguides
W. Kath, J. Jiao, X. Fang and M. Marhic, Northwestern University

Losses for Full Vector-Mode Solutions of Arbitrarily Bent Optical Fibers
Ann Cahill and William L. Kath, Northwestern University

Resonant Forcing of a Damped Simple Pendulum
Peter J. Bryant, University of Canterbury, New Zealand

Application of Control Region Approximation to Guided Wave Computation
Brian J. McCartin, United Technologies Research Center, East Hartford

Least Noise Trim Patterns for Laser Trimmer Resistors
Deborah Penick Levinson and Arthur David Snider, University of South Florida, Tampa

Bifurcations and Periodic Solutions of the Kinetic Equations for Collisionless Plasmas
James Paul Holloway and J.J. Dommg, University of Virginia

Fast Interactive Lasing Codes on the AMT DAP 610
Stewart F. Reddaway, Active Memory Technology Ltd., England

Friday, July 15/10:30 AM
Contribution Presentations 20/Greenway B

DOMAIN DECOMPOSITION AND GRID METHODS

Spectral Domain Decomposition Techniques for Solving Poisson and Biharmonic Problems
T.J. Phillips, University College of Wales, United Kingdom

New Technique for Finite Element Mesh Generation by Using Coon’s andBezier Interpolation
Norihito Nakajima, Hitachi Ltd., Japan

Cell-Dynamical System Modeling of Nonequilibrium Phenomena
Y. Ono, C. Yeung and M. Beljans, University of Illinois, Urbana

Effects of Grid Irregularity on Iterative Methods
George J. Fix and Tso-Fen Chen, University of Texas, Arlington

Optimal Triangulation Incidence for Interpolating Convex Quadratic Surfaces
Eduardo D’Azevedo, University of Waterloo, Canada

Automatic Mesh Generation Based on a Vertex Label Assignment Scheme
Fuhua Cheng and Jerzy W. Jaromczyk, University of Kentucky; Junmin-Lin, National Tsing-Hua University, China; Shyue-Shian Chang and Ji-Yeou Lu, Chung-Shan Institute of Science and Technology, China

Grid Refinement in Nonlinear SOR
Tso-Fen Chen and R. Kannan, University of Texas, Arlington

The Fast Adaptive Composite Grid Method for Time-Dependent Problems
J.W. Thomas and M. Heroux, Colorado State University
## CONTRIBUTED PRESENTATIONS

**Friday, July 15/10:30 AM**  
**Contributed Presentations 21/Greenway A**

**APPLIED GEOMETRY AND FRACTALS**

*Is Henon's Strange Attractor Really Strange?*
Gregory J. Davis, University of Wisconsin, Green Bay

*Strange Saddles and the Dimensions of Their Invariant Manifolds*
Guang-Hong Hau, Naval Surface Weapon Center, Silver Spring, Edward Ott and Celso Grebogi, University of Maryland, College Park

*On the Dimension of Fractal Functions which are Attractors of Dynamic Systems*
Peter R. Massopust, LaGrange College

**Symmetry and Periodicity of Generalized Mandelbrot Sets**
J.R. Caspar, J.C. Hanson and R.E. LaBarre, United Technologies Research Center, East Hartford

**Error Estimates for the Calculation of Fractal Dimension**
Farn Hunt, Howard University, Washington, DC

*Layered Representation of 3-D Surface Using Level Curves and Its Orthogonal Curves*
He-Jin Kim, Ajou University, South Korea

*Fast Evaluation of the Fractal Dimension of Boolean Images*
Stewart F. Reddaway, Active Memory Technology Ltd., England

*Constructive Deformations of Star Worlds for Exact Robot Navigation*
Elon Rimon and Daniel E. Koditschek, Yale University

**Friday, July 18/10:30 AM**  
**Contributed Presentations 22/Greenway C**

**ORDINARY DIFFERENTIAL EQUATIONS**

*Construction and Investigation of Finite-Difference Models of the Van der Pol Equation Using a Discrete Multi-Time Procedure*
Ronald E. Mickens, Atlanta University

*On the Numerical Reconstruction of Forcing Terms*
Disco A. Murio and Doris Hinestroza, University of Cincinnati

*A Stability Criterion for Boundary Values Runge-Kutta Methods*
Aron Jozefczyk and Reginald P. Tewarson, SUNY, Stony Brook

*Efficient Numerical Solution of Time-Varying Stiff Riccati Differential Equations*
Chu Chai and Alan J. Laub, University of California, Santa Barbara

*Consistent Initialization of Differential-Algebraic Equations*
Benjamin J. Leimkuhler and C.W. Gear, University of Illinois, Urbana, and Linda R. Petzold, Lawrence Livermore National Laboratory

*Two-Step Obrechkoff Methods for Periodic Initial Value Problems*
David A. Voss, Western Illinois University; and A.Q.M. Khaliq, Bahram University

**Friday, July 15/2:00 PM**  
**Contributed Presentations 24/Greenway C**

**FLUID FLOW AND HEAT TRANSFER 2**

*Nonlinear Dynamics in Two-Phase Flow with Three Forcing Functions*
Rowan-uddin and J.J. Dorming, University of Virginia

*Computational Methods for Solving Variational Problems in Fluid Dynamics*
Alexander Eydal, University of Massachusetts, Amharat

*Stability of Drawn Fibers*
Charles Thompson and Monica Brown, University of Lowell

*Acoustic Wave Interactions a Mean-Flow Stagnation Point*
C. Thompson and M. Manley, University of Lowell

*Surface Temperature Histories of Materials in the Presence of Surface Reradiation*
M.A. Delichatsios and J. de Rios, Factory Mutual Research Corporation, Norwood, MA

**Friday, July 15/2:00 PM**  
**Contributed Presentations 25/Greenway B**

**WAVE PROPAGATION 2**

*Selection Mechanisms and Resonant Limits in the Perturbed Nonlinear Schrödinger Equation*
Paul Newton, University of Illinois, Urbana

*Internal Solitary Waves of Large Amplitude*
Stephen A. Rennel and Rida M. Mirza, University of Lowell

*Wall Shear Effects on Solitary Wave Profiles in Thin Liquid Films*
L. Michael Santi, Memphis State University

*Sound Waves in Fogs*
R. Duraliwaran and A. Prosperetti, Johns Hopkins University

*Acoustic Scattering from a Baffled Cavity-Backed Membrane Surrounded by an Elastic Layer*
Gregory A. Kriegsmann, Edward L. Reiss and Vincenzo Villanueva, Northwestern University

*Numerical Experiments for a Complex-Valued Nonlinear Klein-Gordon Equation*
Jon C. Luke, Indiana University/Purdue University, Indianapolis

*Robust Soliton-Like Properties*
Ralph Kelsey, Bradley University

*Surfing on Solitary Waves*
J.-M. Vanden-Broeck, University of Wisconsin, Madison

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**POSTER PRESENTATIONS**

**Tuesday, July 12/3:30 PM**  
**Poster Session 1/Exhibit Hall**

*The Accuracy of Numerical Conformal Mapping Methods*
Thomas K. DeLillo, Duke University

*The New Fortran Language*
Alan Wilson, Active Memory Technology, Irvine

*Fractal Regions in Hopf Bifurcations*
Allen Moore, Long Island University, Southampton

*Fixed Points of Higher Dimensional Dynamic Systems*
Stephen T. Welstead and Thomas Cromer, COLSA, Inc., Huntsville

*Singularly Perturbed Systems Containing Singular Manifolds*
Zhong-Mei Gu, Rensselaer Polytechnic Institute

*Fully Discrete Approximations of Parabolic Problems with Nonsmooth Dirichlet Boundary Data*
Gilbert K. Choudary, University of Cincinnati

*Probing Complex Iteration Functions Graphically*
J.R. Caspar, J.C. Hanson and R.E. LaBarre, United Technologies Research Center, East Hartford

*Regeneration of Images From IFS Codes on an Array Processor*
S.F. Reddaway, Active Memory Technology Ltd., England

**Wednesday, July 13/10:30 AM**  
**Poster Session 2/Exhibit Hall**

*Supercomputer Dynamic Simulation of Sustained Chemical Oscillations*
Robert F. Steixen, Florida Atlantic University; William A. Hogan, Convex Computer Corporation, Richardson

*Numerical Simulation of Precipitate Nucleation and Growth*
J.P. Levine and G.A. Hawkins, Eastman Kodak Company, Rochester

*Snells Laws at the Interface Between Nonlinear Dielectrics*
Alejandro Aceves, Jerome V. Maloney and Alan C. Newell, University of Arizona

*Application of Singular Perturbation in Modeling Load Disturbances For Power Systems Reliability Evaluation*
J. Olu, Clemson University; and S.M. Shahidehpour, Illinois Institute of Technology

*On the Thermomechanical Characterization of Thin Film Superconductors*
Georges V. Abi-Ghanem, EWA, Inc., Minneapolis

*A Salary Structure Simulation Model*
Donald E. Miller, St Mary's College, Notre Dame, IN

*On Built-In Balanced Models with Guaranteed Structural Parameters*
L. Fortuna, A. Gallo, G. Nunnari and P. Zuccheri, Universita di Catania, Italy

*The Consistency of an Asymptotic Method with the Result of Inverse Scattering Method for a Modal Equation of Water Waves*
Qiu Zou, Kansas State University

*Integral Equation Solution of Viscous Free Surface Flow Problems*
Erik B. Hansen, Technical University of Denmark
Use order form on reverse side of this page and return in envelope in centerfold, which is to be used also for your meeting registration.

MULTIGRID METHODS
Edited by Stephen F. McCormick
Frontiers in Applied Mathematics 3
viii + 292 pages, Hardcover
Order Code F53
List price $38.50
SIAM member price $20.80
A thorough consideration of the current level of development of multigrid methods, this is a carefully edited collection of papers that addresses its topic on several levels. The first three chapters orient the reader who is familiar with standard numerical techniques to multigrid methods, first by discussing multigrid in the context of standard techniques, second by detailing the mechanics of using the method, and third by applying the basic method to some current problems in fluid dynamics. The fourth chapter provides a unified development, complete with theory, of algebraic multigrid (AMG), which is a linear equation solver based on multigrid principles. The last chapter is an ambitious development of a very general theory of multigrid methods or variational posed problems. Included as an appendix is the latest edition of the Multigrid Bibliography, an attempted completion of all existing research publications on multigrid.

Published December 1987

A MULTIGRID TUTORIAL
William L. Briggs
ix + 68 pages, Softcover
Order Code OT17
List price $13.50
SIAM member price $8.90
Assuming little familiarity with basic iterative methods and no acquaintance with multigrid, this tutorial begins from first principles. First, conventional relaxation methods applied to systems of linear equations are examined, since an understanding of their convergence properties and limitations is essential to multigrid. Second, the fundamental two-grid cycling scheme is discussed, leading to the introduction of the necessary intergrid transfer functions. Third, more complex multigrid schemes are then presented. This tutorial concludes with an explanation of “why multigrid works.”
Published September 1987

LINEAR ALGEBRA IN SIGNALS, SYSTEMS, AND CONTROL
Edited by B. N. Datta, C.R. Johnson, M.A. Kaashoek, R. Plemmons, and E. Sontag
87 pages (tet.), Hardcover
Order Code P692
List price $28.50
SIAM member price $16.90
Proceedings of the SIAM Conference on Linear Algebra in Signals, Systems, and Control held in Boston, May 1986. Forty-six papers by mathematicians, computer scientists, and engineers present results on analytic and computational linear algebra and its applications. The conference covered deterministic theory; geometric theory of multivariable control; signal processing, estimation, filtering, and prediction; and robust, adaptive, and stochastic control. Divided evenly among the general areas of systems and control theory, analysis of digital filter structures, VLSI and dedicated processors, and signal processing and control, numerical linear algebra, and linear algebra, this collection will be of interest to all researchers involved in applying linear algebra numerical methods to problems in signals and control.

Published May 1988

FIRST INTERNATIONAL SYMPOSIUM ON DOMAIN DECOMPOSITION METHODS FOR PARTIAL DIFFERENTIAL EQUATIONS
Edited by Roland Glowinski, Gene H. Golub, Gerard A. Meurant, and Jacques Periaux
ix + 431 pages, Hardcover
Order Code P690
List price $46.50
SIAM member price $28.80
Proceedings of the First International Symposium on Domain Decomposition Methods for Partial Differential Equations, held at École Nationale des Ponts et Chausées in Paris on January 7–9, 1987. Topics discussed include theoretical foundations of the methods and the underlying approximation theory, applications to the solution of complicated problems in science and engineering, and implementation on vector and parallel computers. Discissions of block relaxation and element by element methods and other related techniques are also included.
Published January 1989

Please turn page for additional books.
DYNAMICAL SYSTEMS APPROACHES TO NONLINEAR PROBLEMS IN SYSTEMS AND CIRCUITS
Edited by Fathi M. A. Salam and Mark L. Levi
viii + 413 pages. Hardcover
Order Code PSP31
List price $44.50
SIAM member price $35.60
Proceedings of the Second Engineering Foundation Conference on Qualitative Methods for the Analysis of Nonlinear Dynamics held at New England College in June 1986, which brought together researchers from applied mathematics and engineering to focus on sample works and approaches of dynamical systems that are useful in treating nonlinear circuits and systems in engineering and in physical sciences. Development addressed include the increased use of computer algebra in normal form and bifurcation calculations, the introduction of algebraic ideas to the study of bifurcations of systems with symmetries, the interaction between noise and deterministic chaos, the use of methods of bifurcation theory in control, methods of reduction in the dynamics of coupled rigid bodies, and bifurcations of the equilibria of the rotations double-joined pendulum.

Published January 1988

CONTACT PROBLEMS IN ELASTICITY: A STUDY OF VARIATIONAL INEQUALITIES AND FINITE ELEMENT METHODS
N. Kikuchi and J.T. Oden
viii + 495 pages. Hardcover
Order Code FAM68
List price $92.50
SIAM member price $76.00
A comprehensive treatment of the mathematical and numerical analysis of contact problems in elasticity. Because contact problems are at the heart of all boundary- and initial-value problems in solid and structural mechanics, a broad view of unilateral contact is presented that attempts to unify understanding of both the physical problems and mathematical models. A detailed study of the qualitative features of the models and numerical approximation methods, including algorithm development and analysis of numerical stability, accuracy, and convergence, is included. The first part of the book discusses classical problems of linearly elastic solids with no friction present; the book concludes with considerations of the mechanics of friction, new models for static and dynamic problems of contact in motion, and applications to problems in areas such as elastic deformations and rolling contact with finite deformation.
Available July 1988

TO ORDER BOOKS, call (215) 564-2829 or fill out the coupon below and mail to: SIAM, Dept. AM88, P.O. Box 7260, Phila., PA 19101-7260.

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*Note: If you are a SIAM member, your order must be billed and shipped to your membership address to validate the SIAM member price.

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☐ If you are not enclosing payment and your order totals less than $30, add an invoicing charge of $3.

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<th>Price</th>
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</table>

Subtotal __________________________
Handling charges __________________
Optional priority shipping charge ______

TOTAL ____________________________
TRANSPORTATION INFORMATION

BY AIR

UNITED and DELTA AIRLINES have been chosen as the official carriers for this meeting. You can fly to Minneapolis and save on travel from July 8, 1988 thru July 18, 1988 inclusive.

United
DELTA

In a special arrangement with SIAM, United and Delta Airlines are offering you the services of their toll free convention reservation desks, along with a complement of discounts:

• 5% off any fare for which you qualify, including First Class and Ultra Saver Fares.
• THE DISCOUNTS CAN RANGE FROM 40%–70% OFF NORMAL COACH FARES!

OR... for those of you who do not qualify for the above discounts:

• United and Delta Airlines will offer a minimum of 40% off regular coach fares. There is no minimum stay or advance purchase required with United Airlines, or Delta Air Lines.
• United and Delta Airlines have a special discounted fare that we at SIAM encourage you to ask for. It does involve staying overnight either the Saturday before or after the conference. However, in many cases the cost of the hotel for the extra night is still cheaper than paying the airfare to arrive on a Sunday and depart on a Thursday or Friday.

To make reservations for one of the above discounted fares:

• Call United Airlines Convention Desk, at 1-800-521-4041, seven days a week 8:00 AM to 11:00 PM Eastern Time. Be sure to mention the SIAM account number: 81293
• Call Delta Air Lines Convention Desk, at 1-800-241-6760, seven days a week 8:00 AM—8:00 PM Eastern Time. Be sure to mention the SIAM account number: U0315
• Both United and Delta Airlines will arrange to mail your tickets to your home or office, or you may purchase them from your local travel agent. If you purchase from your local travel agent, be sure you or the agent call United or Delta's Convention Desk to make your reservations. The special SIAM fare is only available through the Convention Desks.

CAR RENTAL

DOLLAR RENT A CAR has been selected as the official car rental agency for the 1988 SIAM Annual Meeting. The following rates will apply:

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<tr>
<th>Type of Car</th>
<th>Daily Rate</th>
<th>Weekly Rate</th>
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<tr>
<td>Economy</td>
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</tr>
<tr>
<td>Premium</td>
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<td>$265.00</td>
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</tbody>
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• We encourage you to make an advance reservation, as on-site availability cannot be guaranteed. Make reservations by calling: 1-800-421-8878. When making your reservation, be sure to give the SIAM account number CCMMSP. You should also mention that you are attending the 1988 SIAM Annual Meeting, July 11 – 15, 1988, in Minneapolis, in order to receive the discounted rate.
• Cars may be picked up at the airport at the Dollar Car Rental Desk located in the baggage claim area of the airport.
• Cars must be picked up and dropped off at the same location.
• You must be 21 years of age and have a valid U.S. or International Driver's License. There is a $3.00 per day surcharge for drivers under 25 years of age.
• You will be given 150 free miles per day (cumulative) and charged $0.15 per mile thereafter.
• You must have one of the following credit cards to rent a car: AMEX, Master Card, VISA, Diners Club.
• The prices quoted do not include fueling services, tax, optional collision damage waiver, and personal accident insurance.

BY CAR

When leaving the airport, follow the signs for 494 North to 35 West. Follow 35 West for about 7 or 8 miles. This will take you directly into downtown Minneapolis. Exit on Eleventh Street. Stay in the left lane and go 3 lights until you intersect with Second Avenue. Make a left on Second Avenue and follow it until you reach 13th or Grant Street. Make a right on Grant or 13th Street and the Hyatt Regency is on the right approximately 1 1/2 blocks down.

PUBLIC TRANSPORTATION FROM THE AIRPORT

The airport is approximately 20–25 minutes from the hotel. There is an airport shuttle called the Airport Limousin. You will find it coming every hour on the half hour outside the baggage claim area 5:30 AM–11:00 PM, seven days a week. The cost for a one way ticket is $6.50. However, if you purchase a round trip ticket for your return back to the airport at the time that you arrive, the entire round trip ticket is $9.50.

There are a number of different cab companies that operate around the airport. The average one way cost from the airport to the hotel is $18.25.

HOTEL INFORMATION

Hyatt Regency Hotel
1300 Nicollet Mall
Minneapolis, MN 55403
(812) 370-1234

SIAM is holding a block of rooms at the Hyatt Regency Hotel. These rooms are being held on a first come, first served basis at $69/Single and $83/Double. These rooms will be held for our exclusive use only until June 24, after which data reservations will depend on availability.

We urge you to make your reservations as soon as possible. You may do so by telephoning (612) 370-1234 or by mailing in the Hotel Reservation Form, located in the back of this program. When making your reservation via phone, please be certain to identify yourself as an attendee at the 1988 SIAM Annual Meeting to receive the discounted rate.

Late Arrival Policy: If you plan to check-in after 6:00 PM, you must guarantee your room for late arrival by making payment in advance for one night. Payment can be made by either AMEX, MC, VISA, DC or check.

Check-In: Check-in time is 3:00 PM and Check-out time is 1:00 PM. If you need to change or cancel your reservation, be certain to contact the hotel by 1:00 PM Eastern Time on your stated date of arrival to avoid any unnecessary charges.

Weather: It is said that the best possible time to be in Minneapolis is in July. Usually, the daily temperatures range from 75° to 90°. It is sunny yet not humid. Cool summer clothing is highly suggested.

About the Hotel: The Hyatt Regency is a downtown property, so you will find many areas highly accessible from the hotel. You can easily catch a cab outside the hotel and the average price for going anywhere within the downtown area is $2.00 per person with approximately $5.50 per additional person. The Hyatt has 4 restaurants on premise, the Dynasty, which serves Chinese cuisine; the Pronto, which serves Italian cuisine; the Willows, which is the Hyatt's formal dining restaurant; and the Terrace, which is more like a cafe serving light dishes and sandwiches. There is also 24 hour room service available in the hotel. The second floor of the hotel features a retail mart, a shopper's paradise with more than twenty individual boutiques and services ranging from gifts and apparel to florist and a bank. The Greenway Athletic Club is a year-round facility connected to the Hyatt with complete recreational facilities, featuring racquetball, squash, tennis, nautilus equipment, massages, running tracks, saunas, jacuzzi, hot tubs and a pro shop. This is available to the Hyatt Hotel guests at a rate of $6.00 per person. There is an indoor pool at the Hyatt that guests can utilize at no cost.

Parking: There is a large parking ramp attached to the Hyatt. Parking fee for hotel guests are $4.50 per day. For those not staying at the hotel, the cost for parking can range between $8.00 and $8.00 per day.
REGISTRATION INFORMATION

Please complete the Advance Registration Form found on the back page of this brochure and return it in the envelope provided in the middle section of this program. We urge attendees to register in advance, as the registration fee is lower for advance registrants. The registration desk will be open as listed below.

Saturday, July 9
5:00 PM – 9:00 PM
Sunday, July 10
8:00 AM – 9:00 AM
Monday, July 11
7:30 AM – 5:30 PM
Tuesday, July 12
8:00 AM – 6:00 PM
Wednesday, July 13
8:30 AM – 4:30 PM
Thursday, July 14
8:00 AM – 6:00 PM
Friday, July 15
8:00 AM – 4:00 PM

SPECIAL EVENTS

Welcoming Reception
Sunday, July 10, 8:00 PM – 10:00 PM
Nicoll D1-D2
Cash Bar

Beer Party
Monday, July 11, 6:00 PM – 8:00 PM
Exhibit Hall
$15.00

Wednesday, July 13, 6:30 PM – 9:30 PM
Dinner/Mississippi River Boat Cruise
Boon Island, Minneapolis, MN
$28.00

REGISTRATION FEES:

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<th>SIAM Member</th>
<th>Non Member</th>
<th>Student</th>
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<td>Short Course</td>
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<td>On-Site</td>
<td>$110</td>
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Non SIAM Members
Non-member registrants are encouraged to join SIAM in order to obtain the member rate for meeting registration and enjoy all the other benefits of SIAM membership. You can join SIAM by filling out a membership form at the SIAM Registration Desk located in the Promenade of the Hyatt Regency Hotel. If you join for this conference, SIAM will retroactively give you the member rate for registration.

Special Note
There will be no prorated fees. No refunds will be issued once the meeting has started.

If SIAM does not receive your Advance Registration Form by the stated deadline, you will be asked to give us a check or a credit card number at the conference. We will not process either until we have ascertained that your registration form has gone astray. In the event that you receive your form after the conference, we will destroy your check or credit card slip.

Telephone Messages
The telephone number at the Hyatt Regency Hotel is 1-812-370-1234. The Hyatt Regency will either connect you with the SIAM registration desk or forward a message.

Credit Cards
SIAM is now accepting Visa, MasterCard and American Express for the payment of registration fees and special functions. When you complete the Advance Registration Form, please be certain to indicate the type of credit card, the number and the expiration date.

SIAM CORPORATE MEMBERS
Non-member attendees who are employed by the following institutions are entitled to the SIAM member rate.
Aerospace Corporation
Amoco Production Company
AT&T Bell Laboratories
Bell Communications Research
Boeing Company
Cray Research, Inc.
Cutter Scientific Systems Corporation
E.I. DuPont de Nemours and Company
Eastman Kodak Company
Exxon Research and Engineering Company
General Electric Company
General Motors Corporation
Giers Schlumberger
GTE Laboratories, Inc.
Hollandia Signallapparaten B.V.
IBM Corporation
Institute for Computer Applications in Science and Engineering (ICASE)
IMSL, Inc.
MacNeal-Schwendler Corporation
Marathon Oil Company
Martin Marietta Energy Systems
Mathematical Sciences Research Institute
Standard Oil Company of Ohio (SOHIO)
Supercomputing Research Center, a division of
Institute for Defense Analyses
Texasco, Inc.
United Technologies Corporation

TOURS
Summer months mean vacation time for many of you with spouses and families. SIAM does encourage you to bring them with you when attending our meetings and conferences. In an attempt to accommodate those who attend, we would like to make a few tours available that may be of interest to newcomers to St. Paul and Minneapolis. Should you be interested in attending one of these tours, just fill in the appropriate spaces on the Advance Registration Form in the back of this brochure and your reservations will be made.

TOUR #1 Hello Twin Cities Tour: Festivities begin when you board your deluxe bus for a lively narrated tour of the Twin Cities. Begin with Nicollet Mall, circle about Hubert Humphrey Metrodome, the Federal Reserve Bank, Orchestra Hall and other outstanding buildings in the heart of the city. Refreshments and Danish will be served along the way. Continue on around Loring Park, past the Guthrie Theatre and into the lovely Kenwood residential area. Drive past sparkling city lakes, along green parkways and stop at beautiful Minnehaha falls and enjoy a delicious boxed lunch along the banks. After lunch you will proceed into St. Paul. You’ll see the beautiful mansions of Summit Avenue, St. Paul Cathedral and the State Capitol. All are jewels at the end of this historic boulevard. Journey through downtown St. Paul for a glimpse of the main business area, city parks and notable downtown landmarks. Return to the hotel through the campus of the University of Minnesota.
This tour is available on Monday, July 11, 1988. The buses will depart from the Hyatt Regency Lobby at 9:00 AM and return at 2:00 PM. The cost for this tour is $25.00. Space is limited and will be on a first come first served basis.

TOUR #2 Historic St. Paul Tour: Leave the bustle of the city and head for Stillwater, the first town site in Minnesota on the banks of the wild and beautiful St. Croix River. The history and quaintness of this historic place will come alive as you enjoy refreshments while your guide shares a few stories about this preserved river town. Stroll the streets and browse a little in the Old Post Office Shops, Grand Gallery, Brick Alley, and Staples Mill (antiques). Stop and enjoy lunch on your own at any of the charming restaurants in town, you may wish to pick one with a deck so you can watch the scenic St. Croix River flow by. At the end of a pleasant and refreshing afternoon, board your deluxe motorcoach for your trip back to Minneapolis.
This tour is available on Tuesday, July 12, 1988. The buses will depart from the Hyatt Regency Lobby at 9:00 AM and return at 3:30 PM. The cost for this tour is $20.00. Space is limited and will be on a first come first served basis.

Your confirmations for the above tours will be placed in your registration packets which you pick up upon checking in at the SIAM Registration Desk.

UPCOMING CONFERENCES

March 20 – 22, 1989
SIAM Conference on Domain Decomposition Methods
Intercontinental Hotel
Houston, TX
Abstract Deadline: September 28, 1988

April 3 – 5, 1989
Third SIAM Conference on Optimization
57 Park Plaza Hotel
Boston, MA
Abstract Deadline: November 4, 1988

May 17 – 19, 1989
SIAM Conference on Control and Systems Theory
Cathedral Hill Hotel
San Francisco, CA
Abstract Deadline: December 7, 1988

July 17 – 21, 1989
1989 SIAM Annual Meeting
Sheraton Harbor Island
San Diego, CA
Abstract Deadline: February 2, 1989

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HOTEL RESERVATION FORM
The Hyatt Regency Hotel, Minneapolis, Minnesota

PLEASE SEND ME A CONFIRMATION NOTICE
Specially discounted rooms are being held for our exclusive use until June 24, 1988. After that date, reservations will depend on availability. Your reservation is not confirmed until acknowledged in writing by the hotel or verified by phone. When making reservations by phone, be certain to identify yourself as an attendee at the 1988 SIAM Annual Meeting. Telephone: 1-612-370-1234.

Name_________________________________________ Phone__________________________
Address___________________________________________
City_________ State______ Zip_________

Please reserve [ ] Single ($69) [ ] Double ($83) Arrival Date _______

[ ] Single ($69) [ ] Double ($83) Check-Out Date _______
Arrival Time__________________________ Check-Out Time__________________________

[ ] Guarantee my room for late arrival (after 6:00 PM) [ ] Yes [ ] No

[ ] I choose to pay by:* [ ] AMEX [ ] VISA [ ] MC [ ] Check

Credit Card Number ___________________________ Expiration Date _______
Deposit $__________________________ (Late Arrivals Only)

Signature ____________________________

If you list your credit card number, please enclose this card in an envelope and mail to: Reservations, The Hyatt Regency Hotel, On Nicollet Mall, 1300 Nicollet Mall, Minneapolis, MN 55403.

* You only need to list your credit card number if you want to guarantee your room for late arrival.

ADVANCE REGISTRATION FORM
1988 SIAM Annual Meeting

*Advance registration form must be received at the SIAM office by July 7, 1988. If paying by check, please make check payable to SIAM.

REGISTRATION FEES:

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Name_________________________________________ First (please print) Last________
Affiliation______________________________________
Department_______________________________________
Address___________________________________________
City_________ State______ Zip_________
Telephone Number_______________________________

Local Address in Minneapolis __________________________

I wish to pay by [ ] AMEX [ ] VISA [ ] MC [ ] Check

Credit Card Number ___________________________ Expiration Date _______

Signature ____________________________

I am a member of [ ] SIAM [ ] Other(s)__________________________

[ ] Please send me information about SIAM Membership