## Preliminary Program

# SIAM 35th Anniversary Meeting

## OCTOBER 12 – 15, 1987

**and Short Course on Parallel Computing**
October 11, 1987

## Marriott Hotel-City Center, Denver, Colorado

**The general theme of the meeting will be computational sciences and evolving areas of applied mathematics.**

- Combinatorial Optimization, Intersection Graphs and Applications, Complexity of Parallel and Distributed Computing, Graph Minor Algorithms, Computational Geometry
- Vector and Parallel Computing, Architectures and Languages
- Multigrid Methods, Domain Decomposition, Finite Element Methods
- Earth System Models, Hypersonic Aerodynamics, The Supercomputer Centers, Mathematical Modeling
- Inverse Scattering, Wave Propagation
- Materials Science, Mathematics of Crystal Physics, Robust Control, Numerical Methods for ODE's and PDE's, Robotics, Data Analysis

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# ORGANIZING COMMITTEE

**Hans Weinberger,** Chair
University of Minnesota, Minneapolis

**Peter Olver**
University of Minnesota, Minneapolis

**David Sattinger**
University of Minnesota, Minneapolis

# 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: Conference Coordinator, SIAM, 117 S. 17th St., 14th Floor, Philadelphia, PA 19103. Telephone: (215) 564-2929. Contributions must be received by September 4, 1987, in order to appear in the final program. SIAM will consider contributions until September 22, but those received after September 4 will be listed in an addendum.

## *FROM THE MAYOR OF DENVER, COLORADO*

*Greetings!*

*I am pleased to extend a warm welcome to all attending the 35th Anniversary Meeting of the Society for Industrial and Applied Mathematics (SIAM) being held in Denver the week of October 12-15, 1987.*

*I have perused your general announcement and registration information and am impressed with the quality of speakers at your symposia and those making major presentations. I am sure that all those fortunate to attend this meeting will find it to be informative and valuable.*

*I sincerely hope that all delegates, guests and family members who are in Denver this week will take advantage of the many cultural and recreational facilities which our city has to offer you, and I know you will enjoy Denver's many fine shops and restaurants as well.*

*With best wishes to all in attendance and good luck as you pursue your important work.*

*Sincerely,*
*Federico Peña*
*MAYOR*

# SHORT COURSE

**Short Course on Parallel Computing**
Sunday, October 11, 1987
Marriott City Center
Colorado Ballroom F

The short course will be conducted by Harry Jordan and Robert Schnabel of the University of Colorado, Boulder, and Oliver McBryan of the Courant Institute, New York University. The course, organized by Lloyd Fosdick of the University of Colorado, Boulder, is designed for applied mathematicians, and other scientists and engineers interested in learning about basic concepts, current ideas, and future research directions in parallel computation. It is intended to serve as a refresher course for those with some knowledge of parallel computation.

The lectures will begin with an overview of parallel architectures and algorithms, followed by lectures on parallel software portability, on tools and techniques for developing and writing parallel programs, and on parallel numerical applications. There will be six hours of lecture plus discussion periods.

***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.***

PROGRAM

| Time | Topic |
|------|-------|
| 9:00 AM | **An Overview of Parallel Architecture and Algorithm Characteristics** Robert B. Schnabel |
| 11:00 AM | Coffee and discussion |
| 11:30 AM | **Software Portability Issues for Parallel Environments** Oliver McBryan |
| 12:30 PM | Lunch and discussion |
| 2:00 PM | **Managing Multiple Instruction Streams** Harry Jordan |
| 4:00 PM | Coffee and discussion |
| 4:30 PM | **Numerical Applications on Parallel Machines** Oliver McBryan |
| 5:30 PM | Discussion |
| 6:00 PM | Course adjourns |

**Registration Fees***

| | SIAM Member | Non Member | Students |
|------|------|------|------|
| Advance | $85 | $105 | $45 |
| On-Site | $105 | $125 | $55 |

* *Registration Fee includes preprints and lunch.*

# MEETING HIGHLIGHTS

## INVITED PRESENTATIONS

*Monday, October 12, 8:30 AM*
Invited Presentation 1
**Modeling the Earth System**

Changes in climate and our global environment due to the burning of fossil fuel and other human activities give urgent impetus to understanding the complete Earth System over the next few decades. Models of the large scale motions of the atmosphere have long been a principal application for supercomputers, but these are now being extended to include atmospheric chemistry, ocean circulation and land surface vegetation, which involve stiff systems of partial differential equations with very many degrees of freedom. Models of biological subsystems and the biogeochemical cycles are under development. A key program requirement is to document changes in key variables as they occur over the next decades. In the mid 1990's global observing systems are expected to yield 10 to 13 bits/day, which will have to be processed and assimilated into global analyses for model operations and testing.

Francis P. Bretherton
National Center for Atmospheric Research

*Monday, October 12, 9:15 AM*
Invited Presentation 2
**Robust Control Theory and Matrix Perturbation Problems**

Robust control theory (RCT) addresses the problem of analyzing and synthesizing control systems that provide acceptable performance in the presence of model uncertainty. The ability to design such systems is important in practical applications because mathematical models of physical systems are never exact.

Typically, a model will have significant structural information about the interconnection of components and subsystems, but substantial uncertainty about their details. The development of control design methodologies that deal directly with this type of model leads naturally to a number of interesting mathematical problems. Among these are the so-called structured singular values (SSVs) which are used in treating structured matrix perturbation problems. SSVs have both eigenvalues and singular values as special cases and are used to generalize the notion of spectra. Beyond their intrinsic mathematical interest, SSVs are used in applications programs, including the space shuttle and the AH-64A LHX helicopter. Other problem areas where SSVs are used include design studies of high-purity distillation columns, catalytic reactors, F-15 SMTP, F-16XL, and the oblique-wing research aircraft.

RCT is currently an exciting research area because it coincides with frontiers in both mathematics and engineering applications. The speaker will examine the general problem area of RCT with a focus on operator-theoretical methods and on SSVs.

Two minisymposia will augment the presentation (on Tuesday PM and Wednesday

## INVITED PRESENTATIONS

AM). The first minisymposium will explore in detail the mathematics of RCT, including series of non-self adjoint operators, Hankel operators, Hardy spaces, generalized interpolation, and convex programming. The second minisymposium will feature experts in these applications areas.

John Doyle
California Institute of Technology

*Monday, October 12, 2:00 PM*
Invited Presentation 3
**Computational Hypersonic Aerodynamics**

During the past several years, there has been renewed interest in the development of hypersonic airplanes powered by airbreathing engines. The design of such airplanes poses unique problems to the aerodynamics community—problems which cannot be addressed with traditional wind-tunnel techniques.

Plans now call for relying on computational fluid dynamics (CFD) to an unprecedented degree in solving aerodynamic/fluid dynamic design problems relating to issues such as propulsion/airframe integration, propulsion system component design, and configuration optimization. There are no CFD codes available today for dealing with these complex problems; thus, intensive research is now underway to develop the required codes. The research includes algorithm tuning to the high-Mach number case, inclusion of real-gas physics, improvements in transition and turbulence modeling, and grid generation for complex geometries. In addition, CFD is being used to provide unique insights into the basic physics of phenomena such as hypersonic transition and supersonic combustion.

The speaker will outline the problem areas in hypersonic aerodynamics where CFD will play a major role. He will present some typical results based on present-day codes, highlight some of the reseach problem areas and describe the unique contributions CFD is making toward understanding the basic physics of hypersonic flight.

Douglas L. Dwoyer
NASA Langley Research Center

*Tuesday, October 13, 8:30 AM*
Invited Presentation 4
**Liquid Crystal Theory**

The layman is familiar with the practical applications of liquid crystals in the form of displays used in watches, personal computers and so forth, or as products formed by spinning liquid crystal polymers, the very high-strength fibers used in radial tires and canoes, for example. Scientists, in general, are finding that much has been learned about the behavior of point and line defects in materials from experimental and theoretical studies of liquid crystals. Some have been struck by their beauty.

With a few notable exceptions, the development of the mathematical theory has, until recently, been left to the non-mathematician.

But, this is changing rapidly with the appearance of a number of deep and physically interesting analyses, which are enhancing the understanding of the theory of defects.

Here is an expository lecture covering some of the physical phenomena and elements of the mathematical theory, with some mention of unsolved problems.

Jerry L. Ericksen
University of Minnesota

*Tuesday, October 13, 9:15 AM*
Invited Presentation 5
**Viscoelastic Properties of Rodlike Polymers in Solution**

Molecular order in a liquid crystal is intermediate between that in the crystalline and amorphous solids. Thus, the nematic liquid crystalline state exhibits a high degree of long-range orientational order, but lacks long-range translational order. Higher degrees of order are found in smectic and cholesteric liquid crystals.

In this talk the speaker will address the rheological behavior of nematic liquid crystalline solutions of a rod-like polymer chain. The continuum theory developed by Ericksen and Leslie provides a constitutive equation (i.e. one that depends on the material properties but not on the geometry) for slow flows and explains elastic and quasi-elastic light scattering exhibited by these liquid crystals. The model has been very useful in theoretical studies of the effects of surface orientation on flow.

The speaker will discuss methods to create a fully oriented (monodomain) nematic solution of a rodlike polymer chain and its characterization by light scattering methods to obtain the Frank elasticity coefficients and the Leslie-Ericksen viscosity coefficients. Observations on the flow behavior of this solution will be discussed in terms of these coefficients and a certain flow stability criterion available in the literature. Disclination defects observed during formation of the monodomain will also be discussed, along with the viscoelastic behavior of solutions exhibiting a highly textured structure (e.g., not a monodomain).

The lecture will include illustrations of disclinations and other textural features observed in the nematic solution study.

Guy C. Berry
Carnegie-Mellon University

*Wednesday, October 14, 8:30 AM*
Invited Presentation 6
**Inverse Scattering and Applications to Nonlinear Evolution Equations**

In recent years, there has been a resurgence of interest in the study of the inverse scattering associated with certain linear, ordinary and partial differential operators. The mathematical methods used to study these inverse problems are those of complex function theory, in particular, Riemann-Hilbert boundary value problems and the so-called DBAR method.

Applications are quite varied. Of particular interest is the fact that the techniques of inverse scattering are essential in the development of the exact solution of certain nonlinear evolution equations of physical interest, e.g. Korteweg-de Vries and Kadomtsev-Petriashvili equations for which soliton solutions (stable localized waves) exist.

The speaker will review some of the recent developments in the study of certain classes of inverse problems in one, two, and higher dimensions and their application to nonlinear waves.

Mark J. Ablowitz
Clarkson University

*Wednesday, October 14, 9:15 AM*
Invited Presentation 7
**Recent Progress in Theoretical Reflection Seismology: Identifying Partial Differential Equations from Attributes of Their Solutions**

The reflection seismic method provides images of the mechanical properties of crustal rocks, with resolution far exceeding that of other geophysical methods.

Through the 1960's, most emphasis in reflection data processing fell on the use of arrival time information of major reflections. In recent years, the availability of very high-quality recording devices, on the one hand, and of computers sufficiently powerful to process physically sophisticated models of seismic wave propagation, on the other hand, have stimulated much interest in the use of other aspects of the seismogram, particularly of the signal amplitude.

Suggestions for interpretation of seismic amplitudes have ranged from straightforward extension of conventional processing, based on simplified models, to complete fitting of the reflection seismogram, based on elastodynamics in inhomogeneous media. The more radical approaches bring to the fore questions of regularity and stability in the model/data relationship, which have been largely ignored in the past, but which will be critical in design of efficient algorithms. Techniques from hyperbolic partial differential equations, such as high-frequency asymptotics and energy estimates, and extensive numerical simulation have been applied to these problems, and the demands of geophysical phenomenology have in turn suggested the extension of these techniques in new directions, such as relaxation of smoothness requirements for coefficients.

The speaker will review work performed over the last few years in the United States and in Europe, which hs greatly clarified the nature of the model/data relationship.

William W. Symes
Rice University

# MEETING HIGHLIGHTS

## INVITED PRESENTATIONS

*Thursday, October 15, 1:30 PM*
Invited Presentation 8
**Graph Minor Algorithms: Path Routing and Coloring**

Questions in communications theory, theoretical computer science, operations research and in combinatorial mathematics can be formulated in terms of graphs, and thus graph theory has become a very important tool in the solution of routing problems and coloring problems. Some of these problems have produced a number of conjectures, some of which have remained unproven for more than thirty years.

For several years now, Neil Robertson and the speaker have been developing a theory of "graph minors". Although this research was mainly motivated from a "pure combinatorics" point of view (well-quasi-ordering) it has turned out to have several algorithmic consequences, two of which will be sketched here. Impractical, but low order, polynomial algorithms will be described for two specific problems:

(1) *The disjoint-path problem:* Given a graph, and, for example, ten pairs of vertices of it, to decide whether there are ten disjoint paths of the graph linking the pairs. The speaker will show an algorithm that exhibits such a set of disjoint paths.

(2) *An algorithmic version of Hadwiger's conjecture:* Given a graph, one wants to exhibit a ten-coloring of it, or to construct a bounded-size minor which is not colorable.

The algorithm developed by the speaker and his colleague produces a ten-coloring when each minor of the graph is ten-colorable.

Paul D. Seymour
Bell Communications Research

## SPECIAL PRESENTATIONS

*Wednesday, October 14, 2:00 PM*
The John von Neumann Lecture
**The Complexity of Parallel Computation**

Massive parallelism is widely seen as a highly promising approach to augmenting the effectiveness of computers. Many highly parallel computers have recently become commercially available, and intensive experimentation is being carried out to determine how computations can best be organized for execution on these machines. Concurrently with these experiments, computer science theoreticians have constructed and analyzed a variety of abstract models of parallel computers and have devised a number of principles for the construction of parallel algorithms. The speaker will review these efforts to provide a fundamental understanding of both the power and the intrinsic limitations of parallel computation. He will discuss several parallel algorithms chosen to illustrate the capabilities of various types of abstract parallel computing devices — boolean circuits, parallel random-access machines, alternating machines, vector machines, and sparsely interconnected networks of processors. He will use these examples to identify three classes of problems — those for which it is possible to obtain a speed-up over sequential computation by a factor proportional to the number of processors used; those for which extreme speed-up is possible, but only through the inefficient use of processors; and those for which extreme speed-up is not feasible at all.

Richard M. Karp
University of California, Berkeley

*Thursday, October 15, 11:00 AM*
The George Polya Prize Lecture
**Boolean Circuits and Computational Complexity**

The study of Boolean circuits provides a promising approach toward resolving fundamental open questions in computational complexity such as the P versus NP problem. In the last few years, significant progress has been made in deriving lower bounds to the size of Boolean circuits for performing certain computations. In particular, strong exponential lower bounds were proved for circuits of bounded depth, which has the implication that in certain computational models, each additional level of nondeterminism enables one to solve a strictly larger class of computational problems. Although several different methods are now known for proving results of this type, the idea of approximating functions by some subclass of functions plays an important role in all these methods. The speaker will review the recent advances in the study of Boolean circuits and discuss their implications for computational complexity. He will also conjecture on directions and prospects for future progress in this area.

Andrew C. Yao
Princeton University

## SPECIAL SESSIONS

**SPECIAL SESSION ON MULTIGRID METHODS**

This is a four-part series of lectures designed to provide the novice with a basic understanding of multigrid processes and principles (Sessions 1 and 2); to acquaint the participant with a selection of advanced topics in the area of adaptive methods and parallel computation, algebraic multigrid, and variational multigrid theory (Session 3); and to summarize recent advances that multigrid has made in areas other than partial differential equations (Session 4).

CHAIR AND ORGANIZER
Stephen McCormick
University of Colorado, Denver

Session 1
*Wednesday, October 14/10:30 AM*
**Tutorial on Basic Concepts**
William L. Briggs
University of Colorado, Denver

Session 2
*Wednesday, October 14/4:00 PM*
**Tutorial on Basic Concepts**
William L. Briggs
University of Colorado, Denver

Session 3
*Thursday, October 15/8:30 AM*
**Advanced Concepts**

**Adaptive Methods and Parallel Computation**
Stephen McCormick
University of Colorado, Denver
**Advanced Concepts Algebraic Multigrid (AMG)**
John Ruge
University of Colorado, Denver
**Advanced Concepts Variational Multigrid Theory**
Jan Mandel
University of Colorado, Denver

Session 4
*Thursday, October 15/2:45 PM*
**Recent Advances**
Achi Brandt
Weizmann Institute of Science

**FEDERAL FUNDING OF RESEARCH IN THE MATHEMATICAL SCIENCES**

The Federal government, through a number of its funding agencies, sponsors programs for basic and applied research in the mathematical sciences. The Interagency Committee for Extramural Mathematics Programs (ICEMAP) is the coordinating group for those agencies.

In a plenary session, the ICEMAP chairman will give a brief overview of federal funding for mathematical research and, with representatives of the funding agencies, discuss the funding patterns that are evolving in those agencies.

To facilitate questions and discussion about areas of common interest between attendees and the agencies, sessions have been scheduled for each of the agencies immediately following the plenary session on Tuesday,

# MEETING HIGHLIGHTS

October 13, and on Wednesday, October 14, 1987.

**ICEMAP Overview**
*Tuesday, October 13, 2:00 PM*
Chair: Jagdish Chandra
U.S. Army Research Office; and Chair, ICEMAP
An overview of trends in federal funding of research in the mathematical sciences, with special attention to funding patterns such as centers of excellence, large vs. small grants, individual vs. group support, focus programs, URI's, and issues peculiar to individual agencies.

**Discussion Sessions (concurrent sessions),**
Part 1 of 2
*Tuesday, October 13, 3:30 PM*
Division directors of the funding agencies that support research in the mathematical sciences will discuss their program plans and be available for questions and discussion.

National Science Foundation
Judith S. Sunley, Director
Division of the Mathematical Sciences

National Science Foundation
John W.D. Connolly, Director
Division of Advanced Scientific Computing

Army Research Office
Jagdish Chandra, Director
Mathematical Sciences Division

National Security Agency
Brent S. Morris, Director
Mathematical Sciences Program

**Discussion Sessions (concurrent sessions),**
Part 2 of 2
*Wednesday, October 14, 4:00 PM*
Division directors of the funding agencies that support research in the mathematical sciences will discuss their program plans and be available for questions and discussion.

Office of Naval Research
John R. Cannon, Head
Mathematics Division

Department of Energy
Don M. Austin, Manager
Applied Mathematical Sciences Program

Air Force Office of Scientific Research
Major James M. Crowley, Acting Director
Directorate of the Mathematical Sciences

Defense Advanced Research Projects Agency (to be confirmed)

## 1987 SIAM ANNUAL BUSINESS MEETING

The annual business meeting of SIAM will be held on Wednesday, October 14th, at 3:00 PM in Colorado Ballroom F.

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.

## MINISYMPOSIA

1. **Computational Advances at the NSF Supercomputer Centers**
John Connolly, National Science Foundation

2. **Numerical Methods for Viscous, Incompressible Flow**
John B. Bell, Lawrence Livermore Laboratory
Alan Berger, Naval Surface Weapons Center

3. **Research Issues in Robotics**
*(Sponsored by the SIAM Activity Group on Discrete Mathematics)*
John Hopcroft, Cornell University

4. **Dense Matrix Computation on Vector and Parallel Computers**
*(Sponsored by the SIAM Activity Groups on Linear Algebra and Supercomputing)*
Danny C. Sorensen, Argonne National Laboratory

5. **Science, Supercomputing and Graphics/Imaging**
*(Sponsored by the SIAM Activity Group on Supercomputing)*
Robert Wilhelmson, National Center for Supercomputing Applications, University of Illinois, Urbana-Champaign

6. **Sparse Matrix Computation on Vector and Parallel Computers**
*(Sponsored by the SIAM Activity Group on Linear Algebra)*
J. Alan George, Oak Ridge National Laboratory and University of Tennessee, Knoxville

7. **Ship Wave and Floating Body Problems**
Ralph Kleinman, University of Delaware

8. **Supercomputing Research: Scientific Results on the Cornell National Supercomputing Facility**
*(Sponsored by the SIAM Activity Group on Supercomputing)*
Lawrence Lee, Cornell University
Linda Morris, Cornell University

9. **Methods for Compressible Fluid Computations**
Phillip Colella, Lawrence Livermore National Laboratory
James Glimm, Courant Institute of Mathematical Sciences
David Sharp, Los Alamos National Laboratory

10. **Solitons and Coherent Structures**
David K. Campbell, Los Alamos National Laboratory

11. **Domain Decomposition Methods for Partial Differential Equations**
Roland Glowinski, University of Houston

12. **Optimization and Supercomputing**
*(Sponsored by the SIAM Activity Group on Optimization)*
Michael Healy, Boeing Computer Services

13. **Inverse Scattering Problems**
Roger Newton, Indiana University, Bloomington

14. **Mathematics of Robust Control Theory**
*(Sponsored by the SIAM Activity Group on Control and Systems Theory)*
John Doyle, California Institute of Technology

15. **Adaptive Mesh Refinements in Finite Element Methods**
James H. Bramble, Cornell University

16. **Integrated Environments for Scientific Computing**
Guy William Cherry, Tektronix Inc.

17. **Applications of Robust Control Theory**
*(Sponsored by the SIAM Activity Group on Control and Systems Theory)*
John Doyle, California Institute of Technology

18. **New Vector Algorithms for the IBM 3090 Vector Facility**
Fred Gustavson, IBM T.J. Watson Research Center

19. **Computational Geometry**
*(Sponsored by the SIAM Activity Group on Discrete Mathematics)*
Bernard Chazelle, Princeton University

20. **Combinatorial Optimization and Applications**
*(Sponsored by the SIAM Acivity Group on Discrete Mathematics)*
Bernhard Korte, Universitat Bonn

21. **Intersection Graphs and Their Applications**
*(Sponsored by the SIAM Activity Group on Discrete Mathematics)*
F. R. McMorris, Office of Naval Research and William T. Trotter, Arizona State University

22. **Finite Element Method in Meteorological and Oceanographic Flows**
Beny Neta, Naval Postgraduate School

23. **Complexity of Parallel and Distributed Computation**
*(Sponsored by the SIAM Activity Group on Discrete Mathematics)*
Eli Upfal, IBM Almaden Research Center

24. **The 1987 Mathematical Contest in Modeling**
Ben Fusaro, Salisbury State College

## SPECIAL EVENTS

**Welcoming Reception**
*Sunday, October 11   8:00 PM – 10:00 PM*
Prefunction Lobby
Cash Bar

**Beer and Taco Party**
*Monday, October 12   6:00 PM – 8:00 PM*
Prefunction Lobby
$10.00

**Heritage Square Dinner/ Show**
*Tuesday, October 13*
Heritage Square, Golden, Colorado
Buses leave hotel at 6:00 PM
$25.00

Heritage Square is reminiscent of an 1880's western mining town, complete with a delightful variety of specialty shops. The hilarious comedy show "Svengali", will be presented in the stately victorian dinner theatre on the square, called the Opera House. The unique G. William Oakley freely-adapted 19th century play combines hearty laughter and active audience participation to boo the villain, cheer the hero, and swoon over the heroine. Join in on cocktails, or browse the square, then enjoy the play, which will be preceded by a buffet dinner of soup, salad, carved roast beef, chicken teriyaki, trout or red snapper, duck, and a variety of vegetables, potatoes, stuffing, breads and desserts. Wine will be served with dinner.

## Saturday, October 10/PM

*5:00 PM/Colorado Corridor*
**Registration Opens for Short Course**

*10:00 PM/Colorado Corridor*
**Registration Closes**

## Sunday, October 11/AM

*7:30 AM/Colorado Ballroom Corridor*
**Registration opens for Short Course**

*9:00 AM/Colorado F*
**An Overview of Parallel Architecture and Algorithm Characteristics**
Robert Schnabel
University of Colorado, Boulder

*11:00 AM/Prefunction Lobby*
Coffee

*11:30 AM/Colorado F*
**Software Portability Issues for Parallel Environments**
Oliver McBryan
Courant Institute of Mathematical Sciences

## Sunday, October 11/PM

*12:30 PM/Colorado H-J*
Lunch

*2:00 PM/Colorado F*
**Managing Multiple Instruction Streams**
Harry Jordan
University of Colorado, Boulder

*4:00 PM/Prefunction Lobby*
Coffee

*4:30 PM/Colorado F*
**Numerical Applications on Parallel Machines**
Oliver McBryan
Courant Institute of Mathematical Sciences

*5:30 PM/Colorado F*
Discussion

*5:30 PM/Colorado Corridor*
**Registration Opens for Meeting**

*8:00 PM/Prefunction Lobby*
**Welcoming Reception**

*10:00 PM*
**Registration Closes**

## Monday, October 12/AM

*7:00 AM/Colorado Corridor*
**Registration Opens for Meeting**

*8:15 AM/Colorado F*
**Opening Remarks**
Hans F. Weinberger
Univerity of Minnesota, Minneapolis

*8:30 AM/Colorado F*
*Invited Presentation 1*
Chair: Robert G. Voigt
ICASE
NASA Langley Research Center

**Modeling the Earth System**
Francis P. Bretherton
National Center for Atmospheric Research

*9:15 AM/Colorado F*
*Invited Presentation 2*
Chair: Arthur Krener
University of California, Davis

**Robust Control Theory and Matrix Perturbation Problems**
John Doyle
California Institute of Technology

*10:00 AM/Prefunction Lobby*
Coffee

*10:30 AM*
CONCURRENT SESSIONS

*Minisymposium 1/Colorado F*
**Computational Advances at the NSF Supercomputer Centers**
Chair: John Connolly
National Science Foundation

*Minisymposium 2/Colorado I*
**Numerical Methods for Viscous, Incompressible Flow**
Chairs: John B. Bell, Lawrence Livermore National Laboratory and Alan E. Berger, Naval Surface Weapons Center

*Minisymposium 3/Denver 1*
**Research Issues in Robotics**
Chair: John E. Hopcroft
Cornell University

*Minisymposium 4/Denver 3*
**Dense Matrix Computation on Vector and Parallel Computers**
Chair: Danny C. Sorensen
Argonne National Laboratory

*Contributed Presentations 1/Denver 4*
**Classical Analysis 1**
Chair: Dan Zwillinger
Rensselaer Polytechnic Institute

*Contributed Presentations 2/Colorado G*
**Inverse Problems 1**
Chair: Andrew Yagle
University of Michigan, Ann Arbor

*Contributed Presentations 3/Colorado H*
**Data Analysis**
Chair: Richard I. Shrager
National Institutes of Health

## Monday, October 12/PM

*12:30 PM*
Lunch

*2:00 PM/Colorado F*
*Invited Presentation 3*
Chair: Jack Dongarra
Argonne National Laboratory

**Computational Hypersonic Aerodynamics**
Douglas Dwoyer
NASA Langley Research Center

*2:45 PM/Prefunction Lobby*
Coffee

*3:15 PM*
CONCURRENT SESSIONS

*Minisymposium 5/Colorado F*
**Science, Supercomputing, and Graphics/Imaging**
Chair: Robert B. Wilhelmson
National Center for Supercomputing Applications, University of Illinois, Urbana-Champaign

*Minisymposium 6/Colorado I*
**Sparse Matrix Computation on Vector and Parallel Computers**
Chair: J. Alan George
Oak Ridge National Laboratory and the University of Tennessee, Knoxville

*Minisymposium 7/Denver 1*
**Ship Wave and Floating Body Problems**
Chair: Ralph Kleinman
University of Delaware

*Contributed Presentations 4/Colorado G*
**Computational Geometry and Robotics**
Chair: Keith Phillips
New Mexico State University, Las Cruces

*Contributed Presentations 5/Colorado H*
**Classical Analysis 2**
Chair: Benjamin F. Esham, Jr.
Virginia Commonwealth University

*Contributed Presentations 6/Denver 3*
**Robust Control Theory**
Chair: Richard Rebarber
University of Nebraska, Lincoln

**Poster Session**/*Denver 4*

*6:00 PM/Prefunction Lobby*
**Taco and Beer Party**

# PROGRAM-AT-A-GLANCE

## Tuesday, October 13/AM

8:30 AM/Colorado F
Invited Presentations 4 and 5
Chair: John Nohel
University of Wisconsin, Madison

**Liquid Crystal Theory**
Jerry L. Ericksen
University of Minnesota

**Viscoelastic Properties of Rodlike Polymers in Solution**
Guy C. Berry
Carnegie-Mellon University

10:00 AM/Prefunction Lobby
Coffee

10:30 AM
CONCURRENT SESSIONS

Minisymposium 8/Colorado F
**Supercomputing Research: Scientific Results on the Cornell National Supercomputing Facility**
Chairs: Lawrence Lee, Cornell University
Linda Morris, Cornell University

Minisymposium 9/Colorado I
**Methods for Compressible Fluid Computations**
Chairs: Phillip Colella, Lawrence Livermore National Laboratory
James G. Glimm, Courant Institute of Mathematical Sciences
David H. Sharp, Los Alamos National Laboratory

Minisymposium 10/Denver 1
**Solitons and Coherent Structures**
Chair: David K. Campbell
Los Alamos National Laboratory

Minsymposium 11/Denver 3
**Domain Decomposition Methods for Partial Differential Equations**
Chair: Roland Glowinski
University of Houston

Contributed Presentations 7/Denver 4
**Systems and Control Theory 1**
Chair: Robert E. Scheid
Jet Propulsion Laboratory, Caltech

Contributed Presentations 8/Colorado G
**Matrix Algebra 1**
Chair: Alex Pothen
Pennsylvania State University

Contributed Presentations 9/Colorado H
**Optimization 1**
Chair: Richard A. Tapia
Rice University

## Tuesday, October 13/PM

12:30 PM
Lunch

2:00 PM/Colorado F
**ICEMAP Overview: Federal Funding of Research in the Mathematical Sciences**
Chair: Jagdish Chandra
Army Research Office; Chair, ICEMAP
    An overview of trends in federal funding of research in the mathematical sciences, with special attention to funding patterns such as centers of excellence, large vs. small grants, individual vs. group support, focus programs, URI's and issues peculiar to individual agencies.
    Division directors of the funding agencies that support research in the mathematical sciences will discuss their program plans and be available for questions and discussion.

3:00 PM/Prefunction Area
Coffee

3:30 PM
CONCURRENT SESSIONS

Minisymposium 12/Colorado F
**Optimization and Supercomputing**
Chair: Michael J. Healy
Boeing Computer Services

Minisymposium 13/Colorado I
**Inverse Scattering Problems**
Chair: Roger G. Newton
Indiana University, Bloomington

Minisymposium 14/Denver 1
**Mathematics of Robust Control Theory**
Chair: John Doyle
California Institute of Technology

Minisymposium 15/Denver 3
**Adaptive Mesh Refinements in Finite Element Methods**
Chair: James H. Bramble
Cornell University

Contributed Presentations 10/Denver 4
**Matrix Algebra 2**
Chair: John R. Gilbert
Cornell University and Chr. Michelsen Institute

Contributed Presentations 11/Colorado G
**Fluid Mechanics 1**
Chair: David R. Kassoy
University of Colorado, Boulder

Contributed Presentations 12/Colorado H
**Wave Propagation 1**
Chair: Robert L. Higdon
Oregon State University

ICEMAP Discussion Sessions: Part 1 of 2
**Discussion with Federal Program Managers**

National Science Foundation/Matchless Room
Judith S. Sunley, Director
Division of Mathematical Sciences

National Science Foundation/Gold Coin Room
John W. D. Connolly, Director
Division of Advanced Scientific Computing

Army Research Office/Nat Hill Room
Jagdish Chandra, Director
Mathematical Sciences Division

National Security Agency/Silver Heels Room
Brent S. Morris, Director
Mathematical Sciences Program

6:00 PM/Hotel Lobby
**Buses Leave for Heritage Square Dinner/Show**

## Wednesday, October 14/AM

8:30 AM/Colorado F
Invited Presentations 6 and 7
Chair: Peter Olver
University of Minnesota, Minneapolis

**Inverse Scattering and Applications to Nonlinear Evolution Equations**
Mark J. Ablowitz
Clarkson University

**Recent Progress in Theoretical Reflection Seismology: Identifying Partial Differential Equations from Attributes of their Solutions**
William W. Symes
Rice University

10:00 AM/Prefunction Lobby
Coffee

10:30 AM
CONCURRENT SESSIONS

**Special Session on Multigrid Methods**
1 of 4/Colorado F
**Tutorial on Basic Concepts**
Chair: William Briggs
University of Colorado, Denver

Minisymposium 16/Colorado I
**Integrated Environments for Scientific Computing**
Chair, Guy William Cherry
Tektronix Inc.

Minisymposium 17/Denver 3
**Applications of Robust Control Theory**
Chair: John Doyle
California Institute of Technology

Minisymposium 18/Denver 1
**New Vector Algorithms for the IBM 3090 Vector Facility**
Chair: Fred G. Gustavson
IBM T.J. Watson Research Center

Contributed Presentations 13/Colorado G
**Materials Science**
Chair: Timothy J. Burns
National Bureau of Standards

Contributed Presentations 14/Denver 4
**Inverse Problems 2**
Chair: E. Mark Haacke
Case Western Reserve University

Contributed Presentations 15/Colorado H
**Wave Propagation 2**
Chair: Robert K. Krueger
Iowa State University

# PROGRAM-AT-A-GLANCE

## Wednesday, October 14/PM

*12:30 PM*
Lunch

*2:00 PM/Colorado F*
*The John von Neumann Lecture*
Chair: C. William Gear
University of Illinois, Urbana-Champaign

**The Complexity of Parallel Computation**
Richard M. Karp
University of California, Berkeley

*3:00 PM/Colorado F*
**SIAM Business Meeting**

*3:30 PM/Prefunction Lobby*
Coffee

*4:00 PM*
CONCURRENT SESSIONS

*Special Session on Multigrid Methods 2 of 4/Colorado F*
**Tutorial on Basic Concepts**
Chair: William Briggs
University of Colorado, Denver

*Minisymposium 19/Colorado I*
**Computational Geometry**
Chair: Bernard Chazelle
Princeton University

*Minisymposium 20/Denver 1*
**Combinatorial Optimization and Applications**
Chair: Bernhard Korte
Universitat Bonn

*Contributed Presentations 16/Denver 4*
**Architectures and Languages for Parallel Processing 1**
Chair: Eric F. Van de Velde
California Institute of Technology

*Contributed Presentations 17/Colorado G*
**Systems and Control Theory 2**
Chair: Georges A. Becus
University of Cincinnati

*Contributed Presentations 18/Colorado H*
**Numerical Methods for ODE's and PDE's 1**
Chair: Dale H. Mugler
Santa Clara University

**ICEMAP Discussion Sessions:** *Part 2 of 2*
**Discussions with Federal Program Managers (continued)**

*Office of Naval Research/Matchless Room*
John R. Cannon
Head, Mathematics Division

*Department of Energy/Gold Coin Room*
Don M. Austin
Manager, Applied Mathematical Sciences
Program

*Air Force Office of Scientific Research/Nat Hill Room*
Major James. M. Crowley
Acting Director, Directorate of the
Mathematical Sciences

*Defense Advanced Research Projects Agency/Silver Heels Room*
(to be announced)

## Thursday, October 15/AM

*8:30 AM*
CONCURRENT SESSIONS

*Special Session on Multigrid Methods 3 of 4/Colorado F*
**Advanced Concepts**

**Adaptive Methods and Parallel Computation**
Stephen F. McCormick
University of Colorado, Denver

**Advanced Concepts Algebraic Multigrid**
John Ruge
University of Colorado, Denver

**Advanced Concepts Variational Multigrid Methods**
Jan Mandel
University of Colorado, Denver

*Minisymposium 21/Colorado I*
**Intersection Graphs and their Applications**
Chairs: F. R. McNorris
Office of Naval Research and
William T. Trotter
Arizona State University

*Minisymposium 22/Colorado H*
**Finite Element Method in Meteorological and Oceanographic Flows**
Chair: Beny Neta
Naval Postgraduate School

*Contributed Presentations 19/Denver 3*
**Architectures and Languages for Parallel Processing 2**
Chair: Robert E. Benner
Sandia National Laboratories

*Contributed Presentations 20/Colorado G*
**Optimization 2**
Chair: John E. Dennis, Jr.
Rice University

*Contributed Presentations 21/Denver 1*
**Mathematical Modeling**
Chair: Donald J. Rose
Duke University

*10:30 AM/Prefunction Lobby*
Coffee

*11:00 AM/Colorado F*
*The George Polya Prize Lecture*
Chair: Victor L. Klee
University of Washington

**Boolean Circuits and Computational Complexity**
Andrew C. Yao
Princeton University

## Thursday, October 15/PM

*12:00 PM*
Lunch

*1:30 PM/Colorado F*
*Invited Presentation 8*
Chair: Maria Klawe
IBM Almaden Research Center

**Graph Minor Algorithms: Path Routing and Coloring**
Paul Seymour
Bell Communications Research

*2:15 PM/Prefunction Lobby*
Coffee

*2:45 PM*
CONCURRENT SESSIONS

*Special Session on Multigrid Methods 4 of 4/Colorado F*
**Recent Advances**
Chair: Achi Brandt
Weizmann Institute of Science

*Minisymposium 23/Colorado I*
**Complexity of Parallel and Distributed Computation**
Chair: Eli Upfal
IBM Almaden Research Center

*Minisymposium 24/Denver 1*
**The 1987 Mathematical Contest in Modeling**
Chair: Ben Fusaro
Salisbury State College

*Contributed Presentations 22/Denver 3*
**Numerical Methods for ODE's and PDE's 2**
Chair: David E. Womble
Sandia National Laboratories

*Contributed Presentation 23/Denver 4*
**Fluid Mechanics 2**
Chair:
(to be announced)

*4:45 PM*
Meeting adjourns

# MINISYMPOSIA

## COMPUTATIONAL ADVANCES AT THE NSF SUPERCOMPUTER CENTERS

The National Science Foundation, through its initiative in advanced scientific computing, has established a national computational facility, consisting of five supercomputer centers and a national network.

This facility has opened up a whole new range of problems for researchers in all disciplines, which could not previously have been approached.

Several examples from the fields of geology, atmospheric science, astrophysics, materials sciences and molecular biology are presented in this minisymposium.

*Chair and Organizer*
John Connolly
National Science Foundation

**Supercomputing for Geophysical Imaging**
Larry Brown
Cornell University

**Supercomputing for Large Scale Environmental Problems**
Gregory McRae
Carnegie-Mellon University

**Supercomputing for Compressible Convection in Stars**
Juri Toomre
University of Colorado, Boulder

**Supercomputer Simulations of the New High Temperature Superconducting Materials**
Arthur Freeman
Northwestern University

**Supercomputer Simulations of Peptide Analogs for Drug Design**
Arnold Hagler
Agouron Institute, La Jolla

## NUMERICAL METHODS FOR VISCOUS, INCOMPRESSIBLE FLOW

Large scale modeling of viscous, incompressible flow raises a number of numerical difficulties. The momentum conservation equations form a nonlinear, convection-dominated parabolic system. The incompressibility condition imposes an additional elliptic constraint on the flow field. Straightforward discretizations of the system are plagued by spurious oscillatory behavior at high Reynolds number and lead to very large and poorly conditioned systems of nonlinear equations that must be solved to compute solutions. In this minisymposium we will discuss a number of discretization procedures that address these issues. In particular, the speakers will discuss high-resolution, non-oscillatory methods for convection-dominated problems and computationally effective ways of coupling these methods with the incompressibility constraint to obtain robust and efficient numerical procedures.

*Chairs and Organizers*
John B. Bell
Lawrence Livermore National Laboratory

and
Alan E. Berger
Naval Surface Weapons Center

**Numerical Solution of the Incompressible Navier-Stokes Equations for Shear-Layer Flows**
William Szymczak and Jay Solomon
Naval Surface Weapons Center

**Spectral Element Methods for Incompressible Navier-Stokes**
Anthony T. Patera
Massachusetts Institute of Technology

**The Reduced Basis Methods for Incompressible, Viscous Flow Calculations**
Max Gunzburger
Carnegie-Mellon University
and
Janet Peterson
Los Alamos National Laboratory

**A Second Order Projection Method for the Incompressible Navier-Stokes Equations**
John Bell and Phillip Colella
Lawrence Livermore National Laboratory
and
Harland M. Glaz
University of Maryland, College Park

## RESEARCH ISSUES IN ROBOTICS
*(Sponsored by the SIAM Activity Group on Discrete Mathematics)*

Robotics is a multi-disciplinary area encompassing research from fields such as computer science, cognitive sciences, and engineering. In addition to providing an understanding of the design of industrial robots, robotics is concerned with the more general tasks of representing, manipulating and reasoning about physical objects. This session discusses a wide range of research issues including control, compliance, navigation, sensing, and applications in design, manufacture, medicine, and space.

*Chair and Organizer*
John E. Hopcroft
Cornell University

**Formal Models for Motion Control**
Roger Brockett
Harvard University

**Some Frictional Problems of Peg-in-Hole Insertion**
Jacob T. Schwartz
Courant Institute of Mathematical Sciences

**Simulation of Physical Objects**
(to be presented by the Chair)

## DENSE MATRIX COMPUTATION ON VECTOR AND PARALLEL COMPUTERS
*(Sponsored jointly by the SIAM Activity Group on Linear Algebra and the SIAM Activity Group on Supercomputing)*

Dense linear algebra problems are important in scientific computing. Therefore it is of interest to assess the performance of modern computers on these problems. The theme of this minisymposium is to survey the state-of-the-art for solving dense problems on various computer architectures. The architectures that will be represented are large-scale shared memory hierarchy, parallel vector processors, local memory message passing, and systolic arrays of processors. The speakers will present a discussion of the solution of standard problems such as solving $Ax = b$ (A real, nonsymmetric), and, within this framework, will discuss architectural features that dictate the choice of algorithm.

*Chair and Organizer*
Danny Sorensen
Argonne National Laboratory

**Dense Matrix Calculations on the Cedar Multiprocessor**
Ahmed Sameh
University of Illinois, Urbana

**Parallel Matrix Computations on Hypercubes**
Michael T. Heath
Oak Ridge National Laboratory

**SVD Computation on Systolic Machines**
Franklin T. Luk and Haesun Park
Cornell University

**Dense Linear Algebra on High Performance Computers**
Jack J. Dongarra and Danny Sorensen
Argonne National Laboratory

## SCIENCE, SUPERCOMPUTING, AND GRAPHICS/IMAGING
*(Sponsored by the SIAM Activity Group on Supercomputing)*

For many researchers, the vast amount of data associated with using the supercomputer requires an ability to visualize the data in a variety of ways, depending on the particular subjects being investigated. Four researchers have been selected to give talks on the role of graphics and imaging in scientific discovery and supercomputing. The speakers will discuss the importance of graphics and imaging in their work, and in particular how the use of graphics and imaging techniques have enhanced their ability to study the data and to foster new discoveries.

*Chair and Organizer*
Robert B. Wilhelmson
National Center for Supercomputing Applications
University of Illinois, Urbana-Champaign

**Flows Through Complex Geometries**
Richard N. Ellson
Eastman Kodak Company

**Numerical Simulation of Interacting Cosmic Strings**
Richard Matzner
University of Texas, Austin

**Molecular Modeling and Human Interaction**
Mike Pique
Scripps Clinic

**(title to be determined)**
Karl-Heinz Winkler
Los Alamos National Laboratory

*Monday, October 12, 3:15 PM*
*Minisymposium 6/Colorado I*

## SPARSE MATRIX COMPUTATION ON VECTOR AND PARALLEL COMPUTERS

*(Sponsored by the SIAM Activity Group on Linear Algebra)*

New computer architectures are making it necessary for researchers in scientific computation generally, and those in (sparse) numerical linear algebra in particular, to study problems in communication networks, load balancing, software portability, and related issues. Many effective sparse matrix algorithms access the data in ways that cannot be predicted before the algorithm is executed. Thus, it is difficult to determine how to map the problem onto the processors. On the positive side, orderings for sparse matrices that are ideal for serial machines in the sense of reducing arithmetic and fill-in also turn out to be desirable when using multiprocessors. Some methods which appear to be inferior when using serial computers are much more desirable when used on a multiprocessor. This minisymposium will feature speakers who are active contributors in the field of sparse matrix computation, and who will attempt to present some of the important ideas currently being developed for solving large sparse systems of equations on multiprocessors.

*Chair and Organizer*
J. Alan George
Oak Ridge National Laboratory and
The University of Tennessee, Knoxville

**Sparse Cholesky Factorization for the Hypercube**
Robert Schreiber
Rensselaer Polytechnic Institute

**Direct Solution of Sparse Linear Systems on Multiprocessors**
Esmond Ng
Oak Ridge National Laboratory

**Parallel Combinatorial Algorithms in Sparse Matrix Computation**
John R. Gilbert
Cornell University and Chr. Michelsen Institute

**Parallel Sparse Matrix Computation for Discrete Elliptic Problems**
Howard C. Elman
University of Maryland, College Park

*Monday, October 12, 3:15 PM*
*Minisymposium 7/Denver 1*

## SHIP WAVE AND FLOATING BODY PROBLEMS

This minisymposium focuses on problems of surface waves and their interaction with ships. Different approaches and problems attendant to the forward speed of the ship, including zero, moderate and high speeds will be highlighted. The various velocity regimes lead to different mathematical models and this minisymposium is intended to delineate these differences. Particular attention will be paid to the numerical solution of the equations resulting from these models.

*Chair and Organizer*
Ralph Kleinman
University of Delaware

**The Near Field Term in the Green Function for Ship Waves**
Francis Noblesse and John Telste
David Taylor Naval Ship Research and Development Center

**Numerical Analysis of Panel Methods for Convective Free Surface Flows**
Paul Sclavounos
Massachusetts Institute of Technology

**An Analytic Approach to Very High Speed Flat Ship Theory**
Susan Cole
Rensselaer Polytechnic Institute

**On a Boundary Integral Equation for the Two-Dimensional Floating Body Problem**
George Hsiao
University of Delaware

*Tuesday, October 13, 10:30 AM*
*Minisymposium 8/Colorado F*

## SUPERCOMPUTING RESEARCH: SCIENTIFIC RESULTS ON THE CORNELL NATIONAL SUPERCOMPUTING FACILITY

*(Sponsored by the SIAM Activity Group on Supercomputing)*

Three researchers whose work has been significantly impacted by access to the Cornell Supercomputer will describe their projects, discussing what role the supercomputer played, what algorithmic techniques were employed, and what progress was achieved. The director of the CNSF, Lawrence Lee will introduce the speakers and provide first the backdrop against their work. He will describe the resources available at CNSF and the Cornell Center for Theory and Simulation in Science and Engineering (Theory Center). The CNSF is one of five NSF-funded supercomputer centers that provide unique resources to a national user community. The speaker will describe the parallel processing capabilities and the extensive memory that characterize the CNSF. Currently, the CNSF supports over 700 users working on over 200 research projects representing a broad range of disciplines.

*Organizer*
Linda Morris
Cornell University

*Chair*
Lawrence Lee
Cornell University

**Multi-Grid Solution of the Euler Equations for Transonic Flow Problems**
David A. Caughey
Cornell University

**Chaotic Dynamics in Mechanical Systems and Large Space Structures**
Francis C. Moon
Cornell University

**Mathematics Population and Communities**
Simon A. Levin
Cornell University

*Tuesday, October 13, 10:30 AM*
*Minisymposium 9/Colorado I*

## METHODS FOR COMPRESSIBLE FLUID COMPUTATIONS

Hybrid computational methods can combine the best features of several distinct approaches. For the Grand Unified Scheme (GUS) of compressible fluid dynamics, this session will present upwind, tracked, adaptive and asymptotic methods and hybrid ideas for their combination.

*Chairs and Organizers*
Phillip Colella
Lawrence Livermore National Laboratory
James G. Glimm
Courant Institute of Mathematical Sciences
David H. Sharp
Los Alamos National Laboratory

**Front Tracking and Shock-Contact Interactions**
John W. Grove
Courant Institute of Mathematical Sciences

**Discontinuity-Capturing Techniques Applied to Unstable Fluid Flow**
Paul R. Woodward and Jeffrey A. Pedelty
University of Minnesota
Karl-Heinz Winkler
Los Alamos National Laboratory
and
Norman J. Zabusky
University of Pittsburgh

**Detonation Failure as a Bifurcation Problem**
James W. Jones
Los Alamos National Laboratory

**Adaptive Grid Methods for Numerical Weather Prediction**
Joseph Oliger, William Skamarock and Robert Street
Stanford University

*Tuesday, October 13, 10:30 AM*
*Minisymposium 10/Denver 1*

## SOLITONS AND COHERENT STRUCTURES

This minisymposium will present three sets of novel and useful results clarifying the relations between the solitons found in completely integrable nonlinear PDE's and the more general persistent spatially, localized "coherent structures" observed in both non-integrable PDE's and real physical systems such as turbulent fluid flows. These results include (1) the non-existence of multi-soliton solutions in certain non-integrable PDE's; (2) the geometry and "collective coordinates" natural for the description of the weakly perturbed Sine-Gordon system; and (3) the use of "mode reduction" techniques to explain the dynamics of turbulent boundary layers in terms of "coherent structures" whose motion is controlled by a (small) finite set of coupled ODE's.

*Chair and Organizer*
David K. Campbell
Los Alamos National Laboratory

**Multi-Soliton Solutions in Non-Integrable Theories: Asymptotics Beyond All Orders**
Harvey Segur
Aero Research Association of Princeton

# MINISYMPOSIA

**Perturbed Sine-Gordon Equations: Geometry and Finite Mode Truncations**
Greg Forest
Ohio State University

**Dynamics of Coherent Structures in Boundary Layers**
Phillip Holmes
Cornell University

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*Tuesday, October 13, 10:30 AM*
*Minisymposium 11/Denver 3*

## DOMAIN DECOMPOSITION METHODS FOR PARTIAL DIFFERENTIAL EQUATIONS

The main goal of this minisymposium is to review the recent progresses done in a very active field of scientific computing since the meeting held in France on the same topics last January. The four lectures by J. Pasciak, J. Periaux, M. F. Wheeler, and O. Widlund will discuss the theoretical aspects of domain decomposition methods (convergence of the associated iterative techniques, approximation questions) as well as the practical aspects (applications to reservoir and aerospace engineerings).

*Chair and Organizer*
Roland Glowinski
University of Houston, University Park

**Domain Decomposition and Mixed Finite Elements**
Mary F. Wheeler
Rice University

**(title to be determined)**
J. E. Pasciak
Brookhaven National Laboratory

**Domain Decomposition in Aerospace Fluid Dynamics**
J. Periaux
Avions Marcel Dassault

**(title to be determined)**
O. Widlund
Courant Institute of Mathematical Sciences

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*Tuesday, October 13, 3:30 PM*
*Minisymposium 12/Colorado F*

## OPTIMIZATION AND SUPERCOMPUTING
*(Sponsored by the SIAM Activity Group on Optimization)*

The current generation of supercomputers represents the rapidly-evolving state-of-the-art in architectural parallelism. This generation has appeared concomitantly with a maturing state-of-the-art in numerical optimization. Applications are growing in size to take advantage of recent advances in optimization algorithms. The new challenge in algorithm development is to exploit parallelism to allow larger, more difficult applications problems to be solved. In this minisymposium four speakers will present their experiences with implementing optimization algorithms on a variety of architectures.

*Chair and Organizer*
Michael J. Healy
Boeing Computer Services

**Vectorization and Multitasking of Nonlinear Network Programming Algorithms**
Stavros A. Zenios
The Wharton School, University of Pennsylvania

**Parallel Newton Methods for Mathematical Programming Problems**
Jong-Shi Pang
The University of Texas, Dallas

**Algorithms for Nonlinear Equations and Least Squares on a Hypercube**
Thomas F. Coleman
Cornell University

**Supercomputers and An Efficient Implementation of Karmarkar's Algorithm**
Stephen Chen
AT&T Bell Laboratories
Holmdel, NJ

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*Tuesday, October 13, 3:30 PM*
*Minisymposium 13/Colorado I*

## INVERSE SCATTERING PROBLEMS

This minisymposium is expected to present an overview of the present state of the inverse scattering problems for several different linear differential equations of physical interest. In this problem one infers, if possible, the coefficient functions in the differential equation from asymptotic data of its physically interesting solutions. The method has applications in seismology, non-destructive testing, particle scattering, as well as for the solution of certain nonlinear evolution equations.

*Chair and Organizer*
Roger G. Newton
Indiana University, Bloomington

**An Overview of Multidimensional Inverse Scattering for the Schrödinger Equation**
(to be presented by the Chair)

**Impedance Scattering Theory**
Pierre C. Sabatier
Universite des Sciences et Techniques du Languedoc, France

**The $\bar{\partial}$ Method in Multidimensional Inverse Problem**
Adrian Nachman
University of Rochester

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*Tuesday, October 13, 3:30 PM*
*Minisymposium 14/Denver 1*

## MATHEMATICS OF ROBUST CONTROL THEORY
*(Sponsored by the SIAM Activity Group on Control and Systems Theory)*

The general problem area of this minisymposium is the mathematics of robust control theory (RCT), with the focus on operator-theoretic methods. In the last decade or so there has been a major effort to extend linear optimal control theory beyond the previous limited scope to include much richer classes of models in performance objectives. This effort has been driven by applications needs and the failure of existing theory to treat practical issues, such as model uncertainty. The result has been the introduction into the control community of not only more applicable theory, but also a substantial amount of new

and powerful mathematics. This minisymposium will expand on the plenary address and explore in more detail the mathematics of RCT, including theories of non-self adjoint operators, Hankel operators, Hardy spaces, generalized interpolation and convex programming. Applications of these methods to engineering problems will be considered in the companion minisymposium.

*Chair and Organizer*
John Doyle
California Institute of Technology

**Operator Approximation Problems in Optimal Control**
Bruce Francis
University of Toronto

**Linear Controller Design Via Convex Optimization**
Stephen Boyd
Stanford University

**Generalized Interpolation Theory in Control**
Allen Tannenbaum
University of Minnesota

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*Tuesday, October 13, 3:30 PM*
*Minisymposium 15/Denver 3*

## ADAPTIVE MESH REFINEMENTS IN FINITE ELEMENT METHODS

In many problems of mathematical interest, the solution exhibits some type of singular behavior. The aim of adaptive mesh techniques is to develop nonuniform meshes, specific to the problem at hand, that lead to uniformly accurate solutions. The speakers will consider various types of local refinements and their relation to the global error. Self-adaptive refinements will also be considered. Some techniques for incorporating refinements for solving the resulting discrete equations will be discussed.

*Chair and Organizer*
James H. Bramble
Cornell University

**The Effect of Grid Refinements on the Accuracy of the Finite Element Method**
A. H. Schatz
Cornell University

**Expert System, Feedback and Adaptive Approaches in Finite Element Method**
Ivo Babuska
University of Maryland, College Park

**Recent Results in Adaptive Local Mesh Refinement**
Randolph E. Bank
University of California, San Diego

**A Pre-Conditioning Technique Toward the Efficient Solution of Problems with the Local Grid Refinement**
J. Pasciak
Brookhaven National Laboratory

# MINISYMPOSIA

## INTEGRATED ENVIRONMENTS FOR SCIENTIFIC COMPUTING

An integrated computing environment is a highly interactive system in which a user can easily manipulate data and perform "experiments" without the tedium of writing and debugging programs. Recent hardware and software advances such as bitmap displays and window systems have greatly enhanced such environments, making it possible for the user to manage many pieces of data (both text and graphics) on the screen simultaneously. Such environments have recently become available for doing various types of mathematical computing (e.g. MATLAB, MathCAD, MathScribe). The purpose of this minisymposium is to explore what issues this technology must face in the next 5 years in order to build useful systems for scientists and engineers.

*Chair and Organizer*
Guy William Cherry
Tektronix Inc.
Beaverton, OR

**Gentran**
Paul Wang
Kent State University

**MATLAB**
Cleve Moler
Intel Corporation and
Dana at Sunnyvale

**MathCAD**
Josh Bernoff
Math Soft, Cambridge, MA

**Camino Real**
Dennis Arnon
Xerox Palo Alto Research Center

**Future Directions in MathScribe**
N. Soiffer
Tektronix Inc.
Beaverton, OR

## APPLICATIONS OF ROBUST CONTROL THEORY
*(Sponsored by the SIAM Activity Group on Control and Systems Theory)*

The general problem for this minisymposium is applications of robust control theory. The emphasis will be on applications of the mathematical methods described in the invited talk by the organizer and the companion minisymposium. In contrast to the so-called theory-practice gap of the seventies, these new methods are quickly finding their way into applications programs, including the space shuttle and H-64 LHX helicopter. Additional design studies are concerned with high purity distillation columns, catalytic reactors, F-15 SMTP, F-16XL, oblique-wing research aircraft, and a ground-based flexible space structure experiment. This minisymposium will feature experts in these application areas.

*Chair and Organizer*
John Doyle
California Institute of Technology

**Chemical Process Control**
Manfred Morari
California Institute of Technology

**Aerospace Control**
Gunter Stein
Honeywell Corp.
and Massachusetts Institute of Technology

## NEW VECTOR ALGORITHMS FOR THE IBM 3090 VECTOR FACILITY

We describe new vector algorithms for elementary functions, matrix algebra, and fast Fourier transform. These algorithms should perform very well on most vector architectures and are particularly well suited for vector machines with a cache based memory. Some of the algorithms are part of ESSL which is a set of high performance vector routines for the IBM 3090 vector facility. The talks will cover overviews of the 3090 vector hardware and ESSL, very fast and accurate (to the last bit) table based vector elementary functions for S/370 arithmetic, super fast matrix multiply, fast solution of dense linear systems, and fully vectorized mixed radix FFT.

*Chair and Organizer*
Fred G. Gustavson
IBM T. J. Watson Research Center

**A Vector Implementation of the Mixed-Radix FFT on IBM 3090 VF**
Ramesh C. Agarwal
IBM T. J. Watson Research Center

**An Overview of ESSL on the 3090 Vector Facility**
Stanley Schmidt
IBM Kingston

**New Vector Linear Algebra Algorithms for the IBM 3090 Vector Facility**
(to be presented by the chair)

**New Super Fast Vector Matrix Multiplication Algorithms for the IBM 3090 Vector Facility**
Ramesh C. Agarwal
IBM T. J. Watson Research Center

## COMPUTATIONAL GEOMETRY
*(Sponsored by the SIAM Activity Group on Discrete Mathematics)*

Over the last decade, the study of geometric algorithms, commonly known as computational geometry, has emerged as one of the most dynamic areas of research in computer science. Computational geometry seeks answers to fundamental questions in fields such as computer graphics, robotics, and pattern recognition. Its close relationship with these application areas has led to a constant flow of practical problems with deep theoretical bearings. As a result, in addition to establishing itself as a major area within theoretical computer science, computational geometry has provided new impetus for many old

combinatorial problems in discrete geometry. This minisymposium will provide an overview of the general area of geometric algorithms, and a survey of some of the most recent developments.

*Chair and Organizer*
Bernard Chazelle
Princeton University

**The Multiaffine Blossoms of Béziers and B-Splines**
Lyle Ramshaw
Digital Equipment Corporation/SRC Palo Alto

**Davenport-Schinzel Sequences and Their Geometric Applications**
Micha Sharir
Courant Institute of Mathematical Sciences,
New York University

**Current Trends in Computational Geometry**
(to be presented by the Chair)

## COMBINATORIAL OPTIMIZATION AND APPLICATIONS
*(Sponsored by the SIAM Activity Group on Discrete Mathematics)*

This session will focus on combinatorial optimization and its applications to large-scale practical problems. The papers illustrate how recent theoretical developments can be applied to increase the size of the problems which are practically solvable. The speakers will focus on applications in physics, classical applications of combinatorial optimization like the travelling salesman problem and matchings, and on applications in the design of layout of VLSI-logic chips (metalogic).

*Chair and Organizer*
Bernhard Korte
Universität Bonn

**Spin Glasses and Max Cut in Toroidal Graphs**
F. Barahona
University of Waterloo

**On the Travelling Salesman Polytope**
V. Chvátal
Rutgers University
and
W. Cook
Columbia University

**Combinatorial Optimization and VLSI Design**
(to be presented by the Chair)

**Geometric Duality and Euclidean Matchings**
M. Jünger
Universität Augsburg
and
W. R. Pulleyblank
University of Waterloo

# MINISYMPOSIA

*Thursday, October 15, 8:30 AM*
*Minisymposium 21/Colorado I*

### INTERSECTION GRAPHS AND THEIR APPLICATIONS
*(Sponsored by the SIAM Activity Group on Discrete Mathematics)*

Intersection graphs arise quite naturally when graphs are used to model physical phenomena in a biological, chemical, physical, and social sciences. In addition, many applications have their origins in communications and signal processing. In this minisymposium, we highlight recent research on intersection graphs and outline directions for future research. The presentations will feature both the wide range of applications of intersection graphs and their intrinsic mathematical value.

*Organizers*
F. R. McMorris
Office of Naval Research
and
William T. Trotter, Jr.
Arizona State University
*Chair*
F. R. McMorris

**Intersection Graphs — Some New Directions**
William T. Trotter, Jr.

**An Evolution of Interval Graphs**
Edward R. Scheinerman
The Johns Hopkins University

**The Total Interval Number of A Graph**
Douglas B. West
University of Illinois, Urbana

**Applications of Intersection Graphs**
Fred S. Roberts
Rutgers University

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*Thursday, October 15, 8:30 AM*
*Minisymposium 22/Colorado H*

### FINITE ELEMENT METHOD IN METEOROLOGICAL AND OCEANOGRAPHIC FLOWS

In the last few years the application of the finite-element method to meteorological and oceanographic flows has passed to the stage of increased applicativity. Irregularly shaped domains and the variable resolution capability allow the finite-element method a flexibility edge over other discretization methods. This minisymposium will emphasize new advances in the application of the finite-element method, in particular for near-shore currents, numerical weather prediction and oceanographic applications.

*Chair and Organizer*
Beny Neta
Naval Postgraduate School

**Finite Element Models of Fluid Flows**
J. N. Reddy
Virginia Polytechnic Institute and State University

**A Highly Accurate Finite Element Method for Solving the Shallow-Water Equations**
I. Michael Navon
Florida State University

**Finite Elements for Regional Modeling**
Andrew Staniforth
Environment Canada

**Some Cost Effective Numerical Procedures for Finite Element Models of the Planetary Boundary Layer**
Robert L. Lee, John M. Leone, Jr., Stevens T. Chan and Philip M. Gresho
Lawrence Livermore National Laboratory

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*Thursday, October 15, 2:45 PM*
*Minisymposium 23/Colorado I*

### COMPLEXITY OF PARALLEL AND DISTRIBUTED COMPUTATION
*(Sponsored by the SIAM Activity Group on Discrete Mathematics)*

This session is devoted to recent advances in the theory of parallel and distributed computation. While research in the theory of parallel computation is mainly devoted to efficient parallelization of the computation, there is a growing interest in graph theoretical questions related to the efficient implementation of parallel computation on networks of processors. This minisymposium offers a survey of recent significant results in both directions of research mentioned above. It should to be of interest to a general audience, as well as to experts in the field.

*Chair and Organizer*
Eli Upfal
IBM Almaden Research Center

**Deterministic Simulation of Idealized Parallel Computers on More Realistic Ones**
H. Alt
Freie Universität Berlin
T. Hagerup, K. Mehlhorn
Universität des Saarlandes
and
F. P. Preparata
University of Illinois

**Efficient Parallel Algorithms Theory and Practice**
John Reif
Duke University

**Constructing Disjoint Paths on Expander Graphs**
David Peleg
Stanford University
and
Eli Upfal
IBM Almaden Research Center

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*Thursday, October 15, 2:45 PM*
*Minisymposium 24/Denver 1*

### THE 1987 MATHEMATICAL CONTEST IN MODELING

MCM, the Mathematical Contest in Modeling, originated with the SIAM Education Committee, and held its first contest in 1985. Ninety solution papers were submitted then. MCM 1986 drew 118 solution papers, and at MCM 1987, a total of 156 solution papers were submitted. In these contests, a team of three undergraduates is given a full weekend to choose and work on one of two applied problems. Computers and libraries may be used. In this minisymposium, three solutions will be presented by the three winning student teams, in addition to the presentation by the chair.

*Chair and Organizer*
Ben Fusaro
Salisbury State College

**An Introduction to the Mathematical Contest in Modeling**
(to be presented by the Chair)

**Salt Pile Stability**
Dan Schroeder, Tom Stone and Danny Wendt
(MCM Advisor, R. M. Jeppson)
Moorhead State University

**The Salt Problem — Making a Mountain out of Molehills**
Daniel Quinlan, Jon Stoffel and Chris Sweeney
(MCM Advisor, W. L. Briggs)
University of Colorado, Denver

**Third Student Team**
(to be determined)

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*Special Notice to Contributed Presentation Authors and Chairmen 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 underlineation is used to denote the author who will present the paper.*

# CONTRIBUTED PRESENTATIONS

*Monday, October 12/10:30 AM*
*Contributed Presentations 1/Denver 4*
**CLASSICAL ANALYSIS 1**

**Steady State Solutions of the Semiconductor Equations Including a Magnetic Field**
Wang Yuanming, Nanjing Institute of Technology People's Republic of China

**Statistical Mechanics of Mesoscale Behaviour**
Dan Zwillinger and Steven P. Marsh Rensselaer Polytechnic Institute

**Bounds on the Cardinality of Minimal 2-Coverings of Finite Euclidean Spaces**
Jaya Srivastava, Colorado State University

**Composition Operators on Hardy Space**
Yusun Tong, University of Minnesota, Minneapolis

**A Singular Perturbation Problem on the Existence of Periodic Orbits for**
$\varepsilon^2\ddot{u} + \dot{u} = u(1 - u)$
Mohammad Riazi-Kermani, Fort Hays State University

**On the Method of Matched Asymptotic Expansions**
D. S. Naidu, Old Dominion University and D. B. Price, NASA Langley Research Center

**Homotopy Method for General A-Matrix Problems**
Moody T. Chu, North Carolina State University, T. Y. Li, Michigan State University and Tim Sauer, George Mason University

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*Monday, October 12/10:30 AM*
*Contributed Presentations 2/Colorado G*
**INVERSE PROBLEMS 1**

**Differential and Integral Methods for Three-Dimensional Inverse Scattering Problems with a Non-Local Potential**
Andrew E. Yagle, University of Michigan, Ann Arbor

**New Characteristic Iterations for Solving Inverse Problems of Wave Equation**
Ganquan Xie, Hunan Computer Technology Research Institute, People's Republic of China

**Connections Between Three-Dimensional Inverse Scattering and Linear Estimation of Random Fields**
Andrew E. Yagle, University of Michigan, Ann Arbor

**On the Resonances and the Inverse Scattering Problem for Perturbed Wave Equations**
Gustavo Perla Menzala, National Laboratory for Scientific Computation, Brazil

**Differential Methods of Multi-Dimensional Inverse Scattering Problems**
Andrew E. Yagle, University of Michigan, Ann Arbor

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*Monday, October 12/10:30 AM*
*Contributed Presentations 3/Colorado H*
**DATA ANALYSIS**

**A Classical Approach to Uncertain Multivariable Systems**
Haniph A. Latchman, University of Florida

**A Parameter Estimation Analysis of Data from an Insect Dispersal Experiment**
Lee L. Zia, University of New Hampshire

**The SEF of an EEG by DFT**
Richard I. Shrager, National Institutes of Health

**MIMO Transfer Function Curve Fitting Using Chebyshev Polynomials**
R. Lane Dailey and Michael S. Lukich, TRW Electronics and Defense

**Characterizing Chaos from Experimental Data**
Eric J. Kostelich, University of Texas, Austin, James A. Yorke, University of Maryland

**Martingale Representation, Malliavin Calculus and Filtering**
Robert J. Elliott, University of Alberta and Michael Kohlmann, Universitat Konstanz, West Germany

**Updating the Fisher Linear Discriminant Method**
Richard M. Crownover, University of Missouri, Columbia

**Circular Segments Curve Fitting on Sine-Bar Data**
Donald W. Fausett, Laurene V. Fausett and Gary W. Howell, Florida Institute of Technology

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*Monday, October 12/3:15 PM*
*Contributed Presentations 4/Colorado G*
**COMPUTATIONAL GEOMETRY AND ROBOTICS**

**Detection and Analysis of Intensity Changes with a Nonlinear Second Order Operator**
Zhiyong Zhao and Keith Phillips, New Mexico State University, Las Cruces

**Plotting Contour Surfaces of a Function of Three Variables**
Granville Sewell, University of Texas, El Paso

**Linear-time Recognition of Similar Shapes**
Tom Altman, University of Kentucky

**The Definition, Editing, Sectioning, and Contouring of Tensor-Product B-Spline Surfaces**
Richard H. Bartels and Robert K. Dickinson, University of Waterloo

**Grid Generation on Surfaces and Curves**
Stanly Steinberg, University of New Mexico and Patrick Roache, Ecodynamics Inc.

**Analytical Properties of Swept Surfaces**
Joseph Pegna and Douglass J. Wilde, Stanford University

**A Dataflow Multiprocessor Architecture for Robot Control**
A. Katbab and S. Geffin, University of Miami

**Repeatability of Redundant Manipulators: Mathematical Solution of the Problem**
T. Shamir, Weizmann Institute of Science, Israel and Y. Yomdin, Ben Gurion University of the Negev, Israel

**Robotics Vision Versus Biovision**
Peter Mbaeyi, Tuebingen, West Germany

**Tracking in Constrained State Space and Its Application in Robotics**
Jia-Yuan Han, Southern Illinois University

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*Monday, October 12/3:15 PM*
*Contributed Presentations 5/Colorado H*
**CLASSICAL ANALYSIS 2**

**Bounds On Polynomial Roots**
E. C. Bekir, Rockwell International

**Computer Determination of an Upper Bound for a Derivative of a Function on a Bounded Domain**
Xingren Ying and I. Norman Katz, Washington University

**Superconvergent Derivatives: A Taylor Series Analysis**
R. J. MacKinnon and G. F. Carey, University of Texas, Austin

**Hyperbolic-Parabolic Singular Perturbations for Scalar Nonlinearities**
Benjamin F. Esham, Jr., Virginia Commonwealth University and Richard J. Weinacht, University of Delaware

**A Fast Algorithm for Rational Interpolation Via Orthogonal Polynomials**
Omer Egecioglu and Cetin K. Koc, University of California, Santa Barbara

**Elementary First Integrals of Differential Equations**
Roman Shtokhamer and Bob F. Caviness, University of Delaware

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*Monday, October 12/3:15 PM*
*Contributed Presentations 6/Denver 3*
**ROBUST CONTROL THEORY**

**Modal Stability of Perturbed Matrices**
David Bensoussan, Universite du Quebec

**Adaptive Controller for the Puma 560 Robot**
H. Li and Y. Shamash, Washington State University

**OPUS (Optimal Projection for Uncertain Systems): A Unified Approach to Fixed-Order, Robust Control Design**
Dennis S. Bernstein, Harris Corporation

**Observer Based Compensator Design for Distributed Parameter Systems**
Gareth J. Knowles, Texas Tech University

**Design of Robust Controllers for Uncertain Systems Using an Observer**
William E. Schmitendorf, Northwestern University

**A Feedback Passivity Constraint For Robust Adaptive Control of ARMAX Systems**
David C. Swanson, AVCO Research Laboratory-TEXTRON

**Robust Controller Design for a Class of Interconnected Systems**
Rajab Challoo and M. Edwin Sawan, Wichita State University

**Eigenvalue Specification for a Class of Distributed Parameter Control Systems**
Richard Rebarber, University of Nebraska, Lincoln

**Stability Margin for Continuous Two-Dimensional Systems**
Masoud Shafiee, Louisiana State University

*Attention Attendees at the Multigrid Methods Minisymposia*

*—A companion book to the Briggs Multigrid Tutorial to be held on Wed., Oct. 14.*

### A Multigrid Tutorial

**William L. Briggs**

*xiii + 100 estimated pages      Softcover*
*54 illustrations      ISBN 0-89871-221-1*

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 analyzed, 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. The standard multigrid schemes are then presented. The tutorial concludes with an explanation of "why multigrid works."

*List price $13.50*
*SIAM member price $10.80*
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### Multigrid Methods

**Edited by Stephen F. McCormick**

Vol. 3 of the SIAM Frontiers in Applied Mathematics
*xx + 272 estimated pages      Hardcover*
*22 illustrations      ISBN 0-89871-214-9*

A thoughtful consideration of the current level of development of multigrid methods, this volume 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 use of 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 for variationally posed problems. Included as an appendix is the latest edition of the Multigrid Bibliography, an attempted compilation of all existing research publications on multigrid.

*Price to be determined*

*—New in discrete mathematics.*

### Ten Lectures on the Probabilistic Method

**Joel Spencer**

*Vol. 52 of the CBMS-NSF Regional Conference Series in Applied Mathematics*
*vi + 78 pages      Softcover      ISBN 0-89871-213-0*

A powerful tool in graph theory and combinatorics that permits rapid proof of the existence of a configuration by showing a positive probability that the "random" configuration meets the desired criteria. Applications are discussed in algorithmic techniques, random graphs per se, and methods from linear algebra.

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### Mathematical Modelling:
### Classroom Notes in Applied Mathematics

**Edited by Murray S. Klamkin**

*xx + 340 pages      Softcover      ISBN 0-89871-204-1*

A compilation designed for classroom use of the Classroom Notes section of *SIAM Review* (1975–1985), which provides short problems in mathematical modeling from various disciplines in the physical, mathematical, and biological sciences.

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*Your price at the SIAM booth $19.95*

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### Geometric Modeling:
### Algorithms and New Trends

**Edited by Gerald E. Farin**

*xii + 404 pages      Hardcover*
*34 color illustrations      Subject index      ISBN 0-89871-206-8*

The latest research in curve/surface design and solid modeling including extensive sections on the modeling of complex shapes and algorithms to solve intersection problems.

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### Selected Papers from the Second Conference on Parallel Processing for Scientific Computing

**Edited by C. W. Gear and R. G. Voigt**

*iv + 288 pages      Softcover      ISBN 0-89871-216-5*

Reprint of refereed papers from the Second Conference on Parallel Processing for Scientific Computing held in November 1985 and originally published as a supplement to the *SIAM Journal on Scientific and Statistical Computing.* The papers address issues in algorithm development, computer architecture, and programming languages in such areas as automatic detection of parallelism, performance prediction, system simulation, communication and synchronization complexity, and load balancing.

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*Your price at the SIAM booth $10.50*

### Hypercube Multiprocessors 1987

**Edited by Michael T. Heath**

*xvii + 763 pages      Hardcover      ISBN 0-89871-215-7*

Proceedings of the Second Conference on Hypercube Multiprocessors held in Knoxville in September 1986 representing the experience of leading researchers with hypercube hardware. Papers range from a re-thinking of such traditional concepts as programming languages, data structures, and operating systems in the light of this new architecture to applications in significant areas such as fluid dynamics and discrete optimization.

*List price $72.50*
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### A National Computing Initiative:
### The Agenda for Leadership

**Edited by H. S. Raveché, Duncan H. Lawrie, and Alvin M. Despain**

*ISBN 0-89871-222-X*

A SIAM report of an NSF/DOE-sponsored workshop held at Leesburg, VA on Feb. 2–3, 1987. Four years after the Lax report, academic and industrial leaders on three separate panels recommended that steps be taken to provide better access to high-performance computers by launching major research efforts in hardware, software, and systems design. Substantial public sector investment is called for over the next five years.

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## SIAM Journal on Discrete Mathematics

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# CONTRIBUTED PRESENTATIONS

# CONTRIBUTED PRESENTATIONS

**MATERIALS SCIENCE**

**Accurate Calculation of Functions Used in a Model of the Nematic Behavior of Self-Assembling Systems**
Alan E. Berger, Naval Surface Weapons Center and Mark P. Taylor, Brandeis University

**Numerical Simulation of Compressible Granular Flows**
E. Bruce Pitman, New Jersey Institute of Technology

**A Kinetic Theory Approach to Particle Size Segregation**
Anthony D. Rosato, New Jersey Institute of Technology and Vishwanath Subramaniam, Ohio State University

**Mathematical Model of Constrained Layer Damping Using Exact Elasticity Theory**
Laurene V. Fausett and Donald W. Fausett, Florida Institute of Technology and Pieter S. Dubbleday, Naval Research Laboratory

**Canonical Forms for Computation of Viscoelastic Flows**
L. Pamela Cook, Gilberto Schleiniger and Richard J. Weinacht, University of Delaware

**Asymptotic Solution of a Damped, Nonhomogeneous Turning-Point Problem Arising in the Study of Plastic Shear Instability**
Timothy J. Burns, National Bureau of Standards

**Analysis of a Model for Viscoelastic Flow**
Maria Carme Calderer, George Mason University, L. Pamela Cook and Gilberto Schleiniger, University of Delaware

**INVERSE PROBLEMS 2**

**Error Propagation in Methods for Solving Block Toeplitz System of Equations**
Ajit K. Choudhury, Howard University

**Renormalized Solutions for Inverse Scattering Theory**
H. Douglas Ladouceur and Arthur K. Jordan, Naval Research Laboratory

**Constrained Reconstruction (CORE): A Superresolution Method**
E. Mark Haacke, Steven H. Izen and Zhi-Pei Liang, Case Western Reserve University

**A Numerical Method for Parameter Estimation in Moving Boundary Problems**
Katherine A. Murphy, University of North Carolina

**Inverse Scattering for Wave Equations with Time Dependent Coefficients**
Gustavo Perla Menzala and Jose Arminio Ferreira, National Laboratory for Scientific Computation (LNCC/CNPq)

**WAVE PROPAGATION 2**

**Analytical Solution to the Problem of Interaction of Simple Waves with a Shock**
Rishi Ram, V. D. Sharma, Banaras Hindu University, India and P. L. Sachdev, Indian Institute of Science, India

**Progressive Wave Approach Analyzing the Decay of a Sawtooth Profile in MHD**
Vishnu D. Sharma, L. P. Singh and R. Ram, Banaras Hindu University, India

**A Green's Function Approach to the Determination of Internal Fields**
Robert J. Krueger and Robert Ochs, Jr., Iowa State University

**A New Adiabatic Invariant Involving the Modulated Phase Shift of Strongly Nonlinear, Slowly Varying, and Weakly Damped Oscillators**
F. Jay Bourland and Richard Haberman, Southern Methodist University

**Wave Number Shocks for the Tail of Korteweg-de Vries Solitary Waves in Slowly Varying Media**
Darrell Allgaier, United States Air Force Academy and Richard Haberman, Southern Methodist University

**Connections Between the Harry Dym and the Korteweg-de Vries Equations and the Construction of an Implicit Solution of The Harry Dym Equation**
Willy Hereman, University of Wisconsin, Madison, Partha P. Banerjee, Syracuse University and Monish R. Chatterjee, State University of New York, Binghamton

**The Evolution of Lumps into Solitons: I and II**
Ralph Kelsey, Bradley University and Richard Koshel, Illinois State University

**ARCHITECTURES AND LANGUAGES FOR PARALLEL PROCESSING I**

**A Parallel Multigrid Solver for Nonlinear Elliptic Equations**
Eric F. Van de Velde, California Institute of Technology

**Parallel Solution Using Element-by-Element Techniques**
E. Barragy and G. F. Carey, University of Texas, Austin

**On The Application of Trajectory Method to Solve Non-Linear Partial Differential Equations and Its Parallel Implementation**
T. C. Su and Z. M. Yu, Florida Atlantic University

**Parallelization of a Product Integration and Extrapolation Method for Solving Singular Integral Equations**
Elise de Doncker and John Kapenga, Western Michigan University, and Alastair Spence, University of Bath, United Kindgom

**A Proposal for a Set of Level 3 Basic Linear Algebra Subprograms**
Jack Dongarra, Argonne National Laboratory; Jeremy Du Croz, Sven Hammarling, Numerical Algorithms Group Ltd, U.K.; and Iain Duff, Harwell Laboratory, U.K.

**The Use of Ada in Mathematical Software**
Richard F. Sincovec, University of Colorado, Colorado Springs

**The nC Programming Language on the FPS T-Series**
D. E. Stevenson, Clemson University

**Conditioned Response-Time Distribution for a Large Closed Processor-Sharing System in Very Heavy Usage**
John A. Morrison, AT&T Bell Laboratories

**SYSTEMS AND CONTROL THEORY 2**

**Eigenstructure Assignment in LQR Design of Multivariable Control Systems**
Georges A. Becus, Bradley Jones and Gokhan Sonmez, University of Cincinnati

**New Approach to Model — Reference Adaptive Control**
Jan T. Bialasiewicz and Wittawat Na Nacara, University of Colorado, Denver

**Trajectory Stability for a Class of Nonlinear Systems**
Andrew J. Fish, Jr., Nonlinear Systems Analysis and Control

**Applications of the Carleman Approximation to Normal Forms Bifurcations and Feedback Equivalence**
Christos A. Tsiligiannis, City College of CUNY

**Applications of Interpolated Cell Mapping to Dynamic Systems**
Benson H. Tongue, Georgia Institute of Technology

**Layman Functions, Root Loci and Stability**
Bruce Jeffrey Layman, Layman Engineering

**Distributed Estimation of Systems with Nonlinear Interaction**
Bahram Shahian, California State University, Long Beach

**A New Model of General Systems and Survey**
Yonghao Ma, University of Utah

**NUMERICAL METHODS FOR ODE's AND PDE's 1**

**Waveform Relaxation Methods for Solving Differential-Algebraic Equations and Their Applications to Power Systems Simulations**
Mariesa L. Crow, M. Ilic and M. A. Pai, University of Illinois, Urbana

**Stability Analysis of One-step Methods for Neutral Delay-differential Equations**
Zdzislaw Jackiewicz, Arizona State University

**Numerical Methods for Solving Differential Equations**
Thiab R. Taha, University of Georgia

**Implicit High Resolution Schemes for Hyperbolic Conservation Laws**
Peter M. Hartwich, Vigyan Research Associates, Inc.

**An FFT Technique for the Solution of the Discrete Heat and Wave Equations**
Dale H. Mugler and Richard A. Scott, Santa Clara University

# CONTRIBUTED PRESENTATIONS

**Finite Element Methods for Partial Integro-Differential Equations**
Elizabeth Greenwell Yanik, Virginia Commonwealth University and Graeme Fairweather, University of Kentucky

**ARCHITECTURES AND LANGUAGES FOR PARALLEL PROCESSING 2**

**Conjugate Gradient Acceleration of Parallel Multigrid Methods**
R. E. Benner, Sandia National Laboratories

**An Efficient Implementation of the FFT on the CONVEX C-1 XP**
Jim Armstrong, CONVEX Computer Corporation

**Multitasking a Three-Dimensional Free Lagrangian Hydrodynamics Production Code**
David A. Mandell, Harold E. Trease and Terri Jeter, Los Alamos National Laboratory

**Oversized Problems on the SLAPP Computer**
Cynthia J. Anfinson and Franklin T. Luk, Cornell University

**Unified Systolic Architectures for Signal Processing Applications**
Barry L. Drake, Cornell University

**A Unified Systolic Array for Adaptive Beamforming**
Adam W. Bojanczyk, Washington University and Franklin T. Luk, Cornell University

**New Scalar and Vector Elementary Functions for the IBM Systems/370**
R. C. Agarwal, J. W. Cooley, F. G. Gustavson, J. B. Shearer, G. Slishman and B. Tuckerman, IBM T. J. Watson Research Center

**Parallel Processing with Fast Fourier Transform, and Free Convection Flow Fields**
Farhad Raiszadeh, NASA Ames Research Center

**OPTIMIZATION 2**

**A Search Technique for Optimization in a Chaotic Environment**
Jack W. Rogers, Jr., Auburn University

**A Nonlinear Solution to the Linear Complementarity Problem**
Layne T. Watson, J. Patrick Bixler Virginia Polytechnic Institute and State University and Aubrey B. Poore, Colorado State University

**A Global Convergence Analysis for the Celis-Dennis-Tapia Algorithm**
J. E. Dennis, Mahmoud El-Alem and R. A. Tapia, Rice University

**On Secant Updates for the use in Constrained Optimization**
R. A. Tapia, Rice University

**A Convergence Theory for the Structured BFGS Secant Method With an Application to Nonlinear Least Squares**
J. E. Dennis, Hector J. Martinez and R. A. Tapia, Rice University

**A Large Scale Nonlinear Optimization Problem Arising From Grid Generation II**
Pablo Barrera-Sanchez, University of New Mexico and Jose E. Castillo, San Diego State University

**Iterative Methods for the Solutions of Complementarity Problems**
R. N. Mukherjee, Banaras Hindu University, India

**MATHEMATICAL MODELING**

**Large Scale Modeling of The Aging Mammalian Ovarian Cycle**
Matthew Witten, University of Louisville

**Operator Waveform Iteration**
Donald Erdman and Donald J. Rose, Duke University

**The Effects of Reactant Consumption on the Ignition of a Combustible Solid by Convection Heating**
D. Glenn Lasseigne, Old Dominion University

**Transient Fields in Dispersive Inhomogeneous Media**
Robert J. Krueger, Iowa State University

**Transient Direct and Inverse Scattering for Anisotropic Electromagnetic Media**
James Corones and Rodney Stewart, Iowa State University

**Transient Direct and Inverse Scattering for Inhomogeneous Viscoelastic Media**
James Corones and Anders Karlsson, Iowa State University

**NUMERICAL METHODS FOR ODE's AND PDE's 2**

**Computational Solid Dynamics with the HULL Code**
John Keith Prentice, Consultant, Albuquerque, NM

**A Front Tracking Method for Multiphase Free Boundary Problems**
David E. Womble, Sandia National Laboratories

**The Spectrum of the Sinc Matrices for the Heat Equations**
John Lund, and Kenneth L. Bowers, Montana State University

**Sinc-Galerkin Solution of Second-Order Hyperbolic Problems in Multiple Space Dimensions**
Kelly Marie McArthur, University of Utah

**On The Numerical Analysis of Transmission Lines**
John D. Thomas, Kaman Sciences Corporation

**FLUID MECHANICS 2**

**On the Burgers-Karman Equation and its Exact Solutions**
T. C. Su, Florida Atlantic University

**Finite Element Approximation For A Model For Nuclear Waste Disposal In Porous Media**
Richard E. Ewing, Yirang Yuan and Gang Li, University of Wyoming

**Application of the FFT to an Unsteady Viscous Flow Problem**
R. R. Chamberlain, University of Alabama, Tuscaloosa

**Computing Solutions of Variational Problems in Fluid Dynamics**
Alexander Eydeland, University of Massachusetts

**Fluid Mixing in Vortical Flows**
Anthony Leonard, Vered Rom-Kedar and Stephen Wiggins, California Institute of Technology

**Interaction of Vorticity and Density Interfaces**
Gretar Tryggvason and Dequan Yu, University of Michigan, Ann Arbor

# POSTER PRESENTATIONS

**A Hybrid Perturbation Galerkin Two Point Expansion Method for Two Point Boundary Value Problems**
Richard Fanning, Penn State University, James F. Geer, State University of New York, Binghamton, and Carl M. Andersen, College of William and Mary

**(Non)integrability of Multiple Three-Wave Interactions**
Frank Verheest, Instituut Voor Theoretische Mechanika, Belgium and Willy Hereman, University of Wisconsin, Madison

**A Thermal Model of Geological Surfaces for Remote Sensing Applications**
Edward C. Fleri, Photon Research Associates

**A Reaction Diffusion Model of Cellular Control with External Control**
Joseph M. Mahaffy, San Diego State University

**An Efficient Finite Difference Scheme for Parabolic Equations**
Mark Casper and David Voss, Western Illinois University

**Perturbations and Stability of Invariant Subspaces of Matrices With Symmetries**
Leiba Rodman, Arizona State University

# TRANSPORTATION INFORMATION

## BY AIR

**UNITED AIRLINES**

UNITED AIRLINES has been chosen as the official carrier for the meeting. You can fly to Denver and save on travel from October 9, 1987 to October 18, 1987, inclusive.

In a special arrangement with SIAM, United Airlines is offering you the services of its toll free convention reservations desk, along with a complement of discounts:
- 5% off any fare for which you qualify, including United's First Class and Ultra Saver fares.
  THE DISCOUNT CAN RANGE FROM 40%–70% OFF NORMAL COACH FARES!

*OR . . . for those not qualifying for the above discounts . . .*
- A minimum of 40% off regular coach fares with no minimum stay or advance purchase requirements.

To make reservations for one of the above discounted fares or any other promotional fares that may be available:
- Call United Airlines Convention Desk at 1-800-521-4041 seven (7) days a week, 8:00 AM to 11:00 PM Eastern Time.
- Be sure to mention the SIAM account number: 7153D
- United will arrange to mail 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's Convention Desk to make your reservations. The special SIAM fare is only available through United's Convention Desk.

## BY CAR

**From The Airport**
When leaving the airport, take the Martin Luther King Blvd. for approximately 2 miles until it intersects with Colorado Blvd. Make a left on to Colorado Blvd. You will travel approximately 1 mile and Colorado Blvd. will intersect with 17th Street. Make a right on to 17th Street. After about 2 miles, 17th Street turns into 18th Street. Travel along this road until 18th Street intersects with California Blvd. The Marriott is on the corner of 18th Street and California Blvd. Please keep in mind that you will be traveling towards the center of the city.

**Taxi**
The rate for taking a cab from the airport to the hotel is $8.50

**Van Service**
Van service is available through American Limousine Service. You will find the limo at doors #2 or #12 in the lower baggage area. The rate for the limo is $5.00 per person. If there is more than 1 person traveling to the hotel, it would be advisable to take a taxi.

## CAR RENTAL

The official car rental agency selected for the SIAM 35th Anniversary Meeting is Dollar Rent-A-Car. The specially discounted rates are:

|                | Daily   | Weekly   |
|----------------|---------|----------|
| Economy        | $26.10  | $126.00  |
| Compact        | $27.90  | $135.00  |
| Intermediate   | $28.80  | $139.50  |
| Standard       | $30.60  | $144.00  |
| Premium/Luxury | $35.10  | $242.10  |

Dollar Rent-A-Car is located IN-TERMINAL at Denver's Stapleton International Airport. When making your reservations, call toll free 1-800-421-6878. *In order to receive the pre-negotiated rates, you must give the SIAM Reservation Code # TT-CCSIA.*

- All cars must be picked up and dropped off at the same location.
- You must have one of the following credit cards to rent a car: AMEX, MC, VISA, DC or Discover Card.
- The prices quoted do not include refueling services, tax, optional collision damage waiver, and personal accident insurance.
- You must have a valid U.S. or International driver's license and be at least 21 years of age.
- The above rates are valid October 9–18, 1987.
- 150 free miles per car per day, 1050 free miles per car per week, $0.15 per mile thereafter.
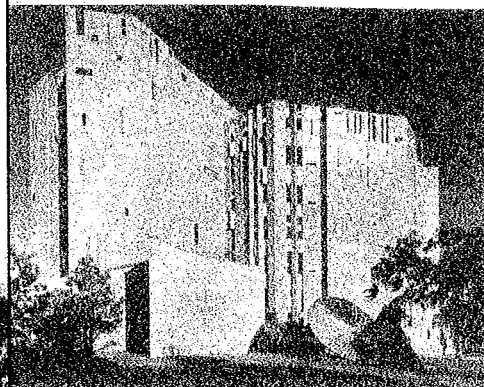
# HOTEL INFORMATION

**Marriott City Center**
1701 California Street
Denver, CO 80202
(303) 297-1300.

SIAM is holding a block of rooms at the Marriott City Center at the specially discounted rates of $68/Single and $80/Double. **However, these rooms will only be held until September 25, 1987, after which time reservations will depend upon availability.**

It is advised that you make your reservations promptly by calling 1-303-297-1300, or by mailing in the Hotel Reservation Request 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 SIAM 35th Anniversary 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, or check.

**Check in time** is 3:00 PM and Check out time is 12:00 PM. If you need to change or cancel your reservation, be certain to contact the hotel by 2:00 PM Denver time on your stated date of arrival to avoid any unnecessary charges.

**Parking:** Valet parking is available at $7.00 per day and $10.00 for overnight storage. There are no facilities available at the hotel for parking your car yourself. However, the following parking lots are within walking distance of the hotel.

| | | |
|---|---|---|
| Plaza Parking | 1800 California Street | $4.00 per day |
| City Center Parking | 1880 Stout Street | $5.00 per day |
| Guaranteed Bank | 1735 Stout Street | $4.00 per day |

**Recreational Facilities:** The following facilities are available at the hotel: indoor pool, whirl pool, sauna, exercise room, and aerobic classes. The hotel has an agreement with the International Athletic Club, which is within walking distance of the hotel, where at no cost you can use their exercise room, basketball court, and indoor running track. For those wishing to play racketball, hotel guest passes are available at $5.00.
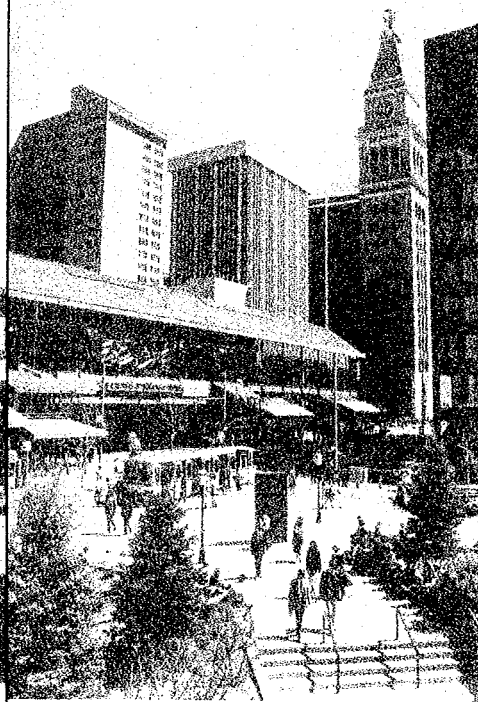
December 1–4, 1987
**Third SIAM Conference on Parallel Processing for Scientific Computing**
The Westin Bonaventure Hotel
Los Angeles, CA

May 23–26, 1988
**Third SIAM Conference on Linear Algebra**
The Concourse Hotel
Madison, WI

June 13–16, 1988
**Fourth SIAM Conference on Discrete Mathematics**
Cathedral Hill Hotel
San Francisco, CA

# REGISTRATION INFORMATION

Please complete the 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 Short Course attendees to register in advance, as space is limited and on-site registration will depend on availability. The registration desk will be located in the Colorado Corridor of the hotel and will be open as listed below:

| | |
|---|---|
| Saturday, October 10 | 5:30 PM – 10:00 PM |
| Sunday, October 11 | 7:00 AM – 10:00 PM |
| Monday, October 12 | 7:00 AM – 6:00 PM |
| Tuesday, October 13 | 7:30 AM – 6:00 PM |
| Wednesday, October 14 | 7:30 AM – 6:00 PM |
| Thursday, October 15 | 7:30 AM – 4:00 PM |

## 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.

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

### Telephone Messages
The telephone number at the Marriott is 1-303-297-1300. The Marriott will either connect you with the SIAM registration desk or forward a message.

### Credit Cards
SIAM is now accepting credit cards 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.

### To Advance Registrants
*Please be certain to process your advance registration form yourself. If this task is delegated to an employee, quite often the form does not reach SIAM by the deadline, and oftentimes not at all.*

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 we receive your form after the conference, we will destroy your check or credit card slip.

| | | SIAM Member | Non Member | Students |
|---|---|---|---|---|
| **Short Course Fees** | Advance | $85 | $105 | $45 |
| | On-Site | $105 | $125 | $55 |
| **Meeting Fees** | Advance | $80 | $100 | $15 |
| | On-Site | $100 | $120 | $15 |

**Beer and Taco Party**
Monday, October 12
6:00 – 8:00 PM
Prefunction Lobby
$10.00

**Heritage Square Dinner/Show**
Tuesday, October 13
Buses leave 6:00 PM
$25.00

## 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.
Culler Scientific Systems Corporation
E.I. Du Pont de Nemours and Company
Eastman Kodak Company
Exxon Research and Engineering Company
General Electric Company
General Motors Corporation
Giers Schlumberger
GTE Laboratories, Inc.

Hollandse Signaalapparaten 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
Texaco, Inc.
United Technologies Corporation

# ADVANCE REGISTRATION FORM

## SIAM 35th Anniversary Meeting

*\* Advance registration form must be received at the SIAM office by October 8, 1987. If paying by check, please make check payable to SIAM.*

|  |  | SIAM Member | Non Member | Students |
|---|---|---|---|---|
| **Short Course Fees** | Advance | $85 | $105 | $45 |
|  | On-Site | $105 | $125 | $55 |
| **Meeting Fees** | Advance | $80 | $100 | $15 |
|  | On-Site | $100 | $120 | $15 |

| | | | |
|---|---|---|---|
| Short Course | $_____ | $_____ | $_____ |
| Meeting | $_____ | $_____ | $_____ |
| Beer Party $10.00 | $_____ | $_____ | $_____ |
| Dinner & Show $25.00 | $_____ | $_____ | $_____ |
| TOTAL | $_____ | $_____ | $_____ |

Detach card and enclose with payment in the envelope provided (domestic mail only), or mail to: SIAM, 117 South 17th Street, 14th floor, Philadelphia, PA 19103-5052. Telephone: 215-564-2929.

Name _____
(please print)

Affiliation _____

Department _____

Address _____

City _____ State _____ Zip _____

Telephone Number _____

Local Address in Denver _____

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

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# ORDER FORM FOR NEW SIAM JOURNALS

Beginning January 1988, SIAM will be publishing two new quarterly journals—*SIAM Journal on Matrix Analysis and Applications* and *SIAM Journal on Discrete Mathematics*. If you are an individual SIAM member, you will be able to obtain these journals at SIAM's special low member rates (see below). If not, join now for 1988 and obtain the same low rates. Use this reply card to order your subscription now.

**For individual SIAM members:**

I am an individual SIAM member and want to order a 1988 subscription at the member rate to the journals checked below. I understand you will bill me when I renew my membership for 1988.

| | North America* | Elsewhere |
|---|---|---|
| ☐ SIAM Journal on Matrix Analysis and Applications | $31 | $34 |
| ☐ SIAM Journal on Discrete Mathematics | $31 | $34 |
| TOTAL | _____ | _____ |

**For individuals who are not SIAM members:**

☐ I want to become a SIAM member for 1988 and order a 1988 subscription to each of the journals checked above. Please send me a membership application and order form.

_____

*United States, Canada, and Mexico.

**For nonmember organizations and corporate and academic members:**

☐ Please send me information about these journals and an order form.

Name _____
(please print)

Organization _____

Address _____

City _____ State _____ Zip _____

Country _____ Telephone _____

To place your order, simply return this card to SIAM, 1400 Architects Building, 117 South 17th Street, Philadelphia, PA 19103-5052, USA.

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# HOTEL RESERVATION FORM

## SIAM 35th Anniversary Meeting
## Marriott City Center, Denver CO
## October 12–15, 1987

**PLEASE SEND ME A CONFIRMATION NOTICE**

Specially discounted rooms are being held for our exclusive use until September 25, 1987. 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 your reservations by phone, be certain to identify yourself as an attendee at the SIAM 35th Anniversary Meeting. Telephone: 1-303-297-1300.

(Please Print)

Name _____ Phone _____

Address _____

City _____ State _____ Zip Code _____

Please reserve ☐ Single ($68)  ☐ Double ($80) Arrival Date _____

Arrival Time _____ Check-out Date _____

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

I choose to pay by: ☐ AMEX  ☐ VISA  ☐ MC  ☐ Check  ☐ Card Number _____

Expiration Date _____ Deposit $_____ (Late Arrival Only)

Signature _____

If you list your credit card number, please enclose this card in an envelope and mail to: Reservations, Marriott City Center, 1701 California St., Denver, Colorado, 80202. You only need to list your credit card number if you want to guarantee your room for late arrival.