Society for Industrial and Applied Mathematics

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SIXTH SIAM CONFERENCE ON PARALLEL PROCESSING FOR • SCIENTIFIC • COMPUTING

Sponsored by SIAM Activity Group on Supercomputing

March 22 - 24, 1993

Norfolk Waterside Marriott Hotel

Norfolk, Virginia

Plus a One-day Tutorial on

PVM and HeNCE: Tools for Heterogeneous Network Computing

March 21, 1993

CONFERENCE THEMES

GRAND CHALLENGE PROBLEMS

APPLICATIONS

ARCHITECTURE

ALGORITHMS

CONTENTS

DEADLINE DATES

Hotel Reservations
Monday, March 1, 1993

Conference Preregistration
Monday, March 8, 1993

ORGANIZING COMMITTEE

Richard F. Sincovec, Chair
Mathematical Sciences Section
Oak Ridge National Laboratory

David E. Keyes
Department of Mechanical Engineering
Yale University

Michael R. Leuze
Mathematical Sciences Section
Oak Ridge National Laboratory

Linda Petzold
Department of Computer Science
University of Minnesota, Minneapolis

Daniel Reed
Department of Computer Science
University of Illinois, Urbana

PROCEEDINGS

A copy of the conference proceedings is included in the cost of registration and will be distributed to attendees at the conference.

FUNDING

SIAM is conducting this conference with the partial support of the National Science Foundation and the Department of Energy.

TUTORIAL

Tutorial on PVM and HeNCE: Tools for Heterogeneous Network Computing

March 21, 1993 • Norfolk Waterside Marriott Hotel • Norfolk, Virginia

Tutorial Description

This tutorial will cover methodologies and strategies for concurrent computing on heterogeneous networks of independent computer systems. We will begin with an overview of software systems and tools that are available to support network-based computing, and will describe several production applications to demonstrate the effectiveness and viability of network computing. We will devote the remainder of the course to PVM and HeNCE — software systems that enable concurrent computing on heterogeneous collections of multiprocessors, supercomputers, scalar machines, and workstations.

PVM (Parallel Virtual Machine) is software infrastructure that allows heterogeneous groups of machines to be used as a general-purpose concurrent computing resource. We will focus on concurrent applications for PVM, using several models of parallelism.

HeNCE is a graphical toolkit and methodology that significantly eases the task of application development for PVM. HeNCE is based on the notion that concurrency can be expressed using a variant of directed acyclic graphs, where vertices represent computation and arcs represent data and control dependencies. We will describe HeNCE and illustrate its use in graphically assembling concurrent applications from simple (sequential) building blocks.

Who Should Attend

This tutorial is intended for people interested in loosely coupled concurrent computing. Application and systems developers in the areas of large scale scientific computing, heterogeneous systems, and general-purpose concurrent processing will benefit from the material covered in this course.

Recommended Background

The lecturers assume a general knowledge of parallel processing and networking.

Lecturers

Adam Beguelin joined the faculty of Carnegie Mellon University in the spring of 1992. He holds a joint appointment with the School of Computer Science and the Pittsburgh Supercomputing Center. He received his Ph.D. in Computer Science from the University of Colorado. His primary research interests are in the area of computer systems, specifically the design and development of programming tools and environments for high performance parallel and distributed computing.

Jack Dongarra is a computer scientist specializing in numerical algorithms in linear algebra and high-performance computing at Oak Ridge National Laboratory's Mathematics Sciences Division and in University of Tennessee's Computer Science Department. He received a Ph.D. in Applied Mathematics from the University of New Mexico in 1980. His current research involves the development, testing and documentation of high quality mathematical software. He was involved in the design and implementation of the packages EISPACK, LINPACK, the BLAS, and LAPACK; and is currently involved in the design of algorithms and techniques for high performance computer architectures.

Al Geist is a computer scientist in the Mathematical Sciences Section of the Oak Ridge National Laboratory. He has received three bachelor degrees and is currently pursuing a doctorate degree in computer science at the University of Tennessee. His research interests are in the areas of parallel processing, algorithm efficiency, scientific computing, and numerical software.

Vaidy Sunderam is Assistant Professor in the Department of Mathematics and Computer Science at Emory University. He received a Ph.D. in Computer Science from the University of Kent, England, in 1986. His research interests are in parallel and distributed processing, particularly high-performance concurrent computing in heterogeneous networked environments.

PROGRAM

9:00 AM	**Overview of Heterogeneous Network Processing and PVM** Vaidy Sunderam
10:30 AM	**Coffee**
11:00 AM	**PVM (continued)** Al Geist
12:00 PM	**Lunch**
1:00 PM	**HeNCE** Jack J. Dongarra
2:00 PM	**Coffee**
2:30 PM	**Monitoring PVM Programs with Xab** Adam Beguelin
3:30 PM	**Discussion**
4:00 PM	**Adjourn**

TUTORIAL REGISTRATION FEES*

	Non Member	Member	Student
Preregistration	$120	$135	$55
Registration	$135	$155	$75

*Registration fee for the tutorial includes preprints, coffee and lunch. Preprints for the tutorial will be distributed upon check in at the registration desk.

Tutorial will be located in Hampton Roads V and the luncheon will be served in Hampton Roads VI. Coffee breaks will take place in the Hampton Roads Foyer.

Following are subject classifications for the sessions. The codes in parentheses designate session type and number. The session types are invited presentations (IP), contributed presentations (CP) and minisymposium (MS).

Applications
Applications I (CP7, page 7)
Applications II (CP13, page 8)
Applications in Electrical Engineering (CP21, page 9)
Control/Circuits (CP33, page 12)
Parallel Numerical Methods for Circuit and Device Simulation (MS3, page 13)
Role of Large-Scale Numerical Simulation in Industrial Applications (IP8, page 11)

Climate and Ocean Modeling
Atmospheric General Circulation Modeling on Massively Parallel Computers (IP5, page 8)

Computational Fluid Dynamics
Computational Fluid Dynamics I (CP1, page 6)
Computational Fluid Dynamics II (CP9, page 7)
Computational Fluid Dynamics III (CP28, page 11)
Fluid Mechanics, Massively Parallel Processors and Interactive Flow Visualization (IP1, page 6)

Distributed Computing
Distributed Computing, Communications and Network I (CP5, page 6)
Distributed Computing, Communications and Network II (CP12, page 8)

Evaluation and Performance
Performance (CP36, page 13)

Geophysical Sciences
Research at the Center for Research on Parallel Computation (MS2, page 12)
Geophysical Modeling I (CP15, page 9)
Geophysical Modeling II (CP22, page 10)
Geophysical, Structures and Algorithms (CP29, page 12)
Multiphase Modeling of Contaminant Transport in Porous Media (IP6, page 10)
Reservoir Modeling (CP35, page 13)

High Performance Computing and Communications Initiative
HPCC Panel: Retrospective on the First Full Year of HPCC and Future Directions (Panel Discussion, page 7)
The Greatest Grand Challenge (IP9, page 12)

Materials Science
Materials Science (CP24, page 10)
Parallel Computers in Large-Scale First Principle Simulation of Clusters (IP3, page 7)

Poster Session
(see column 1, Page 11)

Matrix Computations
Dense Linear Systems (CP17, page 9)
Dense Matrices (CP2, page 6)
Matrix Computations (CP14, page 8)
Matrix Computations and Least Squares (CP37, page 13)
Parallel Preconditioning, Iterative Methods (CP11, page 8)
Scalable and Stable Dense Eigensolvers (MS1, page 10)
Sparse Matrices I (CP3, page 6)
Sparse Matrices II (CP10, page 7)
Sparse Matrices III (CP23, page 10)
Sparse Matrices IV (CP30, page 12)

Numerical Methods
Research at the Center for Research on Parallel Computation (MS2, page 12)
Differential Equations (CP38, page 13)
Domain Decomposition (CP6, page 7)
Numerical Methods I (CP19, page 9)
Numerical Methods II (CP39, page 13)
Parallel Iterative Algorithms for Elliptic Problems (IP4, page 8)
Partitioning, Adaptivity, Performance (CP4, page 6)
Unstructured Grids, Elliptic Equations (CP16, page 9)

Optimization
Research at the Center for Research on Parallel Computation (MS2, page 12)
Matrix Computations and Least Squares (CP37, page 13)
Optimization (CP20, page 9)

Parallel Environments and Tools
A Machine-Independent Programming System for Massively Parallel Computers (IP7, page 11)
Research at the Center for Research on Parallel Computation (MS2, page 12)
Languages and Compilers (CP31, page 12)
Parallel Programming Models (CP26, page 10)
Tools and Language Extensions (CP18, page 9)

Scalable Parallel Algorithms and Libraries
Parallel Iterative Algorithms for Elliptic Problems (IP4, page 8)
Scalable High Performance Libraries in Linear Algebra (IP2, page 6)

Scheduling and Load Balancing
Load Balancing (CP32, page 12)
Scheduling (CP25, page 10)

Simulation and Computation in Biology and Chemistry
Molecular Dynamics I (CP8, page 7)
Molecular Dynamics II (CP34, page 13)

Visualization
Architecture/Visualization (CP27, page 11)
Fluid Mechanics, Massively Parallel Processors and Interactive Flow Visualization (IP1, page 6)

❑ PROGRAM-AT-A-GLANCE

SATURDAY, MARCH 20

6:00 PM-8:00 PM
Registration for Tutorial opens
Hampton Roads Foyer

SUNDAY, MARCH 21

8:00 AM-4:00 PM
Registration for Tutorial opens
Hampton Roads Foyer

9:00 AM-5:00 PM
Tutorial
Hampton Roads 5

6:00 PM-8:00 PM
Registration for Conference opens
Hampton Roads Foyer

6:30 PM-8:30 PM
Welcoming Reception
Hampton Roads Foyer

MONDAY MORNING, MARCH 22

7:30 **Registration opens**
Hampton Roads Foyer

8:00 **Opening Remarks**
Richard F. Sincovec
Hampton Roads 5

8:15 **IP1** **Fluid Mechanics, Massively Parallel Processors and Interactive Flow Visualization**
James A. Sethian
Hampton Roads 5

9:00 **IP2** **Scalable High-Performance Libraries in Linear Algebra**
Jack J. Dongarra
Hampton Roads 5

9:45 **Coffee**
Hampton Roads 1

10:15 **Concurrent Sessions**

- **CP1** **Computational Fluid Dynamics I**
  Hampton Roads 5
- **CP2** **Dense Matrices**
  Marriott 1
- **CP3** **Sparse Matrices I**
  Marriott 5
- **CP4** **Partitioning, Adaptivity, Performance**
  Marriott 3
- **CP5** **Distributed Computing, Communications and Networks I**
  Marriott 4
- **CP6** **Domain Decomposition**
  Chesapeake 1
- **CP7** **Applications I**
  Chesapeake 2

MONDAY AFTERNOON, MARCH 22

12:15 PM **Lunch**

1:30 **IP3** **Parallel Computers in Large Scale "First Principle" Simulations of Clusters**
John H. Weare
Hampton Roads 5

2:15 **HPCC Panel: Retrospective on the First Full Year of HPCC and Future Directions**
Hampton Roads 5

3:00 **Coffee**
Hampton Roads 1

3:30 **Concurrent Sessions**

- **CP8** **Molecular Dynamics I**
  Hampton Roads 5
- **CP9** **Computational Fluid Dynamics II**
  Marriott 1
- **CP10** **Sparse Matrices II**
  Marriott 5
- **CP11** **Parallel Preconditioning, Iterative Methods**
  Marriott 3
- **CP12** **Distributed Computing, Communications and Networks II**
  Marriott 4
- **CP13** **Applications II**
  Chesapeake 1
- **CP14** **Matrix Computations**
  Chesapeake 2

MONDAY EVENING, MARCH 22

6:00 **"Spirit of Norfolk" Dinner Cruise**

TUESDAY MORNING, MARCH 23

7:30 **Registration opens**
Hampton Roads Foyer

8:30 **IP4** **Parallel Iterative Algorithms for Elliptic Problems**
Tony F. Chan
Hampton Roads 5

9:15 **IP5** **Atmospheric General Circulation Modeling on Massively Parallel Computers**
David L. Williamson
Hampton Roads 5

10:00 **Coffee**
Hampton Roads 1

10:30 **Concurrent Sessions**
- **CP15** **Geophysical Modeling I**
  Hampton Roads 5
- **CP16** **Unstructured Grids, Elliptic Equations**
  Marriott 1
- **CP17** **Dense Linear Systems**
  Marriott 5
- **CP18** **Tools and Language Extensions**
  Marriott 3
- **CP19** **Numerical Methods I**
  Marriott 4
- **CP20** **Optimization**
  Chesapeake 1
- **CP21** **Applications in Electrical Engineering**
  Chesapeake 2

TUESDAY AFTERNOON, MARCH 23

12:30 PM **Lunch**

2:00 **IP6** **Multiphase Modeling of Contaminant Transport in Porous Media**
Richard E. Ewing
Hampton Roads 5

2:45 **Coffee**
Hampton Roads 1

3:15 **Concurrent Sessions**
- **MS1** **Scalable and Stable Dense Eigensolvers**
  Organizers: Christian Bischof, and Anna Tsao
  Hampton Roads 5
- **CP22** **Geophysical Modeling II**
  Marriott 1
- **CP23** **Sparse Matrices III**
  Marriott 5
- **CP24** **Materials Science**
  Marriott 3
- **CP25** **Scheduling**
  Marriott 4
- **CP26** **Parallel Programming Models**
  Chesapeake 1
- **CP27** **Architecture/Visualization**
  Chesapeake 2

TUESDAY EVENING, MARCH 23

5:30 - 7:30 **Reception and Poster Session**
Hampton Roads 1

8:00 **Business Meeting of the SIAM Activity Group on Supercomputing**
Chesapeake 1

WEDNESDAY MORNING, MARCH 24

7:30 **Registration opens**
Hampton Roads Foyer

8:30 **IP7** **A Machine-Independent Programming System for Massively Parallel Computers**
Ken Kennedy
Hampton Roads 5

9:15 **IP8** **Role of Large-Scale Numerical Simulation in Industrial Applications**
William T. Thompkins, Jr.
Hampton Roads 5

10:00 **Coffee**
Hampton Roads 1

10:30 **Concurrent Sessions**
- **MS2** **Research at the Center for Research on Parallel Computation**
  Organizer: Ken Kennedy
  Hampton Roads 5
- **CP28** **Computational Fluid Dynamics III**
  Marriott 1
- **CP29** **Geophysical, Structures and Algorithms**
  Marriott 5
- **CP30** **Sparse Matrices IV**
  Marriott 3
- **CP31** **Languages and Compilers**
  Marriott 4
- **CP32** **Load Balancing**
  Chesapeake 1
- **CP33** **Control/Circuits**
  Chesapeake 2

WEDNESDAY AFTERNOON, MARCH 24

12:30 **Lunch**

2:00 **IP9** **The Greatest Grand Challenge**
David J. Kuck
Hampton Roads 5

2:45 **Coffee**
Hampton Roads 1

3:15 **Concurrent Sessions**
- **MS3** **Parallel Numerical Methods for Circuit and Device Simulation**
  Organizer: Andrew Lumsdaine
  Hampton Roads 5
- **CP34** **Molecular Dynamics II**
  Marriott 1
- **CP35** **Reservoir Modeling**
  Marriott 5
- **CP36** **Performance**
  Marriott 3
- **CP37** **Matrix Computations, Least Squares**
  Marriott 4
- **CP38** **Differential Equations**
  Chesapeake 1
- **CP39** **Numerical Methods II**
  Chesapeake 2

5:15 **Conference Adjourns**

MONDAY MORNING, MARCH 22

7:30/Hampton Roads Foyer
Registration opens

8:00/Hampton Roads 5
Opening Remarks
Richard F. Sincovec, Oak Ridge National Laboratory

8:15/Hampton Roads 5
IP1/Chair: James M. Hyman, Los Alamos National Laboratory

Fluid Mechanics, Massively Parallel Processors and Interactive Flow Visualization
The speaker will describe a series of projects which use massively parallel processors to compute and visualize the results of numerical simulations of two and three dimensional turbulent flows. The underlying numerical method is based on a vortex method. The efficient execution of this method on the Connection Machine results from parallel N-body solvers, parallel elliptic solvers, and parallel data structures for the adaptive creation of computational elements on the boundary of the confining region. Flow is visualized using a real-time interactive flow visualization environment which mimics laboratory experiment. In this presentation, the speaker will discuss the underyling mathematical and numerical issues involved in computing turbulent flow using vortex methods, as well as efficient ways to program these techniques on the CM-2 and CM-5. A collection of videos will be shown of a variety of two and three-dimensional internal and external flows.

James A. Sethian
Department of Mathematics
University of California, Berkeley
and Lawrence Berkeley Laboratory

9:00/Hampton Roads 5
IP2/Chair: James M. Hyman, Los Alamos National Laboratory

Scalable High-Performance Libraries in Linear Algebra
High quality portable numerical libraries have existed for many years. These libraries, such as LAPACK and EISPACK, were designed to be accurate, robust, efficient and portable in a Fortran environment of conventional uniprocessors, diverse floating point arithmetics, and limited input data structures. These libraries are no longer adequate for modern parallel high-performance computer architectures. The speaker will describe these inadequacies and discuss how they are being addressed in the design of a scalable high-performance library. He will illustrate the new architectures lead to important changes in the goals as well as the methods of library design.

Jack J. Dongarra
Oak Ridge National Laboratory, and
Department of Computer Science, University of Tennessee, Knoxville

9:45/Hampton Roads 1
Coffee

10:15 AM-12:15 PM
Concurrent Sessions

CP1/Hampton Roads 5
Computational Fluid Dynamics I
Chair: James A. Sethian, University of California, Berkeley

10:15 A Multiple-Grid Navier-Stokes Code for the Connection Machine
Dennis Jespersen and Creon Levit, NASA Ames Research Center

10:35 Solution of Navier Stokes Equations on a Massively Parallel Computer the CM-200
Nahil A. Sobh and Alaa Almillgui, Old Dominion University

10:55 Complex Geometry Navier-Stokes Solutions on High-Performance Multicomputers
Paul F. Fischer, Brown University

11:15 An Efficient Parallel Algorithm for the Time Accurate Simulation of Three Dimensional Hypervelocity Blunt Body Wakes
Andrew Anagnost, Stanford University

11:35 Parallel Computation of Internal and External Flows Using a Portable Message Passing Harness
Jonathan Carter, D.R. Emerson, R.J. Blake, and R.J. Allen, Daresbury Laboratory, United Kingdom

11:55 Parallelization of a Two-Dimensional Compressible Unsteady Navier-Stokes Solver on a Range of MIMD Multiprocessors
Isabelle d'Ast, Centre European de Recherche et de Formation Avance en Calcul Scientifique, France; Michel J. Dayde, ENSEEIHT-IRIT, France; and Azzedine Kourta, Centre European de Recherche et de Formation Avance en Calcul Scientifique, France

CP2/Marriott 1
Dense Matrices
Chair: Jack J. Dongarra, Oak Ridge National Laboratory and University of Tennessee, Knoxville

10:15 LAPACK for Distributed Memory Architectures: The Next Generation
James Demmel, University of California, Berkeley; Jack Dongarra, University of Tennessee, Knoxville and Oak Ridge National Laboratory; Robert van de Geijn, University of Texas, Austin; and David Walker, Oak Ridge National Laboratory

10:45 All-to-all Communication Algorithms for Distributed BLAS
Kapil K. Mathur and S. Lennart Johnsson, Thinking Machines Corporation, Cambridge, MA

11:15 A Ring-Oriented Approach for Block Matrix Factorizations on Shared and Distributed Memory Architectures
Krister Dackland, *Erik Elmroth* and Bo Kagstrom, University of Umea, Sweden

11:45 Portable High Performance Gemm-Based Level-3 BLAS
Bo Kagstrom, *Per Ling,* University of Umea, Sweden; and Charles Van Loan, Cornell University

CP3/Marriott 5
Sparse Matrices I
Chair: Barry W. Peyton, Oak Ridge National Laboratory

10:15 Sparse Matrix Computations on the CM-5
Youcef Saad and Kesheng Wu, University of Minnesota, Minneapolis; and Serge Petiton, Establissement Technique Central de l'Armement, France

10:45 Parallel Sparse Matrix by Vector Multiplication using a Shared Virtual Memory Environment
Francois Bodin and *Jocelyne Erhel,* INRIA/IRISA, France

11:15 Distributed and Shared Implementations of Block Preconditioned Conjugate Gradient Methods using Domain Decomposition on the BBN TC2000
Luc Giraud, Centre European de Recherche et de Formation Avance en Calcul Scientifique, France

11:45 Sparse Matrix Vector Product on Distributed Memory MIMD Architectures
Rod Cook and Jan Sadecki, University of Liverpool, United Kingdom

CP4/Marriott 3
Partitioning, Adaptivity, Performance
Chair: William Gropp, Argonne National Laboratory

10:15 Structured Adaptive Mesh Refinement on the Connection Machine
Jeffrey Saltzman, Los Alamos National Laboratory and Marsha Berger, New York University

10:35 Toward a Parallel Recursive Spectral Bisection Mapping Tool
Charles A. Leete, Barry W. Peyton and Richard F. Sincovec,Oak Ridge National Laboratory

10:55 Non-Deterministic Heuristics for Automatic Domain Decomposition in Direct Parallel Finite Element Calculations
O. Zone, D. Vanderstraeten and R. Keunings, Universite Catholique de Louvain, Belgium

11:15 Rotation and Resampling of Volume Data on SIMD Mesh for Fast Parallel Projections
W.-Y. Ng, The Chinese University of Hong Kong, Hong Kong

11:35 Parallel Algorithms for Multidimensional Quadrature: Scalability and Load Balancing
Marco Lapegna and Alessandra D'Alessio, Universita di Napoli, Italy

11:55 Divide-and-Conquer Algorithms with Recursive Broadcast Communication on Reconfigurable Arbitrary Dimensional Mesh
Z. George Mou and *Xiaojing Wang,* Brandeis University

CP5/Marriott 4
Distributed Computing, Communications and Networks I
Chair: Joel Saltz, University of Maryland, College Park

10:15 Heterogeneous Network Computing
Adam Beguelin, Carnegie Mellon University; Jack J. Dongarra, Oak Ridge National Laboratory and University of Tennessee; G.A. Geist, Oak Ridge National Laboratory; Robert Manchek, University of Tennessee; and V.S. Sunderam, Emory University

10:45 Designing Efficient, Scalable, and Portable Collective Communication Libraries
Vasanth Bala and Shlomo Kipnis, IBM Thomas J. Watson Research Center; Larry Rudolph, The Hebrew University, Israel; and Marc Snir, IBM Thomas J. Watson Research Center

11:15 The Zipcode Message-Passing System as a High-Level Library for PVM
Anthony Skjellum, Steven G. Smith and Charles H. Still, Lawrence Livermore National Laboratory; and Brian K. Grant, Purdue University

11:45 Estimating the Communication Costs for Message Passing Computers
Harry Berryman, Yale University; William Gropp, Argonne National Laboratory; and Philippe Klein, Institut Francais du Petrole DIMA/DER, France

CP6/Chesapeake 1

Domain Decomposition

Chair: Steven F. Ashby, Lawrence Livermore National Laboratory

10:15 **A New Family of Preconditioners for Domain Decomposition**
Mo Mu and John R. Rice, Purdue University, West Lafayette

10:35 **Domain Decomposition and High Order Finite Differences for Elliptic PDEs**
George G. Pitts, Calvin J. Ribbens and Layne T. Watson, Virginia Polytechnic Institute and State University

10:55 **Parallel Overlapping Graph Decomposition Methods for General Sparse Linear Systems**
Xiao Chuan Cai, University of Kentucky; and Youcef Saad,University of Minnesota, Minneapolis

11:15 **An Empirical Study of Scalable Domain Decomposition Methods for a 2-D Parabolic Equation Solver**
Chi-ming Chiang, Qiang Du, *Matt W. Mutka,* and Ron Sass, Michigan State University

11:35 **An Asynchronous Domain Decomposition Method for the Two-Dimensional Poisson Equation**
Bracy H. Elton, Fujitsu America, Inc.

11:55 **Single Step Smooth Interface for Parabolic Spectral Elements**
Kelly J. Black, North Carolina State University

CP7/Chesapeake 2

Applications I

Chair: John N. Shadid, Sandia National Laboratories, Albuquerque

10:15 **Modeling Piezoelectric Crystals on the Intel DELTA**
Tom Canfield, *Mark Jones* and Paul Plassmann, Argonne National Laboratory; and Michael Tang, Motorola, Inc. Schaumburg, IL

10:35 **Multi-Processor Based Accident Analysis Using PVM**
Kevin A. Smith, Oak Ridge National Laboratory

10:55 **Optimization of a Chemical Vapor Deposition Reactor**
Kazufumi Ito, Jeffrey S. Scroggs and *Hien T. Tran,* North Carolina State University

11:15 **Solution of the Landau-de-Gennes Equations of Liquid Crystal Physics on a SIMD Computer**
Paul A. Farrell and *Arden Ruttan,* Kent State University

11:35 **Multidimensional Visualization Applied to Renewable Resource Management**
C.J. Pratico, University of Chicago; *Floyd B. Hanson,*M.S. Vetter and H.-H. Xu, University of Illinois, Chicago

11:55 **An Adaptive Algorithm for Parallel Computation of Radiative Heat Transfer**
J.G. Kolibal and Craig Saltiel, University of Florida, Palm Beach Gardens

MONDAY AFTERNOON, MARCH 22

12:15-1:30

Lunch

1:30/Hampton Roads 5

IP3/Chair: Michael R. Leuze, Oak Ridge National Laboratory

Parallel Computers in Large Scale "First Principle" Simulations of Clusters

The subject of this presentation is the calculation of the electronic properties and dynamic behavior of clusters of second row elements with the particle sizes from 10—150. Aggregates in this size range have technologically important properties, for example catalytic specificity, that are very different from aggregates of molecular sizes of the bulk. Because there is no experimental structural information for these systems, it is necessary to develop methods to identify the lowest energy geometry which is presumed to be responsible for their remarkable properties. "Dynamical" simulated annealing is easy to implement and effective, but a very efficient solution to the Schrödinger equation must be available. Because of the unpleasant size scaling of the present algorithms, vector machine calculations are prohibitively expensive. This requires new algorithms for parallel computers. But improper implementation can result in very significant loses in performance. In this presentation, the speaker will outline the problems, discuss results for carbon and metal clusters and report on the status of implementation on massively parallel CM—2 machines.

John H. Weare
Chemistry Department
University of California, San Diego
and R. Kawai
Physics Department
University of Alabama, Birmingham

2:15/Hampton Roads 5

HPCC Panel: Retrospective on the First Full Year of HPCC and Future Directions

Moderator: Richard F. Sincovec

Panelists:
Melvyn Ciment
NSF-National Science Foundation
Lee Holcomb
NASA-National Aeronautics and Space Administration
Stephen Squires, DARPA-Defense Advanced Research Projects Agency

3:00/Hampton Roads 1

Coffee

3:30-5:30

Concurrent Sessions

CP8/Hampton Roads 5

Molecular Dynamics I

Chair: John H. Weare, University of California, San Diego

3:30 **Parallel Global Optimization Methods for Molecular Configuration Problems**
Richard H. Byrd, Thomas Derby, Elizabeth Eskow, K.P.B.Oldenkamp, *Robert B. Schnabel,* and Christos Triantafillou University of Colorado, Boulder

3:50 **A Topology- and Problem-Independent Scalable Parallel Approach to Molecular Dynamics Simulation**
Peter Nesbeitt and *Richard Enbody,* Michigan State University

4:10 **Molecular Dynamics Simulations of Atomic Clusters**
Kevin M. Nelson, Steve T. Smith and *Luc T. Wille,* Florida Atlantic University

4:30 **A Spatial-Decomposition Algorithm for Parallel Bonded Molecular Dynamics Simulations in Materials Modeling**
Steve Plimpton and Grant Heffelfinger, Sandia National Laboratories,Albuquerque

4:50 **Distributed Molecular Dynamics using the PVM System**
Harald H. Simonsen and Jorn Amundsen, SINTEF Industrial Mathematics, Norway

CP9/Marriott 1

Computational Fluid Dynamics II

Chair: Charbel Farhat, University of Colorado, Boulder

3:30 **EAGLEView: Integration of Grid Generation, Computational Field Simulation, and Field Visualization Under Real-time Control**
Michael L. Stokes, David H. Huddleston and Michael G. Remotique, Mississippi State University Engineering Research Center

4:00 **Multiple Precision, Multiple Processor Vortex Sheet Roll-Up Computation**
David H. Bailey, NASA Ames Research Center; Robert Krasny,University of Michigan, Ann Arbor; and Richard Pelz, Rutgers University

4:30 **A Parallel Implementation of a Finite Difference DNS Code for Turbulence in Supersonic Flows**
Neeraj Tyagi and *Foluso Ladeinde,* State University of New York, Stony Brook

5:00 **CM-2 Performance Evaluation on Panel Method Calculations**
Hong Hu and Isaac T. Jackson, Hampton University

CP10/Marriott 5

Sparse Matrices II

Chair: Robert S. Schreiber, RIACS, NASA Ames Research Center

3:30 **Parallel Solution of Linear Systems using Cholesky Factorization**
Michael T. Heath and *Padma Raghavan,* National Center for Supercomputing Applications, University of Illinois, Urbana

4:00 **Highly Parallel Sparse Triangular Solution**
Fernando L. Alvarado, University of Wisconsin, Madison; and *Alex Pothen,* University of Waterloo, Canada

4:30 **Massively Parallel Implementations of Lanczos Algorithms for Computing the SVD of Large Sparse Matrices**
Michael Berry and *Theresa Do,* University of Tennessee, Knoxville; and Andrew Ogielski, Bellcore

5:00 **A Heuristic for Reducing Fill-in in Sparse Matrix Factorization**
Curt A. Jones, Bloomsburg University and Thang N. Bui,Pennsylvania State University

CP11/Marriott 3
Parallel Preconditioning, Iterative Methods
Chair: Karin R. Bennett, Oak Ridge National Laboratory

3:30 **A Matrix Framework for Conjugate Gradient Methods and Some Variants of CG with Less Synchronization Overhead**
E.F. D'Azevedo, Oak Ridge National Laboratory; *Victor Eijkhout,* University of Tennessee, Knoxville; and C.H. Romine, Oak Ridge National Laboratory

3:50 **The Development of an Iterative Software Package for Solving Large Sparse Linear Systems on Scalar, Vector, Shared Memory, SIMD, and MIMD Computers**
W.D. Joubert, Los Alamos National Laboratory and G.F. Carey, University of Texas, Austin

4:10 **Parallel Preconditioning and Approximate Inverses on the Connection Machine**
Marcus Grote, Stanford University and Horst D. Simon, Computer Sciences Corporation, NASA Ames Research Center

4:30 **Parallel Methods for Boundary Value Problem Linear Algebra**
Ian Gladwell and Gertrud Kraut, Southern Methodist University

4:50 **Parallel Evaluation of Rational Matrix Functions**
D. Calvetti, Stevens Institute of Technology; E. Gallopoulos, University of Illinois, Urbana; and L. Reichel, Kent State University

5:10 **On the Parallelism of the Symmetric Domain Decomposition Method**
Wu Zhijian and Rao Chuanxia, Wuhan University, People's Republic of China

CP12/Marriott 4
Distributed Computing, Communications and Networks II
Chair: George A. Geist, Oak Ridge National Laboratory

3:30 **Using PVM 3.0 to Run Grand Challenge Applications on a Heterogeneous Network of Parallel Computers**
G.A. Geist, Oak Ridge National Laboratory and R.J. Manchek, University of Tennessee, Knoxville

3:50 **Performance of the CM-5 Communication Primitives**
Kesheng Wu and Youcef Saad, University of Minnesota, Minneapolis

3:55 **Results from the CASA Gigabit Testbed Project**
Carl Scarbnick and Gary Hanyzewski, San Diego Supercomputer Center; and Chung-Chun Ma, University of California, Los Angeles

4:10 **Efficient Communication on Mesh Architectures with Hardware Routing**
Mike Barnett, University of Idaho; Richard Littlefield, Pacific Northwest Laboratory, David Payne, Intel Scientific Supercomputing Division, Beaverton, OR; and *Robert van de Geijn,* University of Texas, Austin

4:30 **A Programming Paradigm for Distributed-Memory Computers**
S. Crivelli and E.R. Jessup, University of Colorado, Boulder

4:50 **Fault-Tolerant Broadcasting in Circuit-Switched Mesh**
Hyeong-Ah Choi, Sang-Kyu Lee and Julie Park, George Washington University

CP13/Chesapeake 1
Applications II
Chair: Richard Pelz, Rutgers University

3:30 **A Parallel N-body Code**
Kevin M. Olson, NASA Goddard Space Flight Center

3:50 **Prediction of Protein Tertiary Structure from Sequences using a Very Larger Back-Propagation Neuron Network**
Xiao Liu and G.L. Wilcox, MSI, University of Minnesota, Minneapolis

4:10 **Identification of Continuous-Time Dynamical Systems: Neural Network Based Algorithms and Parallel Implementation**
Robert M. Farber and Alan S. Lapedes, Los Alamos National Laboratory; and Ramiro Rico-Martinez and Ioannis G. Kevrekidis, Princeton University

4:30 **Vectorization of Homotopy Algorithms for Polynomial Systems of Equations**
William I. Thacker and Layne T. Watson, Virginia Polytechnic Institute and State University

4:50 **Kinetic Analysis of Epithelial Cell Migration in the Colon on a Massively Parallel Processor (CM-2)**
Slobodan R. Sipcic, Boston University and Gershom Zajicek, Hebrew University, Israel

5:10 **A Parallel Scheme for Inverse Scattering**
Manuel Campos, Universidad de Concepcion, Chile; and C.A. De Moura, LNCC/CNPq, Brasil

CP14/Chesapeake 2
Matrix Computations
Chair: Robert B. Schnabel, University of Colorado, Boulder

3:30 **Sparse Implementation of Revised Simplex Algorithms on Parallel Computers**
Wei Shu, State University of New York, Buffalo

4:00 **An Algorithm for Solving a 4-Diagonal Toeplitz Linear System of Equations on Vector Computers**
Thiab R. Taha and JerJiann Liaw, University of Georgia

4:30 **A Scalable Eigenvalue Solver for Symmetric Tridiagonal Matrices**
Philip K. McKinley, Christian Trefftz, and Tien-Yien Li, Michigan State University; and Zhonggang Zeng, Northern Illinois University

5:00 **A Parallel Tridiagonal Solver for Vector Uniprocessors**
Josep-L. Larriba-Pey, Angel Jorba and Juan J. Navarro, Universitat Politecnica de Catalunya, Spain

TUESDAY MORNING, MARCH 23

7:30/Hampton Roads Foyer
Registration opens

8:30/Hampton Roads 5
IP4/Chair: David E. Keyes, Yale University
Parallel Iterative Algorithms for Elliptic Problems
The enormous and unsatiable amount of computing power needed in numerically solving partial differential equations arising in scientific computing is one of the main stimulants for the development of massively parallel computers. To realize maximal performance, one needs efficient implementation of the best existing sequential algorithms, as well as new algorithms which exploit both the architecture of the machine and the nature of the underlying physical problem. Elliptic problems are particularly challenging because of their intrinsic dependence on global data which often conflicts with the desire for data locality for maximal parallel efficiency.

The speaker will describe how some recently developed iterative algorithms, namely multilevel preconditoners and domain decomposition algorithms, deal with this fundamental conflict in an effective way. The key idea is to employ a hierarchical (multilevel) exchange of global information, with sufficient parallelism at each level. The speaker will also try to outline some challenging open problems.

Tony F. Chan
Department of Mathematics, University of California, Los Angeles, and Department of Computer Science, Chinese University of Hong Kong, Hong Kong

9:15/Hampton Roads 5
IP5/Chair: David E. Keyes, Yale University
Atmospheric General Circulation Modeling on Massively Parallel Computers
Atmospheric general circulation models provide an essential tool for the study of issues involving global change. They are one component of complex climate models which include the atmosphere, oceans, biosphere, and cryosphere. These atmospheric models describe three dimensional fluid flow above the spherical earth under state-dependent forcing conditions. The underlying numerical methods for the fluid flow, such as spectral transform and semi-Lagrangian methods, have been accepted because they are accurate and provide natural, economical solutions, on conventional computers to the difficulties associated with spherical geometry. However, resolution and length of simulation have been limited by available computing power.

Massively parallel computers offer the promise of greatly increasing our capabilities. The current methods, however, are not ideal for a massively parallel environment. In addition, several non-computational considerations must be taken into account in providing useful codes in this new environment. The models are not static. Many aspects, especially the non fluid flow components, are constantly being changed for individual applications. In addition, the models have many users, most of whom are not, and perhaps should not be required to be computer sophisticates.

The speaker will describe the overall model framework and current numerical algorithms with emphasis on the implications for efficient application on massively parallel computers. He will present an overview of current implementations and discuss performance measures.

David L. Williamson
Climate and Global Dynamics Division
National Center for Atmospheric Research

10:00/Hampton Roads 1
Coffee

10:30 AM-12:30 PM
Concurrent Sessions

CP15/Hampton Roads 5
Geophysical Modeling I
Chair: David L. Williamson, National Center for Atmospheric Research

10:30 Performance of a Portable, Parallel Atmospheric General Circulation Model
A.A. Mirin, W.P. Dannevik, P.G. Eltgroth, M.F. Wehner, J.C. Brown, and B. Chan, Lawrence Livermore National Laboratory

10:50 Performance Characteristics of Algorithms from a Coupled Ocean/Atmosphere Model on Scalable Parallel Architectures
A. Daniel Kowalski, Paul Schopf, and Max Suarez, NASA Goddard Space Flight Center

11:10 Parallelization of a Global Circulation Model
Jeffrey S. Scroggs and *Neil P. Sigmon,* North Carolina State University

11:30 Magnetospheric General Circulation Modelling on Parallel Computers
Clark M. Mobarry, NASA Goddard Space Flight Center; Joel A. Fedder and Steven L. Slinker, Naval Research Laboratory, and John G. Lyon, University of Iowa

11:50 Compressible Magnetoconvection
Anil Deane, Universities Space Research Association; Steven Zalesak and Daniel Spicer, NASA Goddard Space Flight Center

12:10 Coupling Numerical Models of the Atmosphere and Ocean Using the Parallel Virtual Machine (PVM) Package
Norman Barth and *Sharon L. Smith,* Centre European de Recherche et de Formation Avance en Calcul Scientifique, France

CP16/Marriott 1
Unstructured Grids, Elliptic Equations
Chair: Tony F. Chan, University of California, Los Angeles and Chinese University of Hong Kong, Hong Kong

10:30 Parallel Performance of Unstructured Finite Element Methods on Large-scale MIMD Machines
John N. Shadid and Scott Hutchinson, Sandia National Laboratories, Albuquerque

10:50 The Implementation of a Conjugate Gradient Algorithm for Unstructured Sparse Problems on the iPSC/860
Margot Gerritsen, Stanford University and Horst D. Simon, Computer Sciences Corporation, NASA Ames Research Center

11:10 Viscous Flow Computations on MPP Systems: Computational/Implementational Issues and Performance Results for Unstructured Grids
Stephane Lanteri and Charbel Farhat, University of Colorado, Boulder

11:30 Parallel Solution of Unstructured, Sparse Systems of Linear Equations
Mark Jones and Paul Plassmann, Argonne National Laboratory

11:50 Parallel Solution of Elliptic PDE's on Irregular Regions
Jose E. Castillo, San Diego State University and *John Richardson,* NRAD, San Diego

CP17/Marriott 5
Dense Linear Systems
Chair: Robert Van de Geijn, University of Texas, Austin

10:30 Basic Linear Algebra Communication Subprograms (LACS)
Jack Dongarra, University of Tennessee, Knoxville and Oak Ridge National Laboratory; and *Robert van de Geijn,* University of Texas, Austin

10:50 A Dynamic Programming Approach to Modeling Performance of a Class of Distributed Block Factorizations
Greg Henry and *Adolfy Hoisie,* Cornell University

11:10 Conflict--Free Access for Collections of Templates
Doreen L. Erickson and Charles J. Colbourn, University of Waterloo, Canada

11:30 A Minimal-Communication Matrix Transposition for Hypercubes
Richard B. Pelz, Rutgers University

11:50 A New Solution Method for Systems of Linear Equations
Minetada Osano, University of Tokyo, Japan and *Kazuo Nakajima,* University of Maryland, College Park

12:10 On the Pair of Almost Diagonal Skew-Symmetric and Symmetric Positive Definite Matrix
Vjeran Hari, University of Zagreb, Croatia and *Noah H. Rhee,* University of Missouri, Kansas City, MO

CP18/Marriott 3
Tools and Language Extensions
Chair: Ken Kennedy, Rice University

10:30 Distributed Code Management in a Heterogeneous System
Michael H. Lambert and Christopher J. Maher, Pittsburgh Supercomputing Center

10:50 Coupling Symbolic Processing with Parallel Numeric Computation
Thomas J. Willis and Edward A. Bogucz, Syracuse University

11:10 A Sequential to Parallel Fortran Transformation Assistance Tool
Michael R. Franks, State University of New York, Buffalo

11:30 Compiler Optimization of Test Suite Applications
Wei Shu, State University of New York, Buffalo

11:50 Real-Valued Array Indices: A Possible FORTRAN Extension
Charles Severance and Richard Enbody, Michigan State University

12:10 Parallel Programming in 2 Dimensions ($\int |\pi^{2D}$)
Stephen M. Nemecek, Elizabeth City State University

CP19/Marriott 4
Numerical Methods I
Chair: Elizabeth R. Jessup, University of Colorado, Boulder

10:30 Recent Developments in Parallel Pseudorandom Number Generation
Michael Mascagni, Steven Cuccaro, Daniel V. Pryor and M.L. Robinson, Supercomputing Research Center, Bowie, MD

11:00 Airy and Bessel Functions by Parallel Integration of ODEs
Daniel W. Lozier, National Institute of Standards and Technology and Frank W.J. Olver, University of Maryland, College Park

11:30 Convergence Results and Speedup of Parallel Numerical Integration Algorithms
Elise de Doncker, Western Michigan University and Ignatios Vakalis, Capital University

12:00 The Baer Radicals of Generalized Matrix Rings
Shouchuan Zhang, HengYang Medical College, People's Republic of China

CP20/Chesapeake 1
Optimization
Chair: Virginia Torczon, Rice University

10:30 Very Large-Scale Linear Programming: A Case Study in Exploiting both Parallelism and Distributed Memory
Anne Kilgore and *Virginia Torczon,* Rice University

10:50 Distributed Constrained Optimization
Liam Murphy and Felix F. Wu, University of California, Berkeley

11:10 A Parallel-Vector Simplex Algorithm on Distributed- Memory Computers
Jiangning Oin and *Duc T. Nguyen,* Old Dominion University

11:30 Solving the Phase Problem of X-Ray Crystallography on Parallel Machines
C.-S. Chang, State University of New York, Buffalo; G. DeTitta, Medical Foundation of Buffalo; H. Hauptman, State Univerity of New York, Buffalo and Medical Foundation of Buffalo; R. Jones, Thinking Machines Corporation, Cambridge, MA; *Russ Miller* and P. Thuman, State University of New York, Buffalo; and C. Weeks, Medical Foundation of Buffalo

11:50 On Parallelization of Interval Newton Method on Distributed-Memory Multiprocessor
Chenyi Hu, University of Houston, Downtown

12:10 Sampling Pareto-Optimal Solutions in Multi-Objective Optimization Problems by Parallel Distributed Computation
W.-Y. Ng, The Chinese University of Hong Kong, Hong Kong

CP21/Chesapeake 2
Applications in Electrical Engineering
Chair: Patrick H. Worley, Oak Ridge National Laboratory

10:30 An Electromagnetic PIC Code on the MasPar
Peter MacNeice, Hughes STX, NASA Goddard Space Flight Center

10:50 Implementation of Electromagnetic Scattering from Conductors Containing Loaded Slots on the Connection Machine CM-2
Yinghua Lu, A. Gaber Mohamed, Geoffrey Fox and R.F. Harrington, Syracuse University

11:10 A Homotopy Method for Solving Riccati Equations on a Shared Memory Parallel Computer
Dragan Zigic and *Layne T. Watson,* Virginia Polytechnic Institute and State University; Emmanuel G. Collins, Jr. and Larry D. Davis, Harris Corporation, Melbourne, FL

11:30 A New Design for Parallel Computer Used in Image Processing
Guoliang Zeng, Arizona State University

11:50 Parallel Simulation and Optimization of High-speed VLSI Interconnects
R.G. Griffith, *Q.J. Zhang* and M.S. Nakhla, Carleton University, Canada

12:10 Mathematical Models for Parallel Loops
Gita Alaghband, University of Colorado, Denver; Harry F. Jordan and Bernardo Rodriguez, University of Colorado, Boulder

TUESDAY AFTERNOON, MARCH 23

12:30-2:00
Lunch

2:00/Hampton Roads 5
IP6/Chair: Charles H. Romine, Oak Ridge National Laboratory

Multiphase Modeling of Contaminant Transport in Porous Media

The speaker will discuss model equations for multiphase and multicomponent flows and techniques for incorporating effects of heterogeneities and viscous fingering in large-scale, coarse-grid models via effective diffusion/dispersion coefficients.

He will present some of the computational aspects of a three-dimensional saturated-unsaturated code to simulate contaminant transport in the vadose zone and discuss implementation of this code on a distributed memory INTEL Paragon.

Richard E. Ewing
Institute for Scientific Computation
Texas A&M University, College Station

2:45/Hampton Roads 1
Coffee

3:15-5:15
Concurrent Sessions

MS1/Hampton Roads 5
Scalable and Stable Dense Eigensolvers

Because of the fundamental nature of eigenvalue computations, the development of scalable and stable algorithms for dense eigenvalue problems and their robust implementation on large-scale parallel multiprocessors is of great importance for the high-performance computing software infrastructure. This minisymposium focusses on the so-called "invariant subspace decomposition approach", where the matrix is decomposed by a series of so-called subspace annihilators. Computationally, this approach hinges on matrix-matrix multiplication and the computation of invariant subspaces. This minisymposium present an introduction into the invariant subspace decomposition approach and present our algorithms and implementations for matrix-matrix multiplication, tridiagonalization, and subspace decomposition on the Intel Delta multiprocessor. Lastly, an overview is given with respect to the state of the art in parallel methods for the nonsymmetric eigenvalue problem.

Organizers: Christian Bischof, Argonne National Laboratory and Anna Tsao, Supercomputing Research Center, Bowie, MD

3:15 **A Parallel Implementation of the Invariant Subspace Decomposition Algorithm for Dense Symmetric Matrices**
Steven Huss-Lederman and *Anna Tsao,* Supercomputing Research Center, Bowie, MD;and Guodong Zhang, University of Maryland, College Park

3:45 **Matrix Multiplication on the Intel Touchstone Delta**
Steven Huss-Lederman, *Elaine M. Jacobson,* and Anna Tsao, Supercomputing Research Center; and Guodong Zhang, University of Maryland, College Park

4:15 **Parallel Bandreduction and Tridiagonalization**
Christian Bischof, Mercedes Marques, and Xiaobai Sun, Argonne National Laboratory

4:45 **Design of a Parallel Nonsymmetric Eigenroutine Toolbox**
Zhaojun Bai, University of Kentucky; and *James Demmel,* University of California, Berkeley

CP22/Marriott 1
Geophysical Modeling II

Chair: Richard E. Ewing, Texas A&M University, College Station

3:15 **Parallelizing the Spectral Transform Method: A Comparison of Alternative Parallel Implementations**
Ian Foster, Argonne National Laboratory; *Patrick H. Worley,* Oak Ridge National Laboratory; and Florence Jacquis, Argonne National Laboratory

3:45 **Large-Scale Optimization Approaches to Inverse Problems in Subsurface Flow**
J.E. Dennis, Jr. and *Robert Michael Lewis,* Rice University

4:15 **Drought Monitoring through Parallel Computing**
John Belward and *Kevin Burrage,* University of Queensland, Australia; Frank Duncalfe, Spatial Modelling Centre, QDPI, Australia; Lawrence Lau and Mike Rezny, University of Queensland, Australia; and Robert Young, Spatial Modelling Centre, QDPI, Australia

4:45 **Running Some Modules of Large Air Pollution Models on the Massively Parallel Processors**
Jerzy Wasniewski, Danish Computer Center for Research and Education, Denmark

CP23/Marriott 5
Sparse Matrices III

Chair: Esmond Ng, Oak Ridge National Laboratory

3:15 **Parallel Sparse Cholesky Factorization Algorithms for Shared-Memory Multiprocessor Systems**
Edward Rothberg and Anoop Gupta, Stanford University; Esmond Ng and *Barry W. Peyton,* Oak Ridge National Laboratory

3:35 **Performance Evaluation of the Parallel Multifrontal Method in a Distributed Memory Environment**
Roldan Pozo, University of Tennessee, Knoxville and Sharon L. Smith, Centre European de Recherche et de Formation Avance en Calcul Scientifique, France

3:55 **Parallel Orthogonal Factorizations of Large Sparse Matrices on Distributed-Memory Multiprocessors**
Thomas F. Coleman and *Chunguang Sun,* Cornell University

4:15 **Basic Sparse Matrix Computations on Massively Parallel Computers**
William R. Ferng, National Chiao-Tung University, Taiwan, Republic of China; Kesheng Wu, University of Minnesota, Minneapolis; Serge Petiton, ETCA, France and Yale University; and Youcef Saad, University of Minnesota, Minneapolis

4:35 **Stability of a Parallel Method for Solving Sparse Triangular Systems**
Nicholas J. Higham, University of Manchester, United Kingdom

4:55 **A Fast LU Decomposition Algorithm for Sparse Revised Simplex Method**
Min-You Wu, State University of New York, Buffalo and Yong Li, Transtech Parallel Systems Corporation, Ithaca, NY

CP24/Marriott 3
Materials Science

Chair: Mark Jones, Argonne National Laboratory

3:15 **Massively Parallel Computing in the Solid State Theory Group at Ames Laboratory**
Dave Turner, Ames Laboratory

3:35 **Spectral Transform Lanczos for Eectronic States from Density Functional Computation**
Gen-Ching Lo and *Frank Webster,* State University of New York, Stony Brook

3:55 **Recent Results in the Modeling of Tyep-II Superconductors on Massively Parallel Computers**
Mark Jones and *Paul Plassmann,* Argonne National Laboratory

4:15 **Monte Carlo Simulation of Oxygen Ordering in the High- Temperature Superconductor YBa2Cu3Oz**
C.P. Burmester and R. Gronsky, University of California, Berkeley and Lawrence Berkeley Laboratory; and L.T. Wille, Florida Atlantic University

4:35 **A Fast Parallel Method for Exhaustive C_{60} Enumeration**
Bryant W. York, Northeastern University and Ottorino Ori, Thinking Machines Corporation, Cambridge, MA

4:55 **Numerical Simulation of Polymer Flows: A Parallel Computing Approach**
R. Aggarwal, P. Henriksen and R. Keunings, Universite Catholique de Louvain, Belgium

CP25/Marriott 4
Scheduling

Chair: Vijay K. Naik, IBM Thomas J. Watson Research Center

3:15 **Existence and Optimality of the Hyperplane Schedule for Reccurrence Equations**
Changweon Park and Yu Hen Hu, University of Wisconsin, Madison

3:45 **Scheduling of Large Scientific Applications on High- Performance, Distributed Multiprocessor Systems**
Vijay K. Naik, IBM Thomas J. Watson Research Center; Sanjeev K. Setia, University of Maryland, College Park; and Mark S. Squillante, IBM Thomas J. Watson Research Center

4:15 **A New Heuristic for UET and Pipeline Scheduling**
Donald W. Gillies, University of Illinois, Urbana

4:45 **Parallel Stochastic Reaction Algorithms**
Scott M. Stark and Michael T. Klein, University of Delaware

CP26/Chesapeake 1
Parallel Programming Models

Chair: Tony Skjellum, Lawrence Livermore National Laboratory

3:15 **An Implementation of the LPAR Parallel Programming Model for Scientific Computations**
Scott R. Kohn and Scott B. Baden, University of California, San Diego

3:45 **Distributed Objects: Sequential Objects with Parallel Performance**
C. Addison, B. Beattie, N. Brown, R. Cook, B. Stephens, and D. Watson, University of Liverpool, United Kingdom

4:15 **Architecture Adaptive Algorithms**
Arnold R. Krommer and Kristoph W. Ueberhuber, Technical University of Vienna, Austria

4:45 **A New Library for Parallel Algebraic Computation**
Wolfgang Schreiner and Hoon Hong, Johannes Kepler University, Austria

CP27/Chesapeake 2

Architecture/Visualization

Chair: Harry F. Jordan, University of Colorado, Boulder

3:15 **Parallel Algorithms for Radiosity**
Elise de Doncker, John Kapenga, *Christopher Oliver,* and Ankur Mittal, Western Michigan University

3:45 **An Interactive Visualization Environment for Financial Modeling on Heterogeneous Computing Systems**
Gang Cheng, Kim Mills and Geoffrey Fox, Syracuse University

4:15 **I/O for TFLOPS Supercomputers**
Erik P. DeBenedictis, Scalable Computing, Redwood City, CA

4:45 **Fast Arithmetic Decoder Architectures**
Gireesh Shrimali and *Keshab K. Parhi,* University of Minnesota, Minneapolis

5:30-7:30/Hampton Roads 1

Poster Session

Parallel Fourth Order Methods for Second Order PDEs
A.Q.M. Khaliq and D.A. Voss, Western Illinois University

Overlapping Multisplitting Preconditioners for the ConjugateGradient Method
R. Bru, C. Corral and *J. Mas,* Universitat Politecnica de Velencia, Spain

Iterative Solution Applied to Global Spectral Collocation Implemented on an Intel iPSC/860 Parallel Computer
Herman Migliore, Portland State University

Estimating Optimum Parallelism in Standard Scientific Applications
E. Chabot and Daniel Audet, Universite du Quebec, Canada

Development of Implicit CFD Algorithms for Distributed Memory Parallel Computers
James D. Padgett, Tektronix, Inc., Wilsonville, OR and *Gerald W. Recktenwald,* Portland State University

A Parallel Algorithm for the Distance Embedding Problem
G. Sampath, Marist College

A Parallel Implementation of an Unstructured Grid Generation Program using PVM and APPL
Trey Arthur and Michael J. Bockelie, Computer Science Corporation, NASA Langley Research Center

Parallel Assignment, Reduction and Communication for Data Parallel Programming
Sanjay Rajopadhye, IRISA, France and Manjunath Muddamagegowda, Oregon State University

A Parallel Processing Algorithm for Discrete Time Optimal Control Problem
Li-zhi Liao and Christine A. Shoemaker, Cornell University

Optimal Eigenvalue Computation
S. Crivelli and E.R. Jessup, University of Colorado, Boulder

Parallelized Interactive Data Management of Large, Scientific Data Sets
Sandra Walther and *Richard L. Peskin,* Rutgers University

Circuit Simulation on Multicomputers
Jay A. Jackson, University of Southwestern Louisiana and *Peter S. Pacheco,* University of San Francisco

P4: Portable Programs for Parallel Processors
Ralph Butler and *Rusty Lusk,* Argonne National Laboratory

Collective Rhythmicity in Biological Oscillator Ensembles
Jeffrey L. Rogers and *Luc T. Wille*, Florida Atlantic University

Adaptive Grids for Time-Dependent Problems in a Heterogeneous Parallel Environment
J.C. Diaz and *J.C. Sevillano*, University of Tulsa

An Undergraduate Course in High-Performance Scientific Computing
S. Alam, G. Domik, L. Fosdick, *E.R. Jessup,* and C.J.C. Schauble, University of Colorado, Boulder

Parallel Solution of Separable Elliptic Equations
Christopher Beattie and Calvin J. Ribbens, Virginia Polytechnic Institute and State University

Fast *QR* Decomposition for Weighted Least Squares Problems
Andre A. Anda and Haesun Park, University of Minnesota, Minneapolis

8:00/ Chesapeake 1

Business Meeting
SIAM Activity Group on Supercomputing

WEDNESDAY MORNING, MARCH 24

7:30/Hampton Roads Foyer

Registration opens

8:30 IP7/Hampton Roads 5

Chair: Daniel Reed, University of Illinois, Urbana

A Machine-Independent Programming System for Massively Parallel Computers

A major problem with current parallel computing systems is that each system provides a machine-dependent programming interface at the Fortran level. As a result, a program written for one parallel machine must be rewritten for any new parallel architecture. Fortran D is an extended version of Fortran 77 designed to address this problem for "data-parallel" problems. It provides a set of statements that specify the distribution of data structures across the processor array. Parallelism is derived by the compiler via the "owner computes" rule, which specifies that the processor owning a datum computes its value.

The speaker will presnt an overview of the compiler techniques and supporting programming environment needed to make this language an effective tool for scientific programming. Since almost all of the relevant features in Fortran D have been included in High Performance Fortran, the discussion will be directly applicable to that language as well.

Ken Kennedy
Center for Research on Parallel Computation
Rice University

9:15 IP8/Hampton Roads 5

Chair: Daniel Reed, University of Illinois, Urbana

Role of Large-Scale Numerical Simulation in Industrial Applications

The potential of parallel processing computers has been intensely discussed, and the computing technologies involved are a key US economic strength. A few applications, especially from the aerospace industry, have gotten wide-spread publicity, but the degree to which these technologies are already key elements in improving advanced product design and manufacturing processes is generally under-appreciated.

The speaker will present an overview of a spectrum of applications being used in a large multi-national corporation for both product and process improvement. Some examples that will be reviewed include fluid and structural dynamics, materials design and processing, computational chemistry, operations research, scheduling and dispatching, machine learning, and communication network modeling.

William T. Thompkins, Jr.
United Technologies Research Center

10:00/Hampton Roads 1

Coffee

10:30 AM-12:30 PM

Concurrent Sessions

MS2/Hampton Roads 5

Research at the Center for Research on Parallel Computation

In this minisymposium, the speakers will present an overview of four of the six areas of research being conducted at the Center for Research on Parallel Computation.

Organizer: Ken Kennedy
Rice University

10:30 **Compositional Programming Systems**
Mani Chandy, California Institute of Technology

11:00 **Multidisciplinary Optimization**
J.E. Dennis, Jr., Rice University

11:30 **Numerical Simulation**
Steve Roy, California Institute of Technology

12:00 **Parallel Algorithms for Modeling Flow in Porous Media**
Mary F. Wheeler, Rice University

CP28/Marriott 1

Computational Fluid Dynamics III

Chair: William T. Thompkins, Jr., United Technologies Research Center

10:30 **A Computational Aeroacoustics Application on the SIMD WAVETRACER Computer**
Mohammad M.S. Khan, Lockheed Missiles and Space Company

10:50 **Spline Methods for Hydrodynamic Equations**
A.S. Umar, Oak Ridge National Laboratory and Vanderbilt University; C. Bottcher, and M.R. Strayer, Oak Ridge National Laboratory; and D.J. Dean, Kellog Radiation Laboratory, Pasadena, CA

11:10 **Parallelization of a Godunov Type Method for the Solution of Systems of Conservation Laws**
Marcin Paprzycki and Ken Bridges, University of Texas at Permian Basin, Odessa; and Xuefeng Li, Loyola University

11:30 **3-D Point Vortex Methods for Parallel Flow Computations**
D.J. Doorly and M. Hilka, Imperial College, United Kingdom

11:50 **A Parallel Spectral Element Method for the 3D Navier-Stokes Equations**
W. Couzy and M.O. Deville, Universite Catholique de Louvain, Belgium

CP29/Marriott 5

Geophysical Structures and Algorithms

Chair: Mary F. Wheeler, Rice University

10:30 **Fast 3-D Poisson Solver for Ocean Dynamics**
Logan K. Kuiper, Los Alamos National Laboratory

10:50 **Parallelization of Lanczos Method and It's Application in Ocean Modeling**
William Cunningham and *Andrea Hudson,* Hughes STX, Lanham, MD

11:10 **Solution of Large Linear Systems Arising in Four- Dimensional Atmospheric Data Assimilation**
James Pfaendtner, NASA, Goddard Space Flight Center

11:30 **Iterative Solution Methods for Industrial Massively Parallel Applications. I: Fluid - Structure Interaction Problems**
Horst D. Simon, Computer Sciences Corporation, NASA Ames Research Center and *A. Yu. Yeremin,* Russian Academy of Sciences, Russia

11:50 **Iterative Methods for Large-Scale Static Analysis of Structures on a Scalable Multiprocessor Supercomputer**
Nahil A. Sobh, Old Dominion University

12:10 **Topology Optimization of Trusses by Evolution Techniques**
Bernd Kost, Technical University of Berlin, Germany

CP30/Marriott 3

Sparse Matrices IV

Chair: Victor Eijkhout, University of Tennessee, Knoxville

10:30 **Fast Solution of Three-Dimensional Poisson Orthogonal Spline Collocation Problems on the CM-5**
Karin R. Bennett, Oak Ridge National Laboratory; Bernard Bialecki and Graeme Fairweather, University of Kentucky

10:50 **Parallel Partitioned-Inverse Sparse Matrix Solutions**
Osman Yasar, Hasan Dag, and Fernando Alvarado, University of Wisconsin, Madison

11:10 **A New Torus-like Mapping for Parallel Sparse Matrix Factorization**
Andrew J. Cleary, Australian National University, Australia

11:30 **An Efficient Orthogonal Projection Method for Parallel Sparse Least Squares Problem**
Szu-Min Lu and Jesse L. Barlow, Pennsylvania State University

11:50 **A Parallel Algorithm for Solving Periodic Banded Toeplitz Linear Systems**
Thiab R. Taha and Peiqing Jiang, University of Georgia

12:10 **Lanczos Methods for the Smallest Eigenvalues of Large Matrices on Distributed Memory Supercomputers**
John Kapenga and Elise de Doncker, Western Michigan University

CP31/Marriott 4

Languages and Compilers

Chair: Adam Beguelin, Carnegie Mellon University

10:30 **Block FORALL Statement for Scientific Applications**
Min-You Wu, State University of New York, Buffalo

11:00 **A CONLAB Compiler for a Distributed Memory Multicomputer**
Peter Drakenberg, *Peter Jacobson* and Bo Kagstrom, University of Umea, Sweden

11:30 **2lp: A Highly Parallel Constraint Logic Programming Language**
Coskun Atay, Ken McAloon and Carol Tretkoff, Brooklyn College of the City University of New York

12:00 **Polynomial Time and Exact Data Dependence Analysis**
Zhaoyun Xing and *Weijia Shang,* University of Southwestern Louisiana

CP32/Chesapeake 1

Load Balancing

Chair: Harry Berryman, Yale University

10:30 **A Fast Multilevel Implementation of Recursive Spectral Bisection for Partitioning Unstructured Problems**
Stephen T. Barnard, Cray Research, Inc. and Horst D. Simon, Computer Sciences Corporation, NASA Ames Research Center

11:00 **An Improved Spectral Load Balancing Method**
Bruce Hendrickson and Robert Leland, Sandia National Laboratories, Albuquerque

11:30 **Efficient Mesh Partitioning for Parallel PDE Solvers on Distributed Memory Machines**
David C. Hodgson and Peter K. Jimack, University of Leeds, United Kingdom

12:00 **Dynamic Load Balancing for PDE Solvers which use Adaptive Unstructured Meshes**
Chris Walshaw and Martin Berzins, University of Leeds,United Kingdom

CP33/Chesapeake 2

Control/Circuits

Chair: Stephen D. Roy, University of Illinois, Chicago

10:30 **A Parallel Processing algorithm for Discrete Time Optimal Control Problems**
Li-zhi Liao and Christine A. Shoemaker, Cornell University

11:00 **High Performance Computing in Linear Control**
Biswa Nath Datta, Northern Illinois University

11:30 **Finite Element Computation of the Hydrodynamic Model of Semiconductor Devices**
Zhangxin Chen and Bernardo Cockburn, University of Minnesota, Minneapolis; and Joseph W. Jerome, Northwestern University; and Chi-Wang Shu, Brown University

12:00 **Parallel Solution Techniques for the Drift-Diffusion Equations**
Luc Giraud and *Ray S. Tuminaro,* Centre European de Recherche et de Formation Avance en Calcul Scientifique, France

WEDNESDAY AFTERNOON, MARCH 24

12:30-2:00

Lunch

IP9/Hampton Roads 5

Chair: Linda R. Petzold, University of Minnesota, Minneapolis

The Greatest Grand Challenge

The key question about the future of supercomputing is not whether parallelism will be used but how it will be used. Parallelism is necessary because the increase in the fastest machine clock speeds over the past few decades finally is leveling off as designers begin feeling the constraints of fundamental physical limitations imposed by the speed of light.

After years of debate, the Federal High Performance Computing and Communications Initiative has now been launched. While HPCCI has focussed much attention on parallel computing, it has also promised performance improvements that seem unachievable.

The Greatest Grand Challenge (GGC) is to design parallel computing systems that can continue to produce speed increases into the indefinite future, through parallelism. The parallel processing community must avoid outrageous promises based on peak speeds alone, push parallel software ahead as vigorously as possible, and focus HPCCI on the GGC.

David J. Kuck
Center for Supercomputing Research and Development
University of Illinois, Urbana-Champaign

2:45/Hampton Roads 1

Coffee

3:15-5:15
Concurrent Sessions

MS3/Hampton Roads 5
Parallel Numerical Methods for Circuit and Device Simulation

The enormous computational expense and the growing importance of circuit and device simulation, as well as the increasing availability of parallel computers, suggest that specialized, easily parallelized, algorithms be developed for these application areas. The circuit and device simulation problems each have particular characteristics that make the application of certain numerical techniques more advantageous than others.

The speakers in this minisymposium will discuss parallel numerical methods that have been successfully applied to the problem of simulating circuits and semiconductor devices. The primary emphasis will be on parallel iterative techniques, but direct methods will be discussed as well.

Organizer: Andrew Lumsdaine
University of Notre Dame

3:15 **Waveform Iterative Techniques for Device Transient Simulation**
Andrew Lumsdaine, Organizer

3:45 **A-stability of Multirate Integration Methods, with Application to Parallel Semiconductor Device Simulation**
Mark Reichelt, Massachusetts Institute of Technology; Farouk Odeh, IBM Thomas J. Watson Research Center; *Jacob White,* Massachusetts Institute of Technology

4:15 **Parallel Circuit Simulation using Relaxation Based Methods**
Resve Saleh, University of Illinois

4:45 **PACE: A Multiprocessor System for VLSI Circuit Simulation**
Prathima Agrawal, AT&T Bell Laboratories

CP34/Marriott 1
Molecular Dynamics II

Chair: Steve Plimpton, Sandia National Laboratories, Albuquerque

3:15 **Parallelizing Molecular Dynamics Codes using the Parti Software Primitives**
R. Das and J. Saltz, ICASE, NASA Langley Research Center

3:45 **Parallel Computation of Polymeric Materials**
B. Ostrovsky and *Y. Bar-Yam,* Boston University; M.A. Smith, N. H. Margolus and T. Toffoli, Massachusetts Institute of Technology; and Y. Rabin, Bar-Ilan University, Israel

4:15 **Constitutive Modeling of Material Deformation using Molecular Dynamics Modeling on the Connection Machine**
Paul A. Scagnetti, Thomas G. Bifano, Raymond J. Nagem and Guido V.H. Sandri, Boston University

4:45 **The Completed Double Layer Boundary Integral Equation Method: Parallel Computational Strategies for Three-Dimensional Laplace, Stokes and Navier Equations**
Sangtae Kim, Mary K. Vernon, Frank Traenkle, Brian E. Saunders, and Matthew Frank, University of Wisconsin, Madison

CP35/Marriott 5
Reservoir Modeling

Chair: R. Michael Lewis, Rice University

3:15 **UTCHEM, a Chemical Flood Simulator, on the CM-5**
Adam Greenberg and Kirk E. Jordan, Thinking Machines Corporation; Marcelo Rame and Mary F. Wheeler, Rice University

3:35 **Massively Parallel Groundwater Flow in Three Dimensions**
Mark Curran, Sandia National Laboratories, Albuquerque

3:55 **Parallelizing in Oil Refining Simulation: Numerical Methods, Implementations and Experience**
Xiaodong Zhang, University of Texas, San Antonio and John E. Dennis, Jr., Rice University

4:15 **Domain Decomposition Techniques for Matrix Building up in Numerical Reservoir Simulation**
S. Buitrago, INTEVEP, S.A., Venezuela; J. Groba, C. Maulino, and K. Millan, University Central de Venezuela, Venezuela

4:35 **Parallelization of a Reservoir Simulator Linear System Solver on Distributed Memory Multiprocessor**
Saul Buitrago, INTEVEP, S.A.; O. Chacon and C. Maulino, Universita Central de Venezuela, Venezuela

4:55 **Parallelization of Seismic Codes in Distributed Memory Computers**
Enrique Rodriguez, INTEVEP, S.A., Venezuela

CP36/Marriott 3
Performance

Chair: David J. Kuck, University of Illinois, Urbana-Champaign

3:15 **Issues Concerning the Benchmarking of Massively Parallel Computers for Automotive Applications**
Myron Ginsberg, General Motors Research and Environmental Staff, Warren, MI

3:35 **Performance of Seismic Kernels on Fujitsu's VPP500 Hybrid Vector Parallel Supercomputer**
Bracy H. Elton, *Siamak Hassanzadeh* and Sergio E. Zarantonello, Fujitsu America, Inc., San Jose, CA

3:55 **Development of Parallel Algorithms on KSR-1 Parallel Computers**
Jianping Zhu, Mississippi State University

4:15 **Performance Evaluation of Early Systems: An HPCC Perspective**
Tarek A. El-Ghazawi, George Washington University

4:35 **Data Locality for Shared Memory**
Joan D. Lukas, Massachusetts Institute of Technology

4:55 **Analysis and Evaluation of Memory Access Patterns for Scientific Computations on Large Scale Shared-memory Multiprocessors**
Xiaodong Zhang and Keqiang He, University of Texas, San Antonio

CP37/Marriott 4
Matrix Computations, Least Squares

Chair: Paul Plassmann, Argonne National Laboratory

3:15 **Improving the Unsymmetric Parallel QR Algorithm on Vector Machines**
Greg M. Henry, Cornell University

3:35 **An Efficient and Accurate Parallel Algorithm for the Singular Value Problem of Bidiagonal Matrices**
T.Y. Li, Michigan State University; Noah Rhee, University of Missouri, Kansas City; and *Zhonggang Zeng,* Northern Illinois University

3:55 **Computing the Singular Value Decomposition on the CM-5**
Tong J. Lee, Cornell University and Franklin T. Luk, Rensselaer Polytechnic Institute

4:15 **Parallel Inverse Iteration**
George I. Fann and Richard J. Littlefield, Battelle Pacific Northwest Laboratory

4:35 **Parallel Tensor Methods for Nonlinear Equations and Nonlinear Least Squares**
Ali Bouaricha and Robert B. Schnabel, University of Colorado, Boulder

4:55 **Parallel Methods for Large Least Norm Problems**
Alvaro R. De Pierro, University of Pennsylvania

CP38/Chesapeake 1
Differential Equations

Chair: Calvin J. Ribbens, Virginia Polytechnic Institute and State University

3:15 **Parallel Solution of the Three-Dimensional, Time-Dependent Ginzburg-Landau Equation**
David Gunter, University of Wisconsin, Milwaukee; Gary Leaf and *David Levine,* Argonne National Laboratory; and Salman Ullah, University of Chicago

3:35 **Large-Scale Three-Dimensional Numerical Solutions of Hyperbolic Partial Differential Equations**
Siamak Hassanzadeh, Fujitsu America, Inc.; and Gerard T. Schuster, University of Utah

3:55 **Multigrid Waveform Relaxation Methods for Time-Dependent PDEs**
Hong Zhang, Clemson University

4:15 **Direct Numerical Simulations of Turbulent Shear Flows on Distributed Memory Architectures**
Norberto Mangiavacchi and Rayhaneh Akhavan, University of Michigan, Ann Arbor

4:35 **A Time Dependent Approach to the Solution of the Helmholtz Equation at High Wave Numbers**
Marie-Odile Bristeau, INRIA-Rocquencourt, France; *Jocelyne Erhel,* INRIA/IRISA, France; Roland Glowinski, University of Houston; and Jacques Periaux, Dassault Aviation, France

4:55 **L-Stable Parallel One-Block Methods for Ordinary Differential Equations**
Philippe Chartier, SIMULOG, France and Bernard Philippe, IRISA, France

CP39/Chesapeake 2
Numerical Methods II

Chair: Xiao-Chuan Cai, University of Kentucky

3:15 **PSMG Multiscale Method for Anisotropic Problems**
Yi-Hua Chang and Oliver A. McBryan, University of Colorado, Boulder

3:45 **Parallel Cluster Analysis on 2-D Grids**
Michael W. Berry, Jane G. Comiskey and *Karen S. Minser,* University of Tennessee, Knoxville

4:15 **Performance and Scalability of Conjugate Gradient Methods on Parallel Computers**
Anshul Gupta and Vipin Kumar, University of Minnesota, Minneapolis and Ahmed Sameh, University of Illinois, Urbana

4:45 **Evaluation of Distributed Memory Systems for Parallel Numerical Applications**
Larry Wittie, Gudjon Hermannsson and Ai Li, State University of New York, Stony Brook

5:15
Conference Adjourns

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CP = Contributed Presentation
IP = Invited Presentation
MS = Minisymposium

M	B	P	P	9	3	SIAM USE ONLY					

SOCIETY for INDUSTRIAL and APPLIED MATHEMATICS

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Primary Professional Interests (Check no more than 3)

- ❑1. Linear algebra and matrix theory.
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- ❑4. Partial differential equations including inverse problems.
- ❑5. Discrete mathematics and graph theory including combinatorics, combinatorial optimization, and networks.
- ❑6. Numerical analysis (theory).
- ❑7. Computational mathematics including scientific computing, parallel computing, and algorithm development.
- ❑8. Computer science including computer architecture, computer hardware, computational complexity, applied logic, database, symbolic computation.
- ❑9. Applied probability including stochastic processes, queueing theory, and signal processing.
- ❑10. Statistics including data analysis and time series analysis.
- ❑11. Control and systems theory including optimal control.
- ❑12. Optimization theory and mathematical programming including discrete and numerical optimization and linear and nonlinear programming.
- ❑13. Communication theory including information theory and coding theory.
- ❑14. Applied geometry including computer-aided design and related robotics.
- ❑15. Image processing including computer graphics, computer vision, related robotics, and tomography.
- ❑16. Classical mechanics of solids including elasticity, structures and vibrations, and constitutive models.
- ❑17. Fluid mechanics including turbulence, aeronautics, and multiphase flow.
- ❑18. Quantum physics, statistical mechanics, and relativity.
- ❑19. Geophysical sciences including reservoir modeling, seismic exploration, and petroleum engineering.
- ❑20. Atmospheric and oceanographic sciences.
- ❑21. Chemical kinetics, combustion theory, thermodynamics, and heat transfer.
- ❑22. Biological sciences including biophysics, biomedical engineering, and biomathematics.
- ❑23. Environmental sciences.
- ❑24. Economics.
- ❑25. Social sciences.
- ❑26. Functional analysis and operator equations, and integral and functional equations.
- ❑27. Management sciences including operations research.
- ❑28. Applied mathematics education (K-12, undergraduate curriculum, graduate study and modeling courses).
- ❑29. Astronomy, planetary sciences, and optics.
- ❑30. Simulation and modeling.
- ❑31. Materials science, polymer physics, and structure of matter.
- ❑32. Electromagnetic theory, semiconductors, and circuit analysis.
- ❑Other _____

SIAM use only

F/M _____

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Inv.# _____

Sub ____ Logged _____

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please complete reverse side

Society Memberships
(Check all that apply)

ACM_____	AIAA_____	AMS_____	APS_____	ASA_____	ASME_____
IEEE_____	IMS_____	MAA_____	ORSA_____	TIMS_____	Other_____

Membership Benefits

Dues cover the period January 1, 1993 through December 31, 1993. Members will receive all issues of *SIAM Review* and *SIAM News*. Members are entitled to purchase one each of no more than four SIAM journals, for their personal use only, at member discount prices. Members can join any of the SIAM Activity Groups at $10 per group. Members are entitled to 20% off list prices on all SIAM books, and receive member discounted registration at SIAM sponsored meetings.

Student members have the same benefits as regular members. Students receive one activity group membership free; additional activity group memberships are $10 each.

Associate members are spouses of regular members and are entitled to all privileges of regular members except that they do not receive *SIAM Review*. Associate members should indicate the full name of their spouse on their application.

Fees and Subscriptions

Compute payment as follows:

Dues (Regular Members): $79.00 _____

Dues (Student Members): $15.00 _____

Dues (Associate Members): $18.00 _____

Dues (Activity Groups): $10.00 per group checked below: _____

Control and Systems Theory _____ Discrete Mathematics _____ Dynamical Systems _____

Geometric Design _____ Geosciences _____ Linear Algebra _____ Optimization _____

Orthogonal Polynomials and Special Functions _____ Supercomputing _____

SIAM Journal on . . .	Member Prices: USA, Canada, Mexico/Elsewhere	
Applied Mathematics (bimonthly)	$54/$59	_____
Computing (bimonthly)	$54/$59	_____
Control and Optimization (bimonthly)	$54/$59	_____
Discrete Mathematics (quarterly)	$44/$47	_____
Mathematical Analysis (bimonthly)	$54/$59	_____
Matrix Analysis and Applications (quarterly)	$44/$47	_____
Numerical Analysis (bimonthly)	$54/$59	_____
Optimization (quarterly)	$44/$47	_____
Scientific Computing (bimonthly)	$54/$59	_____
Theory of Probability and Its Applications (quarterly)	$99/$102	_____
1992-93 Combined Membership List	$9	_____

TOTAL $ _____

Application for Membership

I apply for membership in SIAM:

Signature _____

Spouse's Name (If applying for Associate Membership) _____

Student Status Certification

CERTIFICATION (student members only)

I hereby certify that the applicant is actively engaged in a degree program and is a full-time student, teaching/research assistant, or fellow:

Name of College or University _____

Department Chair (signature please) _____ Date _____

Please enclose payment with this application and mail to: SIAM, P.O. Box 7260, Philadelphia, PA 19101-7260

MEMBERS OUTSIDE THE USA

For SIAM members residing outside the USA, SIAM will accept payment of membership dues and subscription fees by American Express, MasterCard, and VISA. Because SIAM incurs considerable cost in obtaining payment via credit cards, please use credit cards only when other methods of payment are difficult to arrange.

❑ American Express ❑ MasterCard ❑ VISA

Credit Card # _____ Expiration date_____

For further information, please contact SIAM Customer Services:
Telephone: 215-382-9800 / Toll-free (U.S. only): 800-447-SIAM / Telex: 446715 / Fax: 215-386-7999
E-mail: service@siam.org / Address: 3600 University City Science Center, Philadelphia, PA 19104-2688

HOTEL INFORMATION

Norfolk Waterside Marriott Hotel
235 E. Main Street
Norfolk, Virginia 23510
804-627-4200

The newest hotel on Norfolk's downtown skyline, the Marriott soars 23 stories above the city's sparkling waterfront. Covered walkways connect the hotel to the popular Waterside Festival Marketplace.

Room Rates
$74.00 Single
$84.00 Double
There is a 9.5% occupancy tax that will be added to your room rate.

Reservation Deadline
Monday, March 1, 1993

To make a reservation
Use the Hotel Reservation Card on the back of this program or call the Marriott at (804)-627-4200.
Identify yourself as an attendee at the SIAM Conference on Parallel Processing.
Be sure to request a confirmation number.

Deposit
A deposit in the amount of one night's room rate or the use of a major credit card with the number and expiration date is required to confirm your reservation.

Cancellation
To obtain a refund, reservations must be cancelled by 5:00 PM, 48 hours prior to your scheduled arrival.

Arrivals and Departures
You may check in anytime after 3:00 PM ; you must check out by 11:00 AM.

Hotel Facilities
The hotel is equipped with an indoor pool with 3 jacuzzis and a weight room. All are available to the attendees on a complimentary basis. The facilities are located on the 6th floor of the hotel and are open from 6:30 AM - 10:00 PM.

Within Walking Distance
Directly across from the Marriott is the Waterside Marketplace and Food Court filled with an assortment of 150 restaurants and retail shops. The Marketplace is open daily from 10:00 AM - 9:00 PM. Some restaurants may be open later.

Parking
Located on Main Street across from the Marriott is city parking. The cost for self parking is $6.50 per day; $8.50 per day if you valet park.

Babysitting Service
Babysitting service is available through the hotel's Concierge Desk by calling 804-627-4200. Babysitting is done in your room. The cost is approximately $6.00 per hour for the first child and $1 per hour for each additional child. SIAM supplies the information, but in no way takes responsibility or is liable for any damages that may occur by using any of the suggested services. It is the responsibility of the attendees to choose the service that best suits their needs.

TRANSPORTATION INFORMATION

Shuttle Service
From the Airport: The Norfolk International Airport Shuttle leaves the airport from the baggage claim area every 1/2 hour. The shuttles are white and blue, and cost $12.00 per person each way.

Driving
From the Airport: When exiting the airport, take 64 West to 264 West to Norfolk exit. At the Norfolk exit you will take the Waterside Drive exit (left). At the third stop light (Martins Lane) turn right. Proceed one block where you will dead end onto Main Street. The Marriott is on the right.

Car Rental
Dollar Rent A Car has been selected as the official car rental agency for this conference. Cars can be rented at the Norfolk International Airport. The following unlimited mileage rates will apply between March 15 - 29, 1993. (These rates do not include refueling services, tax, optional collision damage waiver, and personal accident insurance.)

Type of Car	Daily Rate	Weekly Rate	Weekend Rate
Economy	$28.93	$129.97	$19.93
Compact	$30.97	$149.97	$20.93
Intermediate	$31.93	$158.97	$21.93
Standard	$34.93	$168.97	$22.93
Premium	$48.97	$244.95	$35.93
Luxury	$52.99	$268.99	$36.93
Mini Van	$69.99	$349.95	N/A

Reservations
We encourage you to make an advance reservation, since on-site availability cannot be guaranteed. Make reservations by calling 1-800-800-0044. When making reservations, be sure to give the SIAM Reservation Code: CCSIA5. You should also mention that you are attending the SIAM Conference on Parallel Processing, March 22-24, 1992 in Norfolk, Virginia, in order to receive the indicated rates.

Cars can be picked up at the Norfolk International Airport at the Dollar Car Rental Desk located in the baggage claim area of the airport, and must be dropped off at the same location.

You must be 21 years of age, have a valid U.S. or international driver's license, and have an American Express, Master Card, VISA or Diner's Club credit card in order to rent a car.

GET-TOGETHERS

SIAM Welcoming Reception
Sunday, March 21, 1993
6:30 PM - 8:30 PM
Hampton Roads Foyer
Cash bar and assorted mini hors d'oeuvres.

"Spirit of Norfolk"
Harbor dinner cruise and show
Monday, March 22, 1993
6:00 PM - 10:00 PM
Waterside Dock

The evening begins with a short walk to the Waterside dock to board the "Spirit of Norfolk". We will depart at 7:00 PM and tour past the famous Norfolk landmarks of Old Fort Norfolk, Blackbeard's hiding place, Norfolk Naval Base - the world's largest installation of submarines, aircraft carriers, and freighters, Portsmouth Naval Hospital, and Downtown Norfolk.

A buffet dinner will be served on board, featuring beef, chicken and fish entrees as well as an array of vegetables, salads and desserts. Vegetarian meals will be available.

After dinner, sit back and enjoy the crew as they perform a Broadway Revue of songs and dances. After the show, you can venture to the top deck and sip a cocktail and enjoy the view on the return cruise. A cash bar will be available to purchase drinks.
Cost: $30.00 per person

Poster Session
Tuesday, March 23, 1993
5:30 PM - 7:30 PM
Hampton Roads I-III

Come join your colleagues to participate in the exchange of ideas with the presenters and others who have interest in their work. During the session, complimentary beer and assorted sodas, chips and dips will be served.

SIAM Activity Group on Supercomputing
Business Meeting
Tuesday, March 23, 1993
8:00 PM
Chesapeake 1
Complimentary beer and soda.
All are welcome.

❑ REGISTRATION INFORMATION

Please complete the Preregistration Form found on the back of this program. We urge attendees to register in advance to get the lower registration fee. The preregistration deadline is Monday, March 8, 1993. The registration desk will be located in the Hampton Roads Foyer and will be open as listed below:

Saturday, March 20	6:00 PM - 8:00 PM
Sunday, March 21	7:30 AM - 4:00 PM
	6:00 PM - 8:00 PM
Monday, March 22	7:30 AM - 4:00 PM
Tuesday, March 23	7:30 AM - 4:00 PM
Wednesday, March 24	7:30 AM - 2:00 PM

Registration Fees:

	SIAG/SC	Member	Non Member	Student
TUTORIAL				
Preregistration		$120	$135	$55
Registration		$135	$155	$75
CONFERENCE				
Preregistration	$140	$145	$175	$45
Registration	$170	$175	$205	$45

The conference registration fees include a copy of the proceedings which will be available at the conference.

Notice

There will be no prorated fees. No refunds will be issued once the conference has started. If SIAM does not receive your Preregistration Form and payment by March 8, 1993, you will be asked to register and pay the full registration fee **for** the meeting.

Credit Cards

SIAM accepts Visa, MasterCard, and American Express for payment of registration fees, special functions, memberships, and book orders. When you complete the Preregistration Form, please be certain to indicate the type of credit card, the account number and the expiration date.

Telephone Messages

The telephone number of the Marriott is (804) 627-4200. The Marriott Hotel will either connect the caller with the SIAM registration desk or leave a message in the attendees hotel room.

SIAM Corporate Members

Non-member attendees who are employed by the following institutions are entitled to the SIAM member rate.

Amoco Production Company
AT&T Bell Laboratories
Bellcore
The Boeing Company
BP America
Cray Research, Inc.
E.I. du Pont de Nemours & Company
Eastman Kodak Company
Exxon Research and Engineering Company
General Motors Corporation
GTE Laboratories, Incorporated
Hollandse Signaalapparaten, B.V.
IBM Corporation
ICASE
IDA Center for Communications Research
IMSL, Inc.
Lockheed Corporation
MacNeal-Schwendler Corporation
Martin Marietta Energy Systems
Mathematical Sciences Research Institute
NEC Research Institute
Supercomputing Research Center, a Division of Institute for Defense Analyses
Texaco, Inc.
United Technologies Corporation

BOOK ORDERING INFORMATION

TO ORDER
Use your credit card (AMEX, MC, and VISA):
Call toll free in USA: 800-447-SIAM
Outside USA call: 215-382-9800
Fax: 215-386-7999 / E-mail: service@siam.org
Or send check or money order to:
SIAM, Dept. BC1992
P.O. Box 7260
Philadelphia, PA 19101-7260

Shipping and Handling
USA: Add $2.75 for first book and $.50 for each additiional book.
Canada: Add $4.50 for first book and $1.50 for each additional book.
Outside USA/Canada: Add $4.50 per book.

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PARALLEL PROCESSING
FOR • SCIENTIFIC • COMPUTING

March 22-24, 1993
Norfolk Waterside Marriott Hotel
Norfolk, Virginia

Specially discounted rooms are being held for our exclusive use until Monday, March 1, 1993. After that date, reservations will depend on availability. Your reservation is not confirmed until acknowledged in writing by the hotel or verified by phone. A deposit in the amount of one night's room rate is required in order to confirm your reservation. When making reservations by phone, be certain to identify yourself as an attendee at the SIAM Conference on Parallel Processing.
Marriot Telephone: 804-627-4200

HOTEL RESERVATION FORM

Please send me a confirmation

PLEASE PRINT

Name _____

Phone _____

Address _____

City _____ State _____ Zip _____

Please reserve a ❑ $74/Single _____ [ ] $84/Double _____

Arrival Date _____ Arrival Time _____ Departure Date _____

I am enclosing my deposit for the first night's room rate. I choose to pay by:
❑ American Express ❑ MasterCard ❑ Visa ❑ Personal Check

Credit Card Number _____

Exp. Date _____ Deposit $ _____

Signature _____

Detach this card and enclose it in an envelope with postage and mail to:
Reservations, Norfolk Waterside Marriott Hotel, 253 E. Main Street, Norfolk, VA 23510

PREREGISTRATION FORM

Registration Fees: (Please circle your appropriate fee category)

	SIAG/SC*	Member	Non Member	Student
TUTORIAL				
Preregistration		$120	$135	$55
Registration		$135	$155	$75
CONFERENCE				
Preregistration	$140	$145	$175	$45
Registration	$170	$175	$205	$45
DINNER CRUISE	$30	$30	$30	$30
TOTAL	$_____	$_____	$_____	$_____

*Members of SIAM Activity Group on Supercomputing

The conference registration fees include a copy of the proceedings which will be distributed at the conference.

PLEASE PRINT

Name _____

Organization _____

Department _____

Business Address _____

City _____ State _____ Zip _____

Phone _____ Fax _____ E-mail Address _____

Home Address _____

City _____ State _____ Zip _____

Please update my SIAM records ❑ Yes ❑ No
All correspondence from SIAM should be sent to the above address ❑ Home ❑ Business

NAME BADGE I prefer my name and affiliation to read as follows:

Name: (20 characters) _____

Affiliation: (30 characters) _____

I wish to pay by ❑ American Express ❑ VISA ❑ MC ❑ Check

Credit Card No. _____ Expiration Date _____

Signature _____

Detach this form and enclose it with payment in the envelope provided (domestic mail only) and mail to SIAM Conference Department, 3600 University City Science Center, Philadelphia, PA 19104-2688. Telephone: 215-382-9800; E-mail: meetings@siam.org; FAX: 215-386-7999. Preregistration and payment must be received by March 8, 1993 or you will have to pay the full registration fee on-site.

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PARALLEL PROCESSING
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March 22-24, 1993
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Preregistration form and payment must be received at the SIAM office by Monday, March 8, 1993 or you will be required to pay the full registration fee. Please make checks payable to SIAM.

Society of Industrial and Applied Mathematics
3600 University City Science Center
Philadelphia, PA 19104-2688

POSTMASTER PLEASE DELIVER TO:

Science and Industry Advance with Mathematics

If you should get multiple copies of this program, please pass them along to a colleague.