

# SC2000 Advance Program

**HIGH PERFORMANCE NETWORKING  
AND COMPUTING**

DALLAS CONVENTION CENTER  
Conference: November 04 – 10  
Exhibition: November 06 – 09

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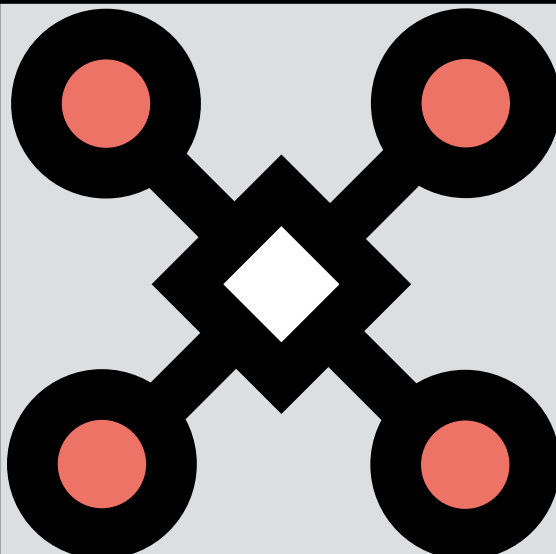
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# SC2000 CONFERENCE AT A GLANCE

	SAT	SUN	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY
<b>REGISTRATION &amp; STORE</b>	1pm–5pm	7:30am–6pm	7:30am – 9pm	7:30am – 5:30pm	7:30am – 5:30pm	7:30am – 5pm	8am – 11am
<b>TUTORIALS</b>		8:30am–5pm	8:30am – 5pm				
<b>EDUCATION PROGRAM</b>	1pm–9pm	9am – 6:30pm	8:30am – 7pm	8:30am – 9pm	8:30am – 9pm	8:30am – 2pm	
<b>GALA OPENING</b>			GALA, 7 – 9pm Preview exhibits!				
<b>KEYNOTE ADDRESS</b>				8:30 – 10am TBA			
<b>STATE-OF-THE-FIELD</b>					8:30am: T. Sterling 9:15am: E. Spafford	8:30am: M. Wright 9:15am: J. Browne	
<b>TECHNICAL SESSIONS</b> • Masterworks • Panels • Papers • Awards • Invited Speakers • SC2000 Reception			10:30am – 12noon	<b>Masterworks</b> Computational BioSciences: Genomics	<b>Masterworks</b> IEEE Award Winners Seymour Cray Computer Engineering Award Winner Sidney Fernbach Award Winner	<b>Masterworks</b> Supercomputing Trends in MCAE I	8:30am – 10am  <b>Panels</b> Convergence of the Extremes Computational Grids: A Solution Looking for a Problem?
			1:30pm – 3pm	<b>Panel</b> Venture Capital Panel	<b>Papers</b> Compiler Optimization	<b>Papers</b> Software Tools	
				<b>Papers</b> MPI Numerical Algorithms	<b>Papers</b> Applications I Visualization	<b>Papers</b> Data Grid Gordon Bell II	
			3:30pm – 5pm	<b>Masterworks</b> Computational Biochemistry and Drug Discovery	<b>Masterworks</b> Real World Scalable Computing I	<b>Plenary Session</b> Awards and Invited Speaker	10:30am – 12noon  <b>Panels</b> Open Source: IP in the Internet Era MegaComputers
				<b>Papers</b> Scheduling MPI/OpenMP Potpourri	<b>Papers</b> Hardware-Based Tools Applications II Networking		
			6:30pm – 10pm	<b>Masterworks</b> Computing Platforms	<b>Masterworks</b> Real World Scalable Computing II	<b>Masterworks</b> Supercomputing Trends in MCAE II	
				<b>Papers</b> Cluster Infrastructure QoS/Fault Tolerance Biomedical Applications	<b>Panel</b> TCP Panel	<b>Panel</b> Petaflops Around the Corner	
					<b>Papers</b> Gordon Bell I Parallel Programming	<b>Papers</b> Scientific Applications Support Grid Middleware	
						<b>SC2000 Reception</b> Open to all SC2000 technical registrants.	
<b>RESEARCH GEMS, RESEARCH AND INDUSTRY EXHIBITS</b>			GALA, 7 – 9pm Preview exhibits!	10am – 6pm	10am – 6pm Research Gems Reception 10am – 11am	10am – 6pm Research Gems Reception 10am – 11am	
<b>EXHIBITOR FORUM</b>				10am – 5pm	10am – 5pm	10am – 4pm	

# DON'T MISS SC2000!

Are you interested in smaller machines with faster speeds and science that pushes the knowledge edge? Then don't miss SC2000 in Dallas! SC2000 will include all the familiar elements—the technical program, tutorials, industry and research exhibits, education program, and pioneer experimental networking—which have made the conference such a success. **This year's conference organizers will build on this strong foundation with two exciting new additions—eSCape 2000 and Venture Village.**

eSCape 2000 is a technology demonstration that will explore how the rapid development of ubiquitous, perva-

sive computing infrastructures based on wireless communications will extend the reach of high performance computing beyond today's technological boundaries. This demonstration will highlight the next generation of high performance computing access and applications using such devices as palm computers, wearable computers, etc. The convergence of these technologies with the National Grid opens new frontiers in high performance computing and communications.

The **Venture Village**, located in the exhibit hall, will showcase entrepreneurial information technology companies that are creating next generation solutions. The village

atmosphere will include exhibits of products and technologies from a number of early venture-funded companies and from large corporate research laboratories.

As always, a strong computational science education program brings together the best of high performance computing methods and a diversified set of teachers from rural, urban and suburban school districts who represent the nation's middle and high school math and science teachers. Teachers this year start their integrated experience at SC2000 and continue throughout the school year.

Venture into the web site, eSCape your daily routine, and explore further what SC2000 offers you!

## SC2000 TUTORIALS AT A GLANCE

SUNDAY FULL DAY	MONDAY FULL DAY
S1 Using MPI-2: A Tutorial on Advanced Features of the Message-Passing Interface	M1 Performance Analysis and Prediction for Large-Scale Scientific Applications
S2 An Introduction to High Performance Data Mining	M2 Parallel I/O for Application Developers
S3 Design and Analysis of High Performance Clusters	M3 Framework Technologies and Methods for Large Data Visualization
S4 High Performance Numerical Computing in Java: Compiler, Language, and Application Solutions	M4 Computational Biology and High Performance Computing
S5 Performance Analysis and Tuning of Parallel Programs: Resources and Tools	MONDAY HALF DAY—AM
SUNDAY HALF DAY—AM	M5A Application Building with XML: Standards, Tools, and Demos – Part I
S6A Mesh Generation for High Performance Computing – Part I	M6A Parallel Programming with OpenMP: Part I, Introduction
S7A Introduction to Effective Parallel Computing Part I	M7 High-Speed Numerical Linear Algebra: Algorithms and Research Directions
S8 Tools and System Support for Managing and Manipulating Large Scientific Datasets	M8 Parallel Programming for Cluster Computers
SUNDAY HALF DAY—PM	MONDAY HALF DAY—PM
S6B Mesh Generation for High Performance Computing – Part II	M5B Application Building with XML: Standards, Tools, and Demos – Part II
S7B Introduction to Effective Parallel Computing – Part II	M6B Parallel Programming with OpenMP: Part II, Advanced Programming
S9 Concurrent Programming with Pthreads	M9 Current and Emerging Trends in Cluster Computing
S10 Commodity-based Scalable Visualization	M10 Performance Tuning and Analysis for Grid Applications

# SC2000 TUTORIAL PROGRAM

[www.sc2000.org/tutorials](http://www.sc2000.org/tutorials)

**TUTORIALS CO-CHAIR:** Valerie Taylor, *Northwestern University*  
**TUTORIALS CO-CHAIR:** Michelle Hribar, *Pacific University*

This year's tutorials include exciting offerings in new topics, such as mesh generation, XML, parallel programming for clusters, numerical computing in Java, and management of large scientific datasets, along with the return of some of the most requested presenters from prior years, with new and updated materials. In addition, we offer some of the full day tutorials as two half-day tutorials (denoted by the numberings with a and b), thereby increasing the number of half-day tutorials. We have a total of 9 full-day and 15 half-day tutorials covering 20 topics. Attendees also have the opportunity for an international perspective on topics through the tutorials on large data visualization, cluster computing, performance analysis tools, and numerical linear algebra. Separate registration is required for tutorials; tutorial notes and luncheons will be provided on site (additional tutorial notes will be sold on site). A One- or Two- day Tutorial Passport allows attendees the flexibility to attend multiple tutorials.

## SUNDAY FULL DAY

### S1 Using MPI-2: A Tutorial on Advanced Features of the Message-Passing Interface

William Gropp, Ewing "Rusty" Lusk, Rajeev S. Thakur, *Argonne National Laboratory*  
20% Introductory | 40% Intermediate | 40% Advanced

This tutorial will discuss methods for using MPI-2, the collection of advanced features that were added to MPI (Message-Passing Interface) by the second MPI Forum. These features include parallel I/O, one-sided communication, dynamic process management, language interoperability, and some miscellaneous features. Implementations of MPI-2 are beginning to appear. A few vendors have completed implementations; other vendors and research groups have implemented subsets of MPI-2, with plans for complete implementations. This tutorial will explain how to use MPI-2 in practice, particularly, how to use MPI-2 in a way that results in high performance. We will present each feature of MPI-2 in the form of a series of examples (in C, Fortran, and C++), starting with simple programs and moving on to more complex ones. We assume that attendees are familiar with the basic message-passing concepts of MPI-1.

### S2 An Introduction to High Performance Data Mining

Robert L. Grossman, *Magnify, Inc.* and *U of Illinois at Chicago*, Vipin Kumar, *U of Minnesota*  
50% Introductory | 30% Intermediate | 20% Advanced

Data mining is the semi-automatic discovery of patterns, associations, changes, anomalies, and statistically significant structures and events in data. Traditional data analysis is assumption-driven in the sense that a hypothesis is formed and validated against the data. Data mining, in contrast, is discovery-driven in the sense that patterns are automatically extracted from data. The goal of the tutorial is to provide researchers, practitioners, and advanced students with an introduction to data mining. The focus will be on basic techniques and algorithms appropriate for mining massive data sets using approaches from high performance computing. There are now parallel versions of some of the standard data mining algorithms, including tree-based classifiers, clustering algorithms, and association rules. We will cover these algorithms in detail as well as some general techniques for scaling data mining algorithms. In addition, we will give an introduction to some of the data mining algorithms, which are used in the recommended systems that are becoming important in e-business. The tutorial will include several case studies involving mining large data sets, from 10-1000 Gigabytes in size. The case studies will be from science, engineering and e-business.

### S3 Design and Analysis of High Performance Clusters

Robert Pennington, *NCSA*, Patricia Kovatch, Barney Maccabe, David Bader, *UNM*  
25% Introductory | 50% Intermediate | 25% Advanced

The National Computational Science Alliance (the Alliance) has created several production NT and Linux superclusters for scientists and researchers to run a variety of parallel applications. The goal of this tutorial is to bring

together researchers in this area and to share the latest information on the state of high-end commodity clusters. We will discuss details on the design, implementation and management of these systems and demonstrate some of the current system monitoring and management tools. A wide variety of applications and community codes run on these superclusters. We will examine several of these applications and include details on porting applications and application development tools for NT and Linux. We will also discuss how to use these tools to tune the system and applications for optimal performance.

### S4 High Performance Numerical Computing in Java: Compiler, Language, and Application Solutions

Manish Gupta, Samuel P. Midkiff, Jose E. Moreira, *IBM T.J. Watson Research Center*  
15% Introductory | 65% Intermediate | 20% Advanced

There has been an increasing interest in using Java for the development of high performance numerical applications. Although Java has many attractive features—including reliability, portability, a clean object-oriented model, well defined floating point semantics and a growing programmer base—the performance of current commercial implementations of Java in numerical applications is still an impediment to its wider adoption in the performance-sensitive field. In this tutorial we will describe how standard libraries and currently proposed Java extensions will help in achieving high performance and writing more maintainable code. We will also show how Java virtual machines can be improved to provide near-Fortran performance. The proposals of the Java Grande Forum Numerics Working Group, which include a true multidimensional array package, complex arithmetic and new floating point semantics, will be discussed. Compiler technologies to be addressed include array bounds and null pointer check optimizations, alias disambiguation techniques, semantic expansion of standard classes, and the interplay of static and dynamic models of compilation. We will also discuss the importance of language, libraries and compiler codesign. The impact of these new technologies on compiler writers, language designers, and application developers will be described throughout the tutorial.

## SUNDAY HALF DAY—AM

### S5 Performance Analysis and Tuning of Parallel Programs: Resources and Tools

Barton Miller, *U of Wisconsin-Madison*, Michael Gerndt, *Technical U Munich, Germany*, Bernd Mohr, *Research Centre Juelich, Germany*  
50% Introductory | 25% Intermediate | 25% Advanced

This tutorial will give a comprehensive introduction into the theory and practical application of the performance analysis, optimization, and tuning of parallel programs on currently used high-end computer systems like the IBM SP, SGI Origin, and CRAY T3E as well as clusters of workstations. We will introduce the basic terminology, methodology, and techniques of performance analysis and give practical advice on how to use these in an effective manner. Next we describe vendor, third party, and research tools available for these machines along with practical tips and hints for their usage. We show how these tools can be used to diagnose and locate typical performance bottlenecks in real-world parallel programs. Finally, we will give an overview of Paradyn, an example of a state-of-the-art performance analysis tool that can be used for parallel programs of today. The presentation will include the Performance Consultant that automatically locates the performance bottlenecks of user codes. This presentation will be concluded with a live, interactive demonstration of Paradyn.

### S6A Mesh Generation for High Performance Computing Part I: An Overview of Unstructured and Structured Grid Generation Techniques

Steven J. Owen, Patrick Knupp, *Sandia National Laboratories*  
100% Introductory | 0% Intermediate | 0% Advanced

Mesh generation plays a vital role in computational field simulation for high performance computing. The mesh can tremendously influence the accuracy and efficiency of a simulation. Part I of this tutorial will provide an overview of the principal techniques currently in use for constructing computational grids for both unstructured and structured techniques. For unstructured techniques, Delaunay, advancing front and octree methods will be described with respect to triangle and tetrahedral elements. An overview of

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current quadrilateral and hexahedral methods will be provided, including medial axis, paving, q-morph, sub-mapping, plastering, sweeping and whisker weaving as well as mixed element methods such as hex-tet and h-morph. A survey of some of the unstructured codes currently available will also be provided. For structured techniques, the idea of a mapping from a logical to a physical domain will be discussed. Transfinite interpolation, Lagrange and Hermite interpolation techniques will be described. A one-dimensional problem will be used as an example to introduce basic ideas in grid generation such as grid generation PDEs, optimization, and variational techniques. In addition, basic approaches to two-dimensional grid generation, such as algebraic, conformal mapping, elliptic, and hyperbolic, will be presented. Application of structured grid generation techniques to curves and surfaces as well as adaptive methods will also be described.

## S7A Introduction to Effective Parallel Computing, Part I

Quentin F. Stout, Christiane Jablonowski, *U of Michigan*  
75% Introductory | 25% Intermediate | 0% Advanced

Effective parallel computing is one of the key solutions to today's computational challenges. This two-part tutorial will provide a comprehensive and practical overview of parallel computing, emphasizing those aspects most relevant to the user. It is designed for new users, managers, students, and people needing a general overview of parallel computing. The tutorial will discuss both hardware and software aspects, with an emphasis on standards, portability, and systems that are now (or soon will be) commercially or freely available. We will examine systems ranging from low-cost clusters to highly integrated supercomputers. Part I will survey basic parallel computing concepts and terminology, such as scalability and cache coherence, and illustrates fundamental parallelization approaches using examples from engineering, scientific and data intensive applications. These real-world examples will be targeted at distributed memory systems, using the message passing language MPI, and at shared memory systems, using the compiler directive standard OpenMP. Both parallelization approaches will be briefly outlined. The tutorial will show step-by-step parallel performance improvements, and discuss some of the software engineering aspects of the parallelization process. Furthermore, pointers to the literature and web-based resources will be provided. This tutorial can serve as an introduction to other specialized programming tutorials.

## S8 Tools and System Support for Managing and Manipulating Large Scientific Datasets

Joel Saltz, *U of Maryland, Johns Hopkins School of Medicine*,  
Alan Sussman, Tahsin Kurc, *U of Maryland*  
30% Introductory | 60% Intermediate | 10% Advanced

This tutorial will address the design, implementation and use of systems for managing and manipulating very large datasets, both on disk and in archival storage. The datasets we target are generated through large scale simulations or gathered by advanced sensors, such as those attached to satellites or microscopes. These datasets are large (hundreds of gigabytes to many terabytes) and typically represent physical quantities, measurements or composited images in a physical or attribute space. Two systems will be described in detail, the Active Data Repository (ADR) and DataCutter. ADR is designed to optimize storage and processing of disk-based large datasets on a parallel machine or network of workstations, while DataCutter is designed to provide support for subsetting and filtering operations on datasets stored in archival (tertiary) storage systems in a Grid environment. The overall design of ADR, and the interfaces for customizing ADR for particular data intensive applications will be explained, and an example application will be used to illustrate the customization. The customization includes storing and indexing datasets into ADR, and providing user-defined processing functions for the end application. Similarly, the design and current implementation of the DataCutter services will be described, and examples of filter-based applications will be discussed. The relationship of ADR and DataCutter to other systems software for data intensive computing will also be addressed. Such systems include the ISI/Argonne Globus Metacomputing toolkit, the UTK NetSolve network-based computational server, and the SDSC Storage Resource Broker (SRB).

## SUNDAY HALF DAY—PM

### S6B Mesh Generation for High Performance Computing Part II: Mesh Generation for Massively Parallel-Based Analysis

Scott Mitchell, Patrick Knupp, and Timothy Tautges, *Sandia National Laboratories*  
50% Introductory | 50% Intermediate | 0% Advanced

Part II will focus on specific application of mesh generation techniques to high performance computing. Topics discussed will include advanced hexahedral algorithms, mesh quality and mesh generation issues related to massively-parallel based analysis. Advanced hexahedral mesh generation algorithms for meshing assembly geometries will be described; these algorithms are found in the CUBIT Mesh Generation Toolkit and other mesh generation packages. Also discussed will be additional hexahedral mesh generation research ideas. Basic mesh quality requirements will be described for finite element meshes including shape and size metrics for both simplicial and non-simplicial element types. Mesh quality can be improved by various node-movement strategies; their use in mesh sweeping and morphing algorithms will be described. Mesh quality metrics, used to devise discrete objective functions, will also be discussed. Advances in massively parallel and high performance computing have made possible computational simulation at much higher fidelity and finer resolution. Issues specific to larger analysis will be introduced, including techniques for handling model complexity, a team-based approach to generating meshes, tools for generating meshes in pieces and assembling the pieces into a larger mesh, and preparing the mesh for input to massively parallel-based analysis.

### S7B Introduction to Effective Parallel Computing, Part II

Quentin F. Stout, Christiane Jablonowski, *U of Michigan*  
50% Introductory | 50% Intermediate | 0% Advanced

This tutorial will provide broader and deeper insight into the iterative process of converting a serial program into an increasingly efficient, and correct, parallel program. This tutorial assumes the basic background knowledge of parallel computing concepts and terminology presented in Part I. Using examples from large-scale engineering and scientific applications, Part II will discuss the steps necessary to achieve high performance on distributed memory, shared memory and vector parallel machines. We will give an overview of techniques for code optimization, load balancing, communication reduction and efficient use of cache. The tutorial will include up-to-date performance analysis tools, showing how they can help diagnose and locate typical bottleneck situations in parallel applications and provide hints for tuning. In addition, aspects such as the user's view of system's software and principle life-cycle concerns with parallel software will be addressed. Overall, the tutorial will give an overview of the primary parallelization options available, explaining how they are used in real-world applications and what they are most suitable for. These guidelines will help users make intelligent planning decisions when selecting among the various software approaches and hardware platforms.

### S9 Concurrent Programming with Pthreads

Clay P. Breshears, *Rice U / ERDC MSRC*, Henry A. Gabb, *Kuck & Associates, an Intel Company*  
65% Introductory | 35% Intermediate | 0% Advanced

Multithreading is becoming more prevalent with the increasing popularity of symmetric multiprocessors (SMPs). Multithreading allows programmers to utilize shared memory hardware to its fullest. Pthreads is the POSIX standard library for multithreading and is available on a wide range of platforms. The Pthreads library consists of over 60 functions governing thread creation and management, synchronization, and scheduling. This tutorial will cover design issues involved in concurrent and multithreaded programming, using Pthreads as a practical means of implementation. Before laying a foundation in concurrency, the tutorial will introduce a core of the most useful Pthreads functions. Each function will be discussed in detail with example codes to illustrate usage. Classic models (e.g., monitors, rendezvous, and producer/consumer) will illustrate the use of threads to express concurrent tasks as well as the pitfalls of race conditions and deadlock.

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## S10 Commodity-based Scalable Visualization

Constantine J. Pavlakos, *SNL*, Randall Frank, *LLNL*, Patrick Hanrahan, *Stanford U*, Kai Li, *Princeton U*, Alan Heinrich, *Compaq Tandem Labs*, Allen McPherson, *LANL*  
40% Introductory | 40% Intermediate | 20% Advanced

The DOE's ASCI Program is constructing massive compute platforms for the purpose of enabling extremely complex computational simulations. Further, the ASCI/VIEWS program is working to develop data management, data exploration, and visualization technologies that are matched to ASCI's compute capabilities. To do so, technologies that scale to the power of thousands of today's highest performing graphics systems must be developed, and super-resolution display systems are needed that enable the visual comprehension of intricate details in high-fidelity data. Cost-effectiveness is also an important pragmatic consideration. This tutorial will motivate the investigation of cluster-based graphics systems, introduce the participant to information regarding the construction of such clusters, address various issues related to the components used, introduce the participant to how parallel rendering can be achieved on the clustered architectures, and provide an overview of results that have been achieved. The status of efforts to develop such systems by the three ASCI national laboratories and certain external partners will also be presented. Upon completing the tutorial, the participant should have a much better understanding of what it takes to construct such a system, what features they offer, whether such systems show any promise for scalable visualization, and what challenging issues remain to be addressed.

### MONDAY FULL DAY

## M1 Performance Analysis and Prediction for Large-Scale Scientific Applications

Adolfy Hoisie, Harvey J. Wasserman, *Los Alamos National Laboratory*  
30% Introductory | 50% Intermediate | 20% Advanced

Performance is the most important criterion for a supercomputer. But how do you measure performance? We will present a methodical, simplified, approach to analysis and modeling of large-scale, parallel, scientific applications. Various techniques (modeling, simulation, queuing theory), will be discussed so as to become a part of the application developer's toolkit. We will introduce rigorous metrics for serial and parallel performance and analyze the single most important single-processor bottleneck—the memory subsystem. We will demonstrate how to obtain diagnostic information about memory performance of codes and how to use such information to bound achievable performance. Commonly-utilized techniques for performance optimization of serial and parallel Fortran codes will also be presented. Finally, we will discuss analytical modeling of application scalability using ASCI codes as examples. No particular machine will be emphasized; rather we will consider RISC processors and widely utilized parallel systems, including clusters of SGI Origin2000s, IBM SP2 and CRAY T3E.

## M2 Parallel I/O for Application Developers

John M May, *Lawrence Livermore National Laboratory*  
50% Introductory | 50% Intermediate | 0% Advanced

This tutorial will present parallel I/O techniques for developers of scientific applications. Because the design of storage devices and file systems profoundly affects I/O performance, the course will begin with a brief review of these topics. It will then proceed to examine the I/O patterns that are common in large scientific applications and show how these patterns affect I/O performance. Next, it will look at a variety of techniques that have been developed to improve performance for common access patterns and discuss their pros and cons. Attendees will learn how to put these techniques into practice using modern I/O interfaces such as MPI-IO and HDF5. We will also discuss two specialized forms of I/O used in parallel computing: checkpointing and data staging for out-of-core problems. The tutorial will conclude with a discussion of current research in the area of scientific data management, including data mining.

## M3 Framework Technologies & Methods for Large Data Visualization

W.T. Hewitt, *U of Manchester*, I. Curington, *Advanced Visual Systems Inc.*  
20% Introductory | 70% Intermediate | 10% Advanced

This tutorial will address large data visualization issues in the context of commercial visualization tool development. A review of techniques for multidimensional data visualization will be followed by case studies from CEM, CFD, VLSI, Medicine, and Geophysics. An artifact of this type of visualization is that the visualization task itself becomes a consumer of HPC resources. The second part of the tutorial is concerned with the issues of implementing these techniques in a multiprocessor environment, and improving the performance of current visualization systems. A range of technical areas will be discussed, including experimental research and production algorithm development. Both current research and future challenges facing visualization system vendors will be discussed. Attendees at the tutorial will gain an understanding of the issues underlying visualization in a parallel and distributed environment including: familiarity with domain decomposition methods and parallelization techniques; knowledge of the principles of volume, flow and multidimensional visualization; ability to use distributed computation to enable accurate and timely visualization of large complex datasets; and familiarity with the latest developments in visualization and HPC systems.

## M4 Computational Biology and High Performance Computing

Manfred Zorn, Sylvia Spengler, Inna Dubchak, *NERSC/CBCG*, Horst Simon, *NERSC*, Craig A. Stewart, *Indiana U*

40% Introductory | 40% Intermediate | 20% Advanced

The pace of extraordinary advances in molecular biology has accelerated in the past decade due in large part to discoveries coming from genome projects on human and model organisms. The advances in the genome project so far, happening well ahead of schedule and under budget, have exceeded any dreams by its protagonists, let alone formal expectations. Biologists expect the next phase of the genome project to be even more startling in terms of dramatic breakthroughs in our understanding of human biology, the biology of health and of disease. Only today can biologists begin to envision the necessary experimental, computational and theoretical steps necessary to exploit genome sequence information for its medical impact, its contribution to biotechnology and economic competitiveness, and its ultimate contribution to environmental quality. High performance computing has become one of the critical enabling technologies which will help to translate this vision of future advances in biology into reality. Biologists are increasingly becoming aware of the potential of high performance computing. This tutorial will introduce the exciting new developments in computational biology and genomics to the high performance computing community.

### MONDAY HALF DAY—AM

## M5A Application Building with XML: Standards, Tools, and Demos—Part I

Bertram Ludaescher, Richard Marciano, *UCSD/SDSC*

40% Introductory | 40% Intermediate | 20% Advanced

This tutorial will guide participants through the maze of emerging XML standards and focus on practical areas where the use of XML can have immediate benefits for application development. The general theme is "What you need to know for rearchitecting your HPC with XML under the hood." This tutorial provides a "jump-start" to XML ("what you always wanted to know about XML") and includes a roadmap to the XML universe, coverage of core standards and technology, and how to (re-)architect "XML-enabled" applications.

## M6A Parallel Programming with OpenMP: Part I, Introduction

Rudolf Eigenmann, *Purdue University*, Tim Mattson, *Intel Corp.*

75% Introductory | 20% Intermediate | 5% Advanced

OpenMP is an Application Programming Interface for directive-driven parallel programming of shared memory computers. Fortran, C and C++ compilers supporting OpenMP are available for Unix and NT workstations. Most vendors of shared memory computers are committed to OpenMP making it the de facto standard for writing portable, shared memory, parallel programs. This tutorial will provide a comprehensive introduction to OpenMP.

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We will start with basic concepts to bring the novice up to speed. We will then present a few more advanced examples to give some insight into questions that come up for experienced OpenMP programmers. Over the course of the morning, we will discuss the following: the OpenMP parallel programming model and its specification in Fortran, C and C++; examples of OpenMP programs from scientific/engineering applications; and the status of OpenMP compilers and tools.

## M7 High-Speed Numerical Linear Algebra: Algorithms and Research Directions

Jack Dongarra, *U of Tennessee*, Iain Duff, *Rutherford Lab*, Danny Sorensen, *Rice U*, Henk van der Vorst, *U of Utrecht*

20% Introductory | 50% Intermediate | 30% Advanced

Present computers, even workstations, allow the solution of very large scale problems in science and engineering. Most often a major part of the computational effort goes into solving linear algebra subproblems. We will discuss a variety of algorithms for these problems, indicating where each is appropriate and emphasizing their efficient implementation. Many of the sequential algorithms used satisfactorily on traditional machines fail to exploit the architecture of advanced computers. We briefly review some of the features of modern computer systems and illustrate how the architecture affects the potential performance of linear algebra algorithms. We will consider recent techniques devised to utilize advanced architectures more fully, especially the design of the Level 1, 2, and 3 BLAS. We will highlight the LAPACK package, which provides a choice of algorithms mainly for dense matrix problems that are efficient and portable on a variety of high performance computers. For large sparse linear systems, the situation is more complicated and a wide range of algorithms is available. We will give an introduction to this field and guidelines on the selection of appropriate software. We will consider both direct methods and iterative methods of solution, including some recent work that can be viewed as a hybrid of the two. Finally, we will address the challenge facing designers of mathematical software in view of the development of highly parallel computer systems. We will discuss ScaLAPACK, a project to develop and provide high performance scalable algorithms suitable for highly parallel computers.

## M8 Parallel Programming for Cluster Computers

David A. Bader, *U of New Mexico*, Bruce Hendrickson, Steve Plimpton, *Sandia National Labs*

25% Introductory | 50% Intermediate | 25% Advanced

The price/performance benefits inherent in commodity cluster computers are attracting the attention of a wide range of researchers, many of whom have not traditionally been involved in parallel computing. Clusters are likely to be the computational platforms of choice over the next decade not just for computer scientists, but for disciplinary researchers in fields such as bioinformatics, astrophysics and economics. Unfortunately, these clusters are among the most challenging parallel computers to use effectively. In this tutorial, we will describe the performance challenges inherent to commodity clusters, including poor communication performance, heterogeneity, and 2-level hardware (clusters of 2- and 4-way SMP nodes). We will outline an approach for designing scientific algorithms that works well for clusters and present some case studies. The approach is based on a distributed-memory message-passing model with an emphasis on load-balancing, minimal communication, and latency-tolerant algorithms. Finally we'll also highlight tools and libraries currently available for improving parallel programming productivity.

## MONDAY HALF DAY—PM

## M5B Application Building with XML: Standards, Tools, and Demos—Part II

Richard Marciano, Bertram Ludaescher, *UCSD/SDSC*

20% Introductory | 30% Intermediate | 50% Advanced

This tutorial will include a brief XML overview; however, will mostly focus on how multiple standards can be used and woven together to help build useful applications that can benefit HPC application developers. This tutorial naturally extends Part I, however it is packaged independently and is self-

contained. If you already know how to design, create, store and massage your data with XML, XPath, XSLT and the like, then you are ready for "more mileage with XML." This tutorial focuses on applications including website management, directory services and wireless computing with XML.

## M6B Parallel Programming with OpenMP: Part II, Advanced Programming

Rudolf Eigenmann, *Purdue U*, Tim Mattson, *Intel Corp.*

10% Introductory | 50% Intermediate | 40% Advanced

OpenMP is rapidly becoming the programming model of choice for shared-memory machines. After a very brief overview of OpenMP basics we will move on to intermediate and advanced topics, such as advanced OpenMP language features, traps that programmers may fall into, and a more extensive outlook on future OpenMP developments. We will also discuss mixing OpenMP with message passing applications written in MPI. We will present many examples of OpenMP programs and discuss their performance behavior. Over the course of the afternoon, we will discuss the following: a brief overview of the OpenMP parallel programming model in C, C++, and Fortran; problems and solutions in OpenMP programming; advanced examples of OpenMP programs and their performance; and future developments for OpenMP.

## M9 Current and Emerging Trends in Cluster Computing

Mark Baker, *U of Portsmouth*, Rajkumar Buyya, *Monash U, Melbourne Australia*, Jack Dongarra, *U of Tennessee*

50% Introductory | 30% Intermediate | 20% Advanced

The commercial success of clusters has pushed them into the vanguard of general purpose computing. They have now permeated all spheres of the computing industry, from the traditional science and engineering field through to the retail and commercial marketplace. This commodity-driven computing platform is advancing at a tremendous pace in terms of both new and emerging hardware and the associated software tools and environments. Clusters are now the platform of choice for providing computing services to a huge range of diverse applications. This tutorial will discuss the current and emerging trends in cluster computing. In particular, we will detail the current and emerging technologies in areas such as system architecture, networking, software environments, systems configuration and management tools as well as application libraries and utilities. In the second half of the tutorial, we will review four successfully deployed cluster systems that are being used in commerce, industry and research environments. Finally, we will summarize our findings, drawing a number of conclusions about current clusters and then briefly consider emerging technology trends and how these will influence clusters of the future.

## M10 Performance Tuning and Analysis for Grid Applications

Brian Tierney, Dan Gunter, *LBNL*, Rich Wolski, Martin Swamy, *U of Tennessee*

25% Introductory | 75% Intermediate | 0% Advanced

For distributed application developers, achieving high-performance in a Grid environment can be especially challenging due to the fact that the bottlenecks can be in any of a number of places, such as the hosts, networks, operating systems, applications and so on. Therefore one must monitor all system components and instrument all software. This tutorial will discuss what should be monitored, and describe some tools that can be used to perform the monitoring and manage the large volumes of performance information that results. It will also discuss scalable techniques for instrumenting applications and system level resources. Both the problem of scaling end-to-end network performance monitoring and the tradeoff between monitor intrusiveness and monitor accuracy will be discussed. The tutorial will show how to use the monitored data to do performance analysis and to predict resource load and availability dynamically. Further, we will discuss some general techniques for improving application performance in a high-speed WAN environment. performance analysis and to predict resource load and availability dynamically. Further, we will discuss some general techniques for improving application performance in a high-speed WAN environment.

# SC2000 EDUCATION, STUDENT VOLS, TECHNICAL PROGRAM

## EDUCATION PROGRAM

[www.sc2000.org/education](http://www.sc2000.org/education)

**EDUCATION VICE CHAIR:** Jeffrey C. Huskamp, *East Carolina University*

SC2000 offers high school teachers an opportunity to participate in the SC2000 conference to learn computer modeling and simulation, and its application to the science and mathematics curricula. After the conference the selected teachers receive ongoing support from SC2000 staff and continue their training at regional forums. Finally, at SC2001 the teachers will share their experiences with a new group of teachers and will be expected to be leaders in their school systems for a wider adoption of modeling and simulation by additional teachers.

Education Program sessions are scheduled from 1:00pm Saturday, November 4 through 2:00pm Thursday, November 9 in the Dallas Convention Center. Check the SC2000 Education Program web site for rooms and times or the SC2000 Final Program (distributed on-site at SC2000).

Teams of participating teachers were selected in July. However, teachers local to the Dallas area and other teachers who don't need accommodations or travel support are welcome to attend on a space available basis if they register with the Education Program ahead of time (see email address below). SC2000 Technical Registrants are also welcome to attend the Education Program, although participation in the hands-on sessions will be limited to the pre-selected teacher teams.

Please visit the SC2000 Education Program website for further information.

---Questions: [education@sc2000.org](mailto:education@sc2000.org)

## STUDENT VOLUNTEERS

**STUDENT VOLUNTEER CHAIR:** Bruce Loftis, *NCSA*

Undergraduate and graduate student volunteers are needed for SC2000. A student volunteer helps with the administration of the conference in exchange for free conference registration, housing, most meals, conference goodies,—and more. We ask for a total of 20-25 hours of work. You will interact with the conference organizers and presenters, and you will meet other students from all over the world. It is an opportunity to be involved with a great conference. And it is a nice item to have on your resume.

Student volunteers have the opportunity to see and discuss the latest high-performance networking and computing technology and meet leading researchers from around the world while contributing to the success of this annual event. No special skills or experience are necessary for most volunteer positions.

For more information and to apply, check our website:  
[www.sc2000.org/students/](http://www.sc2000.org/students/)

---Application deadline: Friday, September 8, 2000



[www.sc2000.org/techpapers](http://www.sc2000.org/techpapers)

## TECHNICAL PROGRAM

[www.sc2000.org/techpapers](http://www.sc2000.org/techpapers)

**CONFERENCE VICE-CHAIR, TECHNICAL PROGRAM:** James R. McGraw, *Lawrence Livermore National Laboratory*

This year's technical program continues the tradition of a diverse set of strong technical papers, enhanced with an equally diverse set of invited speakers, tutorials, panels, and research gems. Highlights to look for in the conference include:

- 62 technical papers, selected from 179 submissions, including six finalists for Gordon Bell prizes. These papers were chosen based on the significance of their contributions to the field of high performance networking and computing (HPNC).
- 24 tutorials (9 full day and 15 half day sessions). These tutorials were chosen competitively to address expressed interests of SC attendees.
- Four State-of-the-Field plenary talks, highlighting the most significant results and critical future directions in HPNC.
- The new "Masterworks" track of invited speakers that will showcase the application of HPNC technologies to deliver new capabilities.
- 7 panel sessions, chosen to stimulate understanding of the issues surrounding hot topics of debate within the HPNC community.
- Numerous competitively selected "research gems" representing late-breaking research results that will be showcased on the Exhibit Floor.

The technical program committee is very proud of the program this year. It would not have been possible without the volunteer efforts of over one hundred committee members and reviewers. Thank you for once again making SC 2000 the premier technical conference in this field!

## SC2000 WEBCASTS

[www.sc2000.org/webcasts](http://www.sc2000.org/webcasts)

**WEBCASTS CHAIR:** Greg Johnson, *NPAC/SDSC*

This year, SC2000 will broadcast live over the Internet select presentations using the unique capabilities of SCinet2000 to deliver high-quality audio and video over the world wide web. SC2000 will webcast a number of technical and exhibitor presentations, including plenary sessions, selected exhibitor demonstrations and other conference events. In addition—back by popular demand—a robotic camera will allow viewers to pan the exhibit hall and zoom in on exhibit floor booths.

The SC2000 talks will be broadcast in several formats to accommodate users who may not have a access to a high performance network to their desktop. These formats will include an audio-only broadcast for lower bandwidth connections, an audio with video broadcast for medium-bandwidth connections, and a high-bandwidth audio with video multicast.



Webcast events are indicated by this symbol in the conference program and on conference signage. User support will be available by telephone and email for the duration of all live broadcasts. Feedback regarding the quality and scope of Webcasts is strongly encouraged.



# SC2000 TECHNICAL PROGRAM



[www.sc2000.org/techpapers](http://www.sc2000.org/techpapers)

## MASTERWORKS

[www.sc2000.org/masterworks](http://www.sc2000.org/masterworks)

**MASTERWORKS CHAIR:** Pat Teller, *University of Texas El Paso*

**Masterwork**—an outstanding work of art or craft.

The Masterworks track at SC2000 features invited speakers who will emphasize novel and innovative uses of high-performance networking and computing (HPNC) in solving challenging problems in the real world. This track will highlight research-quality results that serve practical priorities. For many of the Masterworks presenters, such real-world applications take priority over potential publication, so each Masterwork contribution will be a unique addition to SC2000. Feedback from past conferences has indicated strong interest in this type of talk. This year, we have made a concerted effort to identify the most outstanding works of art or craft in HPNC and one entire track (8 sessions, 16 speakers) will be devoted to these talks. The speakers will discuss their results so that they can be appreciated by the diverse expertise represented in SC conference attendees.

This year, the Masterworks track will include presentations on Computational Biology, Scalable Computing/Servers, Computer-Aided Engineering, Large Computing Platforms, and work by the winners of two prestigious IEEE computing awards. Please check the Technical Program for details on each presentation. We hope that you find this track stimulating and that it expands your understanding of just how broadly HPNC technology can benefit the larger scientific community and the general public.

## KEYNOTE ADDRESS

**TUESDAY, NOV. 7 | 8:30AM – 10AM**

[www.sc2000.org/statefield](http://www.sc2000.org/statefield)

## STATE OF THE FIELD TALKS

See [www.sc2000.org/statefield](http://www.sc2000.org/statefield) for abstracts and bios for all state-of-the-field talks.

**WEDNESDAY, NOVEMBER 8**

**8:30am**

### COTS Cluster Systems for High-Performance Computing

Thomas Sterling, *NASA Jet Propulsion Laboratory, High Performance Computing Group, and California Institute of Technology, Center for Advanced Computing Research*



**9:15am**

### A Small Dose of INFOSEC

Dr. Eugene H. Spafford, *Purdue University*



**THURSDAY, NOVEMBER 9**

**8:30am**

### Numbers, Lots of Numbers, and Insight too: Scientific Computing 2000

Margaret H. Wright, *Bell Laboratories, Lucent Technologies, Murray Hill, NJ*



**9:15am**

### Parallel/Distributed Programming: Research Success—Application Failure?

J.C. Browne, *The University of Texas at Austin, Department of Computer Science*



## TECHNICAL SESSIONS

**TUESDAY, NOV. 7 | 10:30AM – NOON**

## MASTERWORKS

### COMPUTATIONAL BIOSCIENCES: GENOMICS

#### From First Assembly Towards a New Cyber-Pharmaceutical Computing Paradigm

Sorin Istrail  
*Celera Genomics*

#### Unveiling the Human Genome

Jill Mesirov  
*Whitehead Institute, MIT*

## PANEL

### VENTURE CAPITAL PANEL

#### Venture Capital: Who wants to be a billionaire?

**Moderator:** Steve Wallach, *CenterPoint Ventures*

**Panelists:** Matt Blanton, *Startech*, Jackie Kimzey, *Sevin Rosen Funds*,  
Scott Grout, *Chorum*

## TECHNICAL PAPERS

### MPI

#### The Implementation of MPI-2 One-Sided Communication for the NEC SX-5

Jesper Larsson Traff, Hubert Ritzdorf, Rolf Hempel, *C&C Research Laboratories, NEC Europe Ltd*

#### Single sided MPI implementations for SUN MPI

Stephen P. Booth, Elson Mourao, *EPCC, The University of Edinburgh*

#### Automatically Tuned Collective Communications

Sathish S. Vadhiyar, Graham E. Fagg, Jack Dongarra, *University of Tennessee*

### NUMERICAL ALGORITHMS

#### Landing CG on EARTH: A Case Study of Fine-Grained Multithreading on an Evolutionary Path

Kevin B. Theobald, Gagan Agrawal, Rishi Kumar, Guang Gao, *U of Delaware*,  
Gerd Heber, Paul Stodghill, Keshav Pingali, *Cornell University*

#### Highly Parallel Algebraic Multigrid on Massively Parallel Machines

Ray S. Tuminaro, *Sandia National Labs*, Charles Tong, *Lawrence Livermore Labs*

#### Scalable Algorithms for Adaptive Statistical Designs

Robert C. Oehmke, Janis Hardwick, Quentin F. Stout, *University of Michigan*

# SC2000 TECHNICAL PROGRAM

[www.sc2000.org/techpapers](http://www.sc2000.org/techpapers)

TUESDAY, NOV. 7 | 1:30PM – 3PM

## MASTERWORKS

### COMPUTATIONAL BIOCHEMISTRY AND DRUG DISCOVERY

**Modeling and simulation of complex biological systems: Moving from analysis to synthesis in the Biological Sciences**

Andrea Califano

*IBM Computational Biology Center*

**Basic Computational Research for Drug Discovery**

Simon Kearsley

*Merck Research Laboratories*

TUESDAY, NOV. 7 | 3:30PM – 5PM

## MASTERWORKS

### COMPUTING PLATFORMS

**Blue Gene**

Monty Denneau

*IBM*

**Status of the Earth Simulator Project in Japan**

Keiji Tani

*Japan Atomic Energy Research Institute*

## TECHNICAL PAPERS

### SCHEDULING

**Randomization, Speculation, and Adaptation in Batch Schedulers**

Dejan Perkovic, Peter J. Keleher, *University of Maryland*

**An Object-Oriented Job Execution Environment**

Lance Smith, Rod Fatoohi, *San Jose State University*

**Towards an Integrated, Web-executable Parallel Programming Tool Environment**

Insung Park, Nirav H. Kapadia, Renato J. Figueiredo, Rudolf Eigenmann,

Jose A. B. Fortes, *Purdue University*

### MPI/OPENMP

**Performance of Hybrid Message-Passing and Shared-Memory Parallelism for Discrete Element Modeling**

David S. Henty, *University of Edinburgh*

**A Comparison of Three Programming Models for Adaptive Applications**

Hongzhang Shan, Jaswinder P. Singh, *Princeton University*, Leonid Oliker, *NERSC, Lawrence Berkeley National Lab*, Rupak Biswas, *NASA Ames Research Center*

**MPI versus MPI+OpenMP on IBM SP for the NAS Benchmarks**

Franck Cappello, *CNRS-LRI*, Daniel Etiemble, *LRI*

### POTPOURRI

**A Wrapper Generator for Wrapping High Performance Legacy Codes as Java/CORBA Components**

Maozhen Li, Omer F. Rana, Matthew S. Shields, *Cardiff University, UK*,

David W. Walker, *Oak Ridge National Laboratory*

**A Scalable SNMP-Based Distributed Monitoring System For Heterogeneous Network Computing**

Rajesh Subramanyan, José Miguel-Alonso, José A. B. Fortes, *Purdue University*

**ESP: A System Utilization Benchmark**

Adrian T. Wong, Leonid Oliker, William T.C. Kramer, Teresa L. Kaltz, David H. Bailey, *Lawrence Berkeley National Laboratory*

## TECHNICAL PAPERS

### CLUSTER INFRASTRUCTURE

**PM2: A High Performance Communication Middleware for Heterogeneous Network Environments**

Toshiyuki Takahashi, Shinji Sumimoto, Atsushi Hori, Hiroshi Harada, Yutaka Ishikawa, *Real World Computing Partnership*

**Performance and Interoperability Issues in Incorporating Cluster Management Systems within a Wide-Area Network-Computing Environment**

Sumalatha Adabala, Nirav H. Kapadia, Jose A. B. Fortes, *Purdue University*

**Architectural and Performance Evaluation of GigaNet and Myrinet**

**Interconnects on Clusters of Small-Scale SMP Servers**

Jenwei Hsieh, Tau Leng, Victor Mashayekhi, Reza Rooholamini, *Dell Computer Corporation*

### QoS / FAULT TOLERANCE

**MPICH-GQ: Quality-of-Service for Message Passing Programs**

Alain J. Roy, *University of Chicago*, Ian Foster, *Argonne National Laboratory and University of Chicago*, William Gropp, *Argonne National Laboratory*, Nicholas Karonis, *Northern Illinois University*, Volker Sander, *Forschungszentrum Juelich GmbH*, Brian Toonen, *Argonne National Laboratory*

**Scalable Fault-Tolerant Distributed Shared Memory**

Florin Sultan, Thu Nguyen, Liviu Iftode, *Rutgers University*

**Realizing Fault Resilience in Web-Server Cluster**

Mon-Yen Luo, Chu-Sing Yang, *National Sun Yat-Sen University*

### BIOMEDICAL APPLICATIONS

**Data Access Performance in a Large and Dynamic Pharmaceutical Drug Candidate Database**

Zina Ben-Miled, *Indiana University Purdue University, Indianapolis*, Yang Liu, *Indiana University*, Dave Powers, *Eli Lilly*, Omran Bukhres, *Indiana University Purdue University, Indianapolis*, Michael Bem, Robert Jones, Robert Oppelt, Samuel Milosevich, *Eli Lilly*

**Real-Time Biomechanical Simulation of Volumetric Brain Deformation for Image Guided Neurosurgery**

Simon K. Warfield, *Harvard*, Matthieu Ferrant, Xavier Gallez, *Universit e Catholique de Louvain*, Arya Nabavi, Ferenc A. Jolesz, Ron Kikinis, *Harvard*

**Computer Simulations of Cardiac Electrophysiology**

John B. Pormann, Craig S. Henriquez, John A. Board, Donald J. Rose, David M. Harrild, *Duke University*, Sandy A. Henriquez, *North Carolina Supercomputing Center*

# SC2000 TECHNICAL PROGRAM

[www.sc2000.org/techpapers](http://www.sc2000.org/techpapers)

WEDNESDAY, NOV. 8 | 10:30AM – NOON

## MASTERWORKS

### IEEE AWARD TALKS

### SEYMOUR CRAY COMPUTER ENGINEERING AWARD WINNER

### SIDNEY FERNBACH AWARD WINNER

WEDNESDAY, NOV. 8 | 1:30PM – 3PM

## MASTERWORKS

### REAL WORLD SCALABLE COMPUTING I

#### High Performance Networks for Clustered Web Servers

David Fair  
*Giganet*

#### From RAIN to Rainfinity

Jehoshua Bruck  
*Rainfinity*

## TECHNICAL PAPERS

### COMPILER OPTIMIZATION

#### Tiling Imperfectly-Nested Loop Nests

Nawaaz Ahmed, Nikolay Mateev, Keshav Pingali, *Cornell University*

#### Tiling Optimizations for 3D Scientific Computations

Gabriel Rivera, Chau-Wen Tseng, *University of Maryland*

#### Improving Fine-Grained Irregular Shared-Memory Benchmarks by Data Reordering

Y. Charlie Hu, Alan Cox, Willy Zwaenepoel, *Rice University*

### APPLICATIONS I

#### Parallel Algorithms for Radiation Transport on Unstructured Grids

Steve Plimpton, Bruce Hendrickson, Shawn Burns, *Sandia National Labs*,  
Will McLendon III, *Texas A&M University*

#### A Parallel Dynamic-Mesh Lagrangian Method for Simulation of Flows with Dynamic Interfaces

James F. Antaki, *University of Pittsburgh Medical Center*, Guy E. Blesloch,  
Omar Ghattas, Ivan Malcevici, Gary L. Miller, Noel J. Walkington, *Carnegie Mellon University*

#### Self-Consistent Langevin Simulation of Coulomb Collisions in Charged-Particle Beams

Ji Qiang, Robert D. Ryne, Salman Habib, *Los Alamos National Laboratory*

### VISUALIZATION

#### Using High-Speed WANs and Network Data Caches to Enable Remote and Distributed Visualization

Wes Bethel, Jason Lee, Dan Gunter, Lau Stephen, Stephen Lau, *LBL*

#### High Performance Visualization of Time-Varying Volume Data over a Wide-Area Network

Kwan-Liu Ma, David M. Camp, *UC Davis*

#### Distributed Rendering for Scalable Displays

Greg Humphreys, Ian Buck, Pat Hanrahan, *Stanford University*

## TECHNICAL PAPERS

### HARDWARE BASED TOOLS

#### Using Hardware Performance Monitors to Isolate Memory Bottlenecks

Bryan Buck, Jeffrey Hollingsworth, *The University of Maryland*

#### Hardware Prediction for Data Coherency of Scientific Codes on DSM

Jean-Thomas Acquaviva, *CEA DAM/PRISM*, William J.P. Jalby, *PRISM*

#### A Scalable Cross-Platform Infrastructure for Application Performance Tuning Using Hardware Counters

Shirley Browne, Nathan Garner, Kevin London, *University of Tennessee*, Jack Dongarra,  
*University of Tennessee and Oak Ridge National Laboratory*, Phil Mucci, *University of Tennessee*

### APPLICATIONS II

#### Performance Modeling and Tuning of an Unstructured Mesh CFD Application

William D. Gropp, Dinesh K. Kaushik, *Argonne National Laboratory*, David E. Keyes, *Old Dominion University*, Barry F. Smith, *Argonne National Laboratory*

#### The Parallel Ratchet for Phylogenetic Inference

Quinn O. Snell, Michael Whiting, Mark Clement, David McLaughlin, *Brigham Young University*

#### Parallel Unsteady Turbo-Pump Simulations For Liquid Rocket Engines

Cetin C. Kiris, *ELORET/NASA-Ames*, Dochan Kwak, *NASA-Ames*, William Chan, *ELORET/NASA-Ames*

### NETWORKING

#### The Failure of TCP in High-Performance Computational Grids

Wu-chun Feng, *Los Alamos National Laboratory*, Peerapol Tinnakornsrisuphap, *University of Wisconsin*

#### PSockets: The Case for Application-level Network Striping for Data Intensive Applications using High Speed Wide Area Networks

Sivakumar Harinath, Robert Grossman, *University of Illinois at Chicago*,  
Stuart Bailey, *Infoblox Inc.*

#### Efficient Wire Formats for High Performance Computing

Fabian E. Bustamante, Greg Eisenhauer, Karsten Schwan, Patrick Widener, *Georgia Institute of Technology*

# SC2000 TECHNICAL PROGRAM

[www.sc2000.org/techpapers](http://www.sc2000.org/techpapers)

WEDNESDAY, NOV. 8 | 3:30PM – 5PM

## MASTERWORKS

### REAL WORLD SCALABLE COMPUTING II

**Computing Challenges in the Travel & Transportation Industry**

Richard Ratliff  
*Sabre Holdings, Inc.*

**SETI@home: Internet Distributed Computing for SETI**

David Anderson  
*United Devices, Inc.*

## PANEL

### TCP PANEL

**Is TCP an Adequate Protocol for High Performance Computing Needs?**

**Moderator:** Hilarie Orman, *Novell*

**Panelists:** Jamshid Mahdavi, *Novell*, Volker Sander, *Central Institute for Applied Mathematics (ZAM) John von Neumann Institute for Computing (NIC)*, Wu-chun Feng, *Los Alamos National Laboratory and Purdue University*, Stuart Bailey, *Infoblox*, Lawrence Brakmo, *Compaq*, Deepak Bansal, *MIT LCS*, Brian L. Tierney, *Lawrence Berkeley National Laboratory*

## TECHNICAL PAPERS

### GORDON BELL I

**A 992 Gflops simulation of black holes in a galactic center on GRAPE-6**

Junichiro Makino, Toshiyuki Fukushige, Masaki Koga, *University of Tokyo*

**98C/MFlop, Ultra-Large-Scale Neural-Network Training on a PIII Cluster**

Douglas A. Aberdeen, Jonathan N.E. Baxter, Robert Edwards, *Australian National University*

**Scalable Molecular Dynamics for Large Biomolecular Systems**

Robert K. Brunner, James C. Phillips, Laxmikant V. Kale, *University of Illinois*

### PARALLEL PROGRAMMING

**A Comparative Study of the NAS MG Benchmark across Parallel Languages and Architectures**

Bradford L. Chamberlain, Steven J. Deitz, Lawrence Snyder, *University of Washington*

**Is Data Distribution Necessary in OpenMP?**

Dimitrios S. Nikolopoulos, Theodore S. Papatheodorou, *University of Patras*, Constantine D. Polychronopoulos, *University of Illinois at Urbana-Champaign*, Jesus Labarta, Eduard Ayguade, *Technical University of Catalunya*

**Extending OpenMP for NUMA Machines**

John A. Bircsa, Peter W. Craig, Raelyn Crowell, Zarka Cvetanovic, Jonathan Harris, C. Alexander Nelson, Carl D. Offner, *Compaq Computer*

THURSDAY, NOV. 9 | 10:30AM – NOON

## MASTERWORKS

### SUPERCOMPUTING TRENDS IN MCAE I

**Satisfying CFD Engineering Constraints (with Parallel Processing)**

Stephen A. Remondi, Jame Hoch  
*EXA Corporation*

**Stochastic Simulation: Breaking the stagnation and fragmentation of contemporary HPC**

Jacel Marczyk  
*EASI Engineering*

## TECHNICAL PAPERS

### SOFTWARE TOOLS

**A Tool Framework for Static and Dynamic Analysis of Object-Oriented Software with Templates**

Kathleen A. Lindlan, Janice Cuny, Allen D. Malony, Sameer Shende, *CIS, University of Oregon*, Bernd Mohr, *ZAM, Forschungszentrum Juelich*, Reid Rivenburgh, *CRAG, LANL*, Craig Rasmussen, *ACL, LANL*

**From Trace Generation to Visualization: Scalable Data Management for Distributed Parallel Systems**

C. Eric Wu, Anthony Bolmarcich, Marc Snir, David Wootton, Farid Parpia, *IBM*, Anthony Chan, Ewing Lusk, William Gropp, *Argonne National Laboratory*

**Dynamic Software Testing of MPI Applications with Umpire**

Jeffrey S. Vetter, Bronis R. de Supinski, *Center for Applied Scientific Computing, LLNL*

### DATA GRID

**Computing and Data Grids for Science and Engineering**

William E. Johnston, *NASA Ames and Lawrence Berkeley National Lab*, Dennis Gannon, *NASA Ames and University of Indiana*, Bill Nitzberg, *Veridian Systems, PBS Products*, Leigh Ann Tanner, Bill Thigpen, Alex Woo, *NASA Ames*

**The MicroGrid: a Scientific Tool for Modeling Computational Grids**

Hyo J. Song, Xin Liu, Dennis Jakobsen, Ranjita Bhagwan, Xianan Zhang, *University of California, San Diego*, Kenjiro Taura, *University of Tokyo, Japan & UCSD*, Andrew A. Chien, *University of California, San Diego*

### GORDON BELL II

**1.02 Tflops Molecular Dynamics Simulation for NaCl with a Special-Purpose Computer: MDM**

Tetsu Narumi, Ryutarou Susukita, Hideaki Furusawa, Atsushi Kawai, Takahiro Koishi, Kenji Yasuoka, *RIKEN, Keio University*, Toshikazu Ebisuzaki, *RIKEN*

**High-Cost CFD on a Low-Cost Cluster**

Thomas Hauser, Timothy I. Mattox, Raymond P. LeBeau, Henry G. Dietz, P. George Huang, *University of Kentucky*

**Efficient Simulation of Carbon Detonations**

A. C. Calder, L. J. Dursi, B. Fryxell, *University of Chicago*, G. Henry, *Intel*, P. MacNeice, *NASA Goddard*, K. Olson, P. Ricker, R. Rosner, F. X. Timmes, *University of Chicago*, H. M. Tufo, *University of Chicago/Argonne National Laboratory*, J. W. Turan, M. Zingale, *University of Chicago*

# SC2000 TECHNICAL PROGRAM

[www.sc2000.org/techpapers](http://www.sc2000.org/techpapers)

THURSDAY, NOV. 9 | 1:30PM – 3PM

## PLENARY SESSION

### AWARDS SESSION SPEAKER

**On the Scale and Performance of Cooperative Web Proxy Caching**

Goeff Voekler, *UC San Diego*  
*Computing Research Association Digital Fellow*



[www.sc2000.org/awards](http://www.sc2000.org/awards)

## AWARDS SESSIONS

**AWARDS CHAIR:** Sally D. Haerer, *Oregon State University*

The second annual IEEE Computer Society Seymour Cray Computer Engineering Award will be presented in recognition of innovative contributions to high performance computing systems that best exemplify Seymour Cray's creative spirit. The IEEE Computer Society Sidney Fernbach Memorial Award will be presented for an outstanding contribution in the application of high performance computers using innovative approaches.

The SC2000 Conference will present several other awards. The Gordon Bell Awards were established to reward practical uses of parallel processing and will be given for the best performance improvements in an application within several categories. Awards will also be given for the best technical paper, the best student technical paper (with a student as principal author), the HPC Games winners, and the best Research Gem.

---IEEE Awards: [computer.org/awards/](http://computer.org/awards/) ---Questions: [awards@sc2000.org](mailto:awards@sc2000.org)

THURSDAY, NOV. 9 | 3:30PM – 5PM

## PANEL

### PETAFLUPS AROUND THE CORNER: WHEN? HOW? IS IT MEANINGFUL?

**Moderator:** Neil Pundit, *Sandia National Laboratories*

**Panelists:** Marc Snir, *IBM Research*, Bill Camp, *Sandia National Laboratories*, Thomas Sterling, *JPL/NASA/Caltech*, Paul Messina, *DOE HQ*, Rick Stevens, *Argonne National Laboratory*, Pete Beckman, *Turbolabs*

FRIDAY, NOV. 10 | 8:30AM – 10AM

## PANELS

### CONVERGENCE OF THE EXTREMES

**Moderator:** David Culler, *University of California, Berkeley*

**Panelists:** Jim Demmel, *University of California, Berkeley*  
Deborah Estrin, *UCLA*  
Gaetano Borriello, *University of Washington*

### COMPUTATIONAL GRIDS: A SOLUTION LOOKING FOR A PROBLEM?

**Moderator:** Jennifer Schopf, *Northwestern University*

**Panelists:** Ian Foster, *Argonne National Laboratory*  
Cherri Pancake, *Oregon State University*  
Mark Snir, *IBM Research*

THURSDAY, NOV. 9 | 3:30PM – 5PM

## MASTERWORKS

### SUPERCOMPUTING TRENDS IN MCAE II

**Title:** TBA

David Lombard  
*MSC Software Corporation*

**LS-DYNA—Application-driven Strategies for High Performance Computing**

Mark Christon  
*Livermore Software Technology Corporation*

## TECHNICAL PAPERS

### SCIENCE APPLICATIONS SUPPORT

**Integrating Parallel File I/O and Database Support for High-Performance Scientific Data Management**

Jaechun No, Rajeev Thakur, *ANL*, Alok Choudhary, *Northwestern University*

**A Framework for Sparse Matrix Code Synthesis from High-level Specifications**

Nawaaz Ahmed, Nikolay Mateev, Keshav Pingali, Paul Stodghill, *Cornell University*

**A Unified Algorithm for Load-balancing Adaptive Scientific Simulations**

Kirk Schloegel, George Karypis, Vipin Kumar, *University of Minnesota, AHPCRC*

### GRID MIDDLEWARE

**The AppLeS Parameter Sweep Template: User-Level Scheduling Middleware for the Grid**

Henri Casanova, Graziano Obertelli, *UCSD*, Rich Wolski, *UTK*, Francine Berman, *UCSD*

**On the Performance of Remote Method Invocation for Large Scale Scientific Applications**

Madhusudhan Govindaraju, Aleksander Slominski, Venkatesh Choppella, Randall Bramley, Dennis Gannon, *Indiana University*

**Expressing and Enforcing Distributed Resource Sharing Agreements**

Tao Zhao, Vijay Karamcheti, *New York University*

FRIDAY, NOV. 10 | 10:30AM – NOON

## PANELS

### OPEN SOURCE: IP IN THE INTERNET ERA

**Moderator:** Robert Borchers, *NSF*

**Panelists:** Susan Graham, *UC Berkeley, PITAC member*  
Richard Gabriel, *Sun Microsystems*  
Todd Needham, *Microsoft Research*  
José Muñoz, *U.S. Dept. of Energy*

### MEGACOMPUTERS

**Moderator:** Larry Smarr

**Panelists:** Andrew Chien, *Entropia*  
Ian Foster, *Argonne National Laboratory*  
Thomas Sterling, *JPL*

[www.sc2000.org/venture](http://www.sc2000.org/venture)

## VENTURE VILLAGE

**CONFERENCE VICE CHAIRS, VENTURE VILLAGE:** Dennis Duke, *SCRI, Florida State University*, Steve Wallach, *CenterPoint Ventures*

An innovative new exhibit joins SC2000 to showcase the best of the best! The Venture Village will showcase a collection of entrepreneurial information technology companies, which are creating new products for the 21st century. The Venture Village will be located strategically on the Main exhibit floor, and will offer a village atmosphere for visiting with the venture companies and/or your colleagues.

...Contact: [venture@sc2000.org](mailto:venture@sc2000.org)

[www.sc2000.org/bofs](http://www.sc2000.org/bofs)

## BIRDS-OF-A-FEATHER

**BOFS CHAIR:** Rajeev Thakur, *Argonne National Laboratory*

Birds-of-a-Feather (BOF) sessions are informal get-togethers for conference attendees to discuss topics of mutual interest. Meeting rooms are provided both before and after the formal hours of the technical program. A BOF notice board that will be updated daily will publicize the meeting schedule.

...Contact: [bofs@sc2000.org](mailto:bofs@sc2000.org)

[www.sc2000.org/games](http://www.sc2000.org/games)

## HPC GAMES

**HPC GAMES CO-CHAIRS:** Eleanor Anne Schroeder, *Naval Oceanographic Office*  
James Arthur Kohl, *Oak Ridge National Laboratory*

"Speed has always been important, otherwise we wouldn't need the computer." These are the words of Seymour Cray, the father of supercomputing. In the spirit of Seymour Cray's vision, this year's HPC Games is thrilled to introduce a new and exciting challenge: The \$10K Computer Challenge. Participants are being asked to build their own high-performance computing machine (or machines) for under \$10K, and bring these machines to the SC2000 exhibition floor to compete, running a series of predetermined benchmarks. The benchmarks will exercise a balanced assortment of metrics covering CPU performance, disk performance and network performance, and various combinations of these metrics as seen in typical high-performance applications.

Remember that bigger is not always better, and some pretty good things do come in small packages. Do you DARE to accept the HPC Games Challenge? The 19th century gave us Charles Babbage. The 20th century gave us Seymour Cray. Who knows? The winner of this contest may become the 21st century's computing visionary...

The benchmarks distribution will be ready very soon! Check the web site at <http://www.sc2000.org/games> for the scoring and qualification info!

...Contact: [games@sc2000.org](mailto:games@sc2000.org)

[www.sc2000.org/gems](http://www.sc2000.org/gems)

## RESEARCH GEMS

**RESEARCH GEMS CHAIR:** Jennifer Schopf, *Northwestern University*

SC2000 Research Gems, formerly known as Poster Exhibits, will report late-breaking results and experiences on topics related to HPNC. These exhibits will offer researchers an opportunity to present their results informally and to interact with interested attendees. The Research Gems will be conveniently located on the Exhibition floor in an environment shared with lounge and coffee space to encourage interaction and casual conversation among attendees and presenters with common interests. The special Research Gems morning sessions, on Wednesday and Thursday, will allow attendees to meet with Research Gem exhibitors and discuss their research efforts.

...Contact: [gems@sc2000.org](mailto:gems@sc2000.org)

[www.sc2000.org/escape2000](http://www.sc2000.org/escape2000)

## ESCAPE 2000

**ESCAPE 2000 CO-CHAIRS:** Stephen Jones and John West, *U.S. Army ERDC*

SC2000 will host a technology demonstration to explore the reach of computing and information access anticipated in the 21st century. Personal digital assistants, digital appliances, E-books, wearable computers, wireless networking, and emerging software infrastructures represent some of the technologies that are likely to form part of the commonplace interface to a variety of computing environments.

The convergence of these technologies with the Grid—the evolving information architecture integrating computing, data exploration, large databases, and remote instrumentation—creates a new potential for ubiquitous access to the nation's high performance computing infrastructure. SC2000 will provide a wireless gateway to SCinet to serve as a prototype for demonstrations of novel interfaces to HPC resources, data, and applications.

...Contact: [escape2000@sc2000.org](mailto:escape2000@sc2000.org)

[www.sc2000.org/exhibits](http://www.sc2000.org/exhibits)

## SC2000 EXHIBITION

**VICE CHAIR, EXHIBITS:** Joe McCaffrey, *Mississippi State University*

The SC2000 exhibits will feature the latest in high performance networking and computing from research institutions, national laboratories, HPC vendors and users. The exhibition floor will be brimming with new technology, new ideas and new exhibits, so take advantage of the opportunity to visit as many exhibits as possible. Starting with the Monday night Gala Opening (7 – 9pm), running Tuesday and Wednesday from 10am – 6pm, and Thursday from 10am – 4pm, the SC2000 exhibition will offer variety and excitement in exhibits that will give you plenty to talk about during SC2000 breaks and social activities.

Don't miss the Venture Village, Research Gems, eSCape 2000, research exhibits, industry exhibits or exhibitor forum—all included with your SC2000 registration.

\*\*\*Contact: [exhibits@sc2000.org](mailto:exhibits@sc2000.org)

[www.sc2000.org/industry](http://www.sc2000.org/industry)

## INDUSTRY EXHIBITS

**EXHIBITION MANAGEMENT:** Don Collier, *DC Expositions, Inc.*

The SC2000 Industry Exhibits complement the technical program and feature industry leaders in HPNC and associated software, visualization, tools, storage, applications and services. This exhibition is one you will not want to miss! It begins with a Gala Opening on Monday night and continues through Thursday of SC2000.

\*\*\*Contact: [industry@sc2000.org](mailto:industry@sc2000.org)

[www.sc2000.org/research](http://www.sc2000.org/research)

## RESEARCH EXHIBITS

**RESEARCH EXHIBITS CHAIR:** Virginia To, *High Performance Technologies, Inc.*

Resource-intensive computational science, scientific collaboration and leading-edge technologies characterize the SC2000 Research Exhibits, which feature work from the world's research universities, labs and centers. New and innovative research efforts and results best suited to live interchange and demonstration will be exchanged and exhibited, promoting interactions among the presenters and attendees. High performance network links will be used for dynamically presenting research that involves distributed collaborating sites or for linking to remote resources or special facilities. These exhibits are adjacent to the industry exhibits and are staffed during all announced exhibition hours, beginning with the Monday evening Gala Opening event.

\*\*\*Contact: [research@sc2000.org](mailto:research@sc2000.org)

[www.sc2000.org/forum](http://www.sc2000.org/forum)

## EXHIBITOR FORUM

**EXHIBITOR FORUM CHAIR:** Joe McCaffrey, *Mississippi State University*

The exhibitor forum provides industry exhibitors the opportunity to give presentations which showcase recent breakthroughs in research and development and to discuss new application areas, new directions, and new technologies in areas related to HPNC.

\*\*\*Contact: [forum@sc2000.org](mailto:forum@sc2000.org)

[www.sc2000.org/scinet](http://www.sc2000.org/scinet)

## SCINET 2000

**VICE CHAIR FOR INFORMATION ARCHITECTURE:** Bill Kramer, *NERSC, LBNL*

A significant part of the technology showcased each year at SC2000 is the network that supports it and makes it (for the duration of the show) the most intense network on the planet.

SCinet 2000 is working with Qwest Communications, Nortel and others to establish flexible wide area connections. Using Qwest fiber infrastructure, the wide area network will feature multiple OC-48 (2.5 Gigabit per second) connections, several OC-12 connections and possibly an OC-192 connection, using the latest technology and protocols. These connections link the show to the major research and commercial networks, including Internet2/Abilene, ESnet, HSCC, vBNS and others. SCinet plans to support IPv4, IPv6, ATM, Fiber Channel and Packet over SONET connections, Quality of Service demonstrations, and advanced network monitoring.

In order to support the complex logistics and requirements of SC2000, SCinet is deploying four overlapping networks within the Dallas Convention Center. They are all interconnected, but can operate independently of each other. Before the show starts, SCinet will deploy a commodity Internet network. Next, a production network will be provisioned with leading-edge hardware featuring Gigabit Ethernet, OC-48 ATM, and at least one lambda of DWDM gear. Working with Cisco and other vendors, SCinet will create a large 11 Mbps wireless network on the exhibit floor, in the educational program area and other locations. This wireless network will support the education program and the eSCape 2000 activities. Finally, a bleeding-edge network known as Xnet, will showcase equipment that may not yet be formally supported by vendors. SCinet is hoping to use that network to showcase technologies such as 10-Gigabit Ethernet.

To encourage the demonstration of Bandwidth Intensive Applications on this unique, once a year network, SCinet is sponsoring innovative, bandwidth intensive application demonstrations. These are applications that will both stress the capabilities of the SCinet network infrastructure and deliver innovative application value. The most impressive of these applications will be recognized with special awards at the Award session on Thursday. More information is at the SCinet 2000 web page, along with the latest details about the network.

\*\*\*Contact: [scinet@sc2000.org](mailto:scinet@sc2000.org)

## SC2000 SOCIAL ACTIVITIES

**GALA OPENING** Start your week off with some good old Texas fun! SC2000 will officially begin with a Gala Opening Monday, Nov. 6, from 7 – 9pm. View the latest advances in high performance hardware, software and communications as you stroll through the exhibit hall. Meet up with old friends and make new ones while enjoying food and beverages—some unique to the Dallas area!

**CONFERENCE RECEPTION** Bar-B-Que and betting make for fun Thursday, Nov. 9, when SC2000 will host a conference reception at the Lone Star Park at Grand Prairie. Each attendee will be briefed on wagering and given a race day program providing the odds. A Texas-style buffet dinner and beverages, music for listening and dancing, and a spectacular fireworks display rounds out the evening.

# SC2000 HOUSING RESERVATION INFORMATION

[www.sc2000.org/housing](http://www.sc2000.org/housing)

## SC2000 HOUSING INSTRUCTIONS

Room reservations at conference hotels are handled on a first-come, first-served basis through the Dallas Convention & Visitors Bureau (DCVB) Housing Bureau. Information regarding locations, rates and amenities are located in the Hotel Amenities Chart on the SC2000 Housing website ([www.sc2000.org/housing](http://www.sc2000.org/housing)). Reservations must be made by using the SC2000 Conference Housing Form or the online reservation system (see SC2000 website). Conference rates will not be given to persons who directly contact the hotels.

All hotels are in compliance with the Americans with Disabilities Act (ADA): guest rooms, common areas, meeting facilities and transportation services are within ADA requirements.

### SEND THE HOUSING FORM TO:

**SC2000 Housing Services**  
DCVB Housing  
1201 Elm St., Ste 2000  
Dallas, TX 75270  
800/792-1029 (US or Canada)  
214/571-1023  
214/571-1024 (fax)

### ONLINE RESERVATIONS:

To make your reservation requests directly online, please go to: [www.sc2000.org/housing/](http://www.sc2000.org/housing/).

This service is for individual room reservations only (roommates included). Exhibitors or attendees interested in reserving room blocks (10 or more rooms) or who have special requirements regarding their reservations should contact the SC2000 Housing Coordinator for further assistance.

### FOR INFORMATION AND ASSISTANCE, PLEASE CONTACT:

Mercy Little, Housing Director  
Dallas Convention & Visitors Bureau  
[sc2000@dallascvb.com](mailto:sc2000@dallascvb.com)

(see other contact information for DCVB Housing above) or

Debbie Huszar, SC2000 Housing Coordinator  
c/o Task Handlers  
PO Box 308  
Gladstone, OR 97027  
503/722-2262  
[info@taskhandlers.com](mailto:info@taskhandlers.com)

### DEPOSITS

A \$150 deposit is required for each room request in advance by check, money order or credit card in order to guarantee a reservation. This deposit will be processed within three (3) days of receipt. Deposit checks and money orders must be made out to DCVB and sent within 14 days of date processed. Total occupancy tax is 15% (subject to change). **ALL ROOMS MUST BE GUARANTEED WITH A DEPOSIT OR YOUR RESERVATION WILL BE RELEASED!**

### ACKNOWLEDGMENTS AND CONFIRMATIONS

Please assign one person to make the reservations and inform the Housing Bureau of the other person(s)' name. DCVB's Housing Bureau will send a confirmation via mail, fax or email depending on the date your reservation was received.

### GUARANTEES, CANCELLATIONS AND CHANGES

Guaranteed reservations are typically held until 6:00am the following morning, at which time the reservation and deposit are forfeited and a "no show" charge may be applied (individual hotel's discretion for fees). However, each hotel has its own guarantee policy, so if you are going to arrive after mid-

night, it is important you notify the hotel of your planned late arrival to ensure your reservation and avoid any "no show" or cancellation fees. If a notice of cancellation is received by the DCVB Housing Bureau prior to the deadline of October 6, 2000 the DCVB Housing Bureau will send a full refund. If your request is received after the deadline and at least seventy-two (72) hours prior to the arrival date, the deposit is refunded by the hotel less a \$10 processing fee. Deposits will not be refunded if a cancellation is received less than 72 hours prior to your arrival date. If you cancel a room, keep your reservation/cancellation number. This is your proof of cancellation should there be a dispute about billing. Name changes (including roommate information) are allowed as well as arrival and departure dates.

Changes to reservations must be made through DCVB's Housing Bureau by phone, fax or email. At time of check-in, verify your departure date and make any date adjustments. Lack of notification may result in an additional night's room charge plus applicable tax (at the discretion of individual hotels).

**DEADLINE for Housing Reservations guaranteed at the conference rate: Friday, October 6, 2000.** Reservations received after the cut-off date are accepted by DCVB's Housing Bureau on a "space available" basis and cannot be guaranteed at the conference rates. Do not contact the hotels directly to make housing reservations.

### MULTIPLE ROOM BLOCKS

If a room block of 10 or more is requested, a minimum of \$150 deposit for each room is required in advance by check, money order or credit card and is NON-REFUNDABLE. This deposit will be processed within three (3) days of receipt. Depending on the hotel, a special contract with an attrition clause may be required by the person or group requesting 10 or more rooms. Purchase orders are not accepted. For more information and instructions, please contact the SC2000 Housing Coordinator (see above).

**DEADLINE for Rooming Lists (10 or more rooms)** with deposits to include names, arrival/departure dates, credit card numbers, type of accommodations and a primary contact person's name, address, phone number, fax number and email address (see SC2000 Housing Form for details required): Friday, September 22, 2000. If your rooming list is not received by the deadline date, your room block is automatically cancelled.

### MEETING ROOM SPACE

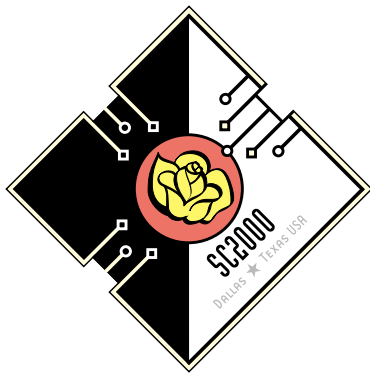
For exhibitors who require meeting room or reception space at any of the conference hotels, please contact Debbie Huszar, SC2000 Housing Coordinator, for information at: [info@taskhandlers.com](mailto:info@taskhandlers.com) or call 503/722-2262.

### HOTEL LOCATIONS AND TRANSPORTATION

Most of the conference hotels are located within 10 blocks of the Dallas Convention Center. Conference bussing will be provided to all conference hotels. There is also a DART Light Rail system that runs past most of the conference hotels as well as past the Convention Center. See the Housing Map and Hotel Amenities Chart (on the SC2000 website) for details.

Conference Bussing will be provided during the conference (see "SC2000 Shuttle Bus Services" under "Information" on the SC2000 website). Car rental services are available at the rental car mall (about a 15 minute shuttle ride from the airport) and most hotels. Check with your hotel for the specific car rental service on their property. SuperShuttle provides transportation services to and from the airport. Their rate is currently \$11 one way or \$22 round trip. Taxi service and private town car services are approximately \$27-\$75 one way from the airport to the Conference Hotels.





# SC2000 CONFERENCE HOUSING FORM

**IMPORTANT: READ HOUSING INSTRUCTIONS BEFORE COMPLETING THIS FORM!**  
 Print or type information. Use one (1) form for each room request.  
 Photocopy additional forms as necessary.

## SEND CONFIRMATION TO:

Name \_\_\_\_\_ Title \_\_\_\_\_

Sharing with \_\_\_\_\_

Organization \_\_\_\_\_

Mailing address \_\_\_\_\_

City \_\_\_\_\_ State \_\_\_\_\_ Postal/Zip Code \_\_\_\_\_ Country \_\_\_\_\_

Daytime Phone \_\_\_\_\_ Fax \_\_\_\_\_

Email Address \_\_\_\_\_

Arrival Date \_\_\_\_\_ Departure Date \_\_\_\_\_

## HOTEL PREFERENCE:

Please indicate your hotel choices below in order of preference. The DCVB Housing Bureau will do its best to accommodate your first preference. However, in the event that is not possible, please indicate your second and third choices below.

\_\_\_\_\_

First choice

\_\_\_\_\_

Second choice

\_\_\_\_\_

Third choice

**Government rate requested.**  
 (If the government rate is not available, the conference rate will be used and you will be notified. You may be required to show proper identification as proof you qualify for the government rate. If you cannot verify your government affiliation, you may be charged a substantially higher rate at the discretion of the hotel.)

## TYPE OF ACCOMMODATIONS:

- |   |   |
|---|---|
| <input type="checkbox"/> Single - 1 person, 1 bed                                       | <input type="checkbox"/> Non-smoking        |
| <input type="checkbox"/> Double - 2 people, 1 bed                                       | <input type="checkbox"/> Smoking            |
| <input type="checkbox"/> Dbl/Dbf - 2 people, 2 beds                                     | <input type="checkbox"/> King bed requested |
| <input type="checkbox"/> Triple - 3 people, 2 beds                                      | <input type="checkbox"/> ADA, w/companion   |
| <input type="checkbox"/> Quad - 4 people, 2 beds  | <input type="checkbox"/> ADA, w/o companion |
| <input type="checkbox"/> Suite - w/parlor and 1-bdrm (circle: King or Dbl/Dbf)          |   |
| <input type="checkbox"/> Suite - w/parlor and 2-bdrms (specify bdrm requirements below) |   |

Special needs or requirements? Please provide us with the details:

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

## CREDIT CARD INFORMATION:

- Mastercard     Visa     American Express     Discover     Diners Club

Credit card # \_\_\_\_\_ Expiration Date \_\_\_\_\_

Cardholder's Name \_\_\_\_\_ Signature \_\_\_\_\_

The DCVB Housing Bureau and assigned hotel are authorized to use this card information to assess a \$150 deposit on my hotel room. This deposit is NON-REFUNDABLE if cancellation is received less than seventy-two hours prior to arrival date shown above.

**Individual Housing Reservations** must be made by using the Conference Housing Form via the web, mail, or fax. Reservations at conference hotels are handled on a first-come, first-served basis. If you fax your form, please do not duplicate by mailing the original. Purchase orders are not accepted.

Changes must be made through the Dallas Convention and Visitors Bureau (DCVB) Housing Bureau via phone (see toll free number below), fax or mail. For more details regarding changes or cancellations, refer to the Housing Instructions or SC2000 Website.

Please assign one person to make reservations for rooms being shared and inform the Housing Bureau of the other names. For Multiple Room Blocks, read the Housing Instructions or go to the SC2000 website.

A \$150 deposit is required in advance by check, money order or credit card in order to guarantee a reservation. Deposit checks and money orders must be made out to DCVB Housing Bureau and sent within 14 days of the date processed. **ALL ROOMS MUST BE GUARANTEED WITH A DEPOSIT OR YOUR RESERVATION WILL BE RELEASED!**

### DEADLINES

For Housing reservations guaranteed at conference rate, **Friday, October 6, 2000.**

For exhibitors or attendees requesting room blocks, rooming lists and deposits (10 or more rooms), **Friday, September 22, 2000.**

Please return this form by mail or fax to:

SC2000 Housing Services  
 DCVB Housing  
 1201 Elm Street, Suite 2000  
 Dallas, TX 75270  
 214/571-1023  
 800/792-1029 (US or Canada only)

**214/571-1024 (DCVB FAX)**

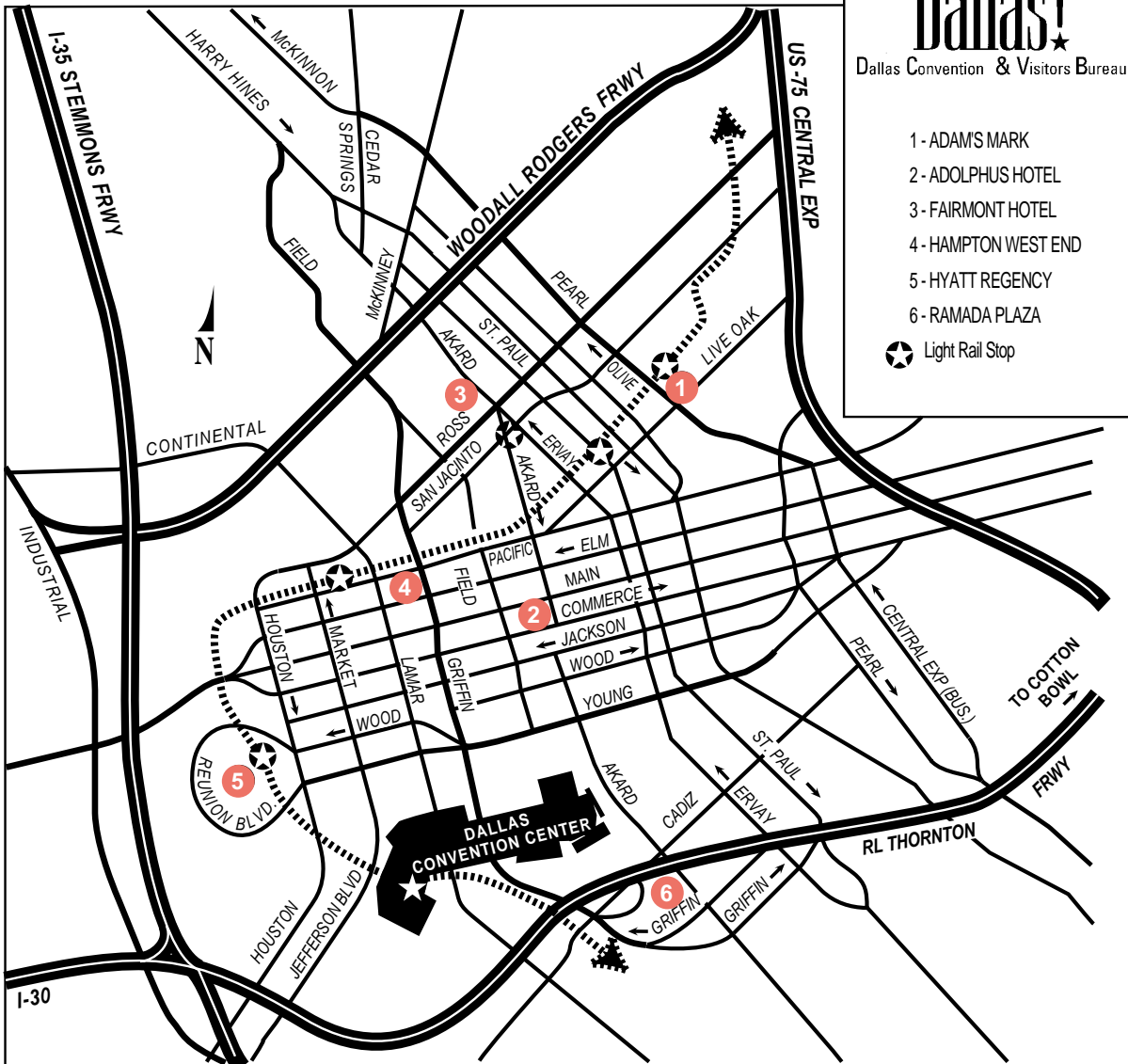
For more information regarding policies, multiple room blocks, or meeting space, contact:

SC2000 Housing Coordinator:  
 Debbie Huszar  
 c/o Task Handlers  
 503/722-2262 (phone)  
 info@taskhandlers.com

# SC2000 CONFERENCE HOTELS

[www.sc2000.org/housing](http://www.sc2000.org/housing)

Hotel	Single	Double	Triple	Quad	Hotel	Single	Double	Triple	Quad
<b>1 Adams Mark Hotel</b> 400 North Olive 214/922-8000	\$140	\$150	NA	NA	<b>4 Hampton Inn West End</b> 1015 Elm St 214/742-5678	\$119	\$119	\$129	\$129
<b>2 Adolphus Hotel</b> 1321 Commerce St 214/742-8200	\$156	\$176	NA	NA	<b>5 Hyatt Regency Dallas</b> 300 Reunion Blvd (near Convention Ctr) 214/651-1234	\$155	\$175	NA	NA
<b>3 Fairmont Hotel</b> 1717 N Akard St 214/720-2020	\$155	\$155	NA	NA	<b>6 Ramada Plaza Hotel - DCC</b> 1011 Akard St (near Convention Ctr) 214/421-1083	\$119	\$129	NA	NA



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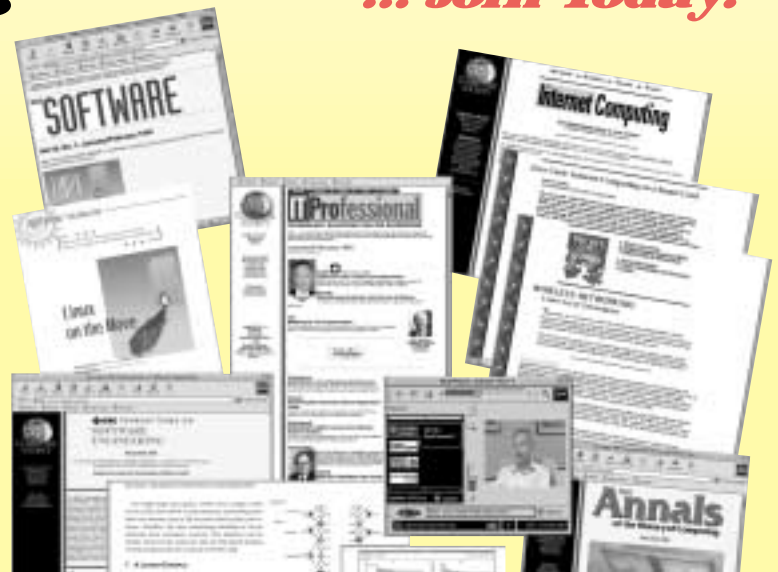
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Fax: +32 2 770 8505  
Email: [euro.ofc@computer.org](mailto:euro.ofc@computer.org)

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Email: [tokyo.ofc@computer.org](mailto:tokyo.ofc@computer.org)

IEEE  
**COMPUTER  
SOCIETY**



# SC2000 CONFERENCE REGISTRATION INFORMATION

[www.sc2000.org](http://www.sc2000.org)

## ADVANCE REGISTRATION

You can register in advance for SC2000 in two ways:

- Use the online registration form at [www.sc2000.org/registration](http://www.sc2000.org/registration) (credit cards only), which is encrypted with Secure Sockets Layer (SSL) technology and can only be read by the IEEE Computer Society.
- Complete the registration form in this Advance Program and mail or fax it with your payment to the IEEE Computer Society.

To qualify for advance registration discounts, your registration form and payment must be received by 5:00pm EDT, Friday, September 29, 2000. Registrations received between September 29th and October 13th will be charged at the late/on-site registration rate; those received after 5:00pm EDT, Friday, October 13, 2000 may not be acknowledged and must be resubmitted for processing on-site at SC2000 at the Dallas Convention Center.

### MEMBER, RETIRED MEMBER AND STUDENT DISCOUNTS

To qualify for discounted registration rates, include your current ACM, ACM SIGARCH, IEEE, or IEEE Computer Society membership number(s) or a copy of a valid full-time student identification card with the registration form.

### INTERNATIONAL ATTENDEES

International attendees can register in advance and pay by wire transfer for an additional processing fee of \$25 per wire transfer. Wire transfers must be received by October 13, 2000, and will not be accepted at on-site registration.

### REGISTRATION CONFIRMATION

Written confirmation of conference registration will be mailed by the IEEE Computer Society within five days of receiving your registration. If you do not receive confirmation, please call +1-202/371-1013 or send a message to [register@computer.org](mailto:register@computer.org). Bring this confirmation to SC2000 to receive your registration materials.

### PAYMENT

Payment must accompany all registration forms and can be made by credit card (MasterCard, VISA, American Express, and Diners Club), company or personal check, or wire transfers (a fee of \$25 per wire transfer should be added to the total amount). Purchase Orders are generally not permitted. Under rare circumstances, U.S. Federal Government Purchase Orders will be accepted with prior approval from Tony Baylis, SC2000 Registration Chair. Late registration fees apply on all registration forms submitted with Purchase Order payments. Checks or money orders must be in U.S. funds, drawn on U.S. banks, and payable to the IEEE Computer Society. You can mail, fax, or submit your registration form from the WWW. No registrations will be accepted over the phone. Forms received without payment will not be processed.

### ON-SITE REGISTRATION

On-site registrants will pay late registration fees. Forms of payment accepted on-site: credit cards (MasterCard, VISA, American Express, Diners Club), traveler's checks, company and personal checks, and cash. U.S. Federal Government Purchase Orders and Wire transfers will not be accepted at on-site registration.

### TUTORIALS

Full-day tutorials are being offered on Sunday and Monday, November 5th and 6th. These are not included in the technical program registration and require separate registration.

A special Tutorials Passport for one or two days is available. A one-day passport (either Sunday or Monday) entitles you to attend any tutorials offered on that day, a tutorial luncheon, and your selection of notes for one full-day tutorial. A two-day passport gives you approximately a 20% discount on the price of two one-day passports. Your selection of tutorial notes must be specified on the registration form.

Seating at the tutorials is on a first-come, first-served basis. You are welcome to sit in on as many other tutorials as you like for the day(s) you are registered, but you will receive only the notes that you reserve in advance.

### TUTORIAL NOTES

Tutorial notes can be picked up at the SC2000 Conference Store upon presentation of the notes ticket(s) provided in your registration packet. You will only receive notes for the tutorial(s) you selected on your registration form. Extra copies of tutorial course notes will be on sale at the Conference Store starting Tuesday, November 7. Orders for additional tutorial notes can be placed at any time in the Conference Store for delivery after the conference.

### PROCEEDINGS

Attendees registered for the technical program will receive one copy of the SC2000 proceedings on CD-ROM. The proceedings may also be accessed during and after the conference on the WWW. Any extra copies of the proceedings will be on sale at the Conference Store.

### EXHIBITS ONLY BADGES

Exhibits Only Badges (\$80) allow entrance to the exhibit floor for one of the three days of the exhibition: Tuesday (10am–6pm), Wednesday (10am–6pm), or Thursday (10am–4pm). Exhibits Only Badges will go on sale beginning Tuesday morning. SC2000 is offering Exhibits Only registration to children 12-16 who must purchase Exhibits Only Badges (\$80) and be accompanied by an adult at all times. Children under age 12 are not permitted on the exhibit floor at any time.

### MEDIA REGISTRATION AND INFORMATION

Members of the media should contact SC2000 Media Coordinator Jon Bashor at [JBashor@lbl.gov](mailto:JBashor@lbl.gov) for registration information.

### CANCELLATIONS AND SUBSTITUTIONS

Cancellations and substitutions are allowed. However, full registration fees will be charged unless a cancellation notice is sent in writing, and received, or faxed on or before October 20, 2000 to: IEEE Computer Society; Attn: SC2000 1730 Massachusetts Avenue NW; Washington, DC 20036 USA +1-202/728-0884 (fax)

A \$50 handling fee will be applied to all canceled registrations. Please allow 10 weeks for processing. Fees cannot be refunded for registrations canceled after the meeting begins. No-shows will be billed. Contact the IEEE Computer Society at the above address for substitutions (allowed at any time).

A letter on your company's letterhead is required from the original registrant stating the conditions of the substitution and the name of the replacement.

### SPECIAL REGISTRATION NEEDS

If under the Americans with Disabilities Act you require specific aids or services during your visit, please notify us prior to the registration deadline. We will attempt to accommodate participants' special needs. Please contact: Tony Baylis, SC2000 Registration Chair, [tbaylis@ncsa.uiuc.edu](mailto:tbaylis@ncsa.uiuc.edu) (email) +1-217/244-5354 (phone) +1-217/244-2909 (fax)

### AIRLINE DISCOUNT FOR CONFERENCE ATTENDEES

We are pleased to announce that we have been able to secure a special discount agreement with United Airlines unavailable to the general public.

A 5% discount off the lowest applicable fare will be offered ONLY when you or your travel agent call United's toll-free number, 1-800-521-4041 and refer to the Meeting ID Number 583IQ. A 10% discount off the unrestricted mid-week coach fares is available when purchased 7 days in advance. Discounts apply on United, Shuttle by United and United Express. Dedicated reservationists are on duty 7 days a week, 7:00 am to 12:00 midnight EST. Book early to take advantage of promotional fares that give you the greatest discount. Mileage Plus members receive full credit for all miles flown to this meeting.

### REGISTRATION AND STORE HOURS

See Conference at a Glance on page 2.

# SC2000 CONFERENCE REGISTRATION FORM

Registration is available electronically (credit cards only) at [www.sc2000.org/](http://www.sc2000.org/).

PRINT IN BLACK INK OR TYPE. Dr.  Prof.  Ms.  Mr.

Last/Family name \_\_\_\_\_ First name \_\_\_\_\_ Mid initial \_\_\_\_\_

Badge name (if different from first name) \_\_\_\_\_

Organization  
**ORGANIZATION TYPE**

<input type="radio"/> University/College	<input type="radio"/> Computer Industry	<input type="radio"/> Government Laboratory
<input type="radio"/> Military	<input type="radio"/> Government Agency	<input type="radio"/> Non-profit Corporation
<input type="radio"/> Non-Profit Research Center	<input type="radio"/> Independent Consulting	<input type="radio"/> Private Research Center
		<input type="radio"/> Other

Mailing Address \_\_\_\_\_

City \_\_\_\_\_

State \_\_\_\_\_ Postal/Zip Code \_\_\_\_\_ Country \_\_\_\_\_

E-mail Address \_\_\_\_\_

Telephone \_\_\_\_\_ Fax \_\_\_\_\_

**MAILING LISTS**

- Do not include my name on a published list of attendees.
- Do not include my name and mailing address on any mailing lists.

**MEMBERSHIP INFORMATION** Member numbers must be provided to receive member rates.

IEEE and/or Computer Society Member # \_\_\_\_\_  
 ACM and/or SIGARCH Member # \_\_\_\_\_  
 Non-member  
 Full-time Student (attach a copy of a valid student identification)

## TECHNICAL PROGRAM REGISTRATION

Includes admission to all conference sessions, exhibition, one copy of the SC2000 Proceedings (CD-ROM), refreshment breaks, Monday Gala Opening, and Thursday social event.

	Member	Nonmember	Full-Time Student
Received on or before 29 Sept. (Advanced)	\$390	\$495	\$100
Received after 29 Sept. but by 13 Oct.	\$560	\$700	\$150

**A. Enter technical program registration fee:** \_\_\_\_\_

## TUTORIAL PASSPORT REGISTRATION

Includes admission to any of the tutorials offered on the selected day for a One-day Passport and on both days for a Two-day Passport. Includes a set of tutorial notes (one full day or two half day) and lunch for each day selected. **PLEASE NOTE:** There is no half-day tutorial passport option. You must select one whole day OR two half-day notes with your daily Passport. **Please check the set of notes desired for each day registered.**

Sunday Full Day	<input type="radio"/> S1	<input type="radio"/> S2	<input type="radio"/> S3	<input type="radio"/> S4	<input type="radio"/> S5
Sunday Half Day - AM	<input type="radio"/> S6A	<input type="radio"/> S7A	<input type="radio"/> S8		
Sunday Half Day - PM	<input type="radio"/> S6B	<input type="radio"/> S7B	<input type="radio"/> S9	<input type="radio"/> S10	
Monday Full Day	<input type="radio"/> M1	<input type="radio"/> M2	<input type="radio"/> M3	<input type="radio"/> M4	
Monday Half Day - AM	<input type="radio"/> M5A	<input type="radio"/> M6A	<input type="radio"/> M7	<input type="radio"/> M8	
Monday Half Day - PM	<input type="radio"/> M5B	<input type="radio"/> M6B	<input type="radio"/> M9	<input type="radio"/> M10	

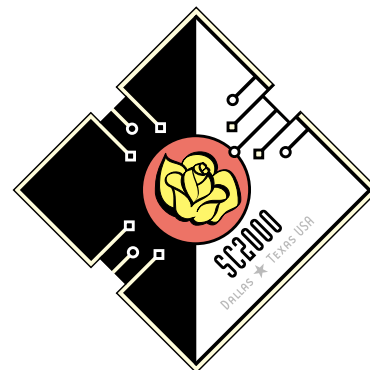
## ONE-DAY PASSPORT

	Members	Nonmembers	Full-Time Students
Received on or before 29 Sept. (Advanced)	\$375	\$485	\$100
Received after 29 Sept. but by 13 Oct.	\$525	\$660	\$150

## TWO-DAY PASSPORT

	Members	Nonmembers	Full-Time Students
Received on or before 29 Sept. (Advanced)	\$595	\$755	\$160
Received after 29 Sept. but by 13 Oct.	\$825	\$1035	\$240

**B. Enter total Tutorial Passport registration fee:** \_\_\_\_\_



## DO NOT SEND THIS FORM WITHOUT PAYMENT.

Registrations received without payment will not be processed. Advance registration fees apply through 5pm EDT, Friday, 29 September. Late fees will apply on registrations received after 5:00pm on 29 September and up to 5pm EDT, Friday, 13 October. **After 13 October, please register on site.** Written requests for refunds must be received in the registration office no later than 20 October. Refunds are subject to a \$50 processing fee. All no-show registrations will be billed in full.

## PAYMENT

Return this form along with payment to:

IEEE Computer Society  
 Attn: SC2000  
 Dept. 6006  
 Washington, DC 20042-6006 USA  
 202-371-1013 (Sorry—no phone reservations)  
 202-728-0884 fax

Do not send this form without payment. Forms received without payment will not be processed.

**C. For international wire transfers, add \$25 fee per wire transfer:**

(a copy of the wire transfer transaction must accompany this form)

**D. Payment due, U.S. funds drawn on U.S. banks only (A+B+C):**

## Method of payment:

Company check # \_\_\_\_\_  
 Personal check # \_\_\_\_\_  
 International Wire Transfer

## CHECKS SHOULD BE MADE PAYABLE TO IEEE COMPUTER SOCIETY

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All credit card charges will appear as IEEE COMPUTER SOCIETY REGISTRATION-WASHINGTON, DC on your statement.

# SIGARCH & acm

The ACM Special Interest Group on Computer Architecture serves a unique community of computer professionals working on the forefront of computer design in both industry and academia. It is ACM's primary forum for interchange of ideas about tomorrow's hardware. The newsletter *Computer Architecture News* publishes 5 times yearly and includes the ISCA and

ASPLOS proceedings. SIGARCH also offers Member Plus proceedings benefits to members.

The Association for Computing Machinery (ACM) is a not for profit educational and scientific computing society. Benefits include a subscription to *Communications of the ACM*, *Membernet*, discounts on books and conferences, and the option to subscribe to the ACM Digital Library (www.acm.org/dl).

- SIGARCH (ACM Member) ..... \$ 28\*
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- SIGARCH (Non-ACM Member) ..... \$ 28\*
- ACM (Professional Member \$95) & SIGARCH(\$28) ..... \$123
- ACM (Professional Member \$95) & SIGARCH(\$28) + ACM Digital Library (\$90) ..... \$213
- ACM (Student Member \$38) & SIGARCH (\$14) ..... \$ 52
- Computer Architecture News only ..... \$ 55
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- Expedited Air for Communications (outside N. America) ..... \$ 37
- SIGARCH Member Plus Package (Must be a SIGARCH Member)\*\*
- SPAA: ACM Symposium on Parallel Algorithms and Architectures (July) ..... \$ 22
- International Conference on Supercomputing (July) ..... \$ 23
- Supercomputing Conference (Nov.) ..... \$ 39

Expedited Air Rates for outside North America

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\*Annual subscription cost of \$19.95 is included in member dues of \$28 (for students cost is included in \$14).  
\*\*International members please contact ACM Member Services for expedited air prices.

## Payment Information

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 ACM occasionally makes its mailing list available to computer related organizations, educational institutions and sister societies. All email addresses remain strictly confidential. Check one of the following if you wish to restrict the use of your name

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- ACM and other sister society announcements (2)
- ACM subscription and renewal notices only (3)

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# SC2000

high performance networking and computing

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## COME TO BIG D AND VOTE NOTE

Texas is becoming another high technology industry base. Dallas is the home of a great number of high performance networking and computing businesses and research centers. Dallas has over 6,000 restaurants; fajitas and frozen margaritas were popularized here. Dallas has more stores per capita than any other U.S. city, over 200 golf courses, and a multitude of public attractions.

SC2000 takes place during the first Tuesday of November 2000, which is national election day in the US. Don't forget to vote by early or absentee ballot.

### Dallas info:

[www.dallascvb.com](http://www.dallascvb.com)

[www.dallascc.com](http://www.dallascc.com)

[www.yourdallas.com](http://www.yourdallas.com)

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