

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53

Proceedings

Frontiers '96

The Sixth Symposium on the
Frontiers of Massively Parallel Computing

October 27–31, 1996
Annapolis, Maryland

Sponsored by

IEEE Computer Society

In cooperation with

NASA Goddard Space Flight Center
USRA/CESDIS



IEEE Computer Society Press
Los Alamitos, California

Washington • Brussels • Tokyo



1
2 IEEE Computer Society Press
3 10662 Los Vaqueros Circle
4 P.O.Box 3014
5 Los Alamitos, CA 90720-1264
6
7
8
9

10 Copyright © 1996 by The Institute of Electrical and Electronics Engineers, Inc.
11 All rights reserved.
12
13
14

15 *Copyright and Reprint Permissions:* Abstracting is permitted with credit to the source. Libraries may
16 photocopy beyond the limits of US copyright law, for private use of patrons, those articles in this volume
17 that carry a code at the bottom of the first page, provided that the per-copy fee indicated in the code is paid
18 through the Copyright Clearance Center, 222 Rosewood Drive, Danvers, MA 01923.
19
20 Other copying, reprint, or republication requests should be addressed to: IEEE Copyrights Manager, IEEE
21 Service Center, 445 Hoes Lane, P.O. Box 1331, Piscataway, NJ 08855-1331.
22
23 *The papers in this book comprise the proceedings of the meeting mentioned on the cover and title page. They*
24 *reflect the authors' opinions and, in the interests of timely dissemination, are published as presented and*
25 *without change. Their inclusion in this publication does not necessarily constitute endorsement by the*
26 *editors, the IEEE Computer Society Press, or the Institute of Electrical and Electronics Engineers, Inc.*
27
28
29

30 IEEE Computer Society Press Order Number PR07551
31 IEEE Order Plan Catalog Number 96TB100062
32 ISBN 0-8186-7551-9
33 Microfiche ISBN 0-8186-7553-5
34 ISSN 1088-4955
35
36

37 *Additional copies may be ordered from:*

38 IEEE Computer Society Press IEEE Service Center IEEE Computer Society IEEE Computer Society
39 Customer Service Center 445 Hoes Lane 13, Avenue de l'Aquilon Ooshima Building
40 10662 Los Vaqueros Circle P.O. Box 1331 B-1200 Brussels 2-19-1 Minami-Aoyama
41 P.O. Box 3014 Piscataway, NJ 08855-1331 BELGIUM Minato-ku, Tokyo 107
42 Los Alamitos, CA 90720-1314 Tel: +1-908-981-1393 Tel: +32-2-770-2198 JAPAN
43 Tel: +1-714-821-8380 Fax: +1-908-981-9667 Fax: +32-2-770-8505 Tel: +81-3-3408-3118
44 Fax: +1-714-821-4641 misc.custserv@computer.org euro.ofc@computr.org Fax: +81-3-3408-3553
45 Email: cs.books@computer.org tokyo.ofc@computer.org
46
47
48
49
50
51
52
53

54 Editorial production by Penny Storms
55 Cover by Kerry Bedford and Alex Torres
56 Printed in the United States of America by KNI, Inc.



57 The Institute of Electrical and Electronics Engineers, Inc.

Contents

Message from the General Chair.....	ix
Message from the Program Chair	x
Conference Committee	xi
Referees.....	xiii
Session 1: Invited Speaker	
From ASCI to Teraflops	
<i>John Hopson, Accelerated Strategic Computing Initiative (ASCI)</i>	
Session 2A: Scheduling 1	
Gang Scheduling for Highly Efficient Distributed Multiprocessor Systems	4
<i>H. Franke, P. Pattnaik, and L. Rudolph</i>	
Integrating Polling, Interrupts, and Thread Management.....	13
<i>K. Langendoen, J. Romein, R. Bhoedjang, and H. Bal</i>	
A Practical Processor Design for Multithreading	23
<i>M. Amamiya, T. Kawano, H. Tomiyasu, and S. Kusakabe</i>	
Session 2B: Routing	
Analysis of Deadlock-Free Path-Based Wormhole Multicasting in Meshes in Case of Contentions	34
<i>E. Fleury and P. Fraigniaud</i>	
Efficient Multicast in Wormhole-Routed 2D Mesh/Torus Multicomputers: A Network-Partitioning Approach.....	42
<i>S-Y. Wang, Y-C. Tseng, and C-W. Ho</i>	
Turn Grouping for Efficient Multicast in Wormhole Mesh Networks	50
<i>K-P. Fan and C-T. King</i>	
Session 3A: Applications and Algorithms	
A ³ : A Simple and Asymptotically Accurate Model for Parallel Computation.....	60
<i>A. Grama, V. Kumar, S. Ranka, and V. Singh</i>	
Fault Tolerant Matrix Operations Using Checksum and Reverse Computation.....	70
<i>Y. Kim, J.S. Plank, and J.J. Dongarra</i>	
A Statistically-Based Multi-Algorithmic Approach for Load-Balancing Sparse Matrix Computations.....	78
<i>S. Nastea, T. El-Ghazawi, and O. Frieder</i>	
Session 3B: Petaflops Computing / Point Design Studies	
Pursuing a Petaflop: Point Designs for 100 TF Computers Using PIM Technologies	88
<i>P.M. Kogge, S.C. Bass, J.B. Brockman, D.Z. Chen, and E. Sha</i>	
Hybrid Technology Multithreaded Architecture	98
<i>G. Gao, K.K. Likharev, P.C. Messina, and T.L. Sterling</i>	
The Illinois Aggressive Coma Multiprocessor Project (I-ACOMA).....	106
<i>J. Torrellas and D. Padua</i>	

1
2 **Panel Session—How Do We Break the Barrier to the Software Frontier?**
3 *Panel Chair: Rick Stevens, Argonne National Laboratory*

5 **Session 4: Invited Speaker**

7 **Session 5A: Scheduling 2**

Largest-Job-First-Scan-All Scheduling Policy for 2D Mesh-Connected Systems.....	118
<i>S.-M. Yoo and H.Y. Youn</i>	
Scheduling for Large-Scale Parallel Video Servers.....	126
<i>M.-Y. Wu and W. Shu</i>	
Effect of Variation in Compile Time Costs on Scheduling Tasks on Distributed Memory Systems	134
<i>S. Darbha and S. Pande</i>	

16 **Session 5B: SIMD**

Processor Autonomy and Its Effect on Parallel Program Execution.....	144
<i>D.M. Hawver and G.B. Adams III</i>	
Particle-Mesh Techniques on the MasPar	154
<i>P. MacNeice, C. Mobarry, and K. Olson</i>	
MIMD Programs on SIMD Architectures	162
<i>M.-Y. Wu and W. Shu</i>	

24 **Session 6A: I/O Techniques**

Intelligent, Adaptive File System Policy Selection.....	172
<i>T.M. Madhyastha and D.A. Reed</i>	
An Abstract-Device Interface for Implementing Portable Parallel-I/O Interfaces.....	180
<i>R. Thakur, W. Gropp, and E. Lusk</i>	
PMPIO - A Portable Implementation of MPI-IO	188
<i>S.A. Fineberg, P. Wong, B. Nitzberg, and C. Kuszmaul</i>	
Disk Resident Arrays: An Array-Oriented I/O Library for Out-Of-Core Computations	196
<i>J. Nieplocha and I. Foster</i>	

36 **Session 6B: Memory Management**

Hardware-Controlled Prefetching in Directory-Based Cache Coherent Systems	206
<i>W. Hu and P. Xia</i>	
Preliminary Insights on Shared Memory PIC Code Performance on the Convex Exemplar SPP1000.....	214
<i>P. MacNeice, C.M. Mobarry, J. Crawford, and T.L. Sterling</i>	
Scalability of Dynamic Storage Allocation Algorithms	223
<i>A. Iyengar</i>	
An Interprocedural Framework for Determining Efficient Data Redistributions in Distributed Memory Machines	233
<i>S.K.S. Gupta and S. Krishnamurthy</i>	

1	Panel Session—Petaflops Alternative Paths	
2	<i>Panel Chair: Paul Messina, California Institute of Technology</i>	
3	 	
4	Session 7: Invited Speaker	
5	Independence Day	
6	<i>Steven Wallach, HP-Convex</i>	
7	 	
8	Session 8A: Synchronization	
9	A Fair Fast Distributed Concurrent-Reader Exclusive-Writer Synchronization.....	246
10	<i>T.J. Johnson and H. Yoon</i>	
11	Lock Improvement Technique for Release Consistency in Distributed	
12	Shared Memory Systems.....	255
13	<i>S.S. Fu and N.F. Tzeng</i>	
14	A Quasi-Barrier Technique to Improve Performance of an Irregular Application	263
15	<i>H.V. Shah and J.A.B. Fortes</i>	
16	 	
17	Session 8B: Networks	
18	Performance Analysis and Fault Tolerance of Randomized Routing on	
19	Clos Networks	272
20	<i>M. Bhatia and A. Youssef</i>	
21	Performing BMMC Permutations in Two Passes through the Expanded	
22	Delta Network and MasPar MP-2	282
23	<i>L.F. Wisniewski, T.H. Cormen, and T. Sundquist</i>	
24	Macro-Star Networks: Efficient Low-Degree Alternatives to Star Graphs	
25	for Large-Scale Parallel Architectures	290
26	<i>C-H. Yeh and E. Varvarigos</i>	
27	 	
28	Session 9A: Performance Analysis	
29	Modeling and Identifying Bottlenecks in EOSDIS.....	300
30	<i>J. Demmel, M.Y. Ivory, and S.L. Smith</i>	
31	Tools-Supported HPF and MPI Parallelization of the NAS Parallel Benchmarks	309
32	<i>C. Clémenton, K.M. Decker, V.R. Deshpande, A. Endo,</i>	
33	<i>J. Fritscher, P.A.R. Lorenzo, N. Masuda, A. Müller,</i>	
34	<i>R. Rühl, W. Sawyer, B.J.N. Wylie, and F. Zimmerman</i>	
35	A Comparison of Workload Traces from Two Production Parallel Machines	319
36	<i>K. Windisch, V. Lo, D. Feitelson, R. Moore, and B. Nitzberg</i>	
37	Morphological Image Processing on Three Parallel Machines	327
38	<i>M.D. Theys, R.M. Born, M.D. Allemang, and H.J. Siegel</i>	
39	 	
40	Session 9B: Petaflops Computing / Point Design Studies	
41	MORPH: A System Architecture for Robust High Performance Using	
42	Customization (An NSF 100 TeraOps Point Design Study)	336
43	<i>A.A. Chien and R.K. Gupta</i>	
44	Architecture, Algorithms and Applications for Future Generation	
45	Supercomputers	346
46	<i>V. Kumar, A. Sameh, A. Grama, and G. Karypis</i>	
47	 	

Explore Litigation Insights



Docket Alarm provides insights to develop a more informed litigation strategy and the peace of mind of knowing you're on top of things.

Real-Time Litigation Alerts



Keep your litigation team up-to-date with **real-time alerts** and advanced team management tools built for the enterprise, all while greatly reducing PACER spend.

Our comprehensive service means we can handle Federal, State, and Administrative courts across the country.

Advanced Docket Research



With over 230 million records, Docket Alarm's cloud-native docket research platform finds what other services can't. Coverage includes Federal, State, plus PTAB, TTAB, ITC and NLRB decisions, all in one place.

Identify arguments that have been successful in the past with full text, pinpoint searching. Link to case law cited within any court document via Fastcase.

Analytics At Your Fingertips



Learn what happened the last time a particular judge, opposing counsel or company faced cases similar to yours.

Advanced out-of-the-box PTAB and TTAB analytics are always at your fingertips.

API

Docket Alarm offers a powerful API (application programming interface) to developers that want to integrate case filings into their apps.

LAW FIRMS

Build custom dashboards for your attorneys and clients with live data direct from the court.

Automate many repetitive legal tasks like conflict checks, document management, and marketing.

FINANCIAL INSTITUTIONS

Litigation and bankruptcy checks for companies and debtors.

E-DISCOVERY AND LEGAL VENDORS

Sync your system to PACER to automate legal marketing.