

Wolfgang Gentzsch Uwe Harms (Eds.)

High-Performance Computing and Networking

International Conference and Exhibition
Munich, Germany, April 18-20, 1994
Proceedings
Volume II: Networking and Tools

Springer-Verlag

Berlin Heidelberg New York
London Paris Tokyo
Hong Kong Barcelona
Budapest



Series Editors

Gerhard Goos
Universität Karlsruhe
Postfach 69 80
Vincenz-Priessnitz-Straße 1
D-76131 Karlsruhe, Germany

Juris Hartmanis
Cornell University
Department of Computer Science
4130 Upson Hall
Ithaca, NY 14853, USA

Volume Editors

Wolfgang Gentzsch
FH Regensburg and GENIAS Software GmbH
Erzgebirgstraße 2, D-93073 Neutraubling, Germany

Uwe Harms
Harms Supercomputing Consulting
Bunsenstraße 5, D-81735 München, Germany

CR Subject Classification (1991): C.2-4, D, F.2, G.1, H.2, J.1-2, J.6, K.6

ISBN 3-540-57981-8 Springer-Verlag Berlin Heidelberg New York
ISBN 0-387-57981-8 Springer-Verlag New York Berlin Heidelberg

This work is subject to copyright. All rights are reserved, whether the whole or part of the material is concerned, specifically the rights of translation, reprinting, re-use of illustrations, recitation, broadcasting, reproduction on microfilms or in any other way, and storage in data banks. Duplication of this publication or parts thereof is permitted only under the provisions of the German Copyright Law of September 9, 1965, in its current version, and permission for use must always be obtained from Springer-Verlag. Violations are liable for prosecution under the German Copyright Law.

© Springer-Verlag Berlin Heidelberg 1994
Printed in Germany

Typesetting: Camera-ready by author
SPIN: 10131015 45/3140-543210 - Printed on acid-free paper

Preface

High-Performance Computing and Networking (HPCN) is driven by several initiatives in Europe, the United States, and Japan. In Europe several groups, the Rubbia Advisory Committee, the European Industry Initiative, the Teraflops Initiative, and others encouraged the Commission of the European Communities (CEC) to start an HPCN programme. They recognized the economic, scientific, and social importance of the HPCN technology for Europe.

Members of these groups started the first HPCN conference last year in Amsterdam. The other player in this field was Supercomputing Europe, an annual exhibition and conference, that was founded by Royal Dutch Fairs in 1989.

Due to the personal engagement of Bob Hertzberger, University Amsterdam, Dorte Olesen, University Copenhagen, Peter Linnenbank, Royal Dutch Fairs, and others, we succeeded in combining important European HPCN activities to organize the HPCN Europe 1994 in Munich.

The HPCN Foundation is responsible for the Conference and the Technology Demonstrators Display. The Exhibition and the Vendors Session is organized by Royal Dutch Fairs. The Organizing Committee's intention is that HPCN Europe becomes a sister of the well-known American supercomputer events.

This new start inspired many HPCN experts in Europe. More than 60 specialists decided to take an active role in the Advisory Board and in the Programme Committee, to look for interesting contributions in this field. They enthusiastically broadened the base for HPCN in Europe.

As a result of this activity, more than 220 contributions from all over the world have been submitted, and the Programme Committee selected 140 papers and 40 posters. Over 20 well-known experts from Europe and the United States have agreed to present an invited lecture, demonstrating the advantages of using high-performance computers in their industrial and research application fields, including the keynote speakers, Horst Forster, CEC, Geoffrey Fox, NPAC, and David Williams, CERN.

Many different application areas, such as engineering, environmental sciences, material sciences, computational chemistry, electrical CAD, high-energy physics, astrophysics, neural networks and parallel databases are covered in the conference. In the context of real applications, subjects like languages, programming environments, algorithms, compilers, data parallel structures, monitoring, debugging, and benchmarking of parallel systems are discussed as well.

This event would not have been possible without the broad and personal support and the invaluable suggestions and contributions of the members of the Programme Committee and the Advisory Board. In addition, we would like to thank the referees in the Programme Committee, who spared no effort in evaluating so many papers, in a very short time over Christmas.

Many thanks to our sponsors, the CEC and the Royal Dutch Fairs, for their financial support of HPCN Europe 1994; without this support it would have been impossible to start such a considerable initiative. Also, we highly appreciate the personal efforts of Monika Grobecker and Anschi Kögler, who managed the conference secretariat and prepared these proceedings, and Hans-Georg Paap, who decoded and uncompressed nearly 100 Mbytes of papers. Finally, we are pleased to thank the staff from Springer-Verlag for publishing these proceedings just in time.

March 1994

On behalf of the Advisory Board
and the Programme Committee
Wolfgang Gentzsch and Uwe Harms

Committees

Organizing Committee

Chairman: Wolfgang Gentzsch
Co-Chair: Bob Hertzberger
Co-Chair: Dorte Olesen
Local Organizer: Uwe Harms
Demo-Display: Ad Emmen
Exhibition: Peter Linnenbank

FH Regensburg
University Amsterdam
University Copenhagen
Munich
SARA Amsterdam
Royal Dutch Fairs Utrecht

Programme Committee

A. Bachem
T. Bemmerl
A. Bode
H. Burkhardt
E. Clementi
I. Duff
A. Emmen
W. Gentzsch
U. Harms
J. Häuser
B. Hertzberger
A. Hey
G. Hoffmann
F. Hoßfeld
S. Jähnichen
W. Jalby
E. Krause
C. Lazou
G. Meurant
J. Murphy
D. Olesen
R. Perrott
A. Reuter
D. Roose
U. Trottenberg
C. Upstill
A. van der Steen
H. van der Vorst
J. Volkert
E. Zapata

University of Cologne
RWTH Aachen
Technical University of Munich
University of Basel
University of Strasbourg and CRS4
RAL-CERC Chilton and CERFACS
SARA, European Watch
FH Regensburg
Supercomputing Consulting Munich
FH Braunschweig
University of Amsterdam
University of Southampton
ECMWF Reading
KFA Jülich Research Center
GMD FIRST Berlin
University of Versailles
RWTH Aachen
HiPerCom-Consultants London
CEA Villeneuve-St-Georges
British Aerospace Bristol
University of Copenhagen
University of Belfast
University of Stuttgart
KU Leuven
GMD St. Augustin
PAC Southampton
ACCU Utrecht
University of Utrecht
University of Linz
University of Malaga

Advisory Board

R. Asbury
 F. Baetke
 H. Berendsen
 M. Boasson
 I. Carmichael
 M. Carpentier
 M. Cosnard
 P. Cros
 J. Dongarra
 D. Duval
 D. Evans
 H. Forster
 R. Geisen
 L. Grandinetti
 J. Hollenberg
 J. Kreatsoulas
 P. Lecca
 R. Levy
 B. Madahar
 R. Mendez
 B. Monien
 Y. Muraoka
 H. Nedderhoff
 J. Omnes
 J. Periaux
 G. Polosa
 M. Reeve
 D. Schneider
 H. Simon
 H. Soboll
 B. Spalding
 A. Spencer
 S. Stoichev
 U. Thiel
 P. Walker
 P. Zanella
 E. Znaty

Intel Europe
 Convex Europe
 University of Groningen
 HSA Hengelo
 Shell International
 CEC Brussels
 Ecole Normale Supérieure de Lyon
 CERFACS Toulouse
 University of Tennessee and ORNL
 Telmat Informatique France
 Loughborough University
 CEC Brussels
 Parsytec Aachen
 University of Calabria
 SARA, European Watch
 Digital Equipment Bruxelles
 ONERA Chatillon
 CRAY Research Europe
 GEC-Marconi HRC
 ISR Tokyo
 University of Paderborn
 Waseda University Tokyo
 AEG Konstanz
 CEC Brussels
 Dassault Aviation
 RCI Europe
 CEC Brussels
 University of Illinois
 NASA Ames Research Center
 Daimler Benz AG
 CHAM London
 Meiko
 TU Sofia
 IBM Scientific Center Heidelberg
 parallelogram London
 CRS4 Cagliari
 Bertin France

Contents

13. Networking

High-Performance Computing and Networking for Numerical Weather Prediction (Invited Paper) <i>G.-R. Hoffmann, ECMWF, Reading</i>	1
High-Performance Computing and Networking as Base Element of the Environmental Information System UIS of Baden-Württemberg (Invited Paper) <i>F. Schmidt, IKE, Stuttgart</i>	5
High Speed Networking for the Research Community in Europe (Invited Paper) <i>K. Ullmann, DFN, Berlin</i>	13
The National Information Infrastructure Testbed (NIIT) <i>M. McKeown</i>	18
Parallel Knowledge Processing in Open Networks <i>P.M. Borst, H.-T. Goetz, P.S. Sapaty, W. Zorn</i>	24
Distributed File Caching in Parallel Architectures Utilizing High Speed Networks <i>A. Klauser, R. Posch</i>	30
Application Fundamentals of Distributed, High-Performance Computing and Networking Systems <i>H. Westphal, D. Popovic</i>	36
Massive Parallelism with Workstation Clusters - Challenge or Nonsense? <i>C.H. Cap</i>	42

14. Future European Cooperative Working Possibilities in Industry and Research, as Demonstrated by the RACE Project PAGEIN

Networking Perspectives for Collaborative Supercomputing in European Aerospace Research and Industry <i>J.P. Peltier, P. Christ</i>	53
Future Aerospace Working Scenarios Using High Speed Networks and Supercomputers Applied to Flow Simulation for Complete Aircraft <i>S. Rill, R. Grosso</i>	60
A Software Environment for Cooperative Simulation and Visualization in the Aerospace Field <i>U. Lang</i>	70
Implementation of Visualization Tools in a Distributed Environment <i>S. Causse, F. Juaneda, M. Grave</i>	77

Networking Issues in PAGEIN: The "N" of "HPCN" <i>P. Haas, P. Christ</i>	86
Wavelet Interactive In-Line Analysis with Pégase <i>F.X. Roux, J. Ryan, B. Troff, T.H. Lê, K. Dang-Tran</i>	94

15. HPCN Computer Centers Aspects

European HPC Competitiveness Centers for Industry (Invited Paper) <i>A. Scheidegger, CSCS Switzerland</i>	103
An Open High-Performance Computing Infrastructure in Industry <i>R. Iffert, U. Harms</i>	109
A Catalog of Classifying Characteristics for Massively Parallel Computers <i>T. Bönniger, R. Esser, D. Krekel</i>	114
Building a Parallel Computing Environment from Heterogeneous Resources <i>K. Koski</i>	120
A Distributed Computing Center Software for the Efficient Use of Parallel Computer Systems <i>F. Ramme, T. Römke, K. Kremer</i>	129
InfoMall: A Scalable Organisation for the Development of High-Performance Computing and Communications – Software and Systems <i>G.C. Fox, E. Bogucz, D.A. Jones, K. Mills, M. Podgorny, K.A. Hawick</i>	137
Cluster Management Software for Open Object-Oriented Systems <i>A. Uszok, A. Król, K. Zielinski</i>	140

16. Performance Evaluation and Benchmarking

Transmission Rates and Performance of a Network of Computers <i>K. Boryczko, M. Bubak, M. Gajecski, J. Kitowski, J. Moscinski, M. Pogoda</i>	142
Measurement of Communication Rates on the Cray T3D Interprocessor Network <i>R.W. Numrich, P.L. Springer, J.C. Peterson</i>	150
A Evaluation of the Meiko CS-2 Using the GENESIS Benchmark Suite <i>M. Baker, R. Cloke</i>	158
A Very High-Performance Algorithm for NAS EP Benchmark <i>R.C. Agarwal, F.G. Gustavson, M. Zubair</i>	164
Evaluation of Parallel Operating Systems <i>C. Lazou, G.R. Nudd</i>	170
JNNIE: Evaluation of Scalable Parallel Processing Architectures <i>S. Hotovy, T. Sterling</i>	172

17. Numerical Algorithms for Engineering

Recent Developments in Hybrid CG Methods (Invited Paper) <i>H.A. van der Vorst, Utrecht</i>	174
The Preconditioned Conjugate Gradient Method on Distributed Memory Systems <i>L.G.C. Crone</i>	184
Communication Cost Reduction for Krylov Methods on Parallel Computers <i>E. de Sturler, H.A. van der Vorst</i>	190
Parallel Arnoldi Method for the Construction of a Krylov Subspace Basis: an Application in Magnetohydrodynamics <i>J.G.L. Booten, P.M. Meijer, H.J.J. te Riele, H.A. van der Vorst</i>	196
A Scalable Paradigm for Effectively-Dense Matrix Formulated Applications <i>G. Cheng, G.C. Fox, K.A. Hawick</i>	202
Automatic Differentiation on Distributed Memory MIMD Systems <i>L. De Luca, P. Fiorino</i>	211
Optimisations for the Memory Hierarchy of a Singular Value Decomposition Algorithm Implemented on the MIMD Architecture <i>A. Czezowski, P. Strazdins</i>	215
Parallelization and Data Locality of a Multigrid Solver on the KSR1 <i>Ulrich Schwardmann</i>	217
On the Parallel Evaluations of Recurrences <i>A. Kiper</i>	219

18. Domain Decomposition in Engineering

Implementation of a Parallel Euler Solver with GRIDS <i>U. Geuder, M. Härdtnr, B. Wörner, R. Zink</i>	221
Distributed Mapping of SPMD Programs with a Generalized Kernighan-Lin Heuristic <i>J. de Keyser, D. Roose</i>	227
Mesh Decomposition and Communication Procedures for Finite Element Applications on the Connection Machine CM-5 System <i>Z. Johan, K.K. Mathur, S.L. Johnsson, T.J.R. Hughes</i>	233
CAPTtools - Semiautomatic Parallelization of Mesh-Based Computational Mechanics Codes <i>M. Cross, C.S. Ierotheou, S.P. Johnson, P.F. Leggett</i>	241

19. Parallel Programming Environments

The MPI Standard for Message Passing (Invited Paper) <i>R. Hempel, GMD, St. Augustin</i>	247
A Comparison of the Iserver-Occam, Parix, Express, and PVM Programming Environments on a Parsytec GCel <i>P.M.A. Sloot, A.G. Hoekstra, L.O. Hertzberger</i>	253
Message-Passing-Systems on Workstation Clusters and Parallel Computers - The Impact of Software- and Network-Architectures on Applications <i>M. Resch, A. Geiger, J. Zikeli</i>	260
EASYPVM - An Enhanced Subroutine Library for PVM <i>S. Saarinen</i>	267
DynamicPVM – Dynamic Load Balancing on Parallel Systems <i>L. Dikken, F. van der Linden, J. Vasseur, P.M.A. Sloot</i>	273
A Large-Scale Metacomputer Approach for Distributed Parallel Computing <i>V. Strumpen</i>	278
Developing Applications for Multicomputer Systems on Workstation Clusters <i>G. Stellner, A. Bode, S. Lamberts, Th. Ludwig</i>	286
System Support for Distributed Computing <i>S. Maffei</i>	293
Assembly Environment for Development of Application Parallel Program <i>V.E. Malyszhkin</i>	302
MaX - Investigating Shared Virtual Memory <i>R.G. Hackenberg</i>	308
Experiences with the Mether-NFS Virtual Shared Memory System <i>J.-Th. Pfenning</i>	316
Adapting PICL and ParaGraph Tools to Transputer-Based Multicomputers <i>V. Blanco, F.F. Rivera, O. Plata</i>	324
SCIDDLE: A Tool for Large Scale Cooperative Computing <i>P. Arbenz, H.P. Lüthi, Ch. Sprenger, S. Vogel</i>	326
TRAPPER: A Graphical Programming Environment for Parallel Systems <i>L. Schäfers, C. Scheidler, O. Krämer-Fuhrmann</i>	328

20. Load Balancing and Performance Optimization

Load Leveling on the Paragon Multicomputer <i>S. Tritscher, R. Zajcew, M. Barnett</i>	330
A Data-Parallel View of the Load Balancing – Experimental Results on MasPar MP-1 <i>C. Fonlupt, P. Marquet, J.-L. Dekeyser</i>	338

Distributed Scheduling for Multicomputers <i>L. Philippe, G.-R. Perrin</i>	344
A Tool for Optimizing Programs on Massively Parallel Computer Architectures <i>O. Hansen</i>	350
A Case Study in the Parallel Implementation of Functional Languages Using Skeletons <i>J. Schwarz, F.A. Rabhi</i>	357
A Dynamic Task Allocation Scheme in Benes-Type Nonblocking Networks <i>T. Feng, Y. Kim</i>	363
A Methodology for Dimensioning SPMD Distributed Systems Applied to Industrial Applications <i>A. Pinti, J.-C. Grossetie</i>	365
 21. Monitoring, Debugging, and Fault Tolerance	
Do-Loop-Surface: An Abstract Performance Data Visualization <i>O. Naïm, A.J.G. Hey</i>	367
A Graphic Distributed Monitoring System for Unix-Based Architectures <i>G. De Pietro, A. Esposito, G. Reitano</i>	373
Parallel Application Design: The Simulation Approach with HASTE <i>P. Pouzet, J. Paris, V. Jorrand</i>	379
On-line Distributed Debugging on Scaleable Multicomputer Architectures <i>T. Bemmerl, R. Wismüller</i>	394
The FTMPs-Project: Design and Implementation of Fault-Tolerance Techniques for Massively Parallel Systems <i>J. Vounckx, G. Deconinck, R. Lauwereins, G. Viehöver, R. Wagner, H. Madeira, J.G. Silva, F. Balbach, J. Altmann, B. Bieker, H. Willeke</i>	401
 22. Programming Languages in HPC	
High-Performance Fortran Languages: Advanced Applications and Their Implementation (Invited Paper) <i>B. Chapman, H. Zima, Vienna, P. Mehrotra, Hampton</i>	407
Evaluation of High-Performance Fortran on Some Real Applications <i>T. Brandes</i>	417
Experiments with HPF Compilation for a Network of Workstations <i>F. Coelho</i>	423
High-Performance Fortran <i>G.M. van Waveren</i>	429

Value-Based Distributions in Fortran D <i>R. v. Hanxleden, K. Kennedy, J. Saltz</i>	434
Basic Linear Operators in Fortran 90 <i>R. Hanson, T. Leite</i>	441
parLisp - Parallel Symbolic Processing with Lisp on the Distributed Memory Machine MANNA <i>A. Sodan, H. Bi</i>	445
 23. Compilers and Data Parallel Structures	
Parallelizing Compilers: What Can Be Achieved? (Invited Paper) <i>M. Dion, Y. Robert, Ecole Nat. Lyon, J.-L. Philippe, Société Archipel</i>	447
A Family of Data-Parallel Derivations <i>M. Clint, S. Fitzpatrick, T.J. Harmer, P.L. Kilpatrick, J.M. Boyle</i>	457
Automatic Data Distribution <i>P. Crooks, R.H. Perrott</i>	463
Some Synthesis Aspects for Data Parallel Programming <i>G.-R. Perrin</i>	469
Influence of Fortran 90 Features on Performance on Cray Vector Computer Systems <i>U. Küster, M. Zürn</i>	475
Mapping of Patterns - The Way of Insight into Multi-Dimensional Data Structures <i>W.Dzwiniel</i>	484
 24. Architectural Aspects	
The Instruction Systolic Array - Implementation of a Low-Cost Parallel Architecture as Add-On Board for Personal Computers <i>M. Schimmeler, H.-W. Lang, R. Maaß</i>	487
The BBN Butterfly Family: An Overview <i>J.S. Alherbish</i>	489
Architectural Principles of the RPM <i>Y.A. Mamatov, V.P. Yemelin</i>	491
 25. Late Papers	
Applications Performance on Intel Paragon XP/S-15 <i>S. Saini, H.D. Simon</i>	493
Status Report on ESPRIT Project P7519 Palace: Parallelization of GEANT <i>C. Casari, C. Catelli, M. Guanziroli, M. Mazzeo, G. Meola, S. Punzi, A.L. Scheinine, P. Stofella</i>	499

A Practical Experience in Parallelizing a Large CFD Code: The ENSOLV Flow Solver <i>M. Amato, A. Matrone, P. Schiano</i>	508
Author Index	515

Contents of Volume I

1. Keynote Talks

- Information Processing and Opportunities for HPCN Use in Industry 1
G.C. Fox, K. Mills, NPAC, Syracuse
- Information Superhighways – Does Europe Need Them, Can Europe Build Them? 15
D.O. Williams, Head of Computing and Networking Division at CERN, Geneva

2. HPCN and Visualization in Industry

- Simulation of Metal Forming Processes with Respect to MPP-Systems 21
(Invited Paper)
M. Hillmann, J. Weiher, INPRO, Berlin
- High Image Quality Rendering on Scalable Parallel Systems (Invited Paper) 31
R. Herken, Mental Images, Berlin
- Parallel Processing in High Integrity Aircraft Engine Control 32
S.H. Duncan, P.L. Gordon, E.J. Zaluska, S.I. Edwards
- An Embedded Solution Using High-Performance Computing for Cost Effective 40
On-Line Real-Time Monitoring of Industrial Processes
*G. D. García, F. Suarez, M. García, E. Lasso, R. Guzman, T. Carden,
D. Watson, C. McGregor, F. Obeso, M. Tarrio, G. Rota, F. Cocola, F. Degli*
- EUROPORT - Esprit European Porting Projects 46
A. Colbrook, M. Lemke, H. Mierendorff, K. Stüben, C.-A. Thole, O. Thomas

3. Algorithms for Engineering Applications

- Communication Requirements in Parallel Crashworthiness Simulation 55
G. Lonsdale, J. Clinckemallie, S. Vlachoutsis, J. Dubois
- PAFEC-FE - A Commercial Parallel Finite Element Package 62
I. Boston, M. Surridge, C. Upstill
- Solving Large-Scale Nonnormal Eigenproblems in the Aeronautical Industry 72
Using Parallel BLAS
M. Bennani, T. Braconnier, J.C. Dunyach
- Supercomputing on a Workstation Cluster: A Parallelized Lattice-Gas Solver 78
for Transient Navier-Stokes-Flow
M. Krafczyk, E. Rank
- Parallel Techniques for Large-Scale Nonlinear Network Optimization 84
L. Grandinetti, F. Guerriero, R. Musmanno

Experiences Concerning the Parallelization of the Finite Element Code SMART <i>A. Watermann, J. Altes</i>	92
 4. Electrical Computer Aided Engineering	
Electrosmog and Electromagnetic CAD (Invited Paper) <i>W. Daehn, SICAN, Hannover</i>	94
Three-Dimensional Simulation of Semiconductor Devices <i>W. Klix, R. Dittmann, R. Stenzel</i>	99
A Distributed Automatic Test Pattern Generation System <i>P.A. Krauss</i>	105
Distributed Logic Simulation – A Test Environment for the Evaluation of Different Approaches <i>P. Luksch</i>	111
Modelling Hierarchy as Guideline for Parallel Simulation <i>A. Hunger, F. Müller</i>	117
 5. Computational Fluid Dynamics	
Large Implicit Finite Element Simulations of Time-Dependent Incompressible Flows on Scalable Parallel Systems <i>H. Daniels, A. Peters, O. Bergen, C. Forkel</i>	119
Parallel Simulation of Reacting Flows Using Detailed Chemistry <i>D.Thévenin, F. Behrendt, U. Maas, J. Warnatz</i>	125
Unstructured Computational Fluid Dynamics on Massively-Parallel SIMD-Systems <i>S. Haberhauer</i>	131
An Advanced Parallel Multiblock Code for the Solution of 2D Flow-Fields <i>C. de Nicola, G. De Pietro, M. Giuliani</i>	139
Parallel Multigrid Results for Euler Equations and Grid Partitioning into a Large Number of Blocks <i>C.W. Oosterlee, H. Ritzdorf, A. Schüller, B. Steckel</i>	145
Parallel Distributed Implementations of 2D Explicit Euler Solvers <i>L. Giraud, G.M. Manzini</i>	151
A Parallel Multiblock Euler/Navier-Stokes Solver on a Cluster of Workstations Using PVM <i>E. Issman, G. Degrez, J. de Keyser</i>	157
Parallelization of a 3D Multi-Block Navier-Stokes Flow Solver on a Distributed Memory MIMD Machine <i>G. van Beek, J.P. Geschiere, A.R. Sukul</i>	163

Porting of a Three-Dimensional Navier-Stokes Solver to a Range of Parallel Computers and a Network of Workstations <i>I. d'Ast</i>	171
Lattice Gas Automata and Molecular Dynamics on a Network of Computers <i>K. Boryczko, M. Bubak, J. Kitowski, J. Moscinski, R. Slota</i>	177
Parallel Scalar Optimized Direct Simulation Monte Carlo Method for Rarefied Flows on the SP-1 <i>S. Dietrich, I. Boyd</i>	181
 6. Computational Chemistry	
Modern Quantum Mechanical Techniques and Computations on the Electronic Structure of Polymers (Invited Paper) <i>J.M. André, B. Champagne, J. Delhalle, J.G. Fripiat, D.H. Mosley, Namur</i>	183
Object-Oriented Simulation Software for Drug Design <i>R. Bywater, W. Joosen, S. Bijmens, P. Verbaeten, T. Larsen, J. Perram</i>	189
Mapping Strategies of Sequential Sequence Comparison Algorithms on LAN-Based Message Passing Architectures <i>O. Trelles-Salazar, E.L. Zapata, J.-M. Carazo</i>	197
Parallel Computing in Quantum Chemistry - Message Passing and Beyond for a General Ab Initio Program System <i>H. Lischka, H. Dachsel, R. Shepard, R.J. Harrison</i>	203
Solving Dynamic and Quantum Chemical Problems with the Help of Concurrent Processors <i>P. Bleckmann, F.H. Walter</i>	210
Intelligent Software: The OpenMol Program <i>G.H.F. Diercksen</i>	219
Parallel Molecular Dynamics Simulation of Commercial Surfactants <i>E. O'Toole, M. Surridge, C. Upstill</i>	223
Computer Simulations of Molecular Collision Processes <i>J. Schulte, G. Seifert</i>	226
Parallel Processing for Generating Large Molecular Databases <i>H. Braun, M. Assfalg, K. Weymann, T. Harvey</i>	232
Applications of Parallel Constraint Logic Programming to Molecular Biology and Genetics <i>D.A. Clark, Ch. Rawlings, J. Shirazi</i>	236
Simulating Biological Evolution on a Parallel Computer <i>U. Tangen, H. Weberpals</i>	238

7. Material Sciences

Supercomputing in Polymere Research (Invited Paper) <i>K. Kremer, KFA Jülich</i>	244
Parallel Finite Element Algorithms Applied to Polymer Flow <i>R. Keunings, R. Aggarwal, P. Henriksen, D. Vanderstraeten, O. Zone</i>	254
Performance of a Molecular-Dynamics Algorithm on Connection Machines CM-200 and CM-5 <i>O.H. Nielsen</i>	261
Parallel Molecular Dynamics Simulations of Liquid and Amorphous Metals <i>U.K. Rößler, H. Teichler</i>	267
Computational Materials Science from First Principles <i>D. Hohl</i>	274
Automatic Parallelization of a Crystal Growth Simulation Program for Distributed-Memory Systems <i>M. Gerndt</i>	281
A Parallel Molecular-Dynamics Simulation of Crystal Growth at a Cluster of Workstations <i>M.J.P. Nijmeijer</i>	287
Simulated Annealing for N-body Systems <i>J.M. Voogd, P.M.A. Sloot, R. v. Dantzig</i>	293

8. Weather Simulations

The Message Passing Version of ECMWF's Weather Forecast Model <i>S.R.M. Barros, D. Dent, L. Isaksen, G. Robinson, F.G. Wollenweber</i>	299
Parallel Computing for Weather Prediction <i>U. Gärtel, W. Joppich, A. Schüller</i>	305
Parallelization of a Mesoscale Model of Atmospheric Circulation - An Object-Oriented Approach <i>J. Gerlach, B. Kähler</i>	311
Parallelization of Scientific Applications: Data Assimilation in Meteorology <i>Y. Trémolet, F.X. Le Dimet, D. Trystram</i>	317

9. Environmental Applications and Climate

Parallelization of Large Scale Ocean Models by Data Decomposition <i>H.-P. Kersken, B. Fritsch, O. Schenk, W. Hiller, J. Behrens, E. Krauß</i>	323
Simulation of Tidal Flows for Southern North Sea and Sediment Transports for Western Scheldt Estuary on Parallel Computers <i>Z.W. Song, K.P.P. Pathirana, D. Roose, J. Berlamont</i>	329

A Sequential-Parallel Approach for Coupling Chemistry and Transport in Groundwater Quality Modelling <i>Ch. Kervévan, R. Fabriol, A. Guillén, J.-P. Sauty</i>	335
Supporting an Oil Reservoir Simulator in a Distributed Memory Environment <i>C. Addison, T. Christensen, J. Larsen, T. Oliver, A. Sunderland</i>	340
The Parallelization of the AEA Probabilistic Safety Assessment Program, MASCOT <i>H.W. Yau, K.A. Cliffe, J.E. Sinclair, P.J. Sumner</i>	346
 10. High Energy Physics and Astrophysics	
Monte Carlo Simulations of Lattice Gauge Theories on Multiprocessor Systems <i>P. Altevogt, F. Gutbrod</i>	352
The Formation of Galaxies: A Challenge for Supercomputers - A Simple Task for GRAPE? <i>M. Steinmetz</i>	358
Parallel Magnetohydrodynamics on the CM-5 <i>S. Poedts, P.M. Meijer, J.P. Goedbloed, H.A. van der Vorst, A. Jakoby</i>	365
First Results from the Parallelization of CERN's NA48 Simulation Program <i>J. Apostolakis, C.E. Bruschini, P. Calafiura, F. Gagliardi, M. Metcalf, A. Norton, B. Panzer-Steindel, L.M. Bertolotto, K.J. Peach</i>	371
Software Package for Reflection High Energy Electron Diffraction Beam Intensity Measurement and Analysis System <i>G.E. Cirlin, G.M. Guryanov, N.P. Korneeva, Yu.B. Samsonenko</i>	377
 11. Neuro-Science and Neural Networks	
Conceiving Computationally Intensive Approaches to Vision (Invited Paper) <i>N. Petkov, Groningen</i>	380
A Transputer-Based Visually-Guided Robot System Using Neuro-Control <i>S. Hagmann, H. Kihl, D. Kuhn, J.-P. Urban</i>	390
A Scalable Performance Prediction Method for Parallel Neural Network Simulations <i>L. Vuurpijl, T. Schouten, J. Vytöpil</i>	396
PREENS, a Parallel Research Execution Environment for Neural Systems <i>L. Vuurpijl, T. Schouten, J. Vytöpil</i>	402
Parallel Implementation of Control Tasks for an Automated Stereo Camera Mount <i>D.A. Castelov, N.D. Gent</i>	408
Simulating Neural Networks on Telmat T-node <i>Z. Hanzalek</i>	416

A Genetic Algorithm for Grammatical Inference <i>M.M. Lankhorst</i>	418
A Massively Parallel Implementation of the Full Search Vector Quantization Algorithm <i>P. Lukowicz, J. Schiffers, R. Cober</i>	420
12. Database Applications	
Commercial Database Applications on Parallel Systems <i>I. Cramb, C. Upstill</i>	422
Evaluation of High-Performance Parallel Database Machines <i>J. Kerridge, I. Jelly, Ch. Bates</i>	424
A Free-Text Retrieval Index-Server on a Massively Parallel Machine <i>F.R. Kroll</i>	430
Large Scale Data Management and Massively Parallel Architectures in Automatic Fingerprint Recognition <i>D. Walter, J. Kerridge</i>	435
PARCS: Parallel Picture Archiving and Communication System <i>M. Fruscione, L. Marenzi, S. Punzi, P. Stoffella</i>	441
The Performance of a Parallel Scheme Using the Divide-and-Conquer Method <i>Q. Yang, C. Yu, C. Liu</i>	446
Author Index	449