

# High Speed Computer and Algorithm Organization

*EDITED BY*

DAVID J. KUCK

DUNCAN H. LAWRIE

AHMED H. SAMEH

Department of Computer Science  
University of Illinois  
Urbana, Illinois



ACADEMIC PRESS, INC. New York San Francisco London 1977

A Subsidiary of Harcourt Brace Jovanovich, Publishers

# Contents

<i>Contributors</i>	viii
<i>Preface</i>	xi
<b>I. COMPUTER SYSTEM DESIGN AND THEORY</b>	<b>1</b>
1. It's Really Not as Much Fun Building a Supercomputer as It Is Simply Inventing One (invited) <i>N. R. Lincoln</i>	3
2. Component Progress: Its Effect on High Speed Computer Architecture and Machine Organization (invited) <i>E. Bloch and D. J. Galage</i>	13
3. The Interpretive Interface: Resources and Program Representation in Computer Organization (invited) <i>Michael J. Flynn</i>	41
4. An Evaluation of the CRAY-1 Computer (invited) <i>Forest Baskett and Tom W. Keller</i>	71
5. Burroughs Scientific Processor (invited) <i>Richard A. Stokes</i>	85
6. Networks and Interconnection Schemes (invited) <i>James E. Thornton</i>	91
7. A Discourse on a New Super Computer, PEPE <i>Hiram G. Martin</i>	101
8. Efficient High Speed Computing with the Distributed Array Processor <i>P. M. Flanders, D. J. Hunt, S. F. Reddaway, and D. Parkinson</i>	113
9. A Complexity Result on a Pipeline Processor Design Problem <i>Michael Schlansker and D. E. Atkins</i>	129
10. Application of Data Flow Computation to the Weather Problem <i>Jack B. Dennis and Ken K.-S. Weng</i>	143
11. An Investigation of Fault-Tolerant Architectures for Large-Scale Numerical Computing <i>Algirdas Avižienis, Miloš Ercegovic, Tomás Lang, Pierre Sylvain, and Alexander Thomasian</i>	159
12. Fault-Tolerance and Longevity: Goals for High-Speed Computers of the Future <i>Algirdas Avižienis</i>	173
13. Semigroups of Recurrences <i>Daniel D. Gajski</i>	179
14. Array Processors and Their Application <i>T. E. Rudy</i>	185
15. The Use of Ladders for the Execution of APL <i>Charles R. Minter</i>	189
16. Distributed Signal Processing as Implemented in the L-2000 Remote Radar Tracking Station <i>Frank P. Hiner III</i>	191
17. A Family of Special-Purpose Processors for Distributed Dedicated Computer Systems <i>Maniel Vineberg</i>	195

18.	The Parallel Processing of Large Applications <i>Harvey S. Koch</i>	199
19.	Processor Interconnection Networks, Some New Results <i>David Stevenson and Gary Feierbach</i>	201
20.	A Massively Parallel Processing Computer <i>Lai-wo Fung</i>	203
<b>II.</b>	<b>NUMERICAL ALGORITHMS</b>	205
1.	Numerical Parallel Algorithms—A Survey (invited) <i>Ahmed H. Sameh</i>	207
2.	The Influence of Vector Computer Architecture on Numerical Algorithms (invited) <i>Robert G. Voigt</i>	229
3.	Algorithms for Solving Two-Point Boundary Value Problems (invited) <i>Victor Pereyra</i>	245
4.	Vectorization for the CRAY-1 of Some Methods for Solving Elliptic Difference Equations (invited) <i>B. L. Buzbee, G. H. Golub, and J. A. Howell</i>	255
5.	Minimal Storage Band Elimination <i>S. C. Eisenstat, M. H. Schultz, and A. H. Sherman</i>	273
6.	A Large Mathematical Model Implementation on the STAR-100 Computers <i>E. Dick Giroux</i>	287
7.	An Analysis of the Recursive Doubling Algorithm <i>P. Dubois and G. Rodrigue</i>	299
8.	Algorithm Design for Digital Image Correlation on a Parallel Processor <i>David L. Ackerman</i>	307
9.	Iterative Methods for Asynchronous Multiprocessors <i>G�rard M. Baudet</i>	309
10.	Experience with a Vectorized General Circulation Climate Model on STAR-100 <i>David B. Soll, Nadim R. Habra, and Gary L. Russell</i>	311
11.	Some Linear Algebraic Algorithms and Their Performance on CRAY-1 <i>T. L. Jordan and Kirby Fong</i>	313
12.	Nonlinear Recurrences and Parallel Computation <i>D. Stott Parker, Jr.</i>	317
13.	Minimal Parallelism for Computations under Time Constraints <i>Don Heller</i>	321
14.	Effectiveness of Multi-Microprocessor Networks for Solving the Nonlinear Poisson Equation <i>Gerard G. L. Meyer</i>	323
<b>III.</b>	<b>SYSTEM, SOFTWARE, AND ALGORITHM PERFORMANCE</b>	327
1.	Analysis of Applications Programs and Software Requirements for High Speed Computers (invited) <i>John M. Gary</i>	329
2.	Algorithms and Architecture (invited) <i>Paul Budnik, Jr., and Joseph Olinger</i>	355
3.	The Costs of Processing Power: The Process, the Programmer, and the Processor <i>David W. Hogan, John C. Jensen, and Merrill Cornish</i>	371

4.	Matching Machines and Problems <i>J. E. Wirsching and T. Kishi</i>	379
5.	To Vectorize or to "Vectorize": That Is the Question <i>R. N. Remund and K. A. Taggart</i>	399
6.	The Effect of Computer Architecture on Algorithm Decomposition and Performance <i>Robert W. Hon and D. Raj Reddy</i>	411
7.	A Software Technique for Reducing the Routing Time on a Parallel Computer with a Fixed Interconnection Network <i>H. T. Kung and D. Stevenson</i>	423
8.	Prepaging and Applications to the STAR-100 Computer <i>Kishor S. Trivedi</i>	435
9.	Application of the Vectorizer for Effective Use of High-Speed Computers <i>John M. Levesque</i>	447
X 10.	The Impact of Scalar Performance on Vector and Parallel Processors <i>L. Rudsinski and J. Worton</i>	451
X 11.	Performance Bounds in Parallel Processor Organizations <i>Ruby Bei-Loh Lee</i>	453
X 12.	Automatic Error Analysis for Serial and Parallel Algorithms <i>John Larson</i>	457
13.	Some Numerical Effects of a FORTRAN Vectorizing Compiler on a Texas Instruments Advanced Scientific Computer <i>Myron Ginsberg</i>	461
14.	Computers in Chemistry: The American Chemical Society and the National Resource for Computation in Chemistry <i>Peter Lykos</i>	463
	<i>List of Referees</i>	468