

Lecture Notes in Computer Science

Edited by G. Goos and J. Hartmanis

111

CONPAR 81

Conference on Analysing Problem Classes
and Programming for Parallel Computing
Nürnberg, June 1981
Proceedings

Edited by Wolfgang Händler



Springer-Verlag
Berlin Heidelberg New York

This series reports new developments in computer science research and teaching – quickly, informally and at a high level. The type of material considered for publication includes:

1. Preliminary drafts of original papers and monographs
2. Lectures on a new field or presentations of a new angle in a classical field
3. Seminar work-outs
4. Reports of meetings, provided they are
 - a) of exceptional interest and
 - b) devoted to a single topic.

Texts which are out of print but still in demand may also be considered if they fall within these categories.

The timeliness of a manuscript is more important than its form, which may be unfinished or tentative. Thus, in some instances, proofs may be merely outlined and results presented which have been or will later be published elsewhere. If possible, a subject index should be included. Publication of Lecture Notes is intended as a service to the international computer science community, in that a commercial publisher, Springer-Verlag, can offer a wide distribution of documents which would otherwise have a restricted readership. Once published and copyrighted, they can be documented in the scientific literature.

Manuscripts

~~Manuscripts should be no less than 100 and preferably no more than 500 pages in length.~~

~~They are reproduced by a photographic process and therefore must be typed with extreme care. Symbols not on the typewriter should be inserted by hand in indelible black ink. Corrections to the typescript should be made by pasting in the new text or painting out errors with white correction fluid. Authors receive 75 free copies and are free to use the material in other publications. The typescript is reduced slightly in size during reproduction; best results will not be obtained unless the text on any one page is kept within the overall limit of 18 x 26.5 cm (7 x 10½ inches). On request, the publisher will supply special paper with the typing area outlined.~~

Manuscripts should be sent to Prof. G. Goos, Institut für Informatik, Universität Karlsruhe, Zirkel 2, 7500 Karlsruhe/Germany, Prof. J. Hartmanis, Cornell University, Dept. of Computer-Science, Ithaca, NY/USA 14850, or directly to Springer-Verlag Heidelberg.

Springer-Verlag, Heidelberger Platz 3, D-1000 Berlin 33
Springer-Verlag, Neuenheimer Landstraße 28-30, D-6900 Heidelberg 1
Springer-Verlag, 175 Fifth Avenue, New York, NY 10010/USA

ISBN 3-540-10827-0
ISBN 0-387-10827-0

Lecture Notes in Computer Science

Edited by G. Goos and J. Hartmanis

111

CONPAR 81

Conference on Analysing Problem Classes
and Programming for Parallel Computing
Nürnberg, June 10–12, 1981
Proceedings

Edited by Wolfgang Händler



Springer-Verlag
Berlin Heidelberg New York 1981

Editorial Board

W. Brauer P. Brinch Hansen D. Gries C. Moler G. Seegmüller
J. Stoer N. Wirth

Editor

Prof. Dr. rer. nat. Wolfgang Händler
Universität Erlangen-Nürnberg
Institut für Mathematische Maschinen und Datenverarbeitung
Martensstr. 3, 8520 Erlangen

AMS Subject Classifications (1979): 68B99

CR Subject Classifications (1981): 4.9

ISBN 3-540-10827-0 Springer-Verlag Berlin Heidelberg New York

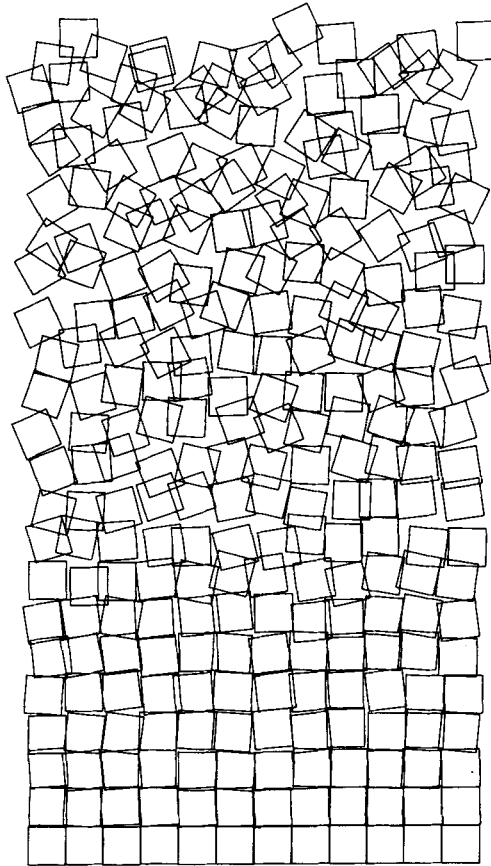
ISBN 0-387-10827-0 Springer-Verlag New York Heidelberg Berlin

This work is subject to copyright. All rights are reserved, whether the whole or part of the material is concerned, specifically those of translation, reprinting, re-use of illustrations, broadcasting, reproduction by photocopying machine or similar means, and storage in data banks. Under § 54 of the German Copyright Law where copies are made for other than private use, a fee is payable to "Verwertungsgesellschaft Wort", Munich.

© by Springer-Verlag Berlin Heidelberg 1981
Printed in Germany

Printing and binding: Beltz Offsetdruck, Hemsbach/Bergstr.
2145/3140-543210

CONPAR 81



Die Graphik wurde mit einer Siemens-Datenverarbeitungsanlage erstellt.
Computer Graphic from: Georg Nees; Generative Computergraphik.

P R E F A C E

Wolfgang Händler
General Chairman

In its title this conference differs from some similar events dealing with parallelism in computer systems and with distributed computing. Such conferences discuss structures which are proposed for the solution of problems by the computation of particular algorithms, but are only useful for these problems. Some more sophisticated structures are useful in broader classes. Finally there are good reasons to expect in the future <Adaptable Architectures> [1, 2].

Nevertheless there is a lack in knowledge about the very nature of algorithms, their partitionability in principle into parallel constituents and about the way in which such algorithms can be dealt with, e. g. by <divide and conquer> methods. An interesting hint was given by C. R. Vick [3]:

I've always felt that the challenge to map an inherently parallel problem space into a parallel solution space with as few artificial transformations as possible represents one of the most interesting challenges ... (1978).

The German pioneer in computing, Konrad Zuse [4], developed similar ideas (1969). He argues that the contemporary procedure is very often a roundabout way. For example one endeavours to transform an ultimately discrete problem into an analytic, i. e. continuous, approach and to discretize it again for solving it by a (digital) computer. He recommends a direct procedure using what he calls a <Computing Space>.

It seems to be a worthwhile goal for CONPAR 81, to investigate general methods, examples, or case studies, which center on the problem, how parallel algorithms (as a general term) can be implemented and utilized for higher throughput, speed, and fault-tolerant computing. In such a way the Program Committee and the staff of IMMD interpreted the commission from the "Gesellschaft für Informatik" to organise CONPAR 81.

The responsibility of the Program Committee turned out to be not an easy one. In accordance with the decision of the committee not to admit 'parallel sessions' during the conference, we had to select 29 papers from a total of 80 submitted papers. Despite the good quality of some papers we had to reject them because they did not fit the declared aim of CONPAR 81.

We succeeded in getting contributions from distinguished experts in the field, accordingly announced as 'invited speakers'. In this context I welcome in particular our outstanding keynote speaker, Prof. Arthur W. Burks, who directed our attention at an early point of time to the activities of the late John von Neumann [5] concerning cellular automata and also 'growing' automata. Being one of the best known pioneers of the computer scene, A. Burks is at the same time a distinguished philosopher, which made it particularly valuable to receive his contribution.

Originally we planned to hold the conference at the Campus Erlangen-South of the University Erlangen-Nürnberg, where activities in parallelism are located. Unfortunately another conference with the same date in the city of Erlangen prevented this.

Nevertheless Nuremberg (Nürnberg) is an excellent alternative which offers a great spectrum of other opportunities, and we hope that the participants enjoy the medieval and stimulating atmosphere around the conference site.

R E F E R E N C E S

- [1] Vick, C. R., S.P. Kartashev and S. I. Kartashev:
Adaptable Architectures for Supersystems, Computer 13 (1980)
pp. 17 - 35

- [2] Händler, W., F. Hofmann and H. J. Schneider:
A general purpose array with a broad spectrum of applications
in: Computer Architecture, Workshop of the Gesellschaft für
Informatik, Erlangen, May 1975, Berlin, Heidelberg, New York
Springer 1976

- [3] Vick, C. R.:
Research and Development in Computer Technology,
How do we follow the last Act (keynote address)
Proceedings 1978 International Conference on Parallel
Processing. IEEE pp. 1 - 5

- [4] Zuse, Konrad:
Rechnender Raum (Computing Space)
Schriften zur Datenverarbeitung. Bd. 1
Braunschweig: Vieweg und Sohn 1976

- [5] Burks, Arthur W. (edit.)
Essays on Cellular Automata
(To the memory of John von Neumann)
Urbana, Chicago, London:
University Illinois Press 1970

(Citation not exhaustive)

TABLE OF CONTENTS

KEYNOTE SPEAKER

<i>Arthur W. Burks</i>	1
Programming and structure changes in parallel computers	

SESSION 1, MATCHING THE STRUCTURE OF COMPUTATIONS AND MACHINE ARCHITECTURE

<i>F.J. Peters</i>	25
Tree machines and divide-and-conquer algorithms	
<i>M. Feller, M.D. Ercegovic</i>	37
Queue machines: an organization for parallel computation	
<i>D.A. Podsiadlo, H.F. Jordan</i>	48
Operating systems support for the finite element machine	
<i>D.J. Kuck, invited speaker</i>	66
Automatic program restructuring for high-speed computation	

SESSION 2, PROGRAMMING LANGUAGES WHICH SUPPORT PARALLELISM

<i>G. Dávid, I. Losonczy, S.D. Papp</i>	85
Language support for designing multilevel computer systems	
<i>J.P. Banatre, M. Banatre</i>	101
Parallel structures for vector processing	
<i>R.H. Perrott</i>	115
Language design approaches for parallel processors	
<i>A.H. Veen</i>	127
Reconciling data flow machines and conventional languages	
<i>M. Broy</i>	141
On language constructs for concurrent programs	
<i>J.R. Gurd, J.R.W. Glauert, C.C. Kirkham</i>	155
Generation of dataflow graphical object code for the Lapse programming language	
<i>T. Legendi, invited speaker</i>	169
Cellular algorithms and their verification	
SESSION 3, CELLULAR ALGORITHMS AND THEIR VERIFICATIONS	
<i>J. Pecht</i>	189
The development of fast cellular pattern transformation algorithms using virtual boundaries	

<i>E. Katona</i>	203
Cellular algorithms for binary matrix operations	
SESSION 4, SYSTEMATIC DESIGN, DEVELOPMENT, AND VERIFICATION OF PARALLEL ALGORITHMS	
<i>J. Staunstrup</i>	217
Analysis of concurrent algorithms	
<i>P. Lecouffe</i>	231
SAUGE: How to use the parallelism of sequential programs	
<i>A. Pettorossi</i>	245
A transformational approach for developing parallel programs	
<i>Ch. Lengauer, E.C.R. Hehner</i>	259
A methodology for programming with concurrency	
<i>K. Ramamritham, R.M. Keller</i>	271
On synchronization and its specification	
<i>P.M. Flanders, invited speaker</i>	283
Non-numerical aspects of computations on parallel hardware	
SESSION 5, NONNUMERICAL PARALLEL ALGORITHMS	
<i>S.R. House</i>	298
Compiling in parallel	
<i>Y. Shiloach, U. Vishkin</i>	314
Finding the maximum, merging and sorting in a parallel computation model	
<i>G. Salton, D. Bergmark</i>	328
Parallel computations in information retrieval	
<i>D.D. Gajski</i>	343
Recurrence semigroups and their relation to data storage in fast recurrence solvers on parallel machines	
<i>D. Nath, S.N. Maheshwari, P.C.P. Bhatt</i>	358
Parallel algorithms for the convex hull problem in two dimensions	
<i>U. Schendel, invited speaker</i>	373
On basic concepts in parallel numerical mathematics	
<i>Y. Saad and A.H. Sameh, invited speaker</i>	395
Iterative methods for the solution of elliptic difference equations on multiprocessors	

SESSION 6, PARALLELISM OF NUMERICAL ALGORITHMS

PART I

<i>N.K. Kasabov, G.T. Bijeve, B.J. Jechev</i>	414
Hierarchical discrete systems and realisation of parallel algorithms	
<i>M. Vajteršić</i>	423
Solving two modified discrete poisson equations in 7 logn steps on n^2 processors	
<i>L. Halada</i>	433
A parallel algorithm for solving band systems and matrix inversion	
<i>F. Hossfeld, P. Weidner</i>	441
Parallel evaluation of correlation time-of-flight experiments	

PART II

<i>G. Fritsch, H. Müller</i>	453
Parallelization of a minimization problem for multiprocessor systems	
<i>J. Jullian, G.R. Perrin</i>	464
Design and development of concurrent programs	
<i>E. Dekel, S. Sahni</i>	480
Binary trees and parallel scheduling algorithms	
<i>J. Shanehchi, D.J. Evans</i>	493
New variants of the quadrant interlocking factorisation (Q.I.F.) method	
EXPRESSION OF THANKS	508