

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



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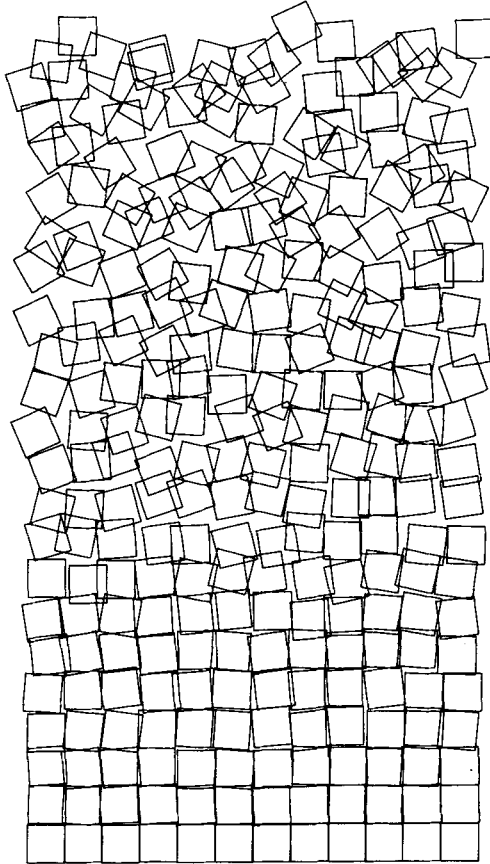
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CONPAR 81



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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)

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