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2 Research Group on Computational Geometry and Graphics

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* with financial support from a third party

Guest: Dr. P.-M. Schmidt (September 1993)

2.1 Research Projects

- **d-dimensional general polyhedra**

  Object-oriented implementation of the kernel of a solid modeler to perform set operations on d-dimensional general polyhedra. The polyhedra are defined as finite Boolean expressions in open halfspaces. The main emphasis is laid on an efficient intersection algorithm based on the idea of the plane-sweep algorithm of Bentley-Ottmann. Pyramids are used as intermediate data structures. The implementation is in C++.

  Research staff: Prof. W. Nef, Th. Mäder

- **QUICKART**

  QUICKART will be an extendable system for the quick generation of many kinds of simple computer art. But primarily it shall be a system to try out new techniques in image synthesis. One field of interest is the combination of various illumination models, another is the trade-off between photorealism and efficiency.

  Research staff: E. Dubuis, S. Amann, Th. Bebie, A. Collison, A. Hofer, Ch. Streit

- **Hyperimages**

  Hyperimages or generalized digital images are based on a new kind of pixel. The conventional pixel, i.e. a closed unit square, is the disjoint union of 9 new pixels of dimensions 0,1 and 2, namely its vertices, sides and interior.
Hyper-images allow the application of euclidean topology and herewith a natural notion of boundary. In this project various tree representations of hyperimages are studied as well as applications to computer graphics and image processing.

Research staff: I. Metz

**CIMMEDIA**

The goal of this project is to create a multimedia teaching tool which can introduce the basic notions of CIM. The underlying medium will be a CD-I. Experts in CIM, graphics design, music, psychology, and system programming are working together to examine the possibilities of this new technology, and to apply it to a practical and well suited subject.

Research staff: B. Grossniklaus
Chief project manager: M.M. Schaub, CIM-Zentrum Muttenz der Ingenieurschulen beider Basel

Financial support: various Swiss industrial firms

### 2.3 Masters' Theses

- Maeder, Th.: PYRAMIDS - Ein System zum Arbeiten mit Pyramiden. (PYRAMIDS - A System for Working with Pyramids)
- Studer, B.: Das Bestimmen der konvexen Hülle von n Punkten in der Ebene mit viel Sweep und wenig Backtracking. (Finding the Convex Hull of n Points in the Plane with Much Sweep and Little Backtracking)
- Streit, Ch.: Modellieren mit Lindemayer-Systemen in der Computergrafik. (Modelling with Lindenmayer-Systems in Computer Graphics)

### 2.5 Further Activities

**Program Committees**

- member of the Program Committee of COMPUGRAPHICS '93 (H. Bieri)
- member of the Program Committee of APL 94 (H. Bieri)

**Reviewing Activities (extract)**

- Jahresbericht der Deutschen Mathematiker-Vereinigung
- Solid Modeling '93 (H. Bieri)
- Computer-Aided Design (H. Bieri)
2.6 Publications


3 Research Group on Computer Vision and Artificial Intelligence

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Guests: Prof. Dr. I. Bruha  (February 1993)
Dr. S. Kockova  (February 1993)
Prof. Dr. T. Yamasaki  (March to December 1993)

3.2 Research Projects

- 3-D Object Recognition Using Greylevel and Range Images

In this project we are developing robust methods for the recognition of three-dimensional objects in scenes. We assume that CAD-models of the objects are given. The input data consists of both greylevel and range images of a scene. The recognition methods that are under development are using either only greylevel or range images, or a combination of both. For a given recognition task, an optimal sequence of processing steps is determined by means of a vision planner.
• Image Analysis of Printed Documents

A variety of problems occurring in the context of image analysis of printed documents are being investigated. These include recognition and understanding of GIRO check forms, recognition and execution of manual correction instructions on printed documents, recognition of handwriting (isolated characters and cursive script), and contextual postprocessing.

Research staff: D. Möri, T. Ha Minh
Financial support: UBILAB, Union Bank of Switzerland, Zürich

• Expert System for Diagnosis of Thyroid Gland Disease

This project is an activity within the European COST research program. It is conducted in cooperation with the Institute of Nuclear Medicine of the Inselspital, Berne. We are developing an expert system for the diagnosis of thyroid gland disease. The system is based on various knowledge representation and reasoning methods, and uses, besides "conventional" textual input, scintigraphic images for making diagnostic inferences.

Research staff: X. Fábregas, F. Grimm
Financial support: COST Research Program, Bundesamt für Bildung und Wissenschaft; Siemens Albris

• Approximate Graph Matching Algorithms for Case-based Reasoning and Machine Learning

The main idea in case-based reasoning is to use the solution of a problem that has been solved earlier in order to solve a new problem. If cases are represented by graph structures, then procedures for determining the similarity of graphs are an essential component of any case-based reasoning system. Determining the similarity of two graphs is also important in the context of machine learning. In this project, we are developing measures of similarity for graphs and efficient procedures for their computation.

Research staff: B. Messmer
Financial support: Swiss National Science Foundation (Schwerpunktforschungsprogramm Informatikforschung)

• Structural and Syntactic Pattern Recognition

The key idea in structural and syntactic pattern recognition is the representation of patterns by means of symbolic data structures such as strings, trees, and graphs. In order to recognize an unknown pattern, its symbolic representation is compared with a number of stored prototypes. In this project, we
aim at developing new symbolic matching and parsing algorithms for a variety of applications.

Research staff: H. Bunke

3.3 Masters' Theses

- Klopfstein, J.: Stereovision - eine experimentelle Studie. (Stereovision - an experimental study)

- Hänni, T.: Fuzzy Logik und Erklärungskomponente in einem medizinischen Expertensystem. (Fuzzy logic and explanation component in a medical expert system)

- Wittwer, R.: Merkmalsextraktion aus szintigrafischen Bildern der Schilddrüse. (Feature extraction from scintigraphic images of thyroid gland)

3.4 Further Activities

Awards

- B. Messmer received one of the three IBM Artificial Intelligence Prizes 1993 for his MS thesis "Fehlertolerantes Graphenmatching mit dem RETE-Algorithmus" (Error Tolerant Graph Matching Using the RETE Algorithm).

- D. Möbi received a prize from the German Pattern Recognition Association DAGM for his paper "Automatic Recognition and Execution of Correction Instructions in Text Documents" presented at the 1993 annual DAGM meeting.

Editorial Boards and Technical Committees

- editor-in-charge of the International Journal of Pattern Recognition and Artificial Intelligence (H. Bunke)

- member of the editorial board of Acta Cybernetica (H. Bunke)

- member of the editorial board of Pattern Recognition and Image Analysis (H. Bunke)

- member of the Technical Committee on Structural and Syntactic Pattern Recognition of the International Association for Pattern Recognition (IAPR) (H. Bunke)

Program Committees

- 11th SPIE Conference on Application of Artificial Intelligence, Orlando, FL, April 12 - 16, 1993 (H. Bunke)
• Conference on "Image Processing: Theory and Applications", San Remo, June 14 - 16, 1993 (H. Bunke)

• 15. DAGM-Symposium Mustererkennung, Lübeck, September 27 - 29, 1993 (H. Bunke)

3.5 Publications

Books


Book Chapters


Journal Papers


Conference Papers


Technical Reports


4 Research Group on Computer Networks and Distributed Systems

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* with financial support from a third party
4.2 Research Projects

- Test generation based on message sequence charts
  The central aspect of this project is conformance testing for communication protocols. The evaluation of a product with respect to its specification is an important issue in system engineering, in particular if parts of the specification are defined by standards such as ISO, CCITT, ... or others. The central question is: Given a formal specification, how can one find out whether an implementation conforms to this specification? Automatic test case generation from formal specifications suffers from the enormous amount of resulting test cases. In this project a combination of so-called "sequence charts" and formal specifications is used for generation in order to reduce the amount of generated tests to the "interesting" ones. Based on this idea a prototype tool is being developed and implemented under the scope of this project.

![Diagram](image)

Fig. 1: Specification, Implementation and Testing

Research staff: J. Grabowski, S. Leue, R. Nahm, A. Spichiger, K. Neuenschwander, P. Gurtner, M. Günter
Financial support: Swiss PTT
Duration: 01.10.91 - 30.9.93

- Test case specification with message sequence charts
  Within the Siemens-Albis AG the message flows of test cases for ISDN components are specified by message sequence charts (MSCs). To describe complete test cases MSCs are currently not sufficient. Therefore the goal of this project is the enrichment of MSCs with additional information which is necessary in order to define complete test cases. The additional information concerns values of transported data, test verdict assignment, and the expression of special actions, such as default and optional behaviour. Our intention is to translate MSC test cases in TTCN and SDL descriptions. The
The scope of the project includes investigations on the relations between MSCs, TTCN and SDL.

**Research staff:** J. Grabowski, A. Spichiger, C. Rüfenacht, S. Suter  
**Financial support:** Siemens-Albis 1.10.91 - 30.09.93  
**Duration:** 01.10.91 - 30.09.94

- **The role of time in formal specifications**

Real-time aspects are usually not considered in specifications based on formal methods like SDL, ESTELLE, LOTOS or Temporal Logic. Most applications of these well established methods focus on functional requirements of systems and unfortunately abstract from real-time. Our aim in this project is to extend the expressiveness of existing techniques to real-time behaviour, such that performance requirements can be specified consistent with functional requirements.

**Research staff:** D. Hogrefe, S. Leue  
**Financial support:** Hasler Stiftung  
**Duration:** 01.01.93 - 31.12.93

- **Formal Description Techniques, Architecture and Performance Evaluation for High Speed Networking**

In the course of this project different aspects of the protocol engineering process for High Speed Protocols are investigated. These distinguish themselves from conventional communication protocols in that they have to meet particular performance requirements as for example throughput, delay or reliability guarantees. These guarantees may be either deterministic or stochastic, and the respective requirements are sometimes referred to as Quality of Service (QoS) requirements. Starting point is the consideration of formal descriptions of these protocols, based on the CCITT specification language SDL. Firstly, the expressiveness of SDL is augmented by complementary specifications using probabilistic real-time temporal logics and equivalent automata models, which allows for a later verification and testing of the QoS requirements. Secondly, the SDL description is used to derive a queueing network model in order to perform complementary performance evaluations. Thirdly, the formal description is the starting point for the derivation of efficient parallel implementations, in particular by exploiting inherent parallelism. These steps are currently investigated, future work in the project will address the implementation of these steps as an integrated toolset and its application to study cases.

**Research staff:** S. Leue, D. Toggweiler, G. Caal (at EPF Lausanne), X. Garcia (at EPF Lausanne), J. Martins (at EPF Lausanne), P. Oechslin (at EPF ausanne)  
**Financial support:** Swiss National Fund (together with EPF Lausanne)  
**Duration:** 01.04.92 - 31.03.94
• Use of structural information for test case generation
The development of conformance test suits to examine protocol implementa-
tions requires methodological assistance and efficient tools. Existing ap-
proaches aim at full automation of the test derivation process and suffer from
the fact that the test purposes employed are often unrelated to the protocol
functions that should be tested. In addition, the number of tests generated is
often too large to be useful in practice. Rather than aiming at complete au-
tomation, test derivation methods are needed which include parameters that
can be adjusted by a test designer. This project develops such a paramete-
trized method, which is based on exploiting the structure information avail-
able in formal descriptions.

Research staff: R. Velthuys
Financial support: IBM
Duration: 01.03.92 - 28.02.93

• Advanced Testing Methods
This project follows the activities of the Technical Committee for Advanced
Methods for Testing and Specification in the European Telecommunication
Standards Institute (ETSI TC MTS). TC MTS is responsible for the promotion
and application of testing and specification methods within ETSI and pre-
pares European standards in this area. The project contributes in particular
to the area of automatic test case generation.

Research staff: A. Spichiger, H.-R. Scheurer
Financial support: ASCOM
Duration: 01.04.91 - 31.03.94

• MUTEST
The central idea of MUTEST is to compare different FDs of a protocol by let-
ting each one generate a test suit and running them against the test suits
generated by the other FDs, as well as against standardised and other test
suits.
Other approaches to validate FDs against other FDs and against test suits
may be considered as well.

Research staff: D. Hogrefe, R. Nahm
in cooperation with other internationally distributed institu-
tions, e.g. GMD Darmstadt and University of Montreal

• Graphical methods in the testing process
This project deals with the representation and interpretation of test results. A
problem in practical testing is that there exist no standardised notation for
test results. All the different manufactures of test equipment use their own
notation. This has consequences for customers and test laboratories. E.g.
the employees of the test laboratories have to learn a lot of different nota-
tions, for customers, it is difficult to make critical test reviews and to compare
test results which are gained with different test equipment. One main goal of this project is to develop a standardised notation for test results and to contribute it to international standardisation bodies. Furthermore, it is intended to visualise test results by means of Message Sequence Charts. The scope of the project includes investigations on the relations between MSC and the test case description language TTCN.

**Research staff:** Jens Grabowski
**Financial support:** KWF (Commission for the promotion of scientific research), Siemens-Albis, Alcatel STR
**Duration:** 01.07.93 - 30.06.95

- **Testability criteria for protocol specifications**

  The European Telecommunication Standards Institute (ETSI) has decided to use the ITU standard specification language SDL. It is believed that the use of SDL, and tools that support SDL will contribute to the quality of ETSI standards. Furthermore, a project is initiated to draft a European Telecommunication Standard with rules and guidelines for the use of SDL. The main objectives of this work are to improve the testability and possibilities for early validation of standards. Testability is understood as the suitability of a standard to serve as a basis for testing telecom products.

  In this project testability and validation of standards are studied. Based on this, consultation of experienced SDL users, and case studies in cooperation with other ETSI project teams a subset of SDL concepts is selected. Furthermore guidelines are given how to use this subset of SDL in combination with message sequence charts, ASN.1 and normal text, tables and figures. The deliverable of the project is a draft standard named "Use of SDL in European Telecommunication Standards". It is expected that this standard will be approved by ETSI members in 1994.

**Research staff:** Jan Kroon
**Financial support:** European Telecommunication Standards Institute (via Swiss PTT)
**Duration:** 01.01.93 - 31.12.93

- **TOPIC: Toolset for Protocol and Advanced Service Verification in IBC Environments**

  The CEC RACE R2088 research project TOPIC focuses in its Work Area 1 on the specification and validation / verification of Quality of Service (QoS) requirements on High Speed Communication Protocols. As application cases the Xpress Transfer Protocol (XTP) and the Joint Viewing Tele Operation Service (JVTOS) have been chosen. The contribution of the University of Berne to the work of TOPIC addresses in particular the specification of QoS requirements in the context of existing standardised formal description techniques like LOTOS, SDL and Message Sequence Charts (MSCs).

**Research staff:** Stefan Leue, Daniel Toggweiler, NN
**Financial support:** EEC-RACE Program via BBW (University of Berne is
• **Corporate Network Design**

The aim of this project is the development of concepts for corporate network (CN) design, and the implementation of corresponding prototypes. Figure 2 shows the CN of a hypothetical enterprise.

![Diagram of a corporate network](image)

**Fig. 2: A corporate network**

This particular arrangement uses leased lines and packet switching services of a public service provider in order to connect the various geographically distributed sites. Of course a modern enterprise might use many very different applications: interactive sessions at terminals (ASCII, X-Windows); speech and image transmission (telephone, telefax); CAD, CAM, ...; transaction processing; database queries; file transfer; monitoring and controlling.

These practical goals translate directly into very specific requirements for the CN with respect to transmission rate, quality, security and reliability. The services like leased line, packet switching, ISDN, MAN, X.400, have different characteristics with respect to the above mentioned requirements and tariffs.

The non-trivial problem of the optimal choice of the mix services in the CN comes up. Beyond that, the requirements for CNs and the existing services give rise to new aspects of service offers, tariffs, and capacity planning for the telecom provider.

**Research staff:** R. Oppliger, S. Weber, A. Greulich, J. Ernst, M. Gautschi

**Financial support:** Swiss PTT

**Duration:** 01.01.91 - 31.12.94
• Nawi - Network Security

NESI is a cooperation project, funded by the information security section of the Swiss Federal Office of Information Technology and Systems (Bundesamt für Informatik, BFI). The aim of the project is to develop and evaluate some possible security concepts for an integrated computer and communications network for the Swiss federal administrative authorities (KOMBV).

The development and evaluation of security concepts for KOMBV is a considerable opportunity, not only because of its large size, but also because of its heterogeneity. Only few restrictions can be made with regard to system platforms, communication protocols and applications that have to be supported.

Every security concept is derived from a security policy, and consists of a set of security services and security mechanisms. Authentication services will be at the core of any security concept. Additional data confidentiality and integrity services may be offered, too. Non-repudiation services depend on the existence of a trusted third party. It is an open question, whether the authentication and key distribution systems that are available today, like Kerberos (OSF/DCE), NetSP, SPX or TESS, can be used for KOMBV.

Research staff: R. Oppliger, M. Scheuner
Financial support: Information security section of the Swiss Federal Office of Information Technology and Systems (Bundesamt für Informatik, BFI)
Duration: 01.11.93 - 30.06.94

4.3 Masters' Theses

• Greulich, A.: Einsatz eines Expertensystems für den Entwurf von Mietleitungsnetzen. (Use of an expert system for the design of leased line networks), February 1993

• Herdener, D.: Personaleinsatzplanung mit Hilfe der Informatik. (ComputerSupported Staff Assignment), June 1993

• Neuenschwander, K.: Simulation von Message Sequence Charts. (Simulation of Message Sequence Charts), December 1993

4.4 Ph.D. Theses


4.5 Further Activities

- Member of the editorial board of the "Journal of High Speed Networks", IOS Person

- Member of program committee of "13th International Conference on Distributed Computing Systems: ICDCS-13", Pittsburgh, USA, May 25 - 28, 1993

- Member of program committee of "IFIP workshop on Protocol Test Systems IWPTS 93", Université de Pau, September 1993

- Member of program committee of "6th SDL Forum", Darmstadt, October 11 - 15, 1993

- Member of program committee of "IFIP conference on Formal Description Techniques FORTE 93", Boston, USA, October 26 - 29, 1993

- Chairman of "IFIP conference on Formal Description Techniques FORTE 94", Bern, October 1994

- Member of program committee of "14th IFIP conference on Protocol Specification, Testing and Verification", Vancouver, Canada, June 1994

- Member of program committee of "IFIP workshop on Protocol Test Systems IWPTS 94", Kogakuin Univ., Tokyo, November 8 - 10, 1994

Standardization activities

- Chairmanship of the ISO/ITU joint project on Formal Methods in Conformance Testing

- Representation of Switzerland in ITU-T Study Group 10 "Formal Languages"

- Representation of ASCOM in the ETSI Technical Committee on Methods for Testing and Specification

- Participation in the SNV, DIN and ISO work on Open Distributed Processing

Reviewing activities (extract)

- reviewer for Eurescom projects (D. Hogrefe)

- reviewer for full professor positions in Europe and North-America (D. Hogrefe)

- IEEE Transactions on Software Engineering (D. Hogrefe)

- IBM Systems Journal (D. Hogrefe)
• *Informatik Spektrum*, Springer Verlag (D. Hogrefe)

• *Computer Networks and ISDN Systems*, North-Holland (D. Hogrefe)

• *IEE Computers and Digital Techniques*, IEE (D. Hogrefe)

• *Real Time Systems Journal*

**Others**

• chairman of the GI/ITG working group 3.3.1: Formal specification methods for distributed systems (D. Hogrefe)

**4.6 Publications**


5 Research Group on Theoretical Computer Science and Logic

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- **Prof. Dr. J. Makowsky** *(October to December, 1993)*  
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5.2 Research Projects

- **Logic and computation**
  This project deals with the close connections between mathematical logic and certain parts of computer science, and emphasis is put on a proof-theoretic approach to some of the central questions in this area of research. These include the development of perspicuous and feasible logical frameworks for studying termination and correctness of functional programs. We
study theories which permit self-application, as well as strongly typed formalisms, and are interested in the connections to constructive and explicit mathematics. Some of the relevant catch words are: Proofs as computations, formulas as types, polymorphism, flexible typing, explicit and constructive mathematics, universes of types, theories of types and names, functional programming.

Research staff: G. Jäger, M. Marzetta, Th. Strahm

• Logic programming and deductive systems

Logic programming is understood in our research group in a very broad sense, and we are interested in the mathematical and logical structure of its central concepts. Proof-theoretic concepts and methods are more important to us than model-theoretic approaches. Our main emphasis is put on the treatment of negative information, forms of resource bounded reasoning, and the use of modern deductive systems in computer science.

Research staff: G. Jäger, C. Jonker

• Algebraic and logical aspects of knowledge processing

In collaboration with Prof. Dr. E. Engeler, ETH Zürich

Several research problems from the general area of knowledge representation are being investigated. They are directed toward the mathematical foundation of this area, and refer to algebraic and logical questions. The work of the group in Berne emphasizes the logical basis of knowledge representation. One of the first and most important steps in a logical approach to knowledge representation is the development and analysis of adequate formal frameworks, both from a declarative and procedural point of view. Depending on the context, various logical formalisms (e.g. Horn logic, modal logics, type theories, etc.) have turned out to be extremely useful. We focus on questions involving structural properties of suitable logical formalisms, and the interplay between logic and computation.

Research staff: S. Artemov, G. Jäger, M. Marzetta, Th. Strahm, T. Strassen

Financial support: Swiss National Science Foundation

• Executable models for analysis and implementation of complex systems

In collaboration with Dr. H. Lienhard, Landis & Gyr

The goal of this project is to develop a tool for the modeling, simulation and verification of complex distributed systems. Our approach is based on SPECS Petri nets, a system of higher order Petri nets that was implemented by Landis & Gyr. This system should be improved in the following directions:

1. Inclusion of time in the model.
2. The SPECS system should be extended to include tools for the formal analysis and verification of nets.
3. New concepts and tools that support efficient modeling of complex systems.

In Berne the theoretical background of SPECS Petri nets is investigated. There is a well-known connection between place-transition Petri nets, linear logic and category-theory. In a first step, an analogous connection between SPECS Petri nets and adequate systems of linear logic as well as category-theoretic semantics is established and applied to the analysis and verification of nets (e.g. reachability and liveness questions). Other points of interest are complexity questions and the behaviour of subnets.

Research staff: G. Jäger, U.-M. Künzi
Financial support: Schwerpunktprogramm Informatik

• Representation and automatic evaluation of empirical especially quantitative knowledge

In collaboration with Prof. Dr. B. Schmid, Hochschule St. Gallen

This project is directed toward the investigation of methods for the representation, organization, and evaluation of quantitative information (such as deductive databases), and utilizes a practical application orientation as well as a theoretical perspective. This undertaking is of considerable economic and scientific relevance with respect to the automatic acquisition and evaluation of quantitative information from heterogenous databases. The relevant theoretical problems shall be investigated in our group at the University of Berne, the application oriented problems by Professor Schmid and his group at the Hochschule St. Gallen.

Research staff: G. Jäger, W. Wolff
Financial support: Schwerpunktprogramm Informatik

• A logics workbench

In collaboration with Prof. Dr. P. Läuchli, ETH Zürich

The goal of this project is to implement a program for the treatment of different propositional logics, including e.g. classical, intuitionistic, modal, temporal logic and non-monotonic approaches. It is planned to build in the most important propositional logics. However, there should also be facilities allowing the definition of new logics by the user. The algorithms are not restricted to theorem proving procedures, but also concern computation of normal forms, simplification of formulas, formulas-as-types interpretation and so on. In order to make the logics workbench accessible to non-experts and available for educational purposes, it is very important to choose a user-friendly design.

Research staff: G. Jäger, M. Bianchi, A. Heuerding, S. Schwendimann
Financial support: Schwerpunktprogramm Informatik
5.3 Ph.D. Thesis


5.4 Further Activities

Editorial Board and Technical Committees

- member of the editorial board of *Theoretical Computer Science* (G. Jäger)
- Reviews Editor of *Journal of Symbolic Logic* (G. Jäger)
- member of interimistic board of the Swiss Center for Supercomputing (interimistischer CSCS-Auschuss) (G. Jäger)

Program Committees

- member of the Program Committee of Computer Science Logic CSL '93, Swansea (G. Jäger)
- members of the Program Committee of the Swiss Computer Science Society (G. Jäger, Th. Strahm)

Courses given at summer schools, etc.

- Logic programming and inductive definitions, Workshop on *Constructivity and Computation* (G. Jäger)
- A deductive approach to logic programming, Summer school *Proof and Computation*, Marktoberdorf (G. Jäger)
- Logics for AI and programming, Pisa (G. Jäger)

5.5 Publications


6 Research Group on Parallel Computing

6.1 Personnel

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Guests: Dr. T. Steffen
(February and July 1993)
e-mail: mdts@musica.mcgill.ca

M. Matyjewski
(1 month between June and December 1993)
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6.2 Research Projects

• SPINET

The interdisciplinary SPINET project applies the current possibilities of parallel computing to the generation of biochemical simulations needed to reveal the mechanics of back injury, while evaluating and enhancing parallel processing. A finite element model is used to investigate the (static) mechanical properties of the spine system, whereas the Petri net based parallel processing tool SystemSpecs is used for the (dynamic) simulation of the neural control mechanism of the muscles involved. The two approaches will be integrated to form a dynamic simulation tool of the spine system. The scientific questions adressed include the evaluation of parallel computers, specifically the SPMD (Single Program, Multiple Data) architecture (MUSIC
system) and programming tools when porting and enhancing a large application (the finite element simulation) as well as the presently unknown procedures of how to simulate and investigate the naturally parallel neuromuscular control of the spine using an advanced parallel processing tool such as the SystemSpecs environment.

**Collaborations:**
- Finite element modelling to the spine: Warsaw University of Technology, Poland (Prof. K. Kedzior, PD Dr. T. Zagrajek, M. Matyjewski)
- Mathematical modelling and Numerics: TnTech Parallel Computing Support AG, Bern (Dr. P. Schwab)
- SystemSpecs tool enhancements: Ivy Team AG, Zug
- EMG measurements: ESSM Magglingen (Prof. H. Hoppeler, Dr. D. Juker) and Institute of Kinesiology, University of Waterloo, Canada (Prof. S. McGill)
- Biomechanical Testing and validation: McGill University, Montreal, Canada (Prof. M. Aebi and Dr. T. Steffen)

**Research staff:** Dr. P. Kropf, Dr. E. Lederer, J. Schneider, Dr. J. Boillat
**Financial support:** Schwerpunktprogramm Informatik, Swiss National Science Foundation and ESSM

- **Analysis of raw data from a sample inquiry with Kohonen like algorithms**

Within the framework of a study of the Psychologisches Institut der Universität Bern (Wohnqualität und Mobilität) a set of raw data from a related inquiry has been analysed with different topological mapping algorithms. The results will be published.

**Research staff:** L. Müller, K. Wyler (IAM); F. Kaiser, M. Marxer (Psychologisches Institut)

- **Neural Networks for Automatic Object-Recognition**

Different "classical" object recognition approaches are compared to neural network methods. The following subjects are currently under research:
- object-ground separation in natural, noisy environments
- object classification using Boundary-Contour Methods
- transformations: Invariant Filters, Gabor Transforms, Wavelet Theory, FFT, using Cellular Neural Networks

**Research staff:** L. Müller, J. Stiefenhofer, K. Wyler; H. Heuer (GRD)
**Financial support:** GRD

- **Self-organizing process mapping in a multiprocessor system**

In this project the applicability of neural networks to the mapping problem in a multiprocessor system is investigated. In this context, our work is presently focused on three specific areas:
- application of neural networks to graph morphism problems
- embedding of graphs into higher dimensional spaces
- quantification of topological preservation produced by a mapping

**Research staff:**  L. Müller, K. Wyler

### 6.3 Masters' Theses

- Messerli, S.: Verteilter Mapping Algorithmus in Parix-CDL. (A Distributed Mapping Algorithm for Parix-CDL)
- Roth, M.: Schablonen Spezifikationssprache zur Generierung von Kommunikationsgerüsten. (A specification language for the stencil generation of communication skeletons)
- Langen, M.: Graphische Benutzeroberfläche für parallele Programmiersprachen: (A graphical Programming Tool for Parallel Programming Languages)

### 6.4 Further Activities

**Seminar on Distributed Systems**

This seminar took place on June 4th, 1993 in Berne with about 60 participants. The specific content of this seminar consisted in 6 invited presentations representing the state of the art topic in Switzerland. Additionally, the main talk (Prof. Cap) was transmitted simultaneously via ISDN to the Engineering school in Fribourg where another 100 people attended the lecture during the annual NDIT/FPIT students meeting. The workshop was jointly organized by the Parallel Computing Group at the IAM, the Special Interest Group on Parallel Systems of the Schweizer Informatikergesellschaft (SIPAR) and NDIT/FPIT.

**Committees**

- president of the Special Interest Group on Parallel Systems SIPAR (P. Kropf)
- Activities in NDIT/FPIT, an interregional society for postgraduate courses in Telecommunications and Informatics: Prof. H. Mey is president, Dr. L. Müller director (on behalf of Ascom) and Dr. P. Kropf a committee member
- Activities in FORMITT, a COMETT project on education in Telecommunications and Informatics (on a European level)
- technical expert at the Informatics Dept. at Ingenieurschule Bern (P. Kropf)
Courses presented at other institutes

- course on Parallel Systems, FORMITT, Palermo, Italy (P. Kropf)

- postgraduate teaching activities (NDIT/FPIT courses): Neural Networks and Genetic Algorithms (L. Müller, K. Wyler), Parallel and Distributed Systems (P. Kropf), Operating-Systems Tools (J. Stiefenofer), Mathematics in computer science (E. Badertscher (MAI), L. Müller (IAM), P. Schwab (TNTECH))


- course on Neural Networks, Ingenieurschule Bern (L. Müller)

6.5 Publications


Appendix A: Teaching Activities

Winter semester 1992/93:

D. Benninger: • Datenbanken
H. Bierl: • Datenstrukturen und Algorithmen
• Geometrisches Modellieren
• Seminar in Computergeometrie
H.P. Blau: • Numerik 1
J. Bollat: • Einführung in die Programmierung 1
• Paralleles Rechnen 1
H. Bunke: • Theoretische Informatik 1
• Künstliche Intelligenz
• Seminar für Lizentiaten und Doktoranden
K. Decker: • Parallel-Algorithmen der Numerik
D. Hogrefe: • Computersysteme
• Software Engineering
• Computernetze
G. Jäger: • Proseminar: Symbolisches Rechnen
• Informatikprojekte
• Rekursionstheorie
• Deduktionssysteme
• Seminar für Lizentiaten und Doktoranden
• Blockseminar Bern und Zürich
P. Kropf: • Petri Netze
H. Mey: • Grundlagen der Informatik 1
• Seminar: Parallelität
L. Müller: • Einführung in die Programmierung 1

Summer semester 1993:

H. Bierl: • Computergrafik
• Modellierung und Simulation
• 3D-Grafik
• Seminar für Lizentiaten und Doktoranden
• Seminar: Mathematik und Informatik
H.P. Blau: • Numerik 2
J. Bollat: • Einführung in die Programmierung 2
• Paralleles Rechnen 2
H. Bunke: • Compiler
• Seminar für Lizentiaten und Doktoranden
• Strukturelle Methoden der Mustererkennung
A.-C. Godet: • Mikrocomputer
• Informatik-Workshop
D. Hogrefe:  
- Betriebssysteme  
- Computersicherheit  
- Seminar: Hochgeschwindigkeitscomputernetze  
- Seminar für Lizentianden und Doktoranden  

B. Housley:  
- Vektorielles Rechnen auf Supercomputern  

G. Jäger:  
- Einführung in die theoretische Informatik  
- Theoretische Informatik 2  
- Informatikprojekte  
- Seminar für Lizentianden und Doktoranden  
- Blockseminar Bern und Zürich  
- Seminar: Mathematik und Informatik  

P. Kropf:  
- Parallele und verteilte Algorithmen  

L. Müller:  
- Einführung in die Programmierung 2  

H. Mey:  
- Grundlagen der Informatik 2  

A. Scheuing:  
- Bewertung von Softwarequalität  

K. Wyler:  
- Einführung in die Theorie und Praxis der Neuronalen Netze  

Winter semester 1993/94:  

H. Bierl:  
- Datenstrukturen und Algorithmen  
- Algorithmische Geometrie  
- Praktikum in Computergrafik  
- Seminar für Lizentianden und Doktoranden  

H.P. Blau:  
- Einführung in die Programmierung  
- Numerik 1  

H. Bunke:  
- Theoretische Informatik 1  
- Künstliche Intelligenz  
- Seminar für Lizentianden und Doktoranden  

D. Hogrefe:  
- Computersysteme  
- Software Engineering  
- Computernetze  

G. Jäger:  
- Proseminar: Symbolisches Rechnen  
- Informatikprojekte  
- Grundlagen der Logik-Programmierung  
- Seminar für Lizentianden und Doktoranden  
- Blockseminar Bern und Zürich  
- Formale Methoden des Reasoning  

G. Karjoth:  
- Verifikation verteilter Systeme: Methoden und Werkzeuge  

P. Kropf:  
- Petri Netze  

J.A. Makowsky:  
- Datenbanken  

M. Marzetta:  
- Typentheorien  

H. Mey:  
- Grundlagen der Informatik 1  

K. Wyler:  
- Neuronale Netze 2
Appendix B: Students' Projects


Steiner, P.: Echolot-Koordinatentransformationen. IAM-PR-480, Betreuer: Klaus Budmiger.


