

Annual Report 1994

IAM-94-021

January, 1995

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1.3 Birthday Colloquium in Honor of Prof. Dr. H. Mey

On October 20, 1994 the Institute of Computer Science and Applied Mathematics had the pleasure in giving a colloquium on the occasion of the 60th birthday of Prof. Hansjürg Mey.

After a short review on the subject of computer science at the University of Bern during its first years, which was given by Prof. H. Bieri, the following speeches were presented by four distinguished guest speakers:

- Prof. J.D. Nicoud, EPF Lausanne: "Des réseaux sous toutes leurs formes"
- Prof. N. Wirth, ETH Zurich: "Elektrotechnik im Informatikunterricht: Grundlage oder Ballast?"
- Prof. H. Meyr, RWTH Aachen: "Über den VLSI-Entwurf: Vom Zusammenspiel zwischen Algorithmen und Architektur"
- Prof. K. Bauknecht, University of Zurich: "Informatik in der Schweiz: Fakten im Spannungsfeld Ausbildung, Forschung und Anwendungen"

1 Research Group on Computational Geometry and Graphics

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1.2 Research Projects

d-dimensional general polyhedra

These polyhedra, now normally called "Nef polyhedra", are those subsets of \mathbb{R}^d which can be obtained by applying finitely many Boolean set operations to a finite number of linear half spaces. The project extends the theory of Nef polyhedra, develops and analyses appropriate data structures and realizes an object-oriented implementation of the kernel of a solid modeler for working with Nef polyhedra.

Research staff: Prof. W. Nef

QuickArt

QuickArt will be an object oriented framework for the integration of geometric modeling, image processing, computer graphics (2D and 3D) and computer vision techniques. Primarily it shall be a system to research new approaches in computer

graphics. Main fields of interest are the combination of various illumination models, the generation of 3D scene descriptions based on various inputs (sketches, photographs, etc.) and innovative user interaction techniques. Traditional approaches in computer graphics are generalized to achieve a common underlying model for a number of existing algorithms.

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

Radiosity

The radiosity method is a sophisticated illumination model, based on the theory of heat transfer or interchange between surfaces in a closed environment. The complexity of radiosity algorithms is essentially $O(n^2)$ in the number of surfaces involved, nevertheless many substantial improvements are possible. Various acceleration techniques, dealing with dynamical subdivision and clustering of surfaces, are developed within this project. All implementations are in C++.

Research staff: E. Dubuis

CIMMEDIA

The goal of this project consists in developing a new kind of multimedia teaching tool. The underlying medium will be a CD-I. The concrete application shall provide an innovative introduction to the basic notions of CIM. Experts in CIM, graphics design, music, psychology, and system programming are working together to examine and apply a number of possibilities of this new technology.

Research staff: B. Grossniklaus

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

Financial support: various Swiss industrial firms

1.3 Master's Theses

- Amann, St.: RadShade - Implementation eines globalen Beleuchtungsmodells basierend auf Radiosity und Raytracing. (Implementation of a global illumination model based on radiosity and raytracing.)
- Collison, A.: Eine physikalisch basierte und eine heuristische Technik zur Generierung von 2D-Haufen. (A physically based and a heuristic technique for generating 2D piles.)
- Bebie, Th.: Texturen, verbesserte z-Buffer-Algorithmen und eine interaktive 3D-Testumgebung. (Textures, improved z-buffer-algorithms and an interactive test environment.)
- Mathis, E.: OOSADM: Object-oriented systems analysis and design method. Co-supervisor: Dr. R. Marty

- Studer, M.: Temporale Erweiterungen der Algebra für relationale Datenbanken. (Temporal extensions of the algebra of relational databases.) Co-supervisor: Dr. D. Benninger
- Nacht, U.: AutoCAD als Basis für das Realisieren von geometrischen Spezialsystemen. (AutoCAD as a basis for the realization of special-purpose geometric systems.)
- Hofer, A.: EasyDo - Interaktive Erstellung direkt manipulierbarer 3D-Szenen. EasyDo - a system for the interactive realization of directly manipulatable 3D scenes.)
- Buehlmann, B.: Ein Framework für Virtual Reality-Applikationen. (A framework for virtual reality applications)
- Niederhauser, R.: Query-Optimierung - Klassische und objektorientierte Ansätze. (Query optimization - classical and object-oriented approaches.) Co-supervisor: Dr. D. Benninger
- Senn, D.: Ein digitales Quicklook-Archiv von NOAA-Satellitenbildern. (A digital quicklook archive of NOAA satellite images.) Co-supervisor: Dr. M. Baumgartner
- Saner, Ch. : Computer-Visualisierung des Pulfrich-Phänomens. (Computer visualization of the Pulfrich phenomenon.) Co-supervisor: Dr. D. Mojon
- Stoffel, E.: PENPAT - Ein MS Windows Programm für das Experimentieren mit Penrose-Mustern. (A MS window program for experimenting with Penrose patterns.)

1.4 Further Activities

- Reviewing for APL'94 (H. Bieri)
- Reviewing for Solid Modeling'95 (H. Bieri)
- Organization of the Dagstuhl-Seminar on Geometric Modeling 1996 (H. Bieri)
- Visiting professor at the Institute of Pure and Applied Mathematics (IMPA) Rio de Janeiro, Brazil, November 1994 - March 1995 (H. Bieri)
- Computer Art Award: Promotion of Young Artists (E. Dubuis)

1.5 Publications

- Bieri, H.: Nef Polyhedra: A Brief Introduction. In Farin, G., Hagen, H., Nolte-meier, H (eds.): Geometric Modeling. To appear in Computing Supplement 10, Springer 1995.
- Bieri, H.: Boolean and topological operations for Nef polyhedra. CSG 94 Set-theoretic Solid Modeling: Techniques and Applications, 35-53. Information Geometers Ltd 1994 (Winchester).

- Bieri, H.: Dynamic Subdivision in Radiosity. Submitted.
- Bieri, H., Schmidt, P.-M.: On the permutations generated by rotational sweeps of planar point sets. Submitted.
- Bieri, H., Schmidt, P.-M.: Recognizing permutations generated by sweeps of planar point sets. Technical Report IAM-94-009.
- Streit, Ch., Bieri, H.: Interactive construction of L-systems in 2- and 3-space. Proceedings of SIBGRAPI 94, 109-115 (Curitiba 1994).
- Thomas Bebie, Hanspeter Bieri, Sandra de Souza Melo: Interpolation in case of a perspective projection (in Portuguese). Proceedings of GRAPHICA 94 (Recife), 222-230 (1994).
- Metz, I. Finding neighbors in d-dimensional binary digital images represented by bintrees. Proc. of the 4th Conference on Discrete Geometry for Computer Imagery, 107-116 (Grenoble 1994).
- Dubuis, E., Bieri, H.: Dynamic Subdivision in Radiosity. Proceedings of WSCG 95, Volume I, 79-86 (Plzen 1995).

2 Research Group on Computer Vision and Artificial Intelligence

2.1 Personnel

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	Dr. R. Robmann *	Tel: +41 31 631 49 87 e-mail: robmann@iam.unibe.ch
	Dr. A. Ueltschi *	until September 1994

* financial support from a third party

Guests:	Prof. Dr. J. Csirik	(January 1994)
	Prof. Dr. K. Boyer	(July - November 1994)
	Prof. Dr. R. Horaud	(July 1994)
	K. Yu	(since May 1994)

2.2 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.

Research staff: X.-Y. Jiang, U. Meier, R. Robmann, A. Ueltschi

Financial support: Swiss National Science Foundation (NFP-23: Artificial Intelligence and Robotics); Landis & Gyr AG, Zug; Migros Foundation

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: G. Kaufmann, T. Ha Minh, D. Möri

Financial support: UBILAB, Union Bank of Switzerland, Zurich; Swiss National Science Foundation (Schwerpunktprogramm Informatikforschung)

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, Bern. 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 Albis

Efficient Graph Matching Algorithms

In this project, we continue our effort in developing new and efficient algorithms for exact and error-tolerant attributed relational graph matching that can be applied in

various domains. The basic idea in improving the efficiency of graph matching algorithms lies in suitable preprocessing procedures for prototype, or model, graphs. By means of these preprocessing procedures, the complexity of the actual matching step can be reduced.

Research staff: B. Messmer

Financial support: Swiss National Science Foundation (Schwerpunktprogramm Informatikforschung)

Analysis of Human Face Images

The first efforts in the area of analysis of human faces date back to the sixties. But face analysis is still one of the most challenging problems in computer vision and far from being solved. We are investigating new techniques and approaches in this area based on range images, full face images and profile images of human faces.

Research staff: B. Achermann, X.-Y. Jiang, K. Yu

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

2.3 Master's Theses

- Lottaz, C.: Behandlung von Unsicherheiten in Expertensystemen. (Uncertainties in expert systems)
- Weiss, S.: Wissensbasierte Diagnose von Schilddrüsenmorphologie. (Knowledge-based diagnosis of thyroid gland morphology)
- Roth, M.: Off-line Erkennung kursiver Handschrift mit Markov-Modellen. (Off-line recognition of cursive handwriting using hidden Markov-models)
- Achermann, B.: Robuste Window-Operatoren für die Analyse von Tiefenbildern. (Robust window-operators for analyzing range images)
- Kropf, M.: Parsing mit kontextsensitiven Grammatiken. (Parsing with context-sensitive grammars)
- Liviero, R.: Fehlerkorrigierende Mustererkennung von Kodierzeilen. (Error-correcting pattern recognition of coding lines)
- Niggeler, D.: Ein Erkennungssystem für handgeschriebene Zahlen. (A recognition system for handwritten numerals)

2.4 Ph.D. Theses

- Ueltschi, A.: Effiziente modellbasierte Objekterkennung in Tiefenbildern. (Efficient model-based object-recognition in range images)
- Fábregas, X.: Ein Expertensystem zur Schilddrüsendiagnostik mit wissensbasierter Bildanalyse von Schilddrüsenszintigrammen. (An expert system for the diagnosis of thyroid gland diseases including knowledge-based image analysis of thyroid gland scintigrams)
- Robmann, R.: Ein System zur Integration und Interpretation von Kanten aus Grauwert- und Tiefenbildern. (A system for integration and interpretation of the edges in gray level and range images)

2.5 Further Activities

Awards

- M. Roth received an award from the Fritz-Kutter-Fonds (ETH Zürich) for his Master Thesis "Off-line Erkennung kursiver Handschrift mit Markov-Modellen"

Editorial Boards and Technical Committees

- editor-in-charge of the International Journal of Pattern Recognition and Artificial Intelligence by World Scientific Publ., Singapore (H. Bunke)
- member of the editorial board of Acta Cybernetica (H. Bunke)
- editor-in-chief of the book series "Machine Perception and Artificial Intelligence" by World Scientific Publ., Singapore (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

- 12 th Int. Conference on Pattern Recognition, Jerusalem, October 10-13, 1994 (H. Bunke)
- IEEE Workshop on Applications of Computer Vision, Sarasota, Florida, December 5-7, 1994 (H. Bunke)
- IEEE Workshop on Biomedical Image Analysis, Seattle, Washington, June 24-25, 1994
- IAPR Workshop on Structural and Syntactic Pattern Recognition, Naharyia, Israel, October 4-6, 1994 (H. Bunke)

- IAPR Workshop on "Document Analysis Systems", Kaiserslautern, Germany, October 18-20, 1994 (H. Bunke)
- 16. DAGM-Symposium Mustererkennung, Wien, September 21 - 23, 1994 (H. Bunke)

Seminar

- A Dagstuhl Seminar on "Environment Modelling and Path Planning for Autonomous Robots" was held the week from October 24-28, 1994. Co-organizers of this seminar were H. Bunke, H. Noltemeier (University of Würzburg), and T. Kanade (Carnegie Mellon Univ.)

2.6 Publications

Books and Special Issues of Journals

- Bunke, H., Wang P.S.P., Baird, H. (eds.): Document Image Analysis. World Scientific Publ., Singapore, 1994. Also available as Special Issue of International Journal of Pattern Recognition and Art. Intelligence 8, No 5, 1994
- Boyer, K.L., Stark, L., Bunke, H. (eds.): Applications of Artificial Intelligence, Machine Vision and Robotics. Special Issue of International Journal of Pattern Recognition and Artificial Intelligence 8, No 6, 1994

Journal Papers

- Sastry, R., Ranganathan, N., Bunke, H.: VLSI architectures for polygon recognition. IEEE Trans. on VLSI Systems. Vol. 1, No. 4, Dec 1993, 398 - 407
- Jiang, X.-Y., Bunke, H.: Fast segmentation of range images into planar regions by scan line grouping. Machine Vision and Applications 7, 1994, 115 - 122
- Grimm, F., Bunke, H., Haehlen, J.: An approach to expert systems for image processing software libraries. Mathematics and Computers in Simulation 36, 1994, 303 - 313
- Yamasaki, T., Bunke, H.: Kansei information processing for handwritten document. The Institute of Electronics, Information and Communication Engineers, ET94-16, AI94-16, 1994, 117 - 122 (in Japanese)
- Ha, T.M., Bunke, H.: Model-based analysis and understanding of check forms. Int. Journal of Pattern Recognition and Art. Intelligence 8, No 5, 1994, 1053 - 1080

Conference Papers

- Möri, D., Bunke, H.: Automatic error recognition and corrections in text documents. Proc. 3rd Int. Conf. Interface to Real and Virtual Worlds, Montpellier, 1994, 175 - 184
- Grimm, F., Fábregas, X., Bunke, H., Haenni, T.: A fuzzy logic expert system for the diagnosis of thyroid gland function. Proc. Int. Conf. on Medical Physics and Biomedical Engineering, MPBE'94, Nicosia, 1994, 112 - 116
- Jiang, X.-Y., Bunke, H.: Line segment based axial motion stereo. Impedovo, S. (ed.): Progress in Image Analysis and Processing III, World Scientific Publ. Co, 1994, 497 - 504
- Bunke, H., Messmer, B.: Similarity measures for structured representations. Wess, S., Althoff, K.-D., Richter, M. (eds.): Topics in Case-Based Reasoning, Lecture Notes in Artificial Intelligence 837, Springer Verlag, 1994, 106 - 118
- Jiang, X.-Y., Bunke, H.: Vision planner for an intelligent multisensory vision system. Sadjadi, F. A. (ed.): Automatic Object Recognition IV, SPIE Proceedings 2234, 1994, 226 - 237
- Ueltschi, A., Bunke, H.: Effiziente modellbasierte Objekterkennung in Tiefenbildern. Kropatsch, W. G., Bischof, H. (Hrsg.): Mustererkennung 1994, Informatik Xpress 5, Springer Verlag, 1994, 81 - 90
- Messmer, B. T., Bunke, H.: Erkennen und Lernen zweidimensionaler Objekte mittels Subgraph-Isomorphismus. Kropatsch, W. G., Bischof, H. (Hrsg.): Mustererkennung 1994, Informatik Xpress 5, Springer Verlag, 1994, 377 - 386
- Jiang, X.-Y., Meier, U., Bunke, H.: Scale-invariant polyhedral object recognition using fragmentary edge segments. Proc. 12th Int. Conf. on Pattern Recognition, Jerusalem, 1994, 850 - 853
- Bunke, H., Roth, M., Schukat-Talamazzini, E.G.: Off-line recognition of cursive script produced by a cooperative writer. Proc. 12th Int. Conf. on Pattern Recognition, Jerusalem, 1994, 383 - 386
- Jiang, X.-Y., Bunke, H.: An intelligent planner for multisensory robot vision. Gelsema, E.S., Kanal, L.N. (eds.): Pattern Recognition in Practice IV, Elsevier Science, 1994, 489 - 500
- Möri, D., Bunke, H.: Off-line interpretation and execution of corrections in text documents. Dengel, A., Spitz, L. (eds.): Proceedings Document Analysis Systems 94, 1994, 401 - 416
- Grimm, F., Fábregas, X., Bunke, H., Weiss, S., Wittwer, R.: Knowledge-based interpretation of thyroid scinitigrams. Proc. 2nd IEEE Workshop on Applications of Computer Vision, Sarasota, 1994, 230 - 239
- Ha, T.M., Bunke, H.: Handwritten numeral recognition by perturbation method. Proc. 4th Int. Workshop on Frontiers in Handwriting Recognition, Tapei, Taiwan, 1994, 97 - 106

Technical Reports and Unrefereed Papers

- Jiang, X.-Y., Meier, U., Robmann, R., Ueltschi, A., Bunke, H.: A multisensory robot vision system for three-dimensional object recognition. Bless, R. (ed.): Proc. 2nd NRP 23-Symposium on Artificial Intelligence and Robotics, 1994, 75 - 90
- Robmann, R.: Interpretation von Schatten- und Intensitätskanten in integrierten Grauwert- und Tiefenbildern. Technical Report IAM-94-007, Institut für Informatik und angewandte Mathematik, Universität Bern, 1994
- Bunke, H., Roth, M., Schukat-Talamazzini, E.G.: Off-line cursive handwriting recognition using hidden Markov models. Technical Report IAM-94-008, Institut für Informatik und angewandte Mathematik, Universität Bern, 1994
- Ha, T.M., Bunke, H.: Text localization and handwriting recognition: Application to numeral extraction and recognition. Technical Report IAM-94-011, Institut für Informatik und angewandte Mathematik, Universität Bern, 1994 (a shortened version appeared in Proc. Priority Programme Informatics Research, Information Conference Module 2 Knowledge Based Systems, Yverdon-les-Bains, 1994, 120 - 131)
- Jiang, X.-Y., Bunke, H.: Symmetries of polyhedra: detection and applications. Technical Report IAM-94-012, Institut für Informatik und angewandte Mathematik, Universität Bern, 1994
- Messmer, B., Bunke, H.: Recognition and automatic learning of graphics symbols by means of graph matching. Proc. Priority Programme Informatics Research, Information Conference Module 2 Knowledge Based Systems, Yverdon-les-Bains, 1994, 54 - 63

3 Research Group on Computer Networks and Distributed Systems

3.1 Personnel

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* financial support from a third party

3.2 Research Activities

3.2.1 Formal Description Techniques

The research on the topic of Formal Description Techniques (FDTs) focuses on specification, implementation and testing of distributed systems.

In particular, the goal of the development of a method with the following characteristics is aimed at:

- efficient and user friendly specification of function and
- performance, implementation-dependent as well as -independent
- implementation can be verified with respect to the specification
- different abstraction levels with smooth transitions between them
- automatic code generation

The central aspect is conformance testing. The evaluation of a product with respect to its specification is an important issue in systems engineering, in particular if parts of the specification are defined by standards (ISO, CCITT, ...).

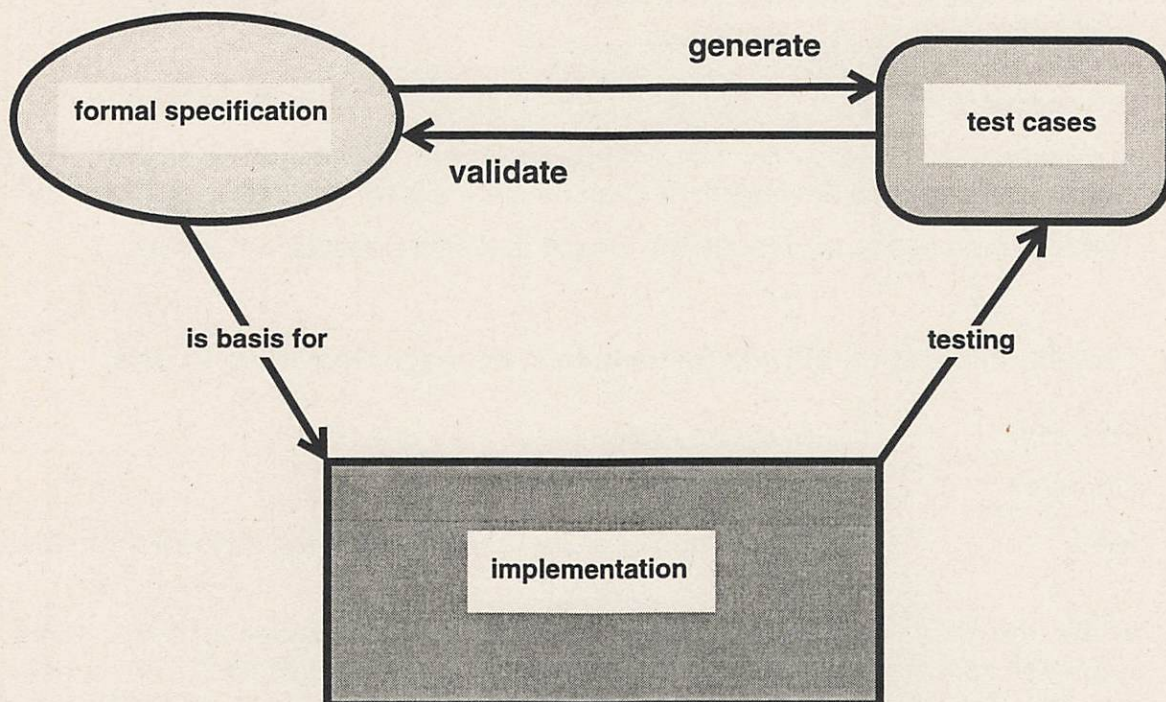


Fig. 1: Specification, Implementation and Testing

Given a formal specification, how can one find out whether an implementation conforms to this specification? This is a general problem from software engineering and not specific to the application in the communication protocol area.

However, the communication protocol area has obviously a very urgent need to solve this problem. In this field specifications are produced, e.g. international standards, which serve as a basis for many different implementations at different places by different manufacturers. These implementations have to be able to cooperate with each other according to the specification they are based on.

In other areas of software engineering, e.g. production of text processing systems, things are different. Here a software manufacturer produces a specification more or less for his own use only. The manufacturer can decide later what it means that the final product conforms to his own specification on a pragmatic basis, just as it is opportune. This remark should not discredit manufacturers of text processing software, it should just indicate the difference in the importance of the conformance

notion between protocol specifications and other types of specifications.

The motivation of this activity is the existence of formally described standards and therefore the need to define the meaning of conformance with respect to formal specifications.

Work that is performed under this subject:

- use of message sequence charts for specification and test case selection
- development of formal semantics for asynchronously communicating processes
- specification techniques and architecture for high speed networking
- conformance testing of real products
- participation in international research projects
- participation in standardization projects
- formal definition of the notion of conformance
- investigation of the role of time in specification and its influence on the concept of conformance development of algorithms, especially for test case selection

The following sections present the current research projects in this area.

Project: Integration of Data Aspects into Message Sequence Charts

Funding: Siemens-Albis
Duration: 1.10.91 - 30.9.95
Staff: Jens Grabowski, Daniel Toggweiler, Matthias Zimmermann, Prof. Dr. D. Hogrefe

Within the Siemens-Albis AG the message flows of test cases for ISDN components are specified by 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 behaviour like default and optional behaviour. It is intended to translate MSC test cases in TTCN and SDL descriptions. The scope of the project includes investigations on the relations between MSCs, TTCN and SDL.

Project: Conformance Testing - A Tool for the Generation of Test Cases

Funding: Swiss PTT
Duration: 1.10.91 - 30.3.95
Staff: Jens Grabowski, Daniel Toggweiler, Rudolf Scheurer, Prof. Dr. D. Hogrefe

In the proceeding project the SAMSTAG method and the SAMSTAG tool have

been developed. They provide algorithms and tool support for the automatic generation of TTCN test cases based on an SDL specification and test purposes in form of MSCs. The SAMSTAG tool is a prototype with several restrictions and limitations. A case study and various discussions have shown that especially an adequate treatment of data and timer is missing. Therefore the goal of the ongoing project is to adapt SAMSTAG to practical needs. The scope of the project also includes investigations in partial order simulation methods for SDL specifications. Such methods may allow a more efficient generation of test cases.

Project: Automatic Generation of Test Purposes

Part of the 2nd series of the 'Priority Programme Informatics' (SPP IF) Module 1: 'Safe Distributed Systems'

Funding: Siemens-Albis AG, Zürich (partially)
Duration: 1.10.94 - 30.9.96
Staff: Jens Grabowski, Prof. Dr. Dieter Hogrefe, Daniel Toggweiler.

The project 'The Automatic Generation of Test Purposes' is part of the second series of the 'Priority Programme Informatics' (SPP IF), Module 1: 'Safe Distributed Systems'. It intends to improve the testing process of communication systems. The international standard ISO/IEC IS 9646 proposes the process of test suite generation to be divided into two steps: Development of test purposes, which select the important behavior of the specification, and Development of the test suite. The second step is treated within the SaMsTaG project. The SPP IF project automatizes the first step of the OSI- Conformance Testing Methodology.

Project: Formal Description Techniques, Architecture and Performance Evaluation for High Speed Protocols

Funding: Swiss National Science Foundation (joint project with EPF Lausanne)
Duration: 1.4.92 - 31.3.96
Staff: at University of Bern: Stefan Leue, Marco Menna, Prof. Dr. D. Hogrefe, at EPF Lausanne: Philippe Oechslin, Guillermo Caal, Juan Martins, Xavier Garcia

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 queuing 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.

Project: MUTEST

Funding: no funding
Duration: not fixed
Staff: Prof. Dr. Dieter Hogrefe in cooperation with other internationally distributed institutions, e.g. GMD Darmstadt and University of Montreal.

The central idea of MUTEST is to compare different FDs of a protocol by letting them generate a test suite each and running them against the test suites generated by the other FDs, as well as against standardized and other test suites.

Other approaches of validation FDs against other FDs and against test suites may be considered as well.

Project: Graphical Methods in the Testing Process

Funding: KWF (Commission for the promotion of scientific research), Siemens-Albis, Alcatel STR
Duration: 1.7.93 - 30.6.95
Staff: Jens Grabowski, Prof. Dr. D. Hogrefe

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 notations, 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.

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

Funding: EEC-RACE Program via BBW (University of Bern is Asso-

ciate Partner in TOPIC)

Duration: 01.07.93 - 31.12.94

Staff: Stefan Leue, Daniel Toggweiler, Prof. Dr. D. Hogrefe, Marco Menna

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 Bern 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).

3.2.2 Network Design

Figure 2 shows a network of a hypothetical customer of a public service provider. The customer uses leased lines and packet switching in order to connect his various geographically distributed sites. The public service provider should be able to offer an optimal combination of services for such a customer. Beyond that, he must be able to change his service offers, e.g. tariffs, new services. He should also be able to optimize his capacity planning based on the requirements of the customers

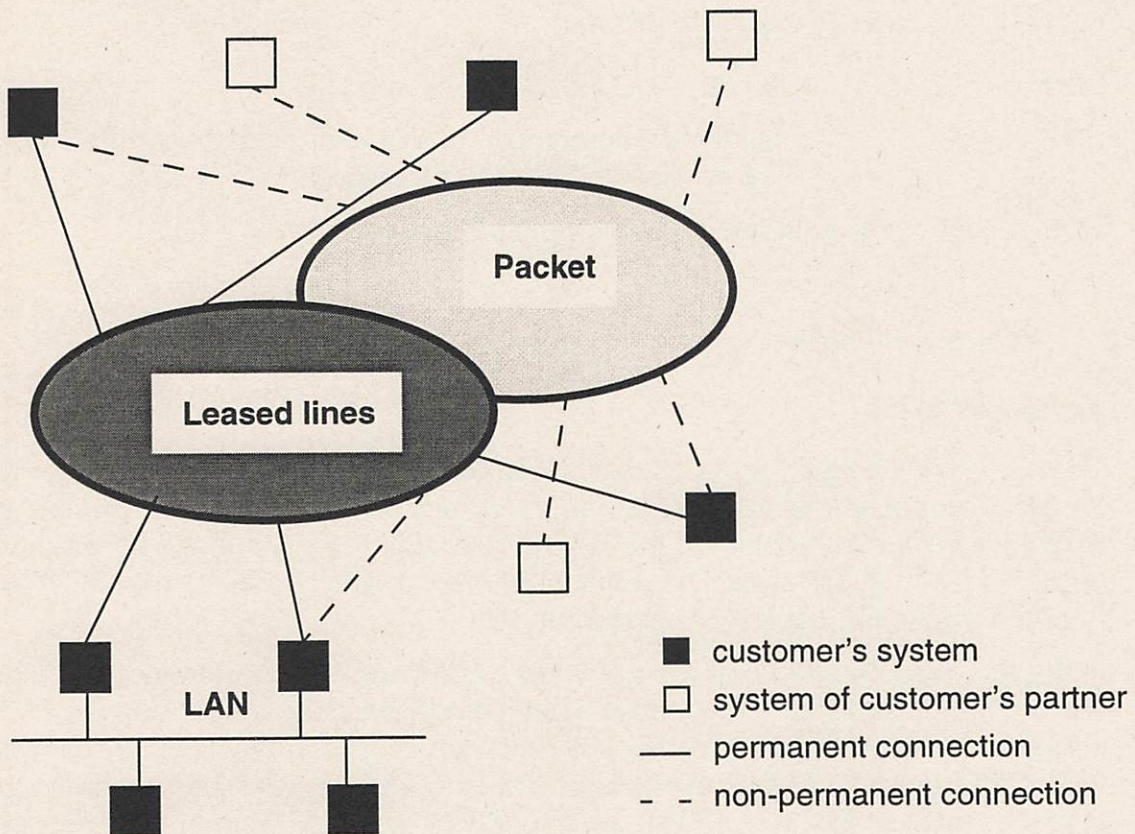


Fig. 2: A private network

The customer has different applications which define requirements for the Net-

works which provide the communication between applications within and outside the enterprise. For example, there are the following applications:

- interactive sessions at terminals (ASCII, X-Windows)
- speech and image transmission (telephone, telefax)
- CAD
- transaction processing
- database queries
- file transfer
- monitoring and controlling

The applications define different requirements for a network 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 to the services comes up. Beyond that, the customer requirements and the existing services give rise to new aspects on service offers, tariffs and capacity planning.

Project: OptiNet

Funding:	Swiss PTT
Duration:	1.1.91 - 31.12.97
Staff:	Matthias Günter (ab 1.1.95), Lukas Spiess, Lorenz Brügger, Daniel Hanhart, Prof. Dr. D. Hogrefe.

This project develops a design tool for private networks.

3.2.3 Network Security

BFI and KOMBV

The project Network Security is a collaboration between the University of Bern and the BFI (Bundesamt für Informatik, Federal Bureau of Computer Science). In 1989, when the hacker intrusion into the BAG (Bundesamt für Gesundheit, Federal Bureau of Health) happened, the section SI (Sicherheit, Security) of the BFI was founded on demand of the Federal Council.

In 1992, it was decided that the networks and information systems of the federal administration shall be embedded in a unique network coordinated by the BFI. This network, called KOMBV (Kommunikation in der Bundesverwaltung, Communication of the Federal Administration), is based on TCP /IP and will be realised in three steps, called KOMBV1, KOMBV2, and KOMBV3 (using ATM) until 1997. For using E-Mail, X.400 and X.500 using TCP /IP as transport layer (RFC 1006) was chosen.

Project: Network Security (NESI)

Funding: BFI
Duration: 1.1.94 - 30.6.95
Staff: Andreas Greulich, Prof. Dr. D. Hogrefe

Project NESI

The section Security (SI) of the Federal Bureau of Computer Science (Bundesamt für Informatik, BFI) is responsible for developing and evaluating security concepts for the Communication of the Federal Administration (Kommunikation in der Bundesverwaltung, KOMBV). As the topology will be quite extended and include many heterogeneous systems, there are special security conditions. Additionally, it is planned to connect the KOMBV with external networks like cantonal (state) network, telecom networks, and mainly the internet. In order to develop security concepts, the project NESI (Netz-Sicherheit, network security) was founded. The University of Bern and the BFI /SI agreed to work together at this project in 1993. The contract was continued in 1994.

At the heart of NESI is an authentication service. Cryptographic algorithms are needed in order to allow strong authentication (equivalent to ITU-T X.509). Hybrid approaches are preferred to symmetric or asymmetric approaches. Those approaches require assigning and distributing certificates.

Current state of NESI

Currently, data, systems, and applications existing in KOMBV are evaluated and assigned the security labels 1 (not classified), 2 (classified), and 3 (secret) using the tool CERIS. Based upon the classification, security measures are proposed. As far as network security is concerned, three main areas of interest exist:

Authentication: As to date, the simple password is the most widely used authentication method. As LANs are easy to tap using ethernet-sniffers and similar devices or programs, this authentication method is not sufficient for many applications. Real hybrid authentication services are expensive to realise. A pragmatic middle way are One-Time password schemes. Of those, Challenge-Response (like Watchword) and simple one-time password systems (like S/Key) are under evaluation. Purely Time-slot based solutions like SecurID are also evaluated, but the former systems will be preferred.

Firewalls: In order to interconnect KOMBV with external networks like internet, firewall concepts are evaluated. Currently, a non-transparent firewall system is running to connect KOMBV with SWITCH (the chosen internet provider), but it will be substituted by a transparent firewall in the near future.

Encryption: According to the DSG (Datenschutzgesetz, data protection law), level-3 data that leave KOMBV have to be encrypted. Thus, encryption techniques are important. In the long range, end-to-end encryption is targeted. Currently, mainly point-to-point encryption is considered.

3.3 Master's Theses

- Ernst, J.: Graphical User Interface for a Network Optimization Tool, January 1994.
- Gautschi, M.: Genetic Algorithms for the Design of Enterprise Networks, January 1994.
- Günther, M.: Generation of TTCN Test Cases Based on SDL Traces, April 1994.
- Gurtner, P.: Case Study for the SAMSTAG Method Based on ITU - T Rec.Q.921, June 1994.
- Koch, B.: Specification and Implementation of a Real-Time System for Controlling of a Mass Spectrometer, June 1994
- Menna, M.: Computer Supported Presentation Techniques, January 1994.
- Rufenacht, C.: The Inclusion of Data Information in Message Sequence Charts, January 1994.
- Scheuner, M.: A Prototype of an IT Security Management Tool, December 1994.
- Scheurer, R.: Case Study ATM Protocol: Specification Methods Using MSC, SDL and TTCN, May 1994.
- Stüssi, P.: Managed Network Services, January 1994.
- Suter, S.: The Analysis of the Message Flow in Asynchronous Test Environments, February 1994.

3.4 Ph.D. Theses

- Grabowski, J.: Test Case Generation and Test Case Specification with Message Sequence Charts. February 1994.
- Leue, S.: Methods and Semantics for Telecommunications Systems Engineering, December 1994.
- Nahm, R.: Conformance Testing Based on FDTs and Sequence Charts, February 1994.
- Spichiger, A.: Testing of Telecommunication Systems Based on ISO/IEC IS 9646, June 1994

3.5 Further Activities

- Member of editorial board of the "Journal of High Speed Networks", IOS Press.
- 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 "15th IFIP Conference on Protocol Specification, Testing and Verification", Warsaw, Poland, June 1995.
- Member of program committee of "Third International Workshop on Feature Interactions in Telecommunications Software Systems", Kyoto, Japan, October 1995.
- Member of program committee of "IFIP Workshop on Protocol Test Systems IWPTS 94", Kogakuin Univ., Tokyo, 8.-10. Nov., 1994.
- Member of program committee of "IFIP Workshop on Protocol Test Systems IWPTS 95", Evry, France, Nov. 1995.
- Member of program committee of Jahrestagung der GI und SI 1995, "Zukünftige Kommunikationsarchitekturen", Zürich, September 1995.
- Founding member of the "SDL Forum Society".
- Member of the "Stiftungsrat SWITCH".
- Chair of the GI working group on "Formal Description Techniques" (FG 3.3.1)
- 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
- Reviewer for NSERC projects (Natural Sciences and Engineering Research Council of Canada)
- Reviewer for full professor positions in Europe, North-America and Asia
- Reviewer for a number of scientific conferences
- Reviewer for Real Time Systems Journal
- Reviewer for IEEE Transactions on Software Engineering
- Reviewer for ACM Computing Reviews
- Reviewer for IBM Systems Journal
- Reviewer for INFORMATIK SPEKTRUM, Springer Verlag
- Reviewer for COMPUTER NETWORKS AND ISDN, North-Holland
- Reviewer for IEE Computers and Digital Techniques, IEE
- Reviewer for IEEE INFOCOM'94, July 1994, Montreal

3.6 Publications

- J. Grabowski: The Generation of TTCN Test Cases from MSCs. Technischer Bericht IAM-94-004, Universität Bern, Institut für Informatik, May 1994.
- J. Grabowski: SDL and MSC Based Test Case Generation - An Overall View of the SAMSTAG Method. Technischer Bericht IAM-94-005, Universität Bern, Institut für Informatik, May 1994.
- J. Grabowski, D. Hogrefe, I. Nussbaumer, A. Spichiger: Improving the Quality of Test Suites for Conformance Tests by Using Message Sequence Charts. In Proceedings of the 'Fourth European Software Quality Conference' in Basel, October 1994.
- J. Grabowski, D. Hogrefe, D. Toggweiler: An Overall View of the SPP IF Project: The Automatic Generation of Test Purposes. In Proceedings 'Priority Programme Informatics Research - Information Conference Module 1: Secure Distributed Systems' in Bern, November 1994.
- J. Grabowski, R. Nahm, A. Spichiger, D. Hogrefe: Die SAMSTAG Methode und ihre Rolle im Konformitätstesten. 'Praxis der Informationsverarbeitung und Kommunikation (PIK) Nr. 4/94', KG Saur Verlag, München, Dezember 1994.
- D. Hogrefe: Framework for formal methods in conformance testing (in Mizuno, Higashino, Shiratori: IWPTS VII, Tokyo), Chapman & Hall, 1994.
- P.B. Ladkin, S. Leue: What Do Message Sequence Charts Mean? In: R.L. Tenney, P.D. Amer, M.U. Uyar (eds.), Formal Description Techniques VI, IFIP Transactions C, Proceedings of the 6th International Conference on Formal Description Techniques, North-Holland, 1994.
- S. Leue: QoS Specification based on SDL /MSC and Temporal Logic, in: G. v. Bochmann, J. de Meer, and A. Vogel (eds.), Proceedings of the Montreal Workshop on Multimedia Applications and Quality of Service Verification, Montreal, May 31 - June 2, 1994.
- S. Leue, Ph. Oechslin: Formalization and Algorithms for Optimized Parallel Protocol Implementation, Proceedings of the IEEE International Conference on Network Protocols ICNP-94, Oct. 25-28, 1994, IEEE Computer Society Press, Boston, Massachusetts, October 1994.
- S. Leue, Ph. Oechslin: Proceedings of the First International Workshop on High Performance Protocol Architectures HIPPARCH'94, Enhancing Integrated Layer Processing using Common Case Anticipation and Data Dependence Analysis, Extended Abstract, INRIA Sophia Antipolis, 1994.
- S. Leue, Ph. Oechslin: From SDL Specification to Optimized Parallel Protocol Implementations, Extended Abstract, in: M. Ito and G. Neufeld (eds.), Proceedings of the Fourth International IFIP Workshop on Protocols for High Speed Networks, Aug. 10-12, 1994, Chapman & Hall, 1994. Full paper with the same title in: M. Ito and G. Neufeld (eds.), Workshop Proceedings of the Fourth International IFIP Workshop on Protocols for High Speed Networks, Aug. 10-12, 1994, pp. 308-328, 1994.

- R. Oppliger; A. Greulich; D. Hogrefe: Authentifikations- und Schlüsselverteilsysteme. Technischer Bericht IAM-94-006, Juni 1994.
- R. Oppliger; D. Hogrefe: Sicherheitsüberlegungen für unternehmensweite Kommunikationsnetze. Telematik-Spektrum, Nr. 1, Februar 1994., Seiten 31 - 33.
- R. Oppliger; D. Hogrefe: Security Concepts for Corporate Networks. Proceedings of the IFIP SEC '94, Curacao, N.A., May 1994
- R. Oppliger: Sicherheit in X.400-Netzen. Telematik-Spektrum, Nr. 2, Mai 1994, Seiten 35 - 37.
- R. Oppliger; Ph.J. Stüssi: Unternehmensweite Kommunikationsnetze Vieweg-Verlag, 1994.
- D. Toggweiler: Realisierung eines SDL Simulations-Tools. Technical Report IAM-94-001, University of Bern, Länggassstr. 51, CH-3012 bern, February 1994.
- J.Grabowski, D. Hogrefe, I. Nussbaumer, A. Spichiger: Combining MSCs and Data Descriptions in order to Generate Executable Test Cases for ISDN Systems. Erscheint in den Proceedings des 'XV International Switching Symposium (ISS'95) - World Telecommunications Congress' in Berlin, April 1995.
- D. Hogrefe, S. Leue: Formal Description Techniques, VII, Proceedings of the Seventh IFIP International Conference on Formal Description Techniques FORTE'94, Chapman & Hall, 1995, to appear.
- P. Ladkin, S. Leue: Interpreting Message Flow Graphs, Formal Aspects of Computing, 32 p., to appear in 1995.
- P. Ladkin, S. Leue: Four Issues Concerning the Semantics of Message Flow Graphs, in: D. Hogrefe and S. Leue (eds.) Formal Description Techniques VII, Proceedings of the Seventh IFIP International Conference on Formal Description Techniques FORTE'94, Oct. 4-7, 1994, Chapman & Hall, 1995, to appear.
- P. Ladkin, S. Leue: Comments on a Proposed Semantics for Basic Message Sequence Charts, The Computer Journal, 3 p., to appear.

4 Research Group on Theoretical Computer Science and Logic

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* financial support from a third party

Guests:	Prof. Dr. S. Artemov (January 1994)
	M. Bianchi (February 1994)
	Dr. R. Dyckoff (November 1994)
	Dr. Th. Glass (November 1994)
	K.-H. Niggl (October - December 1994)
	Prof. Dr. P. Schröder-Heister (January - March 1994)
	Prof. Dr. P. Starke (July 1994)

4.2 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: Th. Glass, G. Jäger, R. Kahle, M. Marzetta, K.-H. Niggli, 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. M. Jonker, P. Schröder-Heister

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 Bern 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 on the interplay between logic and computation.

Research Staff: S. Artemov, G. Jäger, R. Kahle, Th. Strahm, T. Strassen

Supported by the Swiss National Science Foundation

Executable models for analysis and implementation of complex systems

In collaboration with Dr. H. Lienhard, IvyTeam, Zug

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. This system should be improved in the following directions:

- Inclusion of time in the model.
- Extension of the analysis tools.
- New concepts that support efficient modeling of complex systems.

Our contribution to the project in the year 1994 was to improve the analysis tools for SystemSpecs. We developed an algorithm for proving the deadlock-freeness of a Specs-net. This algorithm considers the net structure and the procedural parts (inscriptions) of the Specs-net. The first step in performing the deadlock-analysis consists in the transformation of the problem to a finite problem. The computational complexity of this finite problem can be huge, and we looked for methods to reduce this complexity. We integrated the algorithm into SystemSpecs.

Research Staff: G. Jäger, U.-M. Künzi, P. Starke

Supported by the Swiss National Science Foundation (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 heterogeneous databases. The relevant theoretical problems shall be investigated in our group at the University of Bern, the application oriented problems by Professor Schmid and his group at the Hochschule St. Gallen.

Research Staff: G. Jäger, W. Th. Wolff

Supported by the Swiss National Science Foundation (Schwerpunktprogramm Informatik)

A logics workbench

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

The goal of this project is to provide an interactive system, covering a great variety of propositional logics, including classical, intuitionistic, modal and temporal logics, as well as non-monotonic formalisms. Besides efficient implementations of decision

procedures for the logics mentioned above, additional functions such as computation of normal forms, simplification of formulas and some standard operations are offered by the Logics Workbench (LWB). Furthermore, there is a module concerning the formulas-as-types interpretation allowing for experiments with term calculi (lambda-calculus, combinatory logic). In order to make the Logics Workbench accessible to non-experts as well as a valuable tool for educational purposes, special emphasis has been put on a user-friendly graphical interface and the design of an online information system, which goes — both in depth and spectrum of the material presented — far beyond traditional help systems.

Research Staff: M. Bianchi, R. Dyckoff, A. Heuerding, G. Jäger, S. Schwendimann, M. Seyfried

Supported by the Swiss National Science Foundation (Schwerpunktprogramm Informatik)

4.3 Ph.D. Thesis

- T. Strassen: The basic logic of proofs

4.4 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)

Program Committees

- Member of the program committee of Logical Foundations of Computer Science: Logic at St. Petersburg (G. Jäger)
- Member of the program committee of Proof Theory, Provability Logic, and Computation PPC '94 (G. Jäger)
- Member of the program committee of the Swiss Computer Science Society (G. Jäger, Th. Strahm)

Conferences, Workshops and Summer Academies

- Workshop on applicative theories, Bern, March 1994 (G. Jäger, Th. Strahm)
- International conference on Proof Theory, Provability Logic, and Computation PPC '94, Bern, March 1994 (G. Jäger, Th. Strahm)

- Logikprogrammierung, Sommerakademie der Schweizerischen Studienstiftung, Maienfeld (G. Jäger)

Publications

- B. Büttler, R. Esser, G. Jäger, U.-M. Künzi, H. Lienhard, R. Mattmann: Executable models for analysis and implementation of complex systems, Proceedings Priority Programme Informatics Research: Information Conference Module 1, Secure complex systems, Swiss National Science Foundation, 1994.
- S. Feferman, G. Jäger: Systems of explicit mathematics with non-constructive μ -operator. Part II. Submitted for publication.
- G. Geyer, K. Stanoevska-Slabeva, W. Th. Wolff: Q-Calculus: A framework for representing quantitative knowledge, Proceedings Priority Programme Informatics Research: Information Conference Module 2, Knowledge based systems, Swiss National Science Foundation, 1994.
- A. Heuerding, G. Jäger, S. Schwendimann, M. Seyfried: A logics workbench, Proceedings Priority Programme Informatics Research: Information Conference Module 2, Knowledge based systems, Swiss National Science Foundation, 1994.
- A. Heuerding, G. Jäger, S. Schwendimann, M. Seyfried: Propositional Logics on the Computer, submitted to Fourth Workshop on Theorem Proving with Analytic Tableaux and Related Methods.
- B. Hösli, G. Jäger: About some symmetries of negation, *Journal of Symbolic Logic* 59, 1994.
- G. Jäger, R. F. Stärk: A proof-theoretic framework for logic programming, in S. Buss (ed.), *Handbook of Proof Theory*, North Holland, Amsterdam, to appear.
- G. Jäger, Th. Strahm: Totality in applicative theories, to appear in *Annals of Pure and Applied Logic*.
- G. Jäger, Th. Strahm: Second order theories with ordinals and elementary comprehension, submitted for publication.
- C. M. Jonker and C. Witteveen: Revision by Expansion in Logic Programs, G. Lakemeyer and B. Nebel (editors), *Foundations of Knowledge Representation and Reasoning*, Lecture Notes in Artificial Intelligence 810, pp. 333—355, Springer-Verlag, 1994.
- C. M. Jonker: Constraints and negation in logic programming, Dissertation, Dept. of Philosophy, Utrecht University, *Quaestiones Infnitae* vol. 10, 1994.
- C. M. Jonker: Report on the Workshop Disjunctive Logic Programming and Disjunctive Databases, Fachgespräch FG2 of the IFIP 1994 Conference, *Compulog Newsletter*, to appear.
- U.M. Künzi: Analysis of Specs Petri Nets, Technical Report, 1994.

- Th. Strahm, Partial applicative theories and explicit substitutions, Journal of Logic and Computation, to appear.
- T. Strassen: Syntactical models and fixed points for the basic logic of proofs, Annals of Mathematics and Artificial Intelligence 12, 1994.
- W. Th. Wolff: Von attribuierten Skalenwerten zu Skalentransformationen, Bericht für das Nationalfondsprojekt Nr. 5003-34372, 1994.

5 Research Group on Parallel Computing

5.1 Personnel

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5.2 Research Projects

SPINET

The interdisciplinary SPINET project applies the current possibilities of parallel computing to the generation of biomechanical 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 mechanisms of the muscles involved. The two approaches will be integrated to form a dynamic simulation tool of the spine system. The scientific questions addressed 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. Project has terminated in December 1994.

Collaborations:

Finite element modeling of the spine: Warsaw University of Technology, Poland (Prof. K. Kedzior, PD Dr. T. Zagrajek, M. Matyjewski)

Mathematical modeling 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)

Biomechanical Testing and validation: McGill University, Canada (Prof. M. Aebi and Dr. T. Steffen)

Research staff (at IAM): K. Guggisberg, Dr. P. Kropf, Dr. E. Lederer, M. Müller, J. Schneider

Financial Support: Schwerpunktprogramm Informatik, Swiss National Science Foundation and ESSM

Neural Networks for Automatic Object-Recognition

Different "classical" Object-recognition approaches are compared to neural network methods. The following subjects are currently under research:

- Image segmentation using different multi-resolution feature-extractors (Grey-level, Haralick, Gabor and asymmetric DOG)
- Statistical evaluation of the above feature-extractors Results using the combination of multi-resolution features and SOFMs

Research staff: L. Müller, J. Stiefenhofer, 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 has been investigated. The basic idea is to represent the processes of a parallel program as points in an Euclidian space and to train with these points a self-organizing map (Kohonen network) which has its neurons topologically arranged in the same way as the processors in the computer. After the training of the self-organizing map a process mapping is defined by the winning units of the Kohonen network. Exactly the same process mapping can be used then to execute the program in the parallel computer. The project was completed in January 1994.

Research staff: L. Müller, K. Wyler

BRAINTOOL - An integrated workbench for information process modeling in biological neural networks

BRAINTOOL is an interdisciplinary SPP-project within the priority program Biotechnology (module: neuroinformatics). The aim of the project is to study and simulate the information process in biological neural networks and to develop neuromorphic artificial neural network algorithms and architectures of the 3rd generation. The research work is executed by a collaboration group between the IAM and the institut of physiology (PHY) of the University of Bern and started in March 1994.

Research staff: IAM: Prof. H. Mey, F. Merz, L. Müller, W. Senn, K. Wyler
PHY: Prof. H. Lüscher, M. Larkum, J. Streit, K. Vogt, T. Wanner

Financial support: Schwerpunktprogramm Biotechnologie

5.3 Master's Theses

- Guggisberg, K.: Neuromotorische Stabilitätsregelung der Wirbelsäule - Modelle, Codegenerierung und Simulation (Neuromotoric stability control of the human spine - models, code generation and simulation).
- Müller, M.: Verteiltes dynamisches Loadbalancing — Implementation auf einem Mehrprozessorsystem (Distributed dynamic Load Balancing — Implementation on a Multi Processor System).

5.4 Ph.D. Thesis

- Wyler, K.: Self-organizing process mapping in a multiprocessor system. (Selbstorganisierende Prozesszuordnung in einem Mehrprozessorsystem)

5.5 Further Activities

- International Seminar and Workshop: "Neuronale Netze — Reif für den wirtschaftlichen Einsatz?"

This seminar took place on March 2 and 3, 1994, in Bern with about 60 participants. The seminar was organized to foster scientific contacts and know-how transfer between university and industry. The first day 14 presentations on neural networks and their industrial application were presented by a group of national and international speakers from university and industry. The second day was organized as workshop about development tools for neural networks. During this workshop the participants had the opportunity to gain some practical experience with developing neural network applications.

The workshop was jointly organized by the Parallel Computing Group at the IAM,

NDIT/FPIT (postgraduate formation in computer science and telecommunication), INTEC (Ingenieurschule Bern), Institut für Elektronik der ETH Zürich and Management und Technologie Institut des Zürcher Technoparks and was under patronage of SI (SIPAR and SGAIGO).

5.6 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) (Dr. L. Müller)
- technical expert at the Informatics Dept. at Ingenieurschule Bern (P. Kropf)
- member of the Swiss Science Council (Prof. H. Mey)

5.7 Courses presented at other institutions

- Postgraduate teaching activities (NDIT/FPIT courses): Neural Networks and Genetic Algorithms (L. Müller, K. Wyler), Parallel and Distributed Systems (P. Kropf), Operating-System Tools (J. Stiefenhofer), Information Security and Cryptology (L. Müller), Mathematical Workshop and Numerics (J.E. Boillat (ISBE), L. Müller (IAM), P.Y. Baumann (EISI), R. Müller (ISBE), Ch. Meier (ISBE))

5.8 Publications

- Guggisberg, K, Kropf, P.G, Lederer, E.F.A., Schwab, P. : A Mixed Symbolic-Numerical Environment for the Simulation of Biomechanical Segment Models. In: Halin, J., Karplus, W., Rimane, R. (Eds.) CISS - First Joint Conference of International Simulation, August 22- 25, 1994, p. 553-557
- Schneider, J.G., Lederer, E.F.A and Schwab, P.: The Solution of Systems of Linear Equations using the Conjugate Gradient Method on the Parallel MUSIC-System. In: Aguilar, M. (Ed.) Proceedings of the '94 SIPAR-Workshop on Parallel and Distributed Computing. Fribourg, Switzerland. October 1994, pp. 5 -7
- Schneider, J.G., Lederer, E.A.F., and Schwab, P.: The Solution of Systems of Linear Equations using the Conjugate Gradient Method on the Parallel MUSIC-System. Technical Report, no. IAM-94-014 University of Bern, Institute for Computer Science and Applied Mathematics, 1994.
- Mayjewski, M, Kropf, P.G. and Dietrich, M.: Finite element method simulation

of flow induced deformations in the intervertebral disc. Proceedings of the 1st ISSSL conference.Brussels. August, 1994.

- Kropf, P., Guggisberg, K., Kientsch, M., Lederer, E. A.F. , Matyjewski, M., Müller, M., Schneider, J.G., Schwab, P. and Steffen, Th.: SPINET: An Interdisciplinary Approach to Spine Simulation. Priority Programme Informatics Research, Information Conference Module 3 on Massively parallel systems. Proceedings. Schweizerischer Nationalfonds zu Foerderung der wissenschaftlichen Forschung, November 1994, pp. 1-10.
- Senn, W., Wyler, K., Streit J. and BRAINTOOL.: Dynamics of a Random Neural Network with Synaptic Depression. Submitted to Neural Networks.
- Meier, Ch., Senn, W., Hauser, R. and Zimmermann, M.: Strange limits of host-parasitoid systems. J. Math. Biol. 32, pp. 563-572.
- Müller, L. and Szakacs, A. (eds.): Proceedings of international Seminar and Workshop Neuronale Netze — Reif für den wirtschaftlichen Einsatz?, Bern, March 2—3, 1994.

6 Research Group on Software Composition

6.1 Personnel

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* financial support from a third party

6.2 Research Projects

Composing Active Objects

Traditional software development techniques do not cope well with the needs of open systems, and in particular with rapidly changing requirements. This project aims to develop a new model for object-oriented software composition that cleanly integrates active objects and components, and demonstrate the practical value of the model by applying it to existing component sets. Specifically, this project will develop (1) an object model integrating active objects and components, (2) a composition language, and (3) an experimental component laboratory.

Research Staff: K. Guggisberg, M. Lumpe, T.D. Meijler, T. Richner, J.G. Schneider, P. Varone

This project is supported by the National Science Foundation, grant Nr. 21-40610.94

For further details, see: <http://iamwww.unibe.ch/~scg/Research/cao.html>

6.3 Further Activities

Editorial Boards

- Object-Oriented Systems, Chapman & Hall (Prof. O. Nierstrasz)
- L'OBJET – Logiciel, réseaux, bases de données (Prof. O. Nierstrasz)

Associations

- CHOOSE — Swiss group for Object-Oriented Systems and Environments (Chairman, Prof. O. Nierstrasz)
- AITO — Association Internationale pour les Technologies Objets (Secretary, Prof. O. Nierstrasz)

Program Committees

- World Wide Web Conference '94 (Programme Chair, Prof. O. Nierstrasz)
- ECOOP '94 (Prof. O. Nierstrasz)
- TOOLS Europe '94 (Prof. O. Nierstrasz)
- International Symposium on Object-Oriented Methodologies and Systems '94 (Prof. O. Nierstrasz)
- International Conference on Software Reusability '94 (Prof. O. Nierstrasz)

WWW Activities

- WWW resources in the field of OO research (bibliographies, URL database)
- Maintenance of search engines and related databases in collaboration with the University of Geneva (W3catalog, The Free Compilers List, The Free Database List, The Language List)
- Development of WWW related software

For details, see: <http://iamwww.unibe.ch/~scg>

6.4 Publications

- Object-Oriented Software Composition. Edited by Prof. O. Nierstrasz together with Prof. D. Tschritzis, Prentice Hall, 1995. Scheduled for publication in June 1995. For details, see: <http://iamwww.unibe.ch/~oscar/OOSC>
- Oscar Nierstrasz, "Regular Types for Active Objects," Object-Oriented Software Composition, O. Nierstrasz, D. Tschritzis (Ed.), Prentice Hall, 1995, to appear.
- I. Metz. Finding Neighbours in d-dimensional Binary Digital Images Represented by Bintrees. Proceedings of the 4th Conference on Discrete Geometry for Computer Imagery. Grenoble (F), Sept. 1994.
- Rachid Guerraoui, Oscar Nierstrasz and Michel Riveill (Ed.), Proceedings of the ECOOP '93 Workshop on Object-Based Distributed Programming, LNCS, Springer-Verlag, 1994.
- Oscar Nierstrasz and Theo Dirk Meijler, "Requirements for a Composition Language," Proceedings of the ECOOP '94 Workshop on Coordination Languages, P. Ciancarini, O. Nierstrasz, A. Yonezawa (Ed.), LNCS, Springer-Verlag, 1995, to appear.
- Oscar Nierstrasz and Laurent Dami, "Component-Oriented Software Technology," Object-Oriented Software Composition, O. Nierstrasz, D. Tschritzis (Ed.), Prentice Hall, 1995, to appear.

Appendix A: Teaching Activities

Winter semester 1993/94:

H. Bieri:	Datenstrukturen und Algorithmen Algorithmische Geometrie Praktikum in in Computergrafik Seminar für Diplomanden und Doktoranden
H.P. Blau:	Numerik 1 Einführung in die Programmierung
H. Bunke:	Theoretische Informatik Künstliche Intelligenz Seminar für Diplomanden und Doktoranden
D. Hogrefe:	Computersysteme Software Engineering Computernetze
G. Jäger:	Proseminar: Symbolisches Rechnen Grundlagen der Logik-Programmierung Seminar für Diplomanden und Doktoranden Blockseminar Bern und Zürich: Logik und Informatik Formale Methoden und Reasoning
K. 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

Summer semester 1994:

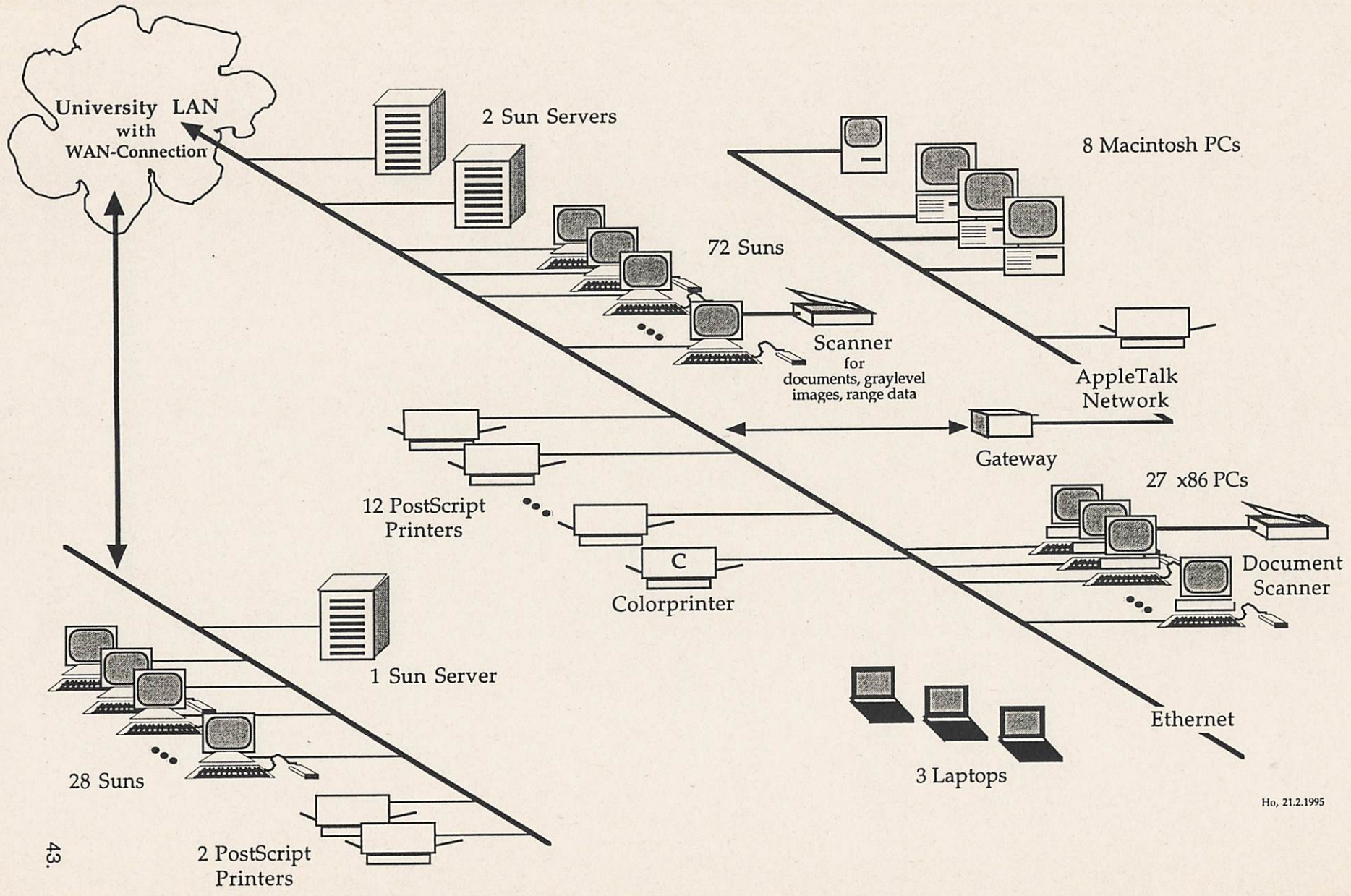
H. Bieri:	Computergrafik 3D-Grafik Räumliche Datenstrukturen
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H.P. Blau:	Anwendungssoftware
H. Bunke:	Compilerbau Praktikum: Expertensysteme Seminar für Diplomanden und Doktoranden
A.-C. Godet:	Informatik-Workshop
D. Hogrefe:	Software Engineering Seminar: Verifikation verteilter Systeme Seminar für Diplomanden und Doktoranden Betriebssysteme
B. Housley:	Computeranwendungen in den Naturwissenschaften
G. Jäger:	Einführung in die theoretische Informatik Logiken für künstliche Intelligenz und Programmierung Seminar für Diplomanden und Doktoranden Blockseminar Bern und Zürich: Logik und Informatik
M. Marzetta:	Unvollständigkeit und Unentscheidbarkeit in der Logik
H. Mey:	Informatik 2
R. Oppliger:	Computersicherheit
A. Scheuing:	Verifikation und Validierung von Software
T. Strassen:	Werkzeuge in der Computeralgebra

Winter semester 1994/95:

S. Amann, A. Collison:	Einführung in die objektorientierte Programmierung mit C++
H.P. Blau:	Programmierung 1
H. Bunke:	Automaten und formale Sprachen Künstliche Intelligenz Seminar für Diplomanden und Doktoranden
E. Dubuis, Th. Bebie:	Praktikum in Computergrafik
D. Hogrefe:	Informatik 1B Computernetze Seminar für Diplomanden und Doktoranden Seminar: Teleteaching
G. Jäger:	Praktikum: Symbolisches Rechnen Logik und Informatik

	Seminar für Diplomanden und Doktoranden
	Blockseminar Bern und Zürich: Logik und Informatik
	Arbeitsgemeinschaft Beweistheorie
	Funktionales Programmieren
M. Marzetta:	Konstruktive Analysis
H. Mey:	Informatik 1A
L. Müller, K. Wyler:	Künstliche neuronale Netze
O. Nierstrasz:	Datenbanken
T. Strassen:	Unifikation
Ch. Streit:	Datenstrukturen und Algorithmen



Ho, 21.2.1995