

Annual Report 2001

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Contents

1	Institute of Computer Science and Applied Mathematics (IAM)	2
1.1	Address	2
1.2	Personnel	2
2	Research Group on Computational Geometry and Graphics	4
2.1	Personnel	4
2.2	Research Projects	4
2.3	Diploma Theses	6
2.4	Applications	7
2.5	Further Activities	7
2.6	Publications	7
3	Research Group on Computer Networks and Distributed Systems	8
3.1	Personnel	8
3.2	Research Projects	9
3.3	Diploma Theses	18
3.4	PhD Thesis	18
3.5	Further Activities	18
3.6	Publications	20
4	Research Group on Computer Vision and Artificial Intelligence	24
4.1	Personnel	24
4.2	Research Projects	25
4.3	Diploma Theses	26
4.4	Further Activities	26
4.5	Publications	27
5	Research Group on Theoretical Computer Science and Logic	32
5.1	Personnel	32
5.2	Research Projects	33
5.3	Diploma Theses	35
5.4	Ph.D. Theses	35
5.5	Habilitation Thesis	35
5.6	Further Activities	36

5.7	Publications	36
6	Research Group on Software Composition	38
6.1	Personnel	38
6.2	Research Projects	38
6.3	Diploma Theses	40
6.4	Ph.D. Theses	40
6.5	Further Activities	40
6.6	Publications	41
A	Teaching Activities	44
A.1	Winter semester 2000/2001	44
A.2	Summer semester 2001	45
A.3	Winter semester 2001/2002	46
B	Colloquium in Informatics	47

1 Institute of Computer Science and Applied Mathematics (IAM)

1.1 Address

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1.2 Personnel

Board of directors

Prof. Dr. Hanspeter Bieri; Prof. Dr. Torsten Braun; Prof. Dr. Horst Bunke;
Prof. Dr. Gerhard Jäger; Prof. Dr. Oscar Nierstrasz.

Docents

Prof. Dr. Hanspeter Bieri; Lecturer Hans Peter Blau; Prof. Dr. Torsten Braun; Prof. Dr. Horst Bunke; Prof. Dr. Gerhard Jäger; PD Dr. Xiaoyi Jiang; Prof. Dr. Oscar Nierstrasz.

Acting chairman

Prof. Dr. Gerhard Jäger.

Administration

René Berliat; Ruth Bestgen; Isabelle Huber (February to April) Therese Schmid; Susanne Thüler; Terri Weibel.

Librarian

Michael Gianfreda (until June); Gudrun Heim (since July).

Technical staff

Florian Baumgartner; Peppo Brambilla.

Scientific staff

Dr. Franz Achermann; Dr. Joel Adler; Luca Alberucci; Lorenz Ammon; Gabriella Arévalo; Roland Balmer; Dr. Florian Baumgartner; Hans-Peter Blau; Peppo Brambilla; Thomas Buchberger; Juan Carlos Cruz; Marc Danzeisen; Ruy de Oliveira; Dr. Stéphane Ducasse; Stefan Fischer; Dr. Manuel Günter; Simon Günter; Corrado Guidobaldi; Pascal Habegger; Fei He; Marc Heisenbüttel; Christophe Irniger; PD Dr. Xiaoyi Jiang; Ibrahim Khalil; Dr. Andrei Kouznetsov; Michel Krebs; Dr. Urs-Martin Künzi; Michele Lanza; Lingqing Liu; Urs-Viktor Marti; Dr. Geoffrey Ostrin; Dieter Probst; Tamar Richner; Matthias Rieger; Vincenzo Salipante; Matthias Scheidegger; Günther Stattenberger; Marc-Alain Steinemann; PD Dr. Thomas Strahm; Dr. Thomas Studer; Sander Tichelaar; Tamas Varga; Thomas Wenger; Marc Wirz; Dr. Roel Wuyts; Matthias Zimmermann.

Number of students in computer science

- Major subject: 222
- Minor subject: 186

2 Research Group on Computational Geometry and Graphics

2.1 Personnel

Head:	Prof. Dr. H. Bieri	Tel.: +41 31 631 8670 email: bieri@iam.unibe.ch
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2.2 Research Projects

d-dimensional general polyhedra

These polyhedra, now called "Nef polyhedra", are those subsets of the d-dimensional Euclidean space that can be obtained by applying a finite number of Boolean set operations to a finite number of linear halfspaces. The project extends the theory of Nef polyhedra, develops and analyses convenient data structures and lays the foundation of an object-oriented implementation of the kernel of a solid modeler for working with Nef polyhedra.

Research staff: H. Bieri, W. Nef

A database system for 3D graphics objects

This project continues previous research done by Andrey Collison (A component-based system for storing and manipulating graphics objects of different representations. The Visual Computer 16(6), 2000). The database system is intended to support the following features: persistency for scene-graph based 3D graphics objects, fine-grained extensional versioning of 3D graphics objects (revisions, alternatives, different representations), multiuser cooperation based on automatic merging of cooperative alternatives, integration of

functionalities and representations of different 3D graphics applications via support for heterogeneous 3D graphics objects.

Research staff: L. Ammon

Creating hierarchical 3D city models

This project continues previous research done by Thierry Matthey (An object-oriented approach to model scenes of buildings. Proceedings of Computer Graphics International 1998). Its goal is the development of a generic city model to be used in miscellaneous multimedia applications. A main problem is the acquisition of the underlying geometric data. Therefore methods are developed that support the semi-automatic generation of the model data from several data sources, as e.g. from city maps or cadastral data. Due to the different accuracies of the input data, a data model supporting multiple levels of detail is being developed. Its refinement and abstraction shall both be supported. In addition to geometric data, the model shall also store topological data. The main focus is put on real-time visualization and interaction abilities. As an example application, the development of the city of Bern as a function of time shall be visualized and animated.

Research staff: Th. Buchberger

Modelling of computer networks with Internet properties

The main goal of this project is the design and implementation of the topology generator GINT (Generator of Internet Network Topologies) that can be used to generate graphs representing network topologies. These topologies show a number of properties that are assumed to be characteristic for the Internet. The Internet, being a loose, dynamic compound of many thousands of single autonomous systems (AS), is represented as an undirected simple graph. The known AS are its vertices, and the existing routing agreements between AS are its edges. GINT is based on a flexible graph framework implemented in Java and containing a number of basic algorithms that operate on graphs. It also provides facilities to verify if topologies generated by GINT or by some other of the existing topology generators show indeed characteristic features of the (interdomain) Internet. The second main goal of this project consists in the development of a new topological model of the Internet, i.e. a hierarchy of graphs growing as a function of time. The available data on the Internet of the last four years is used extensively to validate both, the new generator and the new model.

Research staff: P. Habegger

JMesh: A mesh library in Java

There is much research done at present dealing with triangular meshes in 3D. Currently there doesn't exist any comprehensive software basis in Java that supports and integrates the different approaches of this research. This project intends to build JMesh, i.e. a uniform but flexible framework to experiment with different kinds of mesh data structures and algorithms. The most important basic algorithms for mesh generation, mesh simplification, mesh subdivision, and signal processing on meshes will be included. A number of typical JMesh-based prototype applications will be implemented to investigate the extensibility, efficiency, and reliability of the framework. Although typical target application areas for JMesh will come from research and didactics in computer graphics, JMesh should be useful to application developers too.

Research staff: Th. Wenger

Terrain reconstruction from ordinary road maps

Precise terrain reconstruction from an ordinary road map isn't possible but in certain applications neither necessary. This project consists of two parts: First, a system for the (largely) automatic interpretation of ordinary scanned road maps is being developed. Then a second system for reconstructions is being built, whose core part will be a rule-based system helping to convert road maps (largely) automatically into terrains which are not close approximations to the original terrains but still reasonable and useful.

Research staff: A. Dasen, C. Glauser

2.3 Diploma Theses

- S. K pfer: UniFind - Ein webbasiertes Geografisches Orientierungssystem
- P.C.D. Robert: Real-Time Rendering for Game Applications. The Project O
- A. Dasen: AIS - Ein System f r die automatische Interpretation von Strassenkarten

- Th. Rytz: PARKSIM - Ein Java-basiertes System für die Simulation und Animation von Parkhäusern
- M. Cobo: H-Anim Toolbox - Ein Java-Applet zur Erstellung von virtuellen Akteuren für Web3D-Anwendungen

2.4 Applications

- S. Tetik, Ch. Käser: Implementations for the project artcampus: "Art History 1200 - 2000", Virtual Campus Switzerland (Prof. O. Bätschmann, Dr. J. Nathan, Dr. Ch. Bracht)
- R. Blattner, N. Bonfils: Visualization and animation for the project "Tall al Hamidiya" of the Institute of Ancient Near Eastern Archaeology and Languages (Prof. M. Wäfler, M. Gerber)
- O. Aeberhard, D. Niedermann: Animation for the exhibition "Edle Wirkung" of the Bernese Historical Museum (Peter Jezler, Director)

2.5 Further Activities

- Area editor for Geometric Modeling of the journal The Visual Computer: H. Bieri
- Reviewing for IEEE Transactions on Visualization and Computer Graphics: H. Bieri
- The 15th International Conference on Computer Animation. Member of the Conference Committee: H. Bieri
- Project artcampus: "Art History 1200 - 2000", Virtual Campus Switzerland. Project partner: H. Bieri

2.6 Publications

- D. Bukovac, C. Glauser, M. Helmers: Wie kaputte Statuen unter die Münsterplattform kamen. Unipress Intern, Januar 2001, 13-14
- G. Brunnett, H. Bieri, G. Farin (Eds.): Geometric Modelling. Dagstuhl 1999. Computing Supplement 14. Springer-Verlag 2001. ISBN 3-211-83603-9
- M. Cobo, H. Bieri: A Web3D Toolbox for Creating H-Anim Compatible Actors. Submitted

3 Research Group on Computer Networks and Distributed Systems

3.1 Personnel

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	R. de Oliveira (since April)	Tel.: +41 31 631 3403 email: oliveira@iam.unibe.ch
	M. Scheidegger * (since August)	Tel.: +41 31 631 8692 email: mscheid@iam.unibe.ch
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* with financial support from a third party

3.2 Research Projects

Advanced Network and Agent Infrastructure for the Support of Federations of Workflow Trading Systems (ANAIsoft)

ANAIsoft was a project in the 2nd phase of the SNF CNEC (Competence Network Electronic Commerce) programme. Academic project partners have been the Universities of Zürich and Geneva, EPF Lausanne, and ETH Zürich. In addition, several non-academic partners collaborated within the project: Etat de Vaud, SER Systeme A.G., Swisscom, Swissmetro, TheNet - Internet Services AG. The RVS group provided several mechanisms to set up and monitor mobile virtual private networks (VPNs). In particular, scalable resource provisioning mechanisms for DiffServ VPNs have been designed and evaluated. Monitoring mechanisms based on Java agent technology have been developed and implemented. The monitoring mechanisms are able to monitor whether the parameters negotiated in a service level agreement (SLA) such as delay, bandwidth, and security features such as strong encryption and authentication can really be provided by the Internet Service Provider (ISP) to the customer. The SLA monitoring environment offers a secured interface for direct and generic IP network measurements to customers, peer providers or the ISP's own network management staff. Moreover, a concept called SecMIP (Secure Mobile IP) for providing VPN services to mobile users has been developed by integrating Mobile IP and IP Security protocols. In collaboration with Swisscom Corporate Technology a Linux prototype has been implemented to demonstrate the feasibility of the SecMIP concept. SecMIP allows to keep an active IP communication even if the mobile node's IP address is changing. For both the SLA monitoring work and the Mobile VPN demonstrators have been developed and successfully been presented at the final project site visit.

Research staff: M. Günter, I. Khalil, M. Danzeisen

Financial support: Swiss National Science Foundation Project No. 5003-057753/1

Commercialization of Streamed Information (StreamCom)

StreamCom was another 2nd phase SNF CNEC project. Its main goal was to investigate various problems and issues related to the commercialisation of streamed information. Academic project partners have been EPF Lausanne, as well as the Universities of Geneva, St. Gallen, and Zürich. The

RVS group focused on the development of Quality-of-Service (QoS) support for the streamed information such as video streams. The provider of the StreamCom service can establish, modify, and terminate QoS support for unicast or multicast data streams by delivering the corresponding SLA parameters to a bandwidth broker at the adjacent ISP. The bandwidth broker receives and processes these requests and configures the ISP's routers appropriately. StreamCom data are distributed using multicast and, therefore, the Differentiated Services based QoS support must be able to support IP multicast streams. A protocol has been designed on the basis of the bandwidth broker protocol developed in a previous project (CATI) which allows the StreamCom service provider to negotiate the desired service with the ISP's bandwidth brokers. This protocol has been implemented in Java on a content server responsible for video stream transmission and in C++ on the bandwidth broker. A demonstration scenario has been built in the RVS laboratory and successfully been demonstrated at the final project site visit. Two concepts for network resource usage optimisation in the case of providing QoS to multicast streams have been designed. First, a client authentication mechanism has been introduced, in order to be able to reduce the amount of reservations at runtime to an adequate minimum. Second, a form of measurement based admission control adapted to multicast enables clients to join and leave a running session.

Research staff: R. Balmer, M.Scheidegger

Financial support: Swiss National Science Foundation Project No. 5003-057755/1

Mobile IP Telephony (MIPTel)

The MIPTel project aims to develop and support telephony applications over Differentiated Services (DiffServ) IP networks. Bandwidth Brokers (BBs) are components responsible for managing nodes within a DiffServ domain in order to provide the requested Quality-of-Service (QoS) by the users. Within the project a signaling protocol has been designed and implemented that allows mobile IP systems such as mobile nodes or home agents to specify the QoS demands of mobile users. Additional functionality is needed in the bandwidth broker to handle the case of a mobile user that moves from one access network to another but wants to keep its Quality of Service in the new access network. The protocol itself builds on remote procedure calls (RPC) and can also be used for context transfer between BBs of different domains as well as

for negotiating flow aggregations. This signaling protocol is a main part of an proposed extension to the Authorization, Authentication and Accounting (AAA) architecture. The extension allows mobile users to reserve bandwidth for some flows. This reservation must be negotiated with a bandwidth broker that performs the necessary network reconfigurations. Depending on the routing method the Mobile IP implementation uses different reconfigurations that have to be performed when the mobile host roams from one access network to another. Moreover, the project has investigated the issue of mapping audio data to DiffServ. An audio application has been designed and implemented that can automatically and quickly select the cheapest DiffServ class that is able to provide the desired QoS. This has been achieved by using RTP-based (Real-Time Transport Protocol) QoS monitoring mechanisms.

Research staff: G. Stattenberger, M. Scheidegger, A. Weyland

Financial support: Swiss National Science Foundation Project No. 2100-057077.99/1

QoS Support for the Internet based on Intelligent Network Elements

The project on QoS support in the Internet based on Active Networks includes a collaboration with a research group at Purdue University that already gained experience with Active Networking (AN). AN technology has been applied for management related tasks, i.e. so-called AN capsules (packets carrying programs that can be executed in network nodes such as IP routers) are used to reconfigure routers in order to provide QoS for specific flows in the Internet. This includes topics like traffic conditioning components (especially for Differentiated Services), QoS signalling and routing as well as the development of appropriate multimedia applications, capable to exploit the AN technology benefits. A network emulation tool has been designed and implemented, allowing to combine real network devices like Linux routers with emulated networks. Based on this environment a toolkit for Active Networks emulation has been implemented. Especially the power of AN capsules to configure network devices along a specific path has been investigated. The developed mechanisms support resource reservation for specific flows as well as the establishment of QoS tunnels. The ability of Active Networks to add new services to a network was another focus of this project. A special AN based traffic conditioning mechanism supporting video applications has been developed, implemented and evaluated. Besides the creation

of new services AN technology supports the integration of different concepts to provide Quality of Service. An architecture for Integrated to Differentiated Services mapping has been developed by combining the use of Active Networks for the installation of new functionalities as well as for signalling purposes. Another promising AN application area is the realization of scalable / explicit multicast services for which prototype capsules have been implemented.

Research staff: F. Baumgartner

Financial support: Swiss National Science Foundation Project No. 2100-055789.98/1

Virtual Internet and Telecommunications Laboratory Switzerland

VITELS (project leader: T. Braun) is part of the 1st series of the Swiss Virtual Campus (SVC) projects. The goal is to develop a remote course in English language that provides theory and practical hands-on exercises in the area of telecommunications / computer networks with real network hardware for third year computer science students. Actually, VITELS consists of seven modules designed and maintained by five institutes (Universities of Bern, Fribourg, Geneva, Neuchatel and Engineering School Fribourg). Ongoing work consists in creating and implementing a course architecture that allows the participation of many institutes as course module providers and also the access to the exercise modules by many students located anywhere in the Internet. The architecture includes authentication, authorization and scheduling functions. First prototypes of the IP Security exercise module and the supporting course architecture have been demonstrated. The web-learning platform WebCT leads students through the modules offering a broad spectrum of collaboration and exercise tools with integrated assessment functions. Valuable experiences with similar modules stimulating the design and development of the virtual course modules have already been gained during the development and conduction of a traditional in house network laboratory course in summer semester 2001. In addition to the development of the IP Security module, the development of the module 'Simulation of IP Network Configuration' is going on.

Research staff: M.-A. Steinemann, T. Jampen, S. Zimmerli, E. Kurt

Financial support: Bundesamt für Bildung und Wissenschaft (BBW), Virtual Campus Switzerland Project No. 991043, and University of Bern

National Competence Center in Research for Mobile Information and Communication Systems (NCCR-MICS)

The MICS project will focus usually dispersed efforts towards a single and common goal, namely the creation of an entirely new paradigm for communication and information services, based on the idea of a decentralized, self-organizing network based on (mobile) terminals that could simultaneously work as terminals for users, as well as network nodes connecting inter-user traffic. These multi-purpose terminals are called terminodes (terminal + node). The RVS group especially takes part in the Individual Project 4 about self organizing network layers and investigate novel routing mechanisms for such terminode networks inspired by the behaviour of social insects like ants and the way they forage and explore their neighbourhood. First steps have been made toward the design of such a new routing protocol, and different simulation tools are under evaluation to find an appropriate environment to test these new protocols. Another activity is related to the problem of combining TCP into such a mobile ad-hoc environment. Related approaches to adapt TCP for mobile ad-hoc networks are being analysed.

Research staff: M. Heissenbüttel, R. de Oliveira

Financial support: Swiss National Science Foundation and University of Bern

Service Quality across Independently Managed Networks (SEQUIN)

SEQUIN is a project that involves eight partners (mainly national research network providers) in seven European countries and is co-funded by the European Commission under the Information Society Technologies (IST) Programme. RVS is participating in the project as subcontractor of SWITCH. The project objective is to define and implement an end-to-end QoS approach that will operate across multiple management domains combining distinct network technologies. In this way, SEQUIN will ensure that researchers across Europe have access to network facilities that can be tailored to the requirements of individual groups, thereby offering predictable and stable quality across multiple underlying management domains and networking technologies. The project also intends to address the migration of existing ATM-based

QoS (like the TEN-155 Managed Bandwidth Service) to hybrid environments (like IP over ATM) as well as to pure IP environments (like the existing pan-European research infrastructure called GEANT). So far the project has established a definition for QoS tailored to its goals and test-beds have been set up as well, so that the proposed definitions can be evaluated in a pragmatic approach. RVS has been supporting SWITCH focusing on mainly two aspects: test-bed set-up / measurements and tool development / configuration for QoS monitoring. Specifically, a test-bed connecting the RVS laboratory at Berne to the Poznan laboratory at Poland via the ATM-based TEN-155 has been established and measurements of QoS parameters were performed in order to evaluate the actual capacity of the networks involved. Currently, RVS is investigating potential QoS monitoring tools (SNMP protocol based) to be used by SEQUIN. It includes not only configuration but also adjustments (by new PERL modules inclusion) of existing tools towards SEQUIN requirements.

Research staff: R. de Oliveira

Financial support: SWITCH / EU project IST-1999-20841

Differentiated Services over ATM

This project was a collaboration with NEC Europe Ltd over three years. In its first part the project focused on the implementation of Differentiated Services for Linux Routers in both, Ethernet and ATM networks. The implementation has been tested by various other external organizations, among them a few European telecommunication service providers. The second part of the project during focused on the development of a management software for networks providing QoS for (mobile) users. We have designed and implemented a QoS management API that enables an application programmer to develop QoS management software for heterogeneous networks and various topologies. A generic implementation of this API provides a framework that can support heterogeneous router hardware. As a first application an interface for addressing the Linux router previously developed in this project has been implemented. A generic bandwidth broker to assist a network administrator or a user in configuring a large network to provide QoS for specific flows has been designed and implemented using the API and the Linux Diff-Serv Router implementation. This broker has successfully been tested in the experimental RVS experimentation network and in the research lab of NEC in Heidelberg, Germany. A mobile client software has been implemented that

allows a user to register one or several flows at the bandwidth broker which in turn performs the necessary reservations at the routers. After the mobile client roams to a new access network the previous reservations can be changed to support the traffic from the new location. Those changes can be automatically performed by the bandwidth broker after the new location has been notified.

Research staff: G. Stattenberger

Financial support: NEC Computer & Communication Research Laboratories, Heidelberg, Germany

Next Generation Networks Initiative (NGNi)

The NGN initiative is an open European initiative investigating and analysing standards, identifying technology and market trends and forecasts in the area of network technology for next-generation wired and wireless networks. The QoS group within the umbrella project NGNi identifies and investigates solutions for providing QoS in IPv6-based next generation networks. It also identifies, studies, analyses, and compares various potential QoS technologies for the future Internet and develops roadmaps for the future introduction of QoS technologies. A first deliverable document on ‘Quality of Service Directions, Benchmarking and Roadmaps for IPv6-oriented NGN Multimedia Internetworks’ has been produced together with project partners from BITS Pilani (India), University of Haute-Alsace (France), Universidad Politecnica de Madrid and Versaware (Spain).

Research staff: T. Braun

Financial support: EU project IST-2000-26418

Mobile Wireless Office

This project was established based on the Mobile VPN developments performed within the Anaisoft project. The resulting concept called ‘Secure Mobile IP’ (SecMIP) has been implemented on Linux and installed at a laboratory and demonstration environment at Swisscom. This prototype implementation demonstrates the feasibility of the SecMIP (or ”Mobile Office”) concept. The longer-term vision of the resulting Mobile Office project is on

secure roaming between different access network technologies. In an example scenario, a business traveller is connected to the Intranet while his train arrives in the airport. In this hot spot area of the airport there is a powerful wireless infrastructure deployed such as GPRS or IEEE Wireless LAN (WLAN). The traveller gets connectivity to this broadband infrastructure without being forced to reconnect on the new network and losing his Intranet session. The SecMIP concept has been extended to fit the needs in heterogeneous networks. Support of GPRS, WLAN and Ethernet has been designed and implemented. In addition, an interface was implemented to make an automated decision, which access technology should be used by the software. In collaboration with an external software company Swisscom has transferred the SecMIP concept to Windows platforms. A prototype version of the SecMIP client software was demonstrated. Future activities focus on the evaluation and integration of other access technologies. Considering the growing research activities in ad-hoc networking, technologies such as Bluetooth and security issues in mobile ad-hoc networks will be of special interest.

Research staff: M. Danzeisen, S. Winiker

Financial support: Swisscom AG

Easy Accessible Voice Gateway between Mbone and ISDN/PSTN Networks

This project was aiming for an easy access solution for ISDN/PSTN users to join IP multicast (MBone) sessions. An easy accessible voice gateway between MBone and ISDN/PSTN networks has been implemented on Linux. The gateway's functionality contains gateway control and administration mechanisms. It utilizes some available public domain software to achieve necessary functionalities. With this solution, users can easily set up voice conferences with mobile WAP phones or web browsers, and join in multicast sessions using (mobile) telephones. Another possible application area is the retrieval of Internet audio streaming data via any telephone end system.

Research staff: L. Liu

Financial support: Bundesamt für Berufsbildung und Technologie (BBT) / Kommission für Technologie und Innovation (KTI) Project No. 4486.1, and Telscom AG, Bern

Management of QoS-VPNs on Linux Routers

The combination of VPNs and DiffServ based QoS appeared to be a promising approach for corporation communication infrastructure. However, the management of QoS enabled VPN could be time consuming and error-prone. This project aimed to present a framework for the web-based management approach regarding the related problems, specifically with the combination of FreeS/WAN IPsec and DiffServ on Linux routers. Various related issues have been discussed and analysed. The DiffServ package in Linux platform has been upgraded to kernel version of 2.2.19 and configuration scripts have been implemented in order to establish QoS-VPN in provider environments.

Research staff: L. Liu

Financial support: Bundesamt für Berufsbildung und Technologie (BBT) / Kommission für Technologie und Innovation (KTI), project no. 5157.1 and TheNet Internet Services AG

Test-bed for Mobile and Internet Communications

An experimental test network serves for the implementations performed within the various research projects mentioned above. The network consists of Linux Routers and an Ethernet Switch, that allows the simple configuration of various network topologies. The Linux Routers support the IPv4 and IPv6 protocols as well as Differentiated Services, IPsec encryption, Mobile IP and IP Multicast, all based on open source implementations. Several experiments for service provisioning and video streaming in multicast networks have been performed. Two multi-processor computers are being used for network emulation and the evaluation of active networking implementations. Several measurements were performed for QoS evaluation in the TEN-155 network between the Universities of Berne and Poznan in Poland. Those experiments used several of the available commercial routers and switches.

Research staff: R. Balmer, F. Baumgartner, G. Stattenberger, R. de Oliveira

Financial support: Stiftung zur Förderung der wissenschaftlichen Forschung an der Universität Bern

3.3 Diploma Theses

- Marc Danzeisen: Secure Mobile IP Communication, May 2001
- Matthias Scheidegger: IP-Telefonie über Differentiated Services, June 2001
- Attila Weyland: Mobile-Controlled Handover in Wireless LANs, December 2001

3.4 PhD Thesis

- Manuel Günter: Management of Multi-Provider Internet Services with Software Agents, June 2001

3.5 Further Activities

Awards

- Best Paper Award for the Paper ‘A Range-Based SLA and Edge Driven Virtual Core Provisioning in DiffServ-VPNs’ presented at the 26th Annual IEEE Conference on Local Computer Networks (Ibrahim Khalil and Torsten Braun)
- Fachpreis Mathematik/Informatik for the Ph.D. thesis ‘Management of Multi-Provider Internet Services with Software Agents’ (Manuel Günter)

Memberships

- SWITCH Stiftungsrat (Torsten Braun)
- SWITCH Stiftungsratsausschuss (Torsten Braun)
- SPEEDUP Society Committee (Torsten Braun)
- Swiss Representative of COST 263 Action ‘Quality of future Internet Services’ (Torsten Braun)
- Professor election committees at University of Zürich and ETH Zürich (Torsten Braun)
- Ph.D. Jury of Alex Villazon (University of Geneva) (Torsten Braun)
- Expert for Diploma Exams at FH Bern (Torsten Braun)

Conference Program Committees

- 10th IEEE International Conference on Computer Communications and Networks (ICCCN 2001), October 15-17, Scottsdale AZ, USA (Manuel Günter)
- 29th SPEEDUP Workshop on Distributed Computing and High-Speed Networks University of Bern, Switzerland, March 22 - 23, 2001 (Torsten Braun, Chair)
- Applications & Services in Wireless Networks (ASW'2001), Evry (Paris), France, July 25-27, 2001 (Torsten Braun)
- 2001 IEEE Workshop on High Performance Switching and Routing (HPSR 2001), Dallas, Texas, USA, May 29-31, 2001 (Torsten Braun)
- 26th IEEE Annual Conference on Local Computer Networks (LCN 2001), November 14-16, 2001, Tampa FL, USA (Torsten Braun)
- GI/ITG-Fachtagung Kommunikation in Verteilten Systemen (KiVS'01), February 20-23, 2001, Hamburg, Germany (Torsten Braun)
- 11th IEEE Workshop on Local and Metropolitan Area Networks (LAN-MAN2001), March 18-21 2001, Boulder CO, USA (Torsten Braun)
- Advanced Internet Charging and QoS Technology (ICQT'01) Workshop of "Informatik 2001", Part of the GI and OCG General Annual Meeting, Vienna, Austria, September 26-28, 2001 (Torsten Braun)

Reviewing and Editor Activities

- Editor of Electronic Notes in Future Generation Computer Systems, Elsevier (Torsten Braun)
- Computer Networks Journal, Elsevier (Torsten Braun)
- Computer Communications Journal, Elsevier (Torsten Braun)
- International Conference on Communications (ICC), Helsinki, Finland, June 11-15, 2001 (Torsten Braun)
- IEEE Infocom, Anchorage, Alaska, USA, April 22-26, 2001 (Torsten Braun)

- Journal of Parallel and Distributed Computing (JPDC), Special Issue: "Mobile and Wireless Ad Hoc Networking and Computing", Academic Press
- International Conference on Networking (ICN'01), Colmar, France, July 9-13 (Torsten Braun)
- First IFIP Conference on E-Commerce, E-Business, E-Government 2001, Zürich, October 3-5, 2001 (Torsten Braun)
- Evaluator of EU-IST project proposals (T. Braun)

Tutorials

- Torsten Braun: IP Next Generation, GI/ITG-Fachtagung Kommunikation in Verteilten Systemen (KiVS2001), February 20, 2001, Hamburg, Germany

Organized Events

- 29th SPEEDUP Workshop on Distributed Computing and High-Speed Networks University of Bern, Switzerland, March 22 - 23, 2001

3.6 Publications

Journal and Conference Papers

- Torsten Braun: Distributed Computing and High-Speed Networks, Electronic Notes in Future Generation Computer Systems, Volume 1, Elsevier, <http://www.elsevier.nl/locate/enfgcs>
- Florian Baumgartner and Torsten Braun: Distributed Emulation of IP Networks, 29th Speedup Workshop, Berne 2001, Electronic Notes in Future Generation Computer Systems, Volume 1, Elsevier, <http://www.elsevier.nl/locate/enfgcs>
- Manuel Günter and Torsten Braun: A Fast and Trend-Sensitive Function for the Estimation of Near-Future Data Network Traffic Characteristics, in B. Bodnar (ed.): Applied Telecommunication Symposium (ATS01), Seattle, USA, 22-26 April, 2001, SCS Simulation Series, Vol. 33, No. 3, ISBN 1-56555-235-0, pp.141-146

- Linqing Liu and Torsten Braun: Easy Accessible Voice Gateway between Mbone and ISDN/PSTN Networks, 2nd IP-Telephony Workshop, Columbia University, New York, April 2-3, 2001, pp. 149-158, http://www.fokus.gmd.de/events/iptel2001/pg/final_program/25.pdf
- Torsten Braun, Manuel Günter, and Ibrahim Khalil: Management of Quality of Service Enabled VPNs, IEEE Communications Magazine, Vol. 39, No. 5, May 2001, ISSN 0163-6804, pp. 90-98
- Günther Stattenberger, Torsten Braun, and Marcus Brunner: A Platform-Independent API for Quality of Service Management, IEEE Workshop on High Performance Switching and Routing (HPSR2001), Dallas, Texas, USA, May 29-31, 2001, ISBN 0-7803-6711-1, pp. 255 - 259
- Torsten Braun, Li Ru, and Günther Stattenberger: An AAA Architecture Extension for Providing Differentiated Services to Mobile IP Users, Proceedings of the 6th IEEE Symposium on Computers and Communications (ISCC 2001), Hammamet, Tunisia, July 3-5, 2001, ISBN 0-7695-1177-5, pp. 472-478
- Torsten Braun and Linqing Liu: Multicast for Small Conferences, Proceedings of the 6th IEEE Symposium on Computers and Communications (ISCC 2001), Hammamet, Tunisia, July 3-5, 2001, ISBN 0-7695-1177-5, pp. 145-550
- Manuel Günter, Marc Brogle, and Torsten Braun: Secure Communication: A new Application for Active Networks, in P. Lorenz (ed.): Networking - ICN 2001, Part II, International Conference on Networking (ICN'01), Colmar, France, July 9-13, 2001, Springer LNCS 2094, ISBN 3-540-42303-6, pp. 206-216
- Günther Stattenberger and Torsten Braun: QoS Provisioning for Mobile IP Users, in H. Afifi, D. Zeghlache (eds.): Applications & Services in Wireless Networks, Evry (Paris), France, July 25-27, 2001, Hermes Science, ISBN 2-7462-0305-7, pp. 41-50
- Linqing Liu and Torsten Braun: Easy Accessible Voice Gateway for Between Mbone and ISDN/PSTN Networks, in O. Johnson, K. Waefler, G. Zeibekakis (eds.): 7th International Netties Conference / 3rd International Conference on New Learning Technologies, University of Applied Sciences of Western Switzerland, Fribourg, Switzerland, September 13-15, 2001. ISBN 2-940156-21-2, pp. 6.4.1

- Roland Balmer, Manuel Günter, and Torsten Braun: Video Streaming in a DiffServ/IP Multicast Network, Workshop Advanced Internet Charging and QoS Technologies (ICQT), in: K. Bauknecht, W. Brauer, Th. Mück (eds.): Informatik 2001 - Wirtschaft und Wissenschaft in der Network Economy - Visionen und Wirklichkeit, Tagungsband der GI/OCG-Jahrestagung, Band I, September 25-28, 2001, Vienna, ISBN 3-85403-157-2, pp. 159-165
- Marc Danzeisen and Torsten Braun: Secure Mobile IP Communication: Workshop Mobile Communication over Wireless LAN: Research and Applications, in: K. Bauknecht, W. Brauer, Th. Mück (eds.): Informatik 2001 - Wirtschaft und Wissenschaft in der Network Economy - Visionen und Wirklichkeit, Tagungsband der GI/OCG-Jahrestagung, Band I, September 25-28, 2001, Vienna, ISBN 3-85403-157-2, pp. 562-567
- Ibrahim Khalil and Torsten Braun: Implementation of a Bandwidth Broker for Dynamic End-to-End Capacity Reservation over Multiple Diffserv Domains, 4th IFIP/IEEE International Conference on Management of Multimedia Networks and Services (MMNS), Chicago, USA, Oct 29 - Nov 1, 2001
- Günther Stattenberger and Torsten Braun: Providing Differentiated Services to Mobile IP Users, Proceedings 26th Annual IEEE Conference on Local Computer Networks (LCN'2001), Tampa, USA, November 15-16, 2001, ISBN 0-7695-1321-2, pp. 89-90
- Ibrahim Khalil and Torsten Braun: A Range-Based SLA and Edge Driven Virtual Core Provisioning in DiffServ-VPNs, Proceedings 26th Annual IEEE Conference on Local Computer Networks (LCN'2001), Tampa, USA, November 15-16, 2001, ISBN 0-7695-1321-2, pp. 12-21
- Torsten Braun and Marc Danzeisen: Secure Mobile IP Communication: Workshop on Wireless Local Networks, Proceedings 26th Annual IEEE Conference on Local Computer Networks (LCN'2001), Tampa, USA, November 15-16, 2001, ISBN 0-7695-1321-2, pp. 586-593
- Torsten Braun and Marc Danzeisen: Mobile Virtuelle Private Netze, SWITCHjournal 2/2001, November 2001, pp. 28-30

Technical Reports

- Florian Baumgartner: Virtual Router User Manual and API Description, Technical Report IAM-01-001, University of Berne, December

2001

- R. Banerjee, J. Quemeda, P. Lorenz, T. Braun, B. Martinez: Quality of Service Directions, Benchmarking and Roadmaps for IPv6-oriented NGN Multimedia Internetworks, NGNi Deliverable, November 2001, <http://ipv6.bits-pilani.ac.in/ngni/NGNI-QoS-D1-v1-2-Secure.pdf>
- Matthias Scheidegger: StreamCom QoS Reservation Architecture: Design of Network Elements, StreamCom Project Deliverable, November 2001, <http://www.iam.unibe.ch/~rvs/publications/scom-design-ne.pdf>
- Thomas Bodenmann: Aufbau eines IPv4/IPv6 - Experimentiernetzes, Informatikprojekt, March 2001
- Thomas Jampen: Java API for PGP, Informatikprojekt, April 2001
- Marco Studer: Drei Module für das Praktikum Computernetzwerke, Informatikprojekt, July 2001

4 Research Group on Computer Vision and Artificial Intelligence

4.1 Personnel

Head:	Prof. Dr. H. Bunke	Tel: +41 31 631 44 51 email: bunke@iam.unibe.ch
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	Ch. Irniger*	Tel: +41 31 631 49 87 email: irniger@iam.unibe.ch
	Dr. U.-V. Marti (until February)	marti@iam.unibe.ch
	T. Varga	Tel: +41 31 631 33 27 email: varga@iam.unibe.ch
	M. Zimmermann*	Tel: +41 31 631 48 65 email: zimmerma@iam.unibe.ch
Guests:	Prof. J. Csirik	University of Szeged, Hungary January
	A. Ngatse*	University of Dakar, Senegal January – February
	L. de Santos*	University of Algarve, Faro, Portugal January – March
	Prof. I. Bruha	Mc Master University, Ontario, Canada February – March
	Prof. A. Kandel	University of South Florida, USA May – June
External collaborator:	PD Dr. X. Jiang	Tel: +41 31 631 33 24 email: jiang@iam.unibe.ch

* with financial support from a third party

4.2 Research Projects

Document Image Analysis and Understanding

A variety of problems occurring in the context of document image analysis are being investigated. These include the processing and recognition of both machine printed and handwritten documents. Current focus is on handwriting recognition, particularly on general text recognition and the use of natural language processing techniques. Also multiple classifier systems and their application to handwriting recognition are under investigation.

Research staff: S. Günter, Dr. U.-V. Marti, M. Zimmermann, T. Varga

Graph Matching Algorithms and Applications

Graphs are a flexible and powerful representation mechanism that has been successfully applied in computer vision, pattern recognition and related areas. When graphs are used to represent objects of a particular domain, the recognition problem turns into the task of graph matching. In this project we study a variety of issues, including efficient algorithms for graph matching, the adaptation of concepts and techniques based on vector representations to the domain of graphs, and special classes of graphs that allow matching with polynomial complexity.

Research staff: Ch. Irniger, PD Dr. X. Jiang, Prof. Dr. H. Bunke, F. He, C. Guidobaldi

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 prototypes stored in a database. In this project, we aim at developing new symbolic matching and parsing algorithms for a variety of applications.

Research staff: Prof. Dr. H. Bunke

Automatic Diatom Identification and Classification

The ADIAC project is a pilot study concerning the application of image processing and pattern recognition tools to the automation of diatom identification by computer processing. The project is divided into several subtasks which are solved by different European institutes. At the IAM a solution is searched to identify the shapes in a first step based on their valve outline, and in a second step based on the valve ornamentation. Several feature extraction methods have been implemented and the performance of different classification approaches is evaluated in order to obtain robust algorithms to identify unknown diatoms.

Research staff: S. Fischer

4.3 Diploma Theses

- Abegglen, K.: Berechnung von Medianstrings
- Baldissera, M.: Formbasierte Suche in Dichtungsdatenbanken
- Gilomen, K.: Texturbasierte Identifikation von Diatomeen
- Nemeč, B.: Validierung von Registrierungen in der Computerassistierten Chirurgie

4.4 Further Activities

Editorial Boards and Committees

- Executive Committee member of the Int. Association for Pattern Recognition, IAPR (H. Bunke)
- 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 the International Journal on Document Analysis and Recognition (H. Bunke)
- Member of the editorial board of Pattern Analysis and Applications (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)

Program Committees

- Spanish Symposium on Pattern Recognition and Image Analysis, Castellan, Spain, May 14 - 18, 2001 (H. Bunke)
- 3rd Int. Conference on Audio- and Video-based Biometric Person Authentication, Halmstad, Sweden, June 6 - 8, 2001 (H. Bunke)
- 2nd Int. Workshop Multiple Classifier Systems, Cambridge, UK, July 2 - 4, 2001 (H. Bunke)
- 3rd Int. Conference on Advanced Concepts for Intelligent Vision Systems, Theory and Applications, Baden-Baden, Germany, July 30 - Aug 3, 2001 (H. Bunke)
- 4th IAPR Int. Workshop on Graphics Recognition, Kingston, Ontario, Sept 7 - 8, 2001 (H. Bunke)
- 1st Int. Workshop on Web Document Analysis, Seattle, Sept 8, 2001 (H. Bunke)
- Workshop on Document Layout Interpretation and its Applications, Seattle, Sept 9, 2001 (H. Bunke)
- 6th International Conference on Document Analysis and Recognition, Seattle, Sept 10 - 13, 2001 (H. Bunke)
- 11th Int. Conference on Image Analysis and Processing, Palermo, Sept 26 - 28, 2001 (H. Bunke)
- 10th Int. Conference on Fuzzy Systems, Melbourne, Dec 2 - 5, 2001 (H. Bunke)

4.5 Publications

Books

- Kandel, A., Last, M., Bunke, H. (Eds.): Data Mining and Computational Intelligence, Physica Verlag, 2001

- Bunke, H., Caelli, T. (Eds.): Hidden Markov Models - Applications in Computer Vision, World Scientific, 2001 (also available as Special Issue of Int. Journal of Pattern Recognition and Art. Intelligence, Vol 15, No 1)
- Jiang, X., Bunke, H. (Eds.): Image/Video Indexing and Retrieval, Special Issue of Pattern Recognition Letters 22, Issue 5, April 2001

Journal Publications

- Jiang, X., Muenger, A., Bunke, H.: On median graphs: properties, algorithms, and applications, IEEE Trans. Pattern Analysis and Machine Intell. 23 (10), 2001, 1144 - 1151
- Marti, U.-V., Bunke, H.: Using a statistical language model to improve the performance of an HMM-based cursive handwriting recognition system, Int. Journal of Pattern Recognition and Art. Intelligence 15, 2001, 65 - 90
- Yu, K., Jiang, X., Bunke, H.: Sentence lipreading using hidden Markov model with integrated grammar, Int. Journal of Pattern Recognition and Art. Intelligence 15, 2001, 161 - 176
- Shearer, K., Bunke, H., Venkatesh, S.: Video indexing and similarity retrieval by largest common subgraph detection using decision trees, Pattern Recognition 34, 2001, 1075 - 1091
- Shearer, K., Venkatesh, S., Bunke, H.: Video sequence matching via decision tree path following, Pattern Recognition Letters 22, 2001, 479 - 492
- Schneider, M., Bunke, H., Kandel, A.: Using fuzzy logic to match strings in documents, Int. Journal of Intelligent Systems 16, 2001, 609 - 619
- Rodriguez, W., Last, M., Kandel, A., Bunke, H.: Geometric approach to datamining, Int. Journal of Image and Graphics, Vol. 1, No. 2, 2001, 363 - 386
- Bunke, H., Günter, S.: Weighted Mean of a Pair of Graphs, Computing 67 (3), 2001, 209-224
- Baechler, R., Bunke, H., Nolte, L.-P.: Restricted surface matching - numerical optimization and technical evaluation, Computer Aided Surgery 6, 2001 , 143 - 152

- Bunke, H., Fabregas, X., Kandel, A.: Rule-based object similarity, *Mathware and Soft Computing* 8, 2001, 113 - 128

Refereed Conference Proceedings and Edited Books

- Bunke, H., Günter, S., Jiang, X.: Towards bridging the gap between statistical and structural pattern recognition: two new concepts in graph matching, in S. Singh, N. Murshed, W. Kropatsch (eds.): *Advances in Pattern Recognition - ICAPR 2001*, Springer Verlag, LNCS 2013, 2001, 1 - 11
- Bunke, H.: Recent advances in structural pattern recognition with applications to visual form analysis, in C. Arcelli, L. Cordella, G. Sanniti di Baja (eds.): *Visual Form 2001*, Springer Verlag, LNCS 2059, 2001, 11 - 23
- Bunke, H., Gori, M., Hagenbuchner, M., Irniger, Ch., Tsoi, A. C.: Generation of image databases using attributed plex grammars, in J.-M. Jolion, W. Kropatsch, M. Vento (eds.): *Proc. 3rd IAPR-TC15 Workshop on Graph-based Representations in Pattern Recognition*, 2001, 200 - 209
- Günter, S., Bunke, H.: Validation indices for graph clustering, in J.-M. Jolion, W. Kropatsch, M. Vento (eds.): *Proc. 3rd IAPR-TC15 Workshop on Graph-based Representations in Pattern Recognition*, 2001, 229 - 238
- Irniger, Ch., Bunke, H.: Graph Matching: Filtering large databases of graphs using decision trees, in J.-M. Jolion, W. Kropatsch, M. Vento (eds.): *Proc. 3rd IAPR-TC15 Workshop on Graph-based Representations in Pattern Recognition*, 2001, 239 - 249
- Marti, U.-V., Bunke, H.: Use of positional information in sequence alignment for multiple classifier combination, in J. Kittler, F. Roli (eds.): *Multiple Classifier Systems, MCS 2001*, LNCS 2096, Springer, 2001, 388 - 398
- Dickinson, P., Bunke, H., Dadej, A., Kraetzel, M.: Application of median graphs in detection of abnormalous change in communication networks, *Proc. World Multiconference on Systemics, Cybernetics and Informatics*, Orlando, 2001, Vol 5, 194 - 197

- Campbell, S., Kumar, M., Bunke, H.: Parallel subgraph matching on a hierarchical interconnection network, in H.-N. Teodorescu, L.C. Jain, A. Kandel (eds.): *Hardware Implementation of Intelligent Systems*, Physica Verlag, 2001, 245 - 275
- Fischer, S., Bunke, H.: Automatic identification of diatoms using decision forests, in Perner, P. (ed.): *Machine Learning and Data Mining in Pattern Recognition*, Springer, 2001, 173 - 183
- Marti, U.-V., Messerli, R., Bunke, H.: Writer identification using text line based features, *Proc. 6th Int. Conference on Document Analysis and Recognition*, 2001, 101 - 105
- Marti, U.-V., Bunke, H.: Text line segmentation and word recognition in a system for general writer independent handwriting recognition, *Proc. 6th Int. Conference on Document Analysis and Recognition*, 2001, 159 - 163
- Marti, U.-V., Bunke, H.: On the influence of vocabulary size and language models in unconstrained handwritten text recognition, *Proc. 6th Int. Conference on Document Analysis and Recognition*, 2001, 260 - 265
- Perroud, T., Sobottka, K., Bunke, H., Hall, L.: Text extraction from color documents - clustering approaches in three and four dimensions, *Proc. 6th Int. Conference on Document Analysis and Recognition*, 2001, 937 - 941
- Sobottka, K., Cris, C., Zuber, P., Bunke, H.: Obstacle tracking in registered range and reflectance image sequences using multivalued template matching, in J. Blanc-Talon, D. C. Popescu (eds.): *Imaging and Vision Systems: Theory, Assessment and Applications*, Nova Science Publ., 2001, 281 - 301
- Dick, S., Schenker, A., Last, M., Bunke, H., Kandel, A.: Re-granulating a fuzzy rulebase, *Proc. 10th IEEE Int. Conf. on Fuzzy Systems*, Melbourne, 2001
- Bayer, M., Pullan, M., Mann, D., Juggins, S., Ciobanu, A., Santos, L., Shahbazkia, H., du Buf, H., Fischer, S., Bunke, H., Wilkinson, M., Roerdink, J., Pech-Pacheco, J., Cristobal, G., Cirimele, V., Ludes, B.: ADIAC: Using computer vision technology for automatic diatom identification, in Economou-Amilli, A. (ed.): *Proc. of the 16th Int. Diatom Symposium*. University of Athens, Greece, 2001, 537 - 562

- Rodrigues, W., Last, M., Kandel, A., Bunke, H.: 3-dimensional curve similarity using string matching, Proc. 3rd Int. Symposium on Intelligent Manufacturing Systems, Sakarya, Turkey, 2001

Unrefereed Papers and Technical Reports

- Jiang X., Bunke H.: Preface, Pattern Recognition Letters 22, 2001, 445 - 446
- Zimmermann, M., Bunke, H.: Hidden Markov Model Length Optimization for Handwriting Recognition Systems, Technical Report IAM-01-003, University of Bern, Switzerland, 2001
- Zimmermann, M., Bunke, H.: Automatic Segmentation of the IAM Offline Database for Handwritten English Text, Technical Report IAM-01-004, University of Bern, Switzerland, 2001

5 Research Group on Theoretical Computer Science and Logic

5.1 Personnel

Head:	Prof. Dr. G. Jäger	Tel: +41 31 631 85 60 email:jaeger@iam.unibe.ch
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Guests:	Dr. G. Lenzi (November)	

* with financial support from a third party

5.2 Research Projects

Logic and Computation

This very general 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 typical questions in computer science like termination and correctness of functional programs, properties of distributed systems and the like.

We study applicative theories as well as strongly typed formalisms and are interested in the connections to constructive and explicit mathematics. Furthermore, we are interested in analyzing the close connections between the complexities of computations and proofs in suitable formalizations, ranging from propositional calculi up to abstract frameworks for computations (in higher types).

Some of the relevant key-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, distributed computing.

Research staff: All members of research group

Algebraic and Logical Aspects of Knowledge Processing

Several research problems from the general area of knowledge representation are being investigated. They are directed towards the mathematical foundations 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. applicative theories, type theories, modal logics, 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: G. Jäger, G. Ostrin, D. Probst, V. Salipante, Th. Strahm, Th. Studer, M. Wirz

Financial support: Swiss National Science Foundation

Inference and Deduction: An Approach Integrating Logic and Probability

In collaboration with: Prof. Dr. J. Kohlas.

Inference in its general setting subsumes reasoning under uncertainty. This is a domain of great importance in the actual development of information technology. Correspondingly big and growing interest in this field and impressive progress can be observed. Different, symbolic and numerical formalisms for inference under uncertainty have been elaborated. Among symbolic approaches nonmonotonic logics of different kinds play a predominant role. Probability theory, belief functions and fuzzy systems are the best known representants of numerical approaches to uncertainty.

Inference is closely related to deduction. Inference under uncertainty involves an appreciation of the reliability of the deductions. This points to a close interaction of logic (for deduction) and probability (for reliability). Several propositions have been made so far as to how combine logic with probability. The project presented here proposes to study a particular way to do this, which is different to the other formalism presented in the literature: it is a theory of the reliability of deduction with probable (not fully reliable) arguments and can be labeled as probabilistic argumentation.

The project proposes to study three themes: the first is a comparison of inference and deduction mechanisms for dealing with uncertainty, partial and distributed information. This will help to situate our proposed approach of probabilistic argumentation systems in terms of descriptive power and computational efficiency with respect to other formalisms of nonmonotonic logic, probabilistic logic, Bayesian networks, belief functions, etc. The second theme concerns the inference architecture of probabilistic argumentation and treats basic questions such as modularity, focusing of deduction, distributed reasoning and reasoning with temporal information. The third subject finally is computational logic. This is the basic ingredient for the deductive part of inference under uncertainty.

Research staff: L. Alberucci, P. Balsiger, P. Brambilla, G. Jäger, A. Kouznetsov

Financial support: Swiss National Science Foundation

ViLoLa - A virtual logic laboratory

In collaboration with: Prof. Dr. G. Grasshoff, Prof. Dr. A. Hollenstein, PD Dr. H. Linneweber-Lammerskitten and Prof. Dr. J. Schmid, University of Bern; Prof. Dr. J. Kohlas, University of Freiburg; Dr. U.-M. Künzi, Hochschule Rapperswil and Prof. Dr. J. Rolim, University of Geneva.

ViLoLa is a virtual logic laboratory centered around some basic and advanced logic-oriented modules. Starting off from the fact that logic is a crucial basis for many scientific disciplines, it addresses students with various backgrounds (e.g. computer science, mathematics, philosophy, electrical engineering etc.). ViLoLa intends to provide theoretical knowledge as well as the ability to make use of this knowledge for the solution of practically relevant examples. Keywords: Classical propositional logic, formal languages and automata, computability and complexity theory, logics for computer science, logic and uncertainty, structures for algebraic logic, state transition systems and concurrency, logic and philosophy.

Research staff: J. Adler, G. Jäger, M. Krebs, U.-M. Künzi, Th. Strahm

Financial support: Swiss Virtual Campus

5.3 Diploma Theses

- M. Heissenbüttel: Theories of ordinal strength φ_{20} and $\varphi_{2\varepsilon_0}$
- D. Steiner: Proof-theoretic strength of PRON with various extensions

5.4 Ph.D. Theses

- P. Balsiger: The MacLWB and the Logic of Likelihood
- Th. Studer: Object-Oriented Programming in Explicit Mathematics: Towards the Mathematics of Objects

5.5 Habilitation Thesis

- Th. Strahm: Proof-theoretic contributions to explicit mathematics

5.6 Further Activities

Editorials Board and Technical Committees

- Member of the editorial board of *Theoretical Computer Science* (G. Jäger)
- Member of the editorial board of *The Bulletin of Symbolic Logic* (G. Jäger)
- Member of the *Scientific Council of the European Association for Computer Science Logic* (G. Jäger)
- President of the *Swiss Society for Logic and Philosophy of Science* (G. Jäger)
- Secretary of the *Swiss Society for Logic and Philosophy of Science* (Th. Strahm)

Program Committees

- Member of the program committee of *Models for E-Commerce, E-Business and E-Government* (G. Jäger)

5.7 Publications

- L. Alberucci: Strictness of the modal mu-Calculus Hierarchy, *Proceedings of the Dagstuhl Seminar: Automata, Logics and infinite Games*, to appear
- L. Alberucci and G. Jäger: Partial results about partial cut elimination for the logics of common knowledge, part I, *Technical Report IAM-01-008*, 2001
- G. Jäger: First order theories for nonmonotone inductive definitions: recursively inaccessible and Mahlo, *Journal of Symbolic Logic* 66, 2001
- G. Jäger, R. Kahle and Th. Studer: Universes in explicit mathematics. *Annals of Pure and Applied Logic* 109, 2001
- G. Jäger and Th. Strahm: Upper bounds for metapredicative Mahlo in explicit mathematics and admissible set theory, *Journal of Symbolic Logic* 66. 2001

- G. Jäger and Th. Studer: Extending the system T_0 of explicit mathematics: the limit and Mahlo case, *Annals of Pure and Applied Logic*, to appear
- A. Kouznetsov: Multidimensional algebra on the generalized sequences, *Bulletin of the Section of Logics, Univ. of Lodz, Vol. 29*, 2001
- A. Kouznetsov: N-valued quasi-functional logic, *Abstr. Contr. Talks, Moscow, "Smirnov Readings"*, 2001
- R. Kahle and Th. Studer: Formalizing non-termination of recursive programs, *Journal of Logic and Algebraic Programming 49*, 2001
- G.E. Ostrin and S.S. Wainer: Elementary Arithmetic, submitted
- G.E. Ostrin and S.S. Wainer: Proof Theoretic Complexity, *NATO Advanced Studies Series*, to appear
- D. Probst and Th. Studer: How to normalize the jay, *Theoretical Computer Science 254*, 2001
- C. Rüede and Th. Strahm: Intuitionistic fixed point theories for strictly positive operators, *Mathematical Logic Quarterly*, to appear
- V. Salipante: Completeness of Logic of Partial Terms, *Technical Report IAM-01-005*, 2001
- Th. Strahm: Wellordering proofs for metapredicative Mahlo, *Journal of Symbolic Logic*, to appear
- Th. Strahm: Theories with self-application and computational complexity, submitted
- Th. Studer: A semantics for $\lambda_{str}^{\{\}}$: a calculus with overloading and late-binding, *Journal of Logic and Computation 11*, 2001
- Th. Studer: Impredicative overloading in explicit mathematics, Abstract, *Bulletin of Symbolic Logic 7*, 2001
- Th. Studer: Constructive Foundations for Featherweight Java, *Lecture Notes in Computer Science 2183, Springer*, 2001
- S. Tupailo: Realization of analysis into explicit mathematics, *Journal of Symbolic Logic*, to appear
- S. Tupailo: Realisation of Constructive Set Theory into Explicit Mathematics: a lower bound for impredicative Mahlo universe, submitted

6 Research Group on Software Composition

6.1 Personnel

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Visitors:	Prof. A. Black	email: black@cse.ogi.edu

*financial support from a third party.

6.2 Research Projects

Meta-models and Tools for Evolution Towards Component Systems

In this project we are developing:

1. A *component meta model* for modelling software systems that extends existing standards (such as UML) with concepts required to support evolution, focusing on such issues as non-functional requirements and software dependencies.

2. Based on this meta model, we will develop *component migration* tools and methods that will help to identify candidate components, identify and resolve architectural and design drift, and support transformation to component-based software structures. We will focus on software metrics and visualization to support analysis, and language-independent refactorings to support transformation. Component migration methods will be documented as reverse and reengineering patterns.
3. Finally, we propose to develop a *compositional infrastructure* to support architectural specification, and run-time configuration and evolution, using the agent-based framework of the Piccola composition language.

For further details, please consult: <http://www.iam.unibe.ch/~scg>

Research staff: All members of the research group.

Financial support: Swiss National Science Foundation, project no. 20-61655.00

PECOS

PECOS is an industrial IST European research project that aims to enable component-based software development for embedded systems. While focusing on architectural issues it touches upon the whole software development life cycle and addresses the major technological deficiencies of state-of-the-art component technology with respect to embedded systems by developing:

- a *Component Model* for embedded system components addressing behaviour specification and non-functional properties and constraints,
- an interactive *Composition Environment* for composing embedded applications from components, validating functional (e.g., interfaces) and non-functional compositional constraints (e.g., power-consumption and code size), generating the application executable for the embedded device and monitoring their execution,
- an Ultra-light *Component Environment* to install, run, test, and tune component-based applications on resource limited embedded systems and enable their management.

For further details, please consult: <http://www.iam.unibe.ch/~pecos>

Research staff: Prof. A. Black, G. Arévalo, Dr. S. Ducasse, Dr. R. Wuyts.

Financial support: Swiss Federal Office for Education and Science, BBW project no. 00.0170 (EU IST project 1999-20398).

6.3 Diploma Theses

- Georges Golomingi Koni-N'sapu. A scenario based approach for refactoring duplicated code in object oriented systems. Diploma thesis, University of Bern, June 2001.
- Thomas F. Hofmann. OPENSACES, an object-oriented framework for configurable coordination of heterogeneous agents. Diploma thesis, University of Bern, April 2001.
- Nathanael Schärli. Supporting pure composition by inter-language bridging on the meta-level. Diploma thesis, University of Bern, September 2001.
- Lukas Steiger. Recovering the evolution of object oriented software systems using a flexible query engine. Diploma thesis, University of Bern, June 2001.

6.4 Ph.D. Theses

- Sander Tichelaar. *Modeling Object-Oriented Software for Reverse Engineering and Refactoring*. PhD thesis, University of Bern, 2001.

6.5 Further Activities

Editorial Boards

- L'OBJET – Logiciel, réseaux, bases de données (O. Nierstrasz)
- Annals of Software Engineering (O. Nierstrasz)

Associations

- CHOOSE – Swiss group for Object-Oriented Systems and Environments (Executive Board member, O. Nierstrasz)
- AITO – Association Internationale pour les Technologies Objets (Board member, O. Nierstrasz)

- ESEC, the European Software Engineering Conference (Member of Steering Committee, O. Nierstrasz)
- ESUG (European Smalltalk User Group, Member of Steering Committee, S. Ducasse)
- SSUG (Swiss Smalltalk User Group, Member of Steering Committee, S. Ducasse)

Program Committees

- OOPSLA 2001 (ACM SIGPLAN Object-Oriented Programming Systems, Languages and Applications, PC member, O. Nierstrasz)
- TOOLSEE 2001 (TOOLS Eastern Europe, PC member, O. Nierstrasz)
- CoopIS (International Conference on Cooperative Information Systems, PC member, O. Nierstrasz)
- EDOC 2001 (International Conference on Enterprise Distributed Object Computing, PC member, O. Nierstrasz)
- CAiSE 2001 (Conference on Advanced Information Systems Engineering, PC member, O. Nierstrasz)
- WPDRTS 2001 (Workshop on Parallel and Distributed Real-Time Systems
(PC member, O. Nierstrasz)
- ICSE 2001 (International Conference on Software Engineering, Member of the Tutorials Subcommittee, O. Nierstrasz)

6.6 Publications

Journal and Conference Publications

- Juan-Carlos Cruz. CORODS: A Coordination Programming System for Open Distributed Systems. Proceedings of LMO 2001, vol. 7, Le Croisic, France, 2001, pp. 11-26.
- Juan-Carlos Cruz. Supporting Development of Object Information Systems with CoLaSD. Proceedings of OOIS 2001, Calgary, Canada, 2001.

- Stéphane Ducasse and Michele Lanza. Towards a methodology for the understanding of object-oriented systems. *Technique et science informatiques*, 20(4):539–566, 2001.
- Stéphane Ducasse, Michele Lanza, and Sander Tichelaar. The Moose reengineering environment. *Smalltalk Chronicles*, August 2001.
- Michele Lanza. The evolution matrix: Recovering software evolution using software visualization techniques. In *Proceedings of IWPSE 2001 (International Workshop on Principles of Software Evolution)*, page to be published, 2001.
- Michele Lanza and Stéphane Ducasse. A categorization of classes based on the visualization of their internal structure: the class blueprint. In *Proceedings of OOPSLA 2001*, pages 300–311, 2001.
- Jean-Guy Schneider and Markus Lumpe. A Metamodel for Concurrent, Object-based Programming. In Christophe Dony and Houari A. Sahraoui, editors, *Proceedings of Languages et Modèles à Objets '00*, pages 149–165, Mont Saint-Hilaire, Québec, January 2000. Hermes.

Book Chapters

- Jean-Guy Schneider, Markus Lumpe, and Oscar Nierstrasz. Agent coordination via scripting languages. In Andrea Omicini, Franco Zambonelli, Matthias Klusch, and Robert Tolksdorf, editors, *Coordination of Internet Agents*, pages 153–175. Springer-Verlag, 2001.

Workshop Publications

- Michele Lanza and Stéphane Ducasse. The class blueprint: A visualization of the internal structure of classes. In *Workshop Proceedings of OOPSLA 2001*, page to be published, 2001.
- Michele Lanza, Stéphane Ducasse, and Lukas Steiger. Understanding software evolution using a flexible query engine. In *Proceedings of the Workshop on Formal Foundations of Software Evolution*, 2001.
- Roel Wuyts and Stéphane Ducasse. Composition Languages for Black-Box Components. First OOPSLA Workshop on Language Mechanisms for Programming Software Components, 2001.

- Roel Wuyts and Stéphane Ducasse. Symbiotic Reflection between an Object-Oriented and a Logic Programming Language. ECOOP 2001 International workshop on MultiParadigm Programming with Object-Oriented Languages, 2001.
- Roel Wuyts, Stéphane Ducasse and Gabriela Arévalo. Applying Experiences with Declarative Codifications of Software Architectures on COD. Ecoop 6th International Workshop on Component-Oriented Programming, 2001.
- Roel Wuyts and Stéphane Ducasse. Non-Functional Requirements in a Component Model for Embedded Systems. International Workshop on Specification and Verification of Component-Based Systems, 2001.
- Roel Wuyts. Synchronising Changes to Design and Implementation using a Declarative Meta-Programming Language. International Workshop on (Constraint) Logic Programming for Software Engineering, December 2001.

Technical Reports

- Tamar Richner and Stéphane Ducasse. Using Dynamic Information for the Iterative Recovery of Collaborations and Roles. IAM Technical Report IAM-01-007, December 2001

A Teaching Activities

A.1 Winter semester 2000/2001

H. Bieri: Einführung in die Informatik
3D-Grafik
Praktikum Computeranimation
Seminar: Computergeometrie und Grafik

H.P. Blau: Anwendungssoftware
Programmierung 1

T. Braun: Computernetze
Grundlagen der technischen Informatik
Multimediakommunikation
Seminar: Rechnernetze und verteilte Systeme

H. Bunke: Automaten und formale Sprachen
Künstliche Intelligenz
Seminar: Künstliche Intelligenz

G. Jäger: Datenbanken
Logik und Informatik
Seminar: Logiklabor
Seminar: Theoretische Informatik und Logik

O. Nierstrasz: Seminar: Software Composition

O. Nierstrasz

S. Ducasse: An introduction to Reflective Programming

M. Rieger: Einführung in Software Engineering

A.2 Summer semester 2001

- H. Bieri:** Computergraphik
Datenstrukturen und Algorithmen
Digitale Bilder
Seminar: Computergeometrie und Grafik
- H.P. Blau:** Anwendungssoftware
- H. Bunke:** Compilerbau
Grundlagen der Bildanalyse und Mustererkennung
Praktikum Bildanalyse
Seminar: Künstliche Intelligenz
- T. Braun:** Betriebssysteme und Verteilte Systeme
Praktikum Computernetze
Rechnerarchitektur
Seminar: Rechnernetze und verteilte Systeme
- G. Jäger:** Beweistheorie
Einführung in die theoretische Informatik
Seminar: Logiklabor
Seminar: Theoretische Informatik und Logik
- G. Jäger**
- J. Kohlas:** Inferenz und Deduktion
- O. Nierstrasz:** Praktikum Software Engineering
Programmiersprachen
Programmierung 2
Seminar: Software Composition

A.3 Winter semester 2001/2002

H. Bieri: Algorithmische Geometrie
Einführung in die Informatik
3D-Graphik
Seminar: Computergeometrie und Grafik

H.P. Blau: Anwendungssoftware
Programmierung 1

T. Braun: Computernetze
Grundlagen der technischen Informatik
Mobilkommunikation
Seminar: Rechnernetze und verteilte Systeme

H. Bunke: Automaten und formale Sprachen
Künstliche Intelligenz
Seminar: Künstliche Intelligenz
Mustererkennung 2

G. Jäger: Datenbanken
Logik und Informatik
Seminar: Logiklabor
Seminar: Theoretische Informatik und Logik

G. Jäger

J. Kohlas: Seminar: Inferenz und Deduktion

O. Nierstrasz: Concurrent Programming
Einführung in Software Engineering
Seminar: Software Composition

O. Nierstrasz

S. Ducasse

M. Lanza

R. Wuyts : Software Engineering Applied

B Colloquium in Informatics

- 01/09/2001 Dr. Lorenz Halbeisen
Universität Basel
Über nicht-repetitive Sequenzen
- 01/23/2001 Dr. Bruno T. Messmer
Swisscom AG, Bern
Research in the fast lane - Models and Technology
in the fast moving E-Business World
- 02/06/2001 Prof. Dr. Burkhard Stiller
ETH Zürich
Internet Pricing and its Dilemma with Time-scales
- 04/10/2001 Dr. Marcelo Kallmann
EPF Lausanne
Towards Autonomous Virtual Humans
- 05/08/2001 Michael Seel
Max-Planck-Institut für Informatik, Saarbrücken
Generische Algorithmische Geometrie in CGAL
- 05/11/2001 Prof. Dr. Solomon Feferman
Stanford University
Computation on abstract data types with
infinitary data objects
- 05/15/2001 Prof. Dr. Jean-Yves Le Boudec
EPF Lausanne
Network Calculus
- 05/29/2001 Dr. Jacky Estublier
Centre national de recherche scientifique, Grenoble
CBSE: l'évolution des modèles de composants
- 06/12/2001 Prof. Dr. Ulrike Lechner
Universität St. Gallen
Computational Media - Architectures for New Media

- 06/19/2001 Prof. Dr. Peter Deussen
Universität Karlsruhe
Die "Virtuelle Hochschule Baden-Württemberg"
und ihr Verbundprojekt
"Virtueller Hochschulverbund Karlsruhe (ViKar)"
- 06/26/2001 Dr. Oliver Krone
Swisscom AG, Bern
SHUFFLE: An agent based approach to controlling
resources in UMTS networks
- 06/26/2001 Dr. James Sterbenz
BBN Technologies, USA
Latency Aware Information Access With
User Directed Handling of Cache Misses
- 11/06/2001 Dr. Giacomo Lenzi
Université Bordeaux,
The mu-calculus: a survey
- 12/04/2001 Prof. Dr. Kilian Stoffel
Université de Neuchâtel
Ontology Repurposing