Annual Report 2002

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Contents

1 Institute of Computer Science and Applied Mathematics (IAM)

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1.2 Personnel

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Number of students in computer science

- Major subject: 247
- Minor subject: 213

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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	P. Habegger	Tel.: +41 31 631 4679 email: habegger@iam.unibe.ch
	Th. Wenger	Tel.: +41 31 631 4990 email: wenger@iam.unibe.ch

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: Research Staff: H. Bieri, W. Nef

Collaboration on Scene Graph Based 3D Models

Professional 3D modeling applications like Maya or 3ds max offer only limited support for a team of designers to work on a 3D model collaboratively. There is even less support for managing revisions and variants or different representations of designs. 3D models are often made up of thousands of objects in a scene graph (DAG) that is stored in one single file. Therefore

commercial group authoring tools and revision control systems cannot provide a solution as they generally work file based and/or are specialized in text documents only and thus cannot take advantage of the DAG structure of 3D models.
This project provides support for collaboration on scene graph based 3D models by means of a specialized central repository that implements extensional version control for DAG structured 3D data avoiding pitfalls like version proliferation. Collaboration is based on an optimistic locking scheme combining a check-in/-out mechanism with automatic merging of consistent changes to a 3D model. A revision history keeps track of who made when what changes to a model and also provides information about a model's alternatives and different representations. A simple configuration management implements some intensional versioning aspects on top of the extensional versioning.
Support for collaboration between different 3D modeling applications is provided by heterogeneous 3D scenes that integrate the applications' different representations of 3D models. When working with such a scene in an application, models stored in a representation unknown to that application are transparently replaced by proxy models in a supported representation. Those proxy models can be automatically derived by converters from the models in their original representations. For collaboration purposes, the proxy models do not need to be perfect copies but more or less accurate approximations to the original models they stand for, thus only rather simple converters have to be written or bought. The heterogeneous scene is supposed to be rendered with a common external renderer supported by all applications involved, such as RenderMan or Mental Ray.

Research staff: L. Ammon

Turtle Graphics Based Predictive Site Reconstruction

This diploma project tries a possible algorithmic description and implementation of the CPSR method developed by M. Gerber at the Institute of Ancient Near Eastern Archaeology and Languages at the University of Bern. CPSR (Complexity-based Predictive Site Reconstruction) is an algorithmic approach to computer aided modeling of ancient buildings. Its main purpose is to make predictions of the architecture of ruins, especially of very large structures whose entire excavation is out of question. CPSR provides a possibility to create accurate models based on the available information. Critical parts of the model can be verified by selective excavation. The new information gained thereby, even if the assumptions made in the model are

proven to be incorrect, can be used to create a more accurate new model. The results will often converge to a good reconstruction within a small number of iterations. CPSR is based on A. N. Kolmogorov's theory of complexity. The complexity of an object is measured by the minimal length of its algorithmic description. It can be proven that such a definition of complexity is independent of the description language used. In this project, the models are restricted to ground plots of structures, thus to two dimensions. Being a simple and proven description language for linear plots, turtle graphics is a suitable modeling language. Using a graphical user interface, the known facts can be entered interactively into the modeling process. The plot is then converted to turtle graphics and, by representing the graphic primitives of turtle graphics by characters, can be reduced to character arrays. Text compression algorithms are used to find the maximum compression of these character arrays. Based on Kolmogorov complexity a rating criterion can be defined. It will be used to rate any such model, generated manually or by simulation, on the basis of the collection of graphic elements resulting from the compression process.

Research staff: R. Blattner, M. Gerber, H. Bieri

Creating Hierarchical 3D City Models

This project deals with various aspects of 3D city modelling. Its goal is the development of a generic framework supporting the creation, management, analysis and visualization of 3D city models. A main problem is the acquisition of the underlying geometric data. Today several methods are known, but most of them are time-consuming and expensive. Thus methods that support semi-automatic generation of the model from various easy accessible data sources as e.g. city maps or cadastral data are being developed. Due to the different accuracies of the input data, a data model supporting multiple levels of detail as well as its refinement and abstraction is being worked out. Another problem is the automation of modelling geometric details of house fronts such as windows and doors. Here a rule-based approach for generating house fronts depending on various parameters is pursued. 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

From Roadmaps to 3D Scenes

The system M2S is a Java application for creating virtual worlds based on road maps. A user scans a road map with a color scanner. The software analyzes the image and produces a virtual world which is in accordance with the map. A rich user-interface enables the user to edit and complete the generated 3D models. A large number of properties can be set: From background image via level of detail up to which algorithm to be used for a specific task. An included flytrough serves to explore and evaluate the result. The exporter-tool currently supports VRML97 and Microsoft's X file-format. The project consists of two diploma theses. A. Dasen completed the first one in 2001. He implemented a software which automatically recognizes roads, areas and symbols in scanned road map images. The second diploma thesis deals with the creation of 3D models from such 2D information. A flexible software including a large number of plugins will allow users to build 3D worlds, according to their imagination and corresponding to the given road map. Methods of computational geometry are used, for example the incremental Delaunay triangulation or polygon tesselation. A rule based system tries to correct errors made by the interpretation system. 3D objects like churches, houses, airports, etc. were created by M. Hugi by means of the 3D modelling tool Studio Max.

Research staff: C. Glauser

Evaluating Internet Topologies

The main goal of this project is the design and implementation of the framework GINT (Generator of Internet Topologies) which can be used to generate and analyze graphs representing network topologies. These topologies show a number of properties which 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 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 contains a number of important 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. In addition, the development of the Internet topology over the past four and a half years has been analyzed using GINT. A further goal of this project is the assessment of existing topology models of the Internet. Considering these results, a new topology model is developed

which represents a new way of modeling the growth of the Internet topology.

Research staff: P. Habegger

Low Cost 3D Scanning

The process of creating a virtual, three dimensional copy of a real world object consists of numerous stages, such as the surface sampling of the object, the reconstruction of the shape from the samples, the merging of several partial shapes and the recovery of surface material properties present on the model. The applicability of algorithms and underlying concepts is limited to a specific segment defined by many factors, like the nature of the real world object to be reconstructed, the required precision, the processing speed as well as aesthetic concerns. Therefore, it is desirable to combine various approaches in one framework, in a way that the compatibility of inputs and outputs between different stages of the reconstruction process is assured and platform independence is achieved.
The goals of the project *Low Cost 3D Scanning* were to plan, design and implement a low cost point acquisition and surface scanning device based on consumer electronic devices, to implement an advanced surface reconstruction method and to provide high usability and extensibility by packing the resulting software in a platform independent framework with graphical user interface while offering modular batch mode support. Focused on the surface sampling and surface reconstruction, the framework will promote extensions in several directions such as the implementation of a mesh zippering algorithm to merge surface patches or the support of automatic texture fitting. Additionally, a generic tutorial has been created to give an overview about state-of-the-art sampling and reconstruction algorithms applied today and to ease the choice of technique for a given problem.

Research staff: M. Löffel, D. Niedermann

Interactive Ray Tracing of Implicit Surfaces

Implicit surfaces are a natural approach when visualising many kinds of scientific data, such as molecular models, smoothed particle hydrodynamics and other types of highly complex models. In this project we study a variety of issues, including acceleration data structures and efficient rendering algorithms, which arise when rendering implicit models using interactive ray

tracing techniques. Part of this project is the implementation of a graphics library based on implicit surfaces which enables us to compare various aspects of our work with commonly used scan-line or z-buffer renderers.

Research staff: Philippe C.D. Robert
Support: Silicon Graphics, Inc.

JMesh: A Mesh Library in Java

Polygonal meshes are very popular in 3D graphics and thus the topic of many ongoing research projects all over the world. A lot of standalone tools and mesh libraries with a specialized focus are available today. But currently there doesn't exist any comprehensive software basis in Java that supports and integrates the different research approaches to meshes. This project intends to build JMesh, 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 with meshes will be implemented. Reconstruction tools recently developed at the institute by Mario Löffel and Denise Niedermann will be integrated and extended within JMesh. Several typical JMesh-based prototype applications will investigate the extensibility, efficiency, and reliability of the framework. Although typical target application areas for JMesh come from research and didactics in computer graphics, JMesh will be useful to application developers too.

Research staff: Th. Wenger

2.3 Diploma Theses

- C. Glauser: 3D-Rekonstruktionen aufgrund von Strassenkarten
- J. Hutchison: Artificial Intelligence for Game Applications – The Project O
- C. Koch: Webbasiertes Lernen im Bereich Computergrafik
- M. Löffel: A Java Framework for Point Sampling and Surface Reconstruction

2.4 Applications

- Implementations for the project artcampus: "Art History 1200 - 2000" (Prof. O. Bätschmann, Dr. J. Nathan) of Swiss Virtual Campus: A. Bachmayer, M. Bruhin, Ch. Käser, K. Rollé, I. Steiner, S. Tetik, M. Wälchli)

- Animations for the Historisches Museum Bern (P. Jezler, director): M. Bruhin, O. Burkert, T. Huber, D. Kilchhofer, M. Kozary, S. Schär, D. Schulte

- Development of a Web-based monitoring tool for the company AARDEX Ltd. (Advanced Analytical Research on Drug Exposure): N. Bonfils, P. Schnellmann

- Reconstruction of the interior of the Stadttheater Bern (P. Kolisch, head of workshop) O. Aeberhard

2.5 Publications

- M. Cobo, H. Bieri: A Web3D Toolbox for Creating H-Anim Compatible Actors. Proceedings Computer Animation 2002, 120-125. June 19 - 21, 2002, Geneva.

- P. Habegger, H. Bieri: Modeling the Topology of the Internet - An Assessment. Technical Report IAM-02-002

- H. Bieri: Teaching Algorithms and Data Structures: 10 Personal Observations. To appear in R. Klein, H.-W. Six, L. Wegner (Eds.): Festband Thomas Ottmann, Lecture Notes in Computer Science, Springer 2003

- M. Kallmann, H. Bieri, D. Thalmann: Domain Representation Using the Dynamic Constrained Delaunay Triangulation. To appear in G. Brunnett, B. Hamann, H. Müller (Eds.): Geometric Modeling for Scientific Visualization, Springer 2003

- S. Tetik, H. Bieri, Ch. Bracht: A Local Information System Based on the Marburg Picture Index. Submitted.

2.6 Further Activities

- Area editor for Geometric Modeling of the journal The Visual Computer: H. Bieri

- Project artcampus: "Art History 1200 - 2000" of Swiss Virtual Campus. Project partner: H. Bieri
- Computer Animation 2002, Geneva, June 19 - 21, 2002. Member of the International Program Committee: H. Bieri
- Reviewing for G. Brunnett, B. Hamann, H. Müller (Eds.): Geometric Modeling for Scientific Visualization, Springer 2003: H. Bieri, M. Löffel

3 Research Group on Computer Networks and Distributed Systems

3.1 Personnel

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* with financial support from a third party

3.2 Research Projects

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

NCCR-MICS (www.mics.ch) represents a Swiss-wide effort launched in 2001 to promote long-term research projects on mobile communications based on

self-organizing paradigms. These paradigms have been receiving increasing interest with the advent of ad-hoc networks and peer-to-peer services on the Internet. NCCR-MICS is being funded by the Swiss government, the participating institutions and third parties. It involves a broad group of researchers, from universities and renowned research institutions in Switzerland. NCCR-MICS is composed of eleven research projects, and the RVS group of the University of Berne is taking part in the individual project "Self-Organizing Networking Mechanisms" (IP4). This project aims at investigating in a broad sense the main networking issues in ad-hoc networks. Specifically, the RVS research group is doing research on two topics: bio-inspired routing and TCP in mobile ad-hoc networks. In the area of bio-inspired routing the RVS group is focusing on the network layers and is investigating novel routing mechanisms for such mobile ad-hoc networks inspired by the behavior of social insects like ants and the way they forage and explore their neighborhood. A protocol architecture has been developed introducing three novel algorithms in order to be able to deal with the dynamics and complexity of such networks. A first version of these protocols is being implemented to determine the performance of this approach. Another topic has been investigating the main problems faced by TCP in highly dynamic and unpredictable mobile ad-hoc environments. The work concentrated on evaluating the existing proposed approaches and also on defining our own contributions toward effective enhancements in such a scenario. As a result, related work has been studied in detail and some initial original ideas have been outlined. The performance of TCP over several mobile ad-hoc routing protocols such as AODV, DSDV, DSR and TORA has been evaluated using the network simulator ns. Based on these results, we have started to work on simulation models for the evaluation of our novel conceptual ideas.

Research staff: Marc Heissenbüttel, Ruy de Oliveira, Eveline Kurt

Financial support: Swiss National Science Foundation Project no. 5005-067322 and University of Bern

Mobile IP Telephony (MIPTel)

The MIPTel project aims to develop and support mobile telephony applications over Differentiated Services (DiffServ) IP networks. Bandwidth brokers are components responsible for managing nodes within a DiffServ domain in order to provide the Quality-of-Service (QoS) requested by the users. Within the project a signaling protocol has been designed and implemented that al-

lows mobile IP 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 can also be used for context transfer as well as for negotiating flow aggregations between bandwidth brokers of different domains. This signaling protocol is a main part of a proposed extension to the Authorization, Authentication and Accounting (AAA) architecture. The extension allows mobile users to reserve bandwidth for some flows. Any reservation must be negotiated with a bandwidth broker that performs the necessary network reconfigurations. Depending on the Mobile IP routing method different reconfigurations have to be performed when the mobile node roams from one access network to another. Additional effort has been made to minimize hand-over delay and QoS degradation. The knowledge of when a hand-over will happen is provided by a signal monitoring program. This information is used to pre-negotiate QoS specifications with the bandwidth broker responsible for the new access network.

Research staff: Günther Stattenberger

Financial support: Swiss National Science Foundation Project No. 2100-057077.99/2 and 20-68086.02/1

QoS Support for the Internet based on Intelligent Network Elements (QuINE)

The QuINE project makes use of intelligent network elements providing more flexible network management mechanisms allowing the network provider to offer additional services. In particular QoS support based on Differentiated Services and various multicast mechanisms (e.g. native IP Multicast and explicit multicast) should be provided. A new concept for flexible service establishment has been developed. In this concept, most of the configuration decisions are done inside the network supported by active components. Only the decisions needing a global network view are performed by a central entity. The concept also takes care of security issues, in particular controlling the authenticity of the information and controlling the authorization of the user. Moreover, the virtual router system that has been designed and implemented for the evaluation of active networking concepts has been further improved and extended. In addition to the development of a well defined application programming interface several performance evaluation experiments

have been performed in order to investigate the impact of distributing virtual router topologies on multiple computers. It could be shown that the additional delay caused by distributed emulation does not limit the power of the virtual router approach. Another set of experiments compared performance evaluations of Differentiated Services mechanisms using the ns-2 network simulator and the virtual routers. The experiments showed the capability of virtual routers to emulate even complex traffic conditioning systems and yielded similar results in both cases. Finally, a new active networking system based on the Python language has been implemented. This active networking system is also available for Linux systems and allows to perform experiments in heterogeneous environments consisting of Linux and virtual routers. Active network capsules have been implemented allowing the dynamic establishment and configuration of tunnels by use of mobile and native code for tunnel encryption.

Research staff: Roland Balmer, Florian Baumgartner

Financial support: Swiss National Science Foundation Project No. 2100-57789.98/2 and 2000-066624.01/1

Virtual Internet and Telecommunications Laboratory of Switzerland (VITELS)

VITELS (www.vitels.ch) belongs to the 1st series of the Swiss Virtual Campus (SVC) projects started in the year 2000. The goal of the project is to develop a course in English language that provides theory and practical hands-on exercises in the area of telecommunications / computer networks. The developed experiments are based on simulation or real network hardware and are intended for third year computer science students. Actually, VITELS consists of seven modules designed and maintained by five institutes (Universities of Bern, Fribourg, Genève, Neuchâtel and Engineering School Fribourg). Ongoing work consists in creating and implementing a course architecture allowing several institutes to provide content for course modules. The course architecture includes authentication, authorization, and scheduling functions and allows that the exercises can be accessed by many students located anywhere in the Internet. The web-learning platform WebCT leads the students through the modules and offers a broad spectrum of collaboration and exercise tools with integrated assessment functions. First prototypes of the "IP Security" exercise module and the supporting course architecture have been demonstrated and tested in a regular course during summer semester 2002.

During these tests we could already gain valuable experiences and adapt the "IP Security" module. In this module, students have to configure real IP routers and establish IP Security tunnels. The second module developed at University of Bern called "IP Simulation" includes exercises based on Java applets and router emulations. Students have to experiment with network interface and routing table configurations.

Research staff: Marc-Alain Steinemann, Attila Weyland, Thomas Jampen, Eveline Kurt, Christine Rosenberger, Thomas Spreng, Stefan Zimmerli

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

Student Admission Control Infrastructure for Projects of the Swiss Virtual Campus (Authentication and Authorization Infrastructure Portal)

Authentication and authorization infrastructures (AAI) are systems that simplify the mobility of network services users. SWITCH started to establish an AAI for Swiss universities and related organizations. Student data and the authentication process remain at the respective university (home organization). Resource providers (typically universities and related organizations) that connect to the AAI provide the resources to authenticated users. A disadvantage of an AAI is that resources must be adapted to it, but in many cases this is not possible, for example when the resource code is not based on open software. In other cases it is too costly to adapt a single resource to the AAI significantly. The AAI portal that is under development is located between the core AAI and the resource provider and simplifies the process of connecting non-AAI-enabled resources to the AAI. The design of the AAI portal has almost been finished and the implementation of a first prototype has already started.

Research staff: Marc-Alain Steinemann, Thomas Spreng

Financial support: Bundesamt für Bildung und Wissenschaft (BBW), Mandate within the Swiss Virtual Campus Program, SWITCH Pilot 1

Advanced Architecture for Inter-Domain Quality-of-Service Monitoring, Modelling, and Visualization (InterMON)

InterMON (www.ist-intermon.org) is an EU-IST project with 12 participants from several European countries and is part of the 5th Framework Program of the EU. It aims to develop an architecture for monitoring, modeling, simulation, and visualization of inter-domain quality of service. University of Bern is leading work package 5, which is concerned with developing efficient modeling and simulation techniques to support scaleable simulation of large inter-networks. The deliverable entitled "Specification of the Modeling and Simulation Toolkit" has been compiled, edited and delivered to the EU successfully. The developed concept achieves scalability by combining analytical models for network domain clouds and inter-domain links with classical packet-based simulation techniques. Several ways for integrating these analytical models into the widely used packet-based simulator ns-2 have been investigated.

Research staff: Florian Baumgartner, Matthias Scheidegger

Financial support: EU project IST-2001-34123, Bundesamt für Bildung und Wissenschaft (BBW) Nr. 01.0551

Service Quality across Independently Managed Networks (SEQUIN)

SEQUIN (www.dante.net/sequin/) was an EU-IST project involving eight partners (mainly national research network providers) in seven European countries and running from November 2000 to April 2002. The main goal of this project has been to define and implement an end-to-end QoS approach to operate across multiple management domains combining distinct network technologies. In this way, SEQUIN would ensure that researchers across Europe had access to network facilities that could be tailored to the requirements of individual groups. As an overall view, the project has been successful in defining an achievable QoS model by taking into account the user requirements and the capabilities of emerging technologies. Additionally, such a definition has been evaluated in a pilot environment involving purely experimental networks as well as production networks. During the whole project, University of Bern has supported SWITCH in two aspects mainly: test-bed set-up / measurements and tool development / configuration for

QoS monitoring. In particular, QoS measurements have been performed over international test-beds. The goal of has been to determine the real capacity of the networks in place. Another task was the investigation of effective QoS monitoring tools to be used by SEQUIN. The main outcome was the demand for very specific QoS monitoring tools. This can be met by developing tailored tools or upgrading the existing ones toward the needs of this project.

Research staff: R. de Oliveira

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

Next Generation Networks Initiative (NGNi)

The European Next Generation Networks Initiative (www.ngni.org) analyzed standards as well as identified technology, market trends and forecasts in the area of network technology for next-generation wired and wireless networks. The Quality-of-Service subgroup consisting of partners from BITS Pilani (India), University of Haute-Alsace (France), UPM Madrid, Versaware (Spain), and University of Bern investigated QoS technologies that are currently being used and tested in Internet networks and that might be useful for next generation networks. The project also developed a roadmap for emerging QoS technologies in next generation networks. Based on that a vision has been defined about the most likely future technical scenarios with respect to QoS in next generation networks

Research staff: Torsten Braun, Linqing Liu

Financial support: EU project IST-2000-26418

Cellular Assisted Ad-Hoc / Peer-to-Peer Networking

Most of the problems that are faced in ad-hoc networking research are based on the limited global information about the entire network topology that is available at a mobile node. To find the best route without knowing the location of the correspondent node is a hard problem. Security issues are also getting much more critical without a centralized infrastructure that is able to act as an authentication, authorization, and accounting platform. The reuse of existing cellular infrastructure does make much sense to overcome the shortcomings of pure ad-hoc systems. The main advantage of such a cellular management plane is the availability of global information about the

identity and even the location of each member. This approach avoids many problems that rise up in pure and decentralized ad-hoc networks. One of the main problems in the domain of ad-hoc and peer-to-peer communication including data transactions is authentication of mobile nodes. Without centralized authentication services like certificate authorities or home location registers it seems to be very hard to authenticate a peer device or a user who is not registered or does not have a common shared secret. Moreover, paid services will never be available without authentication. In the elaborated concept that reuses cellular networks as management layer for ad-hoc and peer-to-peer networks, other radio technologies than cellular networks should be used to enable broadband data channels between the participating nodes. The first designed concepts for authenticated message exchange even allow service detection without the need of user intervention. This behavior of environment exploration can have significant impact on the market of location based services like information distribution by sightseeing, timetable broadcasting at train stations, but also newspaper download at kiosks. Ad-hoc services like these will occur wherever electronic information has to be transferred to a mobile device like a personal digital assistant. Within this research work basic concepts have been elaborated (patent pending). General use-cases for "Cellular Assisted Ad-hoc / Peer-to-Peer Networking" have been defined and will be implemented in prototypes to allow future usability and performance tests.

Research staff: Marc Danzeisen, Simi Winiker

Financial support: Swisscom AG

3.3 Diploma Theses

- Stefan Egger: Performance Simulation of Multicast for Small Conferences, November 2002
- Marco Studer: Ein Simulations-Framework für Endpoint Admission Control, November 2002
- Thomas Jampen: Authentication, Authorization and Resource Reservation for Distributed Laboratories, June 2002
- Eveline Kurt: Implementation of a Web-Based Interface for Virtual Router Configuration, June 2002

3.4 PhD Theses

- Florian Baumgartner: Quality of Service Support by Active Networks, February 2002
- Günther Stattenberger: Scalable Quality of Service Support for Mobile Users, December 2002

3.5 Publications

Publications submitted in 2002 and appearing in 2003 are not listed.

Books and Book Chapters

- Manuel Günter: Customer-Based IP Service Monitoring with Mobile Software Agents, Birkhäuser Verlag, 2002, ISBN 3-7643-6917-5
- Marc-Alain Steinemann, Torsten Braun, Marc Danzeisen, Manuel Günter: Virtual Private Networks, in John G. Proakis (editor): Wiley Encyclopedia of Telecommunications, December 2002, ISBN 0-471-36972-1, pp.2807-2815

Journal Papers

- Ibrahim Khalil and Torsten Braun: Edge Provisioning and Fairness in VPN-DiffServ Networks, Journal of Network and System Management, Kluwer Academics / Plenum Press, Vol. 10, No. 1, March 2002, ISSN 1064-7570, pp. 11-37
- Manuel Günter and Torsten Braun: Internet Service Monitoring with Mobile Agents, IEEE Network Magazine, May / June 2002, Vol. 16, No. 3, ISSN 0890-8044, pp. 22-29
- Günther Stattenberger, Torsten Braun, Marcus Brunner and Heinrich Stüttgen: Performance Evaluation of a Linux DiffServ Implementation, Computer Communications Journal, Elsevier, Vol. 25, Issue 13, August 2002, ISSN 0140-3664, August 2002, pp. 1195 - 1213

Conference Papers

- Matthias Scheidegger and Torsten Braun: An Adaptive IP Telephony Application over Differentiated Services, in: Proceedings of

21st IEEE International Performance, Computing, and Communications Conference, 1st Workshop on End-to-End Service Differentiation (EESD2002), Phoenix, USA, April 3-5, 2002, ISBN: 07803-7371-5, pp. 361-368

- Ibrahim Khalil and Torsten Braun: Automated Service Provisioning in Heterogeneous Large-Scale Environment, in: Rolf Stadler, Mehmet Ulema (editors): 8th IEEE/IFIP Network Operations and Management Symposium (NOMS 2002), Firenze, Italia, April 15-19, 2002, ISBN 0-7803-7382-0 , pp. 575-588

- Marc-Alain Steinemann, Thomas Jampen, Stefan Zimmerli, and Torsten Braun: Architectural Issues of a Remote Network Laboratory, Networked Learning 2002 (NL 2002), Berlin, May 1-4, 2002, ISBN 3-906454-31-2, pp. 133

- Silvia Bechter, Torsten Braun, and Günther Stattenberger: Development of a Virtual Computer Architecture Course, 4th International Conference on New Educational Environments (ICNEE 02), Lugano, May 8-11, 2002, ISBN 3-0345-0031-9, pp. 1.1/3-6

- Marc-Alain Steinemann, Thomas Jampen, Stefan Zimmerli, Torsten Braun: Didactical Issues of a Remote Network Laboratory, 4th International Conference on New Educational Environments (ICNEE 02), Lugano, May 8-11, 2002, ISBN 3-0345-0031-9, pp. 1.2/39-41

- Marc Steinemann, Stefan Zimmerli, Thomas Jampen, and Torsten Braun: Global Architecture and Partial Prototype Implementation for Enhanced Remote Courses, Computers and Advanced Technology in Education (CATE 2002), Cancun, Mexico, May 20-22, 2002, ISBN 0-88986-332-6, pp. 441-446

- Attila Weyland, Günther Stattenberger, and Torsten Braun: User-Controlled Handover in Wireless LANs, 2nd IEEE Workshop on Applications and Services in Wireless Networks 2002 (ASWN 2002), Paris, France, July 3-5, 2002, pp. 45-49

- Thomas Jampen, Manuel Günter, and Torsten Braun: A Java API for Using a Native PGP Implementation, in : N. Mastorakis, V. Mladenov (editors): Recent Advances in Computers, Computing and Communications, WSEAS Press, 6th WSEAS CSCC Multiconference, Rethymnon, Crete, Greece, July 7-14, 2002, ISBN 960-8052-62-9, pp. 27-30

- Attila Weyland, Günther Stattenberger, and Torsten Braun: Mobile-Controlled Handover in Wireless LANs, 12th IEEE Workshop on Local and Metropolitan Area Networks 2002 (LANMAN 2002), Stockholm, Sweden, August 11-14, 2002, pp. 119-120

- Marc-Alain Steinemann and Torsten Braun: Remote versus Traditional Learning in a Computer Networks Laboratory, Communications and Computer Networks (CCN 2002), Cambridge, USA, November 4-6, 2002, ISBN 0-88986-329-6, pp. 503-507

- Florian Baumgartner, Torsten Braun, and Bharat Bhargava: Virtual Routers: A Tool for Emulating IP Routers, 27th Annual IEEE Conference on Local Computer Networks (LCN 2002), Tampa, USA, November 6-8, 2002, ISBN 0-7695-1591-6, pp. 363-371

- Florian Baumgartner, Torsten Braun, and Bharat Bhargava: Design and Implementation of a Python-Based Active Network Platform for Network Management and Control, 4th International IFIP TC6 Working Conference on Active Networks (IWAN2002), Zürich, Switzerland, December 4-6, 2002, ISBN 3-540-00223-5, pp. 177-190

Patents

- Marc Danzeisen, Jan Linder: Method and System for Mobile IP Nodes in Heterogeneous Networks, International publication number: WO 02/103978 A2, Publication date: 27.12.2002

Technical Reports

- Ruy de Oliveira and Torsten Braun: TCP in Wireless Mobile Ad Hoc Networks, Technical Report, IAM-02-003, July 2002

- Ruy de Oliveira (ed.): Computer Networks and Distributed Systems, Technical Report, IAM-02-004, November 2002

- Serge Droz, Marc-Alain Steinemann et al.: Authentication and Authorization Infrastructure (AAI) - Authorization Attribute Specification, December 2002, http://www.switch.ch/aai/docs/AAI_Attr_Specs.pdf

- Nicole Beranek Zanon, Marc-Alain Steinemann et al.: Authentication and Authorization Infrastructure (AAI) - Preparatory Study, July 2002, http://www.switch.ch/aai/AAI_Study_v10a.pdf

- Florian Baumgartner, Timea Dreilinger, Gianluca Foddis, Pedro A. Aranda Gutiérrez, Tamas Mahr, Ilka Miloucheva, Maurizio Molina, Fausto Saluta, Matthias Scheidegger, Carsten Schmoll, Joern Seger, Cristina Soto, Attila Vidacs: Modelling and Simulation Specification, InterMON Deliverable 6, December 23, 2002, http://www.ist-intermon.org/download/Deliverable_6.pdf
- Marc Danzeisen: MANET in the World of Telecom Operators, Project Deliverable, August 19, 2002
- Marc Danzeisen, Jan Linder, and Torsten Braun: Cellular Assisted Ad-hoc/P2P Networking, Patent Application, September 11, 2002
- Rahul Banerjee, Juan Quemeda, Pascal Lorenz, Torsten Braun, and Bernardo Martinez: Mechanisms for Attaining QoS in IPv6-based Multimedia Internetworks, NGNi project deliverable D2, February 2002, http://www.ngni.org/projects/NGNI-QoS-D2-v1-3-secure.pdf
- Torsten Braun, Linqing Liu, F. J. Gonzalez Castano, Rahul Banerjee, Juan Quemeda, Pascal Lorenz, and Bernardo Martinez: Benchmark of Next Generation Network Quality of Service Technologies, NGNi project deliverable D3, March 2002, http://www.ngni.org/projects/NGNI-MMI-QoS-Deliverable-D3-v1.3.pdf
- Rahul Banerjee, Juan Quemeda, Pascal Lorenz, Bernardo Martinez, Torsten Braun, Linqing Liu, and F. J. Gonzalez Castano: Roadmapping and Standardization of Next Generation Network Quality-of-Service Technologies, NGNi project deliverable D4, April 2002, http://www.ngni.org/projects/NGNI-MMI-QoS-Deliverable-D4-v1.pdf
- Simi Winiker: Horizontal Heterogeneity through SecMIP Controlled Infrastructure, Computer Science Project, June 2002
- Christine Rosenberger: IP Routing Tutor, Computer Science Project, June 2002

3.6 Further Activities

Events

- RVS Summer School, Summer School 2002, Vira-Gambarogno, August 26-30, 2002 (supported by Burgergemeinde Bern)

Memberships

- SWITCH Stiftungsrat (Torsten Braun)
- SWITCH Stiftungsratsausschuss (Torsten Braun)
- SWITCH Projektausschuss "e-Academia / Authentifizierungs- und Autorisierungs-Infrastruktur (AAI): Pilot-Phase" (Marc-Alain Steinemann)
- SWITCH AAI Task Forces Attributes and Policy (Marc-Alain Steinemann)
- SPEEDUP Society Committee (Torsten Braun)
- Kuratorium Fritz-Kutter-Fonds (Torsten Braun)
- Swiss Representative of COST 263 Action 'Quality of future Internet Services' (Torsten Braun)
- Professor election committees at University of Zürich, ETH Zürich and University of Fribourg (Torsten Braun)
- Ph.D. Jury of of Imad Aad (University of Grenoble) (Torsten Braun)
- Expert for Diploma Exams at FH Bern (Torsten Braun)

Conference Program Committees

- 1st Workshop on End-to-End Service Differentiation (EESD), held in conjunction with the IEEE International Performance Computing and Communications Conference (IPCCC), Phoenix, Arizona, USA, April 3-5, 2002 (Torsten Braun)
- 7th IFIP/IEEE International Workshop on Protocols For High-Speed Networks (PfHSN 2002), April 22 - 24, 2002, Berlin, Germany (Torsten Braun)
- 4th International Conference on New Educational Environments, Lugano, Switzerland, May 8-11 (Torsten Braun)
- 2002 IEEE Workshop on High Performance Switching and Routing (HPSR 2002), Kobe, Japan, May 26-29, 2002 (Torsten Braun)
- 3rd International Conference on Internet Computing (IC 2002), Las Vegas, Nevada, USA, June 24 - 27, 2002 (Torsten Braun)

- 1st International Workshop on Wired / Wireless Internet Communications (WWIC 2002) , Las Vegas, Nevada, USA, June 24 - 27, 2002 (Torsten Braun)
- 2nd IEEE Workshop on Applications and Services in Wireless Networks (ASWN 2002), Paris, France, July 3-5, 2002 (Torsten Braun)
- 12th IEEE Workshop on Local and Metropolitan Area Networks, August 11-14, 2002, Stockholm, Sweden (Torsten Braun)
- 2nd International Workshop on Internet Charging and QoS Technology (ICQT´02), Zürich, Switzerland, October 16-18, 2002 (Torsten Braun)
- 13th IFIP/IEEE International Workshop Distributed Systems: Operations & Management (DSOM), Montreal, Canada, October 21-23 (Torsten Braun)
- 27th Annual IEEE Conference on Local Computer Networks (LCN 2001), November 6-8, 2001, Tampa, Florida, USA (Torsten Braun)
- 4th International IFIP TC6 Working Conference on Active Networks (IWAN2002), Zürich, Switzerland, December 4-6, 2002 (Torsten Braun)

Reviewing Activities

- IEEE Communication Letters (Torsten Braun)
- IEEE Communications Magazine (Torsten Braun)
- IEEE Internet Computing (Torsten Braun)
- IEEE International Conference on Communications, New York, April 28-May 2, 2002 (Torsten Braun)
- IEEE Transactions on Systems, Man and Cybernetics (Torsten Braun)
- IEEE/ACM Transactions on Networking (Torsten Braun)
- Computer Networks Journal, Elsevier (Torsten Braun)
- Computer Communications Journal, Elsevier (Torsten Braun)
- Journal of Systems and Software, Elsevier (Torsten Braun)
- Annales des Télécommunications, Hermes Science (Torsten Braun)
- Addison-Wesley (Torsten Braun)

Invited Talks and Tutorials

- Torsten Braun: QoS Monitoring and Configuration with Active Networks, Dagstuhl Seminar 02071: Concepts and Applications of Programmable and Active Networking Technologies, Dagstuhl, Germany, February 14, 2002
- Torsten Braun and Marc Steinemann: Virtuelles Internet und Telekommunikations-Labor, Fachschaftstag Informatik, Department of Teachers Training, University of Bern, May 13, 2002
- Torsten Braun: Aktive Netze, Informatikseminar Zürcher Hochschule Winterthur, June 18, 2002
- Torsten Braun: Mobile Information and Communication Systems - A Swiss National Center of Competence in Research, Computer Science Colloquium, September 11, 2002, Purdue University, USA
- Torsten Braun: Next Generation Internet Protocols for Optical Networks, Tutorial at National Fiber Optic Engineers Conference, Dallas, Texas, USA, September 15, 2002
- Torsten Braun: IP Telephony over Differentiated Services, Dagstuhl Seminar 02441: Quality of Service in Networks and Distributed Systems, Dagstuhl, Germany, October 30, 2002
- Marc-Alain Steinemann: Technical and Didactical Aspects of an Open Course Architecture for eLearning, 2nd Workshop on Web Enabling Technologies for Scientists, Abdus Salam International Centre for Theoretical Physics, Trieste, Italy, UNESCO, November 19, 2002
- Marc-Alain Steinemann: VITELS - Internet-based Computer Networks Laboratory, 2nd Workshop on Web Enabling Technologies for Scientists, Abdus Salam International Centre for Theoretical Physics, Trieste, Italy, UNESCO, November 19, 2002
- Torsten Braun: Studienplan in Informatik der Universität Bern, SARIT: Nationales Treffen für Bachelor und Master der Informations- und Kommunikationstechnologien, University of Applied Sciences Fribourg, November 28, 2002
- Torsten Braun: Ein Labor für virtuelle und entfernte Experimente im Bereich Computernetze, Kolloquium "Informatik und Computational Sciences", University of Basel, December 11, 2002

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
Office Manager:	S. Thüler	Tel.: +41 31 631 86 81 email: thueler@iam.unibe.ch
Scientific staff:	S. Fischer*	Tel: +41 31 631 86 99 email: fischer@iam.unibe.ch (until 28.02)
	C. Guidobaldi*	Tel: +41 31 631 33 23 email: cguido@iam.unibe.ch (until 15.02 and from 1.10)
	S. Günter*	Tel: +41 31 631 85 74 email: sguenter@iam.unibe.ch
	F. He	Tel: +41 31 631 49 02 email: feihe@iam.unibe.ch (until 15.04)
	Ch. Irniger*	Tel: +41 31 631 49 87 email: irniger@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 February – March
	Prof. A. Kandel	University of South Florida, Tampa, USA May – July
	Dr. M. Kraetzel	DSTO Edinburgh, Australia October

* 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, 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 adaption 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, 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: 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

- Ambauen, R.: Graphmatching-basierte Identifikation von Diatomeen
- Helmers, M.: Verwendung von künstlich erzeugten Texten in der Handschrifterkennung
- Wrobel, N.: String Clustering
- Hertel, C.: Personenidentifikation mit Schriftmerkmalen

4.4 PhD Theses

- Fischer, S.: Automatic Identification of Diatoms

4.5 Publications

Books and Special Issues of Journals

- Hager, G.D., Christensen, H.I., Bunke, H., Klein, R. (Eds.): Sensor Based Intelligent Robots, Springer Verlag, Lecture Notes in Computer Science, Vol. 2238, 2002
- Bunke, H., Kandel. A. (Eds.): Hybrid Methods in Pattern Recognition, World Scientific, 2002
- Kandel, A., Bunke, H., Last, M. (Eds.): Graphical Methods in Data Mining, Special Issue of International Journal of Image and Graphics, Vol 2, No 1, World Scientific, 2002

Journal Publications

- Günter, S., Bunke, H.: Self-organizing map for clustering in the graph domain, Pattern Recognition Letters 23, 2002, 401 - 417
- Sobottka, K., Bunke, H.: Investigating anytime algorithms for future distance warning systems, Real-Time Imaging, Vol. 8, No. 1, February 2002, 61-71

- Bunke, H., Jiang, X., Abegglen, K., Kandel, A.: On the weighted mean of a pair of strings, Pattern Analysis and Applications 5, 2002, 23 - 30

- Fischer, S., Bunke, H.: Automatic identification of diatoms using visual human-interpretable features, Int. Journal of Image and Graphics, Vol 2, No 1, 2002, 67 - 88

- Bunke, H., Kraetzl, M., Shoubridge, P., Wallis, W. D.: Detection of abnormal change in time series of graphs, Journal of Interconnection Networks, Vol.3, Nos 1 & 2, 2002, 85-101

- Last, M., Bunke, H., Kandel, A.: A feature-based serial approach to classifier combination, Pattern Analysis and Applications 5, 2002, 385 - 398

- Marti, U.-V., Bunke, H.: The IAM-database: an English sentence database for offline handwriting recognition, Int. Journal on Document Analysis and Recognition, Vol. 5, 2002, 39 - 46

Refereed Conference Proceedings and Edited Books

- Last, M., Bunke, H., Kandel, A.: Fuzzy modeling of the complexity vs. accuracy trade-off in a sequential two-stage multi-classifier system, in Grmela, A., Mastorakis, N. E. (Eds.): Advances in Intelligent Systems, Fuzzy Systems, Evolutionary Computation, WSEAS Press, Art. Intelligence Series, 2002, 12 - 17

- Bunke, H., Kraetzl, M., Shoubridge, P., Wallis, W.: Measuring change in large enterprise data networks, Proc. Int. Conference on Information, Decision and Control, Adelaide, 2002, 53 - 58

- Dickinson, P., Bunke, H., Dadej, A., Kraetzl, M.: Median graphs and anomalous change detection in communication networks, Proc. Int. Conference on Information, Decision and Control, Adelaide, 2002, 59 - 64

- Jiang, X., Hofer, S., Stahs, T., Ahrns, I., and H. Bunke: A new technique for the extraction and tracking of surfaces in range image sequences, in Hager, G.D., Christensen, H.I., Bunke, H., Klein, R.(Eds.): Sensor Based Intelligent Robots, Springer Verlag, Lecture Notes in Computer Science, Vol. 2238, 2002, 87 - 100

- Günter, S., Bunke, H.: Adaptive self-organizing map in the graph domain, in Bunke, H., Kandel, A. (Eds.): Hybrid Methods in Pattern Recognition, World Scientific, 2002, 61 - 74

- Jiang, X., Irniger, C., Bunke, H.: Training/test data partitioning for empirical performance evaluation, in Christensen, H., Phillips, J. (Eds.): Empirical Evaluation Methods in Computer Vision, World Scientific, 2000, 23 - 37

- Günter, S., Bunke, H.: Generating classifier ensembles from multiple prototypes and its application to handwriting recognition, in Roli, F., Kittler, J.: Multiple Classifier Systems, Proceedings MCS 2002, LNCS 2364, Springer, 2002, 179 - 188

- P.J. Dickinson, H. Bunke, A. Dadej, M. Kraetzl: Similarity measure for hierarchical graph representation and its application to computer network monitoring, in Proc. 6th World Multiconference on Systemics, Cybernetics and Informatics, Orlando, Florida, Vol. IV, 2002, 457 - 462

- Fischer, S., et al.: Contour extraction, in H. du Buf and M. Bayer (Eds.): Automatic Diatom Identification, World Scientific, 2002, 93 - 107

- Fischer, S., Bunke, H.: Identification using classical and new features in combination with decision tree ensembles, in H. du Buf and M. Bayer (Eds.): Automatic Diatom Identification, World Scientific, 2002, 109 - 140

- Fischer, S., Gilomen, K., Bunke, H.: Identification of diatoms by grid graph matching, in Caelli, T., Amin, A., Duin, R., Kamel, M., de Ridder, D. (Eds.): Structural, Syntactic, and Statistical Pattern Recognition, Proc. Joint IAPR Int. Workshops SSPR 2002 and SPR 2002, Springer Verlag, LNCS 2396, 2002, 94 - 103

- Bunke, H., Foggia, P., Guidobaldi, C., Sansone, C., Vento, M.: A comparison of algorithms for maximum common subgraph on randomly connected graphs, in Caelli, T., Amin, A., Duin, R., Kamel, M., de Ridder, D. (Eds.): Structural, Syntactic, and Statistical Pattern Recognition, Proc. Joint IAPR Int. Workshops SSPR 2002 and SPR 2002, Springer Verlag, LNCS 2396, 2002, 123 - 132

- Jiang, X., Bunke, H.: Optimal lower bound for generalized median problems in metric space, in Caelli, T., Amin, A., Duin, R., Kamel, M., de

Ridder, D. (Eds.): Structural, Syntactic, and Statistical Pattern Recognition, Proc. Joint IAPR Int. Workshops SSPR 2002 and SPR 2002, Springer Verlag, LNCS 2396, 2002, 143 - 151

- Günter, S., Bunke, H.: Creation of classifier ensembles for handwritten word recognition using feature selection algorithms, Proc. 8th Int. Workshop on Frontiers in Handwriting Recognition, 2002, 183 - 188

- Zimmermann, M., Bunke, H.: Hidden Markov model length optimization for handwriting recognition systems, Proc. 8th Int. Workshop on Frontiers in Handwriting Recognition, 2002, 369 - 374

- Zimmermann, M., Bunke, H.: Automatic segmentation of the IAM offline database for handwritten English text, Proc. 16th Int. Conference on Pattern Recognition, Vol. IV, 2002, 35 - 39

- Jiang, X., Bunke, H., Abegglen, K., Kandel, A.: Curve morphing by weighted mean of strings, Proc. 16th Int. Conference on Pattern Recognition, Vol. IV, 2002, 192 - 195

- Günter, S., Bunke, H.: A new combination scheme for HMM-based classifiers and its application to handwriting recognition, Proc. 16th Int. Conference on Pattern Recognition, Vol. II, 2002, 332 - 337

4.6 Further Activities

Editorial Boards and Committees

- Executive Committee member of the Int. Association for Pattern Recognition, IAPR (H. Bunke, until August 2002)

- Editor-in-charge of the International Journal of Pattern Recognition and Artificial Intelligence by World Scientific Publ., Singapore (H. Bunke)

- Editor-in-Chief of Electronic Letters on Computer Vision and Image Analysis (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)
- Co-chair of Track 2 on 'Pattern Recognition, Neural Networks, and Document Analysis' at the 16-th International Conference on Pattern Recognition, Quebec City, Canada (H. Bunke)

Program Committees

- Int. Workshop on Multiple Classifier Systems, Cagliari, Italy, June 24 - 26, 2002 (H. Bunke)
- International Workshop Frontiers in Handwriting Recognition, Niagara-on-the-Lake, Aug 6 - 8, 2002 (H. Bunke)
- IAPR Int. Workshop Structural and Syntactic Pattern Recognition, Windsor, Ontario, Aug 6 - 9, 2002 (H. Bunke)

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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	Dr. A. Kouznetsov*	Tel.: +41 31 631 49 76 email: kouznet@iam.unibe.ch
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	M. Wirz	Tel.: +41 31 631 46 83 email: wirz@iam.unibe.ch
Guest:	Prof. Dr. S. Artemov	(January)

* 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).
Keywords: 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

In this project we are mainly interested in the logical analysis of formalisms for representing and dealing with mathematical/computational knowledge.
To this end we study conceptual frameworks, in particular theories connecting classical mathematics with constructive mathematics and especially feasible mathematics, always emphasising on computational questions.
One central formalism for this purpose is provided by applicative theories with flexible typing. This framework is also crucial for our approach to abstract computability and a series of proof-theoretic and computational complexity issues which come up on our way.
In particular, we will focus on explicit/constructive analogues of strong set-theoretic axioms and type systems for object-oriented programming.
Our research activities about abstract computability can be roughly structured as follows:

- bounded applicative theories for various complexity classes and a proof-theoretic approach to higher type complexity theory;

- unfolding schematic formal systems and finitism.

A crucial aspect of our work deals with establishing exact proof-theoretic and complexity-theoretic bounds for the systems and approaches involved. In this context we deal with Mahloness in analysis, higher reflection, higher-order and nonmonotone inductive definability and the proof theory of systems with variable separation.
Keywords: Algebraic and logical knowledge representation; applicative theories; explicit mathematics; type theories; subsystems of set theory and second order arithmetic; higher type recursion theory; functionals of higher types; abstract computations; proof and computation; feasible complexities; object-oriented programming; proof theory; computation and constructivity

Research staff: G. Jäger, G. Ostrin, D. Probst, V. Salipante, Th. Strahm, 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. 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 unertainty, stuctures for algebraic logic, state transition systems and concurrency, logic and philosophy.

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

Financial support: Swiss Virtual Campus

5.3 Diploma Theses

- P. Keller: Information Flow
- M. Kretz: On the treatment of predicative polymorphism in theories of explicit mathematics

5.4 Ph.D. Theses

- L. Alberucci: The Modal mu-Calculus and the Logic of Common Knowledge

5.5 Publications

- L. Alberucci: Strictness of the modal mu-Calculus Hierarchy, in E.Graedel, W.Thomas, T.Wilke (Eds.), *Proceedings of the Dagstuhl Seminar: Automata, Logics and Infinite Games*, Lecture Notes in Computer Science 2500, 2002

- L. Alberucci and G. Jäger: About cut elimination for logics of common knowledge, *Annals of Pure and Applied Logic*, to appear

- L. Alberucci and V. Salipante: On Modal mu-Calculus and Non-Well-Founded Set Theory, submitted

- G. Jäger: An intensional fixed point theory over first order arithmetic, submitted

- G. Jäger and D. Probst: Iterating Sigma operations in admissible set theory without foundation: a further aspect of metapredicative Mahlo, submitted

- G. Jäger and T. Strahm: The proof-theoretic analysis of the Suslin operator in applicative theories, in W. Sieg et al. (Eds.), *Reflections on the Foundations of Mathematics (Essays in Honor of S. Feferman)*, Lecture Notes in Logic 15, 2002

- G. Jäger and Th. Studer: Extending the system T_0 of explicit mathematics: the limit and Mahlo axioms, *Annals of Pure and Applied Logic 114*, 2002

- G.E. Ostrin and S.S. Wainer: Proof Theoretic Complexity, in H. Schwichtenberg and R. Steinbruggen (Eds.) *Proof and System Reliability*, Kluwer Academic Publishers, 2002

- G.E. Ostrin and S.S. Wainer: Elementary Arithmetic, *Annals of Pure and Applied Logics*, to appear

- C. Rüede and T. Strahm: Intuitionistic fixed point theories for strictly positive operators, *Mathematical Logic Quarterly 48*, 2002.

- Th. Strahm: Wellordering proofs for metapredicative Mahlo, *Journal of Symbolic Logic 67*, 2002
- Th. Strahm: Theories with self-application and computational complexity, *Information and Computation*, to appear
- Th. Strahm: A proof-theoretic characterization of the basic feasible functionals, submitted

5.6 Further Activities

Editorials Boards

- Member of the editorial board of *Theoretical Computer Science* (G. Jäger, until March)
- Member of the editorial board of *Archive of Mathematical Logic* (G. Jäger, since April)
- Member of the consulting board of *Dialectica* (Th. Strahm)

Technical Committees

- President of the *Swiss Society for Logic and Philosophy of Science* (G. Jäger)
- Member of the *Scientific Council of the European Association for Computer Science Logic* (G. Jäger)
- Swiss representative of the *COST Action 274 "Theory and Applications of Relational Structures as Knowledge Instruments"* (G. Jäger)
- Expert for "*Maturitätsprüfungen Mathematik*" (G. Jäger)
- Secretary of the *Swiss Society for Logic and Philosophy of Science* (Th. Strahm)

University of Bern

- Dean of the Science Faculty (G. Jäger, since September)

6 Research Group on Software Composition

6.1 Personnel

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6.2 Research Projects

Tools and Techniques for Decomposing and Composing Software

Despite advances in programming languages, software development environments, documentation standards, and software processes, software continues

to be hard to develop, hard to understand, and hard to maintain. In particular, no matter how much effort is put into developing clean, modern, software systems, it seems that successful software inevitably drifts towards increasingly complex and hard-to-maintain "legacy systems".
This project proposes to develop new tools and techniques for decomposing software systems, that is, for breaking down and understanding complex software, and for composing software systems, that is, structuring software so that it becomes easier to maintain, reconfigure, and extend.
The proposed work builds on our previous work on the MOOSE reverse engineering environment and the Piccola composition language.

Research staff: All members of the research group.

Duration: Oct. 2002 - Sept. 2004

Financial support: Swiss National Science Foundation, project no. 2000-067855.02

For further details, please consult:
`http://www.iam.unibe.ch/~scg/Research/NFS02/`

RECAST: Evolution of Object-Oriented Applications

This research project is about reengineering object-oriented applications. Reengineering such applications inherits complex problems related to software maintenance, *i.e.,* program understanding, program analysis, and program transformation and adds to them (1) the complexity introduced by late binding, dynamic typing, and incremental definition specific to object-oriented programming, and (2) the complexity related to the new way of software development (multiple parallel versions, frameworks, and products lines). Based on our research experience, this research project is structured in three non-orthogonal directions: (a) reengineering, (b) analysis of versions, and (c) migration of object-oriented applications towards components.

Research staff: All members of the research group.

Duration: Oct. 2002 - Sept. 2006

Financial support: Swiss National Science Foundation, project no. 620-066077

For further details, please consult:
`http://www.iam.unibe.ch/~ducasse/WebPages/Recast.html`

Meta-models and Tools for Evolution Towards Component Systems

This project focuses on tools and models to support the transition towards component-based software development. The following results have been achieved in the second year:

- *Component Meta-modeling.* A reverse-engineering environment has been developed that supports various forms of analysis and visualization Reengineering. A collection of reengineering techniques has been published in the form of a book.
- *Evolution.* Various tools and techniques have been developed to understand and to implement software evolution.
- *Composition langauges.* A formal semantics of software composition has been elaborated.

Research staff: All members of the research group.

Duration: Oct. 2000 - Sept. 2002

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, 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.pecos-project.org/`

Research staff: G. Arevalo, Dr. S. Ducasse, M. Lanza, P. Liang, Prof. O. Nierstrasz, Dr. R. Wuyts.

Duration: Oct. 2000 - Sept. 2002

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

6.3 Diploma Theses

- Christian Kaufmann. Software engineering im spannungsfeld theorie und praxis. Master's thesis, University of Bern, 2001.
- Daniel Schweizer. Navigation in object-oriented reverse engineering. Diploma thesis, University of Bern, June 2002.

6.4 Ph.D. Theses

- Franz Achermann. *Forms, Agents and Channels - Defining Composition Abstraction with Style*. PhD thesis, University of Berne, January 2002.
- Tamar Richner. *Recovering Behavioral Design Views: a Query-Based Approach*. PhD thesis, University of Berne, May 2002.

6.5 Publications

Journals

- K. Mens, I. Michiels, and R. Wuyts. Supporting software development through declaratively codified programming patterns. *SEKE 2001 Special Issue of Elsevier Journal on Expert Systems with Applications*, 2001. Extended version of [**?**].
- Tom Mens and Michele Lanza. A graph-based metamodel for object-oriented software metrics. *Electronic Notes in Theoretical Computer Science*, 72(2), 2002.
- Benny Sadeh and Stéphane Ducasse. Adding dynamic interface to smalltalk. *Journal of Object Technology*, 1(1), 2002.

Conferences

- Juan-Carlos Cruz. Opencolas – a coordination framework for colas dialects. In *Proceedings of COORDINATION 2002*, York, United Kingdom, 2002.

- Michele Lanza and Stéphane Ducasse. Understanding software evolution using a combination of software visualization and software metrics. In *Proceedings of LMO 2002*, pages 135–149, 2002.

- Kim Mens, Isabel Michiels, and Roel Wuyts. Supporting software development through declaratively codified programming patterns. In *SEKE 2001 Proceedings*, pages 236–243. Knowledge Systems Institute, 2001. International conference on Software Engineering and Knowledge Engineering, Buenos Aires, Argentina, June 13-15, 2001.

- Oscar Nierstrasz, Gabriela Arevalo, Stéphane Ducasse, Roel Wuyts, Andrew Black, Peter Müller, Christian Zeidler, Thomas Genssler, and Reinier van den Born. A component model for field devices. In *Proceedings First International IFIP/ACM Working Conference on Component Deployment*, pages 200–209, Berlin, Germany, June 2002. ACM.

- Oscar Nierstrasz. Software evolution as the key to productivity. In *Proceedings Radical Innovations of Software and Systems Engineering in the Future*, Venice, Italy, Oct. 2002.

- Tamar Richner and Stéphane Ducasse. Using dynamic information for the iterative recovery of collaborations and roles. In *Proceedings of ICSM'2002 (International Conference on Software Maintenance)*, October 2002.

Workshops

- Gabriela Arévalo and Tom Mens. Analysing object oriented application frameworks using concept analysis. In Andrew Black, Erik Ernst, Peter Grogono, and Markky Sakkinen, editors, *ECOOP 2002: Proceedings of the Inheritance Workshop*. University of Jyväskylä, 2002.

- Gabriela Arévalo and Tom Mens. Analysing object oriented framework reuse using concept analysis. In Jean-Michel Bruel and Zohra Bellahsene, editors, *Advances in Object-oriented information systems: OOIS 2002 Workshops*. Springer Verlag, 2002.

- Michele Lanza and Stéphane Ducasse. Beyond language independent object-oriented metrics: Model independent metrics. In Fernando Brito e Abreu, Mario Piattini, Geert Poels, and Houari A. Sahraoui, editors, *Proceedings of the 6th International Workshop on Quantitative Approaches in Object-Oriented Software Engineering*, pages 77–84, 2002.

- Peng Liang, Gabriela Arévalo, Stéphane Ducasse, Michele Lanza, Nathanael Schaerli, Roel Wuyts, and Oscar Nierstrasz. Applying rma for scheduling field device components. In *ECOOP 2002 Workshop Reader*, 2002.

- Nathanael Schärli and Franz Achermann. Partial evaluation of interlanguage wrappers. In *Workshop on Composition Languages, WCL'01*, September 2001.

- Nathanael Schaerli, Stéphane Ducasse, and Oscar Nierstrasz. Classes = traits + states + glue (beyond mixins and multiple inheritance). In *Proceedings of the International Workshop on Inheritance*, 2002.

Technical reports

- Andrew Black, Nathanael Schärli, and Stéphane Ducasse. Applying traits to the smalltalk collection hierarchy. Technical Report IAM-02-007, Institut für Informatik, University of Berne, Switzerland, November 2002. Cross referenced to OGI School of Science & Engineering, Technical Report CSE-02-014.

- Nathanael Schärli, Stéphane Ducasse, Oscar Nierstrasz, and Andrew Black. Traits: Composable units of behavior. Technical Report IAM-02-005, Institut für Informatik, University of Berne, Switzerland, November 2002. Cross referenced to OGI School of Science & Engineering, Technical Report CSE-02-012.

- Nathanael Schärli, Oscar Nierstrasz, Stéphane Ducasse, Roel Wuyts, and Andrew Black. Traits: The formal model. Technical Report IAM-02-006, Institut für Informatik, University of Berne, Switzerland, November 2002. Cross referenced to OGI School of Science & Engineering, Technical Report CSE-02-013.

Books

- Serge Demeyer, Stéphane Ducasse, and Oscar Nierstrasz. *Object-Oriented Reengineering Patterns*. Morgan Kaufmann, 2002.

- Thomas Genssler, Alexander Christoph, Benedikt Schulz, Michael Winter, Chris M. Stich, Christian Zeidler, Peter Müller, Andreas Stelter, Oscar Nierstrasz, Stéphane Ducasse, Gabriela Arévalo, Roel Wuyts, Peng Liang, Bastiaan Schönhage, and Reinier van den Born. *PECOS in a Nutshell*. The Pecos Consortium, September 2002.

6.6 Further Activities

Editorial Boards

Oscar Nierstrasz:

- L'OBJET – Logiciel, réseaux, bases de données
- Annals of Software Engineering

Stéphane Ducasse:

- RSTI (Revue des Sciences et Techniques de l'Information)

Associations

Oscar Nierstrasz:

- CHOOSE – Swiss group for Object-Oriented Systems and Environments (Executive Board member)
- AITO – Association Internationale pour les Technologies Objets (Board member)
- ESEC, the European Software Engineering Conference (Member of Steering Committee)

Stéphane Ducasse:

- CHOOSE – Swiss group for Object-Oriented Systems and Environments (Executive Board member)
- ESUG (European Smalltalk User Group, Member of Steering Committee)
- SSUG (Swiss Smalltalk User Group, Member of Steering Committee)

Program Committees

Oscar Nierstrasz:

- PC Member of Coordination 2002 (Fifth International Conference on Coordination Models and Languages Ñ York, UK, April 8-1, 2002)
- PC Member of FOAL (Foundations of Aspect Oriented Languages Ñ co-located with AOSD, Twente, the Netherlands, April 23-26, 2001)
- PC Member of CAiSE 2002 (The Fourteenth International Conference on Advanced Information Systems Engineering Ñ Toronto, Canada, May 27 - 31, 2002)
- PC Member of CD 2002 (First International Working Conference on Component Deployment Ñ Berlin, Germany, June 20-21, 2002; co-located with PLDI, June 17-19)
- PC Member of EDOC 2002 (The 6th International Conference on Enterprise Distributed Object Computing Ñ Lausanne, Switzerland Sept 17 - 20, 2002)
- PC Member of Radical Innovations of Software and Systems Engineering in the Future ÑVenice, Italy, Oct 7-11 2002
- PC Member of OOPSLA 2002 (Conference on Object-Oriented Programming, Systems, Languages, and Applications Ñ Seattle, Washington, Nov 4-8 2002)

Stéphane Ducasse:

- PC Member of LMO'2002 (Conference on Langages et Modèles à Objets – Montpellier, France, 15 April 2002)

A Teaching Activities

A.1 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
S. Ducasse **M. Lanza** **O. Nierstrasz** **R. Wuyts:**	Software Engineering Applied

A.2 Summer semester 2002

H. Bieri:	Computergraphik Datenstrukturen und Algorithmen Praktikum Computeranimation Seminar: Computergeometrie und Grafik
H.P. Blau:	Anwendungssoftware
H. Bunke:	Compilerbau Grundlagen der Bildanalyse und Mustererkennung Seminar: Künstliche Intelligenz
T. Braun:	Betriebssysteme und Verteilte Systeme Praktikum Computernetze Rechnerarchitektur Netze und Protokolle für das Internet Seminar: Rechnernetze und Verteilte Systeme
G. Jäger **J. Kohlas:**	Inferenz und Deduktion
O. Nierstrasz:	Programmiersprachen Programmierung 2 Seminar: Software Composition
T. Strahm:	Einführung in die theoretische Informatik Seminar: Theoretische Informatik und Logik

A.3 Winter semester 2002/2003

H. Bieri:	Digitale Bilder Einführung in die Informatik 3D-Graphik Seminar: Computergeometrie und Grafik
H.P. Blau:	Anwendungssoftware Programmierung 1
T. Braun:	Computernetze Grundlagen der technischen Informatik Multimediakommunikation Praktikum Computernetze Seminar: Rechnernetze und Verteilte Systeme
H. Bunke:	Automaten und formale Sprachen Künstliche Intelligenz Praktikum Bildanalyse Seminar: Künstliche Intelligenz
G. Jäger:	Seminar: Theoretische Informatik und Logik
G. Jäger: **J. Kohlas:**	Seminar: Inferenz und Deduktion
O. Nierstrasz:	Einführung in Software Engineering Seminar: Software Composition
S. Ducasse **M. Lanza** **O. Nierstrasz** **S. Tichelaar** **R. Wuyts:**	Object-Oriented Reengineering Patterns and Techniques
K. Stoffel:	Datenbanken
T. Strahm:	Logik und Informatik

B Colloquium in Informatics

01/08/2002	Dr. Nicolas Revault University of Cergy-Pontoise and LIP6, Paris Metamodeling exercises
01/15/2002	Prof. Dr. Sergei Artemov Graduate Center CUNY, New York Explicit Logics for Computer Science
01/22/2002	Prof. Dr. Helmar Burkhart Universität Basel, Institut für Informatik Middleware, e-Grids, WebServices: Der evolutionäre Weg zu verteilten Anwendungen
02/05/2002	Dr. Gilles Vanwormhoudt France Télécom Lille 1 Dynamic and Iterative Recovery of Types in VisualAge Smalltalk
04/02/2002	Dr.-Ing. Georg Carle Fraunhofer Institut FOKUS, Berlin Instrumentierung und aktive Komponenten für Internet-Mehrwertdienste
04/16/2002	Dr. Andreas Raab Impara GmbH, Magdeburg Squeak - Combining Media and Technology in Education
04/30/2002	Dr. Henrik Gedenryd The Open University, UK Beyond Inheritance Aspects and Roles: A Unified Scheme for Object and Program Composition
05/21/2002	Prof. Dr. Wolfgang Kreutzer University of Canterbury, Christchurch, New Zealand Department of Computer Science Is Visual Programming Only for Weak Minds?

06/04/2002 Dr. habil. Guerino Mazzola und Dipl. Inf. Stefan Göller
Universität Zürich, Institut für Informatik
Denotator-based Multimedia Navigation on Complex Data

06/11/2002 Dr. Thomas Studer
Crosspoint Informatik AG, Schönbühl
Das Acquiring System - ein Projektbericht

06/25/2002 Dr. Christian Stern
Universität Zürich, Institut für Informatik
Interaktive 3D-Visualisierung medizinischer Datensätze
auf der Basis gefilterter CT- und MRI-Bildserien

11/12/2002 Prof. Dr. Nadia Magnenat-Thalmann
University of Geneva, MIRALab
Centre universitaire d'Informatique (CUI)
Research Problems in the Simulation of Virtual Humans

11/26/2002 Prof. Dr. Bertrand Meyer
ETHZ, Departement Informatik
Trusted Components: Concepts and Progress Report

12/10/2002 Prof. Dr. Stephanie Teufel
University of Fribourg, iimt - International Institute of
Management in Telecommunications
Information Security Culture - the socio-cultural dimension
in information security management