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**UNIVERSITÄT
BERN**

Institut für Informatik und
angewandte Mathematik
Universität Bern

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IAM Annual Report 06/07



IAM Annual Report
Academic Year 2006/2007

August, 2007

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1 Institute of Computer Science and Applied Mathematics (IAM)

1.1 Address

Neubrückestrasse 10, CH-3012 Bern, Switzerland
Telephone: +41 31 631 86 81, Telefax: +41 31 631 32 62
www: <http://www.iam.unibe.ch>

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.

Teaching staff

Prof. Dr. Hanspeter Bieri; Prof. Dr. Torsten Braun; Prof. Dr. Horst Bunke;
Dr. Orla Greevy; Prof. Dr. Rolf Haenni; Prof. Dr. Gerhard Jäger; Prof.
Dr. Oscar Nierstrasz; Prof. Dr. Kilian Stoffel; PD Dr. Thomas Strahm; Dr.
Thomas Studer.

Director

Prof. Dr. Oscar Nierstrasz.

Administration

Ruth Bestgen; Bettina Choffat; Sabine Gerber; Therese Schmid; Susanne
Thüler.

Library

Gudrun Heim; S. Neukomm; Katrin Wegmüller.

Technical staff

Peppo Brambilla; Dragan Milic.

Scientific staff

Dr. L. Alberucci; L. Ammon; M. Anwander; T. Bernoulli; R. Bertolami; P. Brambilla; M. Brogle; Dr. K. Brännler; Th. Buchberger; Dr. M. Denker; Dr. M. Gälli; Dr. T. Gîrba; Dr. O. Greevy; Dr. T. Ha-Minh; Prof. Dr. R. Haenni; M. Hugi; J. Jonczy; V. Kilchherr; R. Kohlas; J. Krähenbühl; Dr. M. Kretz; A. Kuhn; Dr. U.-M. Künzi; P. Lauer; A. Lienhard; M. Liwicki; Dr. R. McKinley; D. Milic; Dr. G. Ostrin; Dr. L. Ponisio; Dr. D. Probst; L. Renggli; K. Riesen; Ph. Robert; D. Röthlisberger; S. Schär; M. Scheidegger; A. Schlapbach; D. Spescha; T. Staub; D. Steiner; Ph. Stouppa; PD Dr. Th. Strahm; Dr. Th. Studer; M. Wachter; G. Wagenknecht; M. Wälchli; R. Wehbe; Th. Wenger; Dr. M. Wulff.

2 Teaching Activities

2.1 Courses for Major and Minor in Computer Science

Winter Semester 2006/2007

- Bachelor 1st Semester

Einführung in die Informatik (H. Bieri, 5 ECTS)

Programmierung 1 (Th. Strahm, 5 ECTS)

Grundlagen der technischen Informatik (Th. Studer, 5 ECTS)

- Bachelor 3rd Semester

Information und Logik (G. Jäger, 5 ECTS)

Einführung in Software Engineering (O. Nierstrasz, 5 ECTS)

Computernetze (T. Braun, 5 ECTS)

- Bachelor 5th Semester

Computergrafik (H. Bieri, 5 ECTS)

Künstliche Intelligenz (H. Bunke, 5 ECTS)

Mensch Maschine Schnittstelle (Th. Strahm, 5 ECTS)

- Master's Courses and Seminars

Automatische Sprachdienste (H. Bunke, U.V. Marti, 5 ECTS)

Blockveranstaltung Bern und Freiburg: Inferenz und Deduktion
(G. Jäger, J. Kohlas, 5 ECTS)

Einführung in die Kryptographie (R. Haenni Sola, 5 ECTS)

Grundlagen der Mustererkennung (H. Bunke, 5 ECTS)

Sensornetze (T. Braun, 5 ECTS)

Lambdakalküle (G. Jäger, 5 ECTS)

Object Oriented Reengineering Patterns and Techniques (O. Nierstrasz, 5 ECTS)

Seminar: Algebra und Logik (G. Jäger, J. Schmid, 5 ECTS)

Seminar: Computergeometrie und Grafik (H. Bieri, 5 ECTS)

Seminar: Künstliche Intelligenz (H. Bunke, 5 ECTS)

Seminar: Rechnernetze und Verteilte Systeme (T. Braun, 5 ECTS)

Seminar: Schliessen mit unsicherer Information (R. Haenni Sola, 5 ECTS)

Seminar: Software Composition (O. Nierstrasz, 5 ECTS)

Seminar: Theoretische Information und Logik (G. Jäger, 5 ECTS)

- Service Course

Anwendungssoftware (Th. Studer, 3 ECTS)

Summer Semester 2007

- Bachelor 2nd Semester

Datenstrukturen und Algorithmen (H. Bieri, 5 ECTS)

Datenbanken (K. Stoffel, 5 ECTS)

Programmierung 2 (O. Greevy, 5 ECTS)

Rechnerarchitektur (Th. Studer, 5 ECTS)

- Bachelor 4th Semester

Automaten und formale Sprachen (H. Bunke, 5 ECTS)

Betriebssysteme (T. Braun, 5 ECTS)

Berechenbarkeit und Komplexität (Th. Strahm, 5 ECTS)

Praktikum in Software Engineering (Th. Studer, 5 ECTS)

- Bachelor 6th Semester

Seminar: Computergeometrie und Grafik (H. Bieri, 5 ECTS)

Seminar: Künstliche Intelligenz (H. Bunke, 5 ECTS)

Seminar: Rechnernetze und Verteilte Systeme (T. Braun, 5 ECTS)

Seminar: Software Composition (O. Nierstrasz, 5 ECTS)

Seminar: Theoretische Information und Logik (G. Jäger, 5 ECTS)

- Master's Courses

Blockveranstaltung Bern und Freiburg: Inferenz und Deduktion (G. Jäger und J. Kohlas, 5 ECTS)

Digitale Bilder (H. Bieri, 5 ECTS)

Multimediakommunikation (T. Braun, 5 ECTS)

Mustererkennung 2 (H. Bunke, 5 ECTS)

Nichtmonotones Schliessen (Th. Strahm, 5 ECTS)

Seminar: Theoretische Information und Logik (G. Jäger, 5 ECTS)

Seminar: Computergeometrie und Grafik (H. Bieri, 5 ECTS)

Seminar: Für Studierende aller Stufen mit Grundkenntnissen in theor. Informatik (G. Jäger and D. Probst, 5 ECTS)

Seminar: Künstliche Intelligenz (H. Bunke, 5 ECTS)

Seminar: Rechnernetze und Verteilte Systeme (T. Braun, 5 ECTS)

Seminar: Software Composition (O. Nierstrasz, 5 ECTS)

Temporal Logics (G. Jäger, G. Sommaruga, U. Ultes-Nitsche, 5 ECTS)

- Service Course

Anwendungssoftware (Th. Strahm, 3 ECTS)

2.2 Colloquium in Computer Science

31/10/2006 Prof. Lawrence O. Hall
University of South Florida
Learning from Large Amounts of Data

23/01/2007 Philipp Murkowsky
Zeix AG, Zürich
Usability Assessments und User Centered Development
– Methoden und deren Anwendung in der Praxis

29/05/2007 Prof. Andreas Dengel
Universität Kaiserslautern und Deutsches
Forschungszentrum für Künstliche Intelligenz (DFKI)
Knowledge Technologies for the Semantic Desktop

2.3 Students

- Major Subject Students: WS 06/07: 219, SS 2007: 202
- Minor Subject Students: WS 06/07: 182, SS 2007: 162
- PhD Candidates: WS 06/07: 31, SS 2007: 30

2.4 Degrees and Examinations

- PhD: 5
- Diploma: 10
- Master: 19
- Bachelor: 3
- Propädeutische Hauptfachprüfung: 15
- Completion of Minor Studies: 26 (60E: 5, 50E: 1, 45E: 1, 40E: 2, 35E: 3, 31E: 1, 30E: 8, 25E: 3, 15E: 2 (931 ECTS)
- Semester Examinations Winter Semester 2006/2007: 561 (2607 ECTS)
- Semester Examinations Summer Semester 2007: 415 (1903 ECTS)

3 Research Group on Computational Geometry and Graphics

3.1 Personnel

Head:	Prof. Dr. H. Bieri	Tel.: +41 31 631 8670 email: bieri@iam.unibe.ch
Office Manager:	S. Gerber	Tel.: +41 31 631 4914 email: gerber@iam.unibe.ch
Scientific Staff:	L. Ammon	Tel.: +41 31 631 8676 email: ammon@iam.unibe.ch
	Th. Buchberger	Tel.: +41 31 631 4864 email: buchberg@iam.unibe.ch
	M. Hugli	Tel.: +41 31 631 3321 email: hugli@iam.unibe.ch
	Ph. Robert	Tel.: +41 31 631 4679 email: robert@iam.unibe.ch
	S. Schär	Tel.: +41 31 631 8955 email: schaer@iam.unibe.ch
	Th. Wenger	Tel.: +41 31 631 4990 email: wenger@iam.unibe.ch
	Guest:	Prof. X. Jiang

3.2 Overview

The research group CGG (computational geometry and graphics) focuses on geometry on the computer and its applications to computer graphics, image processing and computer vision. The group is mainly interested in applications that require techniques from several of those fields and are of practical relevance, for instance in history, art history and archaeology. Its three main areas of interest are the following:

Polyhedra in d dimensions

Since approx. 1975, a promising new kind of polyhedra - the so-called Nef polyhedra - have been developed at this institute. Nef polyhedra are dimension independent and therefore especially interesting for applications

where the dimension of the underlying space is higher than 3. A typical example are configuration spaces. Ongoing work extends the theory of Nef polyhedra and implements the kernel of a modeling system based on them.

Reconstruction of geometric objects

Museums, exhibitions and research projects in history, archaeology, etc. need virtual reconstructions of many kinds of 2D and 3D objects. The existing data are extremely varied, and so have to be the corresponding reconstruction techniques. Several projects deal with such reconstructions, and they typically try to combine some of the most promising techniques, to generalize them and to base them on sound theoretical fundamentals.

Frameworks for graphics applications

A number of independent frameworks are developed, e.g. for interactive ray tracing, 3D games, 3D city models and scene graphs for generic 3D applications. Each such framework is extended with implementations of different comparable techniques, and one main purpose consists in building “intelligent” dispatchers capable to select the most promising technique in view of the requirements and characteristics of a given application.

3.3 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, J. Tammik, T. Jakob

Anatomy of 3D Real-Time Game Engines

This project investigates various aspects of 3D game engines for next generation platforms. We intend to provide the design and implementation of a reference game engine with all major features to build a state of the art computer game:

- Multi resolution geometry (subdivision surfaces)
- GPU shader techniques (per pixel lighting, parallax mapping and dynamic shadows)
- Character animation
- High level scripting language integration
- Content pipeline (authoring, data export and preprocessing)
- Middleware integration

Research staff: Ch. Ammann

Collaboration on Scene Graph Based 3D Models

Professional 3D modeling applications, like Autodesk Maya or discreet 3ds max, offer only limited support for a team of artists to work on a 3D model collaboratively. There is even less support for efficiently managing revisions and variants or different representations of designs. 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. But 3D models are often stored in binary files in a proprietary format assembling thousands of objects in a complex structure called "scene graph" (DAG). This project provides support for collaboration on scene graph based 3D models by means of a specialized 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.

The scene graph repository stores 3D models in an attributed scene graph that has been designed to hold scene graphs of different 3D applications without loss of information. Attributed scene graphs also reflect dependencies between nodes in order to track the effects of changes to nodes through the scene graph. This allows us to reliably detect inconsistent collaborative changes and identify unexpected side effects possibly not taken into account by the modelers. In addition, a GUI helps to track down such unwanted side effects of collaborative changes visually by directing modelers to the critical points in a scene and by isolating changes and their side effects.

An XML schema defines the attributed scene graph model formally and allows us to export/import such scene graphs to/from XML files. Typically, check-out/-in, export/import operations and a conflict resolution GUI are implemented in plug-ins for 3D applications. So far such plug-ins have been developed mainly for Autodesk Maya.

Research staff: L. Ammon, A. Rüttimann

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

Reconstruction of Classical City Models

The principal practical goal of this project is to digitize a famous classical city model in the Historical Museum of Bern which shows Bern at about 1800. The intended result is a representation with little loss of information and close to a CAD model. More generally, we try to establish a generic pipeline for the digital reconstruction of city and similar models, offering a fairly automatic conversion from an initial point cloud to the final CAD representation. At the moment, our scan data consists of approximately 80 million points. A number of established and new techniques relating to point cloud editing and 3D reconstruction are being combined and enhanced, in particular registration methods, point cloud filtering (local and global), automatic noise and error correction, terrain recognition, mesh repair, 3D edge detection, pattern recognition methods, and large data handling.

Research staff: M. Hugli, H. Bieri

Interactive Ray Tracing

This project investigates algorithms, data structures and rendering techniques which have to be adopted in order to design and implement a scalable and interactive ray tracing system. Our main focus lies on aspects which are of particular importance to single system image (SSI) architectures consisting of multiple GPUs and CPUs. Among these are

- general purpose computations on graphics hardware (GPGPU)
- image-space based rendering optimisations
- scalable rendering techniques
- efficient memory management and cache usage
- algorithmic optimisations
- point-based ray tracing techniques

Part of this project is the development of a ray tracing based graphics library and a prototype application, which enables us to research various aspects of interactive ray tracing systems.

Research staff: Ph. Robert, S. Schoepke, R. Künzli

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. Many standalone tools and mesh libraries with a specialized focus are available today. But currently there exists no 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 (e.g. halfedge, corner table, etc.) and algorithms.

A basic mesh abstraction layer is defined that unifies several mesh representations. Different implementation techniques and new language features and extensions to Java (e.g. generic classes, aspect oriented programming) are analyzed and evaluated for their benefit in this context.

The most important basic and state-of-the-art algorithms on meshes have been implemented as mesh operations, in the area of mesh reconstruction, mesh generation, mesh simplification, mesh subdivision, and signal processing with meshes.

These mesh data structures and algorithms offer specific extensions targeting at didactic use cases, like e.g. visualization and documentation. Several typical JMesh based prototype applications investigate the extensibility, efficiency, and reliability of the framework. The novel application called "JMesh Workbench" allows the interactive exploration of 3D meshes and analysis of the attained results of the various mesh operations.

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, E. Aeschlimann, Ch. Aymon, A. Kobel, M. Ryter

Digital Visualization of the History of the Castle of Thun

Thun Castle has changed its outer and inner appearances several times since it was built around 1190. The goal of this project consists in creating a generic digital 3D model and to add refinements as realistic as possible for today's as well as for the most characteristic former states of the castle. For today's state most necessary data (ground plans, side views, etc.) is easily available, but the castle's former states are very poorly documented. Therefore, with the help of experts in history of architecture,

data from other monuments has to be adapted, and sometimes "reasonable" guesswork cannot be avoided. Most modeling and animation is done using Maya and 3DS Max. Creating good textures will be an important prerequisite in order to achieve a convincing appearance. That is decisive as the project's result shall be used for the castle's new designed permanent exhibition.

Research staff: M. Aebischer, M. von Rohr

Digital Terrain Visualization

This project was initiated by the Institute of Archaeology at the University of Berne (Prof M. Heinzelmann) which was looking for an application to visualize their archeological excavation sites and ancient buildings. The gathered data from the sites is stored in a geographic information system (GIS), i. e. Manifold System, which is widely used and well known at the institute. The aim of this project is to create a real-time 3D application to visualize terrains and additional data, e.g. labels and vegetation, from the GIS. The application will contain a number of specialized features:

- Interface to the GIS for easily importing data
- Import of modeled 3D objects from the excavation sites
- Intuitive 6 degrees of freedom navigation (using 3Dconnexion 3D navigation devices)
- Viewshed analysis
- Automatically generated vegetation and structures based on maps
- Comfortable terrain switching
- Geographical and general functions (isolines, distance measurement, ...)
- Configurable time system (day/night, ...)

The challenge lies in the amount of data that has to be visualized. Therefore, intelligent, highly optimized algorithms are needed to reach the goal of real-time. Furthermore, the acquisition of the terrain data is complicated and expensive because it is obtained by satellites. As an example terrain, the province of L'Aquila in the territory of Abruzzo, Italy, will be visualized.

Research staff: R. Hauck, R. Witschi

Implant Deformation

The reposition of bone fractures in trauma and cranio-maxillofacial surgery is followed by fixation using implants and fixation devices. Some of the trauma implants have been designed to fit most of human anatomy. In this case, the challenge is to select the best fitting implant. Sometimes, e.g. when fractures are located around the joints, the implants need to be bent to fit the individual anatomy of the patient. Inadequate bending might lead to loosening of the implant or failure. Surgeons bend the implants with the trial-and-error method throughout surgery. The repetitive deformation may cause fatigue problems of the metal. Moreover, corrections after improper bending are difficult. Therefore, we want to provide surgeons with a computer assisted planning system. With it, a 3D model of the patient morphology is generated out of various formats of images, e.g. CT scans. Then, an implant is selected out of the virtual implant database and deformed until it fits the individual patient's bone structure. With this system it should be possible to create the desired form within the first attempt and to reduce the time required to perform the surgery. Until now, the difficult and expensive task to bend the implants patient-specifically can be only achieved in the virtual model. In order to practically use implant bending in a surgical navigation system, the bending needs to be improved in such a way that it becomes physically realistic.

Research staff: S. Schmutz, in collaboration with the MEM Research Center at the University of Bern

2D to 3D Conversion of Videos Based on Motion Layers

The 2D to 3D conversion of arbitrary videos is still a challenging task. Various algorithms exist to gain 3D data from uncalibrated 2D videos, each being subject to particular restrictions. Amongst others, dynamical scenes cause problems, especially if they contain multiple independently moving objects (IMO).

On the other hand, segmentation and depth ordering of IMOs can be achieved through motion layer segmentation. Furthermore, an exact reconstruction of the 3D scene is not necessary to gain a satisfactory visual 3D effect. Thus, in this project, we analyze the restrictions of the different algorithms used for motion segmentation and study their applicability to

arbitrary videos as well as the possibility to use motion layer segmentation for the 2D to 3D conversion of videos. For this purpose, we implement a test environment, define test cases and perform quality ratings of the visual 3D effect.

Research staff: S. Schär, X. Jiang, H. Bieri

3.4 Diploma Theses

- Joël Marbach: Digitale Rekonstruktion von 3D-Objekten – klassisch und bildbasiert
- Jan Rothen: Computer-Rekonstruktion von menschlichen Gesichtern und Köpfen

3.5 Master's Theses

- Adrian Kobel: Mesh Simplification in Java
- Sascha Michel: Digitale 3D-Rekonstruktion von Gebäuden in Maya – Grundlagen und Tutorial
- Matthias von Rohr: Globale Beleuchtungsmodelle und Render Engines – Theorie und Anwendung
- Severin Schoepke: Ray Tracing auf der GPU

3.6 Bachelor's Theses

- Marco Aebischer: Gebäuderekonstruktion mit Laserscanning – Experimente, Vergleiche und Assessments
- Andreas Keller: Eine Anwendung des Collage Theorems

3.7 Further Activities

- 3D modeling for the exhibition “Karl der Kühne” at the Historical Museum of Bern (M. von Rohr, H. Bieri) Reference: B. Jakob: Aus der Trick-Kiste der Informatiker. In “uniaktuell” (May 15, 2007) and “unilink” (June 2007, 11-12).

- Member of the Programme Committee of WSCG 2007 (H. Bieri)
- Reviewing for WSCG 2007 (L. Ammon, H. Bieri, Ph. Robert, Th. Wenger)
- Expert for PhD exam at the University of Neuchâtel (H. Bieri)

3.8 Publications

- L. Ammon, H. Bieri: Collaboration on scene graph based 3D data. In J. Braz et al. (Eds.): VISAPP and GRAPP 2006, CCIS 4, pp. 78 – 90. Springer 2007
- A. Breyer, X. Jiang, A. Rütscbe, H. Bieri, T. Oexl, A. Baumann, D. Mojon: Influence of the Pulfrich phenomenon on driving performance. Graefe's Archive for Clinical and Experimental Ophthalmology, Vol. 244(12), 1555 – 1561 (2006)
- Ph. Robert, S. Schoepke, H. Bieri: Hybrid Ray Tracing Using GPU-Accelerated Image-Space Methods. In Proceedings of GRAPP 2007, 305-311 (Barcelona)
- H. Bieri, S. Zwahlen (Eds.): "Trinkt, o Augen, was die Wimper hält..." – Farbe und Farben in Wissenschaft und Kunst. Berner Universitätsschriften 52. Haupt-Verlag. To appear.

4 Research Group on Computer Networks and Distributed Systems

4.1 Personnel

Head:	Prof. Dr. T. Braun	Tel.: +41 31 631 4994 email: braun@iam.unibe.ch
Office Manager:	R. Bestgen	Tel.: +41 31 631 8957 email: bestgen@iam.unibe.ch
Scientific Staff:	M. Anwander*	Tel.: +41 31 631 8692 email: anwander@iam.unibe.ch
	(since 1.10.2006)	
	T. Bernoulli*	Tel.: +41 31 631 3403 email: bernoull@iam.unibe.ch
	(until 31.12.2006)	
	M. Brogle*	Tel.: +41 31 631 8668 email: brogle@iam.unibe.ch
	P. Lauer*	Tel.: +41 31 631 8648 email: lauer@iam.unibe.ch
	(since 15.03.2007)	
	D. Milic*	Tel.: +41 31 631 5309 email: milic@iam.unibe.ch
	M. Scheidegger*	Tel.: +41 31 631 8692 email: mscheid@iam.unibe.ch
	(until 31.01.2007)	
T. Staub*	Tel.: +41 31 631 3404 email: staub@iam.unibe.ch	
G. Wagenknecht*	Tel.: +41 31 631 8647 email: wagen@iam.unibe.ch	
M. Wälchli*	Tel.: +41 31 631 3403 email: Wälchli@iam.unibe.ch	
Dr. M. Wulff*	Tel.: +41 31 631 8647 email: mwulff@iam.unibe.ch	

* with financial support from a third party

4.2 Overview

The research group for Computer Networks and Distributed Systems (Rechnernetze und Verteilte Systeme, RVS) is active in several areas of computer communications and distributed systems.

Multimedia Communications The Internet is increasingly being used for multimedia data transfer (audio, video, data). We are studying how such services with high demands on the quality and reliability of communication systems and networks can be supported. In the past, we developed scalable simulation tools to support planning and operation of global IP networks. Nowadays, overlay networks and peer-to-peer systems are becoming more important for new Internet services, in particular to support communication within user groups. We are focusing on the design, development, and evaluation of methods to construct such overlay networks supporting the quality-of-service requirements of distributed applications and using network resources efficiently.

Wireless and Mobile Communication Decentralized system architectures and self-organization are fundamental concepts of future wireless and mobile communication systems. These concepts are particularly important in application scenarios such as sensor networks, mobile ad hoc networks (e.g. for direct communication between vehicles) and so-called mesh networks, which form low cost alternatives for the network access by end users. There is an urgent need for research on routing and transport protocols as well as on security and management mechanisms. In sensor networks, limited energy, computing and memory resources as well as limited reliability require special forms of distributed data processing and management.

Security in Distributed Systems The Internet simplifies access to distributed resources and services such as web services, e-learning contents, computer grids or sensor nodes. Traditional techniques for authentication and authorization are not very user-friendly and barely scalable. We investigate, design, implement, and evaluate novel schemes for efficient and secure authentication and authorization.

Distance Learning In all our lectures, we are using distance learning elements that are based on standard components but also on developments resulted from recent research projects. We are developing new methods and tools to support learners and teachers in e-learning environments. In particular, we aim to support practical experiments, mobile learning, and support for groups of learners.

4.3 Research Projects

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

The NCCR-MICS (<http://www.mics.ch>) project was launched in 2001. Its goal is to study fundamental and applied research questions raised by new generation mobile communication and information services, based on self-organization. Such systems have become very topical with the advent of mobile ad-hoc, peer-to-peer, and sensor networks. NCCR-MICS is composed of more than twenty research projects distributed over four clusters. The research project of the RVS group on “Distributed event detection and localization architecture for wireless sensor networks” (IP4) aims at designing and implementing a distributed event detection, event localization, and data aggregation framework. It includes efficient and reliable signaling protocols as well as mechanisms to dynamically reprogram sensor network applications.

Based on previous work, the distributed event detection and localization architecture (DELTA) has been developed. The current DELTA implementation provides algorithms to efficiently detect environmental events and build dynamic tracking groups to observe them. Each tracking group is led by a designated node (leader), which is responsible for the group organization, to gather and process event relevant data, and to initialize the leadership handover in case the event moves out of its area. The gathered data contains the locations of the group members observing the events and their sensor readings. Based on this information the group leader performs nonlinear function optimization, i.e., a simplex downhill function optimization, to estimate position and amplitude of the event. This information can then be used to classify the event and is reported to the base station. We are planning to use fuzzy logic concepts for classification and outlier detection. We are currently investigating the applicability of a fuzzy c-means clustering algorithm to identify different event classes. This information will then be used to build a fuzzy inference system, which will be implemented on the sensor nodes to classify events and filter outliers.

To support the DELTA framework with a routing topology on the one hand and to provide a energy saving mechanism on the other, a virtual backbone has been developed and implemented. The virtual backbone is able to temporally disconnect redundant nodes. Furthermore, it is periodically (re)established to distribute the backbone load and provides link repair mechanisms.

Another work was the implementation and evaluation of two MAC proto-

cols, namely LMAC and TEEM, on Embedded Sensor Boards (ESBs). We got a number of insights concerning the implementation of a theoretical concept on real sensor hardware with all its limitations. Improvements of SYNC-based MAC protocols have been achieved. The SYNC messages are used to setup a backbone structure enabling the temporal disconnection of redundant nodes on the MAC layer without any additional traffic.

Research staff: Markus Wälchli, Reto Zurbuchen, Michael Meer, Markus Anwander, Samuel Bissig, Piotr Skoczylas, Torsten Braun

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

Mobile IP Telephony (MIPTel)

Wireless mesh networks (WMN) are evolving to an important access technology for wireless broadband services. They provide a cost efficient way to interconnect isolated networks as well as to enhance the network coverage. WMNs usually consist of static mesh routers and mobile or static mesh clients. Both support multi-hop communication and may act as routers. The mesh nodes might support multiple heterogeneous radio interfaces. WMNs offer a more robust and redundant communication infrastructure than many wireless networks deployed today. They provide communication facilities even in special situations where certain systems such as GSM are overloaded.

Our project aims at exploiting wireless mesh networks as an infrastructure for Mobile IP telephony. IP telephony requires short delays and moderate packet loss. In WMNs the quality of the routes may vary unpredictably because of the unreliable and erroneous wireless medium. Routes may break, if the network topology changes due to node or link failures. Links and nodes may become congested, which leads to larger delays or packet loss. This makes the deployment of a real time application such as IP telephony a challenging task.

We see two important approaches to improve the speech quality and to reduce outages in a Mobile IP telephony application in WMNs: path diversity and multi-stream coding. The characteristics of multiple paths are usually uncorrelated, i.e. the delay, jitter, and loss rate of the paths differ a lot from each other. Therefore, the transmission over multiple paths can be used to compensate for the dynamic and unpredictable nature of WMNs. In order to exploit this path diversity for improving the quality of the

audio transmission, a robust multi-path routing protocol and a mechanism for selecting appropriate coding and path allocation for the given network conditions are needed. Our work focuses on developing these protocols and allocation schemes. We currently evaluate different multi-path routing protocols and routing metrics using network simulators and a real world test bed. In order to manage our testbed consisting of 17 low priced embedded x86 based systems, we have developed a secure remote management and software distribution architecture for WMNs. The individual nodes have to be easily managed by a central unit. This includes possibilities of rapidly changing the system software, routing protocols and radio parameters. Further, configuration and system software errors have to be corrected without physical access to the nodes. During the project an embedded Linux distribution is being developed including a management solution with different fallback behaviors in case of errors. Our WMN test bed is now ready for testing protocols. In order to make experiments with larger topologies we have carried on our evaluation on virtualization of a wireless mesh network. We have defined an architecture for integrating real and virtual mesh nodes using a virtual wireless interface driver.

Research staff: Thomas Staub, Alican Gecyasar, Stefan Ott, Michael Lustenberger, Daniel Balsiger

Financial support: Swiss National Foundation Project No. 200020-113677/1

Efficient and Robust Overlay Networks (ERON)

The ERON projects aims at developing an efficient and robust overlay network. An overlay network is a virtual communication network built on top of an existing communication network such as the Internet. Overlay networks are used for different tasks such as routing of multicast messages. Since the full-mesh overlay network, in which every pair of participants is communicating directly with each other, is not scalable, overlay networks usually have other structures. One of the most important criteria for deciding, which overlay network participants get “connected” is the communication delay, since it is the limiting factor on the maximum effective bandwidth for the TCP connections. Similar to a full-mesh overlay networks, measuring the communication delay between all overlay participants does not scale. To still be able to exploit the communication delay information, numerous communication delay

prediction systems such as IDMaps, GNP, ICS, Vivaldi, S-Vivaldi etc. were developed. Most promising communication delay prediction systems are coordinates-based. In coordinates-based systems, communication partners are represented as points in an n -dimensional Euclidean space such that the distance function in that space predicts the communication delay.

In the second phase of the ERON project we focus on improving embedding hosts into the virtual space. We have identified that the objective function, which is minimized to obtain a host position, can have more than one local minimum. The consequence of the existence of multiple local minima is that the numerical function minimization method used by GNP (Downhill Simplex) may converge towards a local minimum that may not be the global one. If such embedding is used for RTT prediction, the results would not be optimal. To solve this problem, we have developed an algorithm to find all local minima of the objective function and thus its global minimum. Currently, we are evaluating the statistical properties of RTT measurements (regarding the mean and variance) for embedding hosts in coordinates-based systems.

As a part of this project we are developing an application level multicast (ALM) routing protocol, which exploits the information about the host positions. The development of the ALM system has two tasks: 1. Developing a general peer-to-peer multicast routing protocol similar to PIM-DM but adapted to conditions of peer-to-peer networks. 2. Developing a system for choosing neighbors based on a fisheye view of the network. Those two tasks combined should result in an ALM, which takes the underlay structure into account to efficiently build multicast trees.

Research staff: Dragan Milic, Roger Strähl

Financial support: Swiss National Foundation Project No. 200021-109270/1

End-to-end Quality of service support over heterogeneous networks (EuQoS)

The *EuQoS* project (<http://www.euqos.eu>) aims to resolve outstanding design issues presently associated with the delivery of end to end Quality of Service across heterogeneous networks. With the help of EuQoS these issues should be solved and the infrastructures should be upgraded so

that new applications can be supported by the Internet and new service packages can be offered by operators, ISPs and other service providers. Our research group is involved in the work packages WP1, WP3, WP5 and WP6.

WP1 (Business Model and System Design) aims to define an architecture for different aspects of the EuQoS system. Support for QoS in IP multicast is difficult to achieve due to the lack of wide deployment of IP multicast in the Internet and it seems that this will probably not change in the near future, even with the adoption of IPv6. Our research focuses on providing transparent support for application level multicast on end systems. This enables multicast communication across the Internet using only unicast communication offering QoS support. The distribution of multicast data is handled by an Application Layer Multicast (ALM) facility called Scribe, which runs on top of the Peer-to-Peer (P2P) routing substrate called Pastry. Mechanisms for setting up a QoS-aware P2P overlay network have been investigated and resulted in an architectural adaptation of Scribe / Pastry. The the ID assignment method of Pastry, which arranges the peers in the overlay has been enhanced and made QoS requirements aware, in order to enforce Scribe to build QoS supporting multicast distribution trees in terms of bandwidth requirements.

WP3 (Implementation of the EuQoS System) delivers the proposed applications and services according to the architectures defined in WP1. We developed a transparent multicast facility known as "Multicast Middleware," which is based on a virtual network interface (TAP) and has been implemented mostly using Java (version 5.0) to support different operating systems (Win32, Linux and Mac OS X). The Multicast Middleware aims to be independent from the underlying QoS mechanisms. It will either use the EuQoS QoS signaling (introduced by the EuQoS project) or the measurement-based multicast to bridge gaps where no QoS is offered by the underlying network. The overlay network is constructed using a Scribe/Pastry implementation called Freepastry. This implementation has been extended to support QoS-aware construction of multicast trees by Scribe through modifying the basic node distribution mechanisms of Pastry. Another focus has been the performance. Therefore, the Multicast Middleware has been optimized to support high bandwidth data dissemination with 100 Mbps and more on end-systems with recent hardware.

WP5 (EuQoS Pan European trials) builds a testbed environment in which the developed prototypes and applications can be tested and evaluated. Different heterogeneous networks (WLAN, UMTS, LAN, xDSL, etc.) are interconnected in a full mesh among the partners. Our testbed represents a high speed gigabit-LAN-based network, which is interconnected by GRE

tunnels to twelve other testbeds belonging to other EuQoS consortium partners involved in WP5. It is directly connected to the university's border router through a 1 Gbit/s network link. Different prototypes of the EuQoS system and some of its applications have been successfully tested in this environment. The testbed located in Bern is also used for evaluating and testing the Multicast Middleware developed in WP3.

WP6 (Dissemination, Standards and Training) focuses on delivering the project results to the public. This shall be achieved by four activities, namely development of training material, delivery of training, standardization contributions, as well as dissemination by demonstrations and publications. In addition to leading and managing the whole work package, our main contributions address the training activities. Within this context, a course focusing on QoS related topics is being developed for students and industrial learners. The goal of the course is also to raise the familiarity with QoS technologies for next generation networks and applications. The course is based on distance learning technologies and consists of seven QoS related modules. We have developed the didactical concept of the e-learning course and are coordinating its implementation. In particular, we have developed the course modules "Applications' QoS demands", "Implementing protocols on network simulators." including a tool for the visualization and animation of simulator trace files (VAT4Net), "Multicast in EuQoS system.", and an overview animation for the "EuQoS overview" module. Some of these course modules have been used for the lecture called "Multimediakommunikation" held during the summer semester 2007. We are further developing and providing the course management system and the authentication & authorization framework required for the various module exercises. The EuQoS e-learning has been recently migrated to the new e-learning platform WebCT Vista.

Starting from the e-learning course the book project "End-to-End Quality of Service over Heterogeneous Networks" has evolved. Besides the coordination of the book project, we are contributing to several chapters and subchapters.

Research staff: Thomas Bernoulli, Marc Brogle, Dragan Milic, Matthias Scheidegger, Thomas Staub, Patrick Lauer, Gerald Wagenknecht, Markus Wulff, Jana Krähenbühl, Daniel Frey, Milan Nikolic, Luca Bettosini, Sonia Schär, Torsten Braun

Financial support: EU project IST-2003-004503

Virtual Internet and Telecommunications Laboratory of Switzerland (VITELS)

VITELS, a first series Swiss Virtual Campus (SVC) project has been funded within the SVC consolidation program. The VITELS goal has been to develop an e-learning course in English language that provides theory and practical hands-on exercises in the area of telecommunications and computer networks with real network hardware for computer science students. Currently, VITELS consists of eight modules, six designed and maintained by University of Bern, one by University of Neuchâtel, and one by University of Fribourg. The course is fully operational and has been productively used in different regular courses on the Bachelor level at the Universities of Bern (in the “Computer Networks” lecture), Fribourg, and Neuchâtel.

In the reporting period several VITELS related activities have been performed. The VITELS course has been migrated to WebCT Vista as the new e-learning platform supported by SWITCH. The course and its hands-on exercises have been maintained. Upgrades to new versions of the Shibboleth based authentication and authorization infrastructure have been performed. The graphical illustration of the VITELS course has been reviewed and possible enhancements have been identified. In the reporting period we have also continued the development of an improved course management system with student profiles and a much more flexible hands-on session resource reservation system. Further, the portal software for the hands-on session has been adapted for the new course management. A first version of the new course management system has been productively used during the summer semester 2007. The gained experiences influence the current development. An enhanced version of the course management system is planned to be deployed in 2007. Additional equipment resources for the “IP Security Module” module have been deployed.

Research staff: Thomas Staub, Markus Anwander, Patrick Lauer, Thomas Bernoulli, Daniel Frey, Reto Gantenbein, Torsten Braun

Financial support: Staatssekretariat für Bildung und Forschung (SBF), Virtual Campus Switzerland Project No. 991043

Operating Systems Laboratory (OSLab)

The Operating System Laboratory, OSLab, is an online course that will teach students about the principles of computer operating systems using a progressive approach and problem-oriented learning. OSLab focuses on the hands-on training experience of the students and will complement existing lectures. The course is modularly structured, each module covers a topic and is self-contained. A teacher can select modules according to his needs and easily add new modules to the course.

During the reporting period four modules have been created together with the project partners at Fribourg and Neuchâtel. The file systems, security, process scheduling as well as the device drivers and input/output modules are finished. This includes a theory section as well as hands-on exercises. In the hands-on part the students have to solve programming and/or configuration tasks in order to deepen the knowledge they gathered by working through the theory chapter. The remaining three modules are currently under development.

In addition to the learning modules we developed a Java applet in order to present a common user interface for the hands-on exercises. The applet can be adapted to the special needs of the respective exercise. The learner sends the solution for the given task to the server and gets a "pass code" and possible log/error messages in return. The pass code contains the user ID, the source code submitted by the user, the test input/output, and the results from the automatic evaluation. It can optionally be encrypted and will be delivered to the tutor of the course for evaluation. Therefore, the tutor uses a complementary tool to decode the pass code and review the solution. Although this infrastructure is already functioning, it is still actively developed to include necessary features and improve stability.

Research staff: Torsten Braun, Gerald Wagenknecht, Markus Wulff

Financial support: Staatssekretariat für Bildung und Forschung (SBF), Programm Virtueller Campus Schweiz, Project No. P-4-019, and University of Bern

Energy-efficient Management of Heterogeneous Wireless Sensor Networks

This project focuses on the investigation of efficient and reliable communication mechanisms that are required for the efficient operation of a wireless sensor network (WSN) management framework. An appropriate WSN management architecture needs to be identified and implemented. The main scientific contributions will be in the design and evaluation of reliable unicast, multicast, and broadcast protocol mechanisms that are essential for the efficient maintenance of WSNs to support individual node management but also for application and operating system code updates / installations in the whole WSN or in parts of it. Reliable and robust transport protocols are needed to distribute operating system / application level code and node parameters efficiently as well as to solicit specific node information.

A WSN consists of a huge number of nodes, often randomly distributed in a large area. Currently, available sensor nodes are mainly prototypes for research purposes. The RVS group owns about 30 Embedded Sensor Board (ESB) nodes. An additional number of sensor nodes have been evaluated, from which three more types of sensor nodes have been chosen to build a heterogeneous sensor network. Beside the available ESB nodes, tmote SKY, BTnodes and micaZ have been chosen. They are widely used in the research community, are well documented and have the adequate properties (memory, energy-efficiency, etc.). For the management backbone a Wireless Router Application Platform Board (WRAP) has been selected.

As operating system we have chosen Contiki (from SICS), which is a dynamic operating system with special focus on portability. It is written in C and supports over 14 platforms and 5 CPUs. A small TCP/IP stack (μ IP) is available. Protothreads, a novel thread-like construct on top of the event-driven kernel, reduces the complexity of event-driven programs by removing state machines. Contiki supports preemptive multi-threading, inter-process communication and dynamic run-time linking of standard Executable Linkable Format (ELF) files. Program modules can be updated and loaded at run-time. Contiki and the network simulator COOJA for Contiki are open source projects and run under BSD license.

A heterogeneous wireless sensor network consists of different types of sensor nodes, which might measure different data and perform different tasks. To operate such a (sub)network the following devices are required: a management station, several mesh nodes, sensor node gate-

ways plugged into a mesh node and a comparatively high number of heterogeneous sensor nodes. To realize the communication between the sensor (sub)networks we use wireless mesh nodes as gateways. From the management point of view there are several tasks required to manage a WSN and its sensor nodes: monitoring the network and the sensor nodes, (re)configuring the nodes and as a special configuration task updating the nodes.

Based on these tasks we defined a management architecture, which affects all components of the WSN. The management station is running on a laptop or remote workstation with a web browser as user interface and the management system for Wireless Mesh Networks (WMN). The mesh nodes contains the main functionality of the management architecture. The WSN manager consists of three databases and three program modules. The databases are: the program version database, the WSN information database, and the sensor value database. The modules consist of the WSN monitor module, the WSN configurator module, and the code update manager module. A sensor node manager running on the sensor nodes performs the managing tasks. The management architecture on the management station (user interface), the mesh nodes (WSN manager) and the code updating functionality are currently being implemented. The latter includes further the evaluation of different code update mechanisms as, e.g., differential patches.

Research staff: Markus Anwander, Gerald Wagenknecht, James Matheka, Simon Morgenthaler

Financial support: Hasler Foundation under grant number ManCom 2060

Power Saving in Wireless Ad Hoc Networks

Power saving mechanisms in wireless multi-hop networks mainly switch off the transmission and reception hardware for a maximum amount of time and turn it on again periodically for a given interval. Many approaches aim to synchronize the state changes of the nodes in the network through distributed beacon generation and introduce mechanisms, where nodes synchronously wake up at designated points of time to exchange announcements about pending traffic. However, synchronization is difficult to achieve, in particular in wireless ad hoc networks. We developed, evaluated, and improved a power saving approach based on asynchronous

wake-up patterns and wake-up announcements integrated with Ad-hoc On-demand Distance Vector (AODV) protocol. This algorithm has been further improved by moving wake periods and integrated into a wireless sensor network scenario. In particular, the broadcast mechanism of the WiseMAC protocol, a medium access control protocol for wireless sensor networks, has been significantly improved in terms of energy efficiency by applying the improved asynchronous wake-up pattern scheme. The evaluation results obtained by simulation will be the basis for an implementation of the scheme on real sensor hardware.

Research staff: Philipp Hurni, Torsten Braun

E-learning module “Sensor Networks”

With the e-learning module “Sensor Networks” some key characteristics of wireless sensor networks will be presented and developed in detail. With this module students have an additional medium to learn key problems of wireless sensor networks in a guided, self-explaining and closed form.

The course essentially consists of a theoretical part introducing the course subject in detail, and of a practical part, in which the learned theoretical concepts are applied. The theoretical part is enhanced with interactive animations and self-tests. In the final, practical hands-on sessions some of the acquired concepts are demonstrated, deepening the understanding and showing some additional properties. Moreover, challenges of real implementations of theoretical concepts can be addressed. The practical exercises start with the implementation of the investigated concepts in a simulator/emulator. The resulting code, also executable on real hardware, then might be downloaded to the sensor nodes in a real testbed allowing the investigation of effects and behaviour in realistic environments.

The scientific focus of the course is on medium access and localization in wireless sensor networks. Both are basic challenges of wireless sensor networks research and development. The e-learning course provides a medium to address these two aspects in more detail than it was possible in the masters course.

Research staff: Markus Wälchli, Torsten Braun

Financial support: University of Bern, VC-Kleinprojekt

Testbed for Mobile and Internet Communications

The RVS research group maintains its own testbed network for various purposes. One part of the testbed is used to build networks of experimental routers and end systems in order to be able to evaluate the behavior of new networking procedures and architectures in a realistic environment. Another part of the network forms a productive network of Linux PCs and provides the storage capacity and CPU power for many of the RVS group's projects. The ERON project for example uses the available CPU power to compute embeddings of network distances into Euclidean space. Furthermore, a significant part of EuQoS project's testbed is located within the RVS testbed. It is a Gigabit LAN environment of 10 machines for pan-european trials, and it is connected via IP tunnels to 11 partners' sites. The available CPU power is used by three network traffic measuring points. An educational laboratory network for students' training is also connected and being extended by the OSLab project. The RVS group also takes part in PlanetLab (<http://planet-lab.org>), an open platform for developing, deploying, and accessing planetary-scale services. For this purpose we are hosting two PlanetLab nodes in our testbed network. The RVS group owns a number of sensor nodes, about 30 Embedded Sensor Board (ESB) nodes, 10 tmote SKY nodes, 5 BTnodes and 5 micaZ nodes. They are widely used in the research community, are well documented and have adequate properties (memory, energy-efciency, etc.). A testbed consisting of multiple MESH nodes has been deployed throughout the building and work environment of the RVS group. In this testbed reliable. secure communication and software distribution/updates are being performed and evaluated.

Research staff: All members of the RVS research group

4.4 Ph.D. Theses

- Matthias Scheidegger: Prediction of Internet Characteristics for Distributed Applications, February 2, 2007

4.5 Diploma Theses

- Benjamin Zahler: An Experience Based Prediction Service for Internet Distance Estimation, May, 2007

- Michael Meer: The DELTA Object Tracking and Localization Algorithm for Sensor Networks, November, 2006
- Markus Anwander: Comparison of TDMA and contention based MAC protocols on embedded sensor boards, September, 2006

4.6 Bachelor Theses and Computer Science Projects

- Dave Wick: Delay Tolerant Networks in a Nutshell, August, 2007
- Reto Gantenbein: The Implementation of the Vitels IP Security Distance Learning Module, April, 2007
- Alican Gecyasar: Ad-Hoc Multipath Routing Protokolle, November, 2006

4.7 Further Activities

Memberships

- Chair of ERCIM working group on eMobility (Torsten Braun)
- Secretary General of ERCIM working group on eMobility (Markus Wulff)
- Erweitertes Leitungsgremium Fachgruppe "Kommunikation und Verteilte Systeme", Gesellschaft für Informatik (Torsten Braun)
- Management Board of EU IST project EuQoS (Torsten Braun)
- Swiss Representative, Management Committee Member, and Working Group Chair of COST 290 Action "Traffic and QoS Management in Wireless Multimedia Networks" (Torsten Braun)
- SWITCH Stiftungsrat (Torsten Braun)
- SWITCH Stiftungsratsausschuss (Torsten Braun)
- Kuratorium Fritz-Kutter-Fonds (Torsten Braun)
- Expert for Diploma Exams at Fachhochschule Bern (Torsten Braun)

Editorial Boards

- Editorial Board of Elsevier's Computer Communications Journal (Torsten Braun)
- Editorial Board of Elsevier's Computer Networks Journal (Torsten Braun)
- Editorial Board of Informatik Spektrum / Springer-Verlag (Torsten Braun)
- Editorial Board of Journal of Internet Engineering (Editor in Chief, Torsten Braun)

Conference Chairs

- Co-chair of 15. ITG/GI Fachtagung Kommunikation in Verteilten Systemen (KiVS), Bern, February 26-March 2, 2007 (Torsten Braun)
- General Chair of 1st ERCIM Workshop on eMobility, May 21, 2007, Coimbra, Portugal (Torsten Braun)
- TPC Co-Chair of 1st ERCIM Workshop on eMobility, May 21, 2007, Coimbra, Portugal (Markus Wulff)
- Co-Chair of the Fourth ACM SIGACT-SIGOPS International Workshop on Foundations of Mobile Computing (DIAL M-POMC 2007), August 16, 2007, Portland, Oregon, USA (Torsten Braun)

Conference Program Committees

- International Conference on Digital Telecommunications, ICDT 2006, August 29–31, 2006, Cap Esterel, Côte d'Azur, France (Torsten Braun)
- 31st Annual IEEE Conference on Local Computer Networks (LCN 2006), Tampa, Florida, November 14–16, 2006 (Torsten Braun)
- 49th Annual IEEE Global Communications Conference (IEEE GLOBECOM 2006), November 27–December 1, 2006, San Francisco, California, USA (Torsten Braun)

- 2nd International Conference on Wireless Communication and Sensor Networks (WCSN-2006), December 17–19, 2006, India (Torsten Braun)
- 4th Annual IEEE Consumer Communications and Networking Conference, Las Vegas, January 11–13, 2007 (Torsten Braun)
- 4th International Conference on Wireless On-demand Network Systems and Services, WONS 2007, January 24–26, 2007, Obergurgl, Austria (Torsten Braun)
- 4th European Conference on Wireless Sensor Networks (EWSN 2007), Delft, The Netherlands, January 29–31, 2007 (Torsten Braun)
- 4th Workshop on Mobile Ad-Hoc Networks (WMAN 2007), Bern, March 1, 2007 (Torsten Braun)
- IEEE Wireless Communications and Networking Conference 2007 (WCNC), March 11–15, Hongkong (Torsten Braun)
- 6th IFIP Networking 2007, May 14–18, 2007, Atlanta, Georgia, USA (Torsten Braun)
- 5th International Conferences on Wireless/Wired Internet Communications, WWIC 2007, May 23–25, Coimbra, Portugal (Torsten Braun)
- 7th International Workshop on Applications and Services in Wireless Networks (ASWN 2007), Santander, Spain, May 24–26, 2007 (Torsten Braun)
- 15th IEEE LAN/MAN Workshop, June 10–13, 2007, Princeton, New Jersey, US (Torsten Braun)
- 2nd Conference on Security in Network Architectures and Information Systems Annecy, France, June 12–15, 2007 (Torsten Braun)
- 2nd IEEE Workshop on advanced Experimental Activities on Wireless Networks & Systems, EXPONWIRELESS, June 18, 2007, Helsinki, Finland (Torsten Braun)
- IEEE International Conference on Communications 2007 (ICC 2007), June 24–28, 2007, Glasgow, UK (Torsten Braun)
- 1st International Workshop on Specialized Ad Hoc Networks and Systems (SAHNS 2007), June 29, 2007, Toronto, Canada (Torsten Braun)

- 33rd Euromicro Conference on Software Engineering and Advanced Applications (SEAA), Track on Multimedia and Telecommunications (MMTC), August 28-31, 2007, Lübeck, Germany (Torsten Braun)

Reviewing Activities

- Institute for the Promotion of Innovation by Science and Technology in Flanders (IWT) (Torsten Braun)
- Swiss National Science Foundation (SNF) (Torsten Braun)
- RMIT University, Melbourne, Australia (Torsten Braun)
- Ph.D. Jury, Université de Nice, France (Torsten Braun)
- Ph.D. Jury, Institut National des Télécommunications, Evry, France (Torsten Braun)
- IEEE Communications Magazine (Torsten Braun)
- IEEE Network Magazine (Torsten Braun)
- IEEE Transactions on Mobile Computing (Torsten Braun)
- IEEE Transactions on Parallel and Distributed System (Torsten Braun)
- IEEE/ACM Transactions on Networking (Torsten Braun)
- ACM Transactions on Multimedia Computing (Torsten Braun)
- ACM/Kluwer Wireless Networks Journal (Torsten Braun)
- Journal of Network and Systems management (Torsten Braun)
- Wiley (Torsten Braun)

Invited Talks and Tutorials

- Torsten Braun: Networking issues in wireless sensor networks, Tutorial at International Symposium on Wireless Communication System, September 5, 2006, Valencia, Spain
- Torsten Braun: TCP Support in Sensor Networks, Séminaire Réseaux, INRIA Sophia-Antipolis, September 21, 2006

- Thomas Staub: Multipath Routing in Wireless Mesh Networks, 7th COST 290 Meeting, September 29, 2006, Split, Croatia
- Torsten Braun: Energy-efficient communication protocols for wireless sensor networks, Informatikkolloquium, Universität Zürich, November 9, 2007
- Torsten Braun: System Issues in Wireless Sensor Networks, Tutorial at 2nd International Conference on Wireless Communication and Sensor Networks (WCSN2006), December 17, 2006, India
- Torsten Braun: Energy-Efficient Communication Protocols for Wireless Sensor Networks, Keynote at 2nd International Conference on Wireless Communication and Sensor Networks (WCSN 2006), December 17, 2006, India
- Torsten Braun: Secure Remote Management and Software Distribution for Wireless Mesh Networks, 8th COST 290 Meeting, February 16, 2006, Malaga, Spain
- Torsten Braun: Energie sparende Kommunikationsprotokolle für Mobile Ad-Hoc und Sensornetze, Informatikkolloquium, TU München, February 23, 2007
- Torsten Braun: Energy-efficient protocols for wireless sensor networks, Keynote at Euro American Conference on Telematics and Information Systems (EATIS 2007), May 17, 2007, Faro, Portugal
- Torsten Braun: Programmability Models for Sensor Networks, Autonomous Infrastructure, Management and Security (AIMS 2007), International conference in cooperation with the ACM, June 21, 2007, Oslo, Norway
- Torsten Braun: Communication Protocols in Wireless Sensor Networks, Tutorial at IEEE Symposium on Computers and Communications (ISCC'07), July 1, Aveiro, Portugal
- Torsten Braun: Federation of Experimental Networks for Teaching and Research, 2nd Opennet Workshop, July 4, 2007, Sophia-Antipolis
- Torsten Braun: Reliability Support in Multicast Overlay Networks, Dagstuhl-Seminar 07301 Resilient and Survivable Networks, Infrastructure and Services, July 23, 2007

- Torsten Braun: Telematiknetze, Kaderkurs Telematik, Bundesamt für Bevölkerungsschutz, November 28, 2006, April 17, 2007, June 5, 2007, Schwarzenburg, Switzerland
- Thomas Staub: Réseaux de communications, cours de cadres pour chefs de la télématique, Office fédéral de la protection de la population, November 28, 2006, April 17, 2007, June 5, 2007, Schwarzenburg, Switzerland

Organized Events

The RVS group organized the following events:

- Organizing a seminar on “Dependable Systems” together with TNS group of University Fribourg, Quarten, Switzerland, July 2–4, 2007
- Hosting and organizing the conference “Kommunikation in Verteilten Systemen” (KiVS), Bern, February 26–March 2, 2007
- Hosting and organizing the “EuQoS Plenary Meeting”, Bern, January 17–19, 2007

Awards

Markus Wälchli, Piotr Skoczylas, Michael Meer and Torsten Braun received the “WWIC 2007 Best Paper Award” for their paper on “Distributed event localization and tracking with wireless sensors” during the 5th International Conference on Wired/Wireless Internet Communications held from May 23–25, 2007, at the University of Coimbra / Portugal.

4.8 Publications

Publications submitted in the academic year 2006/2007 and appearing in 2007/2008 or later are not listed.

Books and Book Chapters

- Arunabha (Arun) Sen, Torsten Braun: Dial-M-POMC 2007, The Fourth ACM SIGACT-SIGOPS International Workshop on Foundations of Mobile Computing, Portland, Oregon, USA, August 16, 2007, ACM, ISBN 978-1-59593-874-9 CD-ROM

- Torsten Braun, Dimitri Konstantas, Saverio Mascolo, Markus Wulff: First ERCIM Workshop on eMobility, May, 2007, ISBN 978-972-95988-9-0
- Torsten Braun, Georg Carle, Burkhard Stiller: KiVS 2007 Kommunikation in Verteilten Systemen, Industriebeiträge, Kurzbeiträge und Workshops, February, 2007, VDE Verlag, ISBN 978-3-8007-2980-7
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- Marc Brogle, Dragan Milic, Torsten Braun: Supporting IP Multicast Streaming Using Overlay Networks, QShine: International Conference on Heterogeneous Networking for Quality, Reliability, Security and Robustness, Vancouver, British Columbia, Canada, August 14 - 17, 2007, ICST, ISBN 978-1-59593-756-8 CD-ROM
- Markus Anwander, Gerald Wagenknecht, Thomas Staub, Torsten Braun: Management of Heterogenous Wireless Sensor Networks, 6. Fachgespräch, Aachen, Germany, July 16 - 17, 2007, pp. 63-66, Distributed Systems Group, RWTH Aachen University, ISSN 0935-3232
- Marc Heissenbüttel, Torsten Braun, Markus Wälchli, Thomas Bernoulli: Evaluating the limitations of and alternatives in beaconing, Ad Hoc Networks, Vol. 5, Nr. 5, July, 2007, pp. 558-578, Elsevier, ISSN 1570-8705
- Torsten Braun: Programmability Models for Sensor Networks, First International Conference on Autonomous Infrastructure, Management and Security, AIMS 2007, Oslo, Norway, June 21 - 22, 2007, pp. 233, Springer Verlag, ISBN 978-3-540-72985-3
- Thomas Staub, Daniel Balsiger, Michael Lustenberger, Torsten Braun: Secure Remote Management and Software Distribution for Wireless Mesh Networks, 7th International Workshop on Applications and Services in Wireless Networks (ASWN 2007), Santander, Spain, May 24 - 26, 2007, pp. 47-54, ISBN 978-84-690-5727-8

- Markus Wälchli, Piotr Skoczylas, Michael Meer, Torsten Braun: Distributed event localization and tracking with wireless sensors, 5th International Conference on Wired/Wireless Internet Communications (WWIC '07), Coimbra, Portugal, May 23 - 26, 2007, pp. 247-258, Springer Verlag, ISBN 978-3-540-72694-4 Best Paper Award
- Philipp Hurni, Torsten Braun: Improving Unsynchronized MAC Mechanisms in Wireless Sensor Networks, 1st ERCIM Workshop on eMobility, Coimbra, Portugal, May 21, 2007, pp. 71-82, ISBN 978-972-95988-9-0
- Markus Wälchli, Thomas Bernoulli, Torsten Braun: Receiver-based Backbone Construction and Maintenance for Wireless Sensor or Multi-Hop Networks, Workshop on Mobile Ad-Hoc Networks (WMAN 2007) at KiVS 2007, Bern, Switzerland, March 1 - 2, 2007, pp. 409-420, VDE Verlag, ISBN 978-3-8007-2980-7
- Torsten Braun, Burkhard Stiller: Netzwerkforschung im Schweizer Hochschulumfeld, Praxis der Informationsverarbeitung und Kommunikation, Vol. 07, Nr. 1, March, 2007, pp. 2-3, K.G. Saur Verlag, ISSN 0930-5157
- Marc Heissenbüttel: Routing and Broadcasting in Ad-Hoc Networks, Kommunikation in Verteilten Systemen (KiVS 2007), Bern, Switzerland, February 26 - March 2, 2007, pp. 259-266, Springer Verlag, ISBN 978-3-540-69961-3
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- Torsten Braun, Thiemo Voigt, Adam Dunkels: TCP Support for Sensor Networks, IEEE/IFIP WONS 2007, Obergurgl, Austria, January 24 - 26, 2007, pp. 162-169, IEEE, ISBN 1-4244-0860-1
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- Attila Weyland, Carolin Latze, Torsten Braun, Thomas Staub: Linux Implementation and Evaluation of a Cooperation Mechanism for Hybrid Wireless Networks, Sixth International Workshop on Wireless Local Networks (WLN), Tampa, FL, USA, November 14, 2006, pp. 939-946, IEEE, ISBN 1-4244-0419-3

Magazine Papers

- Torsten Braun: First ERCIM Workshop on eMobility, Ercim News, Nr. 70, July, 2007, pp. 6-7, ERCIM EEIG, ISSN 0926-4981

Technical Reports

- Markus Anwander, Gerald Wagenknecht, Torsten Braun: Energy-efficient Management of Heterogeneous Wireless Sensor Networks, April 30, 2007, Technical Report IAM-07-002
- Pascal Le Guern, Olivier Dugeon, Marc Brogle, Dragan Milic, et al.: Trial report release 2, EuQoS Deliverable D5.1.5, CEC Deliverable Number 004503/FTRD/DS/D5.1.5/A1, February 15, 2007
- Donal Morris, Thomas Staub, Marc Brogle, et al.: Second summary of standardization documents, EuQoS Deliverable D6.2.2, CEC Deliverable Number 004503/REDZINC/DS/D6.2.2/A1, January 31, 2007
- José Enríquez, María Ángeles Callejo, Marc Brogle, Dragan Milic, et al.: EuQoS Architecture update for Phase 2, EuQoS Deliverable D1.2.2, CEC Deliverable Number 004503/TID/DS/D1.2.2/A1, January 31, 2007
- José Enríquez, María Ángeles Callejo, Marc Brogle, Dragan Milic, et al.: Annex to D1.2.2: EuQoS Architecture update for

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- Thomas Staub, Marc Brogle, et al.: Report on teaching experiences of the e-learning course, the improvements to be done and the improvements achieved as well as the newly produced e-learning modules, EuQoS Deliverable D6.2.1, CEC Deliverable Number 004503/UoB/DS/D6.2.1/A1, December 26, 2006
- Martin Potts, Thomas Staub, et al.: Second report on using and disseminating knowledge, including description of dissemination activities (e.g. demonstrations, publications), EuQoS Deliverable D6.2.3, CEC Deliverable Number 004503/Martel/DS/6.2.3/A1, December 26, 2006
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- Piotr Skoczylas, Markus Wälchli, Torsten Braun: Implementation of the DELTA object tracking algorithm on the ESB sensor nodes, November, 2006, Technical Report IAM-06-008

5 Research Group on Computer Vision and Artificial Intelligence

5.1 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:	R. Bertolami*	Tel: +41 31 631 48 65 email: bertolam@iam.unibe.ch
	Dr. T. Ha-Minh	Tel: +41 31 631 33 23 email: ha-minh@iam.unibe.ch
	V. Kilchherr	Tel: +41 31 631 33 23 email: kilchher@iam.unibe.ch (until 31.05.2007)
	M. Liwicki*	Tel: +41 31 631 85 74 email: liwicki@iam.unibe.ch
	K. Riesen*	Tel: +41 31 631 86 99 email: riesen@iam.unibe.ch
	A. Schlapbach*	Tel: +41 31 631 49 02 email: schlpbch@iam.unibe.ch
Guests:	Dr. A. Kocsor	University of Szeged December 2006
	Dr. K. Kovács	University of Szeged December 2006
	Prof. Csirik	University of Szeged January 2007
	M. Ferrer	Universitat Autònoma de Barcelona April 2007 – June 2007
	A. Fornés	Universitat Autònoma de Barcelona Mai 2007 – June 2007

* with financial support from a third party

5.2 Overview

Since 1984, the FKI group has been working on various topics in pattern recognition, machine vision, and computational intelligence. One of the

current subject areas is document image analysis and handwriting recognition, where we have recently extended our activities from pure off-line to both on-line and off-line data. Furthermore, we are working in the field of structural pattern recognition, where we aim at developing methods to extend and improve current algorithms for clustering and classification using non-vectorial object representations.

5.3 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 analysis 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 for both on-line and off-line handwriting data. Recently, also the problem of writer identification has been studied. Furthermore, multiple classifier systems and their application to handwriting recognition are under investigation. Some of these activities are carried out as part of the Swiss NCCR project "Interactive Multimodal Information Management Systems".

Research staff: R. Bertolami, Dr. T. Ha-Minh, V. Kilchherr, M. Liwicki, A. Schlapbach

Structural Pattern Recognition

Feature vectors are the predominant representation formalism in pattern recognition. Recently, however, non-vectorial representations, such as strings, trees and graphs, are becoming more and more popular for a number of reasons. But in contrast to vector spaces, the domain of symbolic data structures does not have a rich mathematical structure. Therefore, there is a severe lack of mathematical tools and algorithms for graph clustering and classification. In this project, we study a variety of issues, including efficient algorithms for graph matching, graph kernels, embedding of symbolic data structures in vector spaces, and the adaptation of concepts from vector representations to the domains of strings, trees, and graphs.

Research Staff: K. Riesen

5.4 Diploma and Master's Theses

- Scherz, M.: Texterkennung handgeschriebener Texte anhand automatisch vorsegmentierter Textzeilen (September 2006)
- Riesen, K.: Schnelle suboptimale Grapheditierdistanz-Algorithmen (October 2006)
- Jordi, N.: Feature Synthesis for Writer Identification Using Genetic Programming (October 2006)
- Stegmüller, St.: Methoden der Künstlichen Intelligenz zur Zeitreihenvorhersage (October 2006)
- Stettler, M.: Hypergraph Matching (February 2007)
- Martin, P.: Schreibererkennung mit one-class Classification (February 2007)
- Wettstein, F.: Automatic Estimation of the Readability of Handwritten Text Lines (March 2007)

5.5 Bachelor's Theses and Computer Science Projects

- Brügger, A.: IAM DB Results Tool – Datenbank und Tool zur Analyse von Handschriftenexperimenten (November 2006)
- Indermühle, E.: Zeilentrennung bei der Handschrifterkennung mit Hilfe von dynamischer Programmierung (November 2006)
- Fischer, A.: Kernfunktionen auf Zeichenketten der Kopenhagen-Chromosomendatenbank (February 2007)
- Fankhauser, St.: Exaktes Graphmatching mit einer bipartiten Heuristik (July 2007)

5.6 Further Activities

Editorial Boards

H. Bunke

- Editor-in-Chief of *Electronic Letters on Computer Vision and Image Analysis*
- Member of the editorial board of the *International Journal of Pattern Recognition and Artificial Intelligence*
- Member of the editorial board of *Acta Cybernetica*
- Member of the editorial board of *Frontiers of Computer Science in China*
- Member of the advisory board of *Pattern Recognition*
- Editor-in-chief of the book series *Machine Perception and Artificial Intelligence* by World Scientific Publ., Singapore

Membership in Committees

H. Bunke

- Co-chair “10th International Workshop on Frontiers in Handwriting Recognition”, La Baule, France, October 23–26, 2006
- Advisory committee member “6th International Conference on Advances in Pattern Recognition”, Kolkata, January 2–4, 2007
- Program committee member “Workshop on Machine Learning with Graphs”, Berlin, September 18–22, 2006
- Program committee member “Workshop on the Use of Vision in Human Computer Interaction”, Canberra, November 1–3, 2006
- Program committee member “11th Iberoamerican Congress on Pattern Recognition (CIARP)”, Cancún, Mexico, November 14–17, 2006
- Program committee member “22th Annual ACM Symposium on Applied Computing”, Seoul, March 11 – 15, 2007
- Program committee member “7th International Workshop on Multiple Classifier Systems”, Prague, May 23–25, 2007
- Program committee member “3rd Iberian Conference on Pattern Recognition and Image Analysis”, Girona, Spain, June 6–8, 2007

- Program committee member “6th IAPR-TC15 Workshop on Graph-Based Representations”, Alicante, June 18–20, 2007
- Program committee member “5th International Conference on Machine Learning and Data Mining”, Leipzig, July 4–6, 2007
- Program committee member “International Workshop on Mining and Learning on Graphs”, Firenze, August 1–3, 2007

M. Liwicki

- Program committee member “1st IEEE International Workshop on Multimedia Technologies for E-Learning”, San Diego, December 11–13, 2006

Activities in National NCCR

H. Bunke

- Member of the individual project “Video Processing” of the NCCR Project IM2 (Interactive Multimodal Information Management Systems)
- Member of the Steering Committee of the NCCR Project IM2

Additional Activities

H. Bunke

- Member Scientific Advisory Board of the German Research Center for Artificial Intelligence

5.7 Publications

Books

- Bunke, H., Dickinson, P., Kraetzl, M., Wallis, W.: *A Graph-Theoretic Approach to Network Dynamics*, Birkhäuser Boston, 2007
- Kandel, A., Bunke, H., Last, M. (eds.): *Applied Graph Theory in Computer Vision and Pattern Recognition*, Springer, 2007.

Journal Publications

- Reynolds, Z., Bunke, H., Last, M., Kandel, A.: Comparing representative selection strategies for dissimilarity representations. *Int. Journal of Intelligent Systems*, 21(10), 2006, 1093 – 1109
- Bertolami, R., Zimmermann, M., Bunke, H.: Rejection strategies for offline handwritten text line recognition. *Pattern Recognition Letters*, 27(16), 2006, 2005 – 2012
- Schlapbach, A., Bunke, H.: A writer identification and verification system using HMM based recognizers. *Pattern Analysis and Applications*, 10(1), 2007, 33 – 43
- Liwicki, M. and Bunke, H.: Handwriting recognition of whiteboard notes – studying the influence of training set size and type. *Int. Journal of Pattern Recognition and Artificial Intelligence*, 21(1), 2007, 83 – 98
- Neuhaus, M. and Bunke, H.: Automatic learning of cost functions for graph edit distance. *Information Sciences*, 177(1), 2007, 239 – 247
- Irniger, C. and Bunke, H.: Decision trees for filtering large databases of graphs. *Int. Journal of Intelligent Systems Technologies*, 3, 2007, 166 – 187

Refereed Conference Proceedings and Edited Books

- Schenker, A., Bunke, H., Last, M., Kandel, A.: Polynomial time complexity graph distance computation for web content mining. In M. Basu and T. K. Ho, editors, *Data Complexity in Pattern Recognition*, Springer, 2006, 197 – 215
- Bunke, H., Neuhaus, M.: Graph matching – exact and error-tolerant methods and the automatic learning of edit costs. In D.J. Cook and L.B. Holder, editors, *Mining Graph Data*, Wiley, 2007, 17 – 34
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- Bunke, H. and Varga, T.: Off-line Roman cursive handwriting recognition. In B. Chaudhuri, editor, *Digital Document Processing: Major Directions and Recent Advances*, 20, Springer, 2007, 165 – 173
- Bertolami, R., Halter, B., Bunke, H.: Combination of multiple handwritten text line recognition systems with a recursive approach. In *Proc. 10th Int. Workshop Frontiers in Handwriting Recognition*, 2006, 61 – 65
- Schlapbach, A., Bunke, H.: Off-line writer verification: a comparison of a hidden Markov model (HMM) and a Gaussian mixture model (GMM) based system. In *Proc. 10th Int. Workshop Frontiers in Handwriting Recognition*, 2006, 275 – 280
- Liwicki, M., Bunke, H.: HMM-based on-line recognition of handwritten whiteboard notes. In *Proc. 10th Int. Workshop Frontiers in Handwriting Recognition*, 2006, 595 – 599
- Nierstrasz, O., Kobel, M., Girba, T., Lanza, M., Bunke H.: Example-driven reconstruction of software models. In *Proc. 11th European Conference on Software Maintenance and Reengineering*, 2007, 275 – 286
- Riesen, K., Neuhaus, M., Bunke, H.: Bipartite graph matching for computing the edit distance of graphs. In F. Escolano and M. Vento, editors, *Graph-Based Representations in Pattern Recognition*, LNCS 4538, Springer, 2007, 1 – 12
- Neuhaus, M., Bunke, H.: A quadratic programming approach to the graph edit distance problem. In F. Escolano and M. Vento, editors, *Graph-Based Representations in Pattern Recognition*, LNCS 4538, Springer, 2007, 92 – 102
- Riesen, K., Neuhaus, M., Bunke, H.: Graph embedding in vector spaces by means of prototype selection. In F. Escolano and M. Vento, editors, *Graph-Based Representations in Pattern Recognition*, LNCS 4538, Springer, 2007, 383 – 393

- Bertolami, R., Bunke, H.: Multiple classifier methods for offline handwritten text line recognition. In M. Haindl, J. Kittler, and F. Roli, editors, *Multiple Classifier Systems*, LNCS 4472, Springer, 2007, 72 – 81
- Riesen, K., Bunke, H.: Classifier ensembles for vector spaces embedding of graphs. In M. Haindl, J. Kittler, and F. Roli, editors, *Multiple Classifier Systems*, LNCS 4472, Springer, 2007, 220 – 230
- Riesen, K., Kilchherr, V., Bunke, H.: Reducing the dimensionality of vector space embeddings of graphs. In P. Perner, editor, *Machine Learning and Data Mining in Pattern Recognition*, LNAI 4571, Springer, 2007, 563 – 573
- Riesen, K., Fankhauser, S., Bunke, H.: Speeding up graph edit distance computation with a bipartite heuristic. In P. Frasconi, K. Kersting, and K. Tsuda, editors, *Proc. 5th. Int. Workshop on Mining and Learning with Graphs*, 2007, 21 – 24
- Riesen, K., Bunke, H.: Structural classifier ensembles for vector space embedded graphs. In *Proc. 20th Int. Joint Conference on Neural Networks*, 2007

6 Research Group on Theoretical Computer Science and Logic

6.1 Personnel

Head:	Prof. Dr. G. Jäger	Tel: +41 31 631 85 60 email: jaeger@iam.unibe.ch
Office Manager:	B. Choffat	Tel.: +41 31 631 84 26 email: choffat@iam.unibe.ch
Scientific Staff:	Dr. L. Alberucci*	Tel.: +41 31 631 33 34 email: albe@iam.unibe.ch
	P. Brambilla	Tel.: +41 31 631 33 10 email: brambi@iam.unibe.ch
	Dr. K. Brännler	Tel.: +41 31 631 33 32 email: kai@iam.unibe.ch
	Prof. Dr. R. Haenni*	Tel.: +41 31 631 86 43 email: haenni@iam.unibe.ch
	J. Jonczyk*	Tel.: +41 31 631 38 37 email: jonczyk@iam.unibe.ch
	R. Kohlas*	Tel.: +41 31 631 33 39 email: kohlas@iam.unibe.ch
	J. Krähenbühl*	Tel.: +41 31 631 46 83 email: kraehenb@iam.unibe.ch
	Dr. M. Kretz*	(until 31.12.06) email: kretz@iam.unibe.ch
	Dr. U.-M. Künzi*	Tel.: +41 31 631 85 58 email: kuenzi@iam.unibe.ch
	Dr. R. McKinley*	Tel.: +41 31 631 49 80 email: mckinley@iam.unibe.ch
	Dr. G. Ostrin*	Tel.: +41 31 631 49 89 email: geoff@iam.unibe.ch
	Dr. D. Probst*	Tel.: +41 31 631 35 45 email: probst@iam.unibe.ch
	D. Spescha*	Tel.: +41 31 631 86 46 email: spescha@iam.unibe.ch
	D. Steiner*	Tel.: +41 31 631 49 76 email: steiner@iam.unibe.ch
	Ph. Stouppa*	Tel.: +41 31 631 33 32 email: stouppa@iam.unibe.ch

Scientific Staff:	PD Dr. Th. Strahm	Tel.: +41 31 631 49 98 email: strahm@iam.unibe.ch
	Dr. Th. Studer	Tel.: +41 31 631 39 84 email: tstuder@iam.unibe.ch
	M. Wachter*	Tel.: +41 31 631 38 37 email: wachter@iam.unibe.ch
	R. Wehbe*	Tel.: +41 31 631 33 17 email: wehbe@iam.unibe.ch

* with financial support from a third party

6.2 Overview

The TIL research group (theoretical computer science and logic) focuses on theoretical computer science and mathematical logic, especially proof theory, computational logics and theory of computation. We have been dealing for many years with formal methods, analysis of deductions, general computations and, in particular, applications of mathematical logic to computer science. The three main subject areas are the following:

Computational Logic: Logical formalisms are perfectly suited to the specification of complex systems, the representation of knowledge and information, the description of processes (e.g. in distributed multi-agent systems) and for providing formal proofs of important system properties such as, for example, correctness and fairness. The research group has long been interested in the deductive, procedural and dynamic aspects of the corresponding formalisms and in the design of modern deductive systems. New approaches are being developed for information update purposes. In addition, the way in which simple, logical formalisms can be extended to become genuine multi-user systems taking into account the dynamic aspects of ontologies in the data mining context and in connection with the semantic web is being investigated.

Proof Theory: This research topic focuses on the development and analysis of formal systems of first and second order arithmetic, set theory and of what are known as logical frameworks (type and set theoretical, explicit, constructive, extensional, intentional). Our interests range from feasible subsystems of arithmetic to highly impredicative set and type theories and deals with the interplay between constructive, recursive and operational approaches. In addition, abstract computations and computable knowledge are being investigated.

Reasoning under Uncertainty: This area covers researches on reasoning and decision under uncertainty both on the methodological and on the applicative sides. Reasoning is the process of deriving conclusions from given evidence, and these conclusions are then used as a basis for possible decisions. One of the main difficulties in this reasoning and decision-making process is the uncertainty often included in the available evidence. The goal in this research area is to define and implement formal methods to describe and represent all possible aspects of uncertainty. Most of the techniques rely on logical and probabilistic methods.

6.3 Research Projects

A proof theory for modal fixed point logics

Temporal logics are widely used to specify and verify the correctness of information systems when system reliability is crucial. Epistemic logics with common knowledge are important for reasoning about knowledge. Both types of logics are examples of modal fixed point logics. While these logics are well-understood semantically, our syntactic understanding of them is lacking. The state of proof theory for modal logics in general is widely recognized as unsatisfactory. For modal fixed point logics in particular there are no satisfactory cut-free sequent systems. Such systems generally are suitable for automated proof search and, together with their cut elimination procedures, can serve as a basis for declarative programming languages. We intend to address the problem of designing cut-free sequent systems for modal fixed point logics on two levels:

1. Whenever possible we plan to develop such systems together with syntactic cut elimination procedures. If possible, we aim for traditional sequent systems in Gentzen style, but if needed we will also employ ideas from richer proof theoretic formalisms such as the display calculus or deep inference.
2. On the other hand, if no cut-free systems exist for modal fixed point logics, we hope to gain a better understanding of why they do not exist. In this case we are interested in good syntactic approximations.

The development of a proof theory for modal fixed point logics is an important theoretical contribution to the understanding of inference and deduction in these logics, and thus in particular a relevant underpinning of specification and verification of information systems. It is central ground

work concerning the procedural aspects of frameworks dealing with information.

Research staff: L. Alberucci, K. Brännler, G. Jäger, R. Wehbe

Financial support: Hasler Foundation

ABEL

ABEL is modeling language and a solver for problems in the domain of uncertain reasoning. The goal of this project is to redesign ABEL and make the system compatible with the modern view and techniques of probabilistic argumentation.

Research staff: R. Haenni, J. Jonczy, R. Kohlas, M. Wachter

Financial support: Swiss National Science Foundation

Algebraic and Logical Aspects of Knowledge Representation

We are mainly interested in the logical analysis of formalisms for representing and dealing with mathematical and computational knowledge. We employ and set up conceptual frameworks, in particular, theories relating classical mathematics with constructive mathematics and feasible mathematics, thereby always emphasizing the computational properties and complexities of our formalisms.

The formal settings of interest include intensional and extensional set theories, theories of inductive definitions, systems of explicit mathematics, substructural proof and type systems, as well as modal and fixed point logics.

We continue to use proof theory as our main tool for analyzing the constructive and computational content of various formalisms and we aim at further exploiting the proofs as computations paradigm. Theories of explicit mathematics will be one of our central formalism to address the various themes of this project.

In the first part of our project we will focus on:

- the analysis of general, least and largest fixed points of complex inductive definitions,

- higher reflection and higher order functionals.

Our research aims in the second part of the project are centered around the general relation between extensionality and intensionality. In particular, we are interested in:

- the full intersection axiom in explicit mathematics,
- set theories without extensionality and/or foundation,
- proof systems with weakened structural properties.

Finally, our research concerning feasible and (sub-)recursive proof and type systems can be structured as follows:

- a proof-theoretic approach to feasible functionals of higher types,
- the setting up of feasible systems of types and names à la Feferman,
- investigations into deep inference and the calculus of structures.

Research staff: G. Jäger, J. Krähenbühl, R. McKinley, D. Probst, D. Spescha, Th. Strahm

Financial support: Swiss National Science Foundation

Dynamic Ontologies

In collaboration with: Prof. Dr. K. Stoffel, University of Neuchâtel

Over the last decade, ontologies have moved beyond academic domains such as knowledge representation, philosophy, or library science. They became a cornerstone in support of interoperability for facilitation of knowledge management and configuration. This development triggered a lot of interesting research questions. One of the fundamental questions is how to extend the simple logical inference system into real multi-user systems that are able to deal with the dynamic aspects of ontologies in such an environment. The goal of the dynamic ontologies project is to formally analyze, specify and implement a prototype of a complex ontology management system that will be able to meet the requirements imposed by modern information management systems.

Research staff: Ph. Stouppa, Th. Studer

Financial support: Swiss National Science Foundation

Inference and Deduction

In collaboration with: Prof. Dr. J. Kohlas, University of Fribourg

We study in this project further aspects of information and knowledge. These include:

1. Algebraic aspects of information arising from the operations of aggregation (combination) and focusing of information.
2. Modeling of structures of compatible questions or domains and the relation of information and its measures relative to particular questions or domains.
3. Uncertain nature of information, the corresponding inference problems, with particular attention to statistical information.
4. Dynamic nature of information and knowledge, including the passage from information to knowledge and reasoning about knowledge.
5. Proof theory of modal μ -calculus.

These issues will be studied in their own right, but also with the goal to establish links between the fragments and existing fragments of a theory of information. This should be a step towards an integrated theory of information.

The relative nature of information and its measure with respect to particular questions is emphasized. The algebraic aspects of information are studied in the perspective of important practical systems such as relational databases, constraint systems and probability networks. Information and its algebraic structure is also considered in relation to general abstract structures such as contexts, classifications or Chu spaces. The combinatorial nature of information arising from their algebraic structure will be carried over to uncertain information. Frameworks for knowledge representation (including common knowledge) and knowledge accumulation, updates and belief revision will be developed. The dynamical aspects of information and knowledge and their explicit logical treatment will play an important role.

This is a common project of the theoretical computer science groups of the Universities of Fribourg and Berne. Both groups have a specific background: Fribourg in the domain of the algebraic structure of information

(valuation and information algebras), and additionally in probabilistic modeling, in particular probabilistic argumentation systems, Berne in the field of mathematical and computational logic. The alternative, but complementary backgrounds have proven fruitful in the past and will be profitable for the project proposed here.

Research staff: P. Brambilla, G. Jäger, M. Kretz (until December 2006), D. Steiner

Financial support: Swiss National Science Foundation

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).

Research staff: All members of the research group

Logic and Information

In collaboration with: Prof. Dr. J. Schmid, University of Bern; Prof. Dr. J. Kohlas, Prof. Dr. U. Ultes-Nitsche, Prof. Dr. G. Sommaruga, University of Fribourg; Prof. Dr. K. Stoffel, University of Neuchâtel

A collaboration project within the so-called “Réseau BeNeFri” in order to enhance and support research on logic and information and the many connections between both. Focus is on

- good models for the representation and processing of information and knowledge,

- powerful deduction and inference procedures, including the relevant complexity considerations,
- concrete applications.

Research staff: R. Haenni, G. Jäger, G. Ostrin, D. Probst, Th. Strahm, Th. Studer

Financial support: Swiss University Conference (CUS)

Managing Trust in Distributed Systems

In large open networks, handling trust and authenticity adequately is an important prerequisite for security. In a distributed approach, all network users are allowed to issue various types of credentials, e.g. certificates, recommendations, revocations, ratings, etc. This project investigates such a distributed approach, in which the evaluation of trust and authenticity is based on so-called credential networks. The idea is to use probabilistic argumentation as the underlying mathematical machinery. A complete framework for the specification and evaluation of credential networks has been implemented.

Research staff: R. Haenni, J. Jonczyk, R. Kohlas, M. Wachter

Financial support: Hasler Foundation

Probabilistic Argumentation: a Unified Theory of Logical and Probabilistic Reasoning

Logic and probability theory have both a long history in science. They are mainly rooted in philosophy and mathematics, but are nowadays important tools in many other fields such as computer science and, in particular, artificial intelligence. Some philosophers studied the connection between logical and probabilistic reasoning, and some attempts to combine these disciplines have been made in computer science, but logic and probability theory are still widely considered to be separate theories that are only loosely connected.

This project investigates a new perspective which shows that logical and probabilistic reasoning are no more and no less than two opposite extreme

cases of one and the same universal theory of reasoning called probabilistic argumentation. The goal of the project is to further study this theory and its wide range of possible applications in different areas of uncertain reasoning.

Research staff: R. Haenni, J. Jonczy, R. Kohlas, M. Wachter

Financial support: Leverhulme Trust and Proginet

Resource–Bounded Reasoning and Anytime Algorithms

Anytime algorithms are computational procedures for which the quality of the result improves gradually as computation time increases. They give the user the possibility to trade off computational resources against accuracy of the results. Anytime algorithms provide thus a flexible solution to the widespread problem of limited computational resources and are nowadays an emerging research topic in various areas. Of particular importance for this project is the field of real-time reasoning in intelligent knowledge-based systems.

The goal of the project is to analyze the foundations and properties of resource-bounded reasoning and anytime algorithms in intelligent systems more deeply. The project will study generic resource-bounded procedures in the framework of valuation algebras and develop corresponding methods in various specific formalisms such as Bayesian networks, Dempster-Shafer theory, or constraint satisfaction. The expected results will then be implemented and tested with respect to existing techniques, and their relevance to specific application domains will be evaluated.

Research staff: R. Haenni, J. Jonczy, R. Kohlas, M. Wachter

Financial support: Swiss National Science Foundation

ViLoLa - a Virtual Logic Laboratory (maintenance)

In collaboration with: Prof. Dr. J. Schmid and Dr. M. Sprenger, University of Bern; Dr. U.-M. Künzi, Fachhochschule Rapperswil; Prof. Dr. J. Rolim, University of Geneva

ViLoLa provides a modular learning environment for many aspects of logic: Philosophical, mathematical and applications to computer science.

The original aims of the ViLoLa package are met, partially even surpassed. All modules have been field tested and are in regular use at this time. Tools (LWB, Logic Work Bench; AWB, Algebraic Work Bench) are continually expanded and even used in courses outside the original ViLoLa framework. Evaluation procedures are integrated into the project (project partner A. Hollenstein). It has become apparent that a module "Introduction to Set Theory" should complement the package to make it fully self-contained and independent.

Research staff: G. Jäger, U.-M. Künzi

Financial support: Swiss Virtual Campus

6.4 Ph.D. Theses

- M. Kretz: Proof-theoretic aspects of modal logic with fixed points

6.5 Master's Theses and Diploma Theses

- N. Kottmann: Description logic query answering with relational databases
- J. Krähenbühl: Explicit mathematics with positive existential comprehension and join

6.6 Bachelor's Theses and Computer Science Projects

- S. De Zanet: Information Retrieval mittels Snowball
- S. Liniger: Rekursive Operatoren und das Theorem von Myhill-Sheperdson
- M. Wüthrich: GnuPG and probabilistic key validation

6.7 Further Activities

Editorial Boards

- Member of the editorial board of *Archive of Mathematical Logic* (G. Jäger)
- Member of the editorial board of *Logica Universalis* (G. Jäger)
- Member of the consulting board of *Dialectica* (Th. Strahm)

Technical and Research Committees

- Research Council member of the Swiss National Science Foundation (G. Jäger)
- Member of the Steering Committee of the Platform Mathematics, Astronomy and Physics (MAP) of the Swiss Academy of Sciences (G. Jäger)
- Secretary of the Swiss Society for Logic and Philosophy of Science (Th. Strahm)
- Member of the Scientific Council of the European Association for Computer Science Logic (G. Jäger)
- Member of the Council of the Association for Symbolic Logic (G. Jäger, until December 2006)
- Expert for “Maturitätsprüfungen Mathematik” (G. Jäger, D. Probst, Th. Strahm, Th. Studer)
- Program Committee member of the Colloquium Logicum 2006 (G. Jäger)
- Program Committee member and Organizing Committee member of Computer Science Logic 2007 (Th. Strahm)

6.8 Publications

- K. Brännler, Deep sequent systems for modal logic, *Advances in Modal Logic* 6, 2006

- K. Brännler, Locality for classical logic, *Notre Dame Journal of Formal Logic*, 2006
- R. Haenni, Climbing the hills of compiled credal networks, *5th International Symposium on Imprecise Probabilities and their Applications*, to appear
- R. Haenni, Kryptographie in Theorie und Praxis, *Lulu.com*, 2006
- R. Haenni, Non-additive degrees of belief, *Degrees of Belief*, to appear
- R. Haenni, Probabilistic argumentation, submitted
- R. Haenni, Uncover Dempster's rule where it is hidden, *9th International Conference on Information Fusion*, 2006
- R. Haenni and S. Hartmann, Special issue of Minds and Machines on causality, uncertainty and ignorance, *Minds and Machines*, 2006
- R. Haenni and J. Jonczyk, A new approach to network reliability, *5th International Conference on Mathematical Methods in Reliability*, to appear
- R. Haenni and J. Jonczyk, A new approach to PGP's web of trust, *European e-Identity Conference*, to appear
- R. Haenni, J. Jonczyk and R. Kohlas, A new model for public-key authentication, *Kommunikation in Verteilten Systemen*, 2007
- R. Haenni, J. Jonczyk and R. Kohlas, Towards precise semantics for authenticity and trust, *4th Annual Conference on Privacy, Security and Trust*, 2006
- R. Haenni, J. Jonczyk and R. Kohlas, Two-layer models for managing authenticity and trust, *Trust in E-Services: Technologies, Practices and Challenges*, 2007
- R. Haenni, J. Jonczyk and M. Wüthrich, A probabilistic trust model for GnuPG, *23rd Chaos Communication Congress*, 2006
- R. Haenni, M. Pouly and M. Wachter, Compiling solution configurations in semiring valuation systems, submitted
- R. Haenni, M. Pouly and M. Wachter, Optimizing inference in Bayesian networks and semiring valuation algebras, submitted

- R. Haenni and M. Wachter, Logical compilation of Bayesian networks, *Technical Report iam-06-006*, 2006
- R. Haenni and M. Wachter, Logical compilation of Bayesian networks with discrete variables, *9th European Conference on Symbolic and Quantitative Approaches to Reasoning under Uncertainty*, to appear
- R. Haenni and M. Wachter, Multi-state directed acyclic graphs, *20th Canadian Conference on Artificial Intelligence*, 2007
- R. Haenni and M. Wachter, Probabilistic equivalence checking with propositional DAGs, *Technical Report iam-06-001*, 2006
- G. Jäger, On Feferman's operational set theory OST, *Annals of Pure and Applied Logic*, to appear
- G. Jäger, M. Kretz and Th. Studer, Cut-free common knowledge, *Journal of Applied Logic*, to appear
- G. Jäger, M. Kretz and Th. Studer, Cut-free systems for the propositional modal μ -calculus, *Technical Report iam-07-001*, 2007
- G. Jäger, M. Kretz and Th. Studer, Canonical completeness of infinitary μ , *Journal of Logic and Algebraic Programming*, to appear
- J. Jonczyk and R. Kohlas, Trust and authenticity networks, *European e-Identity Conference*, to appear
- N. Kottmann and Th. Studer, Improving semantic query answering, *Database and Expert Systems Applications*, to appear
- M. Kretz and Th. Studer, Deduction chains for common knowledge, *Journal of Applied Logic*, 2006
- R. McKinley, Soft linear set theory, submitted
- D. Probst, The proof-theoretic analysis of transfinitely iterated quasi least fixed points, *The Journal of Symbolic Logic*, 2006
- D. Steiner, A system for consistency preserving belief change, *ESS-LLI Workshop on Rationality and Knowledge*, 2006
- D. Steiner and Th. Studer, Total public announcements, *Logical Foundations of Computer Science*, 2007

- Ph. Stouppa, A deep inference system for the modal logic S5, *Studia Logica*, 2007
- Ph. Stouppa and Th. Studer, A formal model of data privacy, *Perspectives of System Informatics*, 2007
- Th. Strahm and J. I. Zucker, Primitive recursive selection functions for existential assertions over abstract algebras, submitted
- M. Wachter, Representing Boolean functions with propositional directed acyclic graphs, *ECAI'06, Workshop 26: Inference methods based on graphical structures of knowledge*, 2006
- R. Wehbe, A hybrid representation of knowledge and belief, *Formal Approaches to Multi-Agent Systems*, 2006
- R. Wehbe, A sequent system for sets of clauses, *Technical Report iam-06-007*, 2006
- R. Wehbe, Merging rule-based belief databases, *Artificial Intelligence and Applications*, 2007
- R. Wehbe, Revising non-monotonic rule-based belief databases, *Belief Revision, Belief Merging and Social Choice*, 2006

7 Research Group on Software Composition

7.1 Personnel

Head:	Prof. Dr. O. Nierstrasz	Tel: +41 31 631 46 18 email: oscar@iam.unibe.ch
Office Manager:	T. Schmid	Tel: +41 31 631 46 92 email: tschmid@iam.unibe.ch
Scientific Staff:	M. Denker	Tel: +41 31 631 35 47 email: denker@iam.unibe.ch
	Dr. M. Gälli	Tel: +41 31 631 33 13 email: gaelli@iam.unibe.ch
	Dr. T. Gîrba	Tel: +41 31 631 33 14 email: girba@iam.unibe.ch
	Dr. O. Greevy	Tel: +41 31 631 48 68 email: greevy@iam.unibe.ch
	A. Kuhn*	Tel: +41 31 631 35 47 email: kuhn@iam.unibe.ch
	A. Lienhard*	Tel: +41 31 631 35 47 email: lienhard@iam.unibe.ch
	Dr. L. Ponisio	Tel: +41 31 631 33 15 email: ponisio@iam.unibe.ch
	L. Renggli*	Tel: +41 31 631 35 68 email: renggli@iam.unibe.ch
	D. Röthlisberger*	Tel: +41 31 631 48 68 email: renggli@iam.unibe.ch

*with financial support from a third party

7.2 Overview

Complex software systems must change to keep pace with changing needs and requirements. In this context, the Software Composition Group carries out research in programming language design and software reengineering with the goal of facilitating the development of flexible, open software systems. In both cases we are investigating mechanisms and techniques that enable the graceful evolution of software systems by putting change at the center of the software process.

7.3 Research Projects

Analyzing, Capturing and Taming Software Change

Complex software systems must change in order to keep pace with changing needs and requirements. Curiously, however, modern programming languages and environments provide little support for the fact that the systems being built will inevitably change. In fact, more emphasis is placed on mechanisms to enforce consistency and to limit the effects of change than on enabling change.

This research proposal targets the following questions:

- How can we encapsulate change in order to better specify, manipulate and control it?
- How can we manage the scope of change, especially in a running system?
- How can we assess the impact of change in a complex system?
- How can we exploit change to reveal implicit trends and emergent software artifacts?

To answer these questions, we are investigating means to (i) introduce programming language constructs to package incremental modifications to complex software systems, and use these constructs to express both low-level (syntactic) and high-level (semantic) changes, (ii) develop a scoped approach to behavioural and structural reflection in which the visibility of reflective features, and thus of changes, can be controlled at a fine level of granularity, (iii) explore techniques for tracing the impact of changes back to their source by monitoring the flow of object references in a running system, and (iv) analyze the evolution of the software and related artifacts to identify higher-level semantic entities.

Research staff: All members of the research group.

Duration: Oct. 2006 - Sept. 2008

Financial support: Swiss National Science Foundation,
Project #200020-113342

For further details, please consult: scg.iam.unibe.ch/Research/SNF06

NOREX: Network of Reengineering Expertise

NOREX is a collaborative effort between the Universities of Lugano, Timisoara, and Bern. The goal of this joint research project is to provide a comprehensive and extensible support for complex, full-fledged reengineering activities applicable to real-world systems. Specifically, we want to address these issues by building a distributed reengineering environment which is able to make all the techniques and models defined and implemented by each of the three research teams to complement each other. Over the past year, we have built in close collaboration with the Politehnica University of Timisoara an advanced prototype of the NOREX environment. The current implementation allows analyses written in Java and Smalltalk to coexist and to collaborate. We have also started to work together with the University of Lugano on an approach to offer an online overview of large code super-repositories.

Research staff: All members of the research group.

Duration: Oct. 2005 - Sept. 2007

Financial support: Swiss National Science Foundation under SCOPES 2005-2008: Scientific Co-operation between Eastern Europe and Switzerland.

For further details, please consult: scg.iam.unibe.ch/Research/NOREX

7.4 Ph.D. Theses

- Markus Gaelli. *Modeling Examples to Test and Understand Software*. PhD thesis, University of Berne, November 2006.
- Orla Greevy. *Enriching Reverse Engineering with Feature Analysis*. PhD thesis, University of Berne, May 2007.

7.5 Master's Theses

- Niklaus Haldimann. *TypePlug — pluggable type systems for Smalltalk*. Master's thesis, University of Bern, April 2007.
- Christoph Hofer. *Implementing a backward-in-time debugger*. Master's thesis, University of Bern, September 2006.

- Philippe Marschall. Persephone: Taking Smalltalk reflection to the sub-method level. Master's thesis, University of Bern, December 2006.
- Michael Meyer. Scripting interactive visualizations. Master's thesis, University of Bern, November 2006.
- Stefan Reichhart. Assessing test quality — TestLint. Master's thesis, University Bern, April 2007.
- Florian Thalmann. Musical composition with grid diagrams of transformations. Master's thesis, University of Bern, March 2007.
- Rafael Wampfler. Eg – a meta-model and editor for unit tests. Master's thesis, University of Bern, November 2006.
- Pascal Zumkehr. Changeboxes — modeling change as a first-class entity. Master's thesis, University of Bern, February 2007.

7.6 Bachelor's Theses and Computer Science Projects

- Philipp Bunge. Shrew – a prototype for subversion analysis. Bachelor's thesis, University of Bern, February 2007.
- Julien Fierz. Java Wiretap – extracting feature execution models for reverse engineering. Bachelor's thesis, University of Bern, June 2007.
- Matthias Junker and Markus Hofstetter. Scripting diagrams with eye-see. Bachelor's thesis, University of Bern, May 2007.
- Marc Mooser. Parsing the Ada programming language. Bachelor's thesis, University of Bern, February 2007.
- Anselm Strauss. Stamp – a mailing list manager for squeak. Bachelor's thesis, University of Bern, May 2007.

7.7 Further Activities

Editorial Boards

Oscar Nierstrasz:

- Springer LNCS – SL2 – Programming Techniques and Software Engineering (Series Editor)
- ACM TOSEM – Transactions on Software Engineering and Methodology (Associate Editor)

Memberships

Oscar Nierstrasz:

- SARIT – Swiss Association for Research in Information Technology (Board member)
- AITO – Association Internationale pour les Technologies Objets (Vice President)
- CHOOSE – Swiss group for Object-Oriented Systems and Environments (President)
- ESEC – European Software Engineering Conference (Steering Committee Member)
- MoDELS – International Conference on Model Driven Engineering Languages and Systems (Steering Committee Member)
- SC – Software Composition Symposium (Steering Committee Member)

Program Committees

Oscar Nierstrasz:

- PC Member of DLS 2006 (Dynamic Languages Symposium 2006 — collocated with OOPSLA 2006, Portland, Oregon, Oct. 22, 2006)
- PC Member of Coordination 2007 (International Conference on Coordination Models and Languages — Nicosia, Cyprus, June 6-8, 2007)
- PC Member of FAMOOSr Workshop (colocated with TOOLS — Europe 2007, ETH Zurich, June 25, 2007)
- PC Member of TOOLS — Europe 2007 (ETH Zurich, June 24-28, 2007)

- PC Member of Dyla07 (3rd Workshop on Dynamic Languages and Applications — colocated with ECOOP 07, Berlin, July 31, 2007)

Tudor Gîrba:

- PC Member of ICDL 2007 (International Conference on Dynamic Languages / 15th International Smalltalk Joint Conference 2007 – Lugano, Switzerland, August 25-31, 2007).
- PC Member of MSR 2007 (International Workshop on Mining Software Repositories – colocated with ICSE 2007 – Minneapolis, USA, May 19-20, 2007).
- Research Demo Co-Chair of WCRE 2006 (13th Working Conference on Reverse Engineering – Benevento, Italy, October 23-27, 2006).
- PC Member of PCODA 2006 (International Workshop on Program Analysis through Dynamic Analysis – colocated WCRE 2006, October 23, 2006).
- Organization Committee member of CHOOSE Forum 2006 (Bern, Switzerland, December 28, 2006).
- Program Co-chair of FAMOOSr 2007 (Workshop on FAMIX and Moose in Reengineering - colocated with TOOLS 2007, Zurich, Switzerland, June 25, 2007).

Orla Greevy:

- PC Memeber of FAMOOSr 2007 (Workshop on FAMIX and Moose in Reengineering - colocated with TOOLS 2007, Zurich, Switzerland, June 25, 2007).
- Program Co-chair of PCODA 2006 (International Workshop on Program Analysis through Dynamic Analysis – colocated WCRE 2006, October 23, 2006).

Adrian Kuhn:

- Program Co-chair of FAMOOSr 2007 (Workshop on FAMIX and Moose in Reengineering - colocated with TOOLS 2007, Zurich, Switzerland, June 25, 2007).

Reviewing Activities

Oscar Nierstrasz:

- Swiss National Science Foundation,
- ETH Zurich Research Commission
- Hasler Foundation
- IRISA
- Automated Software Engineering Journal
- Transactions in Aspect-Oriented Software Development

Invited Talks

Oscar Nierstrasz:

- Keynote Speaker at ASWEC 2007 (18th Australian Conference on Software Engineering — Melbourne, April 10-13, 2007)

7.8 Publications

Books

- Oscar Nierstrasz, Jon Whittle, David Harel, and Gianna Reggio, editors. *Proceedings MoDELS 2006*. LNCS 4199. Springer-Verlag, Genoa, Italy, October 2006.

Journal Papers

- Orla Greevy, Stéphane Ducasse, and Tudor Gîrba. Analyzing software evolution through feature views. *Journal of Software Maintenance and Evolution: Research and Practice (JSME)*, 18(6):425–456, 2006.
- Adrian Kuhn, Stéphane Ducasse, and Tudor Gîrba. Semantic clustering: Identifying topics in source code. *Information and Software Technology*, 49(3):230–243, March 2007.

Conference Papers

- Alexandre Bergel, Stéphane Ducasse, Oscar Nierstrasz, and Roel Wuyts. Stateful traits. In *Advances in Smalltalk — Proceedings of 14th International Smalltalk Conference (ISC 2006)*, volume 4406 of LNCS, pages 66–90. Springer, 2007.
- Alexandre Bergel, Stéphane Ducasse, Colin Putney, and Roel Wuyts. Meta-driven browsers. In *Advances in Smalltalk — Proceedings of 14th International Smalltalk Conference (ISC 2006)*, volume 4406 of LNCS, pages 134–156. Springer, 2007.
- Stéphane Ducasse and Tudor Gîrba. Using Smalltalk as a reflective executable meta-language. In *International Conference on Model Driven Engineering Languages and Systems (Models/UML 2006)*, volume 4199 of LNCS, pages 604–618, Berlin, Germany, 2006. Springer-Verlag.
- Stéphane Ducasse, Tudor Gîrba, and Adrian Kuhn. Distribution map. In *Proceedings of 22nd IEEE International Conference on Software Maintenance (ICSM '06)*, pages 203–212, Los Alamitos CA, 2006. IEEE Computer Society.
- Orla Greevy, Tudor Gîrba, and Stéphane Ducasse. How developers develop features. In *Proceedings of 11th European Conference on Software Maintenance and Reengineering (CSMR 2007)*, pages 256–274, Los Alamitos CA, 2007. IEEE Computer Society.
- Orla Greevy, Michele Lanza, and Christoph Wyseier. Visualizing live software systems in 3D. In *Proceedings of SoftVis 2006 (ACM Symposium on Software Visualization)*, September 2006.
- Christoph Hofer, Marcus Denker, and Stéphane Ducasse. Design and implementation of a backward-in-time debugger. In *Proceedings of NODE'06*, volume P-88 of *Lecture Notes in Informatics*, pages 17–32. Gesellschaft für Informatik (GI), September 2006.
- Adrian Kuhn and Orla Greevy. Exploiting the analogy between traces and signal processing. In *Proceedings IEEE International Conference on Software Maintenance (ICSM 2006)*, Los Alamitos CA, September 2006. IEEE Computer Society Press.
- Adrian Lienhard, Orla Greevy, and Oscar Nierstrasz. Tracking objects to detect feature dependencies. In *Proceedings International*

Conference on Program Comprehension (ICPC 2007), pages 59–68, Washington, DC, USA, June 2007. IEEE Computer Society.

- Michael Meyer, Tudor Gîrba, and Mircea Lungu. Mondrian: An agile visualization framework. In *ACM Symposium on Software Visualization (SoftVis 2006)*, pages 135–144, New York, NY, USA, 2006. ACM Press.
- Oscar Nierstrasz, Markus Kobel, Tudor Gîrba, Michele Lanza, and Horst Bunke. Example-driven reconstruction of software models. In *Proceedings of Conference on Software Maintenance and Reengineering (CSMR 2007)*, pages 275–286, Los Alamitos CA, 2007. IEEE Computer Society Press.
- David Röthlisberger, Marcus Denker, and Éric Tanter. Unanticipated partial behavioral reflection. In *Advances in Smalltalk — Proceedings of 14th International Smalltalk Conference (ISC 2006)*, volume 4406 of *LNCS*, pages 47–65. Springer, 2007.
- Andy Zaidman, Orla Greevy, and Abdelwahab Hamou-Lhadj. Workshop on program comprehension through dynamic analysis (pcoda). In *Proceedings of IEEE 13th Working Conference on Software Maintenance and Reengineering (WCRE)*, pages 315–315, October 2006.

Workshop Papers

- Marcus Denker and Stéphane Ducasse. Software evolution from the field: an experience report from the Squeak maintainers. In *Proceedings of the ERCIM Working Group on Software Evolution (2006)*, volume 166 of *Electronic Notes in Theoretical Computer Science*, pages 81–91, January 2007.
- Marcus Denker, Orla Greevy, and Michele Lanza. Higher abstractions for dynamic analysis. In *2nd International Workshop on Program Comprehension through Dynamic Analysis (PCODA 2006)*, pages 32–38, 2006.
- Orla Greevy. Dynamix - a meta-model to support feature-centric analysis. In *Proceedings of FAMOOSr 2007 (1st International Workshop on FAMIX and Moose in Reengineering)*, June 2007.

- Adrian Kuhn and Orla Greevy. Summarizing traces as signals in time. In *Proceedings IEEE Workshop on Program Comprehension through Dynamic Analysis (PCODA 2006)*, pages 01–06, Los Alamitos CA, October 2006. IEEE Computer Society Press.
- Adrian Lienhard, Stéphane Ducasse, Tudor Gîrba, and Oscar Nierstrasz. Capturing how objects flow at runtime. In *Proceedings International Workshop on Program Comprehension through Dynamic Analysis (PCODA 2006)*, pages 39–43, 2006.
- Adrian Lienhard, Adrian Kuhn, and Orla Greevy. Rapid prototyping of visualizations using mondrian. In *Proceedings IEEE International Workshop on Visualizing Software for Understanding (Vissoft 2007)*, pages 67–70, June 2007.
- David Röthlisberger, Orla Greevy, and Adrian Lienhard. Feature-centric environment. In *Proceedings IEEE International Workshop on Visualizing Software for Understanding (Vissoft 2007) (tool demonstration)*, 2007.
- David Röthlisberger and Oscar Nierstrasz. Combining development environments with reverse engineering. In *Proceedings of FAMOOSr 2007 (1st International Workshop on FAMIX and Moose in Reengineering)*, 2007.

8 Administration

University:

- H. Bieri: Member of Collegium generale
- T. Braun: Member of the Committee for Computing Services (KID)
Delegate of the University of Bern on the board of trustees of SWITCH
- G. Jäger: Member of the Swiss National Research Council
Member of the Steering Committee of the “Platform Mathematics, Astronomy, Physics” of the Swiss Academy of Sciences

Faculty:

- H. Bunke: Faculty Delegate
- T. Braun: Member of Evaluation Committee
- G. Jäger: Member of the Planning Board

Institute:

- H. Bieri: Director of Studies
- T. Braun: Deputy Director of IAM
- H. Bunke: Member of Hauskommission Engehalde
- O. Nierstrasz: Director of IAM
- T. Strahm: Member of Library Committee Exakte Wissenschaften
Member of Hauskommission Exakte Wissenschaften