IAM Annual Report

Academic Year 2004/2005

August, 2005

Contents

1 Institute of Computer Science and Applied Mathematics (IAM)

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1.2 Personnel

Board of directors

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

Teaching staff

Dr. Florian Baumgartner; Prof. Dr. Hanspeter Bieri; Prof. Dr. Torsten Braun; Prof. Dr. Horst Bunke; Dr. Aurelio Cortesi; Prof. Dr. Stéphane Ducasse; Prof. Dr. Rolf Haenni; Prof. Dr. Gerhard Jäger; Prof. Dr. Oscar Nierstrasz; Prof. Dr. Kilian Stoffel; PD Dr. Thomas Strahm.

Director

Prof. Dr. Oscar Nierstrasz.

Administration

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

Library

Gudrun Heim; Silvia Neukomm; Katrin Wegmüller.

Technical staff

Roland Balmer; Peppo Brambilla.

Scientific staff

L. Ammon; G. Arévalo; A. Bergel; T. Bernoulli; R. Bertolami; Dr. K. Brünnler; P. Brambilla; M. Brogle; Th. Buchberger; T. Burri; J.-C. Cruz; M. Danzeisen; Dr. R. de Oliveira; M. Denker; Prof. Dr. S. Ducasse; M. Gälli; T. Gîrba; O. Greevy; Prof. Dr. R. Haenni; Dr. M. Heissenbüttel; M. Hugi; Dr. Ch. Irniger; J. Jonczy; Dr. U.-M. Künzi; M. Kretz; Dr. B. Le Saux; A. Lienhard; M. Liwicki; D. Milic; M. Neuhaus; N. Nussbaum; Dr. G. Ostrin; L. Ponisio; D. Probst; M. Rieger; Ph. Robert; V. Salipante; N. Schaerli; M. Scheidegger; A. Schlapbach; T. Staub; Dr. M.-A. Steinemann; D. Steiner; Ph. Stouppa; PD Dr. Th. Strahm; Dr. Th. Studer; T. Varga; M. Wälchli; M. Wachter; R. Wehbe; Th. Wenger; A. Weyland; Dr. M. Wirz.

2 Teaching Activities

2.1 Courses for Major and Minor in Computer Science

Winter Semester 2004/2005

- 1st Semester

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

  Grundlagen der technischen Informatik (T. Braun, 5 ECTS)

  Programmierung 1 (Th. Strahm, 5 ECTS)

- 3rd Semester

  Automaten und formale Sprachen (H. Bunke, 3 ECTS)

  Übungen zu Automaten und formale Sprachen (H. Bunke, 1.5 ECTS)

  Datenbanken (K. Stoffel, 3 ECTS)

  Übungen zu Datenbanken (K. Stoffel, 1.5 ECTS)

  Einführung in Software Engineering (O. Nierstrasz, 3 ECTS)

  Übungen zu Einführung in Software Engineering (O. Nierstrasz, 1.5 ECTS)

- 5th Semester

  Künstliche Intelligenz (H. Bunke, 3 ECTS)

  Übungen zu Künstliche Intelligenz (H. Bunke, 1.5 ECTS)

  3D-Grafik (H. Bieri, 3 ECTS)

  Übungen zu 3D-Grafik (H. Bieri, 1.5 ECTS)

  Information und Logik (Prof. G. Jäger, 3 ECTS)

  Übungen zu Logik und Informatik (Prof. G. Jäger, 1.5 ECTS)

Computernetze (T. Braun, 3 ECTS)

Übungen zu Computernetze (T. Braun, 1.5 ECTS)

- Special Program

  Seminar: Künstliche Intelligenz (H. Bunke, 3 ECTS)

  Algorithmische Geometrie (H. Bieri, 3 ECTS)

  Seminar: Computergeometrie und Grafik (H. Bieri, 3 ECTS)

  Seminar: Theoretische Informatik und Logik (G. Jäger, 3 ECTS)

  Seminar: Inductive Definitionen I (G. Jäger, 3ECTS)

  Blockveranstaltung BeNeFri: Logic and Information (G. Jäger, J. Kohlas, K. Stoffel, 3 ECTS)

  Beweistheorie (G. Jäger, 3ECTS)

  Object-oriented Reengineering Patterns and Design (O. Nierstrasz und S. Ducasse, 3 ECTS)

  Smalltalk (S. Ducasse, 3 ECTS)

  Seminar: Software Composition (O. Nierstrasz, 3 ECTS)

  Seminar: Rechnernetze und Verteilte Systeme (T. Braun, 3 ECTS)

  Komplexitätstheorie (Th. Strahm, 3 ECTS)

  Parallel Algorithms and Programming (A. Cortesi, 3ECTS)

  Network Security (F. Baumgartner, 3 ECTS)

- Service Course

  Anwendungssoftware (F. Baumgartner, 4.5 ECTS)

Summer Semester 2005

- 2nd Semester

  Datenstrukturen und Algorithmen (H. Bieri, 5 ECTS)

  Datenbanken (G. Jäger, 5 ECTS)

Programmierung 2 (O. Nierstrasz, 5 ECTS)

Rechnerarchitektur (F. Baumgartner, 5 ECTS)

- 4th Semester

  Computergrafik (H. Bieri, 3 ECTS)

  Übungen zu Computergrafik (H. Bieri, 1.5 ECTS)

  Berechenbarkeit und Komplexität (Th. Strahm, 3 ECTS)

  Übungen zu Berechenbarkeit und Komplexität (Th. Strahm, 1.5 ECTS)

  Praktikum in Software Engineering (F. Baumgartner, 4.5 ECTS)

- 6th Semester

  Compilerbau (H. Bunke, 3 ECTS)

  Übungen zu Compilerbau (H. Bunke, 1.5 ECTS)

  Grundlagen der Mustererkennung (H. Bunke, 3 ECTS)

  Übungen zu Grundlagen der Mustererkennung (H. Bunke, 1.5 ECTS)

  Programmiersprachen (O. Nierstrasz, 3 ECTS)

  Übungen zu Programmiersprachen (O. Nierstrasz, 1.5 ECTS)

  Betriebssysteme und Verteilte Systeme (T. Braun, 3 ECTS)

  Übungen zu Betriebssysteme und Verteilte Systeme (T. Braun, 1.5 ECTS)

- Special Program

  Seminar: Künstliche Intelligenz (H. Bunke, 3 ECTS)

  Praktikum Computeranimation (H. Bieri, 3 ECTS)

  Seminar: Computergeometrie und Grafik (H. Bieri, 3 ECTS)

  Explizite Mathematik (G. Jäger, 3 ECTS)

  Seminar: Information Change und Update Semantics (G. Jäger, 3 ECTS)

  Seminar: Induktive Definitionen II (G. Jäger, 3 ECTS)

Blockveranstaltung Bern und Freiburg: Inferenz und Deduktion (G. Jäger und J. Kohlas, 3 ECTS)

Advanced Design Labs (O. Nierstrasz und S. Ducasse, 3 ECTS)

Seminar: Software Composition (O. Nierstrasz, 3 ECTS)

Sensornetze (T. Braun, 3 ECTS)

Seminar: Rechnernetze und Verteilte Systeme (T. Braun, 3 ECTS)

Praktikum Computernetze (T. Braun, 3 ECTS)

Parallel Computer Architecture (A. Cortesi, 3 ECTS)

- Service Course

  Anwendungssoftware (Th. Strahm, 4.5 ECTS)

2.2 Colloquium in Computer Science

16/11/2004	Avi Bryant Industry and Innovation: Carving a New Platform for Dynamic Web Applications
30/11/2004	Prof. Dr. P. Kropf, Université de Neuchâtel Prof. Dr. C. A. Zehnder, ETH Zürich Festkolloquium Prof. Dr. Hansjürg Mey
07/12/2004	Jean-Yves Beziau Swiss National Science Foundation Sequents and Bivaluations: A General Completeness Result
11/01/2005	Harald Gall Department of Informatics, University of Zurich Software Evolution Analysis and Visualization
25/01/2005	Prof. Dr. Taoufik Nouri Technical University NW-Switzerland Prädiktion und Klassifikation mit Random Forest

The Institute of Computer Science and Applied Mathematics gratefully acknowledges the support of CHOOSE, the Swiss Group for Object-Oriented Systems and Environments, for sponsoring the Colloquium.

2.3 Students

- Major Subject Students: 240
- Minor Subject Students: 196
- PhD Candidates: 32

2.4 Degrees and Examinations

- PhD: 8

- Diploma: 32
- Major Subject Examinations: 37 (Diplom 1. Teil: 14, Propädeutische Hautpfachprüfung: 23, 1746 ECTS)
- Completion of Minor Studies: 34 (60E: 3, 45E: 1, 40E: 2, 36E: 3, 31E: 4, 30E: 1, 27E: 3, 20E: 2, 18E: 10, 15E: 3, 13E: 2, 939 ECTS)
- Semester Examinations Winter Semester 2004/2005: 545 (2452.5 ECTS)
- Semester Examinations Summer Semester 2005: 580 (2615 ECTS)

3 Research Group on Computational Geometry and Graphics

3.1 Personnel

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3.2 Research Projects

D-Dimensional General Polyhedra

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

Research staff: H. Bieri, W. Nef, J. Tammik

Subdivision Surfaces in Real-Time Character Animation

Commercial 3D animation software packages like Maya, Softimage XSI or 3D Max have broad and mature support for subdivision surfaces and

character animation. All these digital content creation packages (CCD) cannot be used directly in real-time applications such as computer games or real-time simulations.
This research project investigates various aspects of real-time character animation with subdivision surfaces for computer games on modern hardware:

- Scalability with Level of Detail techniques.
- Rendering on common triangle based Graphics Processor Units (GPUs) favors polygon based techniques like progressive meshes or subdivision surfaces.
- Recent multicore CPUs

Real-time computation of subdivision surfaces and character animation requires efficient algorithms with a good data locality and branch prediction behavior. The goal of this research project is to design and implement a scalable system that supports real-time character animation with subdivision surfaces in 3D computer games on next-generation platforms.

Research staff: Ch. Ammann

Collaboration on Scene Graph Based 3D Models

Professional 3D modeling applications like Alias Maya or discreet 3ds max offer only limited support for a team of designers to work on a 3D model collaboratively. There is even less support for managing revisions and variants or different representations of designs. 3D models are often made up of thousands of objects in a scene graph (DAG) that is stored in one single file. Therefore commercial group authoring tools and revision control systems cannot provide a solution as they generally work file based and/or are specialized on text documents only and thus cannot take advantage of the DAG structure of 3D models.
This project provides support for collaboration on scene graph based 3D models by means of a specialized 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 models 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. 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 and export/import operations are implemented in plug-ins for 3D applications.
Support for collaboration between different 3D modeling applications is provided by heterogeneous 3D scenes that integrate the applications different representations of 3D models. When working with such a scene in an application, models stored in a representation unknown to that application are transparently replaced by proxy models in a supported representation. Those proxy models can be automatically derived by converters from the models in their original representations. For collaboration purposes, the proxy models do not need to be perfect copies but more or less accurate approximations to the original models they stand for, thus only rather simple converters have to be written or bought. The heterogeneous scene is supposed to be rendered with a common external renderer supported by all applications involved such as RenderMan or Mental Ray.

Research staff: L. Ammon

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

Albert Einstein Exhibition

The Historical Museum of Bern holds a special exhibition about Albert Einstein in 2005 to celebrate the centenary of the Theory of Relativity and its discovery in Bern. This exhibition features in particular a virtual ride with a bicycle through the city of Bern along the route from Einstein's home to his place of work. Depending on the pedalling speed a relativistic visualization will be shown simulating riding at almost speed of light.
As a project partner our research group provides the 3-dimensional computer model of the relevant part of the city of Bern. Multiple student projects are involved in contributing to this project, including

- "a generic house model for buildings of the city of Bern" which allows the quick generation of 3-dimensional house models depending on some input parameters
- "fusion of roof data and cadastral ground plans" which helps integrating photogrammetrically acquired roof data into the city model
- several models of important buildings which are modelled in detail by hand

Research staff: Th. Buchberger, Ch. Ammann, M. Hugi, M. Zaugg, J. Rothen, S. Michel, J. Marbach, Ch. Gutmann, A. Polyansky, H. Bieri

Practical Reconstruction of 3D Objects

Many museums own a large number of precious 3D objects. Digital 3D reconstructions of such objects can be very useful. To replace originals by copies is advantageous in many cases, not only for security reasons. Other applications consist in building animations which include such reconstructions.
This project examines and compares known reconstruction methods with many different applications, and tries to adapt and improve them for the given special situation.

A major motivation for this project is to convert a big classical model of the city of Bern around 1800 to a digital model and then to generalize the procedure. There exist many valuable classical city models, and their conversion to digital models offers a large number of interesting new applications.
An important technique to be examined will be Photogrammetry, especially by applying the software products Photomodeler by EOS Systems and Imagemodeler by REALVIZ. Photogrammetry will be combined with the classical ”CAD approach” as well with Laserscanning in order to arrive at a comprehensive and flexible combined approach to reconstruct 3D objects of good - but not too high - quality in reasonable time and at limited costs.

Research staff: M. Hugi, J. Marbach, H. Bieri

Interactive Ray Tracing

This research 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) multi-GPU and multi-CPU computer based solutions. Among these are

- efficient memory management and cache usage
- computation optimizations using the SIMD programming model
- general purpose computations on graphics hardware (GPGPU)
- frameless rendering o scalable rendering techniques

Part of this effort is the development of a ray tracing based graphics library named RGL, which enables us to compare important facets of our interactive ray tracing system to traditional, z-buffer based renderers such as OpenGL.

Research staff: Ph. Robert, Ch. Gerber, S. Schoepke, R. Kuenzli

Real-Time Fluid Flow Rendering

Previous research efforts have shown that realistic fluid flow rendering can be achieved in real-time in 2D. This project aims at implementing a real-time fluid flow renderer in 3D, based on the well-known Navier-Stokes equations and variations thereof. The required performance for real-time usage will be obtained exploiting coherence (SIMD programming) as well as using the GPU as a stream based coprocessor (GPGPU). The focus of this work is on smoke visualization.

Research staff: D. Schweri, Ph. Robert

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 of Java (e.g. generic classes, aspect oriented programming) are analyzed and evaluated for their benefit in this context. The most important basic algorithms for mesh reconstruction, mesh generation, mesh simplification, mesh subdivision, and signal processing with meshes are being implemented. The 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.

Although typical target application areas for JMesh come from research and didactics in computer graphics, JMesh is useful to application developers too.

Research staff: Th. Wenger, Ch. Aymon, A. Kobel

Virtual Realization of the City Project “Gemeinschafts-zentrum Predigergasse”

“Gemeinschaftszentrum Predigergasse” was a project in the 1960 for a cultural place in the city of Bern. It was meant to become the new cultural center of the city, with opera, theater and exposition rooms. But in order to realize this project it would have been necessary to remove some old buildings, including the valuable City Theater.
The exhibition “Rettet die Altstadt” hold in 2005 needed an animation of the project “Gemeinschaftszentrum Predigergasse”. The animation should visualize a 3D model of the new buildings proposed by the project. There was not much time left to develop this animation, therefore the main challenge consisted in starting with well planned designs. Another challenge was finding a good trade-off between enough simplicity - to show the main ideas of the never realized project - and enough details - to give an impression of the intended ambience.

Research staff: M. Hinnen

Digital 3D Picture Gallery

The famous Old Masters Picture Gallery in Dresden has an interesting history. In particular, the hanging of its pictures has been changed significantly at several well-known moments of time. It is a goal in Art History to study these different hangings. To do this, an appropriate user-friendly software system may be expected to be very helpful.
In the first part of this project, a 2D system has been built to visualize the interior walls of picture galleries and to provide interactive tools to manipulate the pictures and their hangings (www.gallerycreator.unibe.ch). This system has already proved to be useful for the Picture Gallery in Dresden, but for very different kinds of art galleries too.
In a second part of this project, the system shall be extended to 3D. Additional tools for interaction will be developed, 3D visualizations for any given point of view will be provided, and 3D animations - in particular virtual walks through a gallery - will also be possible. An important requirement is that the resulting system will be very user-friendly, for the intended typical user shall not have to be a computer specialist.

Research staff: Ph. Holzmann, T. Weddigen

Systems of Agents with Autonomous Behavior

In traditional particle systems the movement of every particle is controlled by the system. Usually this is handled by simulating physical forces like gravity, wind, repulsion, force fields and so on, and by applying these to the individual particles. In this master project a different approach is investigated. A set of behaviors can be assigned to each particle which is called “agent” in this context. These behaviors define how an agent should react in a given situation, which is defined by the state of the environment and the state of other agents (in the neighborhood). Since the resulting movement only depends on the combination of the individually defined behaviors of each agent, emergent behaviors can be achieved. As a result the entire particle system is dynamically defined by the type and number of the agents that are part of it.

Research staff: Daniel Schulte

3.3 Diploma and Master Theses

- Oliver Burkert: Das Animationsprojekt “Kanderumleitung” - Projektmanagement, statische Aspekte und Humans
- Miklos Kozary: Das Animationsprojekt “Kanderumleitung” - Dynamische Aspekte und Nachbearbeitung
- Darko Bukovac: Computerrekonstruktion einer klassischen Animation anhand eines Beispiels von Lubomir Benes und Vladimir Jiranek
- Raphael Fink: Algorithmen für die Diagramme von Voronoi und Delaunay: Grundlagen, Implementierungen, Visualisierungen
- Michael Zaugg: Generische Gebäudemodellierung in Maya - am Beispiel der Berner Altstadt
- Sonja Schär Koller: Digitale Farbrestaurierung mittelalterlicher Tapisserien
- Kai Rollé: Generische 3D-Rekonstruktion von Gebäuden aufgrund von Grundriss- und Dachdaten
- Thomas Bodenmann: Affine Transformationen digitaler Bilder
- Daniel Schweri: Simulation von Fluids in Echtzeit

3.4 Further Activities

- Project “Albert Einstein Exhibition” of the Historisches Museum Bern. Project partner: H. Bieri
- Stand at Learntec 2005, Karlsruhe, 15.2.2005 - 18.2.2005. Project GalleryCreator: R. Angeli, Ph. Holzmann
- Exhibition “Rettet die Altstadt! Bern - vom Sanierungsfall zum Weltkulturerbe”, Kunstmuseum Bern, 9.3.2005 - 10.7.2005. Collaborators: M. Hinnen, M. Heimann, M. von Rohr
- Reviewing for ISVC 2005 (International Symposium on Visual Computing): L. Ammon, H. Bieri
- Professor election committee at the Swiss Federal Institute of Technology, Zurich: H. Bieri

3.5 Publications

- P. Bhaniramka, Ph. Robert, S. Eilemann: OpenGL Multipipe SDK: A Toolkit for Scalable Parallel Rendering. To appear in IEEE Visualization 2005, Minneapolis, October 23 - 28, 2005
- O. Aeberhard: Die Zuschauersicht im virtuellen Stadttheater. UNIPRESS 123, December 28 - 30, 2004
- S. Schär, H. Bieri, X. Jiang: Digital Restoration of Medieval Tapestries. Submitted
- Ph. C. D. Robert, D. Schweri: Exploring Parallelism for Real-Time Fluid Flow Visualisation. Technical Report IAM-05-003

4 Research Group on Computer Networks and Distributed Systems

4.1 Personnel

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Guests:	Prof. Dr. B. Barghava	Purdue University 15. 7. – 31. 7. 2005

* with financial support from a third party

4.2 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 eleven research projects, and the RVS group of the University of Berne has been participating in the individual project “Self-Organizing Networking Mechanisms” (IP4), which aims at investigating the main networking issues in ad-hoc networks in a broad sense. Specifically, the RVS research group is doing research on two topics: Routing and TCP in mobile ad-hoc networks.

Current routing protocols for ad-hoc and sensor networks require neighbor information in order to optimize routing of packets. This neighbor information is acquired through hello messages, which are broadcast periodically by each node. These transmissions however consume scarce network resources such as battery-power and bandwidth. Furthermore, they do not always provide accurate information about the positions because the movements of the nodes frequently result in very suboptimal forwarding decision in highly dynamic networks. We earlier had proposed the BLR (Beacon-Less Routing) protocol that avoids periodic transmission of hello messages and therefore avoids the aforementioned drawbacks. It is state-less in the sense that nodes do not need to store information about their neighborhood. The results obtained from simulations indicate that BLR provides superior performance under various network conditions compared to other position-based routing protocols that use hello messages. In addition, we implemented the BLR protocol in a real world test bed. The test bed consists of Linux laptop computers equipped with IEEE 802.11 WLAN cards and GPS receivers. The results obtained from the conducted experiments showed that BLR is able to deliver packets with a very short delay over multiple hops. The same principle used for the (unicast) routing protocol BLR has been applied to the design of a broadcast protocol DDB (Dynamic Delayed Broadcasting). DDB is also able to locally optimally transmit packets without knowledge about the neighborhood and, thus, without any control traffic. This allows flooding a packet very efficiently in the network to every node. Simulation results indicate that it outperforms clearly current state-of-the-art broadcast protocols for

mobile ad-hoc networks.
Furthermore, the AMRA (Ants-based Mobile Routing Architecture) was implemented in a network simulator. AMRA proved its potential in large ad-hoc networks with irregular topology where routing between the source and destination node is not possible along a straight line. AMRA was able to find much shorter paths by circumventing voids in the network topology. As the used network simulator was limited in the number of supported nodes, we also implemented a simple Java-based network simulator which allows for the simulations of even larger networks. The obtained results confirmed the results of previously performed simulations with the other network simulator. AMRA found paths that were up to 50% shorter than with using other routing protocols also in the very large networks.
To improve the performance of the transport control protocol (TCP) in multihop wireless networks, we have proposed a technique that minimizes the traffic overhead inherent in this protocol. Specifically, we have developed the dynamic adaptive acknowledgment (DAA) strategy to reduce redundant transmissions as well as unnecessary retransmissions toward higher end-to-end throughput. The key concept of this technique is to use the medium's scarce bandwidth smartly by reducing redundant acknowledgements whenever the wireless channel is unconstrained. For that, the receiver monitors the channel continuously and changes its acknowledgement transmission rate accordingly. This scheme does not only enhance throughput but also reduces energy consumption in many scenarios. In addition, our approach requires changes at the end nodes only, facilitating deployment. Since DAA targets environments facing moderate loss rates, DAAp (DAA plus) was later proposed for noisier channels. DAAp prevents the TCP sender from missing acknowledgements when packet loss is high. As a result, fewer retransmissions caused by timeouts take place at the sender, leading to higher performance. The key concept in DAAp is the more conservative strategy at the receiver regarding the combination of acknowledgements when recovering from lost packets. Simulation evaluations have shown that both DAA and DAAp outperform traditional TCP as well as related work in a variety of scenarios.

Research staff: Marc Heissenbüttel, Ruy de Oliveira, Thomas Bernoulli, Markus Wälchli, Thomas Huber, David Jörg. Intership students: Natalie Boerger and Akcelik Derman

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

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, which is running until June 2006. 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 Neuchatel, and one by University of Fribourg. The course is fully operational and has been productively used in different regular courses at the Universities of Bern, Fribourg, and Neuchatel.

In the reporting period we have further developed the VITELS file formatting tool FFGF (file framework generator & formatter) to a more user-friendly version and subsequently updated the course content files to fit the new tool. FFGF relieves course designers from the task of formatting course content for different platforms. Designers write the course content, formatted with predefined style markers (HTML tags), which are then processed by FFGF. The output files currently match the dimensions and style requirements of WebCT Vista and CE but more output formats can be included if necessary. FFGF also helps designers to manage the table of contents of their learning modules. The tool integrates static text automatically and generates a graphic schedule and chapter title overviews. Simultaneously, we have improved the didactical concept and integrated changes resulting from our teaching experiences with students. The content of our e-learning modules has been reviewed and updated. The hands-on sessions of various modules have been moved to new hardware. Unified systems installation procedures make maintenance easier now. Moreover, the development of an improved course management system with student profiles and a much more flexible hands-on sessions' reservation system has been started. Upgrades to new versions of the Shibboleth based authentication and authorization infrastructure have been performed.

Research staff: Marc-Alain Steinemann, Attila Weyland, Florian Baumgartner, Thomas Staub, Thomas Bernoulli, Daniel Frey, Jana Krähenbühl, Reto Gantenbein, Torsten Braun

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

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

The *EuQoS* project (http://www.euqos.org), which started on September 1 2004, aims to resolve the outstanding design issues presently associated with the delivery of end-to-end Quality of Service (QoS) across heterogeneous networks. With the help of EuQoS these issues should be solved and network infrastructures should be upgraded so that new applications can be supported by the Internet and new service packages can be offered by operators, Internet and other service providers. Our research group is involved in the workpackages WP1, WP3, WP5 and WP6.

WP1 aims to define an architecture for different aspects of the EuQoS system. QoS support for IP multicast is difficult to achieve due to the lack of wide IP multicast deployment in the Internet, and it seems that this will probably not change in the near future, even with adoption of IPv6. Our research focuses on providing a transparent support for application level multicast on end systems to enable multicast communication across the Internet using only unicast communication offering QoS support.

WP3 delivers the proposed applications and services according to the architectures defined in WP1. Our research group provides an implementation of a transparent multicast facility known as “Multicast Middleware,” which is based on a virtual network interface (TAP) and is implemented mostly using Java to support different operating systems. The Multicast Middleware aims to be independent of the underlying QoS mechanisms. It can either use the EuQoS QoS signaling (introduced with the EuQoS project) or it can use measurement-based QoS to bridge gaps where only Best-Effort service is offered by the underlying network.

WP5 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 LAN-based network, which is interconnected by General Routing Encapsulation (GRE) tunnels to 10 other testbeds belonging to all other EuQoS consortium partners involved in WP5.

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, standard-

ization 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 are implementing the course modules “Applications’ QoS demands” and “Implementing protocols on network simulators.” We are further developing and providing the course management system and the authentication & authorization framework required for the various module exercises.

Research staff: Thomas Bernoulli, Marc Brogle, Dragan Milic, Thomas Staub, Marc-Alain Steinemann, Torsten Braun

Financial support: EU project IST-2003-004503

eXperience Based Admission Control (XBAC)

The XBAC project aimed to create an overlay network architecture that provides a distance estimation service to user applications. Before an application opens a connection to a remote endpoint it can ask the service for a prediction of the quality of service to this destination. Depending of the prediction it can then decide to proceed with connection setup, or to back off. Moreover, peer-to-peer networks can use the service to optimally configure their topology and also to adapt to later changes in quality of service.
The XBAC architecture is based on the idea of creating clusters of endpoints that are close to each other in the physical network topology. While communicating these endpoints gather measurement data, which they distribute to the other endpoints in their cluster. Thereby they create a common pool of network measurements, termed the group’s *experience*. Using this experience, the cluster can give robust answers to QoS prediction requests. If the request cannot be answered (e.g. when the request concerns two remote clusters) the local cluster may also communicate with other clusters to fulfill the request. Clustering of endpoints is also useful to reduce the complexity of QoS prediction since the number of required prediction models is significantly reduced.

To create such an architecture a method to remotely identify clusters, based on time series of QoS measurements, has been defined. Furthermore, we have developed a basic architecture for experience exchange and data organization within clusters, as well as communication between clusters. It is based on distributed hash tables (DHTs) and therefore achieves high robustness.

Research staff: Matthias Scheidegger

Financial support: Swiss National Foundation Project No. 200021-101679/1

Mobile IP Telephony (MIPTel)

The MIPTel project aims to develop and support mobile telephony applications over IP networks. Providers are in great need of scalable, extensible, flexible and transparent charging and accounting methods, which take into account the specific attributes of wireless networks and requirements of diversified services. A wide range of accounting, charging and pricing schemes have been analyzed.
Our research focuses on cooperation and accounting strategies in multi-hop cellular networks. With multi-hop cellular networks the coverage area can be increased and the installation costs for the provider can be reduced. However, the individual customers play an important role in such networks and their participation must be encouraged. We proposed a scheme called CASHnet (Cooperation and Accounting Strategy in Hybrid Networks), which makes cooperation a rewarding alternative, but allows uncooperative nodes at the same time. We took a decentralized approach for the accounting as well as for the security architecture. The charging and rewarding is done on the device, the transformation of the rewards is performed at central service stations. Service stations are terminals with a low-bandwidth connection to the accounting center of a provider, much like a loading station for pre-paid cards. The authentication is based on public key cryptography.
We implemented CASHnet in ns2 and made extensive evaluations regarding network liveliness and overal throughput. We compared CASHnet to Nuglet and found that CAShnet outperforms Nuglet using two or more service stations. As a result of further analysis, we improved CASHnet in several ways. We increased the granularity of the rewarding messages and improved the simulation scenario. We are currently analyzing the effect of

reseller nodes and mobile service stations in CASHnet via simulations. We are also implementing a prototype of CASHnet under Linux using Netfilter to conduct some real-life performance measurements.

Research staff: Attila Weyland, Thomas Staub

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

Cellular Assisted Heterogeneous Networking (CAHN)

Existing radio technologies like wireless LAN, Bluetooth, GPRS or Ultra Wide Band (UWB) allow communication between different mobile devices like mobile phones, PDAs or laptops. These wireless technologies require appropriate configuration to work in a desired manner. Too often, more than a basic know-how about the technology itself is required to understand the different settings needed to interconnect devices. With the CAHN approach, this configuration is performed automatically and transparently for the user.
The bandwidth limitation of nowadays cellular networks like GSM/GPRS is a big disadvantage in the competition against broadband wireless radio technologies such as wireless LAN, Bluetooth or UWB, which are much more appropriate for fast data transfer. But on the other hand, the cellular networks benefit from the high coverage and the “always on” characteristics. The paging of a mobile device that is attached to the cellular network is a common functionality. Therefore, the cellular network is very well meeting the requirements of a signaling plane. Taking these facts into account, a framework for Cellular Assisted Heterogeneous Networking has been developed, where the cellular network serves as the signaling plane for wireless broadband data channels.
After having set up a demonstrator for CAHN last year, a simulator was built this year to quantify the benefits introduced by the CAHN concept. Therefore, a new framework called SMACS (Smart Multi-Access Communication Service) was developed. The SMACS framework integrates CAHN and enables the seamless handover from infrastructure to ad-hoc and peer-to-peer links provided by CAHN. SMACS therefore extends the concept of separating the signaling from the data plane for heterogeneous data sessions to any kind of IP network. The simple and convenient session establishment achieved with CAHN has consequently been adapted to work with ad-hoc and infrastructure based links. Nowadays

academic but also commercially available network simulators (ns2, Qualnet, OpNet, etc.) do not provide appropriate support for the simulation of heterogeneous networks with dynamic vertical handovers during runtime, end-to-end communication between nodes using different wireless technologies simultaneously, and switching between infrastructure and ad-hoc mode of operation. Therefore, we implemented our own network simulator that allows the modeling of heterogeneous networks at a simplified level, i.e. no packet transmission are simulated. Simulations have shown, that the throughput can be increased about 80% in certain scenarios. The two features offered by the CAHN framework, namely the ad-hoc and the on-demand capability, are promising increased networking experience not only for the user, but also for the operator, in terms of better battery lifetime and more efficient resource utilization.

Research staff: Marc Danzeisen, Isabel Steiner

Financial support: Swisscom Innovations AG

Power Saving in Wireless Ad hoc Networks

Power saving strategies generally attempt to maximize the time that nodes spend in a low power consumption sleep state. Such strategies often require the sender to notify the receiver about pending traffic using some form of traffic announcements. Although asynchronous traffic announcement mechanisms are particularly suitable for the ad hoc environment, they also provide relatively limited power savings. We propose a mechanism that improves the efficiency of asynchronous traffic announcement mechanisms by reducing the proportion of time that nodes need to spend awake, while still maintaining good connectivity properties. The mechanism is based on allowing traffic announcements to be rebroadcast by neighbouring nodes. Performance evaluation by analysis and simulation showed the usefulness of the mechanism for single-hop scenarios. Preliminary investigations have been performed for multi-hop scenarios.

Research staff: Torsten Braun

Financial support: Swedish Institute of Computer Science, Kista, Sweden

TCP in Sensor Networks

Many applications of wireless sensor networks require external network connectivity to enable communication between monitoring / controlling entities and sensors. By using the TCP/IP protocols inside the sensor network, external connectivity can be achieved to any other IP node at the edge or outside the sensor network. TCP can be used for remote management, configuration and reprogramming of sensor nodes as well as for query distribution. In case, TCP is just deployed at end points, high bit error rates cause a high number of end-to-end retransmissions leading to energy inefficiencies that reduce the lifetime of a sensor network. TCP Support for Sensor nodes (TSS) allows intermediate sensor nodes to cache TCP segments and to perform local retransmissions in case of errors. TSS should be deployed in each sensor node along the path of a TCP connection in order to allow energy efficient operation and to improve performance of TCP connections in a sensor network. TSS extends related work such as Distributed TCP Caching (DTC) by functions such as TCP acknowledgement recovery and easy to deploy backpressure based congestion control. Simulations performed with Omnet++ showed that TSS can improve the performance of DTC and also proves the effectiveness of the backpressure mechanism.

Research staff: Torsten Braun

Financial support: Swedish Institute of Computer Science, Kista, Sweden

Security and Privacy in the Internet

In spring 2004 the Computer Networks and Distributed Systems research group has been granted a Microsoft Research Curriculum Request for Proposal Award for the development of a distance learning course module in the area of Internet Security.
We have completed our course called “Security and Privacy in the Internet,” which addresses both theoretical and practical aspects of the subject. The theoretical part covers a wide range of topics – from vulnerabilities over attacks and countermeasures to general security mechanisms and concepts. In the practical part the course participant has the possibility to set up and validate a Kerberos installation.

The course has been developed based on the VITELS Didactics and Design Guide. The theory consists of HTML code and interactive Flash animations. It is available as stand-alone package or WebCT content. The laboratory consists of several Linux computers running a Kerberos installation and has been integrated into the VITELS reservation system.

Research staff: Attila Weyland, Florian Baumgartner

Financial support: Microsoft Research Curriculum Request for Proposal Award

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 XBAC project for example uses the available CPU power to perform computations on time series of QoS measurements. Furthermore, the 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 lab network for students' training is also connected to the testbed. Moreover, a practical exercise for the students of the operating systems lecture has been realized using a Linux server in the RVS lab.

Research staff: All members of the RVS research group

4.3 Diploma Theses

- David Jörg: Ants-Based Routing in Mobile Ad-Hoc Networks , January, 2005
- Thomas Huber: Ant-Based Mobile Routing Architecture in Large-scale Mobile Ad-hoc Networks, January, 2005

- Markus Wälchli: Optimized Position-based Routing and Broadcasting in Mobile Ad-hoc Networks, December, 2004
- Thomas Bernoulli: Beacon-less Routing in Mobile Ad Hoc Networks, November, 2004
- Thomas Staub: Implementating a Cooperation and Accounting Strategy for Multi-hop Cellular Networks, November, 2004
- Ehsan Maghsoodi: Design and Implementation of WLAN Support for Cellular Assisted Heterogeneous Networking, November, 2004

4.4 PhD Theses

- Ruy de Oliveira: Addressing the Challenges for TCP over Multihop Wireless Networks, June, 2005
- Marc-Alain Steinemann: Distributed Architectures for Laboratory-Based E-Learning, June, 2005
- Marc Heissenbüttel: Routing and Broadcasting in Ad-hoc Networks, June, 2005

4.5 Further Activities

Memberships

- Editorial Board of Elsevier's Computer Communications Journal (Torsten Braun)
- Editorial Board of Informatik Spektrum / Springer-Verlag (Torsten Braun)
- Erweitertes Leitungsgremium GI-Fachgruppe "Kommunikation and Verteilte Systeme" (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)
- Ph.D. Jury at University of Nice (Torsten Braun)
- Expert for Diploma Exams at Fachhochschule Bern (Torsten Braun)
- Swiss Authentication and Authorization Infrastructure Advisory Committee (Marc-Alain Steinemann)

Conference Program Committees

- International Workshop on Quality of Future Internet Services (QofIS), Barcelona, Spain, September 29 – October 1, 2004 (Torsten Braun)
- 4th International Workshop on Advanced Internet Charging and QoS Technologies (ICQT), Barcelona, Spain, September 29 – October 1, 2004 (Torsten Braun)
- 12th IEEE International Conference on Network Protocols (ICNP), Berlin, Germany, October 5 – 8, 2004 (Torsten Braun)
- International Working Conference on Active Networking (IWAN), Lawrence, USA, October 27–29, 2004 (Torsten Braun)
- 15th IFIP/IEEE Distributed Systems: Operations and Management, Davis, USA, November 15–17, 2004 (Torsten Braun)
- Workshop on High-Speed Local Networks, in conjunction with IEEE LCN Conference, Tampa, USA, November 16–18, 2004 (Torsten Braun)
- 29th IEEE Conference on Local Computer Networks (LCN), Tampa, USA, November 16–18, 2004 (Torsten Braun)
- Second International Workshop on Multimedia Interactive Protocols and Systems (MIPS), Grenoble, France, November 16–19, 2004 (Torsten Braun)
- 15th IFIP/IEEE International Workshop on Distributed Systems: Operations & Management (DSOM 2004), Davis, USA, November 15–17, 2004 (Torsten Braun)

- Global Internet & Next-Generation Networks Symposium, at the 2004 IEEE Global Communications Conference (GLOBECOM 2004), Dallas, USA, November 29 – December 3, 2004 (Torsten Braun)
- Workshop “Internet Compatible QoS in Ad hoc Wireless Networks” (IC-QAWN), in conjunction with 3rd ACS/IEEE International Conference on Computer Systems and Applications, Cairo, Egypt, January 3–6, 2005 (Torsten Braun)
- IEEE Consumer Communications and Networking Conference, Las Vegas, USA, January, 3–6, 2005 (Torsten Braun)
- 2nd Annual Conference on Wireless On demand Network Systems and Services (WONSS), St. Moritz, Switzerland, January, 19–21, 2005 (Torsten Braun)
- 14. Fachtagung “Kommunikation in Verteilten Systemen,” Kaiserslautern, Germany, February 28 – March 3, 2005 (Torsten Braun)
- 3rd International Workshop on Internet performance, simulation, monitoring and measurements (IPS-MoMe), Warsaw, Poland, March 14–15, 2005 (Torsten Braun)
- 4th IFIP International Conference on Networking, Waterloo, Canada, May 2–6, 2005 (Torsten Braun)
- 3rd International Conference on Wired/Wireless Internet Communications (WWIC), Xanthi, Greece, May 11–13, 2005 (Torsten Braun, TPC Chair)
- IEEE International Workshop on Management Issues and Challenges in Mobile Computing, Nice, France, May 15, 2005 (Torsten Braun)
- 9th IFIP/IEEE International Symposium on Integrated Network Management (IM 2005), Nice, France, May 15–19, 2005 (Torsten Braun)
- IEEE International Conference on Communications (ICC), Seoul, South Korea, May 16–20, 2005 (Torsten Braun)
- International Conference on Information and Communication Technology in Management (ICTM), Melaka, Malaysia, May 23–25, 2005 (Torsten Braun)

- 4th Conference on Security and Network Architectures (SAR), Batz sur Mer, France, June 6–10, 2005 (Torsten Braun)
- Symposium on Ad Hoc Networks, as part of WirelessCom 2005, Maui, USA, June 13–16, 2005 (Torsten Braun)
- Workshop on Real-World Wireless Sensor Networks (REALWSN), Stockholm, June 20–21, 2005 (Torsten Braun)
- International Conference on Internet Computing (ICOMP), Las Vegas, USA, June 27–30, 2005 (Torsten Braun)
- 5th Workshop on Applications and Services in Wireless Networks, Paris, France, June 29 – July 1, 2005 (Torsten Braun)
- 31st EuroMicro Conference, Porto, Portugal, August 30 – September 3, 2005 (Torsten Braun)

Reviewing Activities

- United States-Israel Binational Science Foundation (Torsten Braun)
- Indo Swiss Joint Research Programme, EPF Lausanne (Torsten Braun)
- Swiss National Science Foundation (Torsten Braun)
- IEEE Communications Magazine (Torsten Braun)
- IEEE Transactions on Mobile Computing (Torsten Braun)
- Journal of Network and Systems Management, Springer Science and Business Media (Torsten Braun)
- 61st IEEE Semiannual Vehicular Technology Conference, Stockholm, Sweden, May 30 – June 1, 2005 (Torsten Braun)
- Journal on Wireless Communications and Mobile Computing, John Wiley (Torsten Braun)

Invited Talks and Tutorials

- Torsten Braun: Telematiknetze, Kaderkurs Telematik, Bundesamt für Bevölkerungsschutz, Schwarzenburg, Switzerland, March – May, 2005
- Torsten Braun: A Dynamic Adaptive Acknowledgment Strategy for TCP over Multihop Wireless Networks, 2nd COST 290 meeting, Wi-QoST: Traffic and QoS Management in Wireless Multimedia Networks, University of Haute Alsace, Colmar, France, February 3, 2005
- Torsten Braun: Sicherheit und Dienstgütenunterstützung in verteilten Kooperationsumgebungen, Fakultät Elektrotechnik und Informatik, TU Berlin, Germany, May 9, 2005

Institutional Research Cooperation

The RVS group maintains an effective collaboration with the RAID laboratory at Purdue University in the United States. RAID belongs to the Department of Computer Science of that University, and focuses on research involving various topics within computer networking field. As part of such a collaboration, the RVS group hosted Prof. Dr. Bharat Bhargava of Purdue University in a technical visit of two weeks during July 2005. Prof. Dr. Torsten Braun spent parts of his sabbatical from at SICS (Swedish Institute of Computer Science) Kista/Stockholm (July 26 to October 17).

4.6 Publications

Publications submitted in the academic year 2004/2005 and appearing in 2005/2006 or later are not listed.

Reviewed Journal and Conference Papers

- Marc Danzeisen, Torsten Braun, Isabel Steiner, and Daniel Rodellar: On the Benefits of Heterogeneous Networking and How Cellular Mobile Operators Can Help, International Conference on Parallel Processing Workshop (IEEE WSNET 2005), Oslo, Norway, June 14–17, 2005, ISBN 0-7695-2381-1, pp. 366–371
- Marc Heissenbüttel, Torsten Braun, Tobias Roth, Thomas Bernoulli: GNU/Linux Implementation of a Position-based Routing Protocol,

IEEE ICPS Workshop on Multi-hop Ad hoc Networks: from theory to reality (REALMAN 2005), Santorini, Greece, July 14, 2005, ISBN 960-531-179-8, pp. 25-33

- Marc Heissenbüttel, Torsten Braun, David Jörg, and Thomas Huber: A Framework for Routing in Large Ad-hoc Networks with Irregular Topologies, Fourth Annual Mediterranean Ad Hoc Networking Workshop (Med-Hoc-Net 2005), Île de Porquerolles, France, June 21-24, 2005

- Marc Heissenbüttel, Torsten Braun, Thomas Huber, and David Jörg: Routing in Large Wireless Multihop Networks with Irregular Topologies, 5th Scandinavian Workshop on Wireless Ad-hoc Networks (ADHOC'05), Stockholm, Sweden, May 3–4, 2005

- Torsten Braun, and Laura Marie Feeney: Power Saving in Wireless Ad hoc Networks Without Synchronization, 5th Scandinavian Workshop on Wireless Ad-hoc Networks (ADHOC'05), Stockholm, Sweden, May 3–4, 2005

- Torsten Braun, Matthias Scheidegger, and Marco Studer: Virtual Dropping for Endpoint Admission Control, IEEE E2EMON Workshop, Nice, France, May 15, 2005, ISBN 0-7803-9249-3, pp. 177-186

- Torsten Braun, Thomas Spreng, and Marc Steinemann: An Authentication and Authorization Architecture for the Mobile Internet, IEEE International Workshop on Management Issues and Challenges in Mobile Computing (MICMC2005), Nice, France, May 15, 2005

- Attila Weyland, Thomas Staub and Torsten Braun: Comparison of Incentive-based Cooperation Strategies for Hybrid Networks, 3rd International Conference on Wired/Wireless Internet Communications (WWIC 2005), Xanthi, Greece, May 11–13, 2005, ISBN: 3-540-25899-X, pp. 169–180

- Torsten Braun and Georg Carle, Editors: Proceedings of the 3rd international conference on Wired/Wireless Internet Communications (WWIC 2005), Xanthi, Greece, May 11–13, 2005, ISBN: 3-540-25899-X

- Torsten Braun, Thiemo Voigt, and Adam Dunkels: Energy-Efficient TCP Operation in Wireless Sensor Networks, Praxis der Informationsverarbeitung und Kommunikation (PIK), special issue on Wireless Sensor Networks, No. 2, 2005, ISSN 0930-5157, pp. 93–100

- Torsten Braun, Vijay Arya and Thierry Turletti: A Backup Tree Algorithm for Multicast Overlay Networks, Networking 2005, Waterloo Ontario Canada, May 2–6, 2005, ISBN 3-540-25809-4, pp. 1430–1434

- Matthias Scheidegger, Florian Baumgartner and Torsten Braun: Simulating Large-scale Networks with Analytical Models, International Journal of Simulation Systems, Science & Technology (IJS^{3}T), Special Issue on: Advances In Analytical And Stochastic Modelling, Vol. 6, Nr. 1–2, January 2005, ISSN 1473-804x online, 1473-8031 print, pp. 24–31

- Ruy de Oliveira and Torsten Braun: A Dynamic Adaptive Acknowledgment Strategy for TCP over Multihop Wireless Networks, IEEE Infocom 2005, Miami, USA , March 13–17, 2005, ISBN 0-7803-8969-7 (CD-ROM)

- Marc Danzeisen, Torsten Braun, Simon Winiker and Daniel Rodellar: Implementation of a Cellular Framework for Spontaneous Network Establishment, IEEE Wireless Communications and Networking Conference (WCNC), New Orleans, USA , March 13–17, 2005, ISBN 0-7803-8966-2 (softbound), ISBN 0-7803-8967-0 (CD-ROM)

- Matthias Scheidegger, Florian Baumgartner and Torsten Braun: An Integrated Simulator for Inter-Domain Scenarios, Kommunikation in Verteilten Systemen 2005 (KiVS), Kaiserslautern, Germany, February 28 – March 3, 2005, ISSN 1431-472-X, pp. 295–306

- Marcin Michalak and Torsten Braun: Common Gateway Architecture for Mobile Ad-hoc Networks, Wireless On demand Network Systems and Services (WONSS), St. Moritz, Switzerland, January 19–21, 2005, ISBN 0-7695-2292-0, pp. 70–75

- Torsten Braun and Hahnsang Kim: Efficient Authentication and Authorization of Mobile Users Based on Peer-to-Peer Network Mechanisms, Quality of Service in Mobile and Wireless Networks as a minitrack of HICSS conference (HICSS), Big Island, Hawaii, USA, January 3–6, 2005, ISSN 1530-1605, pp. 306b

- Marc Steinemann and Torsten Braun: A Generic Broker Portal Linking Authentication and Authorization Infrastructures and Resources, European Journal of Open and Distance Learning (EURODL), October 10, 2004, ISSN 1027-5207

- Torsten Braun et al.: Online Practical Telecommunications Training – The VITELS Project, 33th International Symposium IGIP/IEEE/ASEE 2004 (IGIP), Fribourg, Switzerland, September 27–30, 2004, ISBN: 2-940156-28-X, pp. 385–390

Magazine Papers

- Torsten Braun: Multimediale Dienste als Resultat der Konvergenz von Telekommunikation und Informatik, tcbe-FOCUS, No. 3, February 2005, pp. 18

- Marc Danzeisen, Daniel Rodellar, Simon Winkler, and Torsten Braun: Heterogeneous Networking Facilitated by Cellular Networks, Comtec 03/2004, ISSN 1 420-3715, pp. 18

Technical Reports

- José Enríquez, Marc Brogle, Dragan Milic et al.: Business models and system design specification, EuQoS Deliverable D1.1.3, CEC Deliverable Number 004503/TID/DS/D1.1.3/A1, August 1, 2005

- Laurent Baresse, Enrico Angori, Marc Brogle, Dragan Milic et al.: Extended QoS API and Middleware layer for phase 1 application use-cases, EuQoS Deliverable D3.1.1, CEC Deliverable Number 004503/Datamat/DS/D3.1.1/A1, August 1, 2005

- Pascal Le Guern, Marc Brogle, Dragan Milic et al.: Phase 1B: First individual-based EuQoS System Test Report, EuQoS Deliverable D5.1.3, CEC Deliverable Number 004503/FTRD/DS/D5.1.3/A1, July 31, 2005

- Torsten Braun, Marc Brogle, Dragan Milic, Matthias Scheidegger, Thomas Staub, Thomas Bernoulli, Markus Wälchli, Attila Weland, Marc Danzeisen: RVS Retreat 2005 at Griesalp, June 27–30, Technical Report, IAM-05-002, June 2005

- Enrico Angori, Giuseppe Martufi, Marc Brogle, Dragan Milic et al.: System design: functions, interfaces and API specification, EuQoS Deliverable D1.1.2, Intermediate CEC Deliverable Number 004503/TID/DS/D1.1.2/A1, May 13, 2005

- José Enríquez, Jorge Andrés, Marc Brogle, Dragan Milic et al.: Definition of Business Communication and QoS models (Intermediate), EuQoS Deliverable D1.1.1, Intermediate CEC Deliverable Number 004503/TID/DS/D1.1.1/A1, March 1, 2005

- Régis Frechin, Pascal Le Guern, Marc Brogle, Dragan Milic et al.: Phase 1A: Technical requirements for the Trial Infrastructures, Tasks and Scheduling, EuQoS Deliverable D5.1.1, CEC Deliverable Number 004503/FTRD/DS/D5.1.1/A1, March 1, 2005

- Régis Frechin, Pascal Le Guern, Marc Brogle, Dragan Milic et al.: Phase 1A: Connectivity and Performance Tests Report for Local and Pan-european (across GÉANT) Testbed Design for the Trial, EuQoS Deliverable D5.1.2, CEC Deliverable Number 004503/FTRD/DS/D5.1.2/A1, March 1, 2005

- Wojciech Burakowski, Marc Brogle, Dragan Milic et al.: Definition of monitoring equipment and software and location points, EuQoS Deliverable D2.1.1, CEC Deliverable Number 004503/WUT/DS/D2.1.1/A1, February 15, 2005

- Carolin Latze: Deployment and Performance Analysis of JavaCards in a Heterogenous Environment, Computer Science Project, University of Bern, January 2005

- Marc Heissenbüttel, Torsten Braun, Markus Wälchli, and Thomas Bernoulli: Broadcasting in Wireless Multihop Networks with the Dynamic Forwarding Delay Concept, Technical Report, IAM-04-010, December, 2004

- Torsten Braun, Vijay Arya and Thierry Turletti: Explicit Routing in Multicast Overlay Networks, INRIA, Technical Report RR-5397, November, 2004, ISSN 0249-6399

5 Research Group on Computer Vision and Artificial Intelligence

5.1 Personnel

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Guests:	Prof. J. Csirik	University of Szeged, Szeged, Hungary November – December 2004
	Prof. A. Kandel	University of South Florida, Tampa, USA October – December 2004, April – July, 2005
	Dr. A. Kocsor	University of Szeged, Szeged, Hungary July 2005
	K. Kovács	University of Szeged, Szeged, Hungary July 2005
	Prof. X. Jiang	University of Münster, Germany September 2004
	L. Spitz	DocRec Company, Nelson, New Zealand September 2004
	Prof. Ch. Suen	Concordia University, Montreal, Canada April 2005

* with financial support from a third party

5.2 Research Projects

Document Image Analysis and Understanding

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

Research staff: R. Bertolami, M. Liwicki, A. Schlapbach, T. Varga

Graph Matching Algorithms and Applications

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

Research Staff: Ch. Irniger, Dr. B. Le Saux, M. Neuhaus

Biometric Person Authentication Using Fingerprints and Handwriting

Fingerprint analysis is one of the most reliable and most widely accepted biometric techniques for person identification. Most automatic fingerprint identification systems use a procedure for the extraction of characteristic features followed by a feature matching algorithm. In this project we study the application of structural pattern recognition methods, in particular attributed graph matching, to the problem of fingerprint classification and identification. Our main objective includes the development of efficient fingerprint recognition algorithms based on the ridge line structures occurring in fingerprints.

Handwriting is believed to be unique to one writer. Writer identification is the task of determining the author of a sample of handwriting from a

set of writers. Writer verification is the task of deciding whether or not a handwritten text has been written by a certain writer. In this project we investigate various approaches to writer identification and verification, including Hidden Markov and Gaussian Mixture Models.

Research staff: M. Neuhaus, A. Schlapbach

5.3 Diploma and Master Theses

- Horvath, M.-P.: Automatic Recognition of Class Blueprint Patterns (jointly supervised with Prof. O. Nierstrasz, Software Composition Group, IAM)
- Kilchhofer, D.: Synthetisches Generieren von handschriftlichen Textzeilen
- Humm, A.: Neue Algorithmen für das Analysieren von Sequenzen von Graphen
- Wenger, S.: Klassifikation von Zeichenketten durch Transformation in den n-dimensionalen Vektorraum
- Bachmayer, A.: Synthetisches Generieren von Trainingsdaten für die Handschrifterkennung
- Marti, C.: Ähnlichkeit von Clusterings
- Buchenel, P.: Texturbasierte Merkmale zur Schreiberidentifikation
- Kobel, M.: Parsing by Example (jointly supervised with Prof. O. Nierstrasz, Software Composition Group, IAM)
- Kilchherr, V. Feature Selection for Writer Identification
- Lüthy, F.: Segmentierung von Textzeilen in einzelne Wörter
- Spillmann, B.: Transformation von Zeichenketten in den n-dimensionalen reellen Raum

5.4 PhD Theses

- Irniger Ch.: Graph Matching - Filtering Databases of Graphs Using Machine Learning Techniques

5.5 Further Activities (H. Bunke)

Editorial Boards

- 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 the International Journal on Document Analysis and Recognition
- Member of the editorial board of Pattern Analysis and Applications
- Member of the editorial board of Acta Cybernetica
- Editor-in-chief of the book series Machine Perception and Artificial Intelligence by World Scientific Publ., Singapore

Membership in Committees

- Program Committee member “6th International Workshop on Document Analysis Systems”, Florence, Italy, September 8 - 10, 2004
- Program Committee member “Workshop on Digital Image Computing”, Southbank, Australia, February 21, 2005
- Program Committee member “Document Engineering”, Track at 20th Annual ACM Symposium on Applied Computing, Santa Fe, USA, March 13 - 17, 2005
- Program Committee member “Workshop on Graph-based Representation in Pattern Recognition”, Poitiers, France, April 11 - 13, 2005
- Program Committee member “2nd Iberian Conference on Pattern Recognition and Image Analysis”, Estoril, Portugal, June 7 - 9, 2005
- Program Committee member “6th Int. Workshop on Multiple Classifier Systems”, Seaside, USA, June 13 - 15, 2005
- Program Committee member “12th Conference of the International Graphonomics Society”, Salerno, Italy, June 26 - 29, 2005

- Program Committee member “International Conference On Machine Learning and Data Mining in Pattern Recognition”, Leipzig, Germany, July 9 - 11, 2005
- Program Committee member “Audio- and Video-based Biometrics Person Authentication 2005”, Tarrytown, USA, July 20 - 22, 2005
- Program Committee member “Web Document Analysis 2005”, Seoul, Korea, August 28, 2005
- Program Committee member “Neural Networks and Learning in Document Analysis and Recognition”, Seoul, Korea, August 29, 2005
- Member of the Scientific Advisory Board of the German Research Center for Artificial Intelligence DFKI

Activities in National NCCR

- Head of individual project “Multimodal Access and Contents Protection” of the NCCR Project IM2 (Interactive Multimodal Information Management Systems)

Awards

- M. Liwicki received a best student paper award for his presentation “Handwriting Recognition of Whiteboard Notes” at the 12th Conference of the International Graphonomics Society, Salerno, Italy, 2005

5.6 Publications

Books and Special Issues of Journals

- Schenker, A., Kandel, A., Bunke, H., Last, M.: Graph Theoretic Techniques for Web Content Mining, World Scientific, 2005
- Basu, M., Bunke, H., Del Bimbo, A. (eds.): Syntactic and Structural Pattern Recognition, Special Section of IEEE Trans. Pattern Analysis and Machine Intelligence, 27(7), 2005

Journal Publications

- Rodriguez, W., Last, M., Kandel, A., Bunke, H.: Three-dimensional curve similarity using string matching, Robotics and Autonomous Systems, 49 (3-4), 2004, 165-172

- Günter, S., Bunke, H.: Handwritten word recognition using classifier ensembles generated from multiple prototypes, Int. Journal of Pattern Recognition and Art. Intelligence, Vol. 18, No. 5, 2004, 957-974

- Varga, T., Bunke, H.: Off-line handwriting recognition using synthetic training data produced by means of a geometrical distortion model, Int. Journal of Pattern Recognition and Art. Intelligence, Vol. 18, No.7, 2004, 1285-1302

- Günter, S., Bunke, H.: Multiple classifier systems in off-line handwritten word recognition - on the influence of training set and vocabulary size, Int. Journal of Pattern Recognition and Art. Intelligence, Vol. 18, No. 7, 2004, 1303-1320

- Dickinson, P., Bunke, H., Dadej, A., Kraetzl, M.: Matching graphs with unique node labels, Pattern Analysis and Applications 7 (3), 2004, 243-254

- Dick, S., Meeks, A., Last, M., Bunke, H., Kandel, A.: Data mining in software metrics databases, Fuzzy Sets and Systems, 145 (2004) 81-110

- Günter, S., Bunke, H.: Off-line cursive handwriting recognition using multiple classifier systems - on the influence of vocabulary, ensemble, and training set size, Optics and Lasers in Engineering 43, 2005, 437-454

- Neuhaus. M., Bunke, H.: Self-organizing maps for learning the edit costs in graph matching, IEEE Trans. Systems, Man, and Cybernetics, 35(3), 2005, 503-514

Refereed Conference Proceedings and Edited Books

- Günter, S., Bunke, H.: Ensembles of classifiers for handwritten word recognition specialized on individual handwriting styles, in Marinai, S., Dengel, A. (eds.): Document Analysis Systems IV, Proc. 6th Int. Workshop, Springer LNCS 3163, 2004, 286-297

- Schenker, A., Bunke, H., Last, M., Kandel, A.: A graph-based framework for web document mining, in Marinai, S., Dengel, A. (eds.): Document Analysis Systems IV, Proc. 6th Int. Workshop, Springer LNCS 3163, 2004, 401-412

- Günter, S., Bunke, H.: Combination of three classifiers with different architectures for handwritten word recognition, Proc. 9th Int. Workshop on Frontiers in Handwriting Recognition, 2004, 63-68

- Schlapbach, A., Bunke, H.: Using HMM based recognizers for writer identification and verification, Proc. 9th Int. Workshop on Frontiers in Handwriting Recognition, 2004, 167-172

- Zimmermann, M., Bunke, H.: N-gram language models for offline handwritten text recognition, Proc. 9th Int. Workshop on Frontiers in Handwriting Recognition, 2004, 203-208

- Varga, T., Bunke, H.: Comparing natural and synthetic training data for off-line cursive handwritten text recognition, Proc. 9th Int. Workshop on Frontiers in Handwriting Recognition, 2004, 221-225

- Neuhaus, M., Bunke, H.: Edit distance based kernel functions for attributed graph matching, in Brun, L., Vento, M., (eds.): Graph-Based Representations in Pattern Recognition, Springer, LNCS 3434, 2005, 352-361

- Irniger, Ch., Bunke, H.: Decision trees for error-tolerant graph database filtering, in Brun, L., Vento, M., (eds.): Graph-Based Representations in Pattern Recognition, Springer, LNCS 3434, 2005, 301-311

- Bunke, H., Dickinson, P., Kraetzl, M.: Recovery of missing information in graph sequences, in Brun, L., Vento, M., (eds.): Graph-Based Representations in Pattern Recognition, Springer, LNCS 3434, 2005, 312-321

- Serrau, A., Marcialis, G. L., Bunke, H., Roli, F.: An experimental comparison of fingerprint classification methods using graphs, in Brun, L., Vento, M., (eds.): Graph-Based Representations in Pattern Recognition, Springer, LNCS 3434, 2005, 281-290

- Schenker, A., Bunke, H., Last, M., Kandel, A.,: Classification and clusterings of documents using graph models, in Chen, Ch., Wang,

P. (eds.): Handbook of Pattern Recognition and Computer Vision, Word Scientific Publ. Co., 2005, 287-301

- Bunke, H., Dickinson, P., Kraetzl, M.: Comparison of two different prediction schemes for the analysis of time series of graphs, in Marques, J., Perez de Blanca, N., Pina, P. (eds.): Pattern Recognition and Image Analysis, Proc. 2nd Iberian Conference IbPRIA, Part II, Springer LNCS 3523, 2005, 99-106

- Le Saux, B., Bunke, H.: Feature selection for graph-based image classifiers, in Marques, J., Perez de Blanca, N., Pina, P. (eds.): Pattern Recognition and Image Analysis, Proc. 2nd Iberian Conference IbPRIA, Part II, Springer LNCS 3523, 2005, 147-154

- Schlapbach, A., Bunke, H.: Writer Identification Using an HMM-Based Handwriting Recognition System: To Normalize the Input or Not?, Proc. 12th Conference of the International Graphonomics Society, 2005, 138-142

- Liwicki, M., Bunke, H.: Handwriting Recognition of Whiteboard Notes, Proc. 12th Conference of the International Graphonomics Society, 2005, 118-122

- Varga, T., Kilchhofer, D., Bunke, H.: Template-based Synthetic Handwriting Generation for the Training of Recognition Systems, Proc. 12th Conference of the International Graphonomics Society, 2005, 206-211

- Bunke, H., Dickinson, P., Irniger, Ch., Kraetzl, M. Analysis of Time Series of Graphs: Prediction of Node Presence by Means of Decision Tree Learning, Proc. 4th. Int. Conf. on Machine Learning and Data Mining, 2005, 366-375

- Neuhaus, M., Bunke, H.: A Graph Matching Based Approach to Fingerprint Classification Using Directional Variance, Proc. 5th Int. Conf. on Audio- and Video-Based Biometric Person Authentication, 2005, 191-200

- Schlapbach, A., Kilchherr, V., Bunke, H.: Improving Writer Identification by Means of Feature Selection and Extraction, Proc. 8th Int. Conf. on Document Analysis and Recognition, 2005, 131-135

- Liwicki, M., Bunke, H.: Enhancing Training Data for Handwriting Recognition of Whiteboard Notes with Samples from a Different

Database, Proc. 8th Int. Conf. on Document Analysis and Recognition, 2005, 550-554

- Liwicki, M., Bunke, H.: IAM-OnDB - an On-Line English Sentence Database Acquired from Handwritten Text on a Whiteboard, Proc. 8th Int. Conf. on Document Analysis and Recognition, 2005, 956-961

- Varga, T., Bunke, H.: Tree Structure for Word Extraction from Handwritten Text Lines, Proc. 8th Int. Conf. on Document Analysis and Recognition, 2005, 352-356

- Bertolami, R., Bunke, H.: Multiple Handwritten Text Recognition Systems Derived from Specific Integration of a Language Model, Proc. 8th Int. Conf. on Document Analysis and Recognition, 2005, 521-526

6 Research Group on Theoretical Computer Science and Logic

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* with financial support from a third party

6.2 Research Projects

Logic and Computation

This very general project deals with the close connections between mathematical logic and certain parts of computer science, and emphasis is put on a proof-theoretic approach to some of the central questions in this area of research. These include the development of perspicuous and feasible logical frameworks for studying typical questions in computer science like termination and correctness of functional programs, properties of distributed systems and the like.
We study applicative theories as well as strongly typed formalisms and are interested in the connections to constructive and explicit mathematics. Furthermore, we are interested in analyzing the close connections between the complexities of computations and proofs in suitable formalizations, ranging from propositional calculi up to abstract frameworks for computations (in higher types).

Research staff: All members of the research group

Algebraic and Logical Aspects of Knowledge Processing

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: K. Brünnler, G. Jäger, N. Nussbaum, D. Probst, V. Salipante, Th. Strahm, M. Wirz

Financial support: Swiss National Science Foundation

Inference and Deduction

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

Inference and deduction play an important role in many formal and semi-formal approaches to information and knowledge. Information and knowledge, on the other hand, are concepts which are mostly used in computer science in an intuitive understanding, although there exist some fragments of a formal theory of information: information theory in the sense of Shannon, algorithmic information theory, logic of information or information flow, logic of knowledge. Each of these fragments addresses a particular aspect of the concept of information and knowledge. We plan to study further aspects of information and knowledge. These include:

- Algebraic aspects of information arising from the operations of aggregation (combination) and focusing of information.
- Modelling of structures of compatible questions or domains and the relation of information and its measures relative to particular questions or domains.
- Uncertain nature of information, the corresponding inference problems, with particular attention to statistical information.
- Dynamic nature of information and knowledge, including the passage from information to knowledge and reasoning about knowledge.

These issues will be studied in their own right, but also with the goal to establish links between them and existing fragments of a theory of information. This should be a step towards an integrated theory of information. In particular, Shannon's information measure based on entropy will be generalized in order to represent various forms of information such as constraints on possible choices or probability distributions on the possible choices.

Research staff: P. Brambilla, G. Jäger, M. Kretz, D. Steiner, R. Wehbe

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 faciliation 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: T. Burri, G. Jäger, Ph. Stouppa, Th. Studer

Financial support: Swiss National Science Foundation

ViLoLa - a Virtual Logic Laboratory

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

ViLoLa is a virtual logic laboratory centered around some basic and advanced logic-oriented modules. Starting off from the fact that logic is a crucial basis for many scientific disciplines, it addresses students with various backgrounds (e.g. computer science, mathematics, philosophy, electrical engineering etc.). ViLoLa intends to provide theoretical knowledge as well as the ability to make use of this knowledge for the solution of practically relevant examples.

Research staff: G. Jäger, U.-M. Künzi

Financial support: Swiss Virtual Campus

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.

Financial support: Swiss University Conference (CUS)

Logics for Explicit Common Knowledge

This project is complementary to the project *Inference and Deduction*, supported by the Swiss National Science Foundation. It addresses some conceptual problems in connection with the general theme of *Common Knowledge* and tries to make a genuine step forward in obtaining a better understanding of the crucial logical issues which till now have not been handled to a satisfactory degree.
More precisely, we want to set up a logical framework in which common knowledge and ways how common knowledge is obtained can be treated

- in a clear structural and proof-theoretic way, and
- with emphasis on the procedural aspects of these processes.

To achieve these aims, we want to start of from recent work of Artemov about explicit provability and proof polynomial in modal logics.

Research staff: G. Jäger, G. Ostrin

Financial support: Hasler Foundation

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, M. Wachter

Financial support: Swiss National Science 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, M. Wachter

Financial support: Swiss National Science 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, M. Wachter

Financial support: Swiss National Science Foundation

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. Jonczy, M. Wachter

Financial support: Swiss National Science Foundation

6.3 Diploma Theses

- D. Sonderegger: PLTL – Vollständigkeit und Modell-Konstruktion
- D. Spescha: ALOE – A Graphical Editor for OWL Ontologies

6.4 Ph.D. Theses

- M. Wirz: Wellordering Two Sorts: a Slow-Growing Proof Theory for Variable Separation

6.5 Further Activities

Editorial Boards

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

Technical Committees

- Research Council member of the Swiss National Science Foundation (G. Jäger)
- President of the Swiss Society for Logic and Philosophy of Science (G. Jäger)
- Secretary of the Swiss Society for Logic and Philosophy of Science (Th. Strahm)
- 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)
- PC member of the Logic Colloquium 2005 (G. Jäger)
- Expert for “Maturitätsprüfungen Mathematik” (G. Jäger, Th. Strahm, Th. Studer)

6.6 Publications

- L. Alberucci and G. Jäger, About cut elimination for logics of common knowledge, *Annals of Pure and Applied Logic 133*, 2005
- L. Alberucci and V. Salipante, On modal μ-calculus and non-well founded set theory, *Journal of Philosophical Logic 33*, 2004
- K. Brünnler, Cut Elimination for Predicate Logic inside a Deep Inference System, submitted
- K. Brünnler and D. Steiner, Finitisation for Linear Temporal Logic, submitted

- K. Brünnler and S. Lengrand, On Two Forms of Bureaucracy in Derivations, *Structures and Deduction Workshop 2005*, to appear

- M. Dürig and Th. Studer, Probabilistic ABox Reasoning: Preliminary Results, *Proceedings of Description Logics DL'05*, 2005

- R. Haenni, Towards a Unifying Theory of Logical and Probabilistic Reasoning, *ISIPTA'05, 4th International Symposium on Imprecise Probabilities and Their Applications*, to appear

- R. Haenni, Shedding New Light on Zadeh's Criticism of Dempster's Rule of Combination, *FUSION'05, 8th International Conference on Information Fusion*, to appear

- R. Haenni, Unifying Logical and Probabilistic Reasoning, *8th European Conference on Symbolic and Quantitative Approaches to Reasoning under Uncertainty, ECSQARU'05, LNAI 3571*, 2005

- R. Haenni, Using Probabilistic Argumentation for Key Validation in Public–Key Cryptography, *International Journal of Approximate Reasoning, 38*, 2005

- R. Haenni and S. Hartmann, Modeling Partially Reliable Information Sources: a General Approach based on Dempster-Shafer Theory, *Information Fusion*, to appear

- G. Jäger, Metapredicative and explicit Mahlo: a proof-theoretic perspective, *Logic Colloquium 2000*, 2005

- G. Jäger, M. Kretz and Th. Studer, Cut-free common knowledge, submitted

- G. Jäger, M. Kretz and Th. Studer, A finitary cut-free axiomatization for stratified modal fixed point logic, submitted

- G. Jäger and D. Probst, Iterating Σ-operations in admissible set theory without foundation: a further aspect of metapredicative Mahlo, *One Hundred Years of Russell's Paradox. Papers from the 2001 Munich Russell Conference*, 2004

- G. Jäger and Th. Strahm, Reflections on reflections in explicit mathematics, *Annals of Pure and Applied Logic*, to appear

- J. Jonczy and R. Haenni, Credential Networks: a General Model for Distributed Trust and Authenticity Management, *PST'05, 3rd Annual Conference on Privacy, Security and Trust*, to appear
- M. Kretz and Th. Studer, Deduction Chains for Common Knowledge, *Journal of Applied Logic*, to appear
- D. Probst, On the relationship between fixed points and iteration in admissible set theory without foundation, *Archive for Mathematical Logic 44*, 2005
- K. Stoffel and Th. Studer, Provable data privacy, *Proceedings of Conference on Database and Expert Systems Applications*, to appear
- Ph. Stouppa, A Deep Inference System for the Modal Logic S5, submitted
- Th. Strahm, A proof-theoretic characterization of the basic feasible functionals, *Theoretical Computer Science 329*, 2004
- Th. Studer, Relational representation of ALN knowledge bases, *Proceedings of Multi 2005*, 2005

7 Research Group on Software Composition

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**external PhD student

7.2 Research Projects

A Unified Approach to Composition and Extensibility

The goal of this project is to investigate means to support composability and extensibility in object-oriented languages, while reducing fragility with respect to unanticipated change. The work covers (i) *fine-grained composition* with *traits*, (ii) *coarse-grained composition* with *classboxes*, (iii) *analysis* of software systems with *formal concept analysis* and other techniques, (iv) *testing strategies*. The long-term goal is to develop the first of a new class of dynamic programming languages that are better suited to supporting software evolution than today's static programming languages. Traits offer a fine-grained mechanism for constructing classes out of reusable components. Classboxes offer a coarse-grained mechanism for managing the scope of change in complex systems. We have been able to show that by combining traits and classboxes we can dynamically extend the behaviour of a running system in a controlled way.

Research staff: All members of the research group.

Duration: Oct. 2004 - Sept. 2006

Financial support: Swiss National Science Foundation, project no. 200020-105091/1

For further details, please consult:
`http://www.iam.unibe.ch/~scg/Research/SNF04/`

RECAST: Evolution of Object-Oriented Applications

The goal of the Recast project is to support the evolution of object-oriented applications by focusing on three main directions: reverse engineering and reengineering, versions analysis, and migration towards components.
We continued the development of MOOSE, our reengineering environment. In particular now we are able to extend it easily to support new analyses such as dynamic information and evolution analysis. We plan to refine and unify its meta-model to support code generation. Our environment is now distributed with the CD of the VisualWorks distribution of Smalltalk developed by Cincom, http://www.cincom.com/smalltalk). To the best of our knowledge our environment is used by one company in Germany, Smalltalked-Visuals GmbH and consultants of other companies.

MOOSE is also used by the following research groups: LORE (Prof. Demeyer University of Antwerp), DECOMP (Prof. Wuyts, Université Libre de Bruxelles) and following researchers: Dr. Lanza (University of Lugano), Prof. K. Mens (University of Louvain-la-neuve).
We are currently working on the identification of changes and their predictability. For that purpose we built a new meta-model dedicated to evolution analysis. We investigate the characterization of packages to support the remodularization of object-oriented applications. We are also working on the identification of features using dynamic analysis.

Research staff: All members of the research group.

Duration: Oct. 2002 - Sept. 2006

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

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

Traits in C#

Traits offer a simple compositional model for building classes from groups of methods and a small amount of glue code. This project is investigating how to apply traits to statically typed programming languages, in particular C#.
We have developed a proof-of-concept implementation of traits for C# that effectively *flattens* traits away to the base language. We have also developed a formal treatment of traits for statically typed languages in the context of *featherweight java*, a calculus that captures the essential type features of Java-like languages. We have used this formalism to demonstrate that flattening traits is consistent with the underlying type system.

Research staff: S. Ducasse, O. Nierstrasz, N. Schaerli, R., Wuyts.

Duration: March 2004 - Sept. 2005

Financial support: Microsoft

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

7.3 Diploma and Masters Theses

- Thomas Bühler. Detecting and visualizing phases in software evolution. Diploma thesis, University of Bern, September 2004.
- Marc-Philippe Horvath. Automatic recognition of class blueprint patterns. Diploma thesis, University of Bern, October 2004.
- Markus Kobel. Parsing by example. Diploma thesis, University of Bern, April 2005.
- Adrian Lienhard. Bootstrapping Traits. Master's thesis, University of Bern, November 2004.
- Florian Minjat. Vers une modélisation transverse et modulaire des collaborations par couplage des traits et des classboxes. DEA, Ecole des mines de Nantes, September 2004.

7.4 Ph.D. Theses

- Gabriela Arévalo. *High Level Views in Object Oriented Systems using Formal Concept Analysis*. PhD thesis, University of Berne, January 2005.
- Matthias Rieger. *Effective Clone Detection Without Language Barriers*. PhD thesis, University of Berne, June 2005.
- Nathanael Schärli. *Traits — Composing Classes from Behavioral Building Blocks*. PhD thesis, University of Berne, February 2005.

7.5 Further Activities

Editorial Boards

Oscar Nierstrasz:

- Springer LNCS (SL2 – Programming Techniques and Software Engineering)
- ACM TOSEM (Transactions on Software Engineering and Methodology)
- Software and Systems Modeling (Springer Verlag)

Stéphane Ducasse:

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

Memberships

Oscar Nierstrasz:

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

Stéphane Ducasse:

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

Program Committees

Oscar Nierstrasz:

- PC Member of SC 2005 (Software Composition – Edinburgh, Scotland, April 9, 2005; co-located with ETAPS 2005)
- PC Member of IDM 2005 (Ingnierie Dirige par les Modles – Paris, France, Jun 30 - Jul. 1, 2005)
- PC Member of the Euromicro CBSE Track (31st Euromicro – Porto, Portugal, Aug. 30 - Sept. 3, 2005)
- PC Member of IWPSE '05 (International Workshop on Principles of Software Evolution – Lisbon, Portugal, Sept. 5-6, 2005)

Stéphane Ducasse:

- PC member of ESUG 2005 (European Smalltalk User Group Conference – Brussels, Belgium, August, 2005)
- PC member of LMO 2005 (Languages et Modèles à Objets – Berne, Switzerland, March 2005)
- PC member of UML 2005 (8th International Conference on the Unified Modeling Language – Jamaica, October 2005)
- PC member of JFDLPA (Journée Francophone sur le Développement de Logiciels Par Aspects, September 2005)
- PC member of ECOOP 2005 (European Conference on Object-Oriented Programming – Glasgow, July 2005)
- PC member of ICSM 2005 (International Conference on Software Maintenance – Bupadest, September 2005).
- PC member of ICSM 2005 (International Conference on Software Maintenance – Bupadest, Hungary, September 2005).
- PC member of SDL 2005 (International Symposium on Dynamic Languages – San Diego, USa, October 2005).
- PC member of WCRE 2005 (Working Conference on Reverse Engineering – Pittsburg, USA, November 2005).
- PC member of NetObjectDays 2005 (Erfurt, Germany, September 2005)

Alexandre Bergel:

- PC member of SC 2006 (Software Composition – Vienna, Austria, 2006)
- PC member of IWSAC 2005 (International Workshop on Software Aspects of Context – Santorini, Greece, Jul. 14, 2005)
- PC Member of the Euromicro CBSE Track (31st Euromicro – Porto, Portugal, Aug. 30 - Sept. 3, 2005)

Reviewing Activities

Oscar Nierstrasz:

- Swiss National Science Foundation,
- Netherlands Organisation for Scientific Research,
- Italian Ministry for Education University and Research,
- Australian Research Council,
- NSERC GCS 330 – Natural Sciences and Engineering Research Council of Canada, Member of the Grant Selection Committee for Computing & Information Sciences (subgroup A)
- IEEE Transactions on Software Engineering,

Stéphane Ducasse:

- ACM Transactions on Software Engineering (TSE)
- Journal of Software Evolution and Maintenance (SEM)
- Journal of Empirical Software Engineering

Invited Talks

Oscar Nierstrasz:

- Tutorial speaker at OOPSLA 2004 (“Object-Oriented Reengineering Patterns” tutorial – Vancouver, Canada, October, 2004)
- Invited speaker at UML 2004 (Oct. 11-15, 2004 – Lisbon, Portugal)
- Invited speaker at SC 2005 (Software Composition – Edinburgh, Scotland, April 9, 2005; co-located with ETAPS 2005)

Alexandre Bergel:

- Invited lecturer at the University of Bonn – Germany (Dec. 9, 2004). Title: Dynamic AOP with Dynamic Classboxes and Friends.
- Invited speaker at the Université Libre de Bruxelles, University of Antwerp and Vrije Universiteit Brussel – Belgium (June 2005).
- Talk titled “Introduction to Smalltalk” at RMLL 2005 (Rencontres Mondiales du Logiciel Libre, July 8, 2005, Dijon, France)

Hosted events

- ChaSE (ERCIM-ESF Workshop on Challenges in Software Evolution – Bern, April 12-13, 2005)
- CHOOSE Forum 2005 (Tools for Managing Software Complexity – Bern, April 11, 2005)
- LMO 2005 (Langages et Modles Objets – University of Bern, March 9-11, 2005)
- LOTS 2005 (Let's Open the Source – University of Bern, Feb 17-19, 2005)
- ECOOP 2005 PC meeting (University of Bern, Feb 10-11, 2005)

7.6 Publications

Books

- Stéphane Ducasse. *Squeak: Learn Programming with Robots*. APress, 2005. ISBN: 1-59059-491-6.

Journal Papers

- Franz Achermann and Oscar Nierstrasz. A calculus for reasoning about software components. *Theoretical Computer Science*, 331(2-3):367–396, 2005.
- Alexandre Bergel and Stéphane Ducasse. Scoped and dynamic aspects with classboxes. *L'Objet (Special Issue on JFDPA – Journée française de la programmation par aspects)*, 2005.
- Alexandre Bergel, Stéphane Ducasse, Oscar Nierstrasz, and Roel Wuyts. Classboxes: Controlling visibility of class extensions. *Computer Languages, Systems and Structures*, 31(3-4):107–126, May 2005.
- Stéphane Ducasse and Hilaire Fernandes. Squeak : un smalltalk libre multimédia. *Linux Pratique*, 1(28):18–23, March 2005.

- Stéphane Ducasse and Michele Lanza. The class blueprint: Visually supporting the understanding of classes. *IEEE Transactions on Software Engineering*, 31(1):75–90, 2005.
- Stéphane Ducasse, Nathanael Schärli, and Roel Wuyts. Uniform and safe metaclass composition. *Journal of Computer Languages, Systems and Structures*, pages 143–164, 2005.

Conference Papers

- Gabriela Arévalo, Frank Buchli, and Oscar Nierstrasz. Detecting implicit collaboration patterns. In *Proceedings of WCRE '04 (11th Working Conference on Reverse Engineering)*, pages 122–131. IEEE Computer Society Press, November 2004.
- Gabriela Arévalo, Stéphane Ducasse, and Oscar Nierstrasz. Discovering unanticipated dependency schemas in class hierarchies. In *Proceedings of CSMR '05 (9th European Conference on Software Maintenance and Reengineering)*, pages 62–71. IEEE Computer Society Press, March 2005.
- Gabriela Arévalo, Stéphane Ducasse, and Oscar Nierstrasz. Lessons learned in applying formal concept analysis. In *Proceedings of ICFCA '05 (3rd International Conference on Formal Concept Analysis)*, volume 3403 of *LNAI (Lecture Notes in Artificial Intelligence)*, pages 95–112. Springer Verlag, February 2005.
- Alexandre Bergel, Christophe Dony, and Stéphane Ducasse. Prototalk: an environment for teaching, understanding, designing and prototyping object-oriented languages. In *Proceedings of ESUG Academic Track 2004*, pages 107–130, September 2004.
- Stéphane Ducasse, Adrian Lienhard, and Lukas Renggli. Seaside — a multiple control flow web application framework. In *Proceedings of ESUG Research Track 2004*, pages 231–257, September 2004.
- Markus Gälli. PhD-symposium: Correlating Unit Tests and Methods under Test. In *5th International Conference on Extreme Programming and Agile Processes in Software Engineering (XP 2004)*, volume 3092 of *LNCS*, page 317, June 2004.
- Markus Gälli, Michele Lanza, Oscar Nierstrasz, and Roel Wuyts. Ordering broken unit tests for focused debugging. In *20th International*

Conference on Software Maintenance (ICSM 2004), pages 114–123, 2004.

- Tudor Gîrba, Stéphane Ducasse, and Michele Lanza. Yesterday's Weather: Guiding early reverse engineering efforts by summarizing the evolution of changes. In *Proceedings of 20th International Conference on Software Maintenance (ICSM 2004)*, pages 40–49. IEEE Computer Society Press, 2004.

- Tudor Gîrba, Michele Lanza, and Stéphane Ducasse. Characterizing the evolution of class hierarchies. In *Proceedings of European Conference on Software Maintenance (CSMR 2005)*, pages 2–11, 2005.

- Orla Greevy and Stéphane Ducasse. Correlating features and code using a compact two-sided trace analysis approach. In *Proceedings of CSMR 2005 (9th European Conference on Software Maintenance and Reengineering*, pages 314–323. IEEE Computer Society Press, 2005.

- Florian Minjat, Alexandre Bergel, Pierre Cointe, and Stéphane Ducasse. Mise en symbiose des traits et des classboxes : Application à l'expression des collaborations. In *Proceedings of LMO 2005*, volume 11, pages 33–46, Bern, Switzerland, 2005.

- Matthias Rieger, Stéphane Ducasse, and Michele Lanza. Insights into system-wide code duplication. In *Proceedings of WCRE 2004 (11th Working Conference on Reverse Engineering)*, pages 100–109. IEEE Computer Society Press, November 2004.

Book Chapters

- Stéphane Ducasse, Tudor Gîrba, Michele Lanza, and Serge Demeyer. Moose: a collaborative and extensible reengineering Environment. In *Tools for Software Maintenance and Reengineering*, RCOST / Software Technology Series, pages 55–71. Franco Angeli, 2005.

- Michele Lanza and Stéphane Ducasse. Codecrawler — an extensible and language independent 2d and 3d software visualization tool. In *Tools for Software Maintenance and Reengineering*, RCOST / Software Technology Series, pages 74–94. Franco Angeli, 2005.

- Oscar Nierstrasz and Franz Achermann. Separating concerns with first-class namespaces. In Robert E. Filman, Tzilla Elrad, Siobhán Clarke, and Mehmet Aksit, editors, *Aspect-Oriented Software Development*, pages 243–259. Addison-Wesley, 2005.

Technical Reports

- Stéphane Ducasse, Michele Lanza, and Laura Ponisio. A top-down program comprehension strategy for packages. Technical Report IAM-04-007, University of Berne, Institut of Applied Mathematics and Computer Sciences, 2004.
- Philippe Marschall. Detecting the methods under test in java. Informatikprojekt, University of Bern, April 2005.
- Michael Meer. A generic clustering framework for moose. Informatikprojekt, University of Berne, August 2005.
- Matthias Rieger. Experiments on language independent duplication detection. Technical Report iam-04-002, University of Bern, Institute of Applied Mathematics and Computer Science, 2004.
- David Rothlisberger. The smallbb forum system. Informatikprojekt, University of Bern, October 2004.
- Marc Stettler. Moose domain generator. Informatikprojekt, University of Bern, April 2005.

Workshop Papers

- Stéphane Ducasse and Tudor Gîrba. Being a long-living software mayor — the simcity metaphor to explain the challenges behind software evolution. In *Proceedings of CHASE International Workshop 2005*, 2005.
- Stéphane Ducasse, Tudor Gîrba, and Jean-Marie Favre. Modeling software evolution by treating history as a first class entity. In *Workshop on Software Evolution Through Transformation (SETra 2004)*, pages 71–82, 2004.
- Markus Gälli, Oscar Nierstrasz, and Stéphane Ducasse. One-method commands: Linking methods and their tests, October 2004. OOPSLA Workshop on Revival of Dynamic Languages.

- Tudor Gîrba, Stéphane Ducasse, Radu Marinescu, and Daniel Raţiu. Identifying entities that change together. In *Ninth IEEE Workshop on Empirical Studies of Software Maintenance*, 2004.
- Tudor Gîrba, Jean-Marie Favre, and Stéphane Ducasse. Using meta-model transformation to model software evolution, 2004. 2nd International Workshop on Meta-Models and Schemas for Reverse Engineering (ATEM 2004).
- Oscar Nierstrasz and Marcus Denker. Supporting software change in the programming language, October 2004. OOPSLA Workshop on Revival of Dynamic Languages.

8 Administration

University:

H. Bieri:	Member of Collegium generale
T. Braun:	Member of Kommission Informatikdienste Delegate of the University of Bern at the board of trustees of SWITCH (Vertreter der Universität Bern im Stiftungsrat SWITCH)
G. Jäger:	President of Steuergruppe Virtueller Campus Bern

Faculty:

T. Braun:	Member of Evaluationskommission Member of Strukturkommission Department Chemistry and Biochemistry
G. Jäger:	President of Strukturkommission Geowissenschaften

Institute:

H. Bieri:	Prüfungsleiter
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