UNIVERSITÄT
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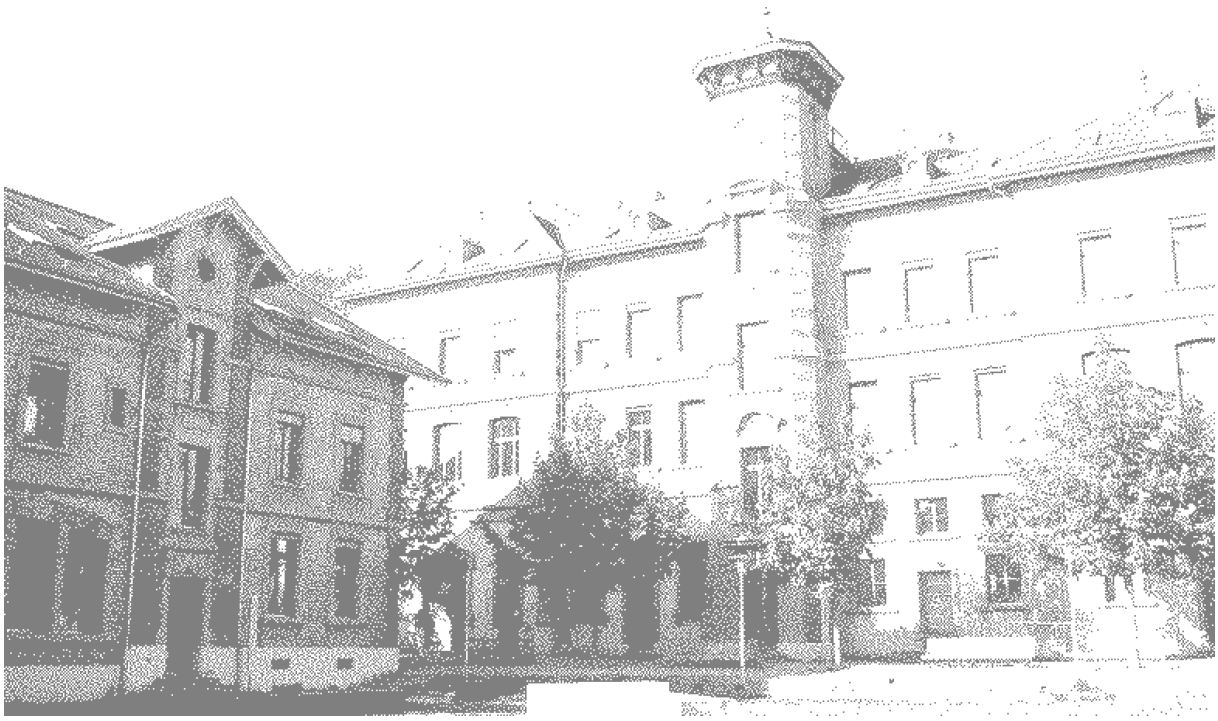
Institut für Informatik und
angewandte Mathematik
Universität Bern

www.iam.unibe.ch

IAM Annual Report 09/10



IAM Annual Report

Academic Year 2009/2010

July, 2010

Contents

1 Institute of Computer Science and Applied Mathematics (IAM)

1.1 Address

Neubrückstrasse 10, CH-3012 Bern, Switzerland
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www: http://www.iam.unibe.ch

1.2 Personnel

Board of directors

Prof. Dr. Torsten Braun; Prof. Dr. Horst Bunke; Prof. Dr. Gerhard Jäger; Prof. Dr. Oscar Nierstrasz; Prof. Dr. Matthias Zwicker.

Teaching staff

P. Brambilla; Prof. Dr. Torsten Braun; PD Dr. Kai Brünnler; Prof. Dr. Horst Bunke; Dr. Kirsten Dolfus; Prof. Dr. Gerhard Jäger; Dr. Richard McKinley; Prof. Dr. Oscar Nierstrasz; Prof. Dr. Thomas Strahm; PD Dr. Thomas Studer; Prof. Dr. Matthias Zwicker.

Director

Prof. Dr. Torsten Braun.

Head of Exams

Prof. Dr. Gerhard Jäger.

Administration

Ruth Bestgen; Bettina Choffat; Dragana Esser; Iris Keller; Susanne Thüler.

Technical staff

Peppo Brambilla; Dragan Milic (until 31.10.2009); Markus Anwander (since 1.11.2009).

Scientific staff

C. Anastasiades; M. Anwander; P. Brambilla; M. Brogle; J. Brugger; PD Dr. K. Brünnler; S. Bucheli; Dr. K. Dolfus; D. Donatsch; S. Eberhard; St. Fankhauser; A. Fischer; D. Flumini; V. Frinken; R. Goetschi; Prof. Dr. R. Haenni; P. Hurni; E. Indermühle; Dr. J. Jonczy; C. Knaus; J. Krähenbühl; A. Kuhn; Dr. R. Kuznets; Dr. A. Lienhard; W. Lo; Dr. M. Lungu; Dr. R. McKinley; D. Milic; Dr. T. Nemoto; F. Perin; L. Renggli; J. Ressia; K. Riesen; D. Röthlisberger; F. Rousselle; S. Schär; N. Schwarz; Dr. D. Spescha; T. Staub; Prof. Dr. Th. Strahm; PD Dr. Th. Studer; T. Verwaest; G. Wagenknecht; R. Wehbe; E. Wernli; Z. Zhao; R. Zumbrunnen

2 Teaching Activities

2.1 Courses for Major and Minor in Computer Science

Autumn Semester 2009

- Bachelor 1st Semester

  Einführung in die Informatik (Die Dozenten der Informatik, 5 ECTS)

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

  Programmierung 1 (Th. Strahm, 5 ECTS)

- Bachelor 3rd Semester

  Information und Logik (G. Jäger, 5 ECTS)

  Computernetze (T. Braun, 5 ECTS)

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

- Bachelor 5th Semester

  Mensch Maschine Schnittstelle (Th. Strahm, 5 ECTS)

  Künstliche Intelligenz (H. Bunke, 5 ECTS)

  Computergrafik (M. Zwicker, 5 ECTS)

- Master Courses

  Grundlagen der Mustererkennung (H. Bunke, 5 ECTS)

  Dynamic Object-Oriented Programming with Smalltalk (O. Nierstrasz, 5 ECTS)

  Sensor Networks (T. Braun, K. Dolfus, 5 ECTS)

  Computational Photography (M. Zwicker, 5 ECTS)

  Modal Fixed Point Logics (G. Jäger, 5 ECTS)

Graduate Seminar Logik und Information (G. Jäger, G. Metcalfe, K. Stoffel, U. Ultes-Nitsche, 5 ECTS)

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

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

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

Seminar: Computer Graphics (M. Zwicker , 5 ECTS)

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

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

- Service Course

  Anwendungssoftware (Th. Studer, 3 ECTS)

Spring Semester 2010

- Bachelor 2nd Semester

  Datenbanken (K. Brünnler, 5 ECTS)

  Datenstrukturen und Algorithmen (M. Zwicker, 5 ECTS)

  Rechnerarchitektur (Th. Studer, 5 ECTS)

  Programmierung 2 (O. Nierstrasz, 5 ECTS)

- Bachelor 4th Semester

  Betriebssysteme (T. Braun, 5 ECTS)

  Berechenbarkeit und Komplexität (R. McKinley, 5 ECTS)

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

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

- Bachelor 6th Semester

  Proseminare (5 ECTS)

- Master Courses

  Explicit Mathematics (G. Jäger, 5 ECTS)

  Rendering Algorithms (M. Zwicker, 5 ECTS)

  Mustererkennung 2 (H. Bunke, 5 ECTS)

  Programming Languages (O. Nierstrasz, 5 ECTS)

  Multimedia Communications (T. Braun, 5 ECTS)

  Graduate Seminar Logik und Information (G. Jäger, G. Metcalfe, K. Stoffel, U. Ultes-Nitsche, 5 ECTS)

  Seminar: Computer Graphics (M. Zwicker, 5 ECTS)

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

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

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

  Seminar: Justification Logics (G. Jäger, G. Metcalfe, 5 ECTS)

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

- Service Course

  Anwendungssoftware (P. Brambilla, 3 ECTS)

2.2 Colloquium in Computer Science

04/09/09 Dr. Kallirroe Flouri
Foundation for Research and Technology Hellas (FORTH) Heraklion, Greece
Adaptive consensus SVM training in Wireless Sensor Networks with power-aware gossip algorithms

11/09/09 Prof. Kavé Salamatian
Lancaster University, UK
On cooperative information diffusion scheme

08/10/09 Ralph Jocham
Zhlke Engineering AG in Bern
The Risks of SCRUM

27/10/09 Prof. Dr. Walter Senn
Institut für Physiologie, Universität Bern
Neural Networks: a historical perspective, viewed from Bern

02/02/10 Dr. Despoina Triantarfyllidou
VTT Technical Research Centre of Finland
Seamless TCP enhancements exploiting link-state routing, in mobile ad hoc networks

11/02/10 Richard Stallman
Free Software Foundation, Boston, USA
Copyright vs. Public

22/02/10 Dr. Marius Portmann
University of Queensland and NICTA's, Australia
Wireless Mesh Network Researach at the NICTA Queensland Lab in Brisbane

09/03/10 Prof. Edmundo Monteiro
Universidade de Coimbra, Portugal
Management and Security of Critical Infrastructures; Routing, Traffic Engineering, QoS and QoE in Mesh and Sensor Networks

21/05/10 Prof. C. Siva Ram Murthy
IIT Madras, India
Information Discovery in Wireless Sensor Networks

21/05/10 Prof. Marilia Curado
Universidade de Coimbra, Portugal
Multi-hop communication: yesterday, today and tomorrow?

2.3 Students

- Major Subject Students: HS 2009: 214, FS 2010: 193
- Minor Subject Students: HS 2009: 135, FS 2010: 124
- Ph.D. Candidates: HS 2009: 33, FS 2010: 32

2.4 Degrees and Examinations

- Habilitation: 2
- Ph.D.: 6
- Diploma: 1
- Master: 13
- Bachelor: 16
- Propädeutische Hauptfachprüfung: 0
- Completion of Minor Studies: 12 (90E: 0, 60E: 0, 30E: 8, 25E: 0, 15E: 4 (300 ECTS)
- Semester Examinations Autumn Semester 2009: 467 (1884 ECTS)
- Bachelor/Diploma/Master Theses and Computer Science Projects Autumn Semester 2009: 13 (340 ECTS)
- Semester Examinations Spring Semester 2010: 405 (1538 ECTS)
- Bachelor/Diploma/Master Theses and Computer Science Projects Spring Semester 2010: 14 (455 ECTS)

2.5 Activities

- Contributing to the “Fit in IT - Roadshow” at the Kantonsschule Baden, Baden, November 3, 2009
- Offering a full day program for the ”Tochtertag”, Bern, November 12, 2009
- Contributing to the “Fit in IT - Roadshow” at the Kantonsschule Lee, Winterthur, December 1, 2009

- Contributing to the “Fit in IT - Roadshow” at the Kantonsschule Schaffhausen, Schaffhausen, January 21, 2010
- Contributing to the “Fit in IT - Roadshow” at the Kantonale Mittelschule Uri, Altdorf, March 25, 2010
- Contributing to the “Fit in IT - Roadshow” at the Kantonsschule Zürcher Oberland, Wetzikon, May 19, 2010
- Contributing to and organization of the “Fit in IT - Roadshow” at the Institut für Informatik und angewandte Mathematik, Bern, June 18, 2010
- Offering an open day program for students of the Gymnasium Thun-Schadau and Gymnasium Seefeld Thun, Bern, June 28, 2010
- Contributing to the “Fit in IT - Roadshow” at the Collège St. Michel, Fribourg, June 29, 2010

2.6 Awards

- Faculty Prize 2009 for the Master thesis “Who Knows about That Bug? Automatic Bug Report Assignment with a Vocabulary-Based Developer Expertise Model” of Dominique Matter
- IAM Alumni Prize 2009 for the Ph.D. thesis “Classification and Clustering ov Vector Space Embedded Graphs” of Kaspar Riesen
- IAM Alumni Prize 2009 for the Master thesis “Quality of Service for Overlay Multicast Content Addressable Network” of Luca Bettosini
- IAM Alumni Prize 2009 for the Bachelor thesis, “Development and Debugging of a Whole-System VM in RPython” of Camillo Bruni

3 Computer Graphics Group

3.1 Personnel

Heads:	Prof. Dr. M. Zwicker	Tel.: +41 31 631 3301 email: zwicker@iam.unibe.ch
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	S. Schär	Tel.: +41 31 631 8955 email: schaer@iam.unibe.ch
	F. Rousselle*	Tel.: +41 31 511 29 38 email: roussell@iam.unibe.ch
	D. Donatsch*	Tel.: +41 31 511 29 37 email: donatsch@iam.unibe.ch
	W. Lo	Tel.: +41 31 511 02 29 email: wan-yen@iam.unibe.ch
Guests:	W. Y. Chang	University of California, San Diego, June – Sept. 2009

* with financial support from a third party

3.2 Overview

The Computer Graphics Group (CGG) was established in September 2008, when Prof. Zwicker joined the University of Bern as the successor of Prof. Bieri. The research of the Computer Graphics Group focuses on fundamental methods to generate and manipulate images using computers. We develop algorithms and systems for realistic and real-time rendering, and animation and modeling of three-dimensional shapes. We are also interested in novel representations for 3D geometry, such as point-based representations. Finally, we investigate signal processing techniques, in particular for multi-view 3D displays. Our research has applications in digital entertainment, multimedia, and data visualization.

Rendering

Rendering, or image synthesis, is a core problem in computer graphics. We develop algorithms for efficient, physically-based rendering. We are

also interested in rendering for interactive applications, and we investigate techniques to simulate light transport in real-time.

Animation and Modeling

Computer graphics scenes are composed of three-dimensional shapes that are stored in computer memory using mathematical representations. Our research is concerned with modeling and animating these three-dimensional shapes. We focus on developing sophisticated mathematical methods that allow for realistic shapes and motions, and intuitive user interfaces that make modeling and animation simple and efficient.

Point-Based Graphics

We are interested in novel mathematical representations of three-dimensional shapes. In our research, we show that point-based techniques are viable alternatives to conventional approaches, such as triangle meshes or parametric surfaces, for a variety of applications from rendering to modeling.

Multi-View 3D Displays

Automultiscopic displays show stereoscopic images that can be viewed from any viewpoint without special glasses. They hold great promise for the future of television and digital entertainment. We develop signal processing techniques to optimize image quality by reducing sampling artifacts and adapting the signal to the display properties. We are also interested in multi-view content creation and manipulation techniques.

3.3 Research Projects

Multi-Dimensional Sampling for Image Synthesis

In this project we address research challenges that are still limiting the capabilities of image synthesis technology. In particular, we are developing more efficient algorithms for image synthesis by studying this problem from the perspective of multidimensional sampling.
Images represent distributions of light. While light in the physical world can be interpreted as a continuous quantity, it needs to be represented

discretely for computer processing. This leads to the problem of sampling, which is at the core of this project. Computer graphics deals with various forms of sampled light to achieve realistic and efficient image synthesis. This includes, for example, the notion of light paths that store the amount of light transmitted along paths including several reflections at surfaces; the concept of transport operators that describe how light is passed between pairs of surface points; or radiance distributions that represent the light that is reflected in each direction at each surface point. All three concepts represent multidimensional functions, which means that we need multiple parameters to identify each sample. Light paths are identified by their sequence of intersection points with surfaces. The dimensionality of a light path depends on the number of intersections, but is potentially unbounded. A sample of a transport operator can be identified by a pair of surface points. A surface point is given by two parameters, hence a pair of points is four-dimensional. Radiance distributions are functions of surface locations and directions, therefore they are also four-dimensional. This is to explain why multidimensional sampling plays a central role in image synthesis.
Our research in this project focuses on two areas, realistic image synthesis and light transport for interactive rendering, which at their core involve multidimensional sampling issues. We analyse both topics from the perspective of multidimensional sampling, identify specific research challenges, and develop more efficient and flexible algorithms. Improvements of these core algorithms for image synthesis will find broad applications in computer graphics. They will reduce the resources required for realistic image synthesis, and enable more natural and effective interactive applications.

Research staff: Claude Knaus, Fabrice Rousselle, Matthias Zwicker

Financial support: Swiss National Foundation

Signal Processing for Multi-View 3D Displays

In this project we develop a multi-dimensional signal processing framework and signal processing algorithms for multi-view 3D displays. Multi-View 3D displays offer viewing of high-resolution stereoscopic images from arbitrary positions without glasses. These displays consist of view-dependent pixels that reveal a different color to the observer based on the viewing angle. Although the basic optical principles of multi-view auto-stereoscopy have been known for over a century, it is only recently that displays with

increased resolution, or systems based on multiple projectors, have made them practical.
Multi-view displays feature a number of advantages over competing autostereoscopic display technologies, such as stereo-projection systems using shuttered or polarized glasses. Most importantly, multi-view displays do not require users to wear any special glasses, which leads to a more natural and unrestricted viewing experience. They also do not require head tracking to provide motion parallax; instead, they provide accurate perspective views from any point inside a viewing frustum simultaneously. They are truly multi-user capable, since none of the display parameters needs to be adjusted to a specific individual user.
As a disadvantage, the amount of data that needs to be processed, rendered, and transmitted to such displays is an order of magnitude larger than for stereo-pair projection systems. In this project we develop techniques that aim at performing these operations as efficiently as possible based on a multi-dimensional signal processing framework for multi-view displays. This approach provides a concise tool to study various aspects of data acquisition, processing, rendering, and compression, and it promises to eliminate several drawbacks of multi-view displays that have been unresolved in the past.

Research staff: Matthias Zwicker

Acquiring 3D Surface Models of Deformable Shapes

The goal of this project is to develop algorithms for capturing and modeling deformable 3D geometry. A system that enables fast and accurate capture of moving shapes has many potential applications, for example in games, movie production, and virtual reality. This topic has recently received considerable attention specifically for capturing human performances.
Our approach assumes that surfaces are scanned using depth cameras. They are especially useful for this application because of their ability to capture detailed surface geometry. These cameras produce range scans, which measure the distance between the camera and the scene at each pixel. With depth cameras capturing at video frame rates, we can capture scans of deforming objects in real-time. This project addresses the challenging problem to produce a consistent model of the deforming shape from such a set of range scans.
Unlike static range scans, moving range scans contain both the information about the surface and how the underlying object moves. This provides

an exciting opportunity to extract both the shape and a model of the motion. A key processing step with range data is registration: the process of aligning frames to reconstruct the complete surface. This problem has been solved for static objects, but it remains unsolved for moving objects that can take different poses in each scan.
In this project, we develop algorithms to reconstruct both a surface and a motion model from a set of range scans. We assume that the object stays rigid during each scan but is allowed to move to a different pose between scans. Our approach to solve the modeling problem is to assume a certain motion model for the shape that captures all possible motions that we expect. We then solve for the model parameters to best predict the observed range scan data. Finally, the goal is to use the reconstructed model for re-posing and animating the shape. This approach promises to vastly simplify the task of generating detailed and realistic animations of complex deforming shapes.

Research staff: Will Chang, Matthias Zwicker

Interactive Motion Synthesis for Character Animation

The goal of this project is to develop algorithms for interactive character animation. Synthesizing realistic motion of human characters is a core topic in computer animation and has broad applications in virtual reality for tele-collaboration and training, computer games, and movie production.
Many of the most successful character animation techniques are based on recombining fragments of motion capture data. Motion capture data records the motion of real people captured using special cameras. To reuse captured motion data to generate new animations, fragments of the captured data are organized in so-called motion graphs. In motion graphs each graph node corresponds to a pose, and potential transitions between poses correspond to arcs in the graph. They produce natural motions because they directly reuse captured motion data, and they can generate complex motions by concatenating a large number of motion fragments. In most systems, a user needs to provide a number of constraints to specify a motion. Based on the user constraints, motion synthesis is cast as a search problem. A search algorithm finds a path through the motion graph that satisfies the user constraints while minimizing some additional cost function. There are many variations of this scheme available in the literature, describing various ways to construct motion graphs, specify constraints, concatenate and interpolate motion fragments, etc. Because the

complexity of searching for an optimal path through a motion graph is exponential to the connectivity of the graph and in the length of the desired motion sequence, it is challenging to apply these techniques for interactive applications.

In this project we develop efficient algorithms to synthesize character animations for interactive applications. Our approach is based on a bidirectional search strategy for motion synthesis using motion graphs. Our goal is to improve the search efficiency while preserving the search quality. In addition, we develop intuitive user interfaces to allow animators to easily specify desired motions. Our approach builds on a sketching metaphor, where the user controls and edits the character animation by indicating desired motions using pen strokes.

Research staff: Wan-Yen Lo, Matthias Zwicker

Introducing Stereo Effects into Cel Animations

Animated cartoons are an imaginative movie genre, often, but not only, made for children. Stereo effects could improve the visual impact of such movies, especially since children are an audience amenable to different visual experiences. New, 3D computer generated imagery (CGI) animations can directly be rendered in stereo, but old, classical cartoons cannot be converted that easily. The goal of our work is to introduce stereo effects into such cartoon animations. The necessary conversion should be easy to perform by an unexperienced user and should not require much user interaction.

In this project, we analyze the characteristics of cel animations and the differences between them and live action movies. As 3D reconstruction from single images or videos is a broad field of research, we mainly study the prominent methods to estimate depth information for a monocular video input (e.g. shape from shading, structure from motion, shape from texture, etc.) and their applicability to cel animations. We implement a conversion framework, define test cases and perform quality ratings of the visual 3D effect.

Research staff: Sonja Schär, Matthias Zwicker

3.4 Phd Theses

- William Chang: Reconstruction of dynamic articulated 3D models from range scans, University of California, San Diego (October 2009)

3.5 Master's Theses

- Michael Pfeuti: Real-time rendering of refractive objects (December 2010)

3.6 Bachelor's Theses

- Gregor Budweiser: Dual quaternion blending und inverse Kinematik (September 2009)
- Stefan Frutig: Ausmessung eines 3D Bildschirms (September 2009)
- Thomas Schär: Flüssigkeitssimulation in Echtzeit (September 2009)
- Marco Manzi: Weiche Schatten in Echtzeit-Applikationen (February 2010)

3.7 Further Activities

Conference Chairs

Matthias Zwicker

- Papers Co-Chair of Eurographics (31st Annual Conference of the European Association for Computer Graphics), May 3 – 7, 2010, Norrköping, Sweden

Editorial Boards

Matthias Zwicker

- Computer Graphics Forum: The International Journal of the Eurographics Association, Associate Editor

Conference Program Committees

Matthias Zwicker

- ACM SIGGRAPH Symposium on Interactive 3D Graphics and Games, February 19 – 21, 2010, Washington DC, USA
- Eurographics Symposium on Rendering, June 28 – 30, 2010, Saarbrücken, Germany
- IEEE Visualization, October 24 – 29, Salt Lake City, Utah, USA

Ph.D. Jury Memberships

Matthias Zwicker

- Vikas Ramachandra, Signal processing for 3D videos and displays, University of California, San Diego, September 23, 2009

Reviewing Activities

Matthias Zwicker

- Swiss National Science Foundation
- European Research Council
- Hasler Stiftung
- ACM Transactions on Graphics
- IEEE Transactions on Visualization and Computer Graphics
- IEEE Transactions on Circuits and Systems for Video Technology
- Computer Graphics Forum, The International Journal of the Eurographics Association
- Computers & Graphics, An International Journal of Systems & Applications in Computer Graphics, Elsevier

Fabrice Rousselle

- Computer Graphics Forum, The International Journal of the Eurographics Association

Invited Talks

Matthias Zwicker

- Efficiently Rendering Realistic Images, Institut für Informatik Kolloquium, Universität Zürich, September 24, 2009

3.8 Publications

Books

- Tomas Akenine-Möller and Matthias Zwicker (guest eds.): Computer Graphics Forum, 29(2), Eurographics Conference Issue, Wiley-Blackwell, 2010, ISSN 0167-7055.

Journal Publications

- Wan-Yen Lo and Matthias Zwicker: Bidirectional search for interactive motion synthesis, Computer Graphics Forum (Proc. Eurographics), 29(2):563-573, May 2010, ISSN 0167-7055.
- Vikas Ramachandra, Keigo Hirakawa, Matthias Zwicker, and Truong Nguyen: Spatio-angular prefiltering for multiview 3D displays, IEEE Trans. on Visualization and Computer Graphics, pre-print, ISSN 1077-2626.

Conference Publications

- Vikas Ramachandra, Keigo Hirakawa, Matthias Zwicker, Truong Nguyen: Spatio-angular sharpening for multiview 3D displays, Proc. IEEE Int. Conference on Acoustics, Speech, and Signal Processing, pages 750-753, 2010, ISSN 1520-6149.
- A. Lagae, S. Lefebvre, R. Cook, T. DeRose, G. Drettakis, D. S. Ebert, J. P. Lewis, K. Perlin, M. Zwicker: State of the art in procedural noise functions, Proc. of Eurographics 2010 - State of the Art Reports, pages 1-19, 2010, ISSN 1017-4656.

4 Research Group on Computer Networks and Distributed Systems

4.1 Personnel

Head:	Prof. Dr. T. Braun	Tel.: +41 31 511 2631 email: braun@iam.unibe.ch
Office Manager:	R. Bestgen	Tel.: +41 31 511 2630 email: bestgen@iam.unibe.ch
Scientific Staff:	C. Anastasiades	Tel.: +41 31 511 2635 email: anastasi@iam.unibe.ch (since 01.09.2009)
	M. Anwander*	Tel.: +41 31 511 2634 email: anwander@iam.unibe.ch
	Dr. M. Brogle*	Tel.: +41 79 407 78 58 email: brogle@iam.unibe.ch (until 31.12.2009)
	Dr. K. Dolfus*	Tel.: +41 79 771 95 11 email: dolfus@iam.unibe.ch (until 31.3.2010)
	P. Hurni*	Tel.: +41 31 511 2640 email: hurni@iam.unibe.ch
	Dr. D. Milic*	Tel.: +41 79 285 24 45 email: milic@iam.unibe.ch (until 31.10.2009)
	T. Staub*	Tel.: +41 31 511 2637 email: staub@iam.unibe.ch
	G. Wagenknecht*	Tel.: +41 31 511 2636 email: wagen@iam.unibe.ch
	Z. Zhao*	Tel.: +41 31 511 2638 email: zhao@iam.unibe.ch (since 01.10.2009)
Guests BNF - Swiss qualification program:	P. Goode*	email: goode@iam.unibe.ch (since 09.11.2009)
	M. Darriulat*	email: darriula@iam.unibe.ch (since 01.06.2010)

* with financial support from a third party

4.2 Overview

The research group for Computer Networks and Distributed Systems (Rechnernetze und Verteilte Systeme, RVS) has been active since 1998 in several areas of computer communications and distributed systems.

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

Wireless and Mobile Communication Decentralized system architectures and self-organization are fundamental concepts of future wireless and mobile communication systems. These concepts are particularly important in application scenarios such as sensor networks, mobile ad hoc networks and wireless mesh networks. There is an urgent need for research on routing and transport protocols as well as on security and management mechanisms. In sensor networks, limited energy, computing and memory resources as well as limited reliability require special forms of distributed data processing and management.

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

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

4.3 Research Projects

Middleware design for embedded networked devices

Data gathering, either for event recognition or for monitoring applications is the primary intention for sensor network deployments. In many cases, data is acquired periodically and autonomously, and simply logged onto secondary storage (e.g. flash memory) either for delayed offline analysis or for on demand burst transfer. Moreover, operational data such as connectivity information, node and network state is typically kept as well. Naturally, measurement and/or connectivity logging comes at a cost. Memory space is limited. Finding a good representative model for the data and providing clever coding of information, thus data compression, may be a means to use the available memory space to its best. In this project, we explored the design space for data compression for wireless mesh and sensor networks by profiling common, publicly available algorithms. Several goals such as low overhead in terms of utilized memory and compression time as well as a decent compression ratio have to be well balanced in order to find a simple, yet effective compression scheme. We evaluated different compression algorithms how they may be simply deployed on such nodes without any previous changes to their implementations. We can conclude from our research that there is not the one, outstanding algorithm which suits all desires. Rather, the choice has to be made according to the primary goals of the application and the restrictions posed by the utilized wireless node platform. When optimizing for speed, MiniLZO should be the choice unless resource restrictions regarding RAM memory exist. If a good compression ratio is mandatory, yet execution time and memory restriction may be disregarded, a higher order arithmetic coding algorithm is an appropriate candidate. LZW variants score well in most categories; especially the simple LZW implementation with 12bit symbols offers a solid performance in all categories. The attained values for SLZW, a LZW variant for sensor networks, were disappointing. The reasons for its failure can be accounted to the structure of the data, hindering all proposed optimizations to come to their full potential.

Research staff: Kirsten Dolfus, Torsten Braun

Financial support: Swiss National Foundation Project No. PAERP2-128767 and Swiss Association for Research in Information Technology (SARIT) supporting an ERCIM Fellowship

Efficient and Robust Overlay Networks (ERON)

The goal of the ERON (Efficient and Robust Overlay Networks) project was to develop an efficient and robust peer-to-peer message routing protocol on top of the Internet protocol. Almost all existing peer-to-peer (P2P) protocols build an overlay network using the Internet as the underlying network. Most of such protocols completely disregard the topology of the underlying network when choosing peering neighbours and making routing decisions for messages. This has the consequence that the length of the paths taken by messages through the underlying network is not optimal.
For constructing a topology aware overlay network we developed a novel protocol for building overlay networks - a distributed fisheye view. Similar to round trip time (RTT) prediction approaches, we consider end systems to be embedded in a virtual metric space. Unlike other approaches, we use only the distances (measured RTTs) to build an RTT proximity aware overlay network. Therefore, we are able to construct a fisheye view without performing the embedding. Simultaneously, we are still able to guarantee the geographical diversity of the neighbors. Once built, the fisheye views on the end systems are continuously refined as information about new potential neighbors becomes available. This makes our overlay network adaptive to changes in the network topology. To evaluate our approach, we compared it with an existing topology aware overlay network construction approach - binning. We based this comparison on RTT measurements obtained using the King RTT measurement method and from the Planet Lab all-site-ping experiment. Our evaluation shows that the overlay network built using our approach outperforms binning in terms of relative RTT stretch. We also show that for an increasing number of neighbors the performance of our approach converges towards an optimal solution.
Further, we developed NetICE9, a novel landmark-less method for embedding RTTs into virtual spaces. NetICE9 is inspired by VIVALDI, the most commonly used landmark-less approach. VIVALDI chooses its neighbors randomly and optimizes only towards one neighbor at a time. With NetICE9, we propose a solution to those drawbacks. NetICE9 significantly improves both the stability of the simulation and the precision of how RTTs are embedded into a virtual space. Our evaluation based on RTTs measured in the Internet show that NetICE9 outperforms VIVALDI in terms of stability and precision of RTT prediction. NetICE9 improves RTT prediction also compared to Global Network Positioning (GNP).
We also investigated possible applications of embedding of end systems in a virtual space. Our goal was to introduce an efficient geographic routing protocol in an overlay network. The main issue of every routing protocol

is to find a path in the overlay network between source and destination end systems. For the case, when end systems have positions in a Euclidean space, we could use geographic routing protocols such as greedy routing. The problem of greedy routing is that it can fail, if it reaches the so called local minimum of the overlay network. The local minimum is an end system within the overlay network which is surrounded by a non-convex gap. In such a case, greedy routing fails, since it is unable to make progress towards the destination of the message. In mobile ad-hoc networks such situations cannot be avoided, since end systems have limited transmission range and are dealt with by using a backup routing strategy. In an overlay network on top of the fixed Internet, where every pair of end systems can communicate directly, it is possible to avoid such situations. With the nearest neighbour convex set (NNCS), we introduced one such overlay network building strategy. By being able to construct and maintain NNCS on every end system, we obtain an overlay network, in which greedy routing is always successful. Using NNCS and combining it with fisheye overlay, we are able to obtain a very efficient unicast routing protocol within the overlay network. Another use of NNCS is building topology aware multicast trees. Such a tree is constructed by forwarding multicast messages along the reverse of the unicast paths towards the position of the sender. Based on such a multicast flooding scheme, we also defined a service discovery protocol. This service discovery protocol is able to flood all end systems (within the given diameter) with a query message. This flooding mechanism can be used in order to find different services in the vicinity of the querying end system. Such a service can be the nearest copy of a file or the nearest end systems providing computing services such as storage or CPU time. We also used the NNCS overlay network in order to simplify the task of finding QoS paths. Finding a QoS path in an overlay network implies finding at least one path consisting of end systems from the overlay network, where required QoS parameters such as RTT, bandwidth, jitter etc. are fulfilled. In general, finding such paths involves flooding the whole overlay network with messages, which try finding all possible routes. In our approach we reduce the number of peers involved by limiting the flooding to the ellipsoid within the virtual space. This ellipsoid is defined by positions of the source and the destination end systems as well as the required RTT. By doing so, we can significantly reduce the number of messages and load of the overlay network.

Research staff: Dragan Milic, Torsten Braun

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

Wireless Sensor Network Testbeds (WISEBED)

The *WISEBED* project (http://www.wisebed.eu) started in June 2008. It aims to provide a multi-level infrastructure of interconnected testbeds of large-scale wireless sensor networks for research purposes, pursuing an interdisciplinary approach that integrates the aspects of hardware, software, algorithms, and data. In the *WISEBED* project, researchers are investigating new theoretical approaches on algorithms, mechanisms and protocols. The project's main aim is to make the distributed laboratories available to the European scientific community, so that other research groups can take advantage of a federated testbed infrastructure. Our research group is involved as task leaders in several work packages.
Within WP1 (*Hardware Installation*) we installed a persistent testbed of 20 TelosB and 5 MSB430 sensor nodes, using a wired backbone of mesh nodes for code distribution and retrieval of debug/trace data. The sensor/mesh network spans over 5 floors of the building Neubrückstrasse 10 in Bern. The TelosB and MSB430 sensor nodes are attached via USB cables to the mesh nodes, which also form the power supply. Using this reliable backbone infrastructure, all nodes can be reset, rebooted and reprogrammed remotely within a short time.
Within WP2 (*Testbed operation, access, and management*) we have designed and implemented the *Testbed Management Architecture for Wireless Sensor Networks (TARWIS)*, a generic experiment and testbed management system for wireless sensor network testbeds. TARWIS has been integrated into the testbed federation and is to-date already the management system of various testbeds of the WISEBED project partners, as e.g. University of Lancaster and Technical University of Delft. Three major releases of the software have been published between July 2009 and July 2010, each with additional functionality. The current version is TARWIS 3.0. TARWIS consists of a server and GUI component. The TARWIS server prepares and controls the experiment execution steps and connects to the individual sensor nodes. The system is independent of the type and the operating system of the sensor nodes, but relies on a set of APIs to access the sensor nodes and obtain experiment data.
Real-world environmental data is of major importance when it comes to real-world evaluation of protocol mechanisms. With yet no existing standard for real-world experimental data, the WISEBED project has devel-

oped the WiseML language, a XML-based XSD Schema that offers a uniform description of experiment trace data. Within WP4, we have been integrating WiseML into the TARWIS system. Every experiment data is described in WiseML and can be downloaded from the web-based GUI interface.
Within WP3, we have implementated the OLSR routing protocol and the Diffie-Hellman Key-Exchange algorithm for the Shawn simulator. We are working on implementations of DYMO routing and Eschenauer-Gligor key management algorithms.

Research staff: Philipp Hurni, Markus Anwander, Gerald Wagenknecht, Zhongliang Zhao, Christoph Knecht, Thomas Staub, Torsten Braun

Financial support: EU project ICT-2008-224460

Traffic Adaptivity in Wireless Sensor Networks (TRAWSN)

Energy efficiency is a major concern in the design of Wireless Sensor Networks (WSNs) and their communication protocols. As the radio transceiver typically accounts for a major portion of a WSN node's power consumption, researchers have proposed Energy-Efficient Medium Access (E^2-MAC) protocols that switch the radio transceiver off for a major part of the time. Today's E^2-MAC protocols are able to deliver little amounts of data with a low energy footprint, but introduce severe restrictions with respect to throughput and latency. Regrettably, they yet fail to adapt to varying traffic loads and changing requirements of the imposed traffic load.
Strong restrictions with respect to throughput and latency may be tolerable in networks with low quality of service requirements. However, many event-based scenarios require reasonable quality of service during short periods of intense activity, and a high energy-efficiency and lower quality of service during long periods of inactivity. Such scenarios can be found, e.g., in monitoring systems for the healthcare system, in disaster-aid-systems, but also in the broad area of environmental monitoring. Once an event has been triggered, e.g., a patient's pulse monitor registering anomalies in a hospital or geriatric clinic, the MAC protocol's primary objective should shift towards delivering good quality of service (high throughput, low delay) rather than saving energy. In such scenarios, today's existing E^2-MAC protocols do not provide reasonable flexibility, as most of them were designed under the assumption of very sparse low-rate traffic.
We intend to bridge this gap with the TRAWSN project, which started in

October 2009. Within TRAWSN, we have developed MaxMAC, an energy-efficient MAC protocol for sensor networks designed for WSN scenarios with varying traffic conditions. While MaxMAC operates similarly as existing E^2-MAC protocols in low traffic situations, it is able to maximally adapt to changes in the network traffic load at run-time. Taking advantage of design principles for E^2-MAC protocols developed over the last couple of years, the protocol introduces novel run-time adaptation techniques to effectively allocate the costly radio transceiver truly in an *on demand* manner. The protocol reaches the throughput and latency of energy-unconstrained CSMA in situations of high-traffic, yet exhibiting a high energy-efficiency in periods of sparse traffic.
We have published novel simulation-based results of the MaxMAC protocol in Europe's most selective conference on WSNs in spring 2010, and have since then been working on a real-world prototype implementation of MaxMAC.

Research staff: Philipp Hurni, Torsten Braun

Financial support: Swiss National Foundation Project No. 200021-126718/1

Wireless Mesh Networks for Interconnection of Remote Sites to Fixed Broadband Networks

This technology transfer project aimed to evaluate the usefulness and feasibility of wireless mesh networks (WMNs) in meteorological and environmental monitoring applications. We identified application and usage scenarios for WMNs and investigated whether and how the used hardware and software components are appropriate for the intended application scenarios and whether the application requirements such as bandwidth, delay, reliability, recovery times etc. can be met. Potential weaknesses and bottlenecks have to be identified.
The project was carried out with three industry/application partners with different interests in the project. MeteoSwiss, the operator of the meteorological network of Switzerland, has approximately 130 weather stations with environmental sensing equipment deployed all over Switzerland. WMNs are a possibility to interconnect weather stations or even some sensors with an own broadband network. WMNs would allow SWITCH, the provider of the Swiss national research and education network, to extend the geographic coverage of their fiber network and to offer broad-

band services to remote locations that are not close to the fiber network. PCEngines provided us with their mesh nodes and expect to extend their business with the achieved results.

We investigated whether wireless mesh networks (WMNs) are appropriate for connecting sensor networks or other devices deployed in remote areas, where no fixed network access is available, to a fixed broadband network. To support a variety of application scenarios, the WMN must meet reliability requirements and high bandwidth over distances of several 10 km, e.g., by using directional radio transmission.

During the project we deployed a WMN based on IEEE 802.11a/h (5 GHz) in the area of Neuchâtel and Payerne. A weather station at Payerne has been connected to the fibre backbone with an access point at Neuchâtel. A camera sensor has been made accessible over a wireless mesh access network to the Internet by two redundant paths in order to provide robustness and reliability. The network consisted of six nodes, of which the four intermediate nodes were solar-powered. One end point of the wireless mesh access network was mounted on the roof of the University of Neuchâtel. It acted as gateway to the fibre backbone. The other end point was mounted on the roof of SwissMeteo at Payerne and operated as gateway to the sensor network with an IP capable camera and another mesh node. Intermediate nodes equipped with solar equipment (panels, chargers, and batteries) were placed on the hills in the area to interconnect Payerne with the fiber network in Neuchâtel.

Our evaluations showed that our setup can provide a network service for transmitting weather data. The network stability can be further improved, e.g. by replacing or extending the used routing daemon to avoid route fluctuations, replacing the MadWiFi wireless driver with its successor driver, and additional self-healing mechanisms.

With the experiences gained from the deployment, we are now able to easily dimension further outdoor wireless mesh networks (approved equipment, possible distances, planning and setup time).

Research staff: Thomas Staub, Markus Anwander, Marc Brogle, Paul Kim Goode, Kirsten Dolfus, Torsten Braun

Financial support: Swiss Commission for Technology and Innovation under grant number 9795.1 PFES-ES and the industry partners (SwissMeteo, SWITCH, and PCEngines)

Wireless Mesh Networks

Besides the technology transfer project, there are further activities in the area of WMNs such as extensions of the framework for administration and deployment of WMNs (ADAM), finalization of a WMN virtualization framework (VirtualMesh), an '"easy-to-install" temporary network for video communication (OViS), and using wireless mesh technology for unmanned aerial vehicles.

Administration and Deployment of Adhoc Mesh networks (ADAM) provides mechansims for fault-tolerant and safe deployment and configuration of WMNs as well as a build system for cross-compilation of tailored embedded Linux distribution with a very small footprint for the mesh nodes. ADAM has been extended to support OpenMesh Mini nodes. We updated the software with newer Linux kernels and the new wireless driver architecture. In addition, we collaborated with the VTT Technical Research Centre of Finland to integrate their passive QoS measurement tool QoSMeT into ADAM.

VirtualMesh is an emulation framework for WMNs and provides new testing facilities during the development of architectures and protocols for WMNs. It virtualizes a complete wireless mesh network by using host virtualization (XEN) for the mesh nodes and redirecting their wireless network traffic to a network simulator. Traffic interception and handling within the simulator is transparent for upper layers. Therefore, the final application software can be tested in various scenarios with the help of the simulation model. Our latest modifications of VirtualMesh include the support for multi-channel communication.

On-site Video System (OViS) reduces the number of costly visits of engineers on construction sites by providing an easily deployable temporary video communication infrastructure. At the time of electrical installations, electrians may face unknown problems or plan deviations, which require consultations with a remote engineer. Unfortunately, in-building communication networks, as well as electrical installations, are set up very lately in the building construction process. In addition, communication over cellular mobile networks is often not possible inside buildings, especially in basements. To support telepresence of the engineer, a temporary communication network has to be deployed. Our approach is to use a WMN. We developed a first prototype of OViS, which provides an '"easy-to-install"' temporary communication network. The user is guided through the deployment process and the network is automatically configured by OViS. We are currently enhancing this system to support multi-channel communication.

Finally, we started the development of an airborne communication network. A WMN is automatically deployed using *unmanned aerial vehicules (UAVs)*. They provide communication facilities in case of natural disasters such as floodings or earthquakes. The UAVs with the wireless mesh nodes position themselves automatically to enable communication between two distant communication peer (airborne relay) or to cover a defined area (airborne mesh). For our prototype network, we connected small wireless mesh nodes to quadrocopters by a serial interface and implemented an API to steer and coordinate the UAVs over the IEEE 802.11g-based WMN. Our research focus is on automatic deployment, replacement and routing. The prototype will be further used in the ORMAN project.

Research staff: Thomas Staub, Paul Kim Goode, Reto Gantenbein, Stefan Ott, Simon Morgenthaler, Markus Anwander, Torsten Braun

Opportunistic Routing for highly Mobile Ad-hoc Networks (ORMAN)

The ORMAN project started in April 2010 and aims to investigate, develop and evaluate novel routing and forwarding schemes based on opportunistic routing schemes. Existing mobile ad-hoc networks protocols are not appropriate for the highly mobile node application scenario such as unmanned aerial vehicles (UAVs) ad hoc networks, because a packet source is unable to calculate a complete route to the destination. Opportunistic routing protocols do not calculate an end-to-end communication path, forwarding choice is performed on a hop-by-hop basis. Therefore, an opportunistic routing scheme seems to be a possible solution for the highly mobile application scenario. We aim to develop a geographic opportunistic routing protocol exploiting the multi-channel capabilities to reduce interference and maximize throughput. In order to maintain a basic connectivity required to apply the routing protocol, we aim to develop an appropriate topology control protocol that not only achieves connectivity but also minimizes interference. Besides the simulation work, real implementations using unmanned aerial vehicles and interconnected test-beds has to be performed in order to prove feasibility of the developed concepts.
In the past months, we mainly worked on the implementation of multi-channel support for the latest Linux kernel version, since the mesh node we are using is loaded with the latest Linux OS kernel version and currently the only available multi-channel support is for older kernels. In the

next couple of months, we plan to develop and evaluate the topology control protocol and the multi-channel opportunistic routing protocol in the network simulator OMNET++. The purpose of the simulation is to provide a proof-of-concept and to investigate scalability issues. Before we use the routing protocol in a real UAV test-bed, we plan to do the emulation first, with the purpose of testing the real implementation in a safe environment. Simulation and emulation are used for evaluating scalability in larger scenarios, while the real test-bed can be used for proof-of-concept evaluation and investigating forwarding via a smaller set of nodes.

Research staff: Zhongliang Zhao, Torsten Braun

Financial support: Swiss National Foundation Project No. 200021-130211/1

Testbed for Mobile and Internet Communications

Our research group maintains its own comprehensive and heterogeneous testbed network for various purposes. 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 protocols and architectures in realistic environments. The testbed also forms a productive network of Linux PCs and provides the storage capacity and CPU power for many of our research group's projects. The ERON project for example used the available CPU power to compute embeddings of network distances into Euclidean space. An educational laboratory network for students' training is also connected and has been extended by the OSLab project. Our research group also takes part in PlanetLab (http://planetlab.org) and GpENI (https://wiki.ittc.ku.edu/gpeni/). PlanetLab is an open platform for developing, deploying, and accessing planetary-scale services. For this purpose we are hosting three PlanetLab nodes in our testbed network. GpENI is a distributed set of sites, interconnected at layer 2 (or layer 2 tunnels) to enable experimentation at layers 3 and higher. For this purpose we are hosting three GpENI nodes, two GpENI routers and one GpENI controller node in our testbed network. We have installed several Cisco routers terminating several L2TP connections in order to provide a major European GpENI concentrator point (https://wiki.ittc.ku.edu/gpeni/Image:GpENI-Euro-topo.png). Our research group owns a number of sensor nodes: Embedded Sensor Board (ESB), Modular Sensor Board (MSB), tmote SKY nodes, BTnodes, TelosB nodes,

and micaZ nodes. A testbed consisting of multiple mesh nodes (17 x PCEngines WRAP, 10 x Meraki Mini, 6 x PCEngines ALIX) has been deployed throughout the building and work environment of the research group. In this testbed, multi-channel communication, multi-path routing and the management framework ADAM have been evaluated. The testbed is currently used by several student projects.

Research staff: All members of the RVS research group

4.4 Ph.D. Theses

- Marc Brogle: IP Multicast using Quality of Service enabled Overlay Networks, May, 2010
- Dragan Milic: Error Resilient and Robust Overlay Networks, May, 2010

4.5 Master and Diploma Theses

- Luca Bettosini: Quality of Service for Overlay Multicast Content Addressable Network (CAN), August, 2009
- Peter Siska: A Framework for the Evaluation of Flow-Based Traffic Monitoring Systems, March, 2010
- Dominic Papritz: MCFTP (Multicast File Transfer Protocol): Simulation and Comparison with BitTorrent, May, 2010
- Reto Gantenbein: VirtualMesh: An Emulation Framework for Wireless Mesh Networks in OMNeT++, June, 2010

4.6 Bachelor Theses and Computer Science Projects

- Sebastian Barthlomé: OM-QOS: Quality of Service for Overlay Multicast applied to the NICE Protocol, August, 2009
- Roger Strähl: Benutzung Statistischer Eigenschaften von RTT-Messungen zur Eingliederung von Netzwerken in Virtuelle Räume, September, 2009

- Ulrich Bürgi: REPOM: Reputation Based Overlay Multicast, December, 2009
- Simon Morgenthaler: Management Extensions for Wireless Mesh and Wireless Sensor Networks, March, 2010
- Christine Müller: Implementation of a Multichannel Multiradio Prototype on Embedded Linux, May, 2010
- Cyrill Schluep: Porting Contiki to the BTnode Sensor Node Platform, June, 2010

4.7 Further Activities

Memberships

- Chair of ERCIM working group on eMobility (Torsten Braun)
- Secretary General of ERCIM working group on eMobility (Marc Brogle)
- Erweitertes Leitungsgremium Fachgruppe “Kommunikation und Verteilte Systeme”, Gesellschaft für Informatik (Torsten Braun)
- Integration Coordination Board and Steering Committee of EU IST project Wisebed (Torsten Braun)
- SWITCH Stiftungsrat (Torsten Braun)
- SWITCH Stiftungsratsausschuss (Torsten Braun)
- SWITCH AAI Advisory Committee (Thomas Staub)
- Kuratorium Fritz-Kutter-Fonds (Torsten Braun)
- Expert for Diploma Exams at Fachhochschule Bern (Torsten Braun)
- Management committee member of the COST Action IC 0804 Energy-Efficiency In Large Scale Distributed Systems (Torsten Braun)
- Management committee member of the COST Action IC 0906 Wireless Networking for Moving Objects (WiNeMO) (Torsten Braun)

Editorial Boards

Torsten Braun

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

Conference Chairs

- TPC Chair of 1st International Conference on Energy-Efficient Computing and Networking, April 13-15, 2010, Universität Passau, Germany (Torsten Braun)
- General Chair of 4th ERCIM Workshop on eMobility, May 31, 2010, Lulea University of Technology, Lulea, Sweden (Torsten Braun)

Conference Program Committees

Torsten Braun

- 35th EUROMICRO Conference on Software Engineering and Advanced Applications (SEAA), Patras, Greece, August 27-29, 2009
- 9th International Conference on Next Generation Wired/Wireless Networking NEW2AN 2009, St. Petersburg, Russia, September 15-18, 2009.
- 12th Asia-Pacific Network Operations and Management Symposium, APNOMS 2009, Jeju Island, South Korea, September 23, 2009
- 3rd IEEE International Workshop on Enabling Technologies and Standards for Wireless Mesh Networking, MeshTech'09, Macau SAR, P.R. China, October 12, 2009
- International Conference on Ultra Modern Telecommunications, St. Petersburg, Russia, October 12-14, 2009
- 34th IEEE Conference on Local Computer Networks (LCN), Zürich, October 20-23, 2009

- 4th Fachgespräch Future Internet, GI/ITG-Fachgruppe ”Kommunikation und Verteilte Systeme” (KuVS), Zürich , November 9-10, 2009
- 1st International Conference on Multimedia Information NEtworking and Security, MINES 2009, Wuhan, China, November 18-20, 2009
- 5th IEEE Broadband Wireless Access Workshop, co-located with IEEE GLOBECOM 2009, Honolulu, Hawai, USA, November 30, 2009
- IEEE Global Communications Conference 2010 (IEEE GLOBECOM 2010), Honoulu, USA, November 30 - December 4, 2009
- 5th ACM International Conference on emerging Networking EXperiments and Technologies, ACM CoNEXT 2009, Rome, Italy, December 1-4, 2009
- 7th European Conference on Wireless Sensor Networks, EWSN 2010, Coimbra, Portugal, February 17-19, 2010
- 3rd International Workshop on OMNeT++, Torremolinos, Malaga. Spain, March 19, 2010
- IEEE Wireless Communications & Networking Conference (WCNC), Sydney, Australia, April 18-21, 2010
- 3rd IFIP/IEEE International Workshop on Bandwidth on Demand and Federation Economics (BoD 2010), Osaka, Japan, April 23, 2010
- 9th IFIP International Conferences on Networking, Madras, Chennai, India, May 10-14, 2010
- IEEE International Communications Conference (ICC 2010), Cape Town, South Africa, May 23-27, 2010
- 12th IFIP/IEEE International Symposium on Integrated Network Management, Dublin, Ireland, May 23-27, 2010
- 8th International Conference on Wired/Wireless Internet Communications (WWIC), Lulea, Sweden, June 1-3, 2010
- 5th Fachgespräch Future Internet, GI/ITG-Fachgruppe ”Kommunikation und Verteilte Systeme” (KuVS), Stuttgart, June 9, 2010
- 18th IEEE International Workshop on Quality of Service (IWQoS 2010), Tsinghua University, Beijing, China, June 16-18, 2010

- 4th International Conference on Autonomous Infrastructure, Management and Security (AIMS 2010), Zürich, Switzerland, June 21-25, 2010
- 3rd International Workshop on Sensor Networks (SN 2010), in conjunction with IEEE ICDCS 2010, Genoa, Italy, June 21-25, 2010
- 2nd International Workshop on Communication Technologies for Vehicles (Nets4Cars 2010), Northumbria University, Newcastle, UK, July 21-23, 2010
- 3rd Workshop on Economic Traffic Management (ETM), Amsterdam, The Netherlands, September 6, 2010

Ph.D. Jury Memberships

Torsten Braun

- Ph.D. Thesis, Thomas Bocek, Universiät Zürich
- Ph.D. Thesis, Carolin Latze, Universität Freiburg
- Ph.D. Thesis, Steffen Ortmann, Brandenburgische Technische Universität Cottbus, Germany

Reviewing Activities

Torsten Braun

- The Croucher Foundation
- European Commission Framework Programme 7
- Hasler Foundation
- Belgian agency for Innovation by Science and Technology
- Research Council of Norway
- Swiss National Science Foundation
- Qatar National Research Fund
- Indian Institute of Technology Madras

- Universita di Pisa
- ACM Transactions on Multimedia Computing Communications
- IEEE Network Magazine
- IEEE Journal on Selected Areas in Communications
- IEEE Transactions on Aerospace and Electronic Systems
- IEEE Transactions on Mobile Computing
- IEEE Transactions on Network and Service Management
- IEEE Transactions on Parallel and Distributed Systems
- IEEE Transactions on Vehicular Technology
- VLSI Journal, Elsevier
- Journal of Network and Computer Applications, Elsevier
- Adhoc Networks, Elsevier
- Telecommunication Systems Journal
- International Journal of Network Management, Wiley

Invited Talks and Tutorials

- Torsten Braun: Interconnecting Sensors via Wireless Mesh Networks to the Internet, 25th Nordunet Conference, Copenhagen, Denmark, September 16, 2010
- Torsten Braun, Philipp Hurni: A Testbed Management Architecture for Wireless Sensor Networks (TARWIS), University of Karlsruhe, Germany, October 5, 2009
- Torsten Braun: Energie-effiziente und adaptive Medienzugriffsprotokolle für drahtlose Sensornetze, Kolloquium Telekommunikationsnetze, TU München, Germany, November 2, 2009
- Torsten Braun: Vom ARPANET zum Internet of Things, Computer Science in Education, PH Bern, November 16, 2009

- Thomas Staub: Telematiknetze, Kaderkurs Telematik, Bundesamt für Bevölkerungsschutz, Schwarzenburg, Switzerland, November 24, 2009
- Thomas Staub: Réseaux de communications, cours de cadres pour chefs de la télématique, Office fédéral de la protection de la population, Schwarzenburg, Switzerland, March 16, 2010
- Torsten Braun: Telematiknetze, Kaderkurs Telematik, Bundesamt für Bevölkerungsschutz, Schwarzenburg, Switzerland, March 16, 2010
- Torsten Braun: An Adaptive and Energy-efficient MAC Protocol for Wireless Sensor Networks, invited lecture, University of Coimbra, Portugal, June 14, 2010
- Torsten Braun: Wireless Sensor Network Testbeds, Fireweek, Barcelona, Spain, invited talk in session on New Frontiers on Future Internet Research, July 1, 2010

4.8 Publications

Publications submitted in the academic year 2009/2010 and appearing in 2010/2011 or later are not listed.

Books

- Marc Brogle, Evgeny Osipov, Torsten Braun, Geert Heijenk: Proceedings of the Fourth ERCIM Workhop on eMobility, University of Technology, Lulea, Sweden, May 31, 2010, ISBN 978-91-7439-103-9
- Torsten Braun, Michel Diaz, Jose Enriquez-Gabeiras, Thomas Staub: Chinese Translation: End-to-end Quality of Service Support over Heterogeneous Networks (EuQoS), Publishing House of Electronics Industry, Beijing, P.R.China, February 01, 2010, ISBN 978-7-121-10170-0

Reviewed Journal and Conference Papers

- Philipp Hurni, Torsten Braun, Markus Anwander: Evaluation of WiseMAC and Extensions on Wireless Sensor Nodes, Springer

Telecommunication Systems Journal, Vol. 43, Nr. 1-2, September 04, 2009, ISSN 1018-4864

- Torsten Braun, Marc Heissenbüttel, Tobias Roth: Performance of the beacon-less routing protocol in realistic scenarios, Ad Hoc Networks, Vol. 8, Nr. 1, January 01, 2010, pp. 96–107, ISSN 1570-8705

- Markus Wälchli, Reto Zurbuchen, Thomas Staub, Torsten Braun: Backbone MAC for Energy-constrained Wireless Sensor Networks, The 34th IEEE Conference on Local Computer Networks (LCN), Zürich, Switzerland, October 20–23, 2009, pp. 77–84, ISBN 978-1-4244-4488-5

- Markus Wälchli, Torsten Braun: Building Intrusion Detection with a Wireless Sensor Network, First International Conference on Ad Hoc Networks, Niagara Falls, Ontario, Canada, September 23–25, 2009, pp. 607–622, ISBN 978-3-642-11722-0

- Marc Brogle, Luca Bettosini, Torsten Braun: Quality of Service for Multicasting in Content Addressable Networks, 12th IFIP/IEEE International Conference on Management of Multimedia and Mobile Networks and Services (MMNS'09), Telecom Italia Future Centre, Venice, Italy, October 26–27, 2009, pp. 170–175, ISBN 978-3-642-04993-4

- Dragan Milic, Torsten Braun: FISHEYE: Topology Aware Choice of Peers for Overlay Networks, The 34th IEEE Conference on Local Computer Networks (LCN), Zürich, Switzerland, October 20–23, 2009, pp. 467–474, ISBN 978-1-4244-4488-5

- Marc Brogle, Luca Bettosini, Dragan Milic, Torsten Braun: A Performance Comparison of Native IP Multicast and IP Multicast Tunneled through a Peer-to-Peer Overlay Network, 2009 International Workshop on Peer-To-Peer Networking (P2PNet'09) at International Conference on Ultra Modern Telecommunications (ICUMT) 2009, St. Petersburg, Russia, October 12–14, 2009, pp. 1–6, ISBN 9781-4244-3941-6

- Philipp Hurni, Torsten Braun: On the Adaptivity of today's Energy-Efficient MAC Protocols under varying Traffic Conditions, International Conference on Ultra Modern Telecommunications (ICUMT) 2009, St. Petersburg, Russia, October 12–14, 2009, pp. 1–8, ISBN 9781-4244-3941-6

- Marc Brogle, Dragan Milic, Torsten Braun: Multicast-Middleware der Universität Bern, Schweiz, resultierend aus EU FP6 IST IP "EuQoS", PIK - Praxis der Informationsverarbeitung und Kommunikation, Vol. 32, Nr. 3, October 05, 2009, pp. 176–178, ISSN 0930-5157

- Marc Brogle, Sebastian Barthlomé, Torsten Braun: Quality of Service for Multicasting using NICE, 25th Symposium On Applied Computing (ACM SAC 2010), Sierre, Switzerland, March 22–25, 2010, pp. 670–677, ISBN 978-1-60558-639-7

- Philipp Hurni, Torsten Braun: MaxMAC: a Maximally Traffic-Adaptive MAC Protocol for Wireless Sensor Networks, 7th European Conference on Wireless Sensor Networks, Coimbra, Portugal, February 17–19, 2010, ISBN 978-3-6421-1916-3

- Philipp Hurni, Torsten Braun: An Energy-Efficient Broadcasting Scheme for Unsynchronized Wireless Sensor MAC Protocols, The Seventh International Conference on Wireless On-demand Network Systems and Services, Kranjska Gora, Slovenia, February 03–5, 2010, ISBN 978-1-4244-6059-5

- Philipp Hurni, Gerald Wagenknecht, Markus Anwander, Torsten Braun: A Testbed Management Architecture for Wireless Sensor Network Testbeds (TARWIS), 7th European Conference on Wireless Sensor Networks (EWSN), Coimbra, Portugal, February 17–19, 2010, ISBN 978-989-96001-3-3

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- Torsten Braun: Das Internet der Zukunft, Informatik-Spektrum, Vol. 33, Nr. 2, February 01, 2010, pp. 103–105, ISSN 0170-6012

- Torsten Braun: Geschichte und Entwicklung des Internets, Informatik-Spektrum, Vol. 33, Nr. 2, February 01, 2010, pp. 201–207, ISSN 0170-6012

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- Marc Brogle, Andreas Rüttimann, Torsten Braun: Quality of Service for Overlay Multicast in Chord, 15th IEEE Symposium on Computers and Communications (ISCC2010), Riccione, Italy, June 22–25, 2010, pp. 734–737, ISBN 978-1-4244-7755-5

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- Thomas Staub, Reto Gantenbein, Torsten Braun: VirtualMesh: An Emulation Framework for Wireless Mesh and Ad-Hoc Networks in OMNeT++, SIMULATION: Transactions of the Society for Modeling and Simulation International, Special Issue on Software Tools, Techniques and Architectures for C, Thousand Oaks, CA, USA, July 02, 2010, ISSN 1741-3133

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- Marc Brogle, Sabina Serbu, Dragan Milic, Markus Anwander, Philipp Hurni, Christian Spielvogel, Claire Fautsch, Derin Harmanci, Lucas Charles, Heiko Sturzrehm, Gerald Wagenknecht, Torsten Braun, Thomas Staub, Carolin Latze, Ronny Standtke: BeNeFri Summer School 2009 on Dependable Systems, Münchenwiler, Switzerland, September 08, 2009, IAM-09-006

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- Mesut Gunes, Philipp Hurni, et al.: Final Hardware Installation, WISEBED Deliverable D1.3, June, 2010

- Geoff Coulson, Gerald Wagenknecht, Markus Anwander, et al.: Report on the Integration of the Software Infrastructure, WISEBED Deliverable D2.3, June, 2010

- Sandor Fekete, Zhongliang Zhao, et al.: Second set of Algorithms Implementation and Library Integration, WISEBED Deliverable D3.2, June, 2010

- Koen Langendoen, Philipp Hurni, et al.: Second Set of Real Test-Bed Experiments and Simulation Scenarios, WISEBED Deliverable D4.2, June, 2010

- Stefan Fischer, Philipp Hurni, et al.: Second Report on Dissemination and Joint Research Activities, WISEBED Deliverable D5.2, June, 2010
- Kirsten Dolfus, Torsten Braun: An Evaluation of Compression Schemes for Wireless Networks, Universität Bern, Institut für Informatik und angewandte Mathematik, Bern, Switzerland, May 24, 2010, IAM-10-0003

5 Research Group on Computer Vision and Artificial Intelligence

5.1 Personnel

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	E. Indermühle*	Tel: +41 31 631 33 27 email: eindermu@iam.unibe.ch
	K. Riesen*	Tel: +41 31 631 86 99 email: riesen@iam.unibe.ch (until 31.12.09)
Guests:	Prof. T. Kuboyama	Gakushuin University, Tokyo, Japan August – September, 2009
	J. Gibert	Universitat Autonòma de Barcelona, Spain March – May, 2010
	N. Sidère	University François Rabelais, Tours, France March – April, 2010

* with financial support from a third party

5.2 Overview

Since 1984, the FKI group has been working on various topics in pattern recognition, machine vision, and computational intelligence. One of the current subject areas is document image analysis with a special focus on handwriting recognition. Furthermore, we are working in the field of structural pattern recognition, where we aim at developing methods to extend and improve current algorithms for clustering and classification using non-vectorial object representations.

5.3 Research Projects

Document Image Analysis and Understanding

A variety of problems occurring in the context of document image analysis are being investigated. These include the processing and analysis of both machine printed and handwritten documents. Current focus is on handwriting recognition, particularly on general text recognition and the use of natural language processing techniques for both on-line and off-line handwriting data. Currently, the problem of text/non-text distinction in online documents and the application of handwriting recognition on mediaeval documents are studied. Furthermore, semi-supervised learning for handwriting recognition is under investigation. Some of these activities are carried out as part of the Swiss National Science Foundation Project "HisDoc: Historical Document Analysis, Recognition, and Retrieval".

Research staff: A. Fischer, V. Frinken, E. Indermühle

Structural Pattern Recognition

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

Research Staff: K. Riesen, S. Fankhauser

5.4 Phd Theses

- Riesen, K.: Classification and Clustering of Vector Space Embedded Graphs (October 2009)

5.5 Master Theses

- Aebischer, M.: Graph Matching mit dem Algorithmus von Ullmann – Implementation und Experimente (Mai 2010)
- Keller, A.: Word Spotting in Handwritten Text (June 2010)

5.6 Honors and Awards

- H. Bunke received the K.S. Fu Award of the International Association for Pattern Recognition 2010 for ”Pioneering Work on Syntactic and Structural Pattern Recognition“
- H. Bunke received the ICDAR Outstanding Achievements Award of the International Association for Pattern Recognition in 2009
- A. Fischer, A. Keller, V. Frinken und H. Bunke received a best Scientific Paper Award for their contribution ”HMM-based word spotting in handwritten documents using subword models“ at the 20th International Conference on Pattern Recognition, Istanbul, Turkey, 2010

5.7 Further Activities

Editorial Boards

H. Bunke

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

Membership in Committees

H. Bunke

- Program Committee Member "DICTA 2009 (Digital Image Computing Techniques and Applications)", Melbourne, Australia, December 1 – 3, 2009
- Program Committee Member "ACM SAC (25th ACM Symposium on Applied Computing)", Sion, Switzerland, March 22 – 26, 2010
- Program Committee Member "MCS 2010 (9th International Workshop on Multiple Classifier Systems)", Cairo, Egypt, April 7 – 9, 2010
- Program Committee Member "ANNPR 2010 (4th IAPR International Workshop on Artificial Neural Networks in Pattern Recognition)", Cairo, Egypt, April 11 – 13, 2010
- Program Committee Member "DAS 2010 (9th IAPR International Workshop on Document Analysis Systems)", Boston, USA, June 7 – 9, 2010

Invited Talks at International Conferences

H. Bunke

- MJCAI 2009 (Malaysian Joint Conference on Artificial Intelligence), Kuala Lumpur, Malaysia, July 14 – 16, 2009
- ICDAR 2009 (International Conference on Document Analysis and Recognition), Barcelona, Spain, July 26 – 29, 2009
- DICTA 2009 (Digital Image Computing Techniques and Applications), Melbourne, Australia, December 1 – 3, 2009
- ANNPR 2010 (4th IAPR International Workshop on Artificial Neural Networks in Pattern Recognition), Cairo, Egypt, April 11 – 13, 2010

Additional Activities

H. Bunke

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

5.8 Publications

Books and Special Editions of Journals

- Bunke, H., Villanueva, J. J., Sanchez, G., Otazu, X. (eds.): Progress in Computer Vision and Image Analysis, World Scientific, 2009

- Cheriet, M., Bunke, H., Hu, J., Kimura, F., Suen, Ch. (eds.): New Frontiers in Handwriting Recognition, Special Issues of Pattern Recognition, Vol. 42, No. 12, 2009

- Riesen, K., Bunke, H.: Graph Classification and Clustering Based on Vector Space Embedding, World Scientific, 2010

Journal Publications

- Neuhaus, M., Riesen, K., Bunke, H.: Novel kernels for error-tolerant graph classification, Spatial Vision, Vol. 22, No. 5, 425 – 441, 2009

- Liwicki, M., Bunke, H.: Feature selection for HMM and BLSTM based handwriting recognition of whiteboard notes, Int. Journal of Pattern Recognition and Art. Intelligence Vol. 23, No. 5, 2009, 907 – 923

- Liwicki, M., Bunke, H.: Combining diverse on-line and off-line systems for handwritten text line recognition, Pattern Recognition 42 (12), 2009, 3254 – 3263

- Riesen, K., Bunke, H.: Graph classification based on vector space embedding, Int. Journal of Pattern Recognition and Art. Intelligence, Vol. 23, No. 6, 2009, 1053 – 1081

- Liwicki, M., Bunke, H., Pittman, J., Knerr, S.: Combining diverse systems for handwritten text line recognition, Machine Vision and Applications, 2009

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- Liwicki, M., Schlapbach, A., Bunke, H.: Automatic gender detection using on-line and off-line information, Pattern Analysis and Applications, 2010

- Fornes, A., Llados, J., Sanchez, G., Otazu, X., Bunke, H.: A combination of features for symbol-independent writer identification in old music scores, Int. Journal on Document Analysis and Recognition, 2010

- Ferrer, M., Valveny, E., Serratosa, F., Riesen, K., Bunke, H.: Generalized median graph computation by means of graph embedding in vector spaces, Pattern Recognition 43 (4), 2010, 1642 – 1655

Papers in Refereed Conference Proceedings and Chapters in Edited Books

- Riesen, K., Bunke, H.: Feature ranking algorithms for improving classification of vector space embedded graphs, Jiang, X., Petkov, N. (Eds.): Computer Analysis of Images and Patterns, Springer, LNCS 5702, 377 – 384, 2009

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- Frinken, V., Peter, T., Fischer, A., Bunke, H., Do, T.M.T., Artieres, T.: Improved handwriting recognition by combining hidden Markov models, recurrent neural networks, and conditional random fields, Jiang, X., Petkov, N. (Eds.): Computer Analysis of Images and Patterns, Springer, LNCS 5702, 189 – 196, 2009

- Ferrer, M., Valveny, E., Serratosa, F., Bunke, H.: Graph-based k-means clustering: a comparison of the set versus the generalized median graph, Jiang, X., Petkov, N. (Eds.): Computer Analysis of Images and Patterns, Springer, LNCS 5702, 342 – 350, 2009

- Fischer, A., Wüthrich, M., Liwicki, M., Frinken, V., Bunke, H., Viehhauser, G., Stolze, M: Automatic transcription of handwritten medieval documents, Proc. of the 15th Int. Conf. on Virtual Systems and Multimedia, VSMM, 2009, 137 – 142

- Indermühle, E., Bunke, H., Shafait, F., Breuel, T.: Text versus non-text distinction in online handwritten documents, Proc. 25th Annual ACM Symposium on Applied Computing, 3 – 8, 2010

- Riesen, K., Jiang, X., Bunke, H.: Exact and inexact graph matching: methodology and applications, in Aggarwal, C.C., Wang, H. (eds.): Managing and Mining Graph Data, Springer, 217 – 247, 2010

- Frinken, V., Fischer, A., Bunke, H.: Combining neural networks to improve performance of handwritten keyword spotting systems, in N. El Gayar, J. Kittler, F. Roli (eds.): Multiple Classifier Systems, MCS 2010, Springer LNCS 5997, 215 – 224, 2010

- Lee, W.-J., Duin, R., Bunke, H.: Global versus local structures for building graph-based multiple classifier systems, in N. El Gayar, J. Kittler, F. Roli (eds.): Multiple Classifier Systems, MCS 2010, Springer LNCS 5997, 155 – 164, 2010

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- Indermühle, E., Liwicki, M., Bunke, H.: IAMonDo-database: an online handwritten document database with non-uniform contents, Proc.9th Int. Workshop on Document Analysis Systems, DAS, 2010 ACM Digital Library, 97 – 104, 2010

- Riesen, K., Bunke, H.: On dissimilarity embedding of graphs in vector spaces, in Chen, C.H. (ed.): Handbook of Pattern Recognition and Computer Vision, 4th Edition, World Scientific, 47 – 72, 2009

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6 Research Group on Theoretical Computer Science and Logic

6.1 Personnel

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* with financial support from a third party

6.2 Overview

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

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

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

approaches. In addition, abstract computations and computable knowledge are being investigated.

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

6.3 Research Projects

A Proof Theory for Modal Fixed Point Logics

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

1. Whenever possible we plan to develop such systems together with syntactic cut elimination procedures. If possible, we aim for traditional sequent systems in Gentzen style, but if needed we will also employ ideas from richer proof theoretic formalisms such as the display calculus or deep inference.

2. On the other hand, if no cut-free systems exist for modal fixed point logics, we hope to gain a better understanding of why they do not exist. In this case we are interested in good syntactic approximations.

The development of a proof theory for modal fixed point logics is an important theoretical contribution to the understanding of inference and deduction in these logics, and thus in particular a relevant underpinning of

specification and verification of information systems. It is central ground work concerning the procedural aspects of frameworks dealing with information.

Research staff: K. Brünnler, G. Jäger, R. Wehbe

Financial support: Hasler Foundation

Algebraic and Logical Aspects of Knowledge Processing

In this project, we employ and set up conceptual frameworks, in particular, theories relating classical mathematics with constructive mathematics and feasible mathematics. Thereby we always emphasize the computational properties and complexities of our formalisms. We use proof theory as our main tool for analyzing the constructive and computational content of various formalisms and aim at further exploiting the proofs as computations paradigm. Besides the traditional subsystems of first- and second-order arithmetic and (admissible) set theory, we will focus on theories of explicit mathematics, operational set theories, and theories of partial truth.

Research staff: S. Eberhard, G. Jäger, J. Krähenbühl, T. Nemoto, D. Spescha, Th. Strahm

Financial support: Swiss National Science Foundation

Structural Proof Theory and the Logic of Proofs

The Logic of Proofs was developed by S. Artemov in the nineties in order to solve a problem posed by K. Gödel in the thirties. It is based on the notion of a so-called ”proof polynomial”, which allows to talk about proofs inside of the logical language. Because of that it has found numerous applications in the areas of epistemic logic, verification systems and foundations of functional programming languages. Epistemic logic is the study of knowledge. Here the Logic of Proofs allows to reason not only about knowledge, but also about the evidence from which we obtain the knowledge. Verification is used to ensure the correctness of computational systems. Here the Logic of Proofs allows to reason about the correctness of the verifier itself. The Logic of Proofs also led to foundations of functional programming languages in which the execution itself can be part of the program, in a certain sense.

Even though the field has been growing rapidly, there still are areas which are not well understood. In particular, it is not known how to design proof polynomials for logics with so-called ”fixed points”. This is unfortunate, because this includes important logics such as epistemic logics with common knowledge and various temporal logics. Common knowledge is a central concept in epistemic logic. It describes the fact that not only everybody knows a fact, but also everybody knows that everybody knows this fact, and everybody knows that everybody knows that... and so on. That we should go at a green light and stop at a red light, for example, is common knowledge among car drivers. Temporal logics, on the other hand, can reason about time and are central in the verification of the correctness of computational systems.
The lack of proof polynomials for fixed points in particular means that there is no formal setting in which evidence-based knowledge and common knowledge can be studied together. Also, there is no evidence-based formal setting for reasoning about time. This is the first problem we want to attack.
Also, the relationship between proof polynomials and the so-called cut elimination is not well understood. Cut elimination is arguably the most important operation on proofs. Crudely speaking it transforms a short creative proof into one that is long and not creative. Among many other things this ensures that proofs can be found even without creativity, such as by a computer. The study of cut elimination in the presence of proof polynomials is the second problem we want to attack.

Research staff: K. Brünnler, S. Bucheli, R. Goetschi, G. Jäger, R. Kuznets

Financial support: Swiss National Science Foundation

Computational Proof Theory

This is a joint research project of the TIL group and the Department of Mathematical Logic and Theory of Algorithms in Moscow. Both groups have a strong background in mathematical logic - in particular proof theory, provability logic and general modal logics - and expertise in applying concepts and techniques of mathematical logic in connection with recent developments in (theoretical) computer science. Among the interests of both groups are the attempts to analyze existing formal systems in order to classify their expressive as well as proof-theoretic powers and to design

new and more flexible formal frameworks. In doing this, interesting results about computational and logical complexities (lower and upper bounds) of algorithms developed within these frameworks can be obtained frequently. Although working towards similar aims, the research traditions of Moscow and Bern are quite distinct.
Berns approach is rooted in traditional Gentzen- and Schütte-style (infinitary) proof theory and the proof-theoretic analysis of subsystems of second order arithmetic, set theory, explicit mathematics and type systems and still pursuing this line. Moscow school of logic has its roots in the works of Kolmogorov, Novikov and Markov. It is traditionally strong in constructive logic and mathematics, algorithmic problems in algebra, various non-classical logics and their semantical and computational aspects, and in descriptive complexity and complexity of algorithms.
The following three research streams address topics of mutual interests:

1. Provability algebras, metapredicativity and impredicativity
2. Functionality and common knowledge in justification logic
3. Structurally enhanced proof-theory for modal and substructural logics

It is expected that the combination and integration of the conceptual approaches and methods of both groups will allow to clarify the general landscape and to solve some long-standing open problems.

Research staff: J. Brugger, K. Brünnler, G. Jäger, R. Kuznets, Th. Strahm, Th. Studer

Financial support: SBF (Staatssekretariat für Bildung und Forschung)

Computational structure of Classical Duality

The Curry-Howard correspondence, also known as the proofs-as-programs correspondence, is the observation that logical proofs and computer programs are two ways of presenting the same mathematical objects. This project aims to extend the scope of the correspondence in two important directions: on the logical side, towards capturing classical logic, the logic used in natural and mathematical reasoning, and on the computational side to the idea of a “process“; a program which interacts with many other programs by passing messages.

Background: In the 1930s, Alonzo Church developed a calculus (the lambda calculus) a language for writing down what we now call computable functions. At the same time Gerhard Gentzen was developing natural deduction; a language for writing down formal proofs. Both these languages were conceived as tools for exploring the foundations of mathematics, with the advent of computer science, representations of computable functions became a more practicle concern. Lambda calculus was the inspiration for Lisp, the first functional programming language. Meanwhile, William Alvin Howard discovered a link between logic and functional programming: natural deduction proofs could be seen themselves as terms of the lambda calculus. In other words, a proof is a kind of computation, and a very well-behaved kind at that. This observation, known as the Curry-Howard correspondence, has led and continues to lead to an enormous body of theoretical and practical work in computer science and logic.
Goals of the project: Computer science has developed much since its inception, and we no longer think of computer problems as simply calculating a function, but more as interacting with a complex, varying environment comprised of users and other programs. The lambda calculus is unsuited for representing such programs, and other calculi (called process calculi) are used instead to reason about them. These calculi lack the elegant theoretic underpinning enjoyed by the lambda calculus. On the other hand, natural deduction fails to faithfully represent a fundamental reasoning mode: the ability to recognise that a statement is the same as its double negation. This property of logic is called ”Duality”. A much better calculus for reasoning under duality, called the sequent calculus, was also developed by Gentzen, but its computational meaning has been difficult to discern.
This project aims to extend the proofs as programs correspondence by representing proofs using duality within a new, theoretically inspired language of processes.

Research staff: R. McKinley

Financial support: Swiss National Science Foundation

Logic and Computation

This very general project deals with the close connections between mathematical logic and certain parts of computer science, and emphasis is put on a proof-theoretic approach to some of the central questions in this area

of research. These include the development of perspicuous and feasible logical frameworks for studying typical questions in computer science like termination and correctness of functional programs, properties of distributed systems and the like.
We study applicative theories as well as strongly typed formalisms and are interested in the connections to constructive and explicit mathematics. Furthermore, we are interested in analyzing the close connections between the complexities of computations and proofs in suitable formalizations, ranging from propositional calculi up to abstract frameworks for computations (in higher types).

Research staff: All members of the research group

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

Financial support: Swiss National Science Foundation

6.4 Habilitation Theses

- K. Brünnler: Nested Sequents

- Th. Studer: Proof-Theoretic Contributions to Modal Fixed Point Logics

6.5 Ph.D. Theses

- J. Jonczy: Generic Frameworks for the Analysis of Dependable Systems: Algebraic Path Problems, Reliability, and Diagnostics
- D. Spescha: Weak Systems of Explicit Mathematics

6.6 Master and Diploma Theses

- J. Brugger: Proof-theoretic Aspects of Weak König's Lemma
- S. Eberhard: Aspekte beweisbar totaler Funktionen in applikativen Theorien
- J. Krähenbühl: Justifying Induction on Modal mu-Formulae
- R. Zumbrunnen: Ontological Questions about Operational Set Theory

6.7 Bachelor Thesis

- Patrik Rauber: Interpreting the LOOP, WHILE and GOTO Pseudo Programming Language Models

6.8 Further Activities

Editorial Boards

- Member of the editorial board of Archive of Mathematical Logic (G. Jäger)
- Member of the editorial board of Logica Universalis (G. Jäger)
- Member of the consulting board of Dialectica (Th. Strahm)
- Member of the editorial board of International Journal of Approximate Reasoning (R. Haenni)
- Member of the editorial board of The Reasoner (R. Haenni)

Technical and Research Committees

- Research Council Member of the Swiss National Science Foundation (G. Jäger)
- Member of the Steering Committee of the Platform Mathematics, Astronomy and Physics (MAP) of the Swiss Academy of Sciences (G. Jäger)
- Member of the Scientific Council of the European Association for Computer Science Logic (G. Jäger)
- PC Member, Fixed Points in Computer Science 2010 (G. Jäger)
- PC Member, Classical Logic and Computation 2010 (R. McKinley)
- Co-Chair, Proof, Computation, Complexity PCC 2010 (K. Brünnler, Th. Studer)
- Organizer, Gentzen Systems and Beyond, Satellite Workshop of Tableaux 2009 (K. Brünnler)
- Expert for Maturitätsprüfungen Mathematik und Informatik (G. Jäger, Th. Studer)
- President of the Swiss Society for Logic and Philosophy of Science (Th. Strahm)
- Secretary of the Swiss Society for Logic and Philosophy of Science (Th. Studer)
- Swiss representative in the International Union of History and Philosophy of Science (Th. Studer)

6.9 Publications

- L. Alberucci and A. Facchini, The modal μ-calculus hierarchy over restricted classes of transition systems, *Journal of Symbolic Logic 74*, 2009
- S. Bucheli, R. Kuznets and Th. Studer, Two Ways to Common Knowledge, in: *Proceedings of the 6th Workshop on Methods for Modalities (M4M-6 2009)*, ed. by T. Bolander and T. Braüner, Elsevier, 2010

- S. Bucheli, R. Kuznets, and Th. Studer, Explicit Evidence Systems with Common Knowledge, *Technical Report, arXiv.org*, 2010

- S. Bucheli, R. Kuznets, B. Renne, J. Sack, and Th. Studer, Justified Belief Change, submitted

- K. Brünnler, How to Universally Close the Existential Rule, in: *Proceedings of Logic for Programming, Artificial Intelligence and Reasoning LPAR 2010*, ed. by G. Fermüller and A. Voronkov, Springer, to appear

- K. Brünnler, R. Goetschi and R. Kuznets, A Syntactic Realization Theorem for Justification Logics, in: *Proceedings of Advances in Modal Logic AiML 2010*, ed. by L. Beklemishev, V. Goranko, and V. Shehtman, College Publications, 2010

- K. Brünnler and Th. Studer (editors), Proceedings of Proof, Computation, Complexity PCC 2010, International Workshop, *Technical Report*, 2010

- R. Haenni, J. W. Romeijn, G. Wheeler, and J. Williamson, Logical relations in a statistical problem, in: *Foundation of the formal Sciences VI, Reasoning about Probabilities and Probabilistic Reasoning, volume 16 of Studies in Logic*, ed. by B. Löwe, E. Pacuit, and J. W. Romeijn, College Publications, 2009.

- G. Jäger, Operations, sets and classes, in: *Logic, Methodology, and Philosophy of Science: Proceedings of the Thirteenth International Congress*, ed. by C. Glymour, W. Wei and D. Westerstahl, College Publications, 2009

- G. Jäger, Modal Fixed Point Logics, in: *Logics and Languages for Reliability and Security*, ed. by J. Esparza, B. Spanfelner and O. Grumberg, vol. 25, IOS Press. NATO Science for Peace and Security Series - D: Information and Communication Security, 2010

- G. Jäger and J. Krähenbühl, Σ^1_1 choice in a theory of sets and classes, in *Ways of Proof Theory*, ed. by R. Schindler, Ontos Verlag, 2010

- G. Jäger and D. Probst, The Suslin operator in applicative theories reconsidered, submitted

- G. Jäger and Th. Studer, A Buchholz Rule for Modal Fixed Point Logics, submitted
- R. Kuznets, Self-Referential Justifications in Epistemic Logic, *Theory of Computing Systems 46*, 2010
- R. Kuznets and S. Buss, Lower Complexity Bounds in Justification Logic, submitted
- R. McKinley, The alpha-epsilon calculus, in: *Proceedings of Structures and Deduction 09, workshop associated to ESSLLI*, ed. by M. Parigot and L. Strassburger, 2009
- R. McKinley, Expansion nets: proof-nets for propositional classical logic, *Logic for Programming, Artificial Intelligence and Reasoning LPAR 2010*, ed. by G. Fermüller and A. Voronkov, Springer, to appear
- Th. Strahm, Weak theories of operations and types, in *Ways of Proof Theory*, ed. by R. Schindler, Ontos Verlag, 2010
- Th. Strahm and S. Feferman, Unfolding finitist arithmetic, *Review of Symbolic Logic*, to appear
- Th. Studer, Privacy Preserving Modules for Ontologies, in: *Proceedings of Perspectives of System Informatics PSI'09, volume 5947 of LNCS*, ed. by A. Pnueli, I. Virbitskaite, and A. Voronkov, Springer, 2010

7 Research Group on Software Composition

7.1 Personnel

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*with financial support from a third party

7.2 Overview

Complex software systems must continuously change if they are to remain useful. The Software Composition Group carries out research in (1) programming language design, and (2) software reengineering with the goal of facilitating the development of flexible, open software systems. In both cases we are investigating mechanisms and techniques that enable the

graceful evolution of software systems by putting change at the center of the software process.

7.3 Research Projects

Bringing Models Closer to Code

Software models are notoriously disconnected from source code. At the start of a software development project, the emphasis is on eliciting system requirements and defining domain and architectural models. Once development commences, the original models become disconnected from the code that they describe. It becomes increasingly difficult to reestablish traceability links as crucial knowledge of design decisions and user features are implicit in the code.
In this project we investigate the problem of bringing models closer to code along several paths.

- *Hermion* is an IDE that integrates static and dynamic information concerning applications under development. In this way, the run-time model of the application is more closely tied to the static model of the source code. Changes to the run-time model are accurately represented in Hermion as it permanently analyzes the running application.

- *Senseo* extends the concepts of Hermion by visually representing the run-time model of an application in the IDE, for instance by integrating interactive ring charts of the calling context tree of methods into the IDE. Senseo also improves the understanding and the navigation of run-time models by hyper-linking dynamically collaborating artifacts in the IDE perspectives.

- *Helvetia* is a framework for developing embedded domain specific languages that integrate with the tools of the host programming language. Helvetia has been used to develop a series of high-level domain specific languages that can be freely mixed with the host language, thus bridging the gap between code and domain models.

- *Pinocchio* is an open language system that provides reflective access to its entire implementation. Whereas conventional language implementations do not provide access to the virtual machine level, Pinocchio provides a high-level model to access to all aspects of its own implementation.

- *Reflectivity* is a framework providing fine-grained structural and behavioural reflection. We are using and extending Reflectivity to explore ways of embedding high-level requirements in code to automatically generate required behaviour in a context-dependent way. For example, instead of cluttering concurrent applications with synchronization code, we specify high-level safety and liveness constraints and generate the needed synchronization code where and when it is needed.

- *Codemap* extends development tools with spatial representations of software. Putting all elements of a software system on a spatial map helps development teams to establish a better mental model of their system. Given that map, developers may use spatial clues to navigate and understand their system and they may share their development activities with co-workers to increase team awareness.

Research staff: All members of the research group.

Duration: Oct. 2008 – Sept. 2010

Financial support: Swiss National Science Foundation,
Project #200020-121594

For further details, please consult:
`http://scg.unibe.ch/research/snf08`

Enabling the evolution of J2EE applications through reverse engineering and quality assurance

Enterprise applications are complex software products that manipulate large persistent datasets and interact with the user through vast and complex user interfaces. For their implementation, technologies like the Java 2 Platform Enterprise Edition (J2EE) are used and they rely on a conglomerate of different programming languages and specification formats (*e.g.*, Java, XML, SQL).
In this context, applying existing reverse engineering and quality assurance techniques fails because these analyses are typically conceived for object-oriented systems and hence focus only on the Java source code. To address this limitation we conduct a systematic study in reverse engineering and quality assurance of J2EE applications taking their idiosyncrasies into account.

During the past year we worked together with an industrial partner on investigating problems that are specific to J2EE. To analyze one of their systems, we developed a meta-model that complements the Java code information with information present in the XML descriptors. We used this information to detect problems such as unsafe and unnecessary database transactions. Another analysis derived from our meta-model is to detect the relations and dependencies between the database and the Java source code.
To support the analysis of the deployment strategy an extension of the meta-model is in development to include information from the build configuration files. The objective is to enable a new kind of clustering of the source code elements from the point of view of the deployment. By exposing which group of classes are deployed together the developers will have an instrument to enhance the deployment strategies while supporting the overall comprehension of the Java Enterprise application itself.

Research staff: All members of the research group.

Duration: Oct. 2007 – Sept. 2010

Financial support: Hasler Foundation (project no. 2234).

For further details, please consult:
`http://scg.unibe.ch/research/hasler07`

7.4 Ph.D. Theses

- David Röthlisberger. *Augmenting IDEs with Runtime Information for Software Maintenance*. PhD thesis, University of Bern, May 2010.

7.5 Master's Theses

- David Erni. Codemap—improving the mental model of software developers through cartographic visualization. Master's thesis, University of Bern, January 2010.
- Marcel Haerry. Augmenting eclipse with dynamic information. Master's thesis, University of Bern, May 2010.
- Lea Hänsenberger. Defect isolation as responsibility of the framework — automated API migration from JUnit to JExample. Master's thesis, University of Bern, September 2009.

- Sandro De Zanet. Grammar generation with genetic programming — evolutionary grammar generation. Master's thesis, University of Bern, July 2009.

7.6 Bachelor's Theses and Computer Science Projects

- Florian S. Gysin. Trust this Code? — improving code search results through human trustability factors. Bachelor's thesis, University of Bern, March 2010.

7.7 Awards

- ACM Student Research Competition (SRC 2010) for Florian Gysin's Bachelor work, *Improved social trustability of code search results*
- Ernst Denert-Stiftung Prize for Software Engineering for Adrian Lienhard's PhD thesis, *Dynamic Object Flow Analysis*

7.8 Further Activities

Editorial Boards and Steering Comittees

Oscar Nierstrasz:

- Journal of Object Technology (Editor-in-Chief)
- Springer LNCS – SL2 – Programming Techniques and Software Engineering (Series Editor)
- ACM TOSEM – Transactions on Software Engineering and Methodology (Associate Editor)
- SARIT – Swiss Association for Research in Information Technology (Board Member)
- AITO – Association Internationale pour les Technologies Objets (Member)
- CHOOSE – Swiss Group for Object-Oriented Systems and Environments (Board Member)

- ESEC – European Software Engineering Conference (Steering Committee Member)
- MoDELS – International Conference on Model Driven Engineering Languages and Systems (Steering Committee Member)
- SC – Software Composition Symposium (Steering Committee Member)
- Moose Association (Board Member)

Program Committees

Oscar Nierstrasz:

- PC Member of TOOLS 2010 (48th International Conference on Objects, Models, Components, Patterns – Malaga, Spain, June 28 - July 2, 2010)
- PC Member of RAM-SE 2010 (7th ECOOP Workshop on Reflection, AOP and Meta-Data for Software Evolution, colocated with ECOOP 2010 – Maribor, Slovenia, July 22, 2010)
- PC Member of Suite 2010 (2nd Intl. Workshop on Search-driven development: Users, Infrastructure, Tools and Evaluation. Colocated with ICSE 2010, Cape Town, South Africa, May 1st, 2010)
- PC Member of WETSoM 2010 (Workshop on Emerging Trends in Software Metrics. Colocated with ICSE 2010, Cape Town, South Africa, May 4th, 2010)
- PC Member of OOPS 2010 (Special track on Object-Oriented Programming Languages and Systems at SAC 2010 – Sierre/Lausanne, Switzerland, Mar 22-26, 2010
- PC Member of the FAMOOSr 2009 (3rd Workshop on FAMIX and Moose in Reengineering; Colocated with WCRE 2009, Lille, France, Oct 13-16, 2009)
- PC Member of FOSD 2009 (1st International Workshop on Feature-Oriented Software Development – Colocated with Models/GPCE/SLE 2009, Denver CO, USA, Oct 4-6 2009)

Adrian Kuhn:

- Co-organizer of DYLA 2010 (Dynamic Languages and Applications) at TOOLS 2010, June 28, Malaga, Spain.
- Co-organizer of SUITE 2010 (Workshop on Search-driven Development) at ICSE 2010, 1 May 2009, Cape Town, South Africa.
- PC member of ICSM 2010 (International Conference on Software Maintenance) in the ERA Track (Early Research Achievements)
- PC member of WASDETT 2010 (Academic Software Development Tools and Techniques)
- PC member of PCODA 2010(Program Comprehension through Dynamic Analysis)

Lukas Renggli:

- PC Member of IWST 2010 (International Workshop on Smalltalk Technologies – Collocated with ESUG 2010, Barcelona, Spain, September 13, 2010).
- PC Member of DSAL 2010 (International Workshop on Domain-Specific Aspect Languages – Collocated with AOSD 2010, Rennes and Saint Malo, France, March 15, 2010).

David Röthlisberger:

- PC Member of Smalltalks 2010 (4th Argentinian Smalltalk Conference – Entre Rios, Argentina, November 11, 2010).

Niko Schwarz:

- PC Member of DYLA 2010 (4th Workshop on Dynamic Languages and Applications, Colocated with 48th Intl Conf on Objects, Models, Components and Patterns, Malaga, Spain, June 28, 2010)

Reviewing Activities

Oscar Nierstrasz:

- ACM Transactions on Programming Languages and Systems (TOPLAS)
- ACM Transactions on Software Engineering and Methodology (TOSEM)

- Elsevier Information and Computation
- Elsevier Science of Computer Programming (SCP)
- IEEE Software
- IEEE Transactions on Software Engineering (TSE)
- Informatica
- Wiley Journal of Software Maintenance and Evolution: Research and Practice (JSME)

Adrian Kuhn:

- TOSEM (Transactions on Software Engineering and Methodology), ACM
- AOSD 2010 (International Conference on Aspect-Oriented Software Development)

Adrian Lienhard:

- TOOLS 2010 (International Conference on Objects, Models, Components, Patterns).

Fabrizio Perin:

- TOOLS 2010 (International Conference on Objects, Models, Components, Patterns).
- ICSM 2010 (International Conference on Software Maintenance).

Lukas Renggli:

- MODELS 2010 (International Conference On Model Driven Engineering Languages And Systems).
- RAM-SE 2010 (Workshop on Reflection, AOP and Meta-Data for Software Evolution).
- TOOLS 2010 (International Conference on Objects, Models, Components, Patterns).
- ECOOP 2010 (European Conference on Object-Oriented Programming).

- OOPS 2010 (Object Oriented Programming Languages and Systems).

Jorge Ressia:

- TOOLS 2010 (International Conference on Objects, Models, Components, Patterns).
- ICSM 2010 (International Conference on Software Maintenance).

David Röthlisberger:

- TOOLS 2010 (International Conference on Objects, Models, Components, Patterns).
- ICSM 2010 (International Conference on Software Maintenance).

Niko Schwarz:

- TOOLS 2010 (International Conference on Objects, Models, Components, Patterns).
- ICSM 2010 (International Conference on Software Maintenance).
- Journal of Object Technology, July and September issue.

Toon Verwaest:

- TOOLS 2010 (International Conference on Objects, Models, Components, Patterns).

Invited Talks

Oscar Nierstrasz:

- Invited Speaker at SOFSEM 2010 (36th International Conference on Current Trends in Theory and Practice of Computer Science, Principles of Software Construction track – Spindleruv Mlyn, Czech Republic, January 23 - 29, 2010)
- Invited Speaker on Die Evolution von Programmiersprachen in the Collegium Generale lecture series Wovon man nicht sprechen kann, darüber muss man schweigen: Natürliche und formale Sprachen in den Wissenschaften (University of Bern – Oct 28, 2009)

Niko Schwarz

- Invited Speaker at SATTOSE 2010 (Seminar on Advanced Techniques and Tools for Software Evolution, Clapiers, France, April 28, 2010)

7.9 Publications

Books

- Stéphane Ducasse, Lukas Renggli, C. David Shaffer, Rick Zaccone, and Michael Davies. *Dynamic Web Development with Seaside*. Square Bracket Associates, 2010.

Journal Papers

- Adrian Kuhn, David Erni, Peter Loretan, and Oscar Nierstrasz. Software cartography: Thematic software visualization with consistent layout. *Journal of Software Maintenance and Evolution (JSME)*, 22(3):191–210, April 2010.

- Mircea Lungu, Michele Lanza, Tudor Gîrba, and Romain Robbes. The Small Project Observatory: Visualizing software ecosystems. *Science of Computer Programming, Elsevier*, 75(4):264–275, April 2010.

Conference Papers

- Florian S. Gysin. Improved social trustability of code search results. In *Proceedings International Conference on Software Engineering, ICSE '10, Student Research Competition*, 2010.

- Oscar Nierstrasz and Tudor Gîrba. Lessons in software evolution learned by listening to Smalltalk. In J. van Leeuwen et al., editor, *SOFSEM 2010*, volume 5901 of *LNCS*, pages 77–95. Springer-Verlag, 2010.

- Lukas Renggli, Marcus Denker, and Oscar Nierstrasz. Language Boxes: Bending the host language with modular language changes. In *Software Language Engineering: Second International Conference, SLE 2009, Denver, Colorado, October 5-6, 2009*, volume 5969 of *LNCS*, pages 274–293. Springer, 2009.

- Lukas Renggli, Stéphane Ducasse, Tudor Gîrba, and Oscar Nierstrasz. Domain-specific program checking. In Jan Vitek, editor, *Proceedings of the 48th International Conference on Objects, Models, Components and Patterns (TOOLS'10)*, volume 6141 of *LNCS*, pages 213–232. Springer-Verlag, 2010.

- Lukas Renggli, Tudor Gîrba, and Oscar Nierstrasz. Embedding languages without breaking tools. In Theo D'Hondt, editor, *Proceedings of the 24th European Conference on Object-Oriented Programming (ECOOP'10)*, volume 6183 of *LNCS*, pages 380–404. Springer-Verlag, 2010.

- David Röthlisberger, Marcel Härry, Alex Villazón, Danilo Ansaloni, Walter Binder, Oscar Nierstrasz, and Philippe Moret. Augmenting static source views in IDEs with dynamic metrics. In *Proceedings of the 25th International Conference on Software Maintenance (ICSM 2009)*, pages 253–262, Los Alamitos, CA, USA, 2009. IEEE Computer Society.

- David Röthlisberger, Marcel Härry, Alex Villazón, Danilo Ansaloni, Walter Binder, Oscar Nierstrasz, and Philippe Moret. Senseo: Enriching Eclipse's static source views with dynamic metrics. In *Proceedings of the 25th International Conference on Software Maintenance (ICSM 2009)*, pages 383–384, Los Alamitos, CA, USA, 2009. IEEE Computer Society. Tool demo.

- David Röthlisberger, Oscar Nierstrasz, and Stéphane Ducasse. Autumn leaves: Curing the window plague in IDEs. In *Proceedings of the 16th Working Conference on Reverse Engineering (WCRE 2009)*, pages 237–246, Los Alamitos, CA, USA, 2009. IEEE Computer Society.

- Rajesh Vasa, Markus Lumpe, Philip Branch, and Oscar Nierstrasz. Comparative analysis of evolving software systems using the Gini coefficient. In *Proceedings of the 25th International Conference on Software Maintenance (ICSM 2009)*, pages 179–188, Los Alamitos, CA, USA, 2009. IEEE Computer Society.

Workshop Papers

- Simon Denier and Tudor Gîrba. Workshop on FAMIX and Moose in software reengineering (FAMOOSr 2009). In *16th Working Conference on Software Maintenance and Reengineering (WCRE 2009)*, pages 325–326, October 2009.

- Stéphane Ducasse, Marcus Denker, and Adrian Lienhard. Evolving a reflective language. In *Proceedings of the International Workshop*

on Smalltalk Technologies (IWST'09), pages 82–86, New York, NY, USA, jun 2009. ACM.

- Florian S. Gysin and Adrian Kuhn. A trustability metric for code search based on developer karma. In *ICSE Workshop on Search-Driven Development-Users, Infrastructure, Tools and Evaluation, 2010. SUITE '10.*, 2010.

- Adrian Kuhn. Immediate search in the ide as an example of socio-technical congruence in search-driven development. In *Search-Driven Development-Users, Infrastructure, Tools and Evaluation, 2010. SUITE '10. ICSE Workshop on*, pages 0–0, 2010.

- Fabrizio Perin. Driving the refactoring of Java Enterprise applications by evaluating the distance between application elements. In *Proceedings of FAMOOSr at the Working Conference on Reverse Engineering (WCRE 2009)*, pages 20–24, October 2009.

- Fabrizio Perin. Enabling the evolution of J2EE applications through reverse engineering and quality assurance. In *Proceedings of the PhD Symposium at the Working Conference on Reverse Engineering (WCRE 2009)*, pages 291–294. IEEE Computer Society Press, October 2009.

- Lukas Renggli, Stéphane Ducasse, Tudor Gîrba, and Oscar Nierstrasz. Practical dynamic grammars for dynamic languages. In *4th Workshop on Dynamic Languages and Applications (DYLA 2010)*, Malaga, Spain, June 2010.

- Lukas Renggli and Tudor Gîrba. Why Smalltalk wins the host languages shootout. In *Proceedings of International Workshop on Smalltalk Technologies (IWST 2009)*, pages 107–113, New York, NY, USA, 2009. ACM.

- Jorge Ressia and Oscar Nierstrasz. Dynamic synchronization — a synchronization model through behavioral reflection. In *Proceedings of International Workshop on Smalltalk Technologies (IWST 2009)*, pages 101–106, New York, NY, USA, 2009. ACM.

- David Röthlisberger. Why and how to substantiate the good of our reverse engineering tools? In *FAMOOSr, 3rd Workshop on FAMIX and Moose in Reengineering*, 2009.

- David Röthlisberger, Oscar Nierstrasz, Stéphane Ducasse, and Alexandre Bergel. Tackling software navigation issues of the Smalltalk IDE. In *Proceedings of International Workshop on Smalltalk Technologies (IWST 2009)*, pages 58–67, New York, NY, USA, 2009. ACM.

- Niko Schwarz, Erwann Wernli, and Adrian Kuhn. Hot clones, maintaining a link between software clones across repositories. In *IWSC '10: Proceedings of the 4th International Workshop on Software Clones*, pages 81–82, New York, NY, USA, April 2010. ACM.

- François Stephany, Tom Mens, and Tudor Gîrba. Maispion: A tool for analysing and visualizing open source software developer communities. In *Proceedings of International Workshop on Smalltalk Technologies (IWST 2009)*, pages 50–57, New York, NY, USA, 2009. ACM.

- Toon Verwaest and Lukas Renggli. Safe reflection through polymorphism. In *CASTA '09: Proceedings of the first international workshop on Context-aware software technology and applications*, pages 21–24, New York, NY, USA, 2009. ACM.

Other Publications

- Oscar Nierstrasz, editor. *CASTA '09: Proceedings of the first international workshop on Context-Aware Software Technology and Applications*, New York, NY, USA, 2009. ACM.

8 Administration

University:

T. Braun:	Member of the Committee for Computing Services (Kommission für Informatikdienste)
	Delegate of the University of Bern at SWITCH Stiftungsrat
H. Bunke:	Member of the Senat
G. Jäger:	Member of the Kantonale Maturitätskommission

Faculty:

G. Jäger:	Member of the Planning Board
Th. Studer:	Member of the Planning Board

Institute:

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