Department of
Computer Sciences

UNIVERSITÄT
SALZBURG


# Annual Report 2014

# Introduction

In 2014, the process of re-integrating three satellite centers into the Department was initiated: The former Center for Embedded Software and Systems joins the Department as the new division "Software and Systems Center", as well as the technical part of the former ICT&S Center joins the Department as the new division "Center for Human-Computer Interaction". Also, the Center for High Performance Computing joins the Department as new division.

Manfred Tscheligi and Andreas Uhl, still acting as a team-head-of-department with Martin Held as deputy, guided the Department through the non-trivial integration processes, interacting with both the department members and the rectorate when issues got complicated from time to time.

Renewal processes have been initiated for the Computer Science Master Program as well as for the Computer Science Teacher Program, to be finalized in 2015.

This report documents the various achievements of the department in 2014. On the level of working groups, current research projects, scientific publications, courses taught, theses advised, and various other things are detailed and showcased. We hope you find things of interest to you.

## Heads of Department

Univ.-Prof. Dr. Andreas Uhl

Univ.-Prof. Dr. Manfred Tscheligi

# Working groups

# 1 Aerospace Research

## Overview

The Aeronautical Research Group of the department has an ongoing tradition of research in the areas of air traffic simulation and wireless communication net- work design. Currently it is extending its expertise to new aerospace research topics like noise abatement, human-in-the-loop simulations, and air traffic management optimization. The research groups's sophisticated simulation tools have been used in a great number of national and international projects and helped to evaluate existing systems and design new ones. The aerospace group was able to establish its expertise in range of relevant topics within the field of aerospace research. Through this research group the University of Salzburg is involved in the "Single European Sky ATM Research" joint undertaking of the European Union. Find more information at `http://www.aero.sbg.ac.at/`.

## Vision

The vision of the Aerospace Research Group is to support the sustainable modernization of European air traffic management. The group's research topics are centered on three main areas of work:

- **Communication**: Development of new wireless technologies, integration of networks, communication security.
- **Procedures**: Air traffic management procedures supported by automation, human-in-the-loop simulation, evaluation and validation of new procedures.
- **Environment**: Air traffic forecast simulation, noise abatement, CO2 reduction.

**Head**
Hon.-Prof. Dr. Carl-Herbert Rokitansky

Funded Project Staff

- Dr. Max Ehammer
- Dr. Thomas Gräupl
- DI Barbara Kubera
- DI Elias Pschernig
- Martin Mayr

## 1.1 Iris Communication Tool

Based on expertise of the Aerospace Group of University of Salzburg / Computer Sciences Institute a special demonstration environment based on simulations and advanced graphics will be developed and delivered to the European Space Agency (ESA) for the purpose of demonstrating the principal functionality and benefits of future digital aeronautical satellite communications between aircraft and air traffic controllers and between crew and airline/airport via a dedicated communication satellite. The principal functionality and benefits of future digital aeronautical satel- lite communications will be demonstrated by a simulation / visualisation of a generic Air Traffic Controller (ATCO) work station, generic cockpit displays, an overview of the areas of satellite beam coverage and a generic visualisation of the data link between Air Traffic Control Center, satellite ground station, future ESA/Iris satellite, aircraft (forward link) and the corresponding reverse link.

**Facts:**

| | |
|---|---|
| **Duration** | 2012 - 2014 |
| **Funding** | ESA/ESTEC |

## 1.2 AeroNauTicAl REsources Satellite based

ANTARES (AeroNauTicAl REsources Satellite based) is the phase B study designing a new Satellite Communication System for Air Traffic Management, within the ESA Iris program (element 10 of ARTES). The Iris program is the satellite-based solution for the Single European Sky ATM Research (SESAR) program. By 2020 it will contribute to the modernization of air traffic management by providing digital data links to cockpit crews in continental and oceanic airspace. Within the Iris program, ANTARES is a two-year study that focuses on the development of a new, purpose-built, satellite-based communication system including low-cost user terminals and a new satellite communication standard. The performance of the telecommunication protocols selected for the standard will be verified end-to-end by a verification test bed.
The Aerospace Group's major contribution is the continuing refinement of the simulation models used for the dimensioning analysis of the system. The work includes extensive statistical evaluations of the expected air traffic and data traffic in the future and contributes significantly to the understanding of the technical requirements of the system.

**Facts:**

| | |
|---|---|
| **Duration** | 2009 - 2015 |
| **Partners** | Thales Alenia Space, Indra, Honeywell, AEdel Aerospace, Airtel ATN, Capgemini, esc, Frequentis, IGUA Software Systems, Innovationszentrum Telekommunikationstechnik GmbH, next, OHB System, SINTEF, gmv, DLR, Space Engineering, Wiser, antwerp space, Space Bel, AETHIS, Jast. |
| **Funding** | European Space Agency / ESTEC |

## 1.3 Tailored and Harmonised satcom for ATM Uses, Maximising re-use of Aero SwiftBroadband

The THAUMAS initiative (Tailored and Harmonised satcom for ATM Uses, Maximising re-use of Aero SwiftBroadband) has been defined in line with the ESA Artes 10 objectives. Starting from the well proven SwiftBroadband technology, the project will define and validate the upgrades needed to offer ATM services. The resulting system, called SB-S (SwiftBroadband-Safety) will be designed for compliance with stringent services and applications defined in the frame of the SESAR program.
The Aerospace Group contributes advanced air traffic and data traffic models for the next decades.

**Facts:**

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|---|---|
| **Duration** | 2011 - 2014 |
| **Partners** | EADS Astrium, Inmarsat, Logica, SITA, Deimos Space |
| **Funding** | European Space Agency / ESTEC |

## 1.4 SESAR Joint Undertaking WP 10.7.1 'Enhanced Data Links'

In the past years the Aerospace Group has been involved in several projects developing concepts for the networking of the sky. It has always been the goal to integrate different aeronautical communication technologies in one heterogeneous network offering the robustness and performance required by air traffic management. Integrating several technologies into one network introduces redundancy making the network failsafe e.g. an interrupted terrestrial ground link can be immediately compensated via a satellite link.
Within the Single European Sky ATM Research Programme (SESAR) workpackage 10.7.1 new applications are developed to gain more benefits from aeronautical datalink communication. These developments are the first step of the evolvement of the legacy air traffic control (ATC) concept currently in use to the air traffic management (ATM) concept envisaged for the future. The Aerospace Research Group contributes to this development in the area of secure networking protocols. In addition they investigate the expected communication load of the proposed datalink applications by means of simulation. It is expected that the currently deployed VDLM2 networks will not be able to offer the required communication capacity. This makes the results of this workpackage also valid for the wireless communication technologies currently under development.

**Facts:**

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|---|---|
| **Duration** | 2011 - 2014 |
| **Partners** | NORACON (NORth European and Austrian CONsortium) |
| **Funding**: | SESAR JU |

## 1.5 SESAR ACSES Academic for Single European Sky ATM Research

The ACSES (ACademia at SESAR) consortium consists of 20 Euro- pean Universities asociated with the SESAR Joint Undertaking.

**Partners**:

National and Kapodistrian University of Athens, Technische Universität Dresden (TUD), UNIZA - Zilinska Univerzita v Ziline, Universita' degli Studi di Trieste (UNITS), Paris-Lodron-Universitaet Salzburg, Technische Universität Berlin, University of Belgrade (Faculty of Transport and Traffic Engineering) (UB-FTTE), Universita' degli studi di Milano- Bicocca (UNIMIB), Universidad Politecnica de Madrid (UPM), Delft Uni- versity of Technology (Faculty of Aerospace Technology (TUD)), Universitat Autonoma de Barcelona (UAB), Imperial College of Science and Medicine London, Technische Universität Braunschweig, Institut fur Flugführung (TUB)

**Facts:**

| | |
|---|---|
| **Duration** | 2011 - |
| **Funding** | SESAR JU |

## 1.6 MET4ATM

Impact of Weather on ATM/ATC (Studie mit AustroControl GmbH und Universität Hannover / IMUK; seit 2012) Die Zielsetzung der Studie MET4ATM ist eine Evaluierung der Möglichkeiten einer Vorhersage der ATM-Kapazitätsauswirkung von signifikanten Wetterphänomenen, insbesondere Gewitter. So soll ein von der Universität Hannover (Prof. Hauf) entwickelter Algorithmus zum Ausweichverhalten von Flugzeugen bei CB-Lagen in Verbindung mit Wetterprognosen der Austro Control und den CFMU-Flugplandaten mittels Simulation durch den NAVSIM-Simulator (Universität Salzburg, Prof. Rokitansky) zur Abschätzung der Verschiebung von Sektorbelastungen im ACC Luftraum herangezogen werden. Anhand eines exemplarischen Tages mit CB-Lagen soll zunächst in sehr begrenztem Umfang die Machbarkeit und Sinnhaftigkeit eines solchen Vorgehens betrachtet werden. Die Studie soll somit als Entscheidungsgrundlage zu einem evtl. darauf folgenden vollwertigen Entwicklungsprojekt dienen.

**Facts:**

| | |
|---|---|
| **Duration** | 2012 - 2014 |
| **Partners** | Austro Control, Universität Hannover |

## 1.7 Innovative An- und Abflugverfahren zur Erhöhung der Lebensqualität (Lärm und Umwelt) am Flughafen Salzburg

The project "Innovative An- und Abflugverfahren zur Erhöhung der Lebensqualität am Flughafen Salzburg" has the goal to study new and innovative arrival and departure routes to improve the quality of living in the surroundings of Salzburg Airport. It has the objective to assess the currently available arrival and departure routes on the basis of new technologies becoming available in the next few years. The focus is on improved satellite navigation technologies (esp. EGNOS, Galileo) enabling new, more sophisticated, routes. University of Salzburg contributed, among other work, the computation of the satellite visibility in the surroundings of Salzburg.

**Facts:**

| | |
|---|---|
| **Duration** | 2011 - 2013; follow-up project planned for 2015 |
| **Partners** | Wirtschaftsförderungsgesellschaft Berchtesgadener Land mbH, Deutsches Zentrum für Luft- und Raumfahrt, TU München, Salzburger Flughafen GmbH |
| **Funding** | EuRegio - Salzburg - Berchtesgadener Land - Traunstein |

## 1.8 Seamless Aeronautical Networking Through Integration of Data Links, Radios and Antennas (SANDRA)

The overall air transportation sector is currently under significant stress. With the demand in aircraft operations expected at least to dou- ble by the 2025 timeframe, there are well-founded concerns that current air transportation systems will not be able to accommodate this growth. Existing systems are unable to process and provide flight information in real time, and current processes and procedures do not provide the flex- ibility needed to meet the growing demand. New security requirements are affecting the ability to efficiently move people and cargo. The integration of different service domains with very heterogeneous requirements through a cost-effective and flexible avionic architecture is thus one of the main challenges addressed by the EU research project SANDRA. In this light, the SANDRA communication system will represent a key enabler for the global provision of distributed services for Common Decision Mak- ing based on the System Wide Information Management concept, and for meeting the high market demand for broadband passenger and enhanced cabin communication services.

**Facts:**

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|---|---|
| **Duration** | 2009 - 2013; closure 2014 |
| **Partners** | SELEX ES SPA, Acreo, Airtel ATN, Alenia Aeronautica, Altys, Bradford University, Cyner, Dassault Aviation, Deutsche Flugsicherung GmbH, DLR e.V., EADS Innovation Works, Gatehouse, IMST GmbH, INRIA, Intecs, LionixBV, Monitorsoft, NLR, RadioLabs, SITA, Slot Consulting, Thales Aerospace, Thales Alenia Space, Thales Avionics, Thales TRT-UK, TriaGnoSys GmbH, University of Pisa, University of Twente |
| **Funding** | EC 7th framework programme |

## 1.9 VDL Mode 2

The Objective of the study is to provide SESAR and the entire ATM community with a reliable picture concerning the VDL2 capability to support the evolution and the exploitation of DL services over the next years, when its limitations will be reached and what would be the consequences of reaching them, on the basis of the assumptions made.
The contribution of the University of Salzburg is the detailed specification of the Baseline Scenarios, Simulation Results Template, and Simulation Run Reports. The final documentation has to give detailed indication to further development and adaptation of the VDL Mode 2 Tools for capacity and performance evaluation in accordance with project specifications and standards aiming to generate all simulation results in the study.

**Facts:**

| | |
|---|---|
| **Duration** | 2014 - 2015 |
| **Partners** | ENAV S.p.A., Airbus, DFS, Enaire - Grupo AENA, LFV, NATS, Air France, British Airways, Easy Jet, Lufthansa, ARINC, SITA. |
| **Funding** | SESAR Joint Undertaking (SJU) |

## 1.10 Publications

[1] M. Mayr T. Gräupl and O. Lücke. Selected results for IPv6 based SWIM, CPDLC and VoIP in the SANDRA flight trial campaign. In *Proc. 33th Digital Avionics Systems Conference (DASC)*, 2014.

[2] M. Mayr T. Gräupl and O. Lücke. "selected results for IPv6 based SWIM, CPDLC and VoIP in SANDRA flight trial campaign". In *Procc. 33rd Digital Avionics Systems Conf.*, Colorado Springs, CO, 2014.

[3] T. Gräupl E. Pschernig C.-H. Rokitansky R. Marschallinger and F. Zobl. Development of simulation-supported long range B-VLOS RPAS mission planning for remote sensing in alpine disaster operations management, 2014.

[4] Zobl R. Marschallinger T. Gräupl E. Pschernig. Simulationsgestützte missionsplanung für B-VLOS RPAS im überregionalen katastrophenhilfeeinsatz, 2014.

[5] Gräupl T. Pschernig E. Rokitansky C. d'Oleire Oltmanns S. Zobl F. Rapid large- and site scale RPAS mission planning for remote sensing of rock falls and landslides in alpine areas, 2014.

[6] P. Hupe T. Hauf C.-H. Rokitansky. Case study of adverse weather avoidance modelling. In *Paper, Fourth SESAR Innovation Days*, Madrid, Spain, 25 - 27 November 2014.

[7] M. Sauer C.-H. Rokitansky J. Lang P. Hupe. T. Hauf. Real-time flugverkehrssimulation der gewitterumfliegung basiernd auf dem wetterausweichmodell DIVMET und dem luftverkehrsmodell NAVSIM. In *Talk Sitzung 2 / 2014 der DGON - Luftfahrtskommission, Thema "Flugmeteorolgie"*, Offenbach, Germany, 14 Oktober 2014.

[8] M. Sauer L. Sakiew A. Fiehn T. Hauf C.-H. Rokitansky M. Kerschbaum. Simulation des ausweichverhaltens von flugzeugen in schlechtwettersituationen mit DIVMET - anwendung auf ein squall line ereignis über Österreich. In *Talk, DACH Meteorologentagung*, Insbruck, Austria, 2 - 6 September 2013.

[9] M. Sauer P. Hupe L. Sakiew T. Hauf C.-H. Rokitansky M. Kerschbaum. Sector occupancy analysis with the adverse weather diversion model divmet. In *Poster, 93th AMS Annual Meeting, 16th Conference on Aviation, Range and Aeorspace Meteorology*, Austin, TX, 6 - 10 Januar 2013.

[10] Simon Plass Romain Hermenier Oliver Lücke Dirk Gomez Depoorter Théophile Tordjman Mark Chatterton Massimiliano Amirfeiz Simone Scotti Yongqiang Jay Cheng Prashant Pillai Thomas Gräupl Frederic Durand Ken Murphy Andrew Marriott and Alexander Zaytsev. "flight trial demonstration of seamless aeronautical networking. *IEEE Communications Magazine*, 52(5), 5 May 2014.

## 1.11 Supervised theses

### Master

- Markus MESSNER, ”Evaluation of Self-Separation Algorithms”.
- Reinhold KOLM, ”The simulation of cyber-attacks in ATC based on ADS-B”

### PhD

- Kurt ESCHBACHER, ”Performance Evaluation of Future Digital Aeronautical Communication Services”.
- Barbara KUBERA; ”Multilink concepts for safety related data link communications in aviation based on the next generation satellite and terrestrial data links”
- Elias PSCHERNIG; ”Optimizing Enroute / TMA / Airport Operations”

## 1.12 Miscellaneous activities

### Conferences

- European Geosiences Union General Assembly, 2014 from April 27th to May 2nd 2014 in Vienna: http://www.aero.sbg.ac.at/?m=201404
- AGIT 2014 Geospacial Innovation for Society, from July 2nd to July 4th 2014 in Salzburg, Austria: http://www.aero.sbg.ac.at/?m=201407
- 33rd Digital Avionics Systems Conference from October 5th to 9th 2014 in Colorado Springs, USA. http://www.aero.sbg.ac.at/?m=201410

### Exhibitions

- I-DAY, July 2014, http://www.aero.sbg.ac.at/?p=938

### Press Coverage

- LDACS1 Website online -LDACS1 stands for L-band digital aeronautical communications system, type 1 March 2014. http://www.ldacs.com/

### Project

- VDLM2 Capacity and Performance Analysis started http://www.aero.sbg.ac.at/?cat=15 The Objective of the study is to provide SESAR and the entire ATM community with a reliable picture concerning the VDL2 capability to support the evolution and the exploitation of DL services over the next years, when its limitations will be reached and what would be the consequences of reaching them, on the basis of the assumptions made.
- Support for SESAR Project 15.2.4 started, The objective of the project is the development of an LDACS-1 Sub-System Emulator providing a behavior and performance model of the LDACS1 A/G sub system on IPv6 layer. http://www.aero.sbg.ac.at/?cat=15

# 2 Center for High Performance Computing

## Overview

The Center for High Performance Computing (CHPC,`chpc.sbg.ac.at`) delivers various computing and training services in the areas of parallel, distributed, and high performance computing. The center conducts own research in order to constantly meet the evolving demand of the participating departments of the university.

**Head**
Univ.-Prof. Dr. Robert Elsaesser
em. Univ.-Prof. Dr. Peter Zinterhof
Faculty Members
- Dr. Peter Zinterhof

Funded Project Staff
- Patrick Buchner

## 2.1 Scientific Cloud

The aim of this project was to establish a modern infrastructure for Cloud based services operated within the existing Doppler-cluster computing environment. The software stack OPENSTACK had to be adapted for use in this environment and special emphasis was given to the performance aspect. Additionally, a remote system based at the university of Linz was also temporarily integrated in the setup, rendering it one of the very first distributed scientific cloud services in Austria.

**Facts:**

| | |
|---|---|
| **Duration** | 2014 |
| **Partners** | HTL Salzburg, Itzling |
| | University Linz |
| **Funding** | FFG |

## 2.2 Topics of research

- **CHPC**
  - high performance computing
  - parallel and distributed algorithms
  - novel architectures
  - accelerator-based computing

## 2.3 Publications

### Proceedings


[1] Peter Zinterhof. Improving data-parallel construction of $\delta$n-nets with maximum dispersion. In *37th International Convention on Information and Communication Technology, Electronics and Microelectronics, MIPRO 2014, Opatija, Croatia, May 26-30, 2014*, pages 284–288, 2014.

[2] Petra Berenbrink, Robert Elsässer, and Thomas Sauerwald. Randomised broadcasting: Memory vs. randomness. *Theoretical Computer Science*, 520:27–42, 2014.

[3] Colin Cooper, Robert Elsässer, and Tomasz Radzik. The Power of Two Choices in Distributed Voting. In *Proceedings of the 41st International Colloquium on Automata, Languages, and Programming (ICALP'14)*, pages 435–446, 2014.

## 2.4 Teaching

### Teaching

- Verteilte Programmierung (VP)
- Praktische Aspekte von HPCTools und Bibliotheken (VP)
- GPU-Programmierung und Anwendungen (VP)
- HPC-Hardware: aktuelle Entwicklungen (VP)
- Algorithmen in großen Netzwerken
- Algorithmen für verteilte Systeme
- Algorithmen und Datenstrukturen
- Aktuelle algorithmische Probleme in Theorie und Praxis
- Formale Sprachen und Komplexitätstheorie

## 2.5 Supervised theses

### Master

- Franziska Halbrainer : *Analysis of Social Networks using Parallel Algorithms*

## 2.6 Miscellaneous activities

### Conference Program Committees

- 39th International Symposium on Mathematical Foundations of Computer Science (MFCS 2014)
- Peter Zinterhof served as PC member for the UCHPC workshop 2014 (EUROPAR conference series)

### Editorship

- Discrete Applied Mathematics: Special Issue on Applications of Graph Spectra in Computer Science

### Invited Talks

- Workshop *Stochastic Graph Models*, Brown University, Providence, RI, USA:
  *The Power of Two Choices in Distributed Voting*
- Seminar Talk at University of Cambridge, UK
- PIMS Summer School on Randomized Techniques for Combinatorial Algorithms, Simon Fraser University, Vancouver, BC, Canada:
  *Random Walks and Their Applications in Algorithms*
- Seminar Talk at King's College, London, UK

**Workshop Talks**

- London Algorithmic Workshop 2014, UK:

  *Faster rumor spreading: Breaking the* $\log n$ *barrier*

- International Workshop on Algorithms and Software for Scientific Computing, Vienna, Austria:

  *On the Influence of Graph Density on Randomized Gossiping*

**Hosted Talks**

- Alessandro Panconesi, Sapienza University of Rome, Italy

  *Trace Complexity of Information Diffusion*

- Gerhard Niederbrucker, University of Vienna, Austria

  *Towards Truly Distributed Computing: Uniting Theory, Algorithms and Practice*

# 3 Computational Intelligence, Simulation And Mathematical Methods

## Overview

The activities of this research group focus mainly on topics in the fields of computational intelligence, discrete and distributed simulation, mathematical foundations of computer sciences, deduction, and applications of mathematical logic and proof theory. In the following the various sub-fields covered by the working group are listed.

Computational Intelligence: evolutionary computation, artificial neural networks, evolutionary robotics, computational neuroethology, computational intelligence and games, industrial applications of computational intelligence

Simulation: methods and tools for discrete event simulation, distributed simulation, simulation and cloud computing, applications

Mathematical Foundations of Computer Sciences: Fourier analysis and wavelet theory with applications in signal and image processing, numerical integration and approximation of functions in reproducing kernel Hilbert Spaces, uniform distribution on compact groups.

Deduction, Mathematical Logic and Proof Theory: automated deduction, logic, calculi of predicate logic for automatic and semi-automatic deduction, algebra of proofs, logic programming, formal systems

**Head**

Ao.Univ.-Prof. DI Dr. Helmut Mayer

Faculty Members

- Ass.-Prof. Dr. Clemens Amstler
- Ao.Univ.-Prof. Dr. Elmar Eder
- Ao.Univ.-Prof. Dr. Helge Hagenauer

## 3.1 Boone Implementation of Spiking Neural Networks

In this internal project our existing Java framework *Boone* (Basic Object–Oriented Neural Environment) has been extended by a new artificial neural network (ANN) type, namely, *Spiking Neural Networks* (SNNs). Contrary to conventional ANNs where transmitted signals are numbers, the signals of SNNs are modelled as (time–dependent) action potentials (spikes). Hence, SNNs allow a more realistic simulation of biolgical neural networks, but may also be useful in technical applications.

**Facts:**

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|---|---|
| **Duration** | 2014 |
| **Partners** | Johannes Mory |
| **Funding** | Internal |

## 3.2 Supervised theses

### Bachelor

- Mirkovski Angel: *JaamSim – Simulation Software in Java*

### Master

- Julia Altenried: *Evolutionary Solutions of the Vehicle Routing Problem*
- Xaver Kienzerle: *Simulationsgestützte Entscheidungshilfe für Fahrdienstleiter im Stellwerksbereich mit Fokus auf die Deutsche Bahn*
- Ortwin Probst: *Contribution Funktionalität – Techniken zur Servicekonfiguration für modulare Java Software durch erweitertes Spring IOC*

## 3.3 Teaching

### Courses

- Algorithmen und Datenstrukturen
- Analysis für Informatik
- Computational Neuroscience (Biologie)
- Digitale Rechenanlagen
- Einführung in die Programmierung
- Einführung Simulation
- Energetik und Bewegung (Biologie)
- Höhere Mathematik für Informatik
- Natural Computation
- Neurale Netzwerke und Biorobotik (Biologie)
- Nichtprozedurale Programmierung (Logische Programmierung)
- Orientierung Informatik
- Pattern Recognition
- Theoretische Informatik
- Wavelets und Filterbänke

## 3.4 Miscellaneous activities

### Conference program committees

- ACM Symposium on Applied Computing (SAC 2012)
- International Conference on Awareness Science & Technology (iCAST 2014)
- IEEE Conference on Computational Intelligence and Games (CIG 2014)
- International Conference on Neural Network and Artificial Intelligence (ICNNAI 2014)
- IEEE International Conference on Systems, Man and Cybernetics (SMC 2014)
- European Simulation and Modelling Conference (ESM'2014)
- Genetic and Evolutionary Computation Conference (GECCO 2014)
- Industrial Simulation Conference (ISC'2014)
- The Middle Eastern Modelling and Simulation MultiConferences (MESM'2014)

### Journal reviews

- Computers & Graphics (1 article)

# 4 Computational Systems

The Computational Systems Group, lead by Prof. Christoph Kirsch, currently hosts one postdoc, four PhD students, and four masters students. Moreover, Prof. Ana Sokolova, is associated with the group as assistant professor. The research focus of the group is on principled engineering of concurrent data structures and memory management systems and benchmarks as well as on probabilistic systems and co-algebraic structures. The group offers classes and seminars on compiler construction, operating systems, concurrency, logic, and verification.

**Head**

Univ.-Prof. Dipl.-Inform. Dr.-Ing. Christoph Kirsch

**Faculty Members**

- Dr. Ana Sokolova

**Postdoc**

- Dr. Rainer Trummer

**Students**

- Dipl.-Ing. Martin Aigner (externally funded)
- Dipl.-Ing. Andreas Haas
- Thomas Hütter (externally funded)
- Dipl.-Ing. Michael Lippautz
- Alexander Miller (externally funded)
- Mario Preishuber (externally funded)

## 4.1 Rigorous Systems Engineering, FWF NFN

**Rigorous Systems Engineering (RiSE)**

Over the past decades, the complexity and size as well as the ubiquity and criticality of computer systems have increased dramatically. They are now at a level where human engineers and programmers require assistance by computer-aided methods and tools that are based on a rigorous mathematical foundation. We have seen much recent progress in such techniques and tools: model checkers and static analyzers are now used routinely in the design of hardware and certain restricted kinds of software. Nevertheless, the exploding presence of concurrent computation — from multi-core processors to cloud computing — has rendered many established methods obsolete and is the single most important challenge facing systems engineering today.

**Facts:**

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|---|---|
| **Title** | Rigorous Systems Engineering |
| **Duration** | 2011–2015 |
| **Partners** | IST Austria, JKU Linz, TU Graz, TU Vienna |
| **Webpage** | http://arise.or.at |
| **Funding** | FWF NFN |
| **Amount** | Total 3,744,000 EUR (Project Part 4 - University of Salzburg 328,230 EUR) |

The traditional use of model checking and related techniques has been a posteriori, i.e., a program or model is analyzed after completion. This procedure is costly and decouples the quality assessment from the engineering process. It is the goal of our project to move beyond classical model checking and a posteriori verification. We use the term "Rigorous Systems Engineering" (RiSE) to describe an approach in which mathematical techniques such as model checking provide a solid foundation for the design process from day one. Within RiSE, we focus on topics that are motivated by the new generation of highly concurrent and embedded systems: We look at software transactions and data center programming to address multi-core and software-as-a-service issues; at virtualization and distributed message passing concepts to address real-time issues; and at the integration of model checking with complementary, execution-based techniques, such as software testing, in order to build tools that can cope with large-scale software systems.

The project has three main research thrusts: First, we develop new language-based, architectural, and verification paradigms for highly concurrent and real-time software. Second, we develop novel game-theoretic algorithms for analyzing and synthesizing individual system components within a larger context. Third, we develop and improve decision procedures that lie at the very heart of every automatic method and tool for system design and analysis.

RiSE consists of five internationally recognized researchers from the model checking community and four renowned researchers from the neighboring fields of software systems, distributed computing, and computational logic. This set-up encourages the integration of different viewpoints and complementary approaches towards the common objective of RiSE.

## 4.2 Cyber-Physical Cloud Computing, NSF Project

**Cyber-Physical Cloud Computing (CPCC)**

How do we program, control, and utilize large networks of mobile devices from cell phones to autonomous vehicles? Our idea is to virtualize such systems and create cyber-physical clouds of virtual vehicles that may be rented and operated by customers just like traditional clouds of virtual machines. The key difference here is that virtual vehicles not only compute but also sense, act, and move in space. Cyber-Physical Cloud Computing promises similar benefits as traditional cloud computing by turning mobile devices into a utility. Customers may focus on the tasks they are interested in and only pay for them while providers may focus on maintaining and operating hardware. The idea opens up a whole new space of interesting problems from spatial scheduling and queueing theory to the engineering of virtual vehicles.

The project is a collaborative effort between the University of California at Berkeley and the University of Salzburg. It is funded by the National Science Foundation in the US. A number of students from Salzburg have already visited UC Berkeley and worked on the project in Berkeley.

**Facts:**

| | |
|---|---|
| **Title** | Making Cloud Computing Sense, Act, and Move |
| **Duration** | 2011–2015 |
| **Partners** | UC Berkeley |
| **Webpage** | http://cpcc.berkeley.edu |
| **Funding** | NSF CPS Medium |
| **Amount** | Total 1,100,000 USD |

## 4.3 Memory Management Benchmarking, Google Project

### Memory Management Benchmarking

The performance of managed programming languages is essentially determined by the performance of code execution and the performance of memory management. While there are numerous tools for benchmarking and profiling code execution there is surprisingly little support for systematic analyses of memory management. The available memory management benchmarks typically do not cover the diverse application space of modern VMs such as Google's V8, and do not allow microbenchmarking best- and worst-case behavior. Performance deficiencies in their memory management systems may therefore remain undetected during development and only be exposed later during deployment.

**Facts:**

| | |
|---|---|
| **Title** | ACDC4GC |
| **Duration** | 07/2013–06/2014 |
| **Partners** | Google Inc. |
| **Webpage** | http://acdc.cs.uni-salzburg.at |
| **Funding** | Google Inc. |
| **Amount** | 80,000 EUR |

In collaboration with Google Inc., we have designed and implemented a tool called ACDC4GC for benchmarking memory management performance of V8. The tool is implemented in JavaScript for V8 with minimal modifications of the VM. ACDC4GC is based on an existing tool developed by us called ACDC written in C for benchmarking explicit heap allocators. ACDC may be configured to emulate explicit single- and multi-threaded memory allocation, sharing, access, and deallocation behavior to expose virtually any relevant allocator performance differences. ACDC mimics periodic memory allocation and deallocation (AC) as well as persistent memory (DC). Memory may be allocated thread-locally and shared among multiple threads to study multicore scalability and even false sharing. Memory may be deallocated by threads other than the allocating threads to study blowup memory fragmentation. Memory may be accessed and deallocated sequentially in allocation order or in tree-like traversals to expose allocator deficiencies in exploiting spatial locality. We have already demonstrated ACDC's capabilities with seven state-of-the-art allocators for C/C++ in an empirical study that was presented at ISMM 2013.

ACDC4GC implements a mutator that may be configured to mimic the allocation, access, and deallocation behavior of real and artificial JavaScript applications for exposing virtually any relevant memory management performance characteristics. Similar to ACDC, the new tool emulates object amounts, sizes, liveness (last access), and lifetimes (unreachability) according to configurable distributions that are typically found in JavaScript applications. Unlike ACDC, the new tool also emulates configurable object types beyond list and tree structures to construct realistic and artificial object graphs for benchmarking the performance of reachability analyses. ACDC4GC has also been enhanced to distinguish object liveness and lifetimes according to configurable distributions (rather than a global parameter as in ACDC) for emulating application deficiencies including reachable memory leaks. ACDC4GC was presented at DLS 2014.

## 4.4 Concurrent Systems, Google PhD Fellowship

**Scalable Software Systems through Relaxed Data Structures**

This project is funded by a Google PhD fellowship awarded to Michael Lippautz who is a PhD student in the Computational Systems Group.

**Facts:**

| | |
|---|---|
| **Title** | Concurrent Systems |
| **Fellow** | Michael Lippautz |
| **Duration** | 2014–2017 |
| **Webpages** | http://scal.cs.uni-salzburg.at and http://scalloc.cs.uni-salzburg.at |
| **Funding** | Google Inc. |
| **Amount** | 180,000 USD |

Parallel processing units (multiple processors with multiple cores) are ubiquitous these days. They can be found in regular desktop machines, big servers, and even in small computing devices such as smart phones. One of the principles for communication between software processes running on those processing units is the use of concurrent data structures (represented on shared-memory), e.g. concurrent First-In-First-Out (FIFO) queues and concurrent stacks. Communication through concurrent data structures, however, limits overall application performance. Hence, it is crucial to provide concurrent data structures that perform fast and scale well, i.e., on which the number of potential operations per second ideally scales linearly with the number of parallel processing units.

The problem is that synchronization (which cannot be parallelized) is necessary to guarantee certain data structure semantics. For example, take a FIFO queue where multiple processes enqueue and dequeue elements concurrently. Providing a strict order inherently requires synchronization as concurrent operations need to determine which operation is performed first. This is even independent of the internal representation of data. The consequence is that programmers avoid such scenarios at all cost, for example by implementing complex cache and distribution logics. However, there is another way out of this quandary: using data structures with relaxed semantics, e.g. by allowing elements to overtake each other in a FIFO queue. The challenge here is to design algorithms that trade off semantics for performance/scalability and to quantify their behavior.

At POPL 2013 we showed that such relaxed data structures perform and scale better than existing implementations, may even provide better determinism under certain circumstances, and can be used in actual systems software such as the scalloc memory allocator developed by us. Scalloc is particularly interesting, because the use of scalable data structures not only increases performance and reduces memory consumption, but also allows a simpler design based on global data structures. Hence, we design general purpose concurrent data structures that will eventually replace custom distribution and cache logics and lead to systems that perform and scale better than currently existing ones.

# 5 Database Systems

## Overview

The research interests of the Database Research Group (`http://dbresearch.uni-salzburg.at`) is centered around data-centric applications in database and information systems. A particular focus is on similarity search queries over large data collections, for example, approximate tree matching, set similarity joins, efficient similarity serach indexes, and top-k queries. Other reserach interests include query processing in geographic information systems and load balancing algorithms for distributed frameworks like MapReduce. The research results are new algorithms with performance guarantees, which are implemented and evaluated on the motivating application.

database
research group

**Head**

Univ.-Prof. Dr. Nikolaus Augsten

**Faculty Members**

- Mateusz Pawlik, PhD
- Dipl.-Ing. Willi Mann

**Technical Staff**

- Alfred Egger

**Student Assistants**

- Michaela Mayr
- Daniel Kocher

## 5.1 Publications

### Journals

[1] Mateusz Pawlik and Nikolaus Augsten. Efficient computation of the tree edit distance. *ACM Transactions on Database Systems*, To appear. Available online: `http://tods.acm.org/Upcoming.html`.

### Proceedings of peer reviewed conferences

[1] Nikolaus Augsten, Armando Miraglia, Thomas Neumann, and Alfons Kemper. On-the-fly token similarity joins in relational databases. In *International Conference on Management of Data, SIGMOD 2014*, pages 1495–1506. ACM, 2014.

[2] Willi Mann and Nikolaus Augsten. PEL: position-enhanced length filter for set similarity joins. In *Proceedings of the 26th GI-Workshop Grundlagen von Datenbanken*, volume 1313 of *CEUR Workshop Proceedings*, pages 89–94. CEUR-WS.org, 2014.

[3] Mateusz Pawlik and Nikolaus Augsten. A memory-efficient tree edit distance algorithm. In *International Conference on Database and Expert Systems Applications (DEXA)*, volume 8644 of *Lecture Notes in Computer Science*, pages 196–210. Springer, 2014.

## 5.2 Teaching

### Courses

- Datenbanken I
- Datenbanken II
- Tuning von Datenbanksystemen
- Datenbanken Vertiefung
- Aktuelle algorithmische Probleme in Theorie und Praxis

## 5.3 Supervised theses

### Bachelor

- Daniel Kocher: Efficient Algorithms in Relational Database Design
- Markus Reiter: SQL Database System for Structured Text Files
- Anton Ebner: On-the-Fly Statistics for Querying Structured Text (ongoing)
- Rupert Eisl: Indexing Structured Text Files (ongoing)
- Robert Zauner: Optimizing Basic SQL Queries (ongoing)

### Master

- Stefan Höller: Anfrageoptimierung in verteilten NoSQL-Datenbanken

### PhD

- Mateusz Pawlik: Efficient Computation of the Tree Edit Distance (07.11.2014)
- Willi Mann: Set Similarity Joins (ongoing)

## 5.4 Miscellaneous activities

### Conference Program Committees

- International Conference on Data Engineering, ICDE 2015
- International Conference on Database Systems for Advanced Applications, DASFAA 2014
- International Conference on Extending Database Technology, EDBT 2015 (demo)

### Referee for Journals

- ACM Transactions on Database Systems (TODS)
- Parallel Computing (PARCO)

### Journal Editorship

- Associate Editor of The VLDB Journal (Springer)

# 6 Efficient Algorithms Group

## Overview

Our research group focuses on different algorithmic aspects of parallel and distributed computing. Parallel and distributed algorithms are used to solve large, computationally intensive problems in science and engineering. We work on the inteface between discrete mathematics, theoretical computer science, and parallel aspects of computing. We combine various techniques from these fields to design efficient solutions for problems such as information dissemination, distributed communication, network exploration, load balancing, and graph models for large real world networks.

In teaching, we cover the basic course for algorithms and data structures for 1st year students, as well as more advanced courses on algorithms for 3rd year bachelor and master students. In addition, we run basic courses in theoretical computer science. We also offer a number of seminars and projects related to parallel and distributed algorithms.

**Head**

Univ.-Prof. Dr. Robert Elsässer

Group Members

- Post-Doc
  - Horst Trinker
- PhD Students
  - Andreas Bilke
  - Dominik Kaaser
- Student Assistants
  - Michael Moser
  - Andreas Pollhammer
  - Sophie Wirnsberger

## 6.1 Analysis of Epidemic Processes and Algorithms in Large Networks

Epidemic processes are often used to model and simulate the spread of a disease in networks, which describe certain interactions between individuals (also called social networks). Randomized algorithms based on such processes are called epidemic algorithms. In this project we have two main objectives. First, we analyze the so called gossiping problem. Here, we assume that at the beginning each node of a network possesses a message, and all these messages have to be distributed to all nodes of the underlying graph. The goal is to solve this problem in a small number of time steps and with a reduced number of message transmissions. First results show that the quality of such algorithms in complete graphs is worse than in the case of broadcasting. In this project, we consider these algorithms in general graphs, and try to improve their performance.
Our second objective consists of the theoretical analysis of epidemic processes in large networks. In most cases, epidemics are studied in static networks. However, one of the main reasons for the spread of diseases in a modern society is due to the mobility of the people. We analyze epidemics in several state-of-the-art network mobility models, which take into account the spacial situation of different locations as well as the mobility of the people within a large urban area. Furthermore, we also consider the impact of the spread of awareness about a disease on the behavior of the underlying epidemic.

**Facts:**

| | |
|---|---|
| **Duration** | 2012 - 2014 |
| **Funding** | FWF |
| **Project Staff** | Horst Trinker |
| | Michael Moser |
| | Andreas Pollhammer |

## 6.2 Teaching and Supervised Theses

### Courses

- Algorithmen in großen Netzwerken
- Algorithmen für verteilte Systeme
- Algorithmen und Datenstrukturen
- Aktuelle algorithmische Probleme in Theorie und Praxis
- Formale Sprachen und Komplexitätstheorie

### Master

- Franziska Halbrainer: *Analysis of Social Networks using Parallel Algorithms*

### PhD

- Andreas Bilke: *Distributed Community Search in Large Social Networks*
- Dominik Kaaser: *Randomized Algorithms for Efficient Information Dissemination*
- Adrian Ogierman (Paderborn): *Epidemic Type Processes in Large Networks*

## 6.3 International Cooperations and Miscellaneous Activities

**Conference Program Committees**

- 39th International Symposium on Mathematical Foundations of Computer Science (MFCS 2014)

**Editorship**

- Discrete Applied Mathematics: Special Issue on Applications of Graph Spectra in Computer Science

**National and International Collaborations**

- Chen Avin, Ben Gurion University, Israel
- Petra Berenbrink, Simon Fraser University, BC, Canada
- Colin Cooper and Tomasz Radzik, King's College, London
- Wilfried Gansterer, University of Vienna, Austria
- George Giakkoupis IRISA/INRIA Rennes, France
- Thomas Sauerwald, University of Cambridge, UK
- Christian Scheideler, Universität Paderborn, Germany
- Christian Schindelhauer, Universität Freiburg, Germany

**Invited Talks**

- Workshop *Stochastic Graph Models*, Brown University, Providence, RI, USA:
  *The Power of Two Choices in Distributed Voting*
- Seminar Talk at University of Cambridge, UK
- PIMS Summer School on Randomized Techniques for Combinatorial Algorithms, Simon Fraser University, Vancouver, BC, Canada:
  *Random Walks and Their Applications in Algorithms*
- Seminar Talk at King's College, London, UK

**Workshop Talks**

- London Algorithmic Workshop 2014, UK:
  *Faster rumor spreading: Breaking the* $\log n$ *barrier*
- International Workshop on Algorithms and Software for Scientific Computing, Vienna, Austria:
  *On the Influence of Graph Density on Randomized Gossiping*

**Hosted Talks**

- Alessandro Panconesi, Sapienza University of Rome, Italy
  *Trace Complexity of Information Diffusion*
- Gerhard Niederbrucker, University of Vienna, Austria
  *Towards Truly Distributed Computing: Uniting Theory, Algorithms and Practice*

## 6.4 Publications

[1] Petra Berenbrink, Robert Elsässer, and Thomas Sauerwald. Randomised broadcasting: Memory vs. randomness. *Theoretical Computer Science*, 520:27–42, 2014.

[2] Colin Cooper, Robert Elsässer, and Tomasz Radzik. The Power of Two Choices in Distributed Voting. In *Proceedings of the 41st International Colloquium on Automata, Languages, and Programming (ICALP'14)*, pages 435–446, 2014.

[3] Therese Biedl, Martin Held, Stefan Huber, Dominik Kaaser, and Peter Palfrader. Straight Skeletons of Monotone Polygons. In *Proceedings of the 30th European Workshop on Computational Geometry (EuroCG 2014)*, Ein-Gedi, Israel, 2014.

[4] Martin Held and Dominik Kaaser. C2 Approximation of Planar Curvilinear Profiles by Cubic B-Splines. *Computer-Aided Design and Applications*, 11(2):206–219, 2014.

# 7 HCI and Usability Unit

## Overview

The HCI and Usability Unit, which is organized as part of the ICT&S Center is concerned with the interplay between humans and computers. Human-Computer-Interaction (HCI) and usability pays central attention to the design, evaluation and implementation of existing and future interactive (computer-)systems and interactive environments. Working group members with the background of computer science, psychology, sociology, communication studies, design and information management work in different research foci. The central topics of research and projects of the HCI and Usability Unit are described in the following chapters.

**Head**

Univ.-Prof. Dr. Manfred Tscheligi

**Faculty Members**

- MMag. Verena Fuchsberger
- Dr. Manuel Giuliani
- Mag. Alina Krischkowsky
- DI Dr. Alexander Meschtscherjakov

**Funded Project Staff**

- please refer to extra page

## 7.1 ANIKETOS

ANIKETOS (Greek for "never conquered") addresses secure and trustworthy composite services, which are of importance for the Future Internet. The project helps to establish and maintain trustworthiness and secure behaviour in a constantly changing service environment. It aligns existing and develops new technology, methods, tools and security services that support the design-time creation and run-time dynamic behavior of composite services, addressing service developers, service providers and service end users. Overall 17 organizations, ranging from large industrial and research organizations, to end user organizations with specific domain competence, participate in the project, which is coordinated by SINTEF, Norway. The HCI & Usability Unit at the ICT&S Center is work package leader for "User Evaluation and Validation". The role of the HCI & Usability Unit is to elicit user and social requirements for ANIKETOS, gather deeper insights on factors influencing trust and acceptance, and extend existing models of trust, usability, quality of experience, and user acceptance. The team working on ANIKETOS further evaluates ANIKETOS and its developed composite services against factors such as trust, usefulness, usability, and effective security for all kinds of users.

**Facts:**

| | |
|---|---|
| **Duration** | 2010 - 2014 |
| **Partners** | SINTEF, ESI, CNR, THALES, LJMU, ELSAG, SEARCH, ATOS, TSSG, UNITN, ATC, SAP, ITALTEL, DBL, WIND, DAEM |
| **Funding** | EU FP7-ICT |

## 7.2 ASSIST 4.0

The aim of the ASSIST 4.0 project is the development of mobile context-sensitive assistance systems for the Industry 4.0. Through an integrating of novel ICT technologies with Human-Computer Interaction concepts workers are supported during decision-making process in production and service. The envisioned assistance system is mobile, multimodal, location-sensitive, personalised, context-adaptive and predictive. The systems aims for high usability, user experience, acceptance and security.

**Facts:**

| | |
|---|---|
| **Duration** | 2014 - 2016 |
| **Partners** | Infineon Technologies Austria AG, AVL List GmbH, evolaris next level GmbH, Research Studios Austria Forschungsgesellschaft mbH, Paris-Lodron-Universität Salzburg, XiTrust Secure Technologies GmbH |
| **Funding** | FFG, FTI-Initiative, Produktion der Zukunft |

## 7.3 CD Labor for Contextual Interfaces

Human-Computer Interaction (HCI) is almost always dependent on the concrete characteristics of the context the interaction happens in. Contextual interaction means situated human-computer interaction - its quality is dependent on a multitude of factors. The Christian Doppler Laboratory (CDL) Contextual Interfaces examines contextual interaction from qualitative, constructional, and methodological viewpoints. Apart from basic research activities focusing on methods and tools for contextual research, the laboratory explores the contexts "car" and "factory" from these three perspectives.

**Facts:**

| | |
|---|---|
| **Duration** | 2009 - 2016 |
| **Partners** | AUDIO MOBIL Elektronik GmbH, Infineon Technologies Austria AG, KEBA AG |
| **Funding** | CDG, Infineon Austria, AUDIO MOBIL, KEBA AG |

## 7.4 ENTRANCE 2

The objectives of ENTRANCE are to develop 1) a platform usable for both trip planning and indoor/outdoor navigation with an adaptive interface for users with different proficiency levels of Internet use, and 2) a multimodal navigation interface and innovate system for indoor positioning combining global and relative positioning technologies (home terminal, smart phone and bracelet). Furthermore, a serious game will be developed, which aims at supporting older adults in indoor navigation.

**Facts:**

| | |
|---|---|
| **Duration** | 2011 - 2014 |
| **Partners** | Commissariat à LEnergie Atomique, Laboratoire dIntégration des Systèmes et des Technologies (CEA List, France), AutonomLab (France), 50plus GmbH (Austria), GeoMobile GmbH (Germany), GFTH Ltd. (Hungary), Idées3Com (France), Splitted Desktop Systems (France) |
| **Funding** | EU AAL/FFG |

## 7.5 GETVIVID

This project aims at supporting older adults with mild impairments (e.g., restricted mobility, hearing or vision impairments) to manage their daily activities in their (residential) home and aims at improving the quality of life, autonomy and participation in social life. The project will offer a useful and valuable set of AAL-related functionalities and services to older adults as well as informal and formal carers through the use of connected TV devices based on the HbbTV standard (Hybrid Broadcast Broadband Television) and complemented with an extended user interface on a mobile second screen (i.e. tablet or mobile phone with touch screen). The proposed services will be (1) a help exchange system that enables older adults to offer/ask for support for activities of daily living to/from other older adults, who are living in geographical closeness; (2) an access to service providers like meals on wheels, shopping assistance, house-keeping, taxi, medical help or assistance, etc. and (3) support functions like reminders (e.g., for medication intake), news, weather, etc. The HCI & Usability Unit is project coordinator and work package leader of the user studies. The unit is responsible for a user-centered design process and the investigation of user requirements together with the two end user organizations, the iterative evaluation of the developed prototype regarding usability, user experience and acceptance according to the ViA model and support of the development of the GeTVivid platform, i.e. the TV and mobile client.

**Facts:**

| | |
|---|---|
| **Duration** | 2011 - 2016 |
| **Partners** | University of St. Gallen (Switzerland), Institut für Rundfunktechnik GmbH (Germany), Hövener & Trapp Evision GmbH (Germany), Ingenieria y Soluciones Informaticas del Sur, S.L. (Spain) CURAVIVA Verband Heime und Institutionen (Switzerland), Verein für Menschen mit Körperbehinderung Nürnberg e.V. (Germany), EURAG |
| **Funding** | EU AAL/FFG |

## 7.6 LiTech

The prime objective of this K-Project concerns sustainable knowledge about easy to use professional business and system control applications as well as future-proved implementation of natural and simple user interfaces for configuration, control, and communication within complex professional systems with high added value for our consortium as well as the scientific community. This K-Project deals with scientific and development issues of alternative user interfaces able to be implemented in professional business and system control applications in the near future for challenging use cases, such as controlling packaging machines in clean rooms, controlling real time data presentation tools during demanding workshops, and controlling global distribution of a broad range of products by means of information technology as well as configuring control systems for big and/or distributed cement plants and configuring medical computer equipment with high safety requirements during assembly, installation, and adjustment of respective products.

**Facts:**

| | |
|---|---|
| **Duration** | 2014 - 2018 |
| **Partners** | Fachhochschule Vorarlberg GmbH Dornbirn, Paris-Lodron-Universität Salzburg, Technische Universität Graz, AlphaGate GmbH Rankweil, Dorner Electronic GmbH Egg, Gebrüder Weiss GmbH Kennelbach, System Industrie Electronic GmbH Lustenau, WolfVision Innovation GmbH Sulz |
| **Funding** | FFG, COMET, K-Projects 5th Call |

## 7.7 ProMe

The project aims at offering an ICT solution that will be designed to facilitate intergenerational dialogue, lifelong learning and to create value among generations. ProMe seeks to provide meaningful opportunities for occupation in the life of older adults, in the transition from work to retirement and beyond. Older adults have acquired a considerable amount of professional formal and tacit knowledge. The platform allows professional intergenerational cooperation and mentoring, bringing together older adults with younger generations, based on theoretical concepts for mentoring. Current professional social networks (e.g., Xing, LinkedIn etc.) allow strengthening social relations among people who, for example, share interests and activities. In addition to this, ProMe offers the opportunity for older adults' meaningful occupation on a voluntary basis through taking an active role as a mentor. It encourages them to share their professional knowledge and expertise with younger generations, including those who are seeking career or more general life advice. ProMe enables older adults to continue and manage meaningful occupation, allowing them to take an active role in social and working life, even after retirement. This in turn creates value for the society and economy as a whole. The ProMe platform will provide different opportunities for informal communication through a variety of functionalities, for example Video/Text-Chat, Email, Blogs, Forums, etc. ProMe does not simply offer informal means of communication. Instead, it provides potential end users with the opportunity to take over different kinds of "mentoring roles", supported by offering those functionalities that support specific roles best.

**Facts:**

| | |
|---|---|
| **Duration** | 2014 - 2017 |
| **Partners** | Siveco (Romania), GlukAdvice (Netherlands), National Foundation of the Elderly (Netherlands), The general Association of Engineers (Romania), Inventya (United Kingdom), EURAG (Austria) |
| **Funding** | EU AAL/FFG |

## 7.8 REMEDI

The ReMeDi project aims at developing a robotic system for medical tele-examination of patients. Use case scenarios targeted in ReMeDi feature a robot capable of performing a physical examination, specifically of the two most widespread examination techniques i) palpation, i.e. pressing the patients stomach with the doctor's hand and observing the stiffness of the internal organs and the patient's feedback (discomfort, pain) as well as ii) ultrasonographic examination. Beside quality teleconferencing, ReMeDi features a mobile robot (placed in a hospital) equipped with a lightweight and inherently safe manipulator with an advanced sensorized head and/or ultrasonic probe; and the remote interface (placed at the doctor's location) equipped with sophisticated force-feedback, active vision and locomotion capabilities. The HCI & Usability Unit is responsible for a user-centered design process. The unit investigates user requirements together with LUM and iteratively evaluates the developed prototype regarding usability, user experience and acceptance.

**Facts:**

| | |
|---|---|
| **Duration** | 2013 - 2016 |
| **Partners** | Technische Universität München (Germany), ACCREA (Poland), Medial University of Lubinie (Poland), Politechnika Wroclawaska (Poland), University Scuola Superiore Sant'Anna (Italy), and ETH Zurich (Switzerland) |
| **Funding** | EU FP7-ICT |

## 7.9 Topics of research

### User Experience

- Going beyond usability (usability is only one factor)
- Comprehensive understanding of User Experience
- Temporal transition of User Experience
- Context characteristics in relation to User Experience factors
- Investigation of factors like emotion, enjoyment, fun, presence, aesthetics, comfort, trust, acceptance
- User experience in various contexts (e.g. embedded/ambient systems, industrial and medical robotics)
- Approaching User Experience from different perspectives (e.g., disciplines)

### Mobile Interfaces

- Improving the users' abilities to use mobile devices and services in a more personalized way and with greater pleasure
- Wide field of user interaction with mobile devices: context, multimodality, input/output techniques, social aspects, integration of emerging technologies etc.
- Effective and innovative forms of human-computer interaction with mobile systems and services
- Various contexts of mobility
- Specific focus on automotive context and autonomous vehicles

## Social Interfaces

- Enabling computers to recognize, express, and respond to social information in new interaction forms
- Focus on new theory and upcoming interface technologies that augment social interaction between people mediated via (new forms of) computers
- Approaching and understanding cooperative and collaborative processes (mediated via ICTs) from multiple perspectives (e.g., disciplines)
- Investigation and conceptualization of needs for successful cooperative and collaborative processes
- Multidisciplinary approaches combining social communication and computer sciences
- Specific focus on Human-Robot Interaction

## Ambient Interfaces

- Seamless and ubiquitous integration of ICTs into our everyday environment
- Study of the effects and potentials of ambient interfaces from the user and interaction perspective
- Prototypical developments and interaction innovations put into different contexts
- Research on the building blocks and integration aspects of Ambient Intelligence
- Ambient light as persuasive technology

## Interdisciplinary Methods and Approaches

- Advanced methodological approaches under the philosophy of user centered and interaction design
  - Contextual analysis methods and tools
  - User interface design methods and tools
  - Evaluation methods and tools
  - Understanding people and use
- Next generation methodological approaches for non standard contexts
- Exploring methods from different disciplines for their potential applicability within the interdisciplinary field of human-computer interaction
- Integrate design in research and practice

## Contextual Interfaces and Advanced Interaction

- Study and develop alternative interaction approaches and paradigms
- Study of the interdisciplinary implications of a specific context for various forms of interaction
- Development and application of a context dependent persuasion strategy
- Context as a concept: Description of circumstances and conditions, which constitute a given situation
- Contexts such as (assistive) living, car, factory, work, public, mobility, industrial and medical robotics, and special user group settings

## 7.10 Staff (cont'd)

- Dr. Ilhan Aslan
- Axel Baumgartner, B.Eng.
- Mag. Elke Beck
- DI Roland Buchner
- Ulrike Bruckenberger, Bakk. Komm.
- Mag.art Christine Döttlinger, B.Eng.
- Julian Fammler
- Magdalena Gärtner, Bakk.Komm.
- Thomas Grah, M.A.
- Tim Kaiser
- Moses Kallweit
- Thomas Kargl, MA
- MMag. Patricia Kluckner
- Dr. Arno Laminger
- Bernhard Maurer, M.Sc.
- Mag. Thomas Meneweger
- Mag. Alexander Mirnig
- Mag. Nicole Mirnig
- DI Christiane Moser
- DI (FH) Martin Murer
- Mag. Katja Neureiter
- MMag. Nicole Perterer

- Michaela Peterhansl
- Christina Rödel, B.Sc.
- Susanne Stadler, B.Eng.
- DI Gerald Stollnberger
- Mag. Ewald Strasser
- Mag.rer.nat. Sandra Trösterer
- Mag. Barbara Weixelbaumer
- Mandy Wilfinger, MA
- Martin Wuchse, B.Eng.
- Mag. Daniela Wurhofer, Bakk.tech.
- Cornelia Zenz

## 7.11 Publications

### Journals


[1] C. Moser, M. Tscheligi, B. Zaman, V. Vanden Abeele, L. Geurts, M. Vandewaetere, P. Markopoulos, and P. Wyeth. Editorial: Learning from failures in game design for children. *International Journal of Child-Computer Interaction*, 2014.

[2] Ewald Strasser Nicole Mirnig. Can you read my face? a methodological variation for assessing facial expressions of robotic heads. *International Journal of Social Robotics*, 6(SI Artificial Empathy):14, 2014.

[3] B. Ratzer, A. Weiss, B. Weixelbaumer, N. Mirnig, M. Tscheligi, D. Raneburger, R. Popp, and J. Falb. Bringing gender into technology: A case study in user-interface-design and the perspective of gender experts. *International Journal of Gender, Science and Technology*, 6(1):3–24, 2014.


### Proceedings of peer reviewed conferences


[1] I. Aslan, A. Uhl, A. Meschtscherjakov, and M. Tscheligi. Mid-air authentication gestures: An exploration of authentication based on palm and finger motions. In *Proceedings of the 16th International Conference on Multimodal Interaction*, ICMI '14, pages 311–318, New York, NY, USA, 2014. ACM.

[2] E. Beck, C. Moser, and M. Tscheligi. Memoing and lenses: Two approaches for exploring player-generated game ideas in videos. In *Proceedings of the 11th International Conference on Advances in Computer Entertainment Technology*, 2014.

[3] Y. Fernaeus, M. Murer, V. Tsaknaki, and J. S. Belenguer. Handcrafting electronic accessories using 'raw' materials. In *Proceedings of the 8th International Conference on Tangible, Embedded and Embodied Interaction*, TEI '14, pages 369–372, New York, NY, USA, 2014. ACM.

[4] V. Fuchsberger, M. Murer, I. Aslan, A. Meschtscherjakov, M. Tscheligi, P. Sundström, and D. Petrelli. Contextual constraints: Consequences for interaction design. In *Proceedings of the 2014 Companion Publication on Designing Interactive Systems*, DIS Companion '14, pages 227–230, New York, NY, USA, 2014. ACM.

[5] V. Fuchsberger, M. Murer, T. Meneweger, and M. Tscheligi. Capturing the in-between of interactive artifacts and users: A materiality-centered approach. In *NordiCHI '14: The 8th Nordic Conference on Human-Computer Interaction Proceedings*, pages 451–460, 2014.

[6] V. Fuchsberger, M. Murer, and M. Tscheligi. Human-computer non-interaction: The activity of non-use. In *Proceedings of the 2014 Companion Publication on Designing Interactive Systems*, DIS Companion '14, pages 57–60, New York, NY, USA, 2014. ACM.

[7] V. Fuchsberger, M. Murer, D. Wurhofer, T. Meneweger, K. Neureiter, A. Meschtscherjakov, and M. Tscheligi. The multiple layers of materiality. In *Proceedings of the 2014 Companion Publication on Designing Interactive Systems*, DIS Companion '14, pages 73–76, New York, NY, USA, 2014. ACM.

[8] M. Gärtner, A. Meschtscherjakov, B. Maurer, D. Wilfinger, and M. Tscheligi. ''dad, stop crashing my car!'': Making use of probing to inspire the design of future in-car interfaces. In *AutomotiveUI '14: 6th International Conference on Automotive User Interfaces and Interactive Vehicular Applications*, Seattle, WA, USA, 2014. ACM.

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## Miscellaneous


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## 7.12 Teaching

### Courses

- Einführung HCI
- User Interface Engineering
- Usability und User Experience Engineering
- Bachelor Projekt
- HCI Anwendungen
- HCI Studio
- User Interface Design
- Seminar aus Informatik
- Masterkonversatorium HCI
- Future HCI Approaches
- Advanced HCI Theories and Methods
- HCI Dissertantenseminar
- The Future of Interaction: An Introduction
- Case Studies der Interaktionsforschung - Human-Computer Interaction, Usability, User Experience

## 7.13 Supervised theses

### Master

- Ulrike Bruckenberger: Die Darstellung von Robotern in den Medien. Terminator vs. Wall-E
- Magdalena Gärtner: How Children adopt and integrate a new Media Technology into their Home: An explorative long-term investigation of the interaction behaviour and user experience of 10 to 13 years old children using the Nintendo 3DS system within the spatial, temporal and social contexts of their home
- Florian Primessnig: Exploring Users Experiences of Full Body Movement Interaction using Movement Qualities
- Martin Wuchse: Toolbased Narration Support in Mobile Environments
- Stefan Riegler: Multimodales Rapid Prototyping Interface Framework
- Susanne Stadler: Robot Programming by Demonstration: Investigation of Acceptance Factors regarding Kinesthetic Teaching and Robot Appearance in the Factory
- Axel Baumgartner: CES: A Contextual Experience Sampling System for Human Computer Interaction Studies In The Wild

## PhD

- Patricia Kluckner: The Power and Evaluation of Long-term Persuasion: User-centered Development of Ambient Persuasive Displays
- Elke Beck: Video-mediated communication in interaction design
- Nicole Mirnig: Robot Feedback: Development of a Taxonomy and Exemplary Feedback Studies
- Christiane Moser: Child-Centered Game Development
- Katja Neureiter: Social Capital. How VMC Systems can support the development of beneficial relationships
- Daniela Wurhofer: Temporal Transitions of User Experience
- Thomas Meneweger: Everyday Interactions with Technology in Production Environments: Accessing (Non-) Ordinary Experiences in Verbal Expressions by Means of Qualitative Interviews
- Alina Krischkowsky: Social Roles Empowering Collaboration: From Offline to Online Social Organizations and vica versa

- Thomas Kargl: Werbung als Kultur- und Technologiefinanzierer. Analyse von Auswirkungen und Alternativen
- Alexander Mirnig: Patterns in Research and Practice: Systems, Use and Generation
- Bernhard Maurer: Integrating context, play, and interaction design: an embodied interaction perspective for colocated play
- Martin Murer: Making Things Apart - Deconstruction in Interactive System Design
- Fuchsberger Verena: Interrelating Materials, Artifacts, Interaction Designers, and Users
- Gerald Stollnberger: Adaptive multimodal interaction for Human-Robot Interaction (HRI) depending on task complexities - Enabeling natural interaction for HRI
- Sandra Trösterer: Design of Gaze-assisted Human-Computer Interaction
- Ilhan Aslan: Interfacing Through Movement: An Integration of Context and Movement Towards Embodied Interaction Design
- Nicole Perterer: Safety through Collaboration: A new Challenger for Automotive Design

# 8 Parallel Algorithmics Lab

## Overview

The research activities of the *Parallel Algorithmics Lab* focus on the design and implementation of efficient parallel algorithms for solving theoretical and practical problems in computer science.
The main goal is to design and implement such algorithms, which reflect the architecture and software characteristics of current supercomputers, aiming to exploit their performance potential efficiently.
The research themes include:

- Algorithms for data retrieval in large data collections by algebraic and clustering methods.
- Fast parallel linear algebra algorithms (matrix multiplication, systems of linear algebraic equations, eigen- and singular value solvers, factorization of matrices and tensors).
- VLSI solvers for elliptic partial differential equations.
- Multimedia and signal processing and compression algorithms for media servers and media processors.
- GPU computing: applications and programming models, medical image processing, discrete mathematics

**Head**

Univ.-Prof. Dr. Marián Vajteršic

Faculty Members

- Assoc.Prof. Dr. Rade Kutil
- Dr. Peter Zinterhof
- Dipl.-Ing. Markus Flatz

## 8.1 Publications

### Journals

[1] Walter R. Gruber, Andrea Zauner, Julia Lechinger, Manuel Schabus, Rade Kutil, and Wolfgang Klimesch. Alpha phase, temporal attention, and the generation of early event related potentials. *NeuroImage*, 103:119–129, December 2014.

### Proceedings

[1] Markus Flatz and Marián Vajteršic. Parallel nonnegative tensor factorization via newton iteration on matrices. In *Proceedings of the 2014 International Conference on High Performance Computing & Simulation (HPCS 2014)*, pages 1014–1015. IEEE, 2014.

### Miscellaneous

[1] Marián Vajteršic and Martin Bečka. Block Jacobi-based routines for SVD versus ScaLAPACK. In *Book of Abstracts of International Workshop on Algorithms and Software for Scientific Computing (SciNum 2014)*, pages 29–30, University of Vienna, 2014. Talk: Marián Vajteršic.

[2] Martin Bečka, Gabriel Okša, and Marián Vajteršic. Parallel Jacobi SVD can be competitive. In *Book of Abstracts of 8th International Conference on Parallel Matrix Algorithms and Applications (PMAA 2014)*, page 8, Universita della Svizzera Italiana, 2014.

[3] Martin Bečka, Gabriel Okša, and Marián Vajteršic. Solving SVD by Jacobi methods on supercomputers. In *Book of Abstracts of International Workshop on Eigenvalue Problems (EPASA 2014)*, page 20, University of Tsukuba, 2014. Invited talk: Marián Vajteršic.

## 8.2 Courses

- Digitale Rechenanlagen
- Basisverfahren für HPC
- Numerische Mathematik
- Parallelverarbeitung
- Lineare Algebra
- Einführung in die Programmierung
- Hardware Oriented Signal Processing
- Programmiersprachen: C/C++
- Statistik
- Audio Processing
- Verteilte Programmierung
- Praktische Aspekte von HPCTools und Bibliotheken
- GPU-Programmierung und Anwendungen
- HPC-Hardware: aktuelle Entwicklungen

## 8.3 Supervised theses

### Bachelor

- Felix Wolfersberger: Fourier-Transformation durch Integer-Rotation

### Master

- Mutlu Ertas: GUI-Pointer-Steuerung mittels stereoskopischem Finger-Tracking

### PhD

- Markus Flatz: Nonnegative Tensor Factorization: Algorithms and Parallelization

## 8.4 Miscellaneous activities

### Conferences

- 26th International Symposium on Computer Architecture and High Performance Computing (SBAC-PAD 2014) (Marián Vajteršic, PC member)
- The 2014 International Conference on High Performance Computing & Simulation (HPCS 2014) (Marián Vajteršic, PC member)
- 8th International Conference on Parallel Matrix Algorithms and Applications (PMAA 2014) (Marián Vajteršic, PC member)
- Parallel and Distributed Computing and Networks (PDCN 2014) (Rade Kutil, PC member)
- UnConventional High Performance Computing (Workshop 14, Euro-Par 2014) (Peter Zinterhof, PC member, session chair)

### Guest speaker

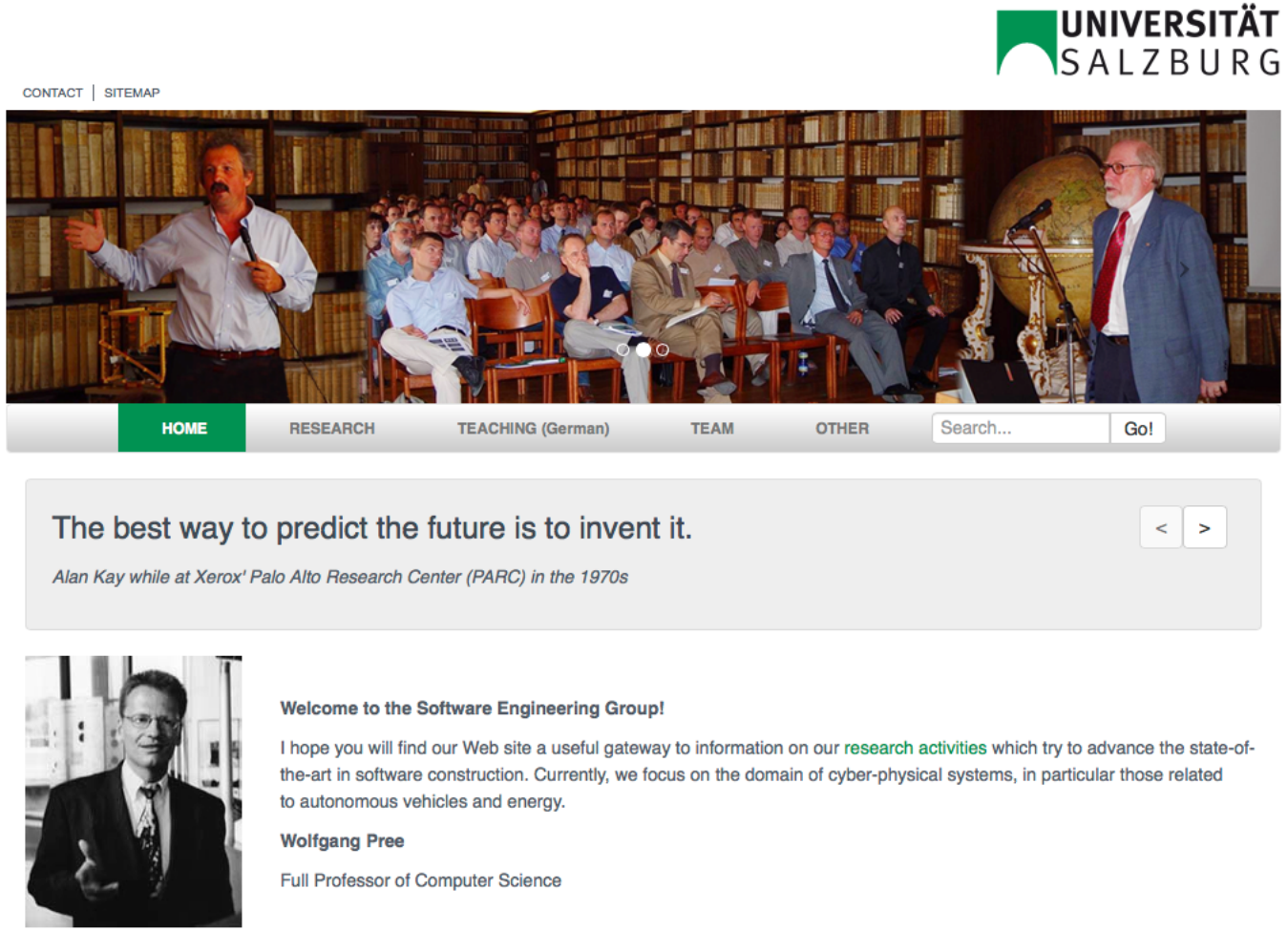
- Marián Vajteršic at University of Palermo, Italy
- Marián Vajteršic at Jozef Stefan Institute, Ljubljana

### Societies

- European Academy of Sciences and Arts (Univ.-Prof. Dr. Marián Vajteršic, member)
- Pro-IT: Working Group of the Austrian Computer Society (Univ.-Prof. Dr. Marián Vajteršic, vice-head)
- Working Group Science of the Austrian Center for Scientific Computing (Univ.-Prof. Dr. Marián Vajteršic, head)
- Working Group Infrastructure of the Austrian Center for Scientific Computing (Dr. Peter Zinterhof)

# 9 Software Engineering

***Please refer to*** `www.SoftwareResearch.net`



# 10 Visual Computing and Multimedia

## Overview

This research group comprises three labs, the Computational Geometry and Applications Lab (`http://www.cosy.sbg.ac.at/~held/work.html`), the Multimedia Communications Lab, and the Multimedia Signal Processing and Security Lab (WaveLab, `wavelab.at`).

**Head**

Ao.Univ.Prof. Dr. Martin Held

Faculty Members

- Ass.Prof. Dr. Bernhard Collini-Nocker
- Ass.Prof. Dr. Roland Kwitt
- Univ.Prof. Dr. Andreas Uhl

Funded Project Staff

- DI Günther Eder
- Bernhard Feldbacher
- DI Michael Gadermair
- DI Sebastian Hegenbart
- DI Dr Heinz Hofbauer
- DI Roland Hufnagl
- Dr Michael Liedlgruber
- DI Andreas Maier
- Mag. Christoph Ortner
- DI Peter Palfrader
- Rudolf Schraml
- DI (FH) DI Andreas Unterweger
- Mag. Georg Wimmer

## 10.1 ICT COST Action IC1106: Integrating Biometrics and Forensics for the Digital Age

Forensics is the application of a broad spectrum of sciences to answer questions of interest to a legal system. This may be in relation to a crime or a civil action" [Wikipedia]. Since many such questions boil down to identifying, or verifying the identity, of people allegedly involved in some action, a clear relationship exists between forensics and biometrics. Biometrics developed a number of techniques which can clearly facilitate the identification of people involved in criminal actions or civil incidents. Thus, although the two communities have traditionally often operated in relative isolation, there are many scenarios where the synergic cooperation of multimodal biometrics and forensics can be successfully applied.

**Facts:**

| | |
|---|---|
| **Duration** | 2012 - 2015 |
| **Partners** | 28 COST management committee members |
| **Funding** | EU - COST (European Cooperation in Science and Technology) |
| **Amount** | Travel & mobility costs (MC meetings, workshop attandence, short term scientific missions) |

## 10.2 ICT COST Action IC1206: De-identification for privacy protection in multimedia content

De-identification in multimedia content can be defined as the process of concealing the identities of individuals captured in a given set of data (images, video, audio, text), for the purpose of protecting their privacy. This will provide an effective means for supporting the EUs Data Protection Directive (95/46/EC), which is concerned with the introduction of appropriate measures for the protection of personal data. The fact that a person can be identified by such features as face, voice, silhouette and gait, indicates the de-identification process as an interdisciplinary challenge, involving such scientific areas as image processing, speech analysis, video tracking and biometrics. This Action aims to facilitate coordinated interdisciplinary efforts (related to scientific, legal, ethical and societal aspects) in the introduction of person de-identification and reversible de-identification in multimedia content by networking relevant European experts and organisations.

**Facts:**

| | |
|---|---|
| **Duration** | 2013 - 2017 |
| **Partners** | 43 COST management committee members |
| **Funding** | EU - COST (European Cooperation in Science and Technology) |
| **Amount** | Travel & mobility costs (MC meetings, workshop attandence, short term scientific missions) |

## 10.3 Biometric Sensor Forensics

Project on using media forensics to enhance biometric systems security. Image and video forensics have emerged to complement classical cryptographic techniques and active media security techniques, in application cases where these passive technologies can offer advantages to the more established methodologies. This projects aims to apply image forensic techniques in the context of fingerprint and iris biometric systems, by taking care of (1) the specific nature of biometric sensors and (2) the specific nature of biometric sample data. In particular, questions of biometric sensor authentication, biometric sample data integrity verification, and biometric sensor ageing will be covered. We will contribute to biometric system accuracy, reliability, and security with the results of this project.

**Facts:**

| | |
|---|---|
| **Duration** | 2014 - 2017 |
| **Partners** | TU Dresden, Chinese Academy of Sciences |
| **Funding** | FWF |

## 10.4 Endoscope Distortion Correction in (Texture Classification-based) Automated Diagnosis Support Systems

Project devoted to the investigation if knowledge about the type and extent of optical distortion in endoscopes can be exploited to improve the accuracy of texture-classification based automated diagnosis support systems. In particular, we focus on the gastrointestinal tract. We rely on datasets generated in earlier projects with Michael Häfner from the St. Elisabeth Hospital Vienna (colon data, aimed at polyp classification and cancer detection), and with Andreas Vecsei from the Vienna St. Anna Childrens Hospital (duodenal data, aimed at diagnosis of celiac disease).

**Facts:**

| | |
|---|---|
| **Duration** | 2012 - 2015 |
| **Partners** | St. Anna Childrens Hospital, Vienna and St. Elisabeth Hospital, Vienna |
| **Funding** | FWF |

## 10.5 Physiological Markers for the Prognosis of Memory Decline

The aim of the project is to identify pysiological markers which allow to distinguish between generic memory decline (i.e. mild cognitive impairment MCI) and MCI associated with temporal lobe epilepsy. The pysiological data considered are MRT scans and EEG data. Our particular contribution is MRT segmentation with emphasis on the hippocampus and derivation of sensible features as well as the application of ensemble classification techniques.

**Facts:**

| | |
|---|---|
| **Duration** | 2011 - 2014 |
| **Partners** | Salzburg Christian Doppler Hospital (Department of Neurology), Innsbruck University Hospital |
| **Funding** | FWF KLIF |

## 10.6 Privacy-protected Video Surveillance on Scalable Bitstreams

Project on developing privacy-protection mechanisms for video surveillance. Specific focus is set on applying RoI-based encryption technique on a bitstream basis, i.e. selectively encrypting JPEG2000 and H.264/SVC.

**Facts:**

| | |
|---|---|
| **Duration** | 2012 - 2014 |
| **Partners** | Commend International GmbH, Salzburg University of Applied Sciences (School of ITS) |
| **Funding** | FFG Bridge 1 |

## 10.7 Traceability of Logs by Means of Digital Images

The aim of the project is to verify the traceability of logs on the basis of additional data acquisition in the forest (digital imagery) and to describe the main methodical framework for this approach to be taken. Focus is set on the development of feature descriptors, which are experessive enough to identify a single log (i.e. tree) based on a digital image of its cross-section.

**Facts:**

| | |
|---|---|
| **Duration** | 2012 - 2015 |
| **Partners** | Salzburg University of Applied Sciences (School of Forest Products Technology) |
| **Funding** | FWF TRP |

## 10.8 Cloud Visualization

The goal of the project is the realistic rendering of cloud scenes based on real-world meteorological data. Key aspects of the project are the modeling of cloud scenes based on the sparse (static) data, the realistic lighting of clouds, and the animation of static clouds to generate realistic transitions between the static states.

**Facts:**

| | |
|---|---|
| **Duration** | 2011 - 2014 |
| **Funding** | FFG Fit-IT “Visual Computing” |

## 10.9 Straight Skeletons

The goal of the project is the study of the theory and application of straight skeletons in 2D and 3D. Based on prior work in a previous FWF project, we plan to extend the knowledge we have gained to (1) weighted straight skeletons in two dimensions and to (2) straight skeletons of three-dimensional polyhedra. Besides working on a thorough mathematical and algorithmic foundation for straight skeletons in 2D and 3D, we place our emphasis on converting our algorithms into software tools, in order to jump-start future work by providing colleagues and companies with ready-to-use libraries. Our tools will be applicable to diverse fields, including, but not limited to, CAD/CAM, architecture and GIS, thereby broadening the practical impact of our work.

**Facts:**

| | |
|---|---|
| **Duration** | 2013 - 2016 |
| **Funding** | FWF |

## 10.10 eHealth for elderly people

The project aims at offering a set of AAL-related functionality and services to older adults as well as informal and formal carers through the use of connected TV devices based on the HbbTV standard complemented with a mobile second screen. The initially proposed services/functions are:

- a help exchange system to enable older adults to offer/ask for support for daily life activities to/from others
- access to service providers like meals on wheels, shopping assistance, house- keeping, taxi, medical help or assistance, etc.
- support functions like reminders, news, weather, etc.

**Facts:**

| | |
|---|---|
| **Duration** | 2013 - 2016 |
| **Partners** | Salzburg University ICT&S |
| **Partners** | IRT GmbH |
| **Partners** | University St. Gallen |
| **Partners** | EVISION GmbH |
| **Partners** | ISOIN |
| **Partners** | various Social Communities |
| **Funding** | FWF TRP |

## 10.11 Topics of research

- **Computational Geometry and Applications Lab**
  - Head: Ao.Univ.Prof. Dr. Martin Held
  - computational geometry,
  - algorithms and data structures (particularly those with a geometric flavor),
  - algorithm engineering,
  - program design, robustness and reliability,
  - GPU-based computing, and
  - applications of geometric algorithms and data structures in, e.g., computer-aided (geometric) design, computer-aided manufacturing, geographical information systems, computer graphics, visual computing, and virtual reality.
  - Website: `http://www.cosy.sbg.ac.at/~held/work.html`
- **Multimedia Signal Processing and Security Lab**
  - Head: Univ.Prof. Dr. Andreas Uhl
  - Other faculty: Ass.-Prof. Dr. Roland Kwitt
  - multimedia security and biometrics,

- medical image processing and analysis,
- (wavelet-based) image and video compression,
- visual object detection and tracking,
- visual data quality assessment, and
- computer vision & machine learning.
- Website(s): `http://www.wavelab.at`, `http://rkwitt.org`

- **Multimedia Communications Lab**
  - Head: Ass.Prof. Dr. Bernhard Collini-Nocker
  - wireless Internet multimedia communication,
  - intelligent caching solutions, and
  - IP multicast related work.
  - Expertise includes work on optimized protocols for wireless and satellite communications, Digital Video Broadcast -based gateway architectures, transparent web caching and app acceleration techniques, multimedia and hypermedia web applications, app architectural design and developmemt, network and application security analysis traffic monitoring, measurement and analysis.

## 10.12 Publications

### Journals


[1] S. Huber, M. Held, P. Meerwald, and R. Kwitt. Topology-Preserving Watermarking of Vector Graphics. *Internat. J. Comput. Geom. Appl.*, 24(1):61–86, March 2014.

[2] M. Held and C. Spielberger. Improved Spiral High-Speed Machining of Multiply-Connected Pockets. *Comput. Aided Design & Appl.*, 11(3):346–357, 2014.

[3] M. Held and D. Kaaser. C2 Approximation of Planar Curvilinear Profiles by Cubic B-Splines. *Comput. Aided Design & Appl.*, 11(2):206–219, 2014.

[4] Andreas Unterweger and Andreas Uhl. Slice groups for post-compression region of interest encryption in H.264/AVC and its scalable extension. *Signal Processing: Image Communication*, 29(10):1158–1170, November 2014.

[5] Thomas Stütz, Florent Autrusseau, and Andreas Uhl. Non-blind structure-preserving substitution watermarking of H.264/CAVLC inter-frames. *IEEE Transactions on Multimedia*, 16(5):1337–1349, 2014.

[6] S. Jenisch and A. Uhl. A detailed evaluation of format-compliant encryption methods for JPEG XR-compressed images. *EURASIP Journal on Information Security*, 2014(6), 2014.

[7] Y. Hong, B. Davis, J. S. Marron, R. Kwitt, N. Singh, J. S. Kimbell, E. Pitkina, R. Superfine, S.D. Davis, C. J. Zdanski, and M. Niethammer. Statistical atlas construction via weighted functional boxplots. *Medical Image Analysis*, 18(4):684–698, May 2014.


### Proceedings of peer reviewed conferences


[1] P. Palfrader and M. Held. Computing Mitered Offset Curves Based on Straight Skeletons. In *Comput. Aided Design Conf.*, pages 97–99, June 2014.

[2] R. Hufnagel and M. Held. Animation of Clouds Based on the Interpolation of Weather Forecast Data. In *2nd EuroVis Workshop on the Visualization in Environmental Sciences (EnvirVis '14)*, pages 25–29, June 2014.

[3] T. Biedl, M. Held, S. Huber, D. Kaaser, and P. Palfrader. Straight Skeletons of Monotone Polygons. In *Proc. 30th Europ. Workshop Comput. Geom.*, March 2014.

[4] T. Biedl, S. Huber, and P. Palfrader. Stable Roommates for Weighted Straight Skeletons. In *Proc. 30th Europ. Workshop Comput. Geom.*, March 2014.

[5] Stefan Jenisch and Andreas Uhl. Visual security evaluation based on SIFT object recognition. In L. Iliadis et al., editors, *Proceedings of the 10th Artificial Intelligence Applications and Innovations Conference (AIAI 2014)*, volume 436 of *Springer IFIP AICT*, pages 624–633, Rhodes, GR, 2014.

[6] Rudolf Schraml and Andreas Uhl. Similarity based cross-section segmentation in rough log end images. In L. Iliadis et al., editors, *Proceedings of the 10th Artificial Intelligence Applications and Innovations Conference (AIAI'14)*, volume 436 of *Springer IFIP AICT*, pages 614–621, Rhodes, GR, 2014.

[7] R. Kwitt, S. Hegenbart, N. Rasiwasia, A. Vécsei, and A. Uhl. Do we need annotation experts? a case study in celiac disease classification. In *Proceedings of the International Conference on Medical Image Computing and Computer Assisted Intervention (MICCAI'14)*, volume 8674 of *Lecture Notes in Computer Science*, pages 454–461, September 2014.

[8] Heinz Hofbauer, Andreas Uhl, and Andreas Unterweger. Transparent Encryption for HEVC Using Bit-Stream-Based Selective Coefficient Sign Encryption. In *2014 IEEE International Conference on Acoustics, Speech and Signal Processing (ICASSP)*, pages 1986–1990, Florence, Italy, May 2014. IEEE.

[9] Andreas Unterweger and Andreas Uhl. Slice Groups for Post-Compression Region of Interest Encryption in SVC. In *IH&MMSec'14: Proceedings of the 2014 ACM Information Hiding and Multimedia Security Workshop*, pages 15–22, Salzburg, Austria, June 2014. ACM.

[10] Michael Gschwandtner, Andreas Uhl, and Andreas Unterweger. Speeding Up Object Detection – Fast Resizing in the Integral Image Domain. In *VISAPP 2014 – Proceedings of the 9th International Conference on Computer Vision Theory and Applications*, volume 1, pages 64–72, Lisbon, Portugal, January 2014. SciTePress.

[11] S. Hegenbart and A. Uhl. An orientation-adaptive extension to scale-adaptive local binary patterns. In *Proceedings of the 22nd International Conference on Pattern Recognition (ICPR'14)*, pages 1120–1125, 2014.

[12] A. Häfner, A. Uhl, and G. Wimmer. A novel shape feature descriptor for the classification of polyps in HD colonoscopy. In *Medical Computer Vision. Large Data in Medical Imaging (Proceedings of the 3rd International MICCAI - MCV Workshop 2013)*, volume 8331 of *Springer LNCS*, pages 205–213, 2014.

[13] S. Hegenbart and A. Uhl. A scale-adaptive extension to methods based on LBP using scale-normalized laplacian of gaussian extrema in scale-space. In *Proceedings of the International Conference on Acoustics, Speech, and Signal Processing (ICASSP'14)*, pages 4352–4356, 2014.

[14] Michael Gadermayr, Michael Liedlgruber, Andreas Uhl, and Andreas Vécsei. Shape curvature histogram: A shape feature for celiac disease diagnosis. In *Medical Computer Vision. Large Data in Medical Imaging (Proceedings of the 3rd International MICCAI - MCV Workshop 2013)*, volume 8331 of *Springer LNCS*, pages 175–184, 2014.

[15] Michael Gadermayr, Andreas Uhl, and Andreas Vécsei. Quality based information fusion in fully automatized celiac disease diagnosis. In *Proceedings of the German Conference on Pattern Recognition (GCPR'14)*, volume 8753 of *Springer LNCS*, pages 1–12, 2014.

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[18] Michael Gadermayr, Andreas Uhl, and Andreas Vécsei. Degradation adaptive texture classification: A case study in celiac disease diagnosis brings new insight. In *Proceedings of the International Conference on Image Analysis and Recognition (ICIAR'14)*, volume 8815 of *Springer LNCS*, pages 263–273, 2014.

[19] Heinz Hofbauer, Fernando Alonso-Fernandez, Peter Wild, Josef Bigun, and Andreas Uhl. A ground truth for iris segmentation. In *Proceedings of the 22th International Conference on Pattern Recognition (ICPR'14)*, Stockholm, Sweden, 2014.

[20] Michael Gadermayr, Andreas Uhl, and Andreas Vécsei. Feature extraction with intrinsic distortion correction in celiac disease imagery: No need for rasterization. In *Medical Computer Vision. Large Data in Medical Imaging (Proceedings of the 3rd International MICCAI - MCV Workshop 2013)*, volume 8331 of *Springer LNCS*, pages 196–204, 2014.

[21] C. Rathgeb, A. Uhl, and P. Wild. Effects of severe image compression on iris segmentation performance (best poster award). In *Proceedings of the IAPR/IEEE International Joint Conference on Biometrics (IJCB'14)*, 2014.

[22] T. Bergmüller, L. Debiasi, Z. Sun, and A. Uhl. Impact of sensor ageing on iris recognition. In *Proceedings of the IAPR/IEEE International Joint Conference on Biometrics (IJCB'14)*, 2014.

[23] L. Debiasi, Z. Sun, and A. Uhl. Generation of iris sensor PRNU fingerprints from uncorrelated data. In *Proceedings of the 2nd International Workshop on Biometrics and Forensics (IWBF'14)*, 2014.

[24] Michael Gadermayr, Andreas Uhl, and Andreas Vécsei. Getting one step closer to fully automatized celiac disease diagnosis. In *Proceedings of the 4th IEEE International Conference on Image Processing Theory, Tools and Applications 2014 (IPTA'14)*, pages 13–17, 2014.

[25] Michael Gadermayr and Andreas Uhl. Degradation adaptive texture classification. In *Proceedings of the IEEE International Conference on Image Processing 2014 (ICIP'14)*, 2014.

[26] M. Häfner, A. Uhl, and G. Wimmer. Shape and size adapted local fractal dimension for the classification of polyps in hd colonoscopy. In *Proceedings of the IEEE International Conference on Image Processing 2014 (ICIP'14)*, October 2014.

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[28] Rudolf Schraml, Johann Charwat-Pessler, and Andreas Uhl. Temporal and longitudinal variances in wood log cross-section image analysis. In *IEEE International Conference on Image Processing (ICIP'14)*, Paris, FR, 2014.

[29] Georg Penn, Gerhard Pötzelsberger, Martin Rohde, and Andreas Uhl. Customisation of paillier homomorphic encryption for efficient binary biometric feature vector matching. In *Proceedings of the International Conference of the Biometrics Special Interest Group (BIOSIG'14)*, Darmstadt, Germany, September 2014.

[30] Christof Kauba, Jakob Reissig, and Andreas Uhl. Pre-processing cascades and fusion in finger vein recognition. In *Proceedings of the International Conference of the Biometrics Special Interest Group (BIOSIG'14)*, Darmstadt, Germany, 2014.

[31] Michael Gadermayr, Sebastian Hegenbart, and Andreas Uhl. Scale-adaptive texture classification. In *Proceedings of 22nd IAPR International Conference on Pattern Recognition (ICPR'14)*, 2014.

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[36] X. Liu, M. Niethammer, R. Kwitt, M. McCormick, and S. Aylward. Low-rank to the rescue: Atlas-based analyses in the presence of pathologies. In *Proceedings of the International Conference on Medical Image Computing and Computer Assisted Intervention (MICCAI '14)*, volume 8675 of *Lecture Notes in Computer Science*, pages 97–104, September 2014.

[37] R. Kwitt, S. Razzaque, J. Lowell, and S.Aylward. Variability sensitivity of dynamic texture based recognition in clinical CT data. In *SPIE Medical Imaging*, 2014.

[38] Y. Hong, R. Kwitt, N. Singh, and M. Niethammer. Geodesic regression on the grassmannian. In *Proceedings of the European Conference on Computer Vision (ECCV '14)*, volume 8690 of *Lecture Notes in Computer Science*, pages 632–646, September 2014.

[39] Y. Hong, N. Singh, R. Kwitt, and M. Niethammer. Time-warped geodesic regression. In *Proceedings of the International Conference on Medical Image Computing and Computer Assisted Intervention (MICCAI '14)*, volume 8674 of *Lecture Notes in Computer Science*, pages 105–112, September 2014.

## Books

## Miscellaneous

[1] Rudolf Schraml, Johann Charwat-Pessler, Alexander Petutschnigg, and Andreas Uhl. Robustness of biometric wood log traceability using digital log end images. Technical Report 2014-08, Department of Computer Sciences, University of Salzburg, Austria, `http://www.cosy.sbg.ac.at/tr`, 2014.

[2] Michael Gadermayr, Sebastian Hegenbart, and Andreas Uhl. Scale-adaptive texture classification. Technical Report 2014-01, Department of Computer Sciences, University of Salzburg, Austria, 2014. `http://www.cosy.sbg.ac.at/tr`.

[3] Michael Gadermayr and Andreas Uhl. Degradation adaptive texture classification. Technical Report 2014-04, Department of Computer Sciences, University of Salzburg, Austria, 2014. `http://www.cosy.sbg.ac.at/tr`.

[4] Michael Gadermayr, Andreas Uhl, and Andreas Vécsei. Dealing with intra-class and intra-image variations in automatic celiac disease diagnosis. Technical Report 2014-07, Department of Computer Sciences, University of Salzburg, Austria, `http://www.cosy.sbg.ac.at/tr`, 2014.

## 10.13 Teaching

### Teaching

- Einführung Unix (VP)
- Diskrete Mathematik (VO+PS)
- Computational Geometry (VO+PS)
- Geometric Modeling (VO+PS)
- Geometrisches Rechnen (VP)
- Computergraphik (SE)
- Einführung Computergraphik (VO+PS)
- Wissenschaftliches Arbeiten und Präsentation (VP)
- Multimedia Sicherheit / Media Security
- Biometrische Systeme / Biometric Systems
- Einführung in Kryptographie und IT-Sicherheit
- Grundlagen Bildverarbeitung / Image Processing and Computer Vision
- Multimedia Datenformate / Media Formats
- Orientierung Informatik
- Multimedia Technologien (SE)
- Anwendungen in Wirtschaft und Technik
- Netze und Verteilte Systeme
- Multimedia Netzwerke
- Rechner und Netzwerksicherheit
- Betriebssysteme
- Betriebssysteme in der Praxis
- Current Topics in Computer Science
- Imaging Beyond Consumer Cameras (VO+PS)
- Advanced Image Processing and Computer Vision (VO+PS)
- Datenbanken I (PS)

## 10.14 Supervised theses

### Bachelor

- Alexander Gruschina: Hand Veins In Biometrics
- Eva Lugstein: Design and Implementation of an Upgradable and Updatable Embedded Device — Safety & Security
- Sebastian Zanner: Using Computer Graphics for Approximatively Generating Voronoi Diagram and Delaunay Triangulation.

### PhD

- Sebastian Hegenbart: On the computer assisted diagnosis of endoscopic data with indication for celiac disease
- Andreas Unterweger: Post-Compression Multimedia Security

### Master

- Günter Eder: Parallel Triangulation of Polygons.
- Davor Jovanoski: Bounding Volume Hierarchies of K-DOPs for CUDA-based Collision Detection.
- Georg Penn: Offensive Security.
- Ernst W. Tillian: Digitaler Identitätsdiebstahl.

## 10.15 Miscellaneous activities

**Commercial licensing**: VRONI/ArcVRONI licenses sold to ADAPT Structural Concrete Solutions (Redwood City, CA, USA), B&B Ingenieurgesellschaft (Donaueschingen, Germany), Grafitroniks (Vitry sur Seine, France), Preference (Paterna, Spain), Ucamco (Gent, Belgium), WiCAM (Pfinztal-Söllingen, Germany; STALGO licenses sold to Urban Games (Schaffhausen, Switzerland).
**Conference Organisation**: Andreas Uhl was main organiser and general chair of the ACM IH&MMSec 2014 Workshop, held in Salzburg in June 2014. Roland Kwitt was PC chair at the same conference.
**Awards**: Andreas Uhl received the Best Reviewer Award of the 2014 EURASIP European Conference on Signal Processing (EUSIPCO 2014). Together with Christian Rathgeb (CASED Darmstadt) and Peter Wild (Univ. of Reading), Andreas Uhl received the Best Poster Award at the IAPR/IEEE International Joint Conference on Biometrics (IJCB'14) for the paper "Effects of Severe Image Compression on Iris Segmentation Performance".
Roland Kwitt was mentioned as an "Outstanding Reviewer" at CVPR 2014, the premier conference in computer vision (see `http://goo.gl/PFxcX0`).
Martin Held and Peter Palfrader received a Best Paper Award at the International CAD'14 Conference.