Biennial Report 2010/2011
Department of Informatics
This is the fourth Biennial report of the Department of Informatics (IFI) at Clausthal University of Technology, covering the years 2010 and 2011. The past two years were characterized by three developments: First, the intensification of efforts in research funding acquisition, leading, amongst others, to the initiation of the Institute for Applied Software Systems Engineering, a large-scale research activity in the area of embedded systems engineering, supported by Volkswagen AG. Second, the department’s engagement in the IT-Ökosysteme collaborative research project, a joint Computer Science research initiative by Clausthal University of Technology, Leibniz Universität Hannover and TU Braunschweig. This engagement so far has led to a successful DFG Focused Research Programme application and to a submitted preproposal for a DFG Graduate School on Human-Centered Information Systems. Third, the extension of educational offerings in and beyond our Bachelor-Master programmes, including the continuous improvement of our existing programmes, a new Master course in Systems Engineering, aiming at industry professionals, and the extension of our Early Studies programme.

In the reporting period, the research funding of the department increased considerably; at the same time, our overall headcount grew to almost 80 (not including student members). Publication and scientific committee activities continue at a high level, and the number of dissertations remains stable. A major challenge for the future lies in securing our basis of young scientists by attracting and educating a sufficient number of new students; to do so, we need to preserve attractiveness of our existing educational offerings as well as create new ones. In this context, we are proud to report that our department has very recently achieved excellent scores in the new university ranking published by the renowned Centrum für Hochschulentwicklung (CHE) in May 2012, where we scored best out of 78 universities on the quality of student mentoring and supervision, among the Top 3 on quality of IT infrastructure, and among the Top 6 on the criterion of overall student satisfaction.

The success of the department could not have been achieved without the high and persistent efforts of each individual person in our department, in teaching, research, administration, and infrastructure support. It is my strong wish to express my appreciation and gratitude to them. Due to their spirit and dedication, the Department is well set up for the future challenges.
Composing a report like this involves long hours of tedious effort from a number of dedicated individuals. Although all research groups provided us with material for Chapter 3, it still was a lot of work to turn it into a coherent and homogeneous booklet. I would like to thank Gabriel Zachmann for contributing Chapter 2. Andrea Behfeld, Stefanie Cronjäger, Christine Kammann and Sandra Karpenstein, Annett Panterodt, and Anita Seiz-Uhlig have helped putting together finance and personnel data. Last but not least, Stefan Aust and Tristan Behrens have done splendid jobs in collecting contributions (sometimes with gentle force) and in putting all the individual contributions together, mastering the secrets of LaTeX with utter proficiency: Thank you very much indeed.

While we did our best to make sure that all data are sound and correct, we do not claim that this report is flawless. It goes without saying that I am solely responsible for any remaining faults.

As the world keeps on progressing rapidly, for more recent information we refer to our webpage http://www.in.tu-clausthal.de/ which is continually updated.

March 2012
Prof. Dr. Jörg Müller
# Table of Contents

Preface ........................................................................................................ i

1 The Department of Informatics ................................................................. 5
  1.1 Overview ......................................................................................... 5
  1.2 History ......................................................................................... 6
  1.3 Research ....................................................................................... 7
  1.4 Education ..................................................................................... 14
  1.5 Staff and Organization .................................................................. 17
  1.6 Major events and activities ........................................................... 21

2 Academic Programmes ............................................................................. 29
  2.1 Overview ....................................................................................... 29
  2.2 Study Programmes ......................................................................... 29
    2.2.1 B.Sc. Programme “Computer Science” .................................. 29
    2.2.2 M.Sc. Programmes in Computer Science and Business Information Systems .................................... 30
    2.2.3 M.Sc. in Internet Technologies and Information Systems ................................................................. 30
    2.2.4 B.Sc. in Computer Engineering .............................................. 31
    2.2.5 M.Sc. in Systems Engineering ............................................... 32
    2.2.6 M.Sc. in Embedded Software Engineering ......................... 33
    2.2.7 B.Sc. TI Online — An Internet-based Bachelor Course for Continuing Education of Professionals .......... 34
    2.2.8 Diploma Programmes .............................................................. 34
    2.2.9 Ph.D. Programme in Computer Science ................................. 35
  2.3 eLearning ......................................................................................... 36
  2.4 International Collaborations ............................................................ 36
  2.5 Outreach Activities ......................................................................... 39
    2.5.1 Summer Seminar ................................................................. 39
    2.5.2 Seminar “Simulation and Visualization” .............................. 39
    2.5.3 School Information Days ..................................................... 40
    2.5.4 Girl’s Day .............................................................................. 41
    2.5.5 School Visits ......................................................................... 41
    2.5.6 TILL 2011 ............................................................................. 41
    2.5.7 Alumni Management ............................................................. 42
    2.5.8 Early Studies Programme for High School Students .......... 42
  2.6 Lecturing ......................................................................................... 42

3 Research Groups ...................................................................................... 57
  3.1 Business Information Technology Unit .......................................... 58
    3.1.1 Overview .............................................................................. 58
    3.1.2 Research Agenda ................................................................. 58
    3.1.3 Supervised Theses ................................................................. 59
    3.1.4 Projects ............................................................................... 62
<table>
<thead>
<tr>
<th>Section</th>
<th>Title</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.1.5</td>
<td>Scientific Activities</td>
<td>73</td>
</tr>
<tr>
<td>3.1.6</td>
<td>Highlights</td>
<td>79</td>
</tr>
<tr>
<td>3.2</td>
<td>Computational Intelligence</td>
<td>81</td>
</tr>
<tr>
<td>3.2.1</td>
<td>Overview</td>
<td>81</td>
</tr>
<tr>
<td>3.2.2</td>
<td>Research Agenda</td>
<td>81</td>
</tr>
<tr>
<td>3.2.3</td>
<td>Supervised Theses</td>
<td>81</td>
</tr>
<tr>
<td>3.2.4</td>
<td>Projects</td>
<td>82</td>
</tr>
<tr>
<td>3.2.5</td>
<td>Scientific Activities</td>
<td>90</td>
</tr>
<tr>
<td>3.2.6</td>
<td>Highlights</td>
<td>100</td>
</tr>
<tr>
<td>3.3</td>
<td>Foundations of Computer Science</td>
<td>102</td>
</tr>
<tr>
<td>3.3.1</td>
<td>Overview</td>
<td>102</td>
</tr>
<tr>
<td>3.3.2</td>
<td>Research Agenda</td>
<td>102</td>
</tr>
<tr>
<td>3.3.3</td>
<td>Supervised Theses</td>
<td>102</td>
</tr>
<tr>
<td>3.3.4</td>
<td>Projects</td>
<td>103</td>
</tr>
<tr>
<td>3.3.5</td>
<td>Scientific Activities</td>
<td>107</td>
</tr>
<tr>
<td>3.3.6</td>
<td>Highlights</td>
<td>108</td>
</tr>
<tr>
<td>3.4</td>
<td>Computer Graphics</td>
<td>110</td>
</tr>
<tr>
<td>3.4.1</td>
<td>Overview</td>
<td>110</td>
</tr>
<tr>
<td>3.4.2</td>
<td>Research Agenda</td>
<td>110</td>
</tr>
<tr>
<td>3.4.3</td>
<td>Supervised Theses</td>
<td>110</td>
</tr>
<tr>
<td>3.4.4</td>
<td>Projects</td>
<td>111</td>
</tr>
<tr>
<td>3.4.5</td>
<td>Scientific Activities</td>
<td>119</td>
</tr>
<tr>
<td>3.4.6</td>
<td>Highlights</td>
<td>120</td>
</tr>
<tr>
<td>3.5</td>
<td>Databases and Information Systems</td>
<td>122</td>
</tr>
<tr>
<td>3.5.1</td>
<td>Overview</td>
<td>122</td>
</tr>
<tr>
<td>3.5.2</td>
<td>Research Agenda</td>
<td>122</td>
</tr>
<tr>
<td>3.5.3</td>
<td>Supervised Theses</td>
<td>122</td>
</tr>
<tr>
<td>3.5.4</td>
<td>Projects</td>
<td>123</td>
</tr>
<tr>
<td>3.5.5</td>
<td>Scientific Activities</td>
<td>128</td>
</tr>
<tr>
<td>3.5.6</td>
<td>Highlights</td>
<td>130</td>
</tr>
<tr>
<td>3.6</td>
<td>Software Systems Engineering</td>
<td>132</td>
</tr>
<tr>
<td>3.6.1</td>
<td>Overview</td>
<td>132</td>
</tr>
<tr>
<td>3.6.2</td>
<td>Research Agenda</td>
<td>133</td>
</tr>
<tr>
<td>3.6.3</td>
<td>Supervised Theses</td>
<td>133</td>
</tr>
<tr>
<td>3.6.4</td>
<td>Projects</td>
<td>134</td>
</tr>
<tr>
<td>3.6.5</td>
<td>Scientific Activities</td>
<td>154</td>
</tr>
<tr>
<td>3.7</td>
<td>Computer Systems</td>
<td>157</td>
</tr>
<tr>
<td>3.7.1</td>
<td>Overview</td>
<td>157</td>
</tr>
<tr>
<td>3.7.2</td>
<td>Research Agenda</td>
<td>157</td>
</tr>
<tr>
<td>3.7.3</td>
<td>Supervised Theses</td>
<td>157</td>
</tr>
<tr>
<td>3.7.4</td>
<td>Projects</td>
<td>158</td>
</tr>
<tr>
<td>3.7.5</td>
<td>Scientific Activities</td>
<td>165</td>
</tr>
<tr>
<td>3.7.6</td>
<td>Highlights</td>
<td>166</td>
</tr>
<tr>
<td>3.8</td>
<td>Embedded Systems, Hardware and Robotics</td>
<td>167</td>
</tr>
<tr>
<td>3.8.1</td>
<td>Overview</td>
<td>167</td>
</tr>
<tr>
<td>Section</td>
<td>Page</td>
<td></td>
</tr>
<tr>
<td>---------------------------------</td>
<td>------</td>
<td></td>
</tr>
<tr>
<td>3.8.2 Research Agenda</td>
<td>167</td>
<td></td>
</tr>
<tr>
<td>3.8.3 Supervised Theses</td>
<td>168</td>
<td></td>
</tr>
<tr>
<td>3.8.4 Projects</td>
<td>168</td>
<td></td>
</tr>
<tr>
<td>3.8.5 Scientific Activities</td>
<td>174</td>
<td></td>
</tr>
<tr>
<td>3.8.6 Highlights</td>
<td>174</td>
<td></td>
</tr>
<tr>
<td>4 Publications</td>
<td>175</td>
<td></td>
</tr>
<tr>
<td>4.1 Books and Edited Volumes</td>
<td>176</td>
<td></td>
</tr>
<tr>
<td>4.2 Book Chapters</td>
<td>177</td>
<td></td>
</tr>
<tr>
<td>4.3 Journal Articles</td>
<td>179</td>
<td></td>
</tr>
<tr>
<td>4.4 Refereed Conference and Workshop Publications</td>
<td>181</td>
<td></td>
</tr>
<tr>
<td>4.5 Technical Reports</td>
<td>195</td>
<td></td>
</tr>
<tr>
<td>4.6 Ph.D. Theses</td>
<td>196</td>
<td></td>
</tr>
<tr>
<td>4.7 Proceedings</td>
<td>197</td>
<td></td>
</tr>
<tr>
<td>4.8 Diploma Theses</td>
<td>198</td>
<td></td>
</tr>
<tr>
<td>4.9 Bachelor’s Theses</td>
<td>203</td>
<td></td>
</tr>
<tr>
<td>4.10 Master’s Theses</td>
<td>204</td>
<td></td>
</tr>
</tbody>
</table>
1 The Department of Informatics

1.1 Overview

Like no other research discipline, computer science has been profoundly and irreversibly changing our society and our daily lives over the past fifty years. The pace of this change is continually increasing (with recent trends like social software or cloud computing), and computer systems are getting more complex and more difficult to understand, to design, and to control. In order to be able to master the complexity of tomorrow’s IT ecosystems, and to maintain Germany’s competitiveness in a global race for innovation and market shares, young computer scientists need to learn about the techniques of professional computer science to understand, analyze, design, and build complex computer-based applications. To make an important contribution to this endeavor is the educational mission of the Department of Informatics at Clausthal University of Technology.

We offer young people high-quality courses in the core disciplines of computer science, such as computer engineering, communication and distributed systems, computer graphics, computer supported collaborative work, database systems, software engineering, theoretical computer science, business information technology, and computational intelligence. Our research groups are fueled by the overarching research theme Interactive Intelligent Information Systems (3IS), acknowledging the key importance of models, methods, and architectures to understand, build and control next-generation human-centered, adaptive, and intelligent software artifacts; The 3IS research cluster carries out basic and applied research in six strategic areas of computer science with international visibility and reputation. In doing so, we exploit and deepen the synergies with engineering sciences and economics.

This biennial report documents the development of the department over the years 2010 and 2011. During that period, the development of the department was characterized by three major strands of activities: (i) continued growth in a difficult economic situation; (ii) the continued collaboration within the Niedersächsische Technische Hochschule through the IT Ecosystems research project; and (iii) the foundation of the Institute for Applied Software Systems Engineering (IPSSE), an industrial Research Institute funded by Volkswagen AG, located in Goslar.
The national and international visibility of our research continues to be at a high level: publication output, citation indices, and international visibility of the department are excellent; at the same time, acquired research funding has grown considerably compared to the previous reporting period, while the number of completed dissertations/ habilitations remains at the same level as in 2008/2009. In the NTH context, the NTH School of IT Ecosystems, which was launched in 2009 as a 3.5 million € research project by the computer science departments of TU Braunschweig, LU Hannover and TU Clausthal, has been run in three sub-projects, with promising research results achieved in each of them. A proposal for a DFG Graduate School on Human Centered IT Ecosystems has been recently submitted, to be able to continue and grow the collaboration on the attractive research area of next-generation large-scale software systems in order to improve our capability to compete with leading national and international research bodies in the quest for research funding.

1.2 History

Founded in 1982, the Department of Informatics at TU Clausthal is looking back to a 30 year tradition in education and research. From 1984 to 2006 the department ran a five-year degree (Diplom) programme in computer science. Since the mid-nineties, this was supplemented by a Diplom programme in business information systems (Wirtschaftsinformatik). In 2006, the Diploma programme was replaced by Bachelor/Master programmes in computer science and Wirtschaftsinformatik.

The department went through a challenging period during the late nineties and early two-thousands: It was understaffed and had to serve a large number of students. Finally, a strategic decision was made in 2002/03 by the federal state of Lower Saxony and the executive management of our university to establish computer science as one of the core technological backbones of Clausthal University of Technology. This resulted in plans to increase the academic headcount to the size recommended by the German Association of Computer Science (Gesellschaft für Informatik).

As a consequence, between 2003 and 2008, the department went through a period of fundamental change, characterized by the retirement of four colleagues, and the successful appointment of eight new professors. Since 2009, the situation at the department has been stable. At the time of writing this report, one more professor position in Foundations of Computer Science (to replace Prof. Hammer) has been advertised and the appointment process is almost completed.
1.3 Research

After the years 2004–2008 were characterized by an almost complete re-staffing of the department’s faculty, the focus in 2009 to 2011 was on establishing and stabilizing the new structures, on improving on research funding, and on positioning the department in the new context of the NTH, which was founded in 2008.

An important indicator of the successful scientific development in the department are the number and quality of scientific publications as well as memberships of researchers of the department in international programme committees. Figure 1-1 illustrates the development of the scientific publication activities of members of the department between 2004 and 2011, categorized by type of publication (peer-reviewed publications only!). It reflects a lively and high-quality publication activity. The visibility of our faculty is also reflected in an average h-index of 19 (according to Google Scholar Citations and Harzing PoP).

---

**Figure 1-1 Scientific publications of the department.**

In the current climate of industrializing universities and focusing resources to “elites”, the acquisition of external funds is gaining importance as a key performance indicator for research. Figure 1-2 shows the development of funding income, broken down into two types of funds:

- Funding from national (e.g., BMBF, DFG) and international agencies (e.g., EC) as well as industry funding (“Drittmittel”)
Additional funding acquired from the federal government of Lower Saxony, e.g., for e-Learning activities and innovation projects ("Sondermittel").

The chart shows that the very positive development witnessed in the last reporting period is continuing. With a total acquired funding of over 4 million €, the performance in this reporting period has more than doubled compared to the 2008/2009 period.

![Figure 1-2 Funding acquisition of the department.](image)

Another important indicator of scientific activity is the number of completed dissertations. In this respect, as shown in Figure 1-3, the performance of the department is basically the same with respect to the previous reporting period — while this is acceptable for a young department, the dissertation rate still has potential to grow.

Figure 1-4 illustrates the development of the number of students who graduated with a Diplom, bachelor, or master degree from our department. After the introduction of Bachelor/Master and the gradual termination of the Diplom programme, the number of Diplom students is decreasing. The first Bachelor students graduated in 2009, the first Master students in 2011.
1.3 Research

Figure 1-3 Completed dissertations in the department.

Figure 1-4 Number of students graduated in the department.
Finally, it should be mentioned that the department has been active in numerous national and international cooperations in education and research, which led and will lead to new scientific results and funding prospects. In the area of scientific education, the collaboration with other universities within Lower Saxony in the ELAN and ATLANTIS programmes as well as the International Master course on Internet Technologies and Information Systems are worth mentioning (see also Chapter 2) as well as our comprehensive involvement in the ERASMUS programme.

In research, we would like to emphasize three collaboration activities that stand for many others.

**NTH School für IT Ökosysteme**

This collaboration project between the three NTH universities Clausthal, Braunschweig, and Hannover started in March 2009. With a planned five years horizon and 3.5 Mio € funding for the first three-and-a-half years, this research project unites 16 researchers from three universities to study and develop new approaches to the design, management, and controlled evolution of future large-scale software-intensive systems. Prof. Dr. Andreas Rausch from Clausthal University of Technology is the speaker of this project. An airport check-in demonstrator (see Figure 1-5) was built to validate the project results and presented at the 2011 CeBIT expo. For more information, see [http://www.it-oekosysteme.org](http://www.it-oekosysteme.org). A main strategic goal of the project is to prepare large (and successful) proposals for funded research. An intermediate milestone is a pre-proposal of a DFG Graduate School Human-Centered IT Ecosystems, which was completed at the end of 2011 and submitted to DFG. A first success of the project is the DFG Focused Programme *Design for Future – Managed Software Evolution*.

---

*Figure 1-5 IT Ökosysteme airport check-in demonstrator.*
DFG Focused Programme *Design for Future – Managed Software Evolution*

In April 2011, the Deutsche Forschungsgemeinschaft (DFG) has accepted a national Focused Research Programme *Design for Future – Managed Software Evolution* initiated by the Computer Science units of the NTH. The main topic of this programme is the development of long-lived software systems. The problem, how software systems that evolve over decades can be managed, maintained, extended, and modernized, has been known for a long time, however principled, sustainable solutions are lacking. The computer scientists participating in this program aim to explore models and methods that enable one to represent and maintain the knowledge related to structure and behavior of the system and its components over its lifetime. Based on these models and methods, a new approach towards software lifecycle management will be developed that interleaves design-time and run-time activities. The DFG funds the first phase of the project with more than 5 million €; the programme is planned for an overall duration of six years.

The coordinator of the programme *Design for Future – Managed Software Evolution* is Prof. Ursula Goltz, who is the Head of the Institute for Programming and Reactive Systems at Technische Universität Braunschweig. Co-initiator is Prof. Dr. Andreas Rausch from our department.

**IPSSE: Institute for Applied Software Systems Engineering**

Starting in the end of 2010, Prof. Andreas Rausch initiated a kick-off project with Volkswagen in cooperation with Prof. Ursula Goltz at Technische Universität Braunschweig. The idea of this project was to find out, whether our competence in software systems engineering can support Volkswagen during their everyday tasks in the field of engine control software development. The following year showed that there was a high potential: the initial project team of four researchers identified several fields where optimization of the workflow at Volkswagen could shorten time to market and improve overall software quality. This covers areas like tool support, the workflow itself, or modeling methods. As a consequence, in 2011 the Research Center "Institute for Applied Software Systems Engineering" (IPSSE) was founded, backed up by Volkswagen’s guarantee to cover at least the costs of eight PhD students and several additional student researchers for at least five years. IPSSE’s core idea is the combination of application projects with improvement projects. Currently, there are eight PhD students at IPSSE and about ten additional student researchers. While IPSSE focus is on Volkswagen now, there are already first contacts to companies from other domains as well as to other research groups about further projects. This will enable us to expand further in the future.
**Future Directions: 3IS**

In order to position ourselves better in the context of the national and international research competition, our department focuses its research activities in the new research cluster “Interactive Intelligent Information Systems” (3IS). 3IS investigates models, architectures, methods and applications of future internet-based and embedded information systems. Such systems are characterized by the necessity

- to flexibly and robustly communicate across the boundaries of networks, systems, and organizations in order to coordinate their activities;
- to continuously adopt their structure, their behaviour, and their control and regulation regimes to changing environmental conditions and new requirements;
- to consider the human as part of the 3IS, and to provide adequate and intuitive mechanisms for interaction, collaboration, and control.

Realizing 3IS requires leading competencies in several areas of computer science. In the NTH development plan of Computer Science, a number of challenging disciplines were identified that provide opportunities for TU Clausthal and the NTH. Figure 1-6 illustrates the main research topics of the 3IS and their interconnection.

---

**Figure 1-6 3IS: Interactive Intelligent Information Systems.**

The left side of Figure 1-6 identifies the three eponymous core research areas of 3IS:
Human-Machine Interaction, Multimedia, and Computer Graphics
The focus of investigation in this area is cooperation between humans and computers in future internet-based systems. It includes, among others, novel interaction techniques, algorithms for multimodal interactions and ergonomy in the context of future computer-supported systems and processes.

Artificial Intelligence and Algorithms
This area deals with the question how computer systems can behave in a situated, goal-directed, effective and flexible way in dynamic environments. This capability is a key prerequisite for further automation of processes, but also of more effective and flexible systems for decision support and user assistance.

Information Systems
Research in information systems studies models, methods, architectures, and tools for representing, processing, exchanging, and managing information in heterogeneous, possibly decentralized Systems. These systems often consist of large numbers of actors and components that may change over time.

Interleaved with the three core disciplines are three other important areas, which lay foundations for the Internet of the Future, from intelligent objects over flexible services to the intelligent adaptive process:

Intelligent Networked and Embedded Objects
Network enabling of smart physical objects has become a European research priority known as “Internet of Things” (IoT). Research topics include scalable communication, information and coordination architecture, integration models, energy efficiency, as well as the usage of IoT technologies in new application areas such as engineering or mining and steel industries.

Global Service Engineering
Intelligent business processes need to be based on a flexible software logistics, which provides software components as adaptive, self-describing services. This software logistics has to support flexible service configuration, adaptation, and integration into scalable software architectures. Verification and validation as well as IT service management are further important aspects in this research area.

Internet-based Business Processes and Systems
Here we research foundations of flexible, intelligent business processes and their automation. We develop models, methods, and tools for representing (modeling), automating, monitoring, and executing business processes, e.g. via multi-agent technologies. A related issue is the process-driven development and adaptation of business application systems.
1.4  Education

After the successful preparation and accreditation of the new Bachelor/Master programme in 2007, educational activities in the past two years were focused on establishing and finetuning the Bachelor and Master programmes in the areas of computer science and business information technology (see Section 2.2 for details), and on extending our offering in the areas of computer engineering (with a Bachelor-Master Programme). The Early Studies programme in Computer Science has been extended, and a new Master Course in Systems Engineering has been started, targeting professional education.

A recent proof of the success of our educational activities is the excellent position of the Computer Science department in the prestigious university ranking 2012/2013 led by the Centrum für Hochschulentwicklung (CHE) (http://ranking.zeit.de), published in May 2012. In this ranking, the computer science education at TU Clausthal came out best out of 78 universities in the German-speaking area, regarding the quality of student mentoring and supervision; we were attested the third-best quality in IT infrastructure, and were among the top 6 on the criterion of overall student satisfaction. Figure Figure 1-7 shows an excerpt from the official CHE ranking available at http://ranking.zeit.de, illustrating the excellent performance of TU Clausthal in comparison with some other German top universities and neighboring universities in Lower Saxony.
In undergraduate education, the B.Sc. Informatik/Wirtschaftsinformatik (computer science / business information technology) offers students a high quality foundation in computer science, mathematics, economy, and engineering. Based on this solid scientific underpinning, students can choose between two general directions:

- **Computer Science**, 
- **Business Information Technology.**

Within each direction, students can individually choose their specialization to prepare for different graduate programmes. This unique combination of computer science, computer engineering, and business information technology in a single programme allows students to choose their study direction only after one year; we are confident that having this possibility as well as the chance to switch between the directions easily in the first phase of studying improves the quality of decisions and reduces the number of students withdrawing early from university.
Research-oriented Master programmes in computer science and business information systems build on these undergraduate courses. A unique feature of the Master programme *Business Information Technology* at Clausthal University of Technology is the possibility to specialize in the area of *Energy Management*. It focuses on IT-based scheduling, configuration, administration, and optimization of processes and systems for raw materials management, energy production, and distribution, addressing economic and technical aspects alike. Benefitting from both the professional and geographical proximity of the *Energieforschungszentrum Niedersachsen* (Research Centre for Energy of Lower Saxony) which is located nearby in the town of Goslar, this Master Programme provides bright academic and industrial job prospects in a fascinating and essential future research area.

In addition, the department contributes to the interdisciplinary B.Sc. programmes in *Applied Mathematics and Technical Economics* and to the interdisciplinary Master programmes in *Operations Research, Computer Science, and Automation Engineering*.

To complete the overview of study programmes, we would like to mention two new Master programmes that are targeted towards specific user groups: The Master programme *Internet Technologies and Information Systems* which is held in English language attracts an international audience. This programme, which started in 2011, is conceived in cooperation with the universities of Braunschweig, Göttingen, and Hannover. Also, our new Master programme in *Systems Engineering* specifically targets the area of lifelong education. This programme has been devised and is executed in cooperation with Siemens AG.

A continuing challenge refers to keeping up and increasing the student base of our department, i.e., the number of students beginning their university education in computer science and business information systems. After the number of new enrollments has been at a fairly low level for the past three years, we are glad to report a healthy increase of more than 300% of new inscriptions into our Bachelor Programme for the winter term 2011/2012, with an overall 45 new students. Currently, the overall number of students in our department is 330 (not including Ph.D. students).

**Mentoring Programme**

The department provides a mentoring programme for first-year students in computer science that helps to get accustomed to the new environment. In small groups, students meet regularly in order to discuss work issues, but also problems of daily university life.
Each group is coordinated and led by an experienced sophomore student that not only helps by giving practical advice but also takes them on a tour to the local nightlife and cultural activities. In addition, each group is supervised by one of the professors to help build a familiar atmosphere and to act as a confidant in case of problems.

1.5 Staff and Organization

Staff

Eight professors, and two adjunct professors have been members of the Department of Informatics by December 31, 2011.

We are happy to report that Prof. Dr. Niels Pinkwart (formerly Junior professor in the department, and a post-doc at Carnegie Mellon University) was appointed Professor of Human-Centered Information Systems in our department in June 2010.

The department is also delighted that Prof. Dr. Andreas Rausch, who holds the chair of Software Systems Engineering in our department, rejected an offer from Hamburg University in 2011 and has decided to continue his work at TU Clausthal.
With a mixture of sadness and pride, we report that Professor Dr. Barbara Hammer has accepted an offer of a professorship at Universität Bielefeld in Summer 2010. In Bielefeld, she is now a professor of Theoretical Computer Science in the Center of Excellence Cognitive Interaction Technology (CITEC). We thank Barbara for six years of dedicated and fruitful work in our department, where she was a member of the board of directors from 2005 to 2010; our best wishes for the future are with her, and with research collaborations going on, she will continue be a very welcome guest. Barbara’s example has shown that the department offers young scientists an inspiring and fruitful work environment in which they can develop their skills and personalities and create research results at an internationally competitive level.

During the reporting period, the number of research staff (without professors) grew from 40 to 50, reflecting in particular the increase in research funding. Last but not least, the department also enjoys the dedicated support by three technicians and two trainees, as well as six administrative staff members. For more detailed and recent information, please visit http://www.in.tu-clausthal.de/personen/.
1.5 Staff and Organization

☐ Professors

- Prof. Dr. Jürgen Dix
  *Computational Intelligence*
- Prof. Dr. Barbara Hammer (until 03/2010)
  *Theoretical Foundations of Computer Science*
- Prof. Dr. Sven Hartmann
  *Databases and Information Systems*
- Prof. Dr. Michaela Huhn
  *Theoretical Foundations of Computer Science*
- apl. Prof. Dr. Günter Kemnitz
  *Hardware-Design and Robotics*
- Prof. Dr. Jörg P. Müller
  *Business Information Technology: Mobile and Enterprise Computing*
- Prof. Dr. Niels Pinkwart
  *Business Information Technology: Human-Centered Information Systems*
- Prof. Dr. Andreas Rausch
  *Software Systems Engineering*
- apl. Prof. Dr. Matthias Reuter (CUTEC)
  *Modelling and Simulation*
- Prof. Dr. Harald Richter
  *Technical Informatics and Computer Systems*
- Prof. Dr. Christian Siemers (50%)
  *Distributed Systems and Communication*
- Prof. Dr. Gabriel Zachmann
  *Computer Graphics and Multimedia*

☐ Lecturers

- PD Dr. Helmut Lessing (CUTEC)
  *Computer Science in Environmental Studies*

☐ Former Professors

- Prof. Dr. Klaus Ecker (until 3/2005)
  *Applied Computer Science*
- Prof. Dr. Torsten Grust (2/2005—5/2005)
  *Databases*
- Prof. Dr. Kai Hormann (until 09/2009)
  *Computer Graphics*
- Prof. Dr. Gerhard Joubert (until 9/2003)
  *Practical Computer Science*
Department Organization

The department structure consists of nine research units, reflecting the main research areas: Business Information Technology (with the research groups Human-Centered Information Systems and Mobile and Enterprise Computing), Computational Intelligence, Computer Engineering, Computer Graphics, Embedded Systems, Databases and Information Systems, Hardware Design and Robotics, Neural Networks, and Software Systems Engineering (with the affiliated Institute for Applied Software Systems Engineering).

In April 2011, the departmental management board was re-elected. Prof. Dr. Jörg P. Müller continues to be director of the department, Prof. Dr. Gabriel Zachmann, and Prof. Dr. Sven Hartmann are the other members of the management board.

- **Head of department (Institutsdirektor)**
  - Prof. Dr. Jörg P. Müller (since 2008)

- **Board (Direktorium)**
  - Prof. Dr. Sven Hartmann, Prof. Dr. Jörg Müller, Prof. Dr. Gabriel Zachmann

- **Infrastructure team**
  - Dipl.-Ing. (FH) Thomas Bravin
  - Kai Fischer (trainee)
  - Jörn Körner
  - Tim Küster (trainee)
  - Peter Platzdasch

- **Secretarial team (permanent)**
  - Andrea Behfeld
  - Stefanie Cronjäger
  - Christine Kammann
  - Sandra Karpenstein
  - Annett Panterod
  - Anita Seiz-Uhlig
1.6 Major events and activities

TILL 2011: Annual Conference of Teachers in Computer Science

In March 2011, the annual meeting of Computer Science Teachers of Lower Saxony and Bremen (TILL 2011: Tag der Informatiklehrerinnen und -lehrer Niedersachsen / Bremen) was held in Clausthal and organized by our department under the auspices of Prof. Harald Richter and Andrea Behfeld with our administrative team. The event was well attended with 80 participating teachers, six interesting workshops, and an exhibition featuring 18 publishers and other companies from the educational sector (see Figure 1-9).

Figure 1-9 TILL 2011: Annual conference of teachers in computer science.
Colloquium Series

The department’s colloquium series has been running for six years now; it serves as a communication platform for interchanging ideas between the different fields of computer science and related areas. It is a forum for our graduate and postgraduate students to get into contact with internationally renowned scientists and to initiate short term stays abroad, e.g., within the scope of a Master’s or Ph.D. thesis. Therefore, we invite speakers from all over the world to present their recent scientific advances and to discuss possible cooperations on future joint projects. In the reporting period, 16 guest researchers visited our department and presented their work in the colloquium series.

2010

- Prof. Dr. Cees Witteveen (29.01.2010)
  *Decomposition of constraint systems: Equivalences and computational properties*

- Dr.-Ing. Johannes Behr (03.02.2010)
  *DOM — A DOM-based HTML5/X3D Integration Model*

- Prof. Dr. Dirk Langemann (01.07.2010)
  *Qualitative mathematische Modelle zum menschlichen Energiemetabolismus*

- Dr. Wojtek Jamroga (27.05.2010)
  *Variants of Strategic Logics*

- Prof. Dr. Bernhard Thalheim (07.12.2010)
  *Technology Solutions for the Next Generation Web*

2011

- Dr. Hui Ma (25.01.2011)
  *A Geometrically Enhanced Conceptual Data Model*

- Dr. Berndt Müller (01.02.2011)
  *Modern Applications of Agent Technology - Where Mobility and Resources Actually Matter*

- Prof. Dr. Joachim Biskup (08.02.2011)
  *Inference-proof view update transactions with forwarded refreshments*

- Dr. Sujata Ghosh (09.02.2011)
  *Strategic reasoning in extensive form games: a logical study*

- Prof. Dr. Dr. h.c. Manfred Broy (06.04.2011)
  *Theorie des Software Engineering – Wofür denn?*
1.6 Major events and activities

- Prof. Dr. V.S. Subrahmanian (15.04.2011)
  *Social Network Optimization Problems*
- R.-C. Mihailescu, M.Sc. (24.05.2011)
  *An organizational approach to agent-based virtual power stations via coalitional games*
- Dr. Koen V. Hindriks (28.06.2011)
  *Patterns in Agent Programming*
- Dr. Clemens Szyperski (29.09.2011)
  *Composition as a Data Problem*

For more information, see
[http://www.in.tu-clausthal.de/studium/informatik-kolloquium/](http://www.in.tu-clausthal.de/studium/informatik-kolloquium/).

**Awards**

Dr. Nils Bulling received the “E. W. Beth Dissertation Award 2011” for his PhD thesis “Modelling and Verifying Abilities of Rational Agents”. The E.W. Beth Dissertation Prize, named after the Dutch logician and philosopher Evert Willem Beth, is awarded annually by the Association for Logic, Language and Information to PhD thesis making an outstanding contribution in at least two of three fields of Logic, Language, and Computation. Among the twenty-one prize winners Dr. Bulling is only the third German. He shares the prize money of 2500 EUR with Dr. Mohan Ganesalingam from the University of Cambridge who was also awarded (ex aequo).

Dr. Nils Bulling also received the “Förderpreis des Vereins von Freunden der TU Clausthal” for his PhD thesis. The award includes a prize money of 2000 EUR.

**Graduate and Postgraduate Seminar**

In the Graduate and Postgraduate Seminar, our graduate and postgraduate students report on their recent scientific achievements. In the reporting period, we have had the following 46 talks:

- **Summer 2010**
  - Benjamin Neu (27.04.2010)
    *Anpassung von argumentationsunterstützenden Systemen an die Anforderungen mobiler Endgeräte am Beispiel des iPod touch*
  - Lei Zheng (27.04.2010)
    *Entwicklung und Evaluierung von Teamcenter Engineering 2007 Workflows für die dezentrale und kooperative Produktenwicklung*
  - Nils Bulling (03.05.2010)
    *Verifying Agents with Memory is Harder than It Seemed*
• Dong Jiang (18.05.2010)
  Kontraktnetzbasierte Plankoordination in dezentralen Stromversorgungssystemen

• Christoph Gerdes (09.06.2010)
  A data-centric Information Architecture for Power Systems

• Christian Hausknecht (22.06.2010)
  Ein ontologiebasiertes Datenformat für die organisationsübergreifende modellbasierte Produktentwicklung (OMP)

• Wulf Franke (22.06.2010)
  Analyse und Simulation von Peer-To-Peer Overlay-Eigenschaften für die dezentrale und kooperative Produktentwicklung

• Stefan Kiehne (10.08.2010)
  Entwicklung und Bewertung eines Prozessmodells für das Projektmanagement im Bereich der Steuerberatung

• Kilian Stöpler (10.08.2010)
  Der Music Tagger - ein Musikempfehlungssystem in den Kinderschuhen

• Marc Waselewsky (10.08.2010)
  Test und Redesign des Spiels "MusicTagger" hinsichtlich der Benutzeroberfläche und des Musikempfehlungssystems

• Jan Brenner (17.08.2010)
  Die Nutzung des LASAD-Systems zur Unterstützung juristischer Argumentation

• René Fritzsche (01.09.2010)
  Time-Enhanced C - Erweiterung einer imperativen Programmiersprache für eingebettete Systeme um Zeitvorgaben

Winter 2010/2011

• Simon Mühlena (26.10.2010)
  Entwicklung eines elektronischen Fahrkartensystems auf der Basis von RFID und NFC für den öffentlichen Schienenverkehr

• Shuangni Zhu (26.10.2010)
  Ein XML-basierter Loop-Back-Simulator für die Prozessautomatisierung in Stahlwerken

• Tim Warnecke (01.11.2010)
  Entwicklung eines Konzeptes und prototypische Implementierung einer Lernanwendung für die Grundschule unter Nutzung eines Multi-Touch-Tisches

• Giselle Rodriguez (03.11.2010)
  Entwicklung einer Benutzeroberfläche für eine webbasierte Kita-Fortbildungs-Datenbank
1.6 Major events and activities

- Stefan Aust (07.12.2010)
  Skalierbare Rechensysteme für Echtzeitaufgaben
- Yang Xiang (07.12.2010)
  A Network Model for Dynamic Identity Federation
- René Weller (08.12.2010)
  ProtoSphere: A GPU-Assisted Prototype Guided Sphere Packing Algorithm for Arbitrary Objects
- Erkang Zhao (14.12.2010)
  Tabellarische Visualisierung von Argumenten im LASAD-System
- Stefan Kehl (20.12.2010)
  Expansion of the DeCPD network layer for local product model storage
- Sandra Lange (18.01.2011)
  MOD Summer School
- Stefan Rühl (25.01.2011)
  Customizable Software-as-a-Service Applications
- Guy Collins Ndém (21.02.2011)
  Model based testing: Deriving Test Cases from Mechatronic System Models - SysML
- Said Chihani (21.02.2011)
  Beurteilung der inneren Qualität von Softwaresystemen mit Hilfe von Metriken
- Zhenyu Geng (21.02.2011)
  Konzeption und Realisierung eines Projekt- und Teamverwaltungssystems für eine Kollaborationsplattform im Architektursektor
- Martin Vogel (21.03.2011)
  Interoperabilität von Videoservern

**Summer 2011**

- Seraj Fayyad (12.04.2011)
  Architecture Styles
- Stephan Wilde (31.05.2011)
  Entwurf und Implementierung dezentraler Produktentwicklungs-Workflows
- Viet Hung Chu (31.05.2011)
  Verfahren der dynamischen Gruppenbildung zur Koordination autonomer Fahrzeuge im Straßenverkehr
- Marcel Ibe (17.06.2011)
  Testfallableitung aus Anforderungsspezifikationen zur Qualitätssicherung im Softwareentwicklungsprojekt
• Sebastian Mechs (14.07.2011)
Schaltoperationen und Schaltsequenzen in Systemen der Fertigungsautomatisierung zur Erzielung von Energieeffizienz

• Xin Zhou (19.07.2011)
_Distributed Constraint Satisfaction-Probleme (DCSP) als Beschreibungsrahmen zur verteilten Konstruktion in der Produktentwicklung_

• Sebastian Groß (26.07.2011)
Unterstützung kollaborativer Schreibprozesse durch ausgewählte Verfahren der Computerlinguistik

• Philip Peterhansl (10.08.2011)
_Wissensmanagement im Enterprise 2.0 - Automatisches Tagging_

• Chong Hyun Park (24.08.2011)
_Untersuchung der Anpassungsmöglichkeiten des V-Modell XT am Beispiel des V-Modell XT Bund_

• Marcel Bergmann (24.08.2011)
_Weiterentwicklung der DisCComp-Ausführungsumgebung DesignIT_

• Sabrina Paetzold (20.09.2011)
_Konzeption und prototypische Implementierung einer verteilten DCSP-Lösungsplattform_

• Joachim Schramm (21.09.2011)
_Unterstützung von Planung und Design in der Programmierausbildung an Universitäten_

**Winter 2011/2012**

• Sven Strickroth (25.10.2011)
_Empfehlungssysteme für kleine Online-Communities mit regionaler Bindung_

• Ning Yuan (23.11.2011)
_Geo-Informationssysteme in Deutschland und China - Eine vergleichende Betrachtung_

• Dietmar Sommerfeld (13.12.2011)
_Workflow Scheduling for the German D-Grid Using a Two-Tier Approach_

• Tanju Bulut (14.12.2011)
_Six Sigma im Anforderungsmanagement/Requirements Engineering_

• Weiyu Yi (13.01.2012)
_Parallel simulation and collision detection using sphere-spring system_

• Merlin Konert (30.01.2012)
_Erweiterung der Plattform JADE zur agentenorientierten Simulation autonomer Transportfahrzeuge_
1.6 Major events and activities

- Leonidas Athineos (20.02.2012)
  Entwurf und Implementierung einer digitalen Schaltung zur probabilistischen Fehlererkennung innerhalb von Operationen

For more information, see
http://www.in.tu-clausthal.de/studium/diplomanden-und-doktorandenseminar/.

Technical Report Series

The department’s Technical Report Series (ISSN: 1860-8477) was started in 2005 and publishes recent scientific results, either as preliminary version of articles under submission or in print, or as extended versions of workshop proceedings papers. The papers are expected to be written in English and undergo an internal review process. The review board consists of the current and the retired professors of the department. The Editor-in-Chief of the series is Prof. Dr. J. Dix.

For more information, see
http://www.in.tu-clausthal.de/forschung/technical-reports/.

Technical reports in 2010/2011:

☐ Harald Klein and Eric Knaus and Andreas Rausch: (Towards) a systematic approach for planning collaboration in distributed software development, Technical Report IfI-11-02, July 2011.


- Barbara Hammer and Alexander Hasenfuss *Topographic Mapping of Large Dissimilarity Data Sets*, IfI-10-01, January 2010.
2 Academic Programmes

2.1 Overview

Choosing to study at the Department of Informatics at Clausthal University of Technology means choosing to study off the beaten tracks offered by most of the major German universities. Overcrowded lecture halls and anonymous mass education are unknown to our students who benefit from an excellent student/professor-ratio of 30:1.

With more than 16% female students we have a remarkably high gender ratio in computer science compared to overall Germany. In addition, the department has an international flair due to the large percentage of foreign students (33%) and due to the worldwide collaborations in terms of student exchange programmes (35 partner universities in Europe) and ongoing research activities. Our students further enjoy the beautiful landscape of the Harz mountains as a perfect setting for recreational and sports activities, or simply to counterbalance their intensive studies. All of these benefits make Clausthal in general and the Department of Informatics in particular a distinguished place.

The Department of Informatics currently has about 330 students (more than 8% of the total number of students in Clausthal) enrolled in two Bachelor, three Master, and three Diploma programmes. Following the Bologna process, the Bachelor and Master programmes have already replaced the Diploma programmes on the undergraduate and graduate levels. In addition to its own study programmes, the Department significantly contributes to other programmes, especially in the mathematical and engineering sciences, by offering introductory and programming courses on the Bachelor level as well as advanced courses on the Master level. One of the recent additions to the department’s portfolio is the Master programme “Systems Engineering”, which is intended for professional development and training of employees of IT companies.

More programmes are being developed, in order to stay up-to-date with the ever-changing educational landscape.

2.2 Study Programmes

2.2.1 B.Sc. Programme “Computer Science”

For five years, our bachelor programme *B.Sc. in Computer Science* has replaced the former Diploma programmes on the undergraduate level. Currently, 116 students are enrolled in this programme, and the first generation of B.Sc. students has successfully completed their studies.
The Bachelor programme offers attractive courses for students who intend to work in the industry as well as those who continue their studies on a graduate or postgraduate level. The fact that one third of the students come from abroad attests that the programme is internationally attractive. A further advantage of our bachelor programme is that students can flexibly start either in the winter or in the summer term.

In accordance with the European Bologna process for harmonization of university education systems, this programme leads to the B.Sc. vocational qualification after a standard period of six semesters of study. Upon completion, it can be followed on by one of our two Master programmes, which require further four semesters of study.

During the Bachelor programme, the students become familiar with the fundamentals of computer science, mathematics, and social skills. In addition, they can an area of main focus, for which there are three options:

- Computer Science,
- Business Information Systems,
- Computer Engineering.

The programme has a modular course structure. The first year of study consists of compulsory courses which provide the student with the necessary fundamental knowledge. In the second and third year, studies consist of different compulsory courses, depending on their chosen main focus, and a number of elective courses. The programme is completed by writing a Bachelor’s thesis.

A detailed list of compulsory and elective courses as well as other information can be found at [http://www.in.tu-clausthal.de/studium/studiengaenge/bsc-informatik](http://www.in.tu-clausthal.de/studium/studiengaenge/bsc-informatik) and [http://www.in.tu-clausthal.de/studium/studiengaenge/bsc-wirtschaftsinformatik](http://www.in.tu-clausthal.de/studium/studiengaenge/bsc-wirtschaftsinformatik).

### 2.2.2 M.Sc. Programmes in Computer Science and Business Information Systems

For four years, the Department of Informatics has offered two master programmes, namely in Computer Science and in Business Information Systems.

The Master programmes require 4 semesters of study and build on our Bachelor programme in Computer Science/Business Information Systems. The M.Sc. programmes are organized in modular form, enabling the students to choose their main focus according to their interests; thus, they can acquire advanced and specialized knowledge in one of the following fields:

- Human-Centered Computing,
- Parallel and Networked Computation,
2.2 Study Programmes

- Computer Engineering,
- Business Information Systems,
- Energy Management.

As well as participating in lectures, the students are guided towards producing scientific work within seminars and lab sessions. In the final stage of the programme, the students are required to write a research oriented Master’s thesis.


2.2.3 M.Sc. in Internet Technologies and Information Systems

The Master of Science in Internet Technologies and Information Systems (ITIS) is an international master programme that is jointly offered by the universities in Braunschweig, Clausthal, Göttingen, and Hannover. ITIS is a four-semester programme.

During the first two semesters, students choose from a wide range of courses, seminars, and practical courses offered by the four universities using modern e-learning facilities. In the third semester, students undertake a major research project sponsored by one of the research groups contributing to the ITIS programme. The major research areas are “Distributed Systems and Algorithms”, “Databases and Information Systems” and “Networking and Communication”, but students may also specialize in subjects such as “Legal issues and business applications”. In the fourth semester, students write a research thesis under the supervision of an academic advisor. Students will learn to perform up-to-date research on their own responsibility while still benefiting from the professional guidance by experienced researchers.

The close integration into ongoing research projects aims to prepare graduates for future PhD studies.

Applicants for ITIS must have attained a Bachelor’s degree in computer science (or equivalent) with at least 180 ECTS credit points and a grade of 2.3 or better. The intake is strictly limited to 25 students per year, so students will experience individual study plans, the personal atmosphere of small classes, and intensive supervision. The first international ITIS students hosted in Clausthal have started with their studies in October 2011.

For more information regarding ITIS and the application process, see the ITIS website http://www.itis-graduateschool.de.
2.2.4 B.Sc. in Computer Engineering

Since 2010, the Department of computer science offers a bachelor program in Computer Engineering. This program was collaboratively defined with the Department of Electrical Information Technology. It comprises 8 semesters, during which students acquire knowledge in the fields of mathematics, physics, mechanical and electrical engineering, and in computer science. This combination of engineering and computer science accounts for the fact that engineers working in the design and development of complex technological processes need both an engineering background (to understand the technological processes) and a computer science background (to understand the software systems that are required to operate these processes). Within the programme, two areas of specialization are offered: the more engineering-oriented area of automation systems, and the more computer science-oriented area of embedded systems.

In the first four semesters, the basics of engineering and computer science are taught (mathematics, physics, computer science, programming, electronics and circuitry, signals and systems), while the following four semesters teach more specialized topics (e.g., feedback control, mechatronics, embedded systems, computer networks, data bases, etc.). The programme consists of a mixture of compulsory and elective classes; in addition, one specializations includes a 12-week industry internship. The program concludes with a Bachelor’s thesis.

Currently, 27 students are enrolled in this programme, although it has been established only for a very short time.

After achieving their bachelor’s degree, students can choose to work in industry, or they can pursue a master’s degree by continuing to study in one of the consecutive programs, such as computer science or process automation.

More information can be found at [http://www.studium.tu-clausthal.de/studienangebot/mathematik-und-informatik/technische-informatik-bachelor](http://www.studium.tu-clausthal.de/studienangebot/mathematik-und-informatik/technische-informatik-bachelor)

2.2.5 M.Sc. in Systems Engineering

This programme was established in 2011 by the Department of Informatics (in collaboration with a number of other Departments at Clausthal University). It is geared towards people already working in industry for professional development and training.
2.2 Study Programmes

The System Engineering Program is a 4 semester program, but it is also possible to complete the studies within 3 semesters. Overall, the program was developed in close cooperation with industry, in particular with Siemens AG. Typically, engineers working on industry projects face the problem that they must combine knowledge from mechanical and electrical engineering with methods of computer science, specifically software development. Therefore the program consists mainly of compulsory classes teaching advances of information technology, mechanical engineering, and software engineering. The program concludes with a master's thesis, in which the student works on a scientific or engineering topic under the guidance of an academic advisor.

Currently, 10 students are enrolled in this professional development and training program, and the first generation is expected to finish their master's thesis by 2012.

More information can be found at http://www.studium.tu-clausthal.de/studienangebot/mathematik-und-informatik/systems-engineering-weiterbildungsstudiengang-master

2.2.6 M.Sc. in Embedded Software Engineering

Currently, the department is engaged in designing and establishing a new program in embedded software engineering. This is in close cooperation with Nordhausen university of applied science. The focus of this new program will be topics in computer science and computer engineering with applications to embedded systems. This program is, like the previous one, geared towards professional development and training. A unique feature of this new program is that it will span different states in Germany (Lower Saxony and Thüringen). Commencement of the program is planned for the winter term in 2012/2013.
2.2.7 B.Sc. TI Online — An Internet-based Bachelor Course for Continuing Education of Professionals

TI Online is a project spanning several federal states in Germany in order to create an internet-based Bachelor program that can be studied extra-occupational. Participating organizations are the University of Hamburg, University of Technology Hamburg-Harburg, University of Rostock, University of Lübeck, University of Applied Sciences Lübeck, and Clausthal University of Technology. TI Online will comprise multimedia learning content that is organized in modules. It is distinguished from study programs of pure computer science or information engineering by the selection and weighting of modules from computer science, mathematics, and electrical engineering. TI Online will be available at Clausthal University in addition to its standard programs. It is devised as continuing education for professionals working in related areas in industry. Cost-covering study fees will be charged. For more information see http://www.ti-online.org.

2.2.8 Diploma Programmes

Since new students cannot enroll any more in the former Diploma programmes Computer Science and Business Information Systems, the number of students still studying in these programmes has been declining over the years. Currently, about 70 students are still enrolled in the Diploma programs; they will finish their studies during the next year.

The aim of both programmes is to educate young academics with a broad knowledge in computer science, a thorough mathematical background, and optionally with a solid background in economics. They shall not only learn the necessary tools (i.e., programming languages) for developing algorithmic solutions, but moreover have the ability to analyse problems in a structured way and to apply the solutions. Equipped with these abilities they are fit for the market with a wide range of job opportunities.

The first two years of this programme are characterized by a thorough introduction to the foundations of computer science as well as the essential background in mathematics. Next to the standard beginner’s courses the students attend courses that familiarize them with the most common programming languages (C/C++, Java, Prolog, assembler) as well as a lab course on electrical circuits. A seminar course and lectures in a self-chosen minor subject are also obligatory.
Starting with the third year, the students are then offered advanced courses on specialized subjects in attractive fields of computer science as well as modern information and communication technologies. Besides these lecture courses, we organize interesting seminars, project groups, and lab courses, and offer a wide selection of Diploma theses for the students to choose from. The programme is usually completed after five years. For students of the Diploma programme Business Information Systems, some of the courses are replaced by special lectures on business information systems and economics.

More information can be found at [http://www.in.tu-clausthal.de/studium/studiengaenge/informatik/](http://www.in.tu-clausthal.de/studium/studiengaenge/informatik/) and [http://www.in.tu-clausthal.de/studium/studiengaenge/wirtschaftsinformatik/](http://www.in.tu-clausthal.de/studium/studiengaenge/wirtschaftsinformatik/).

### 2.2.9 Ph.D. Programme in Computer Science

We currently have about 60 young academics enrolled as Ph.D. students. Under the supervision of one of the department’s professors, they perform innovative research and present their results at international conferences. In addition, they assist the teaching staff by organizing exercise courses and seminars and co-supervising Bachelor’s and Master’s theses.

Ph.D. studies usually take three to five years and are completed by submitting and defending a dissertation. In the last two years, we had the pleasure to graduate ten students (cf. Section 4.6 on page 196):

- Dr. B. Arnonkijpanich. *Matrix Learning for Topographic Neural Maps.*
- Dr. C. Bartelt. *Kollaborative Modellierung im Software Engineering.*
- Dr. N. Bulling. *Modelling and Verifying Abilities of Rational Agents.*
- Dr. E. Fischer. *Operationalisierung des Projektcontrolling.*
- Dr. C. Gerdes. *A Data-Centric Information Architecture for Power Systems.*
- Dr. C. Giesemann. *Hardware-Entwurf und Robotik: Innovation und Pragmatik.*
- Dr. P. Stiefel. *Eine dezentrale Informations- und Kollaborationsarchitektur für die unternehmensübergreifende Produktentwicklung.*
- Dr. T. Ternité. *Variability of Development Models.*

---

1 Awarded with the Beth Dissertation Prize 2011 and the Förderpreis des Vereins von Freunden of Clausthal University of Technology.
Besides taking part in international conferences, our Ph.D. students have the opportunity to exchange and present their work at regular colloquia which take part within the research groups or the department, respectively. In 2006, a local network DoKoSon\textsuperscript{2} has been established initiated by Profs. Michael Breitner (Hannover), Dirk Mattfeld (Braunschweig) and Jörg P. Müller (TU Clausthal). In the frame of this colloquium series, Ph.D. students in the area of business information systems are provided a forum to meet, to exchange and discuss ideas in the context of their Ph.D. thesis, and to train and develop methodical skills. DoKoSon offers an interesting programme consisting of doctoral presentations and workshops, e.g. on topics such as presenting, writing scientific papers, scientific reviewing, or creativity techniques. By 2011, the DoKoSon community has grown to comprise seven Wirtschaftsinformatik professors, including all colleagues from the universities of Braunschweig, Clausthal, Göttingen, and Hannover.

2.3 eLearning

The Departments of Informatics at Clausthal University of Technology cooperates with the Universities of Göttingen, Hannover, and Braunschweig within the framework of the project “E-Learning in South Lower Saxony”. Clausthal University of Technology has a long experience on exporting and importing lectures between universities, and using sophisticated multimedia-based technology: it not only allows the students to watch and listen to the remote lecturer and see the slides, but also allows them to interactively ask questions. In addition, a database of electronic lectures is being built that allows students to follow the lectures any time on demand.

The department also participates in another ELAN-funded project named ATLANTIS, a collaboration of the chairs for business information systems of the universities of Braunschweig, Clausthal, Göttingen, Hannover, Oldenburg, and Osnabrück. The objective of this project is to set common principles for the curricula of the introductory courses in business information technology and to exchange courses on the Bachelor level based on internet technology.

For more information, we refer to http://www.elan-niedersachsen.de/index.php?id=582.

2.4 International Collaborations

\begin{footnotesize}
\begin{itemize}
\item[\textsuperscript{2}] Doktorandenkolloquium Wirtschaftsinformatik Südost-Niedersachsen
\end{itemize}
\end{footnotesize}
Figure 2-1 Overview of our SOCRATES/ERASMUS partner universities.
At the Department of Informatics, we encourage students to experience the international character of computer science by participating in a foreign exchange study programme. In close collaboration with the International Office, we offer to study as part of the SOCRATES/ERASMUS programme at the following universities (see also Figure 2-1):

- Université de Metz, France
- Centro de Investigación Educación Superior de Ensenada, Baja California, Mexico
- University of Ljubljana, Slovenia
- University of Belgrad, Serbia
- Vysoká skola bánská - Technická Univerzita Ostrava, Czech Republic
- University "1 December 1918", Alba Julia, Romania
- Bergen University College, Norway
- Budapest University of Technology and Economics, Hungaria
- University of Durham, U.K.
- Università della Calabria, Cosenza, Italy
- Jan Długosz University Częstochowa, Poland
- Gdansk University of Technology, Poland
- Göteborg University, Schweden
- Rijksuniversiteit Groningen, The Netherlands
- Izmir University of Economics, Turkey
- Hogskolen I Buskerud, Kongsberg, Norway
- Universidade de Lisboa, Portugal
- Universidad Rey Juan Carlos, Madrid, Spain
- Universitat de les Illes Balears, Palma de Mallorca, Spain
- University of Cyprus, Nicosia, Cyprus
- Université Pierre et Marie Curie, Paris, France
- Technical University of Iceland, Reykjavic, Island
- Technicheski Universitet Varna, Bulgaria
- Delft University of Technology, The Netherlands
- Universitat Autònoma de Barcelona, Spain
- Linköpings Universitet, Schweden
- Università Degli Studi Di Trento, Italy
- Helsinki University of Technology, Finnland
2.5 Outreach Activities

Besides the academic activities for our current students we also regularly organize events for our prospective students and our former students.

2.5.1 Summer Seminar

Every year during a summer weekend, the Department of Informatics invites high school students in their last or second-to-last year from all over the country to Clausthal to participate in an informative two-day, hands-on seminar.

In collaboration with the university’s Office for Public Relations (many thanks to Jochen Brinkmann for organizing this event) we offer an interesting programme to inform about and advertise our study programmes. First, students receive a general introduction that features the key benefits and facts of studying in Clausthal in general and at the Department of Informatics in particular. After that, the professors give down-to-earth overviews of some of their special fields, and the high school students get some insight into the daily work of computer scientists at the institute in presentations, and hands-on experiments. Finally, invited alumni as well as advanced graduate students give the students’ perspective of studying in Clausthal.

The seminar is rounded off by a barbecue party on the evening of the first day.

For more information, we refer to [http://www.in.tu-clausthal.de/en/fuer-schueler/schuelerseminar/](http://www.in.tu-clausthal.de/en/fuer-schueler/schuelerseminar/).

2.5.2 Seminar “Simulation and Visualization”

In October 2010, for one week during the autumn holidays in Lower Saxony, 23 high school students visited Clausthal university to gain some insights into the scientific fields of simulation and visualization. The seminar organized by Dr. Andreas Herzog showed different aspects of the research in mathematics, computer science and engineering.
Not only pupils from the vicinity of Clausthal visited the seminar. They came also from Hamburg, Bremen, the Ruhr area, and Saxony-Anhalt to participate in the event. Most of them attended an A-level course in mathematics at their school.

In lectures, exercises and experiments they learned how processes from nature, technology, and economics can be mapped to models in a computer and how predictions can be made based on these models. For instance, they simulated the energy supply of the 21st century and learned how a virtual plant design could be visualized in 3D.

Within the programme, a number of social events were organized, such as a mountain bike trip to Goslar, a sightseeing tour at the World Cultural Heritage and a visit at the Energy Research Centre Lower-Saxony (“Energie-Forschungszentrum Niedersachsen”).

### 2.5.3 School Information Days

Once every year in springtime, we also address the even younger prospective students from nearby high schools. Since 1981, the annual university-wide school information days are an inherent part of the university’s outreach efforts. On two days, more than 1000 students from about 30 high schools in Lower Saxony and Saxony-Anhalt visit the university and its departments. It is a good chance for prospective students to familiarize themselves with the city of Clausthal, the university, study programmes, and future job prospects. The students visit the different departments in small groups of 20 to 25 students, each guided by a student of Clausthal University of Technology.

As part of the school information days, the Department of Informatics welcomes more than 10 groups on both days. Within one and a half hours, we provide general information about computer science in Clausthal and life at the university, and we answer questions regarding the university and our study programmes. After the general introduction we offer interesting talks, spectacular presentations, and hands-on experiments, e.g.,

- robotics presentation,
- development of a peer-to-peer chat,
- database experiments,
- research topics in Computer Graphics, and
- virtual reality.

Every year, some of the first-year students at Clausthal University are former participants of the school information days, demonstrating the success of this event.
2.5 Outreach Activities

For more information, we refer to http://www.wissenschaft-erleben.de/schuelerinfotage/.

2.5.4 Girl’s Day

The department also participates in an annual event organized by the Equal Opportunities Office since fall 1995 that particularly addresses female pupils and aims at getting them interested in studying engineering or sciences at Clausthal University of Technology. During one week, about 20 to 25 pupils from all over Germany attend regular university lectures, take part in 2-hour practical exercises, get into contact with both students and professors, and visit a number of institutes. Moreover, they participate in several leisure activities.

For more information, we refer to http://www.gb.tu-clausthal.de/schnupperstudium/.

2.5.5 School Visits

In order to show pupils that computer science is a fascinating research subject, we regularly visit schools and give talks in classes. We explain what computer science is, show research projects, and answer all kinds of questions. By these talks, the pupils get an overview of what we are doing at our department and how a study programme at the Clausthal University of Technology looks like.

2.5.6 TILL 2011

In 2011, the annual “Tag der Informatiklehrerinnen und -lehrer Niedersachsen/Bremen” (TILL; professional development for high school teachers) took place at Clausthal. 80 computer science teachers from Lower Saxony and Bremen attended this event to talk about how the syllabi and curricula at high schools can be improved with respect to computer science.

Different project workshops were offered with easy-to-adopt methods for classroom use. Teachers also appreciated very much an industrial exhibition where 19 different companies showed their products for schools.

For more information, we refer to http://ifib.informatik.uni-oldenburg.de/till2011/.
2.5.7 Alumni Management

Every year, the Department of Informatics invites former and current students as well as members of the department to an informal meeting. One of the main benefits for current students is that they can get an overview of how life and work can look like with a degree in computer science. Former students, on the other hand, get the opportunity to learn what has changed since they left Clausthal; in addition, they can refresh their contacts with other former students and their former professors. All students get an overview of the current research and projects at the Department of Informatics.

2.5.8 Early Studies Programme for High School Students

With our department, excellent pupils get the opportunity to regularly visit selected courses in computer science at Clausthal University (including programming classes and introductory classes about computer science, algorithms and data structures). This allows them to experience computer science and how this subject is approached at the university level at a very early age. There are several advantages for students: first, they can better assess whether the subject matches their inclinations; second, they can acquire credit points for classes before they actually start their official computer science programme. That way, they can spend more time on other courses in their first year in the Bachelor programme. Or, they can finish their studies earlier, giving them an advantage when applying for a job.

The programme exists since 2008/2009. Typically, between 10 and 20 students per semester enroll. Approximately a third of these then continue with further computer science studies. But even those that do not decide to focus on computer science for their career still usually give very positive feedback on the early study programme, since it allowed them to experience University.

While the programme is open for students from all high schools, the Department of Informatics is currently cooperating with four local schools in this matter. This includes organized bus transfers and a close cooperation with the schools to avoid overlaps between university class hours and school classes.

2.6 Lecturing

In this section, we list all the lecture courses, seminars, and labs from summer term 2010 through winter term 2010/2011. For each course, we denote by \((x, y, z)\) the weekly hours: \(x\) denotes lecture hours, \(y\) exercise hours, and \(z\) lab hours or seminar hours.

For more detailed information about all courses, we would like to refer the reader to the online university course catalogue at \(https://qis.tu-clausthal.de\).
SS 10: Courses and Seminars

- Einführung in die Künstliche Intelligenz (3, 1, 0)
  Dix and Bulling

- Multi-Agent-System I (2, 0, 2)
  Dix, Behrens and Köster

- Multi-Agent-System II (2, 2, 0)
  Dix and Bulling

- Datenbanken II (3, 1, 0)
  Hartmann, Arnhold and Trinh

- Datenbanken und Simulation (3, 1, 0)
  Hartmann, Arnhold and Trinh

- Mobilkommunikation I (2, 0, 0)
  Hogrefe (eLearning import)

- Compilierbau (3, 1, 0)
  Huhn

- Entwurf digitaler Schaltungen (3, 1, 0)
  Kemnitz and Giesemann

- Simulation komplexer Systeme (3, 1, 0)
  Lessing

- ATLANTIS: Anwendungssysteme in Industrieunternehmen (3, 1, 0)
  Müller (eLearning import)

- ATLANTIS: Business Intelligence (3, 1, 0)
  Müller (eLearning import)

- ATLANTIS: Informationsverarbeitung in Dienstleistungsbetrieben (3, 1, 0)
  Müller (eLearning import)

- ATLANTIS: Mobile Business (3, 1, 0)
  Müller (eLearning import)

- Electronic Commerce / Electronic Business (3, 1, 0)
  Müller and Stiefel

- Modellierung von Informationssystemen (3, 1, 0)
  Müller and Doktors

- Computer Supported Cooperative Work (3, 1, 0)
  Pinkwart and Olivier

- Wissenschaftliche Arbeitstechniken für Seminare (1, 0, 0)
  Pinkwart

- Programmierkurs (2, 0, 2)
  Rausch, Deiters, Deynet and Fischer
Programmierpraktikum (3, 1, 0)
Rausch, Zachmann, Appel, Deiters, Niebuhr, Weller and Ternite

Softwaretechnik II (3, 1, 0)
Rausch and Deynet

Mensch-Maschine-Kommunikation / Ergonomie und Mensch-Maschine-Schnittstellen (3, 1, 0)
Reuter

Rechnerarchitektur I (3, 1, 0)
Richter and Wang

Rechnerarchitektur II (3, 1, 0)
Richter and Aust

Embedded Systems Engineering II (3, 1, 0)
Siemers, Fritzsche and Lützel

Verteilte Systeme I (3, 1, 0)
Siemers and Fritzsche

Computergraphik II (3, 1, 0)
Zachmann

Informatik II (4, 2, 0)
Zachmann

Virtuelle Realität und parallele physikalisch-basierte Simulation (3, 1, 0)
Zachmann

Oberseminar Aktuelle Forschung in der KI (0, 0, 2)
Dix, Behrens, Bulling, Jamroga and Köster

Proseminar Ausgewählte Kapitel der KI (0, 0, 2)
Dix

Seminar Ausgewählte Kapitel der KI (0, 0, 2)
Dix

Seminar Multi-Agent Systems in Real-Time Applications (0, 0, 2)
Dix and Behrens

Seminar Multi-Agent Systems: Modeling, Reasoning, and Verification (0, 0, 2)
Dix and Bulling

Seminar Programming Modular Agent and Multi-Agent Systems (0, 0, 2)
Dix

Hauptseminar Datenbank-Sicherheit (0, 0, 2)
Hartmann, Arnhold and Trinh

Oberseminar Datenbanken und Informationssysteme (0, 0, 2)
Hartmann
2.6 Lecturing

- Seminar Moderne Datenbanktechnologien (0, 0, 2)  
  Hartmann, Arnhold and Trinh

- Oberseminar Wirtschaftsinformatik (0, 0, 2)  
  Müller and Pinkwart

- Projektseminar/Fortgeschrittenenprojekt Wirtschaftsinformatik (0, 0, 6)  
  Müller

- Seminar Wirtschaftsinformatik (0, 0, 2)  
  Pinkwart

- Oberseminar Aktuelle Forschung im Software Systems Engineering (0, 0, 2)  
  Rausch

- Seminar/Hauptseminar/Proseminar Tatort Schreibtisch: Benutzer im Fokus (0, 0, 2)  
  Rausch and Niebuhr

- Oberseminar Aktuelle Forschung in der Computergraphik (0, 0, 2)  
  Zachmann

- Praktikum Datenbanken-Praktikum (0, 0, 6)  
  Hartmann, Arnhold and Trinh

- Praktikum Digitaler Schaltungsentwurf I (0, 0, 2)  
  Kemnitz

- Programmierkurs II / Praktikum Mikrorechner (0, 0, 2)  
  Kemnitz

- Praktikum Chipsynthese mit VHDL (0, 0, 2)  
  Richter and Hu

- Fortgeschrittenenprojekt Datenbanken und Informationssysteme (0, 0, 6)  
  Hartmann, Arnhold and Thinh

- Fortgeschrittenenprojekt Concurrent Computing (0, 0, 4)  
  Rausch

WS 10/11 Courses and Seminars

- ATLANTIS: Informationsverarbeitung in Dienstleistungsbetrieben (3, 1, 0)  
  Breitner, Müller and Foalem (eLearning import)

- Informatik III (3, 1, 0)  
  Dix and Bulling

- Modallogiken (3, 1, 0)  
  Dix and Bulling

- ATLANTIS: Anwendungssysteme in Industrieunternehmen (3, 1, 0)  
  Hahn, Müller and Foalem (eLearning import)
- Datenbanken I (3, 1, 0)
  Hartmann, Arnhold and Trinh
- XML Datenbanken und Semantic Web (3, 1, 0)
  Hartmann and Trinh
- Mobilkommunikation II (1, 1, 0)
  Hogrefe and Hu (eLearning import)
- MBSE — Modellbasierte Softwareentwicklung (3, 1, 0)
  Huhn and Bessling
- Elektronik I (3, 1, 0)
  Kemnitz and Giesemann
- Softwaretechnikpraktikum für Informationstechnik (3, 0, 1)
  Kemnitz
- Projekt- und Qualitätsmanagement im Software Systems Engineering (3, 1, 0)
  Kuhrmann
- ATLANTIS: Business Intelligence (3, 1, 0)
  Mattfeld, Müller and Foalem (eLearning import)
- Einführung in die Wirtschaftsinformatik (3, 1, 0)
  Müller, Dokters and Kehl
- Einführung in SAP ERP (2, 0, 0)
  Müller, Bosse and Jiang
- Wirtschaftsinformatik III - Integrierte Anwendungssysteme (3, 1, 0)
  Müller
- Grundlagen der Programmierung (2, 2, 0)
  Pinkwart and Olivier
- Technologien von Kooperationssystemen (3, 1, 0)
  Pinkwart and Olivier
- Werkzeuge der Informatik (2, 2, 0)
  Pinkwart and Foalem Fotso Sagoun
- Werkzeuge der Informatik für Energietechnologien (2, 1, 0)
  Pinkwart and Foalem Fotso Sagoun
- Informatik I (4, 2, 0)
  Rausch, Bartelt, Deynet and Dohrmann
- Moderne Konzepte der Programmierung (3, 1, 0)
  Rausch
- Softwaretechnik I (3, 1, 0)
  Rausch, Fischer, Gülle, Niebuhr and Ternite
2.6 Lecturing

- Wissenschaftliche Arbeitstechniken für Seminare (1, 0, 0)
  Rausch
- Modellbildung und Simulation (3, 1, 0)
  Reuter
- Rechnernetze I (3, 1, 0)
  Richter, Aust and Hu
- Rechnernetze II (3, 1, 0)
  Richter and Aust
- ATLANTIS: Mobile Business (3, 1, 0)
  Schumann, Müller and Foalem (eLearning import)
- Embedded Systems I (3, 1, 0)
  Siemers and Fritzsche
- Moderne Enterprise Resource Planning Systeme (3, 1, 0)
  Werth and Müller
- Computergraphik (3, 1, 0)
  Zachmann
- Virtuelle Realität und parallele physikalisch-basierte Simulation (3, 1, 0)
  Zachmann
- Oberseminar Aktuelle Forschung in der KI (0, 0, 2)
  Dix, Behrens, Bulling, Jamroga and Köster
- Hauptseminar Ausgewählte Kapitel der KI (0, 0, 2)
  Dix and Bulling
- Proseminar Ausgewählte Kapitel der KI (0, 0, 2)
  Dix and Bulling
- Seminar Multi-Agent Systems: Modeling, Reasoning, and Verification (0, 0, 2)
  Dix and Bulling
- Seminar Multi-Agent Systems in Real-Time Applications (0, 0, 2)
  Dix and Behrens
- Hauptseminar Database as a Service (0, 0, 2)
  Hartmann, Arnhold and Trinh
- Oberseminar Datenbanken und Informationssysteme (0, 0, 2)
  Hartmann
- Seminar Moderne Datenbanktechnologien (0, 0, 2)
  Hartmann, Arnhold and Trinh
- Seminar Autonomy and Trust (0, 0, 2)
  Huhn
Seminar Wirtschaftsinformatik (0, 0, 2) Müller
Oberseminar Wirtschaftsinformatik (0, 0, 2) Müller and Pinkwart
Projektseminar / Fortgeschrittenenprojekt Wirtschaftsinformatik (0, 0, 4) Pinkwart
Oberseminar Aktuelle Forschung im Software Systems Engineering (0, 0, 2) Rausch
Seminar / Hauptseminar / Proseminar Software Systems Engineering in der Automobilindustrie (0, 0, 2) Rausch, Niebuhr and Schindler
Seminar Aktuelle Forschung in verteilten und eingebetteten Systemen (0, 0, 2) Siemers, Drieseberg, Fritzsche and Lützel
Oberseminar Aktuelle Forschung in der Computergraphik (0, 0, 2) Zachmann
Seminar / Hauptseminar / Proseminar Game Physics (0, 0, 2) Zachmann
Datenbank-Praktikum (0, 0, 6) Hartmann, Arnhold and Trinh
Praktikum Digitaler Schaltungsentwurf II (0, 0, 2) Kemnitz
Praktikum Elektronik I (0, 0, 2) Kemnitz
Praktikum Mikrorechner (0, 0, 4) Kemnitz
Praktikum Chipsynthese mit VHDL (0, 0, 2) Richter and Hu
Fortgeschrittenenprojekt Künstliche Intelligenz (0, 0, 6) Dix, Behrens and Köster
Fortgeschrittenenprojekt Datenbanken und Informationssysteme (0, 0, 6) Hartmann, Arnhold and Trinh
Master-Projekt Informatik (0, 0, 4) Hartmann
Fortgeschrittenenprojekt Entwurf sicherheitsgerichteter Systeme (0, 0, 6) Huhn
Master-Projekt Wirtschaftsinformatik (0, 0, 4) Müller and Pinkwart
2.6 Lecturing

- Fortgeschrittenenprojekt Concurrent Computing (0, 0, 6)
  Rausch and Richter
- Fortgeschrittenenprojekt Software Systems Engineering (0, 0, 6)
  Rausch
- Master-Projekt Software Engineering (0, 0, 4)
  Rausch, Deiters and Schindler
- Fortgeschrittenenprojekt Computergraphik / Praktikum im Schwerpunkt
  Praktische und Angewandte Informatik (0, 0, 6)
  Zachmann

SS II: Courses and Seminars

- ATLANTIS: Mobile Business (3, 1, 0)
  Breitner, Müller and Foalem Fotso Sagoun (eLearning import)
- Einführung in die Künstliche Intelligenz (3, 1, 0)
  Dix and Bulling
- Komplexitätstheorie (3, 1, 0)
  Dix and Bulling
- Multi-Agent-System I (2, 0, 2)
  Dix, Behrens and Köster
- ATLANTIS: Anwendungssysteme in Industrieunternehmen (3, 1, 0)
  Hahn, Müller and Foalem Fotso Sagoun (eLearning import)
- Datenbanken II (3, 1, 0)
  Hartmann, Arnhold and Trinh
- Datenbanken und Simulation (3, 1, 0)
  Hartmann, Arnhold and Trinh
- Data Warehousing and Data Mining Techniques (3, 1, 0)
  Hartmann
- Information Retrieval (3, 1, 0)
  Hartmann and Trinh
- Multimedia Databases (3, 1, 0)
  Hartmann and Trinh
- Mobilkommunikation I (2, 0, 0)
  Hogrefe (eLearning import)
- Entwicklung sicherheitskritischer Systeme (3, 1, 0)
  Huhn and Bessling
- Entwurf digitaler Schaltungen (3, 1, 0)
  Kemnitz and Giesemann
Test und Verlässlichkeit (3, 1, 0)
Kemnitz

Projekt- und Qualitätsmanagement im Software Systems Engineering (3, 1, 0)
Kuhrmann

ATLANTIS: Business Intelligence (3, 1, 0)
Mattfeld, Müller and Foalem Fotso Sagoun (eLearning import)

ATLANTIS: Informationsverarbeitung in Dienstleistungsbetrieben (3, 1, 0)
Müller and Foalem Fotso Sagoun (eLearning import)

Electronic Commerce / Electonic Business (3, 1, 0)
Müller

Einführung in SAP ERP (2, 0, 0)
Müller, Bosse and Jiang

Modellierung von Informationssystemen (Wirtschaftsinformatik II) (3, 1, 0)
Müller and Doktors

Computer Supported Cooperative Work (3, 1, 0)
Pinkwart and Olivier

Mensch-Maschine-Kommunikation / Ergonomie und Mensch-Maschine-Schnittstellen (3, 1, 0)
Pinkwart

Programmierkurs (2, 0, 2)
Rausch, Deiters, Deynet, Dohrmann and Fischer

Programmierpraktikum (3, 1, 0)
Rausch, Zachmann, Deiters, Niebuhr, Weller and Ternite

Requirements Engineering und Systementwurf (2, 1, 0)
Rausch

Softwaretechnik II (3, 1, 0)
Rausch and Deynet

System Life Cycle Prozesse (2, 1, 0)
Rausch

Einführung in die Kognitionswissenschaften für Informatiker und Wirtschaftsinformatiker (3, 1, 0)
Reuter

Rechnerarchitektur I (3, 1, 0)
Richter and Aust

Rechnerarchitektur II (3, 1, 0)
Richter and Aust
☐ Wissenschaftliche Arbeitstechniken für Seminare (1, 0, 0)
Richter

☐ Eingebettete Systeme (2, 1, 0)
Siemers

☐ Embedded Systems Engineering II (3, 1, 0)
Siemers, Drieseberg, Fritzsche and Lützel

☐ Verteilte Systeme I (3, 1, 0)
Siemers, Drieseberg and Fritzsche

☐ Software as a Service (2, 0, 0)
Werth and Müller

☐ Geometrische Datenstrukturen für die Computergraphik (3, 1, 0)
Zachmann

☐ Informatik II (4, 2, 0)
Zachmann

☐ Virtuelle Realität und parallele physikalisch-basierte Simulation (3, 1, 0)
Zachmann

☐ Oberseminar Aktuelle Forschung in der KI (0, 0, 2)
Dix, Behrens, Bulling, Jamroga and Köster

☐ Proseminar Ausgewählte Kapitel der KI (0, 0, 2)
Dix

☐ Seminar Ausgewählte Kapitel der KI (0, 0, 2)
Dix and Bulling

☐ Seminar Multi-Agent Systems in Real-Time Applications (0, 0, 2)
Dix and Behrens

☐ Seminar Multi-Agent Systems, Modeling: Reasoning, and Verification (0, 0, 2)
Dix and Bulling

☐ Seminar Programming Modular Agent and Multi-Agent Systems (0, 0, 2)
Dix

☐ Hauptseminar Datenbank-Sicherheit (0, 0, 2)
Hartmann, Arnhold and Trinh

☐ Oberseminar Datenbanken und Informationssysteme (0, 0, 2)
Hartmann

☐ Seminar Moderne Datenbanktechnologien (0, 0, 2)
Hartmann, Arnhold and Trinh

☐ Oberseminar Wirtschaftsinformatik (0, 0, 2)
Müller and Pinkwart
- Seminar Wirtschaftsinformatik (0, 0, 2)
  Müller and Görmer

- Projektseminar/Fortgeschrittenenprojekt Wirtschaftsinformatik (0, 0, 6)
  Pinkwart

- Oberseminar Aktuelle Forschung im Software Systems Engineering (0, 0, 2)
  Rausch

- Seminar/Hauptseminar/Proseminar Tatort Schreibtisch: Benutzer im Fokus
  (0, 0, 2)
  Rausch and Niebuhr

- Oberseminar Aktuelle Forschung in der Computergraphik (0, 0, 2)
  Zachmann

- Praktikum Datenbanken-Praktikum (0, 0, 6)
  Hartmann, Arnhold and Trinh

- Praktikum Design Lab of Digital Systems (0, 0, 6)
  Kemnitz

- Praktikum Digitaler Schaltungsentwurf I (0, 0, 2)
  Kemnitz

- Praktikum Chipsynthese mit VHDL (0, 0, 2)
  Richter and Hu

- Fortgeschrittenenprojekt Künstliche Intelligenz (0, 0, 6)
  Dix, Behrens and Köster

- Fortgeschrittenenprojekt Datenbanken und Informationssysteme (0, 0, 6)
  Hartmann, Arnhold and Thinh

- Master-Projekt Informatik (0, 0, 4)
  Hartmann

- Fortgeschrittenenprojekt Entwurf sicherheitsgerichteter Systeme (0, 0, 6)
  Huhn and Bessling

- Master-Projekt Wirtschaftsinformatik (0, 0, 4)
  Müller and Pinkwart

- Fortgeschrittenenprojekt Concurrent Computing (0, 0, 4)
  Rausch

- Fortgeschrittenenprojekt / Masterarbeit / Praktikum / Studienarbeit / Projektseminar Software Engineering (0, 0, 4)
  Rausch

- Fortgeschrittenenprojekt Computergraphik / Praktikum im Schwerpunkt
  Praktische und Angewandte Informatik (0, 0, 6) Zachmann

**WS 11/12**  Courses and Seminars
- ATLANTIS: Informationsverarbeitung in Dienstleistungsbetrieben (3, 1, 0)
  Breitner, Müller, Jiang and Mumme (eLearning import)
- Einführung in die Modellierung und Analyse von Sicherheitsprotokollen (3, 1, 0)
  Bulling
- Informatik III (3, 1, 0)
  Dix and Behrens
- ATLANTIS: Anwendungssysteme in Industrieunternehmen (3, 1, 0)
  Hahn, Müller, Jiang and Mumme (eLearning import)
- Datenbanken I (3, 1, 0)
  Hartmann, Arnhold and Trinh
- XML Datenbanken und Semantic Web (3, 1, 0)
  Hartmann, Arnhold and Trinh
- Mobilkommunikation II (1, 1, 0)
  Hogrefe and Hu (eLearning import)
- Compilerbau (3, 1, 0)
  Huhn and Bessling
- Elektronik I (3, 1, 0)
  Kemnitz and Giesemann
- Softwaretechnikpraktikum für Informationstechnik (3, 0, 1)
  Kemnitz
- Automotive — Management und Technik in der Fahrzeugentwicklung (2, 0, 0)
  Ludanek
- ATLANTIS: Business Intelligence (3, 1, 0)
  Mattfeld, Müller, Jiang and Mumme (eLearning import)
- Einführung in die Wirtschaftsinformatik (3, 1, 0)
  Müller and Kehl
- Einführung in SAP ERP (2, 0, 0)
  Müller, Bosse and Wittek
- Wirtschaftsinformatik III: Integrierte Anwendungssysteme (3, 1, 0)
  Müller and Mumme
- Grundlagen der Programmierung (2, 2, 0)
  Pinkwart and Olivier
- Technologien von Kooperationssystemen (3, 1, 0)
  Pinkwart and Olivier
- Informatik I (4, 2, 0)
  Rausch, Dohrmann, Ibe and Schindler
- Moderne Konzepte der Programmierung (3, 1, 0)
  Rausch and Fischer

- Softwaretechnik I (3, 1, 0)
  Rausch, Deynet, Fischer, Vogel and Warnecke

- Modellbildung und Simulation (3, 1, 0)
  Reuter

- Rechnernetze I (3, 1, 0)
  Richter, Aust and Langer

- Rechnernetze II (3, 1, 0)
  Richter and Aust

- ATLANTIS: Mobile Business (3, 1, 0)
  Schumann, Müller, Jiang and Mumme (eLearning import)

- Embedded Systems I (3, 1, 0)
  Siemers, Drieseberg and Fritzsche

- Embedded Systems I (3, 1, 0)
  Siemers, Drieseberg, Fritzsche and Lützel

- Moderne Enterprise Resource Planning Systeme (3, 1, 0)
  Werth and Müller

- Computergraphik I (3, 1, 0)
  Zachmann

- Werkzeuge der Informatik (2, 2, 0)
  Zachmann, Hartmann, Müller, Pinkwart and Richter

- Werkzeuge der Informatik für Energietechnologien (2, 1, 0)
  Zachmann, Hartmann, Müller, Pinkwart and Richter

- Virtuelle Realität und parallele physikalisch-basierte Simulation (3, 1, 0)
  Zachmann

- Oberseminar Aktuelle Forschung in der KI (0, 0, 2)
  Dix, Behrens, Bulling Jamroga and Köster

- Hauptseminar Ausgewählte Kapitel der KI (0, 0, 2)
  Dix and Bulling

- Proseminar Ausgewählte Kapitel der KI (0, 0, 2)
  Dix and Bulling

- Seminar Multi-Agent Systems: Modeling, Reasoning, and Verification (0, 0, 2)
  Dix and Bulling

- Seminar Multi-Agent Systems in Real-Time Applications (0, 0, 2)
  Dix and Behrens
2.6 Lecturing

- Hauptseminar Database as a Service (0, 0, 2)
  Hartmann, Arnhold and Trinh
- Oberseminar Datenbanken und Informationssysteme (0, 0, 2)
  Hartmann
- Seminar Moderne Datenbanktechnologien (0, 0, 2)
  Hartmann, Arnhold and Trinh
- Seminar Dependability and Trust (0, 0, 2)
  Huhn
- Oberseminar Wirtschaftsinformatik (0, 0, 2)
  Müller and Pinkwart
- Projektseminar / Fortgeschrittenenprojekt Wirtschaftsinformatik (0, 0, 4)
  Müller and Fiosins
- Seminar Mensch-Computer-Interaktion / Wirtschaftsinformatik (0, 0, 2)
  Pinkwart
- Oberseminar Aktuelle Forschung im Software Systems Engineering (0, 0, 2)
  Rausch
- Seminar / Hauptseminar / Proseminar Komponentenbasierte Softwareentwicklung und Komponentenmodelle (0, 0, 2)
  Rausch
- Seminar Aktuelle Forschung in verteilten und eingebetteten Systemen (0, 0, 2)
  Siemers, Drieseberg, Fritzsche and Lützel
- Wissenschaftliche Arbeitstechniken für Seminare (0, 1, 0)
  Siemers
- Oberseminar Aktuelle Forschung in der Computergraphik (0, 0, 2)
  Zachmann
- Seminar / Hauptseminar / Proseminar Game Physics (0, 0, 2)
  Zachmann
- Datenbank-Praktikum (0, 0, 6)
  Hartmann, Arnhold and Trinh
- Praktikum Digitaler Schaltungsentwurf II (0, 0, 2)
  Kemnitz and Ristig
- Praktikum Mikrorechner (0, 0, 4)
  Kemnitz and Ristig
- Praktikum Elektronik I (0, 0, 2)
  Kemnitz
- Praktikum Chipsynthese mit VHDL (0, 0, 2)
  Richter, Aust and Langer
- Fortgeschrittenenprojekt Künstliche Intelligenz (0, 0, 6)
  Dix, Behrens and Köster

- Fortgeschrittenenprojekt Datenbanken und Informationssysteme (0, 0, 6)
  Hartmann, Arnhold and Trinh

- Master-Projekt Informatik (0, 0, 4)
  Hartmann and Zachmann

- Fortgeschrittenenprojekt Entwurf sicherheitsgerichteter Systeme (0, 0, 6)
  Huhn

- Master-Projekt Wirtschaftsinformatik (0, 0, 4)
  Müller and Pinkwart

- Fortgeschrittenenprojekt Software Systems Engineering (0, 0, 6)
  Rausch

- Master-Projekt Software Engineering (0, 0, 4)
  Rausch, Deiters and Schindler

- Fortgeschrittenenprojekt Concurrent Computing (0, 0, 6)
  Richter

- Fortgeschrittenenprojekt Computergraphik / Praktikum im Schwerpunkt
  Praktische und Angewandte Informatik (0, 0, 6)
  Zachmann
3 Research Groups
3.1 Business Information Technology Unit

3.1.1 Overview

Leaders Prof. Dr. Jörg P. Müller
Prof. Dr. Niels Pinkwart

Secretary Stefanie Cronjäger

Scientific Employees Madiha Ahmad, M.Phil. (since 01/2011)
Dipl.-Wirt.-Inf. Thomas Dokters (until 09/2011)
Dr. sc. Jelena Fiosina (since 06/2011)
Dr. sc. Maksims Fiosins
Dipl.-Wirt.-Inf. Olivier Foalem (until 03/2010)
Dipl.-Wirt.-Inf. Jana Görmer
Dipl.-Wirt.-Inf. Sebastian Groß (since 10/2011)
Dipl.-Wirt.-Inf. Dong Jiang (until 07/2010)
Dipl.-Wirt.-Inf. Stefan Kehl (since 03/2011)
Dr. rer. nat. Nguyen-Thinh Le (since 04/2010)
Dipl.-Wirt.-Inf. Frank Loll (until 10/2011)
Dipl.-Wirt.-Inf. Christopher Mumme
Dipl.-Inf. Sabine Niebuhr (since 05/2011)
Dipl.-Inf. Hannes Olivier, M.Sc.
Giselle Rodriguez, B.Sc. (since 09/2011)
Dr. rer. nat. Patrick Stiefel (until 10/2010)
Sven Strickroth, M.Sc.
Stefan Wittek, B. Sc. (since 10/2011)

External Ph.D. students
Dipl.-Inf. (FH) Matthias Born, SAP AG Research, Karlsruhe
Dr. rer. nat. Christoph Gerdes, Siemens Corporate Technology, München (until 08/10)
Dipl.-Wirt.-Ing. Sebastian Mechs, Siemens Corporate Technology, München
Dipl.-Ing. Marc Glauche, Siemens AG, Berlin

Stipendium holders

3.1.2 Research Agenda

The business information technology unit consists of two research groups.
The research group *Human Centered Information Systems*, led by Niels Pinkwart, focuses on the design of digital media and technologies to support human cooperation, communication, and social interaction. We investigate collaborative systems from a variety of perspectives, including their conceptual design, software architectures, user interfaces, and (last not least) usage by humans in their work, learning or leisure context. In our research, we adopt an interdisciplinary approach which is rooted in Computer Science and Information Technology, but also includes methods from Cognitive and Social Sciences. A specific focus of our research is set on applications in the domain of educational technology, particularly on distributed and collaborative software systems which provide intelligent support to students in order to help them learning.

The main research focus of the *Mobile and Enterprise Computing (MEC)* research group, led by Jörg P. Müller, is on decentralized information technologies, in particular, multi-agent and peer-to-peer (P2P) systems, methods, architecture, models, tools for decentralized and adaptive management, engineering, and coordination in information systems. We are interested in the development, validation, and application of decentralized, self-organizing techniques in various networked domains, such as Transport and Traffic, Energy, Supply Network Management and Product Lifecycle Management. The systems we are investigating are composed of autonomous nodes that are required to cooperate or coordinate their activities, because they co-exist in a shared environment, depend on shared resources, or pursue common goals. Core technology competences at MEC are multiagent systems and intelligent agents, P2P computing, protocols, architectures, and middleware for decentralized information management and coordination including cloud and virtualization technologies, model-driven development of business IT systems, and organic / autonomic computing. MEC teaching activities cover introductory and advanced courses on (distributed) business information systems and technology.

The homepage of the business information technology unit is [http://winf.in.tu-clausthal.de](http://winf.in.tu-clausthal.de)

The homepage of the *Human Centered Information Systems* research group is [http://hcis.in.tu-clausthal.de/](http://hcis.in.tu-clausthal.de/)

The homepage of the *Mobile and Enterprise Computing* research group is [http://meclab.in.tu-clausthal.de](http://meclab.in.tu-clausthal.de)

### 3.1.3 Supervised Theses


### 3.1.4 Projects

**Project 1: Adaptive Interaction Mechanisms (AIM)**

**Project Members**
- Prof. Dr. Jörg P. Müller (Leader)
- Jana Görmer (Project Staff)
- Christopher Mumme (Project Staff)

**Partners**
- Prof. Dr. Jörg P. Müller, (Main Leader)
- Prof. Dr. Bernardo Wagner,
- Prof. Dr. Niels Pinkwart,
- Prof. Dr. Michaela Huhn,

**Funding**
Federal government of Lower Saxony
232,400€ (of 2,500,000€ total)

**Duration**
03/2009 – 08/2012
**Project Description**

Classical approaches of computer science do not scale well for today’s large and complex software-intensive systems. Software systems cannot be considered in isolation, since they are connected among each other and interact massively. Instead they are to be designed as parts of a larger IT Ecosystem. In analogy to biological ecosystems, IT Ecosystems are based on the balance between individuals (autonomy) and sets of rules (control) defining equilibria within an IT Ecosystem. Maintaining and continuously evolving IT Ecosystems requires deep understanding of this balance. The new research topic IT Ecosystems cuts across several research areas, including: emergence of system functions, extending classical engineering approaches, adaptive infrastructures, control of semantic diversity, and enhanced human-environment-machine interaction. These core areas are addressed by the newly established NTH focused Research School for IT Ecosystems, a cooperation of the Universities of Braunschweig, Clausthal, and Hannover. A joint demonstrator will present innovative research results in the context of a smart city application.

The goal of AIM is to investigate methods for decentralized, bottom-up organisation of complex software systems, with special focus on the emergence and adaptation of interaction mechanisms among automated actors in dynamic environments. AIM is a subproject of the IT ecosystems project funded by the Federal government of Lower Saxony.

**References**

[Rausch et al., 2010] (Page 192),
[Huhn et al., 2011] (Page 188),
[Görmer et al., 2011a] (Page 187)

**Contact E-Mail**

**Project Homepage**

[http://www.it-oekosysteme.org](http://www.it-oekosysteme.org)

**Project 2: Planning and Decision-making in Next-generation Traffic Systems (PLANETS)**
Project Members
Prof. Dr. Jörg P. Müller (Leader)
Dr. Maksims Fiosins (Project Staff)
Jana Görmer (Project Staff)

Partners
Prof. Dr. Bernhard Friedrich,
Prof. Dr. Dirk Mattfeld,
Prof. Dr. Markus Fidler,

Funding
Federal government of Lower Saxony
116,200€ (of 415,000€ total)

Duration

Project Description
PLANETS is a research project funded by Niedersächsisch-Technische Hochschule (NTH). The goal is to develop and evaluate innovative approaches for dynamic traffic management based on state-of-the-art technologies in information and communication technology. Main focus of the project is the integration of traffic and communication simulation, considering approaches from business information systems. The complexity of the broad field of technology is managed by interdisciplinary cooperation of expertise in the areas of traffic, business information systems and communication technology. Next to the Decision Support Group, the Institute of Computer Science at the Technische Universität Clausthal, the Institute for Traffic and Urban Engineering at the Technische Universität Braunschweig and the Institute for Communication Technology at the Leibniz Universität Hannover are involved in the project.
Project 3: ADMIT: Agent-oriented Distributed Data Mining using Computational Statistics

Project Member
Prof. Dr. Jörg P. Müller (Leader)

Partner
Dr. sc. Jelena Fiosina, TU Clausthal, DE

Funding
EU FP7 Marie Curie Intra-European Fellowships (IEF)
170,000€ (of 170,000€ total)

Duration
06/2010 – 05/2012

Project Description
Today’s systems for managing critical infrastructure such as traffic, energy, or industry automation systems are highly complex, distributed, and increasingly decentralized. Multi-agent systems (MAS) provide an intuitive metaphor and configurable, robust and scalable methods for problem-solving and control in distributed, decentrally organized system. The purpose of Distributed Data Mining (DDM) is to provide algorithmic solutions for data analysis in a distributed manner to detect hidden patterns in data and extract knowledge necessary for decentralized decision making. A new promising area of research studies possibilities for coupling MAS and DDM by exploiting DDM methods for improving agents’ intelligence and MAS systems performance. In the ADMIT project we focus on methods for distributed estimation of parameters for the individual agents, agent groups, and system-level information models. Our approach is based on Computational statistics (CST), which includes a set of methods for approximate solution of statistical problems without complex statistical procedures. The goal of the ADMIT project is to develop an agent-oriented DDM framework, which includes a set of computationally effective, robust and easy to apply methods for models parameter estimation and allows easy incorporation into MAS applications to analyze models at different levels of MAS. The scientific research objectives of ADMIT are:
- To develop a conceptual architecture of agent-oriented DDM framework as well as a methodology of its usage in multiagent programming frameworks;
- To develop a set of computationally effective and reliable to bad data quality CST-based DDM methods, for efficient estimation of model parameters on the basis of distributed data as well as estimate the methods performance;
- To assess the impact of incorporation of the DDM framework to MAS-based applications (with the main focus on traffic and logistics domains).

References
[Fiosina and Fiosins, 2011] (Page 180),
[Fiosina and Fiosins, 2011a] (Page 177)

Contact E-Mail
jelena.fiosina@tu-clausthal.de

Project Homepage
http://meclab.in.tu-clausthal.de/research/

Project 4: Manufacturing Execution Systems for the Steel Industry

Project Members
Prof. Dr. Jörg P. Müller (Leader)
Christopher Mumme (Project Staff)
Stefan Wittek (Project Staff)
Jens Dehnert (Project Staff)

Partners
Prof. Dr. Jürgen Kletti, MPDV Mikrolab GmbH, Mosbach, DE
Hans-Josef Kay, Deutsche Edelstahlwerke GmbH, Witten, DE
Prof. Dr. Christoph Schwindt, DFKI GmbH, Saarbrücken, DE

Funding
MPDV Mikrolab GmbH
6.000€ (of 12.000€ total)
**Duration**
05/2010 – 10/2010

**Project Description**
The goal of this project was to analyze production processes in the steel industry with specific view to the requirements to Manufacturing Execution Systems. In the first phase of the project, we identified and analyzed production processes and analyzed the IT landscape of a steel-producing company; the value stream analysis method was used for the former, and component and function map diagrams for the latter. In the second phase, we created a reference process model for steel production based on the information recorded in the first phase, containing both the process view and the IT view. The project has done in co-operation with the research group of Prof. Christoph Schwindt at TU Clausthal.

**Contact E-Mail**
joerg.mueller@tu-clausthal.de

**Project Homepage**
http://www.mpdv.de

**Project 5: Mobile2Learn**

**Project Members**
- Prof. Dr. Jörg P. Müller (Leader)
- Prof. Dr. Niels Pinkwart (Leader)
- Sven Strickroth (Project Staff)
- Giselle Rodriguez (Project Staff)

**Partner**
Regina Dürich, Kreisvolkshochschule Goslar, Goslar, DE

**Funding**
Niedersächsisches Institut für Frühkindliche Bildung
25,000€ (of 100,000€ total)

**Duration**
02/2010 – 02/2012
Project Description
The aim of this project, which is conducted within the nifbe (Lower Saxony Institute for Early Childhood Education and Development) framework, is to support parents of young children. Often, these parents do not have the knowledge about the activities and games that may be beneficial for their children - but at the same time, they do often not have enough spare time to inform themselves and do not know where they could do this if they wanted to. In the project, which is conducted by the group of Prof. Müller together with the research group of Prof. Niels Pinkwart at TUC and the KVHS Goslar, we will design, implement and test a combination of a web-based community platform with mobile phone access and field activities. The hypothesis is that these two forms of interaction will have synergy effects in that increased interaction and communication on the web may lead to increased participation in presence activities, and vice versa.

References
[Strickroth et al., 2011] (Page 194)

Contact E-Mail
joerg.mueller@tu-clausthal.de

Project Homepage
http://www.mobile2learn.de

Project 6: BPM4Grillo

Project Members
Prof. Dr. Jörg P. Müller (Leader)
Martin Müller (Project Staff)
Fabian Wagner (Project Staff)
Marc Schlegel (Project Staff)

Partners
consultingTEAM, Clausthal, DE,

Funding
GRILLO Zinkoxyd GmbH
6.500€ (of 6.500€ total)
3.1 Business Information Technology Unit

**Duration**
10/2010 – 12/2010

**Project Description**
For a zinc oxide producing company we analyzed and documented the core business and production processes using ARIS process notations. The resulting document is to provide a basis for subsequent migration of an ERP system.

**Contact E-Mail**
joerg.mueller@tu-clausthal.de

**Project Homepage**
http://www.grillo-zno.de

**Project 7: Architecture and Methods for Flexible Content Management in Peer-to-Peer Systems**

**Project Member**
Prof. Dr. Jörg P. Müller (Leader)

**Partner**
Dipl. Inf. Udo Bartlang, Siemens AG Corporate Technology, Information and Communications, München, DE

**Duration**
01/2006 – 12/2010
**Project Description**

The operation of dedicated content repositories is a change in perspective of content lifecycle management: their application largely promises both technical and financial benefits. Today, centrally managed static client/server architectures are the prevailing design approach for content repositories. However, systems built according to this paradigm inherently lack flexibility regarding the support of different content models and functional properties (for example, dynamic reconfiguration) as well as non-functional aspects (for instance, scalability). We pursue a decentralised approach based on the peer-to-peer architecture paradigm to overcome these drawbacks. Peer-to-peer architectures promise a more flexible architecture pattern migrating into more and more application domains. In spite of the fact it has been nearly a decade that popular peer-to-peer systems appeared as an auspicious paradigm for distributed computing, successful operation is still associated with basic file sharing applications; most of these (monolithic) systems miss sophisticated data management features for concurrent usage – as required by content repository systems. In this project, the applicability of the peer-to-peer paradigm for the implementation of content repository functions is investigated, and an architecture and methods to enable flexible content management in peer-to-peer systems are presented. Research challenges originate in terms of (i) reflecting different characteristics and relationships of content, (ii) supporting an adequate content repository model–both at functional and non-functional level, for example, to ensure reliability and consistency properties, and (iii) coping with peculiarities of a heterogeneous, dynamic peer-to-peer environment.

![Diagram of content management system](image)

**References**

[Bartlang, 2010] (Page 176),  
[Bartlang and Müller, 2010] (Page 179)
Contact E-Mail
joerg.mueller@tu-clausthal.de

Project Homepage
http://winf.in.tu-clausthal.de

Project 8:  A Data-Centric Information and Communication Architecture for Large-Scale Industrial Systems

Project Member
Prof. Dr. Jörg P. Müller (Leader)

Partner
Dr. rer. nat. Christoph Gerdes, Siemens AG Corporate Technology, Information and Communications, München, DE

Duration
01/2007 – 08/2010

Project Description
There exist more than 360 information and communication standards for control and monitoring of electrical transmission and distribution networks. Correspondingly automation equipment of current power infrastructures is highly heterogeneous and exchange of data between devices is rarely possible. Moreover, since equipment is often in operation for multiple decades a unified architecture for all equipment is not feasible. Rather an integration approach is required to achieve seamless inter-device data exchange. This project develops a data-centric information and communication (IC) architecture for energy automation systems that addresses the integration challenge. The architecture describes conceptual building blocks that can be implemented on various device hardware platforms to ease integration.

The challenges emerging in order to create, operate and maintain large-scale industrial systems are addressed by the design of an open architecture called: Ecosystem for Energy Services. As lowest common denominator for all interacting entities, it builds upon unstructured data augmented with quality attributes. The architecture enables all actors to interact, provide and consume services thereby achieving their individual quality requirements and business goals. Supporting a continuous, decentralised and agile design process, the ecosystem can be adapted by its users to meet new regulatory and individual business requirements.
References
[Gerdes, 2010] (Page 197),
[Stäber et al., 2011] (Page 179)

Contact E-Mail
joerg.mueller@tu-clausthal.de

Project Homepage

Project 9: Architecture, Methods and Tools for Decentral and Collaborative Product Development

Project Members
Dr. rer. nat. Patrick Stiefel (Leader)
Christian Hausknecht (Project Staff)

Partner
Prof. Dr. Jörg P. Müller, TU Clausthal, Germany (Main Leader)

Duration
07/2005 – 12/2010

Project Description
In the context of model-driven software development (MDSD) we investigate new models, methods and tools for evaluating and using the concept of a peer to peer (P2P) based software architecture for integrated and collaborative product engineering.
We argue that distributed and cross-enterprise product lifecycle management can benefit from the availability of decentrally managed product model repositories. Our work, while driven by business level issues such as supporting the emergence of organizations, partnerships, and processes for collaborative and cross-enterprise PLM, focuses on aspects of ICT level interoperability. It aims at enabling loosely coupled interaction between changing partners in a decentral environment, where traditional hierarchical client-server based architecture may not be applicable.

References
[Stiefel and Müller, 2010] (Page 193),
[Stiefel and Müller, 2011] (Page 194),
[Stiefel, 2010] (Page 177)

Contact E-Mail
patrick.stiefel@tu-clausthal.de

Project Homepage
http://plm.in.tu-clausthal.de

3.1.5 Scientific Activities
Person Prof. Dr. Jörg P. Müller

- Editorial Board Memberships
  See http://www.springerlink.com/content/1573-7454/
• International Journal of Agent-Oriented Software Engineering, Publishers, Inderscience (2004-).

• Electronic Commerce Research, Springer (2008-).
  See http://www.springer.com/business/business+information+systems/journal/10660

☐ Organization of Conferences and Workshops

• Co-Chair (with Klaus Fischer, Renato Levy) ATOP10: 4th International Workshop on Agent-based Technologies and Applications for Enterprise InterOperability, Toronto, Canada, May,10.
  See http://www-ags.dfki.uni-sb.de/~kuf/atop

• Co-Chair (with Paolo Petta) AT2AI-7: 7th International Symposium From Agent Theory to Agent Implementation, Wien, Austria, April,10.
  See http://www.ofai.at/~paolo.petta/conf/at2ai7/

• Track Co-Chair (with Lars Braubach, Birgit Burmeister, Alexander Pokahr, Ingo Timm) MKWI10: Conference Track em Multiagenten-systeme at Multikonferenz Wirtschaftsinformatik10, Göttingen, Germany, February,10.
  See http://winf.in.tu-clausthal.de/mkwi10/

• Co-Chair (with Danny Weyns) AOSE11: 12th International Workshop on Agent-Oriented Software Engineering at AAMAS11, Taipeh, 'Taiwan, Province Of China', May,11.

☐ PC-Member of Conferences and Workshops

• AAMAS 10: 9th International Joint Conference on Autonomous Agents and Multiagent Systems, Toronto, Canada, May,10.
  See http://www.cse.yorku.ca/AAMAS2010/

• ACEC10: 8th International Workshop on Agent-based Computing for Enterprise Collaboration, Larissa, Greece, June,10.
  See http://www.cs.teilar.gr/wetice/

• ADMI10: 5th International Workshop on Agents and Data Mining Interaction at AAMAS10, Toronto, Canada, May,10.
  See http://admi10.agentmining.org/

• CoopIS10:th International Conference on Cooperative Information Systems, Rome, Italy, September,10.
  See http://www.onthemove-conferences.org/index.php/coopis12/

• DOCEIS10: 1st Doctoral Conference on Computing, Electrical and Industrial Systems, Lisbon, Portugal, February,10.
  See http://www.uninova.pt/doceis/doceis10/
3.1 Business Information Technology Unit

  See http://www.yorku.ca/wiiat10/

- IAT4EB10: Workshop on Intelligent Agents and Technologies for e-Business, in conjunction with ECAI10, Lisbon, Portugal, August,10.
  See http://paginas.fe.up.pt/~iat4eb/

- IESA10: 5th International Conference on Interoperability of Enterprise Software and Applications, Coventry, UK, April,10.
  See http://wwwm.coventry.ac.uk/iesa2010/

- MATES10: 8th German Conference on Multiagent System Technologies, Leipzig, Germany, September,10.
  See http://www.alg.ewi.tudelft.nl/mates2010/

- PAAMS10: 8th International Conference on Practical Applications of Agents and Multi-Agent Systems, Salamanca, Spain, April,10.
  See http://www.paams.net/


- RULEML10: The 4th International Web Rule Symposium, Washington DC, USA, October,10.
  See http://2010.ruleml.org/

- ADMI11: 6th International Workshop on Agents and Data Mining Interaction at AAMAS11, Taipeh, 'Taiwan, Province Of China', May,11.
  See http://admi11.agentmining.org/

  See http://www.ecs.soton.ac.uk/~ss2/amec2011

  See http://www.iaria.org/conferences2011/COLLA11.html

  See http://www.uninova.pt/doceis/doceis11/

  See http://liris.cnrs.fr/~wi-iat11/IAT_2011/
• ICDS11: 5th International Conference on Digital Society, Gosier, Guadeloupe, France, February,11.
  See http://www.riaia.org/conferences2011/ICDS11.html
• ICEC11: 13th International Conference on Electronic Commerce, Liverpool, UK, August,11.
  See http://www.icec11.org/
• INFORMATIK11: Workshop em IT für die Energiesysteme der Zukunft at GI-Jahrestagung11, Berlin, Germany, October,11.
  See http://www.offis.de/f_e_bereiche/energie/gruppen/energiemanagement/workshop_it_fuer_die_energiesysteme_der_zukunft.html
  See http://www.iwei.eu
  See http://epia2011.appia.pt
• MATES11: 9th German Conference on Multiagent System Technologies, Berlin, Germany, October,11.
  See http://www.ia.urjc.es/mates2011/
• PAAMS11: 9th International Conference on Practical Applications of Agents and Multi-Agent Systems, Salamanca, Spain, April,11.
  See http://www.paams.net/
• PROMAS11: 9th International Workshop on Programming Multi-Agent Systems, Taipeih, ’Taiwan, Province Of China’, may,11.
  See http://inf.ufrgs.br/promas2011/
• WIVS11: 1st International Workshop on Flexible Workflows in Distributed Systems, Kiel, Germany, March,11.
  See http://vsis-www.informatik.uni-hamburg.de/events/wivs/

☐ Steering Committees
• ATAL: International Workshop on Agent Theories, Architectures, and Languages (1999-).
  See http://www.atal.org
• MATES: German Conference on Multiagent Systems Technologies (2001-).
  See http://www-aggs.dfki.uni-sb.de/~klusch/mates-series/index.html
• CEEMAS: Central and Eastern European Conference on Multiagent Systems (2003-).
  See http://www.ceemas.org
• AOSE: International Workshop on Agent-Oriented Software Engineering (2005-).
  See http://www.ecs.soton.ac.uk/~mml/aose2007/org/org.html

• Agents and Data Mining Integration and Interaction SIG (2009-).
  See http://www.agentmining.org

**Person** Prof. Dr. Niels Pinkwart

**Organization of Conferences and Workshops**

- Workshop and Tutorial Co-Chair (with Joe Beck) 10th International Conference on Intelligent Tutoring Systems, Pittsburgh, United States, June,10.
  See http://www.cmu.edu/its2010/

- Co-Chair (with Vincent Alevin, Kevin Ashley, Collin Lynch, A. Mitrovic and V. Dimitrova) Workshop on Intelligent Tutoring Systems for Ill-Defined Domains within ITS2010, Pittsburgh, United States, June,10.
  See http://www.cs.pitt.edu/~collinl/ITS10/

- Co-Chair (with Darina Dicheva, Riichiro Mizoguchi and Roger Nkambou) Track on Ontologies and Semantic Web for E-Learning within FLAIRS2011, Palm Beach, United States, May,11.
  See http://compsci.wssu.edu/iis/swel/SWEL11/

**PC-Member of Conferences and Workshops**

- FLAIRS10: International Florida Artificial Intelligence Research Society Conference, Special Track on Intelligent Tutoring Systems, Daytona Beach, United States, May,10.
  See http://rhea.memphis.edu/FLAIRS/index.html

- WMUTE10: International Conference on Wireless, Mobile and Ubiquitous Technologies in Education, Kaohsiung, Taiwan, Province Of China’, April,10.
  See http://wmute2010.cl.ncu.edu.tw/

- MKWI10: Multikonferenz Wirtschaftsinformatik, Track Kooperationssysteme, Göttingen, Germany, February,10.
  See http://www.mkwi2010.de/de/107834.html

- ITS10: 10th International Conference on Intelligent Tutoring Systems, Pittsburgh, United States, June,10.
  See http://sites.google.com/site/its2010home/

- DELFI10: 8. e-Learning-Fachtagung Informatik der Gesellschaft für Informatik, Duisburg, Germany, September,10.
  See http://interaktive-kulturen.de/DeLFI
• CRIWG10: 18th CRIWG Conference on Collaboration and Technology, Maastricht, Netherlands, September,10.

• ISEE@ECTEL10: Workshop on Intelligent Support for Exploratory Environments, Barcelona, Spain, September,10.
  See https://sites.google.com/a/lkl.ac.uk/isee/isee-ectel-10

  See http://www.icce2010.upm.edu.my/

• MCAR@ISMAR 2010: Workshop on Mobile Collaborative Augmented Reality, Seoul, 'Korea, Republic of', October,10.
  See http://research.ict.csiro.au/conferences/collaborative-augmented-reality/

• CSPRED@ITS 2010: Workshop on Computer-Supported Peer Review in Education, Pittsburgh, United States, June,10.
  See http://www.cspred.org/

• AIED11: 15th International Conference on Artificial Intelligence in Education, Auckland, New Zealand, June,11.
  See http://www.aied2011.canterbury.ac.nz/

• CSEDU11: 3rd International Conference on Computer Supported Education, Noordwijkerhout, Netherlands, May,11.
  See http://www.csedu.org/CSEDU2011/

• DELFI11: 9. e-Learning-Fachtagung Informatik der Gesellschaft f.r Informatik, Dresden, Germany, September,11.
  See http://delfi2011.de/

• FLAIRS11: 24th International Florida Artificial Intelligence Research Society Conference, Special Track on Intelligent Tutoring Systems, Palm Beach, United States, May,11.
  See http://rhea.memphis.edu/FLAIRS/index.html

  See http://www.nectec.or.th/icce2011/

  See http://www.cs.cmu.edu/~ilearn/
3.1 Business Information Technology Unit

- FLAIRS12: 25th International Florida Artificial Intelligence Research Society Conference, Special Track on Intelligent Tutoring Systems, Marco Island, United States, May, 11. See https://sites.google.com/site/flairsits/

3.1.6 Highlights

In 10

- February 10: Within the nifbe (Lower Saxony Institute for Early Childhood Education and Development) framework, the State of Lower Saxony supports the research project “Mobile2Learn” which was proposed jointly by Niels Pinkwart, Jörg P. Müller and the KVHS Goslar. The total funding for the project is approximately 100 K€. LASAD renewal
- May 10: Jörg P. Müller is co-chairing (with Klaus Fischer and Renato Levy) the 4th International Workshop on Agent Technologies for Enterprise Interoperability (ATOP ‘2010) in Toronto, Canada, in May 10.
- June 10: Niels Pinkwart acts as workshop and tutorial chair at the 10th International Conference on Intelligent Tutoring Systems, held in Pittsburgh, USA. At the same conference, he co-chairs (with Collin Lynch, Kevin Ashley, Antonija Mitrovic, Vania Dimitrova, and Vincent Aleven) a workshop on AIED Applications for Ill-Defined Domains.
- June 10: Niels Pinkwart receives an “Outstanding Reviewer Award” at the 10th International Conference on Intelligent Tutoring Systems.
- August 10: The game “Parcours”, developed in the Department of Informatics at Clausthal by Tim Warnecke and Patrick Dohrmann (project advisors: Andreas Rausch and Niels Pinkwart) wins the “SMART Multi-touch Application Contest”.

In 11

- February 11: The DFG supports the research group of Niels Pinkwart with approximately 186 K€. The grant is awarded for continuing the research project “Learning to Argue: Generalized Support Across domains (LASAD)” lead by Niels Pinkwart and Bruce McLaren (Saarland University).
• May 2011: Jörg P. Müller is co-chairing (with Danny Weyns, KU Leuven) the 12th International Workshop on Agent-Oriented Software Engineering (AOSE2011), held in Taipih, Canada, in May 2011. June 2011: The European Commission awards a grant of 175,000 € to the research group of Jörg P. Müller and Dr. Jelena Fiosina for the Marie Curie ITN project ADMIT: Agent-oriented Distributed Data Mining using Computational Statistics.

• August 2011: Within the programme “Qualitätspakt Lehre”, the Federal Ministry of Education and Research (BMBF) funds the project “eCULT” (eCompetence and Utilities for Learners and Teachers) with 5.45 million €. Coordinated by the University of Osnabrück, this project is a joint activity of 13 partners and aims at improving the use of digital learning technologies in University Education. For Clausthal University, the research group of Niels Pinkwart and the computing centre participate in the project. The funding awarded for the TUC parts of the project is approx. 300 K€.

• September 2011: Jörg P. Müller has been appointed a German delegate to the management committee of the European COST Action TU1102 “Towards Autonomic Road Transport Systems” (ARTS). In the COST action, he is co-leading (with Apostolos Kotsialos, Durham University) the Working Group on “Architectures, Methods and Models for ARTS”.

• October 2011: The DFG supports the research group of Niels Pinkwart with approximately 250 K€. The grant is awarded for the research project “Learning Feedback in Intelligent Tutoring Systems (FIT)” which was proposed jointly by Niels Pinkwart and Barbara Hammer (University of Bielefeld). The FIT project will be conducted as part of the DFG priority programme “Autonomous Learning”.

 Visitors

• May 2011: Raducasian Mihailescu, Universidad Rey Juan Carlos (URJC) Madrid, Spain.
3.2 Computational Intelligence

3.2.1 Overview

**Leaders**  Prof. Dr. Jürgen Dix

**Associated Member**  apl. Prof. Dr. Matthias Reuter (CUTEC)

**Secretary**  Anita Seiz-Uhlig

**Scientific Employees**  Dr. Tristan Behrens

Dr. Nils Bulling

PD Dr. habil. Wojciech Jamroga

Dipl.-Inf. Michael Köster

Lic. Federico Schlesinger (since 09/2010)

**Associated Members**  Dipl.-Inf. Sven Birkenfeld (CUTEC)

Dipl.-Päd. Sabine Bohlmann (CUTEC)

Dipl.-Inf. Steffen Harneit (CUTEC)

Nils Brandt (CUTEC)

3.2.2 Research Agenda

Our scientific research focuses mainly on the following areas of artificial intelligence:

1. programming multi-agent systems,
2. theories of agencies (logics, rational agents),
3. evaluating and simulating multi-agent systems,
4. game theory and relations to multi-agent systems, and
5. model checking ATL-like logics.

In addition we are also interested in knowledge representation, in particular in computational logic (deductive databases, answer set programming, nonmonotonic reasoning).

See the group's homepage at: [http://cig.in.tu-clausthal.de/](http://cig.in.tu-clausthal.de/)

3.2.3 Supervised Theses

3.2.4 Projects

Project 10: Norms in Multiagentsystems

Project Member
Dr. Nils Bulling (Leader)

Partner
Dr. Mehdi Dastani, Utrecht University, The Netherlands

Duration
since 2010

Project Description
The environment is an essential component of multi-agent systems and is often used to coordinate the behaviour of individual agents. Recently many languages have been proposed to specify and implement multi-agent environments in terms of social and normative concepts. In this project, we work on a formal setting of multi-agent environment which abstracts from concrete specification languages. This setting is based on norms and sanctions and we would like to show how concepts from mechanism design can be used to formally analyse and verify whether specific normative behaviours can be enforced (or implemented) if agents follow their subjective preferences. Complexity issues of associated problems are considered as well.

References
[Bulling and Dastani, 2011a] (Page 183),
[Bulling and Dastani, 2011] (Page 182)

Contact E-Mail
bulling@in.tu-clausthal.de

Project Homepage
http://www.in.tu-clausthal.de/index.php?id=cigproject_Bulling10Norms
Project 11: Resource-Bounded MAS and Resource Bounded Agents

Project Member
Dr. Nils Bulling (Leader)

Partner
Dr. Berndt Müller, Glamorgan University, United Kingdom

Duration
since 2009

Project Description
The verification and modelling of multi-agent systems is an important topic that has attracted much attention in recent years. Resources, however, have only recently entered the picture. In this project, we analyse whether it is possible to verify properties of resource-bounded agents. For this purpose, we develop suitable models and logics and analyse associated complexity and decidability questions.

References
[Bulling and Farwer, 2010a] (Page 183),
[Bulling and Farwer, 2010b] (Page 183)

Contact E-Mail
bulling@in.tu-clausthal.de

Project Homepage
http://www.in.tu-clausthal.de/index.php?id=cigproject_Bulling09Resources

Project 12: Agent Logics and Tractability

Project Member
Dr. Nils Bulling (Leader)

Partner
Dr. Koen Hindriks, Delft University of Technology, The Netherlands

Duration
since 2009
Project Description
Reasoning about the mental states of agents is important in various settings, and has been recognized as vital for teamwork. But the complexity of some of the more well-known agent logics that facilitate reasoning about mental states prohibits the use of these logics in practice. An alternative is to investigate fragments of these logics that have a lower complexity but are still expressive enough for reasoning about the mental states of (other) agents. In this project, we explore this alternative and take as our starting point the linear time variant of BDI logic. Our aim is to identify fragments that may be usefully applied for reasoning about mental states.

References
[Bulling and Hindriks, 2011] (Page 183)

Contact E-Mail
bulling@in.tu-clausthal.de

Project Homepage
http://www.in.tu-clausthal.de/index.php?id=cigproject_Bulling09BDI

Project 13: Verification of Strategic Agents

Project Members
Prof. Jürgen Dix (Leader)
Dr. Nils Bulling (Leader)
Dr. Wojciech Jamroga (Leader)

Duration
since 2009

Project Description
Model checking is a verification method which is successfully used in industry. In particular, it is popular in the context of reactive systems. In this project we consider the verification of multi-agent systems. Our focus is on the model checking complexity of logics which can be used for the specification of such systems.
Project 14: Semantic Variants of Strategic Reasoning

Project Members
Dr. Nils Bulling (Leader)
Dr. Wojciech Jamroga (Leader)

Duration
since 2010

Project Description
Alternating-time temporal logic (ATL) is a modal logic that allows to reason about agents’ abilities in game-like scenarios. Semantic variants of ATL are usually built upon different assumptions about the kind of game that is played, including capabilities of agents (perfect vs. imperfect information, perfect vs. imperfect memory, etc.). ATL has been studied extensively in previous years; however, most of the research focused on model checking. Studies of other decision problems (e.g., satisfiability) and formal meta-properties of the logic (like axiomatization or expressivity) have been relatively scarce, and mostly limited to the basic variant of ATL where agents possess perfect information and perfect memory. In particular, comparison between different semantic variants of the logic is largely left untouched. In this project, we consider various semantics of ATL and show how they affect the set of valid formulae.
Tree unravelling
$A(q_1, \{1\})$-execution tree

References
[Jamroga and Bulling, 2011] (Page 188),
[Jamroga and Bulling, 2010] (Page 188)

Contact E-Mail
bulling@in.tu-clausthal.de

Project Homepage
http://www.in.tu-clausthal.de/index.php?id=cigproject_
Bulling10SemanticVariants

Project 15: A Simulation Platform for Multi-Agent Systems

Project Members
Dr. Tristan Behrens (Leader)
Prof. Dr. Jürgen Dix (Leader)
Dipl.-Inf. Michael Köster (Leader)
Lic. Federico Schlesinger (Leader)

Duration
since 01/2005

Project Description
Since 2005, we are organising a yearly agent contest. This competition is an attempt to stimulate research in the area of multi-agent programming by (1) identifying key problems, and (2) collecting suitable benchmarks. These can serve as milestones for testing agent-oriented programming languages, platforms and tools. The simulation platform we have developed and which is constantly improved, makes it possible to test agent systems in a fair way.
3.2 Computational Intelligence

References
[Behrens et al., 2010c] (Page 176),
[Behrens et al., 2010b] (Page 179),
[Behrens et al., 2010] (Page 195)

Contact E-Mail
dix@tu-clausthal.de

Project Homepage
http://www.multiagentcontest.org

Project 16: An Environment Interface Standard for Agent-Oriented Programming

Project Members
Prof. Dr. Jürgen Dix (Leader)
Dr. Tristan Behrens (Leader)

Partner
Dr. Koen Hindriks, Delft University of Technology, The Netherlands

Duration
since 05/2009
**Project Description**

Our objective is to design and develop a generic environment interface standard (EIS) that facilitates connecting agents programmed in various agent programming languages (APL) to environments. We aim at a de facto standard that possibly can become a real standard in the future. Our motivation is based on the following considerations: 1. implementing an EIS makes already working environments widely available (short-term goal), 2. an EIS allows for the easy distribution of future environments (Multi-Agent Contest, Unreal, ORTS,...), 3. an EIS allows the direct comparison of APL platforms, and 4. an EIS enables the development of a truly heterogeneous MAS, consisting of agents from APL platforms that adhere to the standard of the EIS (long-term goal). Our approach takes the following goals into account: to design an interface that is as generic as possible, and to reuse as much as possible from existing interfaces. Obviously, there is a trade-off between these two goals. Our basic strategy for designing a generic environment interface is 1. to start with what is currently “out there” in existing platforms, and 2. to try to merge this into a generic interface which is sufficiently close to these existing approaches.

**References**

[Behrens et al., 2011] (Page 179),
[Behrens et al., 2011b] (Page 182)

**Contact E-Mail**

behrens@in.tu-clausthal.de
**Project Homepage**
http://cig.in.tu-clausthal.de/eis

**Project 17: LocCom - Local Communities in Information Cities**

**Project Members**
Prof. Dr. Jürgen Dix (Leader)
Dipl.-Inf. Michael Köster

**Partners**
Prof. Dr. Heribert Vollmer, Hannover
Prof. Dr.-Ing. Michael Beigl, TU Braunschweig
Prof. Dr.-Ing. Lars Wolf, TU Braunschweig
Prof. Dr. techn. Dipl.-Ing. Wolfgang Nejdl, Hannover
Prof. Dr. Christian Siemers, TU Clausthal
Prof. Dr. Mark Vollrath, TU Braunschweig

**Duration**
03/2009 – 09/2011

**Project Description**
In this project we develop methods, concepts, and tools for decentralized IT Ecosystems. Important outcomes will be the development of new services and techniques to guarantee certain quality characteristics. In order to do so, we investigate adaptive techniques on all layers ranging from reconfigurable hardware via protocols up to modelling and inference methods. An important aspect will be the application of context in generalized form. In particular, a principal objective is the modeling and implementation of generalized social networks based on mobile devices. Using services and information offered by these devices on one hand, and the needs and duties of users on the other hand, peers will be brought together. Further, recommendations concerning activities and usages will be generated automatically and tailored for the users, by taking into account the autonomy of users and devices. To achieve these goals, techniques and methods of several heterogenous research areas must be combined. The work to be carried out includes:

- Extending temporal logics (LTL, CTL, CTL*) to model local communities and social networks.
- Mechanisms to detect, describe, and use context.
- Scalable networking and communication of mobile devices considering availability of devices and network services.
- Provable characteristics of social networks (privacy and availability).
- Recommender Systems, User-centric Media, Integration with heterogeneous mobile devices.
• Adaptive hardware architectures designed for network scalability, optimization of energy consumption vs. computing power.

Contact E-Mail
dix@tu-clausthal.de, michael.koester@tu-clausthal.de

Project Homepage
http://www2.in.tu-clausthal.de/~it-ecosystems/

3.2.5 Scientific Activities

Person Dr. Tristan Behrens

☐ Editor


☐ Organization of Conferences and Workshops

• Co-Organizer (with Jürgen Dix, Jomi Hübner and Michael Köster Multi-Agent Programming Contest 2010, Clausthal, Germany, September, 2010. See http://www.multiagentcontest.org/

• Co-Organizer (with Jürgen Dix, Jomi Hübner, Michael Köster and Federico Schlesinger Multi-Agent Programming Contest 2011, Clausthal, Germany, September, 2011. See http://www.multiagentcontest.org/

Person Dr. Nils Bulling

☐ PC-Member of Conferences and Workshops


• CLIMA XII: 12th International Workshop on Computational Logic in Multi-Agent Systems, Barcelona, Spain, July, 2011. See http://centria.di.fct.unl.pt/events/climaXII/

Invited

• Model Checking Temporal and Strategic Logic, EASSS ’10: European Agent Systems Summer School, Saint-Etienne, France, August, 2010. See http://easss2010.emse.fr/


• Decision Problems and Decision Procedures for Strategic Logics, ESSLLI ’11: European Summer School on Logic, Language and Information, Ljubljana, Slovenia, August, 2011. See http://esslli2011.ijs.si/


• Comparing Semantics of Strategic Ability, Workshop on “Logic and its Applications”, Kolkata, India, September, 2011.

• Model Checking Strategic Logics for Resource-Bounded Agents, University of Bergen Logic Seminar, Bergen, Norway, August, 2011.
• Comparing Semantics of Strategic Ability, Bergen University College, Bergen, Norwegen, August, 2011.

• Modelling and Verifying Abilities of Rational Agents, GI-Dissertationprize 2010, Dagstuhl, Germany, May, 2011.

• Model Checking, Strategic Logics, and Rational Agents, Nanyang Technological University, Singapore, May, 2011.

• Model Checking Strategic Logics for Resource-Bounded Agents, Grolog colloquium talk, Groningen, Netherlands, March, 2011.


Visits

• Jamroga, Dr. Wojtek, Individual and Collective Reasoning Group, University of Luxembourg, Luxembourg, 2010. 
  See http://icr.uni.lu/wjamroga/

• Dastani, Dr. Mehdi, Intelligent Systems Group Utrecht University, Utrecht, 2010. 
  See http://www.staff.science.uu.nl/~dasta101/

• Hindriks, Dr. Koen, Delft University of Technology, Delft, 2010. 
  See http://mmi.tudelft.nl/~koen/

• Prof. Dr. Rineke Verbrugge, Dr. Sujata Gosh, Logic and Cognition Group, University of Groningen, Groningen, 2011. 
  See http://www.rinekeverbrugge.nl/

• Elkind, Prof. Dr. Edith, Division of Mathematical Sciences, School of Physical and Mathematical Sciences, Nanyang Technological University, Singapore, 2011. 
  See http://www1.spms.ntu.edu.sg/~eelkind/

Person  Prof. Dr. Jürgen Dix

Editorial Board Memberships

• Journal of Applied Logic, Elsevier (2003-). 
  See http://www.elsevier.com/wps/product/cws_home/672712

• IfI Technical Report Series, Department of Informatics, TU Clausthal (2005-). 
  See http://www.in.tu-clausthal.de/forschung/technical-reports/

• International Journal of Agent-Oriented Software Engineering, Publishers, Inderscience (2005-). 
• Theory and Practice of Logic Programming, Press, Cambridge University (2005-).
  See http://journals.cambridge.org/action/displayJournal?jid=TLP

• International Journal of Pattern, Springer (2007-).
  See http://www.ijop.org/

• IEEE Transactions of Knowledge and Data Engineering, Press, AAAI (2008-).
  See http://www.computer.org/tkde/

  See http://www.elsevier.com/wps/locate/jalgor

• Annals of Mathematics and Artificial Intelligence, Springer (2008-).
  See http://www.springerlink.com/content/1573-7470/

• Journal of Knowledge-Based and Intelligent Engineering Systems, Press, IOS (2008-).
  See http://www.kesinternational.org/journal/index.php

- Organization of Conferences and Workshops

  • Co-Chair (with Joao Leite) CLIMA XI: Eleventh International Workshop on Computational Logic in Multi-Agent Systems, Lisbon, Portugal, September, 2010.  
    See http://centria.di.fct.unl.pt/events/climaXI/

  • Co-Chair (with Cees Witteveen) MATES: Eighth International Workshop on Multiagent System Technologies, Bielefeld, Germany, September, 2010.  
    See http://www.alg.ewi.tudelft.nl/mates2010/

    See http://www.cs.uu.nl/ProMAS/ 2010/

  • Co-Chair (with Dov Samet, Aviad Heifetz, Wojciech Jamroga) Dagstuhl Seminar: Reasoning about Interaction: From Game Theory to Logic and back, Schloss Dagstuhl, Germany, March, 2011.  
    See http://www.dagstuhl.de/Seminars/?semmr=11101

  • General Co-Chair (with Georg Gottlob) International RuleML Symposium 2011, Barcelona, Spain, July, 2011.  
    See http://defeasible.org/ruleml2011/

- PC-Member of Conferences and Workshops
See http://www.aamas2010.org/

See http://www.irit.fr/SUM10


COMMA ’10: Third International Conference on Computational Models of Argument, University of Brescia, Italy, September, 2010.
See http://www.ing.unibs.it/comma2010/

See http://2010.foiks.org

AAAI-10 Special Track on New Scientific and Technical Advances in Research (Nectar), Atlanta, United States, July, 2010.

See http://www.dur.ac.uk/lam.10/LAM10/LAM10.html

SBIA ’10: 20th Brazilian Symposium on Artificial Intelligence, Sào Bernardo Dominican Republic Campo, BR, October, 2010.
See http://www.jointconference.fei.edu.br/

See http://www.dur.ac.uk/lam.10/LAM10/LAM10.html

See ecai2010.appia.pt/

Sixth Workshop on Agents and Data Mining Interaction, Toronto, Canada, May, 2010.
See http://admi10.agentmining.org/

See http://www.yorku.ca/cikm10/

See http://mallow2010.emse.fr/

• KEOD ’10: International Conference on Knowledge Engineering and Ontology Development, Valencia, Spain, October, 2010. See http://www.keod.ic3k.org/call_for_papers.asp


• LPNMR ’11: Logic Programming and Nonmonotonic Reasoning, Vancouver, Canada, May, 2011. See http://sites.google.com/site/lpnmr2011/

• SUM ’11: Fifth International Conference on Scalable Uncertainty Management, Dayton, Ohio, United States, April, 2011. See http://www.wright.edu/academicaffairs/sum/

• M4M ’11: 7th workshop on Methods for Modalities, Osuna, Spain, November, 2011. See http://personal.us.es/hvd/m4m/


• CLIMA XII: Twelth International Workshop on Computational Logic in Multi-Agent Systems, Barcelona, Spain, July, 2011.
See http://centria.di.fct.unl.pt/events/climaXII

• Workshop on Logics for Agents and Mobility at CONCUR 2011, Aachen, Germany, September, 2011.
See http://web.me.com/farwer/LAM11/LAM11.html

• MIWAI '11: The Fifth Mahasarakham International Workshop on Artificial Intelligence 2011, Hyderabad, India, December, 2011.
See http://www.miawai.org

• EUMAS '11: Ninth European Workshop on Multi-Agent Systems, Maastricht, Netherlands, November, 2011.
See http://swarmlab.unimaas.nl/eumas2011/

• Workshop on Logics for Agents and Mobility, Logic in Computer Science (CONCUR ’11), Aachen, Germany, September, 2011.
See http://web.me.com/farwer/LAM11/LAM11.html

• 20th ACM International Conference on Information and Knowledge Management, Glasgow, UK, October, 2011.
See http://www.cikm2011.org

See http://www.kr.tuwien.ac.at/wlp11/

• INAP 2011: 19th International Conference on Applications of Declarative Programming and Knowledge Management, Vienna, Australia, September, 2011.
See http://www.kr.tuwien.ac.at/inap11/

• DKB-2011: Third Workshop on Dynamics of Knowledge and Belief: Evolving Knowledge in Theory and Applications, Berlin, Germany, October, 2011.
See http://www.fernuni-hagen.de/wbs/dkb2011.html

☐ Steering Committees

• CLIMA: Computational Logic in Multi-Agent Systems (2002-).
See http://centria.di.fct.unl.pt/~clima/

• ProMAS: International Workshop on Programming Multiagent Systems Languages and Tools (2003-).
See http://www.cs.uu.nl/ProMAS/

• NMR: International Workshops on Nonmonotonic Reasoning (2008-).
See http://kr.org/NMR/

• Multi-Agent Programming Contest (2009-).
See http://www.multiagentcontest.org/steering-committee
3.2 Computational Intelligence

- LAMAS: Network on Logical Aspects of Multi-Agent Systems (2010-).
  See http://www.logic-mas.org

□ Invited

  See http://easss2010.emse.fr/
- How to test and compare Multi-agent systems?, Nonmonotonic Reasoning and Action and Change (NRAC ’11), Barcelona, Spain, July, 2011.
- Benchmarking our research, Nonmonotonic Reasoning and Action and Change (NRAC ’11), Barcelona, Spain, July, 2011.

□ Member

- Institut für Informationssysteme, TU Wien, Favoritenstrasse, 1040 Wien, Austria, 1996-.
  See http://www.tuwien.ac.at
- IEEE, 2001 I. Street, NW. Suite 700, Washington, DC 20036-4910, USA, 2004-.
  See http://www.ieee.org/
- ACM, USA, 2004-.
  See http://www.acm.org
  See http://www.tu-clausthal.de
  See http://en.nth-online.org/

□ Lead Function

- Vertrauensdozent der Studienstiftung an der TU Clausthal, Clausthal University of Technology, Germany, 2008-.
  See http://www.studienstiftung.de
- Member of Lenkungskreis NTH, Area Computer Science, Clausthal University of Technology, Germany, 2008-.
  See http://www.in.tu-clausthal.de/
- Dean of Faculty for Mathematics/Computer Science and Engineering, Faculty 3, Clausthal University of Technology, Germany, 2008-2011.
  See http://www.fakultaeten.tu-clausthal.de/math-inf-maschinenbau/
- Studiendekan der NTH, Clausthal University of Technology, Germany, 2010.
  See http://www.in.tu-clausthal.de/
- Vice Dean of Faculty for Mathematics/Computer Science and Engineering, Faculty 3, Clausthal University of Technology, Germany, since 2011.

**Evaluator**

- Italian Ministry of Information, Expert Evaluator, Rome, Italy, September, 2001-.
  See [https://cofin.cineca.it/](https://cofin.cineca.it/)
- Finnish Academy of Science, Expert Evaluator, Helsinki, FL, September, 2004-.
  See [https://cofin.cineca.it/](https://cofin.cineca.it/)
  See [http://www.epsrc.ac.uk/](http://www.epsrc.ac.uk/)
- Cost Action IC0801, Management Committee Member (nominated by German Government), Brussels, Belgium, June, 2008-.
- FSTC, Expert Evaluator, University of Luxemburg, Luxembourg, October, 2011.
  See [http://www.uni.lu](http://www.uni.lu)
  See [http://ec.europa.eu/dgs/information_society/index_en.htm](http://ec.europa.eu/dgs/information_society/index_en.htm)

**Evaluator (Promotion Committee)**

- Promotion to Assistant Professor, Expert Referee, Delft University, The Netherlands, October, 2010.
  See [http://www.tudelft.nl](http://www.tudelft.nl)

**Evaluator (PhD)**

- Nils Bulling: Modelling and Verifying Abilities of rational Agents, PhD (Erstgutachter), Clausthal University of Technology, Clausthal, Germany, October, 2010.
  See [http://www.in.tu-clausthal.de/](http://www.in.tu-clausthal.de/)
- Michal Sindlar: In the Eye of the Beholder: Explaining Behavior through Mental State Abduction., PhD External Examiner, Utrecht University, November, 2011.
3.2 Computational Intelligence

**Person** Dipl.-Inf. Michael Köster

- **Editorial**

- **Organization of Conferences and Workshops**

- **Visits**
  - Assistant Prof. Dr. Edith Elkind, Division of Mathematical Sciences, School of Physical and Mathematical Sciences, Nanyang Technological University, 637371 Singapore, 2011. See [http://www1.spms.ntu.edu.sg/~eelkind/](http://www1.spms.ntu.edu.sg/~eelkind/)

**Person** Dr. Peter Novák

- **Organization of Conferences and Workshops**

**Person** apl. Prof. Dr. Matthias Reuter

- **Editorial Board Memberships**
  - Autosoft (ASJ)

- **PC-Member of Conferences and Workshops**


Organization of Conferences and Workshops


Person Lic. Federico Schlesinger

Organization of Conferences and Workshops

• Co-Organizer (with Tristan Behrens, Jürgen Dix and Jomi Hübner, Michael Köster) Agent Contest: Multi-Agent Programming Contest, Clausthal-Zellerfeld, Germany, September, 2011. See http://www.multiagentcontest.org/

3.2.6 Highlights

In 2010

• Dr. Rem Collier and Prof. Dr. Jürgen organize ProMAS at AAMAS together with Dr. Peter Novak.

• Prof. Dr. Jürgen Dix organizes the CLIMA Workshop together with Dr. Joao Leite.

• Prof. Dr. Jürgen Dix and Prof. Dr. Cees Witteveen organize the MATES conference at GI.

• Prof. Dr. Jürgen Dix organizes an Agent Contest together with Dr. Tristan Behrens, Dipl.-Inf. Michael Köster and Dr. Jomi Hübner.

• Prof. Dr. Jürgen Dix and Dr. Nils Bulling organize a tutorial at EASSS.

• Prof. Dr. Jürgen Dix and Dr. Peter Novak and Prof. Dr. Michael Fisher publish the proceedings of CLIMA-X 2009 in September.

• Prof. Dr. Matthias Reuter is nominated for the innovation price of the German building industry. His system for detecting cable in the underground via ground penetrating radar systems gets the Innovation Price of the German Federal President in 2010.

In 2011

• Prof. Dr. Jürgen Dix, PD Dr. habil. Wojciech Jamroga and Prof. Dr. Dov Samet organize the Dagstuhl seminar Reasoning about Interaction: From Game Theory to Logic and Back.
• Prof. Dr. Jürgen Dix organizes an Agent Contest together with Dr. Tristan Behrens, Dipl.-Inf. Michael Köster, Lic. Federico Schlesinger and Dr. Jomi Hübner.

• Prof. Dr. Jürgen Dix together with Dr. Tristan Behrens, Dipl.-Inf. Michael Köster, Dr. Mehdi Dastani and Dr. Jomi Hübner publish two AMAI Special Issues about the Multi-Agent Programming Contest.

• Prof. Dr. Jürgen Dix together with Prof. Dr. Gabriele Kern-Isberner, Prof. Dr. Guillermo Simari and Prof. Dr. Sven-Ove Hansson get a Dagstuhl seminar on Belief Change and Argumentation in Multi-Agent Scenarios accepted.

• The special issue for the journal on Autonomous Agents and Multiagent Systems edited by Dr. Rafael Bordini, Dr. Mehdi Dastani, Prof. Dr. Jürgen Dix and Prof. Dr. Amal El Fallah Segrouchni (containing selected papers of the Dagstuhl seminar in 2008) is published.

• Prof. Dr. Jürgen Dix gives an invited talk at the NRAC workshop in Barcelona.

• Dr. Nils Bulling gets the Beth Dissertation Prize 2011 and the Förderpreis des Vereins von Freunden for his dissertation.

• Dr. Nils Buling and PD Dr. habil. Wojciech Jamroga give a course at the European Summer School in Logic, Language and Information (ESSLLI) on “Decision Problems and Decision Procedures for Strategic Logics“.

Visitors:

2010
• Cees Witteveen, Delft University of Technology, The Netherlands.
• Heribert Vollmer, University of Hannover.

2011
• Berndt Müller, University of Glamorgan, United Kingdom.
• Sujata Ghosh, University of Groningen, The Netherlands.
• Koen Hindriks, Delft University of Technology, The Netherlands.
3.3  Foundations of Computer Science

3.3.1  Overview

Leaders  Prof. Dr. Barbara Hammer (until 03/10)
Dr. Michaela Huhn (since 04/10)

Secretary  Christine Kammann
Sandra Karpenstein

Scientific Employees

Dipl.-Wirt.-Inf. Sara Bessling (since 07/10)
M.Sc. Wuzhu Chen (since 07/10)
Dipl.-Inf. Andrej Gisbrecht (until 03/2010)
Dipl.-Inf. Bassam Mokbel (until 03/2010)
Dr. rer. nat. Frank-Michael Schleif (until 04/2010)
Dipl.-Wirtsch.-Ing. Christian Schulze (04/10-12/10)
Dipl.-Ing. Mark Wessel (07/2010 - 06/2011)

External Ph.D.

Dipl.-Inform. Dennis Klar (since 04/10)

Students

3.3.2  Research Agenda

The group of Prof. Richter has its focus on following research areas: Computer networks (Realtime LANs for cars, process control and automation), Automobile mechatronics (X-by-wire, Cockpit-by-wire, driving simulator, autonomously driving rover), Computer architectures (Real-time parallel computers for measurement-data acquisition and -processing, feed forward and feed back control), Grid computing (Job scheduling in compute grids, job allocation in data grids), and Distributed Systems (Global Authentication and Authorization Infrastructure).

See the group’s homepage at:
http://www.in.tu-clausthal.de/abteilungen/technische-informatik-und-rechnersysteme/personen/
and the research home page at:
http://www.in.tu-clausthal.de/abteilungen/technische-informatik-und-rechnersysteme/forschung/

3.3.3  Supervised Theses

3.3 Foundations of Computer Science


3.3.4 Projects

**Project 18: TEMO**

**Project Members**
- Dr. Michaela Huhn (Leader)
- Dipl.-Wirtsch.-Ing. Christian Schulze

**Partner**
- TLK Thermo GmbH, Institut für Thermodynamik, TU Braunschweig,

**Duration**
- 2008 – 2010

**Project Description**
- TEMO aimed at the implementation of an object-oriented, equational library for real-time simulation of thermal systems and their components. The base forms a library of fluids and media upon which fundamental models for heat exchange and tubes are built. Using the library, new component models can be created. A toolbox was realized offering export functionality to real-time operating systems and real-time testing. Another objective was the visualization and analysis of energy flow. The integrated tool framework was demonstrated on a number of case studies like a refrigeration circuit, the thermal management in a vehicle, a thermoelectric hydroextractor, the thermal behavior of a vehicle brake system and a absorption refrigeration.
Project 19: OPENPROD - Open Model-Driven Whole-Product Development and Simulation Environment

**Project Members**

- Dr. Michaela Huhn (Leader)
- M.Sc. Wuzhu Chen

**Partner**

Linköping University, Sweden, Fraunhofer FIRST, Berlin, Bosch-Rexroth, Siemens Energy, Erlangen, u.a.,

**Duration**

2009 – 2012

**Project Description**

OPENPROD is an ITEA2 European project that will provide an open, whole-product model-driven rapid systems development, modeling, and simulation environment integrating in to the leading open industrial software development platform (Eclipse) with open-source (OpenModelica, etc.), as well as industrial modeling and simulation tools and applications. The main research topics are: Integrated hardware software modeling by Modelica - UML - SysML integration, model compiler enhancements, compilation of Modelica to parallel multi-core platforms, tool interoperability and application demonstrators

**References**

[Huhn et al., 2011b] (Page 188),
[Chen et al., 2011] (Page 183)

**Contact E-Mail**

michaela.huhn@tu-clausthal.de

**Project Homepage**

http://www.in.tu-clausthal.de/de/abteilungen/gi/forschung/temo/

---

Project 20: Modellbasierte Diagnose von Bahnsicherungssystemen

**Project Members**

- Dr. Michaela Huhn (Leader)
- Dipl.-Inform. Dennis Klar

**References**

[Huhn et al., 2011b] (Page 188),
[Chen et al., 2011] (Page 183)

**Contact E-Mail**

michaela.huhn@tu-clausthal.de

**Project Homepage**

http://www.in.tu-clausthal.de/de/abteilungen/gi/forschung/openprod/
**Partner**
Siemens AG Mobility Division, Braunschweig,

**Duration**
2009 – 2011

**Project Description**
The purpose of automated monitoring and fault diagnosis of railway systems is to detect failures as early as possible and to support the subsequent restoration measures. This contributes to a minimisation of failure-related down-times and the fullfilment of high quality expectations by customers.

The execution of any diagnostic procedure requires a broad knowledge of the functional and structural dependencies within the target system. This task is influenced by several factors: beginitemize item the ever-increasing complexity and diversity of target systems item the high ratio of third-party and legacy components to be diagnosed enditemize The concept of model-based diagnosis poses a promising approach to the systematic capture and analysis of diagnostic knowledge. The use of explicit models of a system’s structure and behavior allows us to trace deviant system observations directly to causing components. In cooperation with Siemens Mobility Division Braunschweig, we apply model-based diagnostic methods to different application areas, such as: beginitemize item interlockings item rail automation and safety systems item on-board systems of railway vehicles enditemize The manifold of application areas demands a very powerful yet flexible approach which can be adapted to different requirements and conditions. Besides technical complexities, the effort required for the creation and management of model libraries is considered a key factor. The goal of this project is to devise a practical diagnostic procedure, to define a systematic and component-oriented approach to modelling, to clarify the constraints of an adaption to existing techniques, and to evaluate the results based on a conceptual prototype and case studies. Further, the estimation and optimisation of efforts and an early assessment of diagnostic system properties are of particular interest.

**References**
[Klar et al., 2011a] (Page 189),
[Klar et al., 2011] (Page 189)

**Contact E-Mail**
michaela.huhn@tu-clausthal.de

**Project Homepage**
http://www.in.tu-clausthal.de/de/abteilungen/gi/forschung/modellbasierte-diagnose/

**Project 21: IT Ecosystems (FP AIM - AP 8)**
Project Members

Dr. Michaela Huhn (Leader)
Dipl.-Inform. Gianina Homoceanu
Dipl.-Inform. Dennis Klar

Duration

2009 – 2012

Project Description

IT Ecosystems: Classical approaches of computer science do not scale well for today’s large and complex software-intensive systems. Software systems cannot be considered in isolation, since they are connected among each other and interact massively. Instead they are to be designed as parts of a larger IT Ecosystem. In analogy to biological ecosystems, IT Ecosystems are based on the balance between individuals (autonomy) and sets of rules (control) defining equilibria within an IT Ecosystem. Maintaining and continuously evolving IT Ecosystems requires deep understanding of this balance. The new research topic IT Ecosystems cuts across several research areas, including: emergence of system functions, extending classical engineering approaches, adaptive infrastructures, control of semantic diversity, and enhanced human-environment-machine interaction. These core areas are addressed by the newly established NTH focused Research School for IT Ecosystems, a cooperation of the Universities of Braunschweig, Clausthal, and Hannover funded by the Federal government of Lower Saxony. The goal of AIM is to investigate methods for decentralized, bottom-up organisation of complex software systems, with special focus on the emergence and adaptation of interaction mechanisms among automated actors in dynamic environments. AIM is a subproject of the IT ecosystems project. The focus of our working group is formal verification for safety aspects.

References

[Homoceanu and Huhn, 2011] (Page 187),
[Huhn et al., 2011a] (Page 188)

Contact E-Mail

michaela.huhn@tu-clausthal.de

Project Homepage

http://www.in.tu-clausthal.de/de/abteilungen/gi/forschung/
it-ecosystems/

Project 22: CoWaSy

Project Members

Dr. Michaela Huhn (Leader)
Axel Zechner
**Partner**
Institut für Nachrichtentechnik, TU Braunschweig,

**Duration**
2009 – 2010

**Project Description**
Implementation and demonstration of a prototype of a driver assistance system (rail) that supports wireless detection of track allocation on secondary lines

**References**
[Huhn and Scharff, 2010] (Page 188),
[Huhn and Zechner, 2010] (Page 188)

**Contact E-Mail**
michaela.huhn@tu-clausthal.de

### 3.3.5 Scientific Activities

**Person** Barbara Hammer

- **Editorial Board Memberships**
  - Neurocomputing, Elsevier (2003-).
  - Neural Processing Letters, Springer (2007-).
    See [http://http://www.springerlink.com/content/100321/](http://www.springerlink.com/content/100321/)
  - IEEE Transactions on Neural Networks, Society, IEEE Computational Intelligence (2008-).

- **Organization of Conferences and Workshops**
  - Co-Chair (with Pascal Hitzler, Marc Toussaint, Wolfgang Maass)
    See [http://www.dagstuhl.de/de/programm/kalender/semhp/?semnr=10302](http://www.dagstuhl.de/de/programm/kalender/semhp/?semnr=10302)

- **PC-Member of Conferences and Workshops**
    See [http://www.jointconference.fei.edu.br/](http://www.jointconference.fei.edu.br/)
• ANNPR 2010, Cairo, Egypt, April, 2010.
  See http://www.informatik.uni-ulm.de/ni/ANNPR10/index.html
• ICANN 2010, Thessaloniki, Greece, September, 2010.
  See http://delab.csd.auth.gr/icann2010/index.html
• NeSy 2010, Atlanta, Germany, July, 2010.
  See http://www.neural-symbolic.org/NeSy10/
• ESANN 2010, Bruges, Belgium, April, 2010.
  See http://www.dice.ucl.ac.be/esann/

Person Dr. Michaela Huhn

☐ Organization of Conferences and Workshops
• Co-Chair Model-Based Development of Embedded Systems - Workshop (MBEES 2010), Dagstuhl, D, February, 2010.
  See
• Co-Chair Model-Based Development of Embedded Systems - Workshop (MBEES 2011), Dagstuhl, D, February, 2011.
  See

☐ PC-Member of Conferences and Workshops
  See
  See
  See
  See

3.3.6 Highlights

☐ In 2010
• Barbara Hammer accepted a call from the Bielefeld University to become a Professor at the CITEC center of excellence.

• Michaela Huhn started as the acting lead for Foundations of Computer Science.

• Michaela Huhn coorganizes the Dagstuhl workshop on Model-Based Development of Embedded Systems - Workshop (MBEES 2010).

☐ In 2011

• Michaela Huhn coorganizes the Dagstuhl workshop on Model-Based Development of Embedded Systems - Workshop (MBEES 2011).

• The IT Ecosystems project (FP AIM - AP 8) is prolonged.

• Michaela Huhn and Wuzhu Chen organize the national meeting of the German OPENPROD partners in Clausthal-Zellerfeld.
3.4 Computer Graphics

3.4.1 Overview

Leaders Prof. Dr. Gabriel Zachmann

Secretary Christine Kammann

Scientific Employees Dipl.-Inf. David Mainzer (since 05/2008)
Dipl.-Inf. Daniel Mohr
Dipl.-Inf. René Weller

3.4.2 Research Agenda

The Computer Graphics Group focuses on two areas within the field of visual computing.

The first area is computer graphics, which deals with all aspects of three-dimensional graphical objects. Graphical objects can represent anything from real-world objects, hypothetical objects, simulation data, etc. Computer Graphics is the science of modeling, simulating, visualizing, and interacting with these objects and complete virtual environments built from them.

Our group focuses in particular on acceleration data structures (e.g., bounding volume hierarchies) for geometric queries among graphical objects (e.g., collision detection), natural interaction in virtual environments, real-time rendering of complex scenes, and immersive scientific visualization.

The second area is computer vision, which, on the other hand, tries to algorithmically analyze and extract information from image streams.

Our group focuses in particular on markerless, camera-based hand tracking. The goal is to track robustly all 27 degrees of freedom of the human hand in real-time, without using any markers or special lighting conditions.

Our graphics lab is equipped with modern devices that support our research activities (cyberglove, head-mounted display, tracking system, HDR cameras, range cameras, curved powerwall, etc.).

For more information, please visit the group’s homepage at: http://cg.in.tu-clausthal.de.

3.4.3 Supervised Theses

3.4 Computer Graphics


3.4.4 Projects

**Project 23: Collaborative Multi-User Haptic Workspace**

*Project Members*
- Prof. Dr. Gabriel Zachmann (Leader)
- Dipl.-Inf. René Weller (Project Staff)

*Funding*
- BMBF grant Avilus
- 30,000€ (of 184,000€ total)

*Duration*
- 03/2010 – 03/2012

*Project Description*

Haptic feedback is an essential and emerging technology for many applications, ranging from virtual assembly simulation to mobile computing. It can help to improve human-computer interaction as well as, in multi-user scenarios, human-human interactions in many fields like industrial applications, entertainment, education, medicine and arts.

In this project, we have developed a haptic workspace that allows high fidelity, two-handed multi-user interactions in scenarios containing a large number of dynamically simulated rigid objects and a polygon count that is only limited by the capabilities of the graphics card.
The main challenge when doing haptic rendering is the extremely high frequency that is required: While the temporal resolution of the human eye is limited to approximately 30 Hz, the bandwidth of the human tactile system is about 1000 Hz. In most haptic scenarios, the computational bottleneck remains the collision detection, whereas the force computations (i.e., the collision response) can be done relatively fast.

Thus, the heart of our haptic workspace is our new geometric data structure, called Inner Sphere Trees (ISTs), that not only allows us to detect collisions between pairs of massive objects at haptic rates but also enables us to define a novel type of contact information that guarantees stable forces and torques.

Contact E-Mail
zach@tu-clausthal.de

Project 24: Protosphere

Project Members
Prof. Dr. Gabriel Zachmann (Leader)
Dipl.-Inf. René Weller (Project Staff)

Funding
BMBF grant Avilus
60.000€ (of 184.000€ total)

Duration
03/2008 – 03/2011
**Project Description**

Filling objects densely with sets of non overlapping spheres has been investigated for centuries. Sphere packings have diverse applications in a wide spectrum of scientific and engineering disciplines, for example in automated radiosurgical treatment planning, investigation of processes such as sedimentation, compaction and sintering, in powder metallurgy for three-dimensional laser cutting, in cutting different natural crystals, the discrete element method is based on them, and so forth.

In computer graphics, sphere packings also have proven to be very efficient when doing collision detection, which was the starting point of our research.

The goal of this project is to develop new algorithms that are able to efficiently compute a space-filling sphere packings for arbitrary objects. They are independent of the object’s representation and can be easily extended to higher dimensions. Our basic idea is very simple and related to prototype-based approaches known from machine learning. Our approach directly leads to a parallel algorithm that we have implemented using CUDA. As a byproduct, our algorithm yields an approximation of the object’s medial axis.

**References**

[Weller and Zachmann, 2010] (Page 194)

**Contact E-Mail**

zach@tu-clausthal.de
**Project 25: Natural Interaction in Virtual Environments**

**Project Members**

Prof. Dr. Gabriel Zachmann (Leader)
Dipl.-Inf. René Weller (Project Staff)

**Funding**

BMBF grant Avilus
40,000€ (of 184,000€ total)

**Duration**

03/2008 – 03/2011

**Project Description**

Virtual reality promised to allow users to experience and work with three-dimensional computer-simulated environments just like with the real world. Currently, VR offers a lot of efficient and more or less intuitive interaction paradigms.

However, users still cannot interact with virtual environments in a way they are used to in the real world. In particular, the human hand, which is our most versatile tool, is still only very crudely represented in the virtual world. Natural manual operations, such as grasping, pinching, pushing, etc., cannot be performed with the virtual hand in a plausible and efficient way in real-time.
Therefore, the goal of this project is to simulate the real human hand by a virtual hand model that is controlled by the user via hand tracking technologies, such as a CyberGlove or camera-based hand tracking (see our companion project).

The interaction between such a virtual human hand model and the graphical objects in the virtual environment is to be modeled and simulated, such that the afore mentioned natural hand operations can be performed efficiently. Note that our approach is not to try to achieve physical correctness of the interactions but to achieve real-time under all circumstances while maintaining physical plausibility.

In order to achieve our goal, we focus our research on deformable collision detection, physically-based simulation, and realistic animation of the virtual hand.

This technology will have a number of very useful applications, which can, until now, not be performed effectively and satisfactorily. Some of them are virtual assembly simulation, 3D sketching, medical surgery training, or simulation games.

Contact E-Mail
zach@tu-clausthal.de

Project 26: Inner Sphere Trees

Project Members
Prof. Dr. Gabriel Zachmann (Leader)
Dipl.-Inf. René Weller (Project Staff)

Funding
BMBF grant Avilus
54,000€ (of 184,000€ total)
**Duration**

03/2008 – 03/2011

**Project Description**

Collision detection between rigid objects is an essential task in many fields of computer science, e.g. in path-planning, physically-based simulations, and medical applications. Today, there exist a wide variety collision detection libraries that are able to work at interactive rates. Unfortunately, most of them fail, when continuous forces and torques or extremely high frequencies in complex environments are required. Haptic rendering for example needs update rates of at least 1 kHz to guarantee a stable force feedback.

In this project, we developed a new geometric data structure, called *Inner Sphere Trees*, that not only allows to compute both separation distance and penetration volume in a unified algorithm, but it also lends itself very well to multi-threaded time-critical variants.

The main idea is that we do not build an (outer) hierarchy based on the polygons on the boundary of an object. Instead, we fill the interior of the model with a set of non-overlapping simple volumes that approximate the object’s volume closely. On top of these inner bounding volumes, we build a hierarchy that allows for fast computation of the approximate proximity and the *penetration volume*.

The penetration volume corresponds to the water displacement of the overlapping parts of the objects and, thus, leads to a physically motivated and continuous repulsion force. The results show that our data structure can answer both kinds of queries at haptic rates with a negligible loss of accuracy.

**References**

[Zachmann, 2010] (Page 179)

**Contact E-Mail**

zach@tu-clausthal.de
Project 27: Real-time camera-based 3D hand tracking

Project Members
Prof. Dr. Gabriel Zachmann (Leader)
Dipl.-Inf. Daniel Mohr (Project Staff)

Duration
07/2006 – 07/2012

Project Description
Hand tracking is a powerful technique for interaction in many applications, for example for navigation in virtual environments, virtual assembly simulation, gesture recognition, and motion capture. The goal of this project is the markerless tracking of the global position and all finger joint angles of a human hand in real-time.

Due to measurement noise, occlusion, cluttered background, inappropriate illumination, high dimensionality (about 27 Degrees of freedom), and real-time constraints, hand-tracking is a very important and interesting scientific challenge.

Our approach is model-based, utilizing multiple cameras and multiple features e.g. edge gradients and skin color to reduce uncertainty. In order to achieve real-time hand-tracking, we use a hierarchical matching approach and dimension reduction techniques. We will combine both and additionally exploit time coherence to achieve reliable prediction of the hand state in each frame.
References

[Mohr and Zachmann, 2010b] (Page 191),
[Mohr and Zachmann, 2010a] (Page 191),
[Mohr and Zachmann, 2011] (Page 191)

Contact E-Mail

zach@tu-clausthal.de

Project 28: Open-Source Collision Detection Library

Project Members

Prof. Dr. Gabriel Zachmann (Leader)
Dipl.-Inf. René Weller (Project Staff)

Funding

BMBF grant Avilus
16,000€ (of 16,000€ total)

Project Description

Fast and exact collision detection between a pair of graphical objects undergoing rigid motions is at the core of many simulation and planning algorithms in computer graphics and related areas (for instance, automatic path finding, or tolerance checking). In particular, virtual reality applications such as virtual prototyping or haptic rendering need exact collision detection at interactive speed for very complex, arbitrary “polygon soups”. It is also a fundamental problem of dynamic simulations of rigid bodies, simulation of natural interaction with objects, haptic rendering, path planning, and CAD/CAM.
In order to provide an easy-to-use library for other researchers and open-source projects, we have implemented our algorithms in an object-oriented library. Originally based on OpenSG, the library is now completely platform-independent, including support for multithreading. It is structured as a pipeline and contains algorithms for both the broad phase (grid, convex hull test, separating planes) and the narrow phase (Dop-Tree, Box-Tree, etc.).

**Contact E-Mail**

c zach@tu-clausthal.de

### 3.4.5 Scientific Activities

**Person** Prof.-Dr. Gabriel Zachmann

- **Organization of Conferences and Workshops**

- **PC-Member of Conferences and Workshops**
• Vision, Modeling, and Visualization (VMV), Siegen, Germany, November, 2010.
  See http://vmv2010.uni-siegen.de

• International Symposium series on Tools and Methods of Competitive Engineering (TMCE), Ancona, Italy, April, 2010.
  See http://www.tmce.org

  See http://conferences.computer.org/vr/2010/

  See http://www.3dpvt2010.org

• 12th Symposium on Virtual and Augmented Reality (SVR), Rio Grande del Norte, Natal, Brazil, May, 2010.
  See http://www.dimap.ufrn.br/svr2010/calls.php

• 21st International Conference on Artificial Reality and Telexistence (ICAT), Osaka, Japan, November, 2011.
  See http://www.ic-at.org/2011

  See http://www.grapp.org/

  See http://cgi2011.site.uottawa.ca/

  See http://conferences.computer.org/vr/2011/

### 3.4.6 Highlights

- **In 2010**
  - Prof. Zachmann is external examiner for the PhD defense of Muiris Woulfe, Trinity College Dublin.
  - Our algorithms and software for collision detection and force feedback won the first prize at the RTT Emerging Technology Contest.
  - René Weller reads the lecture “Introduction to Computer Graphics” during the summer term at Nordhausen University of Applied Sciences.
  - We demoed our force-feedback algorithms at Eurohaptics, Amsterdam, July 2010, and at the Joint Virtual Reality Conference (JVRC), Stuttgart, September 2010.

- **In 2011**
• Prof. Zachmann was appointed Visiting Professor at Nanyang Technological University (NTU), Singapore.

• Zachmann is the Co-Chair for the Scientific Visualization Contest 2011 at IEEE VisWeek.

• Prof. Zachmann is a member of the review panel of “Information and Communication Technologies” for the Cyprus Research Promotion Foundation (RPF).

• We showcased our software and algorithms for real-time hand tracking at DLR, Oberpfaffenhofen, at the Institute of Robotics and Mechatronics.

• We participated in the presentation at the final status meeting of the BMBF project “Avilus”, funded within the IKT2020 framework.

• René Weller reads the lecture “Introduction to Computer Graphics” during the summer term at Nordhausen University of Applied Sciences.

• Researchers from Bosch visited our group to establish collaborations in the area of embedded 3D rendering.
3.5 Databases and Information Systems

3.5.1 Overview

**Leader**  Prof. Dr. rer. nat. habil. Sven Hartmann

**Secretary**  Andrea Behfeld

**Scientific Employees**  Dr. rer. nat. Thu Trinh

Dipl.-Math. Sven Arnhold

MBA Viktorija Korolevica

**External Ph.D. Students**  Jing Wang, National Centre for Biosecurity and Infectious Disease

Sigrun May, Helmholtz Zentrum für Infektionsforschung

Wolfgang Scherer, Chartis

Alexander Stuwe, Berliner Volksbank

3.5.2 Research Agenda

The research of our group focusses on topics in data engineering (XML data processing, data semantics, data mining, database optimisation, database security, logic in databases, Semantic Web), information systems engineering (conceptual modelling, services, simulation), and optimal discrete structures and algorithms (codes, combinatorial designs, graph decompositions). We are active in interdisciplinary research on emerging applications of databases and information systems in e-science, e-government, and e-business.

For more information, please see our web site at:

http://dbis.in.tu-clausthal.de

3.5.3 Supervised Theses


### 3.5.4 Projects

**Project 29: Databases and Information Systems**
Project Members
Prof. Dr. Sven Hartmann (Leader)
Dr. Thu Trinh
Dipl.-Math. Sven Arnhold
MBA Victorija Korolevica

Partners
Prof. Dr. Joachim Biskup, Dortmund University of Technology
Prof. Dr. Dirk Labudde, Mittweida University of Applied Sciences
Prof. Dr. Dirk Langemann, Braunschweig University of Technology
Prof. Dr. Uwe Leck, University of Wisconsin
Prof. Dr. Dirk Linowski, Steinbeis University
Prof. Dr. Bernhard Thalheim, University of Kiel
Prof. Dr. Millest Vincent, University of South Australia

Funding
Alfried Krupp von Bohlen und Halbach Foundation, administered by the German Scholars Organisation
100,000€ (of 100,000€ total)

Duration
01/2008 – 12/2012

Project Description
We are investigating distributed data- and knowledge-intensive systems from a variety of perspectives, with a focus on models, architectures and methods for describing and developing them, but also on their mathematical, logical, computational and managerial foundations. Our work further includes the implementation of prototype systems that demonstrate the feasibility of our research for developing up-to-date systems for applications in like science, engineering, business, and education.

References
[Biskup et al., 2010a] (Page 182),
[Biskup et al., 2010] (Page 182),
[Ferrarotti et al., 2010] (Page 185),
[Ferrarotti et al., 2011a] (Page 185),
[Ferrarotti et al., 2011] (Page 185),
[Hartmann and Link, 2010a] (Page 187),
[Hartmann et al., 2011] (Page 180),
[Hartmann and Kern-Isberner, 2011] (Page 177)

Contact E-Mail
sven.hartmann@tu-clausthal.de

Project 30: Cardinality Constraints for XML
3.5 Databases and Information Systems

Project Members
Prof. Dr. Sven Hartmann (Leader)
Dr. Thu Trinh

Partners
Prof. Dr. Sebastian Link, University of Auckland (Leader)
Dr. Flavio Ferrarotti, Victoria University of Technology

Funding
Marsden Fund, administered by the Royal Society of New Zealand
100,000€ (of 200,000€ total)

Duration
03/2009 – 02/2012

Project Description
The Extensible Markup Language (XML) has evolved to be the lingua franca for data integration and data exchange on the Internet and elsewhere. This development has led to a dramatic increase of XML data that must be stored, managed and processed in its native format. The syntactic expressibility of XML together with the tree-like nested structure of its data impose new challenges for database researchers. It is particularly difficult to develop data management tools that are both efficient and cater for a large class of properties that are naturally exhibited by XML data. Our project is based on the somewhat surprising observation that cardinality constraints have not been exploited in the context of XML. Cardinality constraints can express many properties of XML data that cannot be captured by other classes of XML constraints. They have a direct impact on many XML recommendations such as schema specification languages, query languages or data manipulation and transformation languages. We aim at developing a well-founded theory that gives original insight into the characteristics of XML data, enhances the semantic capabilities of XML, allows designers to make an informed choice about which classes of cardinality constraints to incorporate into XML recommendations, and provides efficient algorithms to advance XML data processing.

References
[Ferrarotti et al., 2011b] (Page 185),
[Hartmann and Link, 2010] (Page 180)

Contact E-Mail
sven.hartmann@tu-clausthal.de

Project 31: Keys and Functional Dependencies in XML Data

Project Members
Prof. Dr. Sven Hartmann (Leader)
Dr. Thu Trinh
Partners

Prof. Dr. Sebastian Link, University of Auckland
Dr. Flavio Ferrarotti, Victoria University of Technology
Jing Wang, M.Sc., National Centre for Biosecurity and Infectious Disease

Duration

01/2008 – 12/2012

Project Description

XML is the new standard for the native storage, exchange and integration of heterogeneous data in many emerging application areas, including e-business and e-science. While XML provides a high degree of syntactic flexibility, it has little to offer for capturing the semantics of data. Consequently, the study of data dependencies has been recognised as one of the most important yet challenging areas of XML research. The investigation is motivated by a variety of potential applications in XML database operation, ranging from schema design, query optimisation, efficient storing and updating, consistent query answering, security and access control, to data cleaning. Several classes of data dependencies have been defined for XML, with keys and functional dependencies being most prominent examples. While there is a well-accepted single concept for the notion of keys and functional dependency in relational databases, the complex nature of XML data has resulted in various proposals for XML that deviate in their expressiveness but are all justified as they naturally occur in practice. Due the complex structure of XML data, core decision problems for data dependencies like satisfiability and implication often turn out to be computationally intractable. It is therefore interesting to find natural and useful classes of data dependencies that can be reasoned about efficiently. Our objective is to identify such classes, to investigate their usefulness in XML design, to establish sound and complete rule systems for them, and to develop efficient algorithms for dependency inference or for discovering them from given databases.

References

[Ferrarotti et al., 2010a] (Page 185),
[Hartmann et al., 2010c] (Page 187),
[Trinh, 2010] (Page 194)

Contact E-Mail

sven.hartmann@tu-clausthal.de

Project 32: Interactive Constraint Acquisition

Project Members

Prof. Dr. Sven Hartmann (Leader)
Dr. Thu Trinh
**Partners**
Prof. Dr. Sebastian Link, Victoria University of Wellington
Dr. Henning Köhler, N-Squared Software
Prof. Dr. Markus Kircherg, HP Labs Singapore und National University of Singapore

**Duration**
01/2008 – 12/2012

**Project Description**
Integrity constraints model business rules that every legal database instance is compelled to obey. They restrict databases to those considered meaningful for the application at hand. In practice, the gathering and formalisation of integrity constraints is far from trivial. This task does not only demand high abstraction abilities but also tends to be rather complex. Human factors such as the experience and skills of the data architect play a major role in the acquisition process. In view of the problems encountered in database design practice and the importance of the sound and complete gathering of semantic information it is highly desirable to support the acquisition of semantic constraints. We investigate the efficient construction and effective use of example and counter-example databases that can guide the process of constraint acquisition. Such databases serve as a valuable design aid for data architects, e.g., to communicate with domain experts, to study consequences of particular design decisions, and to foresee potential anomalies during database operation. Eventually the generation, analysis and evolution of good example databases at design time may help data architects to specify a constraint set that best reflects the business rules for the application under development, thus preventing expensive corrections at run time.

**References**
[Hartmann et al., 2010] (Page 180),
[Hartmann et al., 2010a] (Page 187)

**Contact E-Mail**
sven.hartmann@tu-clausthal.de

**Project 33:** Modelling Data-Intensive Scientific Workflows for Lab Automation in Analytical Research Laboratories

**Project Member**
Prof. Dr. Sven Hartmann (Leader)
Partners
Jing Wang, M.Sc., National Centre for Biosecurity and Infectious Disease
Prof. Dr. Phoebe Chen, Deakin University
Prof. Dr. Mike Hendy, University of Otago
Prof. Dr. Sebastian Link, University of Auckland
Prof. Dr. Peter Lockhart, Massey University

Funding
Tertiary Education Commission
45,000€ (of 45,000€ total)

Duration
06/2008 – 03/2011

Project Description
Nowadays, huge amounts of data have been generated from biological research laboratories. Lab automation is essential for knowledge discovery process. The goal is to develop a framework for assessing the effectiveness of lab automation for data-intensive applications. Our research is based on various aspects of effectiveness (cost-efficiency, return on investment, quality) that are suitable for analytical research laboratories. We study which internal and external factors impact effectiveness, and to which extent. The idea is to single out factors that can be easily estimated in a running lab and be used to assess the effectiveness sufficiently well. Eventually, we will investigate how our framework can be used for ex ante evaluations of investments. The focus of our research is on lab automation by up-to-date database technology, lab information systems, XML-based information flows, and the deployment of high-throughput instruments (such as DNA sequencers).

References
[Chen et al., 2010] (Page 183),
[Hartmann et al., 2010b] (Page 187),
[Trujillo et al., 2010] (Page 198)

Contact E-Mail
sven.hartmann@tu-clausthal.de

3.5.5 Scientific Activities

Person
Prof.-Dr. Sven Hartmann

Editorial Board Memberships
- Dissertationen zu Datenbanken und Informationssystemen, Verlag, AKA (2009-).
See http://www aka-verlag com/
3.5 Databases and Information Systems

Organization of Conferences and Workshops

  See http://cmlsa2010.mucoms.org/

PC-Member of Conferences and Workshops

  See http://2012.apccm.org/

  See http://apscc2010.hdu.edu.cn

• The 29th International Conference on Conceptual Modeling, ER 2010, Vancouver, Canada, November, 2010.
  See http://www.er2010.sauder.ubc.ca

  See http://www.is.informatik.uni-kiel.de/events/sdkb_2010/

• The 12th International Conference on Enterprise Information Systems, ICEIS 2010, Funchal, Portugal, June, 2010.
  See http://www.iceis.org/

• The 2nd International Workshop on Benchmarking of Database Management Systems and Data-Oriented Web Technologies, BenchmarkX 2010, Tsukuba, Japan, April, 2010.
  See http://ulita.ms.mff.cuni.cz/ws/BenchmarkX10/

  See http://oldwww.acm.org/conferences/sac/sac2010/

  See http://2010.foiks.org/

• The Seventh Asia-Pacific Conference on Conceptual Modelling, APCCM 2010, Brisbane, Australia, January, 2010.
  See http://2010.apccm.org/

• The IEEE Asia-Pacific Services Computing Conference, APSCC 2011, Jeju, KO, December, 2011.
  See http://www.apscc2011.org
• The 30th International Conference on Conceptual Modeling, ER 2011, Brussels, Belgium, November, 2011.
   See http://er2011.ulb.ac.be/

Steering Committees

• The Asia-Pacific Conference on Conceptual Modelling, APCCM (2003-).
   See http://apccm.org/

• The International Workshop on Conceptual Modelling for Life Sciences Applications, CMLSA (2007-).
   See http://cmlsa2007.mucoms.org/

Person M.Sc Thu Trinh

• PC-Member of Conferences and Workshops
  • The International Workshop on Conceptual Modeling of Services, Vancouver, Canada, November, 2010.
    See http://cms2010.mucoms.org/
    See http://www.is.informatik.uni-kiel.de/events/sdkb_2010/

3.5.6 Highlights

• In 2011
  • In October 2011 Sven Hartmann visited the University of Kiel on invitation by Prof. Dr. Thalheim for joint work on database systems.
  • From August to October 2011 Dr. Hui Ma (Victoria University of Wellington) visited our group for joint work on service integration and geospatial web services. Dr. Ma’s visit was funded by a DAAD research and travel grant. Dr. Ma gave a colloquium talk on “A Geometrically Enhanced Conceptual Data Model”.
  • In July 2011 Jing Wang attended the Doctoral Summer School on Bioinformatics and Computational Biology in Lipari.
  • In June 2011 Sven Hartmann attended the Berlin Science Conference on “Building Bridges: Spitzenforscher für Deutschland, Spitzenforschung in Deutschland” on invitation of the German Scholars Organisation (GSO).
  • In June 2011 Prof. Dr. Sebastian Link (Victoria University of Wellington, now University of Auckland) visited our group for joint work on Armstrong SQL databases.
3.5 Databases and Information Systems

- From April to July 2011 Jing Wang (Allan Wilson Centre for Molecular Ecology and Evolution, now National Centre for Biosecurity and Infectious Disease) visited our group for joint work on sample management and to advance her Ph.D. thesis.

- In March 2011, Sven Hartmann visited Victoria University of Wellington on invitation by Prof. Dr. Sebastian Link for joint research on their Marsden-funded project on XML Cardinality Constraints.

- In February 2011 Prof. Dr. Joachim Biskup (Dortmund University of Technology) visited our group for joint work on inference control for secure databases. Prof. Biskup gave a colloquium presentation on “Inference-proof view update transactions with forwarded refreshments”.

In 2010

- In November 2010 Prof. Dr. Bernhard Thalheim (University of Kiel) visited our group for joint work on conceptual data modelling and global database normalisation. Prof. Thalheim gave a colloquium talk on “Technology Solutions for the Next Generation Web”.

- In July 2010 Prof. Dr. Dirk Langemann (Braunschweig University of Technology) visited our group for joint work on conceptual models of complex systems. Prof. Langemann gave a colloquium talk on “Qualitative mathematical models for the human energy metabolism”.

- In April 2010 Dr. Qing Wang (University of Otago, now Australian National University) visited our group for joint work on XML database transformations. Dr. Wang gave a colloquium talk on “A Customised ASM Thesis for Database Transformations”.

- In March 2010 Sven Hartmann visited Massey University on invitation of Prof. Dr. David Penny. Sven gave a seminar talk on “Managing Lab Data in LIMS”.

- In February 2010 Thu Trinh’s Ph.D. thesis on “XML functional dependencies based on tree homomorphisms” has been selected by the faculty as the best Computer Science Ph.D. thesis in 2009 and nominated for the Ph.D. dissertation award of the Gesellschaft für Informatik (GI). Extended abstracts of all nominated works have been published in a special issue “Ausgezeichnete Informatikdissertationen 2009” of Lecture Notes in Informatics.
3.6 Software Systems Engineering

3.6.1 Overview

Leaders
Prof. Dr. Andreas Rausch

Secretary
Annett Panterodt (since 03/2006)
Marina Domjahn
Nadine Heinrich

Scientific Employees
Dr. Sebastian Herold
Dipl.-Inf. Holger Klus
Dipl.-Inf. Benjamin Fischer (since 01/2009)
Dipl.-Inf. Mirco Schindler
Dipl.-Inf. Marcel Ibe (since 06/2011)
Dipl.-Math. Ingrid Schmees (since 11/2011)
M.Sc. Joachim Schramm (since 10/2011)
B.Sc. Dirk Herrling (since 06/2011)
B.Sc. Tim Warnecke (since 06/2011)
Dr. Christian Bartelt
Dipl.-Inf. Constanze Deiters
Dipl.-Inf. Patrick Dohrmann (since 07/2009)
Dr. rer. nat. Christoph Knieke
Dr. Dirk Niebuhr
Dipl.-Wirt.-Inf. Björn Schindler (since 02/2008)
Dr. Thomas Ternité
Dipl.-Inf. Marco Körner (since 11/2010)
Dipl.-Inf. Michael Deynet
M.Sc. Inform. Malte Mauritz (since 04/2011)
Dipl.-Wirt.-Inf. Martin Vogel (since 05/2011)
Dipl.-Inf. Henrik Peters (since 10/2011)
M. Sc. Adina Aniculaeaei (since 11/2011)
Dipl.-Ing. Jean Paul Tatou (since 11/2011)
B. Sc. Yuri Jon (since 11/2011)
Dipl.-Inf. Benjamin Cool (since 11/2011)
Dipl.-Inf. (FH) Matthias Mair (since 01/2012)

Associated Members
Dipl. Inf. Sabine Niebuhr (until 05/2011)
Dipl. Inf. André Appel (until 07/2010)
Dr. Edward Fischer (until 01/2011)
Dipl.-Inf. (FH) Angelo Gülle (until 11/2010)
Dipl.-Inf. Sandra Lange (until 08/2011)
3.6.2 Research Agenda

The research goal of Software Systems Engineering research group is to improve the dependability of software systems and their development, operation, maintenance, support and evolution. Therefore we provide a kit containing methods, techniques and tools for successful engineering of software systems. Our task is to improve this kit with valid and consolidated findings from research, and to transfer it to practice.

The research of the group of Prof. Dr. Rausch focuses on the following areas: practicable and applicable process models, model based software development, and sustainable software architectures. The basis of these research areas is formed by fundamental programming techniques, technologies, and methods of software system engineering. All research results are demonstrated in seamless tool support realized within demonstrating scenarios. The results are validated together with industrial partners, and in their environment.

See Prof. Dr. Rausch’s homepage at: http://sse-world.de/

3.6.3 Supervised Theses


### 3.6.4 Projects

**Project 34: SOWEMA - Development of software, Tools and machines to generate an automatic and closed light construction-manufacturing chain**
3.6 Software Systems Engineering

**Project Members**

Prof. Dr. Andreas Rausch (Leader)  
Dipl.-Inf. Benjamin Fischer (Project Staff)  
Dr. Christian Bartelt (Project Staff)

**Partners**

Cenit AG, Stuttgart, Germany  
CTC GmbH, Stade, Germany  
EADS, Ottobrunn, Germany  
Manz Automation Tübingen GmbH, Tübingen, Germany  
Otto Bock Health Care GmbH, Duderstadt, Germany  
TU München (LCC), München, Germany  
Wethje GmbH, Hengersberg, Germany

**Funding**

BMBF  
225.000€ (of 225.000€ total)

**Duration**

01.06.2011 – 31.05.2014

**Project Description**

Design and production of fiber composite components are basically different from known metal constructions. This Project develops a standardized production process, to reduce the necessary Know-How of the user, by using style guide and proceeding the production automatically.

**Contact E-Mail**

andreas.rausch@tu-clausthal.de

---

**Project 35: IPSSE-Pilot - Pilotprojekt zur Etablierung des Forschungsverbunds Institute for applied Software Systems Engineering**

**Project Members**

Prof. Dr. Andreas Rausch (Leader)  
B. Sc. Dirk Herrling (Project Staff)  
B. Sc. Yuri Jon (Project Staff)  
Dr. Christoph Knieke (Project Staff)  
Dipl.-Inf. Marco Körner (Project Staff)

**Partner**

Volkswagen AG, Wolfsburg, Germany

**Funding**

Volkswagen  
674.000€ (of 674.000€ total)

**Duration**

**Project Description**
Starting in the end of 2010, Prof. Andreas Rausch initiated a kick-off project with Volkswagen in cooperation with the chair of Prof. Ursula Goltz at Technische Universität Braunschweig. The idea of this project was to find out, whether our competence in software systems engineering can support Volkswagen during their everyday tasks in the field of engine control software development.

**Contact E-Mail**
andreas.rausch@tu-clausthal.de

---

**Project 36: IPSSE - Forschungsverbund Institute for applied Software Systems Engineering**

**Project Members**
- Prof. Dr. Andreas Rausch (Leader)
- Dipl.-Inf. Benjamin Cool (Project Staff)
- B. Sc. Dirk Herrling (Project Staff)
- B. Sc. Yuri Jon (Project Staff)
- Dr. Christoph Knieke (Project Staff)

**Partner**
Volkswagen AG, Wolfsburg, Germany

**Funding**
Volkswagen
5.000.000€ (of 5.000.000€ total)

**Duration**

**Project Description**
As a result of project IPSSE-Pilot, in 2011 the Research Center Institute for Applied Software Systems Engineering (IPSSE) was founded, backed up by Volkswagen’s guarantee to cover at least the costs of eight PhD students and several additional student researchers for at least the next 5 years. IPSSE’s core idea is the combination of application projects with so called improvement projects. Currently, there are eight PhD students at IPSSE complemented by about ten additional student researchers. While IPSSE focus is at Volkswagen now, there are already first contacts to companies from other domains as well as to other research groups about further projects.

**Contact E-Mail**
andreas.rausch@tu-clausthal.de

---

**Project 37: ReqBwPilot-II - Extension of the requirements engineering approach by the support of quality management**
**Project Members**

Prof. Dr. Andreas Rausch (Leader)
Dipl.-Inf. Michael Deynet (Project Staff)
Dipl.-Inf. Sabine Niebuhr (Project Staff)
Dipl.-Inf. Björn Schindler (Project Staff)

**Partner**

IT-AmtBw A5, Koblenz, Germany

**Funding**

IT-AmtBw
160,000€ (of 160,000€ total)

**Duration**

01.06.2010 – 31.06.2011

**Project Description**

Requirements engineering and architecture design are key factors in software development: both bear the risk of serious faults, since they include decisions with far-reaching consequences, which may appear later, during project progression. Therefore the previous project ReqBw deal with the development of a software engineering approach for coupling requirements and architecture. The goal of this project is validate, test and adopt this Requirements Engineering Approach within the scope of the pilot project.

**Contact E-Mail**

andreas.rausch@tu-clausthal.de

*Project 38:  Global Software Engineering - distributed collaborative software development*
**Project Members**

- Prof. Dr. Andreas Rausch (Leader)
- Dipl.-Inf. Martin Vogel (Project Staff)
- Dipl.-Inf. Björn Schindler (Project Staff)
- Dr. Christian Bartelt (Project Staff)

**Partner**

- Prof. Dr. Kurt Schneider, Hannover, Germany

**Funding**

- BMBF
  - 369,657€ (of 712,314€ total)

**Duration**


**Project Description**

The research group GloSE generate a methodical and technical approach for the project organization, management and support of the implementation of distributed projects. It takes at that the inter-site processes and information flows, and the documents and information artifacts in globally distributed development projects.

**Contact E-Mail**

andreas.rausch@tu-clausthal.de

---

**Project 39: ReqBwPilot-Evaluation of the early phase considering requirements management**

**Project Members**

- Prof. Dr. Andreas Rausch (Leader)
- Dipl.-Inf. Michael Deynet (Project Staff)
- Dipl.-Inf. Marcel lbe (Project Staff)
- M.Sc. Joachim Schramm (Project Staff)
- Dipl.-Inf. Björn Schindler (Project Staff)

**Partner**

- IT-AmtBw A5, Koblenz, Germany

**Funding**

- IT-AmtBw
  - 115,000€ (of 115,000€ total)

**Duration**

**Project Description**

Requirements engineering and architecture design are key factors in software development: both bear the risk of serious faults, since they include decisions with far-reaching consequences, which may appear later during project progression. Therefore the previous project ReqBw deal with the development of a software engineering approach for coupling requirements and architecture. The goal of this project is validate, test and adopt this Requirements Engineering Approach within the scope of the pilot project.

**Contact E-Mail**

andreas.rausch@tu-clausthal.de

**Project 40: Improvement and Maintenance of the V-Modell XT Bund**

**Project Members**

Prof. Dr. Andreas Rausch (Leader)
Dr. Thomas Ternité (Project Staff)

**Partner**

Weit e.V., Potsdam, Germany

**Funding**

Weit e.V.
8.000€ (of 8.000€ total)

**Duration**

01.04.2010 – 31.05.2011

**Project Description**

The V-Modell XT Bund is an organization-specific adaptation of the V-Modell XT to German federal agencies. It is developed maintained and held consistent to the V-Modell XT in this project.
Contact E-Mail
andreas.rausch@tu-clausthal.de

**Project 41: Improvement and Maintenance of the V-Modell Bayern (WarWeiVMBay)**

**Project Members**
Prof. Dr. Andreas Rausch (Leader)
Dr. Thomas Ternité (Project Staff)

**Partner**
Weit e.V, Potsdam, Germany

**Funding**
Weit e.V.
20,000€ (of 20,000€ total)

**Duration**
01.04.2010 – 31.05.2011

**Project Description**
The bavarian Department of the Interior uses an organization-specific adaptation of the V-Modell XT as process model standard when developing software systems. The V-Modell XT Bayern (Bavaria) was developed in the project WarWeiVMBay. Since then, further development, maintenance and consistency to the V-Modell XT development have are ensured by WarWeiVMBay. Subjects of the project are to provide a change management environment, activation of additional project types, updates to newer version of the V-Modell XT and maintenance support.

Contact E-Mail
andreas.rausch@tu-clausthal.de

**Project 42: RPLAN E3V2**

**Project Members**
Prof. Dr. Andreas Rausch (Leader)
Dr. Sebastian Herold (Project Staff)
Dipl. Inf. (FH) Matthias Mair (Project Staff)

**Partners**
Actano GmbH, Munich, Germany
Fraunhofer IESE, Kaiserslautern, Germany

**Funding**
Actano GmbH
40,000€ (of 40,000€ total)

**Duration**
Project Description

RPLAN from Actano is a planning software broadly used in the automotive domain. For the next future release, Actano plans several improvements regarding look and feel, performance, and the support of collaborative planning. Together we investigate the impacts of the new requirements on the existing software architecture of RPLAN and develop core concepts of the future architecture. This includes a technical framework for data models prepared for use in collaborative environments, a new interaction concept as well as technological issues like RPLAN in the cloud and multi-tenancy.

Contact E-Mail
andreas.rausch@tu-clausthal.de

Project Homepage
http://www.actano.de/

Project 43: IT Ecosystems

Project Members
Prof. Dr. Andreas Rausch (Leader)
M.Sc. Adina Aniculaesoi (Project Staff)
Dipl.-Inf. Constanze Deiters (Project Staff)
Dr. Sebastian Herold (Project Staff)
Dipl.-Inf. Sandra Lange (Project Staff)

Partners
Technische Universität Braunschweig, Braunschweig, Germany
Leibniz Universität Hannover, Hannover, Germany

Funding
MWK
401.110€ (of 2.541.218€ total)

Duration
01.03.2009 – 31.08.2011

Project Description

Classical approaches of computer science do not scale well for today's large and complex software-intensive systems. Software systems cannot be considered in isolation, since they are connected among each other and interact massively. Instead they are to be designed as parts of a larger IT Ecosystem. In analogy to biological ecosystems, IT Ecosystems are based on the balance between individuals (autonomy) and sets of rules (control) defining equilibria within an IT Ecosystem. Maintaining and continuously evolving IT Ecosystems requires deep understanding of this balance.
The new research topic IT Ecosystems cuts across several research areas, including: emergence of system functions, extending classical engineering approaches, adaptive infrastructures, control of semantic diversity, and enhanced human-environment-machine interaction. These core areas are addressed by the newly established NTH focused Research School for IT Ecosystems, a cooperation of Technische Universität Braunschweig, Technische Universität Clausthal, and Leibniz Universität Hannover. A joint demonstrator will present innovative research results in the context of a smart city application.

Contact E-Mail
andreas.rausch@tu-clausthal.de

Project Homepage
http://www.it-ecosystems.org/

Project 44: CoBePro - Support for Controlling and Reporting in the IT Investment Programme of the German Federal Ministry of the Interior

Project Members
Prof. Dr. Andreas Rausch (Leader)
Dipl.-Inf. Patrick Dohrmann (Project Staff)
Dipl.-Inf. Edward Fischer (Project Staff)

Partners
Federal Ministry of the Interior of Germany (BMI), Berlin, Germany
Federal Office of Administration (BVA), Cologne, Germany

Funding
BMI/BVA
1.142.000€ (of 1.142.000€ total)

Duration
**Project Description**

The IT Investment Program (having a budget of 500 m.) was passed by the German Bundestag on February 20th. The available budget will be used to fund over 300 projects with each heading to improve Germany’s IT position in the current crisis. In order to manage that program and validate its outcome, the PG Invest was founded. The first goal of CoBePro is to support PG Invest in respect to controlling and reporting. The second goal is to use the current situation as an opportunity for collecting valuable data of how projects develop.

This will yield an experience database which can be used to improve controlling and management of future projects. For example, a duration ratio like that between the analysis phase and the overall project can be used to make estimations of the actual progress more reliable.

**Contact E-Mail**
andreas.rausch@tu-clausthal.de

**Project 45**: *SmartSchank - Electronic Process and Control Technology for Modular Dispensing Equipment*

**Project Members**
- Prof. Dr. Andreas Rausch (Leader)
- Dipl.-Inf. Benjamin Fischer (Project Staff)
- Dipl.-Inform. Sebastian Herold (Project Staff)

**Partner**
Dirmeier Schanktechnik GmbH & Co KG, Oberviechtach, Germany

**Funding**
AIF
120,000€ (of 450,000€ total)

**Duration**
01.05.2009 – 31.10.2010
**Project Description**

Electronic dispensing equipment helps gastronomic businesses like restaurants or pubs to minimize losing by uncontrolled or inexact serving of beverages. Today dispensing equipment is usually build of different units for tapping, accounting, etc. and a large, monolithic control unit. This central unit is expensive and mostly unaffordable for small gastronomic businesses. Thus, our cooperation partner, Dirmeier Schanktechnik GmbH & Co KG, aims at developing a decentralized solution. This means that dispensing equipments are build of modular units that can function on their own but automatically share and integrate their functionality when plugged together. To enable such modular behavior, a software platform for dynamic adaptive system can be used to ease the development of such dispensing equipments - a platform like the DAiSI developed at our chair. Our task will be to realize the required functionality and to migrate DAiSI to the hardware platform provided by dispensing modules that is characterized by heavily restricted resources.

This project is funded by the Federal Ministry of Economics and Technology of Germany.

![Diagram of dispensing equipment](image)

**Contact E-Mail**

andreas.rausch@tu-clausthal.de

**Project 46: ReqBwPilot - Validation of a Requirements Engineering Approach within the scope of a pilot project**

**Project Members**

Prof. Dr. Andreas Rausch (Leader)  
Dipl.-Inf. Michael Deynet (Project Staff)  
Dipl.-Inf. Edward Fischer (Project Staff)  
Dipl.-Inf. Sabine Niebuhr (Project Staff)  
Dipl.-Inf. Björn Schindler (Project Staff)
**Partner**
IT-AmtBw A5, Koblenz, Germany

**Funding**
IT-AmtBw
160,000€ (of 160,000€ total)

**Duration**
15.03.2009 – 28.02.2010

**Project Description**
Requirements engineering and architecture design are key factors in software development: both bear the risk of serious faults, since they include decisions with far-reaching consequences, which may appear later during project progression. Therefore the previous project ReqBw deal with the development of an software engineering approach for coupling requirements and architecture. The goal of this project is validate, test and adopt this Requirements Engineering Approach within the scope of the pilot project.

**Contact E-Mail**
andreas.rausch@tu-clausthal.de

**Project 47: Study for introducing V-Model XT in projects of the Bundeskriminalamt (EkoBKA)**

**Project Members**
Prof. Dr. Andreas Rausch (Leader)
Dipl.-Inf. Edward Fischer (Project Staff)

**Partners**
4Soft, München, Germany
Bundesministerium des Inneren (BMI), Berlin, Germany
Bundeskriminalamt (BKA), Wiesbaden, Germany
Funding

Bundesminister des Inneren
25000€ (of 25000€ total)

Duration


Project Description

The german BKA (Bundeskriminalamt, a public organization for crime investigation) not only uses information systems, but operates, maintains and develops them as well. In addition to common obstacles like ever-changing requirements and limited resources, BKA’s software development projects are in the need of being balanced with projects and processes of other national and international organizations. Without a well-defined process model, this challenge could not been solved yet. So the goal of this study is to find out how and which parts of the standard process model V-Modell XT could be introduced, in order to improve current situation.

Contact E-Mail

andreas.rausch@tu-clausthal.de

Project 48: Distributed Modeling of User Interfaces, Processes, and Adaptive Services (MoIPAS)

Project Members

Prof. Dr. Andreas Rausch (Leader)
Dipl.-Inform. Sebastian Herold (Project Staff)
Dipl.-Inf. Holger Klus (Project Staff)

Partners

University of Auckland, Auckland, New Zealand
MID, Nürnberg, Germany

Funding

BMBF, RSNZ
11.000€ (of 11.000€ total)

Duration

01.11.2008 – 31.10.2010
Project Description

The paradigm of service-oriented architectures promises to ensure the flexibility of information systems w.r.t. changing business processes and application integration. The size and complexity of such systems are issues that are tackled by Model-Driven Development. However, there do not exist seamless modeling approaches which integrate methods for important aspects of SOA-based systems. The project has two objectives. First, a seamless modeling approach for SOA-based information systems will be developed by integrating existing approaches for interaction modeling (Univ. of Auckland) and architecture modeling (Clausthal University of Technology). Furthermore, the approach will be extended to model the dynamic and adaptive characteristics of such systems for dynamically changing workflows. Secondly, the project addresses the cooperative modeling process. Tools to support cooperative design of freehand sketches of models and their automated integration will be developed.

The project is financially supported by the International Bureau of the Federal Ministry of Education and Research, Germany, and the Royal Society of New Zealand.

Contact E-Mail

andreas.rausch@tu-clausthal.de

Project 49: Open Pervasive Environments for migratory interactive services (OPEN)
**Project Members**

Prof. Dr. Andreas Rausch (Leader)
Dipl.-Inf Holger Klus (Project Staff)
Dipl.-Inf Dirk Niebuhr (Project Staff)

**Partners**

Consiglio Nazionale delle Ricerche, Pisa, Italy
Aalborg University, Aalborg, Denmark
Arcadia Design, Sestu, Italy
SAP AG, Walldorf, Germany
Vodafone Omnitel NV, Ivrea, Italy
NEC Europe, Heidelberg, Germany

**Funding**

EU
350.086€ (of 465.892€ total)

**Duration**

1.2.2008 – 31.01.2011

**Project Description**

The objective of OPEN is to provide users with migratory interactive services, which enable users to change interaction platform and still continue their tasks through an interface adapted to the new context of use. The benefits of this type of service are multifaceted: migration can be used to improve user experience by switching to a more suitable device (bigger screen, better resources, etc.) and/or to a communication channel that can guarantee better Quality of Service (shorter delays, higher bandwidth, etc.).

**Contact E-Mail**

andreas.rausch@tu-clausthal.de

**Project Homepage**

http://www.ict-open.eu/

**Project 50: BIENE**
3.6 Software Systems Engineering

Project Members
Prof. Dr. Andreas Rausch (Leader)
Dipl.-Inf. Christian Bartelt (Project Staff)
Dipl.-Inf. André Appel (Project Staff)

Partners
VHS Goslar, Goslar, Germany
Institut für Elektrische Energietechnik, Clausthal, Germany
Verein Goslar mit Energie, Goslar, Germany

Funding
EFRE
74,142€ (of 184,120€ total)

Duration
01.08.2008 – 31.07.2010

Project Description
Focus of the project is the development of a Second-Life platform for inverting learning. Several interactive models, reactive components and a virtual classroom are developed and evaluated, whether they are sufficient for the means of 3D-learning or not.

Contact E-Mail
andreas.rausch@tu-clausthal.de

Project Homepage
http://energie-goslar.de

Project 51: NuWi (Nutzen- und Wirkungscontrolling) - Support for Controlling and Reporting in the IT Investment Program of the German Federal Ministry of the Interior
**Project Members**

Prof. Dr. Andreas Rausch (Leader)
Dipl.-Inf. Mirco Schindler (Project Staff)
Dipl.-Inf. Patrick Dohrmann (Project Staff)

**Partner**

Federal Ministry of the Interior of Germany (BMI), Berlin, Germany

**Funding**

BMI
249.832€ (of 249.832€ total)

**Duration**

02.08.2010 – 31.12.2011

**Project Description**

The IT Investment Program (having a budget of 500 m.) was passed by the German Bundestag on February 20th. The available budget will be used to fund over 300 projects with each heading to improve Germany’s IT position in the current crisis. In order to manage that program and validate its outcome, the PG Invest was founded. The first goal of CoBePro is to support PG Invest in respect to controlling and reporting. The second goal is to use the current situation as an opportunity for collecting valuable data of how projects develop.

This will yield an experience database which can be used to improve controlling and management of future projects. For example, a duration ratio like that between the analysis phase and the overall project can be used to make estimations of the actual progress more reliable.

**Contact E-Mail**

andreas.rausch@tu-clausthal.de

**Project 52: Portal4BCC**

**Project Members**

Prof. Dr. Andreas Rausch (Leader)
Dr. Christian Bartelt (Project Staff)
Dipl.-Inf. Marcel Ibe (Project Staff)

**Partner**

BCC Business Communication Company GmbH (BCC), Wolfsburg, Germany

**Duration**

01.07.2011 – 30.06.2012
Project Description

Business process management (BPM) engines can help to adapt software systems to processes that change frequently. We develop with our partner, Business Communication Company GmbH (BCC), a new online portal based on the business process management platform Activity and the graphical specification language BPMN 2.0. Thus, changes in processes or new processes can be added to the portal very fast and simple. Furthermore it is possible to connect processes from the portal with in-house processes.

Contact E-Mail

andreas.rausch@tu-clausthal.de

Project 53: SmartPlug

Project Members

Prof. Dr. Andreas Rausch (Leader)
Adina Aniculaesei (Project Staff)
Holger Klus (Project Staff)

Partner

Inensus GmbH, Goslar, Germany

Duration

01.07.2011 – 30.06.2013

Project Description

In 2011, the federal ministry for transportation has required that until 2020 one million electrical cars be used on the german roads. To achieve this goal, an infrastructure of more than ten millions charging stations is necessary. To this moment, in Germany there are approximately 2500 charging stations, and each of them contains a lot of technical equipment which must be protected against vandalisms and criminal offenders.

In order to avoid the complexity of the current charging stations, the SmartPlug project proposes to use the already available power sockets available in the private spaces, i.e. households, and slightly modified power outlets for the public spaces, on which simple RFID-tags have been applied. In this way, a financially feasible and comprehensive charging infrastructure for electrical vehicles can be efficiently and cost-effective deployed.

The electricity in these charging stations is delivered to various prices depending on the energy carrier from which it originates renewable energy vectors i.e. sun or wind, or fossil energy vectors, i.e. fuel oil or natural gas. The customer can find the next charging station with the lowest energy prices.
The goal of the SmartPlug project is to develop a device (hardware & software) for charging electrical cars in the proposed charging infrastructure. A further goal is to develop a software application to provide help to the user in finding the nearest and cheapest charging station as well as to inform him / her of the current charging status, of the current account balance, etc.

Contact E-Mail
andreas.rausch@tu-clausthal.de

Project 54: RASII - System for automatic detection of Vehicle and Rescue Squads for emergency services

Project Members
Prof. Dr. Andreas Rausch (Leader)
Dipl.-Wirt.-Inf. Björn Schindler (Project Staff)
Dipl.-Inf. Patrick Dohrmann (Project Staff)

Partners
Department of Electrical Information Engineering, TU-Clausthal, Clausthal-Zellerfeld, Germany
Sinosys Ltd & Co.KG, Clausthal-Zellerfeld, Germany
DHM embedded systems GmbH, Clausthal-Zellerfeld, Germany
Berufsfeuerwehr (Fire Brigade) Wolfsburg, Wolfsburg, Germany

Funding
EFRE
148.280€ (of 385.688, 80€ total)

Duration
01.06.2011 – 31.05.2013

Project Description
In the field of fire and rescue services provided in Germany a large number of fire-fighters are volunteers. Even in cities where a professional fire brigade exists, volunteer fire brigades are used to support. This fact leads to the problem that the number of available forces varies in a wide range and therefore the formation of rescue squads varies, too. Because of this variation the squad leader or the emergency coordination center as no information about all qualifications or know-how of each fire-fighter in a concrete operation. The aim of the system is to capture information that are relevant for a fire-fighting operation in a very early stage automatically and forward it to the stakeholder. Thus, critical situations can be detected more quickly.

Contact E-Mail
andreas.rausch@tu-clausthal.de

Project 55: KoMo - Collaborative Modeling with Domain-Specific Languages
Project Members

Prof. Dr. Andreas Rausch (Leader)
Dipl.-Inf. Christian Bartelt (Project Staff)
Dipl.-Inf. Martin Vogel (Project Staff)
B. Sc. Tim Warnecke (Project Staff)

Partners

Quinscape GmbH, Dortmund, Germany
MCR Informationssysteme GmbH, Buch am Buchrain, Germany

Funding

BMBF
220,209€ (of 773,970€ total)

Duration

01.07.2011 – 30.06.2013

Project Description

The very early and creative phases are important for success of a project. In this phase whiteboards provide an easy option to draw models and diagrams but later on these models need to be transformed in formal models. The aim of the system is to make use of digital whiteboards to recognize the hand drawn models of software developers and architects and transform these into formal models. The transformed models are managed by a repository explicitly developed for diagrams. The repository will also allow merging different versions of the same diagram. Thus, it is important to detect and visualize conflicts which can happen during a merge process. Another goal is to offer the possibility of modeling diagrams with digital whiteboards in a collaborative way. That is to say software developers at different locations are able to work together.

Contact E-Mail

andreas.rausch@tu-clausthal.de

Project Homepage

http://www.kooperative-modellierung.de/

Project 56: FlexSimPro (A Flexible software architecture for the integrated simulation of manufacturing processes of hybrid machine tools)

Project Members

Prof. Dr. Andreas Rausch (Leader)
Dr. Christian Bartelt (Project Staff)
Dipl.-Ing Jean Paul Tatou (Project Staff)

Partner

Hannover Centre for Production Technology, Hannover, Germany
Funding
Land
64.000€ (of 64.000€ total)

Duration

Project Description
Simulating manufacturing processes today involves many software simulation tools. Each of them covers only a specific view of the manufacturing process. The goal of this project is to design and to implement flexible and extendable software architecture for the integration of these existing software simulation tools. At the end of this project, it should be possible to carry out a complete plant simulation using our implemented simulation platform.

Contact E-Mail
andreas.rausch@tu-clausthal.de

3.6.5 Scientific Activities

Person
Prof. Dr. Andreas Rausch

☐ Editorial Board Memberships

• OBJEKTspektrum, GmbH, SIGS DATACOM (2008-).
  See http://www.sigs-datacom.de/sd/publications/os/

☐ Organization of Conferences and Workshops

• Conference Chair SEE 2010: Software & Systems Engineering Essentials, Koeln, Germany, may, 2010.
  See http://see-conf.de/

• Conference Chair SEE 2011: Software & Systems Engineering Essentials, München, Germany, may, 2011.
  See http://see-conf.de/

☐ PC-Member of Conferences and Workshops

• L2S2 2010: 2nd Workshop: Long-living software systems, Bad-Honnef, Germany, may, 2010.
  See http://akl2s2.ipd.kit.edu/veranstaltungen/dff2010

  See http://www1.gi-ev.de/
3.6 Software Systems Engineering

• REMIDI 2011: 6nd IEEE International Conference on Global Software Engineering (ICGSE), Princeton, USA, August, 2011.

• EUROMICRO 2011: Conference on Software Engineering and Advanced Applications (SEAA), Patras, Greece, August, 2011.
See http://seaa2011.vtt.fi/
3.7 Computer Systems

3.7.1 Overview

**Leader** Prof. Dr.-Ing. Dr. rer. nat. habil. Harald Richter

**Secretary** Andrea Behfeld

**Scientific Employees**
- Dipl.-Ing. (FH) Stefan Aust
- Dipl.-Ing. Xingxing Hu (until 09/2011)
- B.Sc. Mathias Langer (since 11/2011)
- Dipl.-Inf. Tobias Schulze (06/2010 - 03/2011)
- Dipl.-Ing. Rong Wang (until 12/2010)
- Dipl.-Wirt.-Inf. Eduard Weber (since 08/2011)

**External Ph.D. Students**
- Dipl.-Inf. Dietmar Sommerfeld, Computing Center of Max-Planck-Society (GWDG), Göttingen
- Dipl.-Inf. Janko Heilgeist, Fraunhofer-Institute for Algorithms and Scientific Computing (SCAI), St. Augustin
- Dipl.-Inf. Yang Xiang, Computing Center of Max-Planck-Society (RZG), Garching
- M.Sc. Florian Pramme, Ostfalia University of Applied Sciences, Wolfenbüttel

3.7.2 Research Agenda

The group of Prof. Richter has its focus on following research areas: Computer networks (Realtime LANs for cars, process control and automation), Automobile mechatronics (X-by-wire, Cockpit-by-wire, driving simulator, autonomously driving rover), Computer architectures (Real-time parallel computers for measurement-data acquisition and -processing, feed forward and feed back control), Grid computing (Job scheduling in compute grids, job allocation in data grids), and Distributed Systems (Global Authentication and Authorization Infrastructure).

See the group's homepage at:
http://www.in.tu-clausthal.de/abteilungen/technische-informatik-und-rechnersysteme/personen/

and the research home page at:
http://www.in.tu-clausthal.de/abteilungen/technische-informatik-und-rechnersysteme/forschung/

3.7.3 Supervised Theses


### 3.7.4 Projects

**Project 57: CarRing II - A Real-Time Computer Network for Automobiles**

**Project Members**

- Prof. Dr. Harald Richter (Leader)
- Dipl.-Ing. Xingxing Hu
- Dipl.-Ing. Rong Wang
- Dipl.-Inf. Tobias Schulze
- Dipl.-Wirt.-Inf. Eduard Weber
**Project Description**

CarRing II is a real-time computer network which can outmatch and replace the field and multimedia busses that are currently used in cars. It offers high reliability and scalability from small to large systems, efficient medium access, and a higher level of abstraction for the end user, beside a much higher data rate (1.00/3.125/6.25 Gbit/s) than field busses. Furthermore, the mile-long cable tree in the vehicle is significantly reduced. One reason for the superiority is that a two-wired, shielded twisted-pair cabling in ring topology is used. Another reason is the CarRing II’s application programming interface that implements all 7 ISO layers, thus allowing communication functions of higher ISO layers to be realized no longer by individual user programs but by distinct communication controllers. All protocols are executed by a FPGA in real-time. Each FPGA is VHDL-programmed by us in order to guarantee deterministic latency for data transmission and acts as a CarRing II node. Up to 16 nodes can be coupled in a ring, and up to 255 rings are possible in a car by employing additional routers. The project is funded by the DFG, and 12 CarRing II nodes are used in our corresponding TUCar project as a basis for x-by-wire functionality.

**Contact E-Mail**

hri@tu-clausthal.de

---

**Project 58: TUCar - A Test Platform for Communication and Control in Cars**

**Project Members**

Prof. Dr. Harald Richter (Leader)
Dipl.-Ing. (FH) Stefan Aust

**Project Description**

TUCar is a moving test platform for evaluating new concepts in communication and control of electronic controller units (ECUs). The mission of TUCar is the testing of the following two goals for a future car:

- Improved data transmission between all electronic components
• Re-centralization of ECUs

Therefore, the two sub-projects CarRing II and ConPar have been defined. CarRing II allows for intra-car communication by means of a realtime computer network instead of field busses. ConPar bundles ECUs in one unit via emulating them in a reliable realtime parallel computer. The Institutes for Electrical Information Technology and Electrical Energy Technology of the university are supportive to the project which is funded by Volkswagen AG, IAV GmbH and Lenze GmbH. A cooperation exists also with DHB Compomentes Automotivos in Brasil.

Contact E-Mail
hri@tu-clausthal.de

Project 59: ConPar - A Parallel Computer for the Real-Time Emulation of Electronic Controller Units in Cars

Project Members
Prof. Dr. Harald Richter (Leader)
Dipl.-Ing. (FH) Stefan Aust
Project Description

ConPar is a well scalable computer architecture for the emulation of electronic controller units in cars (ECUs). Its task is to emulate commercial ECUs in real time and to execute their functional software without modification. From the view of a computer architect, ConPar has to read-in measurement data from sensors, process multiple tasks in real time, and generate output values. Typical application areas of ConPar are characterized by hard and soft real-time requirements, combined with high computing power. The latter should be easily scalable from 2 to 256 processors even with low financial budget. The application of ConPar is the re-centralization of ECUs, whose number has already reached 100. This large amount leads in the car to high consumption of space and energy and results in high costs and problems during system integration. ConPar may replace up to 256 ECUs in its maximum configuration by one single unit.

References

[Aust and Richter, 2010] (Page 177),
[Aust and Richter, 2010a] (Page 181),
[Aust and Richter, 2010b] (Page 181),
[Aust and Richter, 2011] (Page 182),
[Aust and Richter, 2011a] (Page 182)

Contact E-Mail

hri@tu-clausthal.de

Project 60: An Autonomously Driving Model Car

Project Members

Prof. Dr. Harald Richter (Leader)
Dipl.-Ing. Thomas Hauschild

Project Description

In project model rover, which is developed and built in close cooperation with IAV GmbH at Gifhorn, are the paramount tasks „communication in automobile“, as well as „autonomous driving“ and „central control of steering, motor and sensors“. The rover is a self-steering car which is based in its mechanical construction on a steel chassis and a plastic autobody. The Rover is made in the scale of 1:5 (app. 80x20x10 cm$^3$) and reflects in its design a race car. It contains a 32 Bit microcontroller from Atmel (AVR 32) als central ECU, as well as an electro servo steering, an electro drive, a hall sensor as position encoder, and 6 super sonic sensors. It drives on a programmable trajectory which has, in our case, the shape of a flat laying 8. When the super sonic sensors detect an obstacle standing in the rover’s curve, it reduces speed and tries to circumvent the hindrance, in order to return to its programmed trajectory afterwards.
Project 61: Compute Grid - A Meta Scheduler for DEISA

Project Members

Prof. Dr. Harald Richter (Leader)
Dipl.-Inf. Janko Heilgeist

Project Description

The goals of the Compute Grid project are the design and the implementation of a meta scheduler for DEISA (Distributed European Infrastructure for Supercomputing Applications) which migrates user jobs between 11 European high performance computing centers (= automatic load balancing). Among the tasks to be solved are:

- A situation-dependent selection of algorithms for the discovery and allocation of free resources in the grid to jobs which are ready to run. This is accomplished by means of a robust peer-to-peer overlay communication network.
- An efficient grid scheduling by means of the multiple-criterion optimization-procedure AHP (Analytical Hierarchy Process), together with a dynamic-variable function (Tangens Hyperbolicus) to compute the AHP utility value.
- Design, implementation and test of the software
- Test in an realistic operation scenario (DEISA)
The Open Grid Services Architecture (OGSA) is used as a basis for the implementation, since OGSA provides standard interfaces for the grid environment. The usage of OGSA allows to operate the meta scheduler with Globus Toolkit V4 as well as with Unicore V6 als Grid Middleware.

Contact E-Mail
hri@tu-clausthal.de

Project 62: Data Grid - A Meta Scheduler for D-Grid

Project Members
Prof. Dr. Harald Richter (Leader)
Dipl.-Inf. Dietmar Sommerfeld

Project Description
The goal of this project is to optimize the performance of applications for the German D-Grid (subproject Medigrid), which exhibit frequent access to large data bases. The optimization is achieved by means of a meta scheduler which will become part of the Medigrid middleware. Among the tasks of the meta scheduler is to measure performance parameters of the sites participating in Medigrid, as well as to take into account the desired job requests and the available site resources, such that requests and resources are matched. Performance parameters are the number of CPUs, the lengths of the input queues, the sizes of the main memories, and the job and data transfer times. Part of the meta scheduler is a resource matcher which compares the tasks’ workflow of a job that was specified by means of GWUI (Grid Workflow User Interfaces) with that resources that are currently available. The resource matcher finds appropriate matchings by a just-in-time comparison of offers and requests. All necessary parameters for matching are taken into account in a two-tire procedure. In the first tire, HEFT (Heterogeneous Earliest-Finish-Time) is used as a priority-based algorithm to establish a static precedence for the tasks that have to be executed for a job (= full-ahead schedule). In the second tire, these tasks are allocated to available resources, according to performance measurements in the sites, tasks’ priorities, and estimated data transfer and CPU execution times (= (just-in-time schedule). Implementation is made by Globus Toolkit V4 and the Workflow Manager GWES.

References
[Sommerfeld and Richter, 2011] (Page 193)

Contact E-Mail
hri@tu-clausthal.de
Project 63: AAI - Global Authentication and Authorization Infrastructure

Project Members
Prof. Dr. Harald Richter (Leader)
Dipl.-Inf. Yang Xiang

Project Description
In a collaborative project environment, a flexible mechanism for authentication and authorization of the project members is of high importance. Currently, several solutions such as Shibboleth or the Virtual Organization Membership Service (VOMS) are deployed to solve this problem. Most authentication and authorization methods employ Public Key Infrastructure (PKI), and user communities form Virtual Organizations (VOs) by means of technologies such as VOMS. VOMS however suffers from certain limitations due to its centralized service structure and PKI base. This leads to rigid solutions which require multiple levels of login.

The aim of this project is to provide a single authentication and authorization software infrastructure (AAI) which supports various use cases for single login and which works worldwide. It must be compatible with current middleware such as UNICORE and Globus, while also being usable within a pure web environment, e.g. by means of web services. In addition, the project will provide the necessary tools to ease the integration into different usage areas.

References
[Rieger et al., 2011] (Page 193),
[Rieger et al., 2011a] (Page 193),
[Xiang et al., 2010] (Page 194),
[Xiang et al., 2010a] (Page 195)
Project 64: TI Online - An Internet-based Bachelor Course for Continuing Education of Professionals

Project Members
Prof. Dr. Harald Richter (Leader)
Dipl.-Inf. Tobias Schulze
Dipl.-Inf. Chang Chen
Dipl.-Wirt.-Inf. Eduard Weber

Project Description
TI Online is a project spanning across several federal states in Germany in order to create an Internet-based Bachelor course that can be studied extraoccupational. Participating organizations are University of Hamburg, University of Technology Hamburg-Harburg, University of Rostock, University of Lübeck, University of Applied Sciences Lübeck and University of Technology Clausthal. TI Online will comprise multimedia learning content that is organized in modules. It distinguishes from study courses of pure Informatics and Information Engineering in the selection and weighting of modules from Informatics, Mathematics and Electrical Engineering. TI Online will be available at TU Clausthal in addition to its standard courses. It is devised as continuing education for professional workforce. Cost-covering study fees will be charged.

Contact E-Mail
hri@tu-clausthal.de

3.7.5 Scientific Activities

Person Prof. Dr.-Ing. Dr. rer. nat. habil. Harald Richter

☐ PC-Member of Conferences and Workshops
  See http://www.iaria.org/conferences2010/ADVCOMP10.html

Person Dipl.-Ing. (FH) Stefan Aust

☐ Invited
- Skalierbare Rechensysteme für Echtzeitaufgaben, University of Osnabrück, Osnabrück, Germany, April, 2011.
  See http://www.inf.uos.de/

3.7.6 Highlights

☐ In 2010

• March 2010: Harald Richter has organized and chaired the workshop on “Vehicles and Vehicle Technology”

• March 2010: The president of Clausthal University of Technology, Thomas Hanschke, received the model rover for the purpose of presenting the university to scholars in future. The rover was build in line with a students project which was supported by the IAV GmbH and supervised by Harald Richter.

• July 2010: The TUCar, the model rover plus the CarRing II-Teststand have been shown at “Energietage” of the EFZN in Goslar.

• December 2010: Harald Richter has been elected to the steering committee of the society “Gesellschaft für Informatik”.

☐ In 2011

• March 2011: Harald Richter has organized and chaired the “TILL 2011”, where informatics teachers from schools in Lower Saxony and Bremen attend to presentations and discussions in the field of informatics.

• November 2011: International Academy, Research, and Industry Association best paper award to Stefan Aust and Harald Richter at The Fifth International Conference on Advanced Engineering Computing and Applications in Sciences, Lisbon, Portugal.
3.8 Embedded Systems, Hardware and Robotics

3.8.1 Overview

Leaders
Prof. Dr. Christian Siemers
apl. Prof. Dr. Günter Kemnitz

Secretary
Andrea Behfeld

Scientific Employees
of Christian Siemers
Dipl.-Inf. René Fritzsche
Dipl.-Inf. Sascha Lützel
Dipl.-Inf. Jens Drieseberg

of Günter Kemnitz
Dipl.-Inf. Carsten Giesemann
Dipl.-Ing. Christian Ristig

External Ph.D. Students
of Christian Siemers
Dipl.-Ing. (FH) Simon Gerlach, Volkswagen AG
Michael Hirsch, M.Sc., Volkswagen AG
Matthias Meitzner, M.Sc., Volkswagen AG
Dipl.-Ing. Peter Tabatt, University of Applied Sciences Nordhausen

of Günter Kemnitz
Dipl.-Inf. Hossam Ramadan, Syria

3.8.2 Research Agenda

The research goal of the group of Christian Siemers is to improve the dependability of embedded systems concerning their algorithmic and timing behaviour. This includes design pattern, design methodologies and tool support as well as approaches for observing runtime behaviour to detect runtime failures.

The research in this group mainly deals with various types of technical systems and applications: computer hardware, industrial control systems and mechatronical systems with the focus on embedded systems. Main topics are execution time-based design methodology including hardware/software co-design, system reliability, system observability and in-situ-testing.

See the group’s homepage at:
http://www.in.tu-clausthal.de/abteilungen/embedded-systems

The group of Günter Kemnitz deals with various types of technical systems and applications: computer hardware, control systems, mechatronical systems and robots. The main focus is on reliability.

See the group’s homepage at:
http://techwww.in.tu-clausthal.de/
### 3.8.3 Supervised Theses


### 3.8.4 Projects

**Project 65: Fast+Safe+Net - Hardware and Software Development**

#### Project Members

- **Prof. Dr. Christian Siemers** (Leader)
- **Dipl.-Inf. René Fritzsche** (Project Staff)

#### Partners

- **Dipl.-Ing. Walter Zander**, Zander GmbH&Co KG, Aachen, Germany (Leader)
- **Dipl.-Ing. Alfons Austerhoff**, Zander GmbH&Co KG, Aachen, Germany
Funding
BMWi
136,500€ (of 268,000€ total)

Duration

Project Description
Automation technology for controlling machines and safety technology to prevent persons and machines from accidents - both emerging technologies - are currently joining. While this is already addressed inside the preceding project, this project is started to develop all components for a safe distributed system for automation and control. One main component of this project is the research and development of one or more safe network standards PLCs (Programmable Logic Control), the other consist of the design methodology for safe distributed automation systems.

Contact E-Mail
christian.siemers@tu-clausthal.de

Project 66: University Region Harz (Hochschulregion Harz)

Project Members
Prof. Dr. Christian Siemers (Leader)
Dipl.-Inf. René Fritzsche (until 09/2009) (Project Staff)
Dipl.-Inf. Jens Drieseberg (since 10/2009) (Project Staff)
**Partner**

Prof. Dr. Jörg Wagner, Fachhochschule Nordhausen, Germany (Leader)

**Funding**

Stifterverband für die Deutsche Wissenschaft and Heinz-Nixdorf Stiftung
140,000€ (of 400,000€ total)

**Duration**

04/2008 – 03/2010

**Project Description**

The project “Hochschulregion Harz” is jointly designed and performed by the two partner universities in Clausthal and Nordhausen. The main goals are the development of joint research activities - focused on computer science, energy engineering and geo-engineering - and the development of collaborative teaching programs. While the research part consists of some small-scale projects, a collaboratively offered master of engineering (Embedded Software Engineering) is currently under development as teaching part inside the project.

**Contact E-Mail**

christian.siemers@tu-clausthal.de

**Project 67: Adaptive Hardware Architectures - Local Communities in Information Cities (LocCom)**

**Project Members**

Prof. Dr. Christian Siemers (Leader)
Dipl.-Inf. Sascha Lützel (Project Staff)
3.8 Embedded Systems, Hardware and Robotics

**Partners**

Prof. Dr. Michael Beigl, University of Technology Braunschweig, Braunschweig, Germany (Leader)

Prof. Dr. Jürgen Dix, University of Technology Clausthal, Clausthal-Zellerfeld, Germany (Leader)

Prof. Dr. Wolfgang Nejdl, Leibniz University of Hannover, Hannover, Germany (Leader)

Prof. Dr. Heribert Vollmer, Leibniz University of Hannover, Hannover, Germany (Leader)

Prof. Dr. Lars Wolf, University of Technology Braunschweig, Braunschweig, Germany (Leader)

**Funding**

Land Niedersachsen
152.865€ (of 2.541.218€ total)

**Duration**

03/2009 – 08/2012

**Project Description**

In a time where climatic questions and global heating are on focus, power efficient computing becomes a first class design constraint. Additionally most of the PDA’s have to manage computing with strong limited battery power. The “SmartFolk” will have the same problem, and battery power will not significantly increase next years. On the other side the same device has to offer real-time analyzing of incoming contexts and react to them. Specifically the analysis of contexts will use a lot of limited battery power. The goal of this project is to define a computing architecture with sufficient computational power at a minimum of power consumption.

**Contact E-Mail**

christian.siemers@tu-clausthal.de

**Project 68: Time-Enhanced C (TEC)**

**Project Members**

Prof. Dr. Christian Siemers (Leader)

Dipl.-Inf. René Fritzsche (Project Staff)

**Duration**

since 10/2009
**Project Description**

The TEC project (Time-Enhanced C) deals with design support (both hardware and software) for small embedded systems and implements approaches for execution time-based design methodology. The designer is provided with language constructs to describe the timing behaviour, and a pre-compiler partitions the application and includes scheduling algorithm to schedule the threads accordingly. This is done to avoid malfunctions in real time applications at design time. The actual implementation supports C with time extensions written as special comments.

**References**

[Fritzsche and Siemers, 2010] (Page 186)

**Contact E-Mail**

christian.siemers@tu-clausthal.de

**Project 69: Softerror Mitigation inside FPGAs**

**Project Members**

Prof. Dr. Christian Siemers (Leader)
Dipl.-Inf. Sascha Lützel (Project Staff)

**Duration**

since 10/2008

**Project Description**

Softerror Mitigation inside FPGAs includes the detection and correction of soft errors inside FPGAs caused by cosmic radiation or natural radioactivity. While errors inside data or state memory can be detected directly, e.g. by hamming codes, the detection of such errors inside code memory is more complicated - and in the case of off-the-shelf devices only possible by using indirect methods. The project includes the development and research of methodologies for error detection without using triple-module redundancy to minimise the additional hardware.
3.8 Embedded Systems, Hardware and Robotics

References
[?] (Page ??),
[Lützel and Siemers, 2011] (Page 191)

Contact E-Mail
christian.siemers@tu-clausthal.de

Project 70: Model-driven Development of Automotive HMI-Product Lines

Project Members
Prof. Dr. Christian Siemers (Leader)
Dipl.-Ing.(FH) Simon Gerlach (Project Staff)

Duration
since 10/2009

Project Description
Model-driven technologies inside automotive applications are becoming popular. The advantages of this technologies are widespread. But mapping this technology into the area of human-machine interaction (HMI) with several languages and country-defined versions, major modification will come into account. In this case, the model-driven technology has to handle several more aspects compared to classical applications.
3.8.5 Scientific Activities

3.8.6 Highlights

Person Christian Siemers

- Christian Siemers is involved in the “Exzellenz-Initiative Profil und Kooperation” for small and medium-sized universities (following a call for proposals by the Stifterverband für die Deutsche Wissenschaft and the Heinz-Nixdorf Stiftung), funded from April 2008 until March 2010. Since April 2008 he coordinates the cooperation, and for this purpose he is with the University of Applied Sciences Nordhausen and with the Clausthal University of Technology, each for 50%, to be continued in 2012.

- Christian Siemers was inside the Department of Informatics responsible for the definition and the accreditation of the B.Sc. Computer Engineering (Technische Informatik), a study program in close cooperation with the Institute of Electrical Information Technology, further responsible for the part of the Department of Informatics inside the M.Sc. Process Automation (Automatisierungstechnik) study program, also defined and accredited in 2010, and responsible for the accreditation of the M.Sc. Systems Engineering, a continuing study program cooperatively defined by the Department of Informatics, the Institute of Electrical Information Technology, the Institute of Technical Mechanics, the Institute of Process and Production Technology, the Institute of Mechanical Engineering, and the Institute of Electrical Engineering.

- Christian Siemers is a co-founder and a member of the Institute of Applied Software Systems Engineering (IPSSE), founded in 2011 at the Clausthal university of Technology.
4 Publications
4.1 Books and Edited Volumes (22)


4.2 Book Chapters (19)


4.2 Book Chapters (19)


4.3 Journal Articles (28)


4.4 Refereed Conference and Workshop Publications (121)


4.5 Technical Reports (19)


### 4.6 Ph.D. Theses (10)


4.7 Proceedings (6)


4.7 Proceedings (6)


4.8 Diploma Theses (57)


4.8 Diploma Theses (57)


4.9 Bachelor’s Theses (15)


### 4.10 Master’s theses (2)
