# b-it
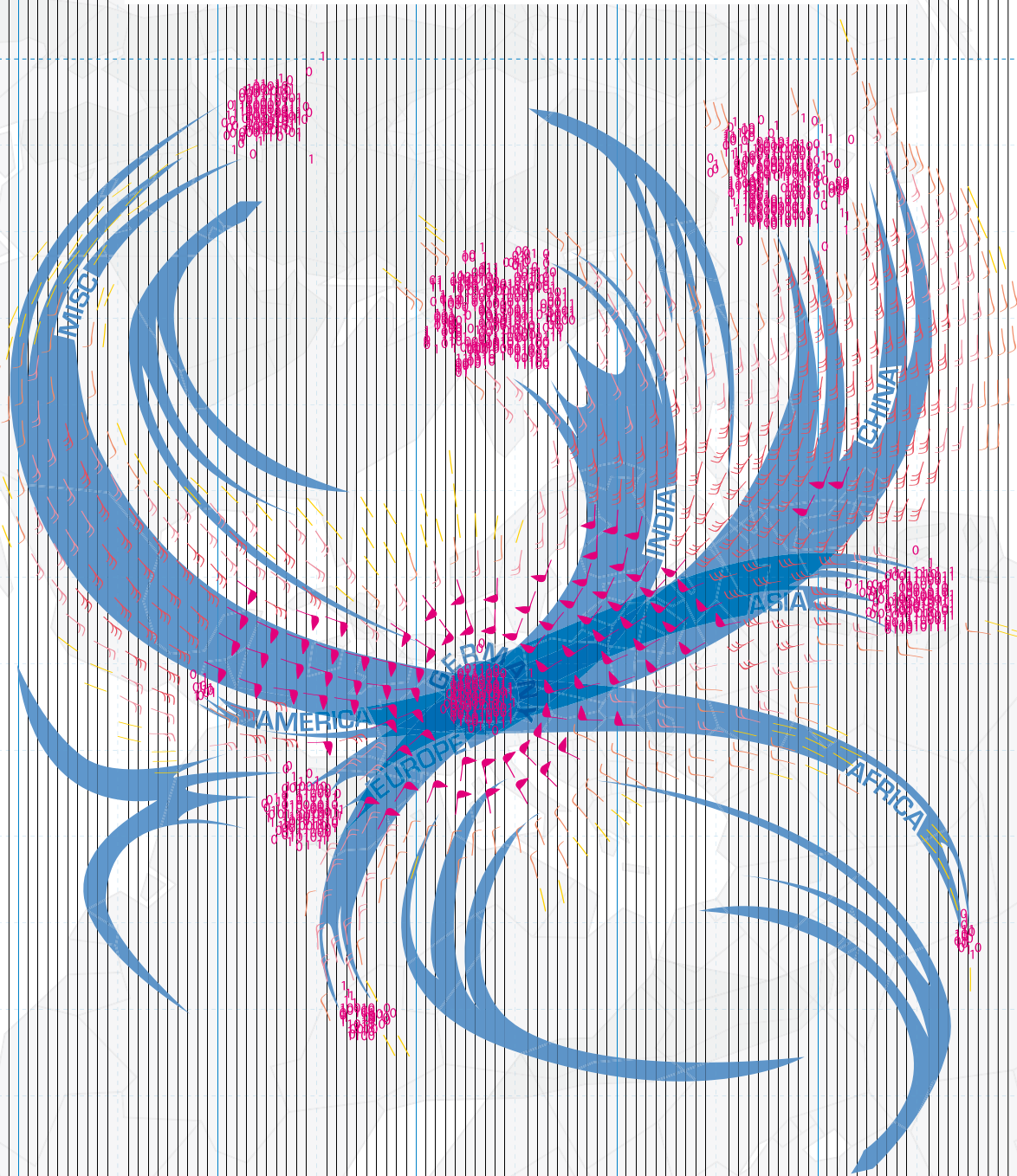
**Bonn-Aachen International Center for Information Technology**



# ANNUAL REPORT
# 2006-2007

*Vice Minister
Dr. Michael Stückradt*

*Prof. Dr. Gerhard Barth*

*The cover image uses a scientific visualization method to illustrate the geographic distribution of B-IT student origins.*

**b-it**
Bonn-Aachen
International Center for
Information Technology

## Foreword by the Chairman of the B-IT Foundation

The renewed growth and confidence of the German economy leads to an even stronger demand for highly qualified engineers and specialists in information and communication technology. As software systems are becoming embedded in all aspects of our life and industries, and as markets are becoming even more globalized, this demand is particularly great for ICT specialists with interdisciplinary as well as inter-cultural skills.

The Bonn-Aachen International Center for Information Technology (B-IT) has been founded with exactly these goals in mind. Its elite international master programs on media informatics, life science informatics, and autonomous systems – started in 2003 – are already producing a regular stream of excellent graduates for the labor market in North Rhine-Westphalia (NRW), Germany, and the rest of the world. This does not only apply to companies such as Siemens, Microsoft, sd&m, MasterCard, or Novartis, but also to leading universities and research institutes. The NRW state government therefore has a strong interest that B-IT extends its activities to the doctoral training level. The NRW University Freedom Act of 2007 (Hochschulfreiheitsgesetz) and recent relaxations of labor restrictions for foreign graduates in the federal laws further broaden the spectrum of possibilities, as do the successes in the German Excellence Initiative which yielded RWTH the status of an "elite university" and an Excellence Cluster in mobile information and communication directly linked to B-IT, and the University of Bonn an Excellence Cluster in mathematics also with participation from B-IT faculty.

I would like to thank the directors of B-IT and the international advisory board and to encourage them to continue their successful work.

**Dr. Michael Stückradt**
**Vice Minister of Innovation, Science and Technology NRW**
**Chairman, B-IT Foundation Council**

## The International Advisory Council of B-IT

RWTH Aachen University, University of Bonn, Bonn-Rhein-Sieg University of Applied Sciences, have, in cooperation with the Fraunhofer Board of Management, established an International Advisory Council. Its mission is to ensure the relevance of B-IT's educational efforts for careers in the business world, to monitor B-IT's international competitiveness, and to foster B-IT's development by giving recommendations and guidelines. The rectors of the participating universities have appointed Prof. Dr. Gerhard Barth as Founding President; Barth is well known as founder of the German AI research institute DFKI, as top manager in companies such as Daimler-Chrysler, Alcatel, and Dresdner Bank, and more recently as partner in a consultancy firm. In addition, the council includes five internationally renowned persons from academia and industry:

- Prof. Dr. Gerhard Fischer, University of Colorado, Boulder
- Dirk Friebel, Nokia Research Center, Bochum
- Prof. Dr. Ossama Khatib, Robotics Lab, Stanford University, Palo Alto
- Prof. Dr. Thomas Lengauer, Max-Planck Institute for Informatics, Saarbrücken
- Prof. Dr. Hermann Maurer, Media Lab, University of Graz

# Report of the Scientific Directors

The Bonn-Aachen International Center for Information Technology (B-IT) is a pilot effort in the internationalization and acceleration of IT study programs in Germany. Supported by the B-IT Foundation since October 2002, B-IT's International Master Programs educate future leaders in areas of particular relevance for the ABC region around Aachen, Bonn and Cologne (and, of course, beyond), whereas the IPEC program provides special offerings for the brightest of the local undergraduate computer science students.

All study programs are now operating at full capacity. Despite careful selection of applicants, the number of beginners in 2007 is even higher than planned, a sign that B-IT has become first choice for most of our international applicants from over 40 countries. One reason may be the excellent placement record B-IT is building up. Our master graduates have been accepted as doctoral candidates in many leading universities and research institutes worldwide. Significant third-party funding acquired by B-IT faculty also offers local opportunities.

However, the majority of master students still aim at positions in business and industry. The design of the study programs along the lines of strategic industrial interest is now paying off: Many large players in the region hire B-IT graduates into attractive R&D positions, e.g. Philips Research, the European Microsoft Innovation Center, Bertelsmann, or Deutsche Post. But also small and medium enterprises with a need for high-quality personnel with inter-cultural experiences such as sd&m, ip labs or Kisters AG offer interesting opportunities in their worldwide activities. For the Aachen-Bonn-Cologne (ABC) science region, the roughly 60 B-IT master graduates have become a competitive advantage also in quantitative terms, constituting a significant share of all computer science graduates in the region.

Well before the current debate on how to make Germany more competitive in the worldwide "battle for the best brains", B-IT has been active in attracting the best international Bachelor graduates in the ICT sector. Due to intense


*B-IT main building.*

international networking, applicants from some of the best international undergraduate programs, e.g. from top Chinese universities such as Tsinghua, Nanjing, or Zheijiang, have been attracted to the program. B-IT students have been unusually successful in obtaining attractive competitive scholarships, ranging from university scholarships via industrial ones to the prestigious Erasmus-Mundus program of the European community.

Top-level ICT education does not begin and end at the master level. B-IT has expanded its International Program of Excellence (IPEC) to address top talents already in highschool, e.g. through courses in robotics and security. It is restructuring its undergraduate offerings to assist the best students within the new Bachelor programs, and it aims at establishing novel structured training programs for doctoral candidates. A proposal for a B-IT Graduate School in the German Excellence Initiative failed narrowly despite excellent scientific evaluation, but the concept will be further pursued with assistance from the state and the participating institutions.

We would like to extend our cordial thanks to the B-IT Foundation Council led by Chairman Vice Minister Michael Stückradt and Secretary Hans Stender, to the B-IT Advisory Board under the able leadership of Founding President Gerhard Barth, to the B-IT faculty and especially the study coordinators and assistant directors, but most of all to the B-IT students for their enthusiasm and excellent cooperation.


**Prof. Dr. Armin B. Cremers**
*University of Bonn*


**Prof. Dr. Matthias Jarke**
*RWTH Aachen University and Fraunhofer FIT*


**Prof. Dr. Kurt-Ulrich Witt**
*Bonn-Rhein-Sieg University of Applied Sciences*

# B-IT in Profile



*B-IT students in a Fraunhofer lab course.*

The southwest of North Rhine-Westphalia is one of the largest, most vibrant locations in the European media and telecom industry. It is also one of the most innovative and fast-growing biotech regions in Germany, and there is much interest in the emerging fields of mechatronics and robotics. To make it the optimal place to study for professional work in these fields, the Bonn-Aachen International Center for Information Technology (B-IT) has been established as a joint venture of RWTH Aachen University, University of Bonn, Bonn-Rhein-Sieg University of Applied Science and the research institutes of the Fraunhofer Institute Center Birlinghoven Castle.

B-IT offers highly selective International Master Programs in Applied IT, as well as summer / winter schools for qualified undergraduate computer science students. Admission to the B-IT Master Programs is linked to, and conditional upon, placement in research lab courses at the participating Fraunhofer institutes. Students in good standing are offered financial support during these lab courses.

The B-IT Universities Institute offers English language Master of Science (M.Sc.) programs in Media Informatics and Life Science Informatics, whereas the University of Applied Sciences offers a Master Program in Autonomous Systems. The Master Programs prepare students for successful international careers that require technical excellence and leadership, creativity and the ability to innovate. B-IT master programs are distinguished by their international orientation (structured according to the European ECTS standard), their focus on IT competence, and the deep integration of teaching and research. They include a significant share of research lab courses in the participating Fraunhofer institutes.

A second goal of B-IT is the optimization and acceleration of existing undergraduate computer science curricula at University of Bonn and RWTH Aachen University for selected top students. B-IT's International Program of Excellence (IPEC) pursues this goal by compact course modules delivered in summer and winter schools during the semester breaks.

B-IT is financially supported by a 56 Mio. Euro Foundation initiated through the Bonn-Berlin program of the German federal government, as well as by matching federal project funds and NRW state funds. The B-IT Foundation was officially set up in October 2002, and a cooperation treaty was signed by the Rectors of the participating universities and the Fraunhofer Board of Directors.

For the participating universities, the B-IT programs have also helped pave the way towards a smooth transition from the traditional German diploma system to the Bachelor-Master system following the Bologna accord; the B-IT master programs were the first to be accredited within the participating universities in 2004-2005. All B-IT professors have significant international and/or industry experience.

In the academic year 2006-2007, a record number of over 100 new students joined the B-IT master programs from about 40 countries (with India and China at the top), while about 60 students – again a record number – finished their degree to leave for a position in industry (about two thirds) or science (one third). Over 20 courses within the IPEC program were conducted, together with many special events. Such events included public lectures within the Informatikjahr 2006 initiative of the German Ministry of Research, summer and winter schools for advanced students and young researchers, special courses to foster interest among highschool students, national and international conferences and workshops.

**Home Countries of B-IT Students**
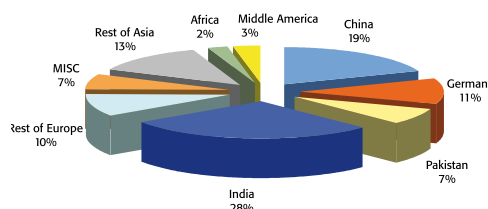
## In memoriam Hartmut Krebs

On September 29, 2007, Dr. h.c. Hartmut Krebs unexpectedly passed away at the age of 61 years. As the former Vice Minister of Science and Technology in the state of North Rhine-Westphalia, Dr. Krebs was one of the key drivers behind the establishment of B-IT and served as the Founding Chairman of the B-IT Foundation for several years. With his enormous enthusiasm and constructive energy, he helped us overcome the many obstacles related to the start-up of B-IT as the first joint institute across NRW universities and the pioneering educational cooperation between universities and extra-university research institutions. We combine our thanks to him with our heartfelt condolences to his family.

*Dr. h.c. Hartmut Krebs*
*Former Vice Minister*
*of Science and*
*Technology*

Armin B. Cremers
Matthias Jarke
Kurt-Ulrich Witt
B-IT Scientific Directors

Gerhard Barth
Founding President
B-IT International Advisory Board

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*Prof. Dr. Matthias Jarke,*
RWTH Aachen University
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(RWTH Aachen University),
Media Informatics
*Prof. Dr. Jürgen Bajorath* (University of Bonn),
Life Science Informatics

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*Dr. Ernst Franceschini*
President, Bonn / Rhein-Sieg Chamber of Commerce

# Events and Visits



*MD Dr. Speier of MIWFT presented a dinner speech at the reception of the 2nd Media Informatics Symposium.*

## Second International Media Informatics Symposium at B-IT

Three years after the first Media Informatics Symposium which was held on the occasion of the B-IT Opening, the second symposium (Nov. 16-17, 2006) focused on emerging social structures resulting from the application of so-called Social Software in the Web 2.0. Under the motto "Cow Paths: Agency in Social Software", speakers from Microsoft Research, several leading international universities, the Collaborative Research Centers on Media in Cologne and Siegen, addressed topics such as Citizens as Journalists, Internet Usage in Postmodern International Conflicts, Tracing of Work in Software Teams and other research communities. The European Network of Excellence in Professional Learning (ProLearn) co-organized the symposium.

## B-IT co-organized Summer School hosted at PICB in Shanghai

B-IT participated in the organization of a DAAD-funded Summer School hosted at the Chinese Academy of Sciences Max-Planck Partner Institute for Computational Biology (PICB) in Shanghai, September 30 – October 13, 2007. The

Summer School on Methods from Mathematics and Computer Science for Pattern Recognition in Biology was jointly organised by B-IT Professors Michael Clausen and Armin B. Cremers with Professors Andreas Dress, Axel Mosig, and Zhenbing Zheng from PICB.

## DAAD: Visit of Taiwanese PhD Students in B-IT on July 2, 2007

German Academic Exchange Service (DAAD) visited B-IT with a group of Taiwanese PhD students in order to show them institutions in Germany offering innovative Master programs. Professor Dr. Armin B. Cremers presented B-IT and its Master programs as well as B-IT International Program of Excellence (IPEC) as offers in the field of applied computer science.

## B-IT hosts Informatiktage 2007

Due to the success of Informatiktage in the past year, it was decided that Informatiktage should be held in B-IT again. Informatiktage 2007 organized by the Gesellschaft für Informatik e.V. (Informatics Society), were held in the time of March 30-31, 2007 at B-IT. This gathering focused on workshops and keynote lectures, addressing excellent graduate and doctoral students in computer science.



*Professor Jarke opens Informatiktage March 30-31, 2007 at B-IT.*

## B-IT hosted 5th Fraunhofer-Symposium on Text Mining

The 5th Fraunhofer-Symposium on Text Mining in Life Sciences was held at B-IT on September 24-25, 2007. Selected professionals from industry and academic research discussed advancements in information extraction and knowledge discovery, focusing on combining textual and image information in biomedical and chemical research. The 2008 symposium will be held at B-IT again.



*B-IT Life Science delegation at Waseda University in November 2006.*

## B-IT broadens cooperation with Waseda University

Waseda University is the largest private university in Japan. In October 2007, on the occasion of celebrating its 125th Anniversary, NRW Prime Minister Dr. Jürgen Rüttgers received an honorary doctorate during his Japan visit; Rector Winiger of B-IT partner University of Bonn gave the celebratory speech on behalf of Waseda's international partners due to more than 40 years of cooperation between Bonn and Waseda. B-IT cooperates intensely with Waseda in the field of Life Science Informatics since 2005.

In November 2006, a B-IT delegation led by Vice Minister Dr. Stückradt visited Waseda to present research topics and to plan researcher and student exchanges, followed by a counter visit at B-IT in November 2007 and further individual meetings.

## Lecture on IT security

Professor Der-Tsai Lee, Institute of Information Science, Academia Sinica, Taipei, Taiwan and Christian Hang, Armorize Technologies, visited B-IT on June 14, 2007. Both guests gave a very well attended lecture on "Automated Web Application Vulnerability Detection using Static Analysis – From Theory to Practice".



*(From left) B-IT professors Schmidt, Gathen, and Cremers welcomed Professor Lee, Institute of Information Science, Academia Sinica, Taipei, Taiwan and Christian Hang, Armorize Technologies.*

In this lecture Professor Lee describes an algorithm that has created a market demand and led Armorize Technologies (represented in the talk by Christian Hang) to join and capitalize on it. This lecture and the following exchange of ideas with Professor Lee, Christian Hang and B-IT Professors working in this and related fields reflected one important focus of B-IT: The focus on applied computer science and the transfer of knowledge to products.

# Master Program in Media Informatics



*Prof. Dr. Jan Borchers, Media Computing*



*Prof. Dr. Thomas Rose, Media Processes*

Computer scientists with an applied focus have been in great demand in the past, and this is expected to continue for the foreseeable future. Graduates of the Master Program in Media Informatics will be well-prepared for the challenges faced when working in computer systems engineering and for creative work with audio-visual media. The Aachen – Bonn – Cologne region is home to many prospective employers, including global players such as Philips, Microsoft, Telekom, Vodafone, Bertelsmann Group, as well as many television stations including RTL, WDR etc.

While a Bachelor degree in Computer Science typically qualifies to participate in large software projects, the Master degree provides the qualifications for project leadership. Graduates of the program in Media Informatics can be expected to be technically innovative, to work as system architects, and to manage large projects. Students who excel during their master program will also have the necessary qualification to pursue a doctoral degree in Germany or abroad. The DFG Research Training Group "Software for Mobile Communication Systems" and the new Excellence Research Cluster "Ultra-High-speed Mobile Information and Communication (UMIC)" offer an exceptional research environment for the students.

The Master Program in Media Informatics educates the students to successfully meet the novel technical and economic challenges at the intersection of computer science, software engineering, next-generation communication systems, and the media. It is offered as a joint program of RWTH Aachen University and University of Bonn. The program is characterized by a significant portion of lab courses embedded in research of the participating Fraunhofer Institutes for Applied Information Technology FIT and for Intelligent Analysis and Information Systems IAIS. The degree is conferred by RWTH Aachen University. Cooperation partners from industry and research, including the DFG-funded Collaborative Research Center "Media and Cultural Communication", contribute to a rich teaching program. The course contents are structured according to the ECTS (European Credit Transfer System) and consist of three main blocks:

*   Computer Science and its mathematical foundations;
*   Multimedia Technology;
*   Fundamentals of Media Science and business.

Major topics include: digital interactive media, internet infrastructures, management of information, communication and security, knowledge management, visualization, and virtual engineering on the basis of augmented reality. The program also includes methodological aspects of designing media informatics systems from the perspectives of software engineering, usability, media design, and business requirements.

29 Media Informatics students have completed their degree in the academic year 2006-2007, four more are just awaiting their last grades and will also finish before the end of the year. All graduates quickly found interesting positions either as doctoral students in Germany and abroad, or in attractive companies.

The incoming classes of fall 2006 and 2007 comprise 72 students, from a total of 23 countries. B-IT students were unusually successful in obtaining competitive prestigious scholarships this year. Seven incoming students, pre-selected from more than 300 applicants, were awarded the prestigious Erasmus Mundus scholarship within the European Master of Informatics program we are conducting jointly with the universities of Edinburgh (UK) and Trento (Italy). Moreover, Media Informatics student Ms. Chen Chen won one of only five SIEMENS master scholarships awarded to RWTH Aachen University, while Grace Tai and Tan Zheng won two of the three RWTH master student scholarships awarded within the faculty of Mathematics, Informatics, and Natural Sciences.

Bonn-Aachen International Center for Information Technology

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# Some experience reports by Media Informatics Graduates

### Dragomir Hristov Vatkov
### Siemens AG, Nürnberg, Germany

After my B. Sc. in Computer Science at the Sofia University, Bulgaria, the B-IT Media Informatics program gave me the possibility to collect important experience in three world class educational institutions: RWTH Aachen, University of Bonn and Fraunhofer Institute. I was able to collect a set of important skills such as working in an international environment, teamwork, close touch to the newest technologies, etc. that helped me to achieve two of my biggest dreams: to find my dream job as a software developer and IT security consultant, and to publish a scientific paper.

### Omer Mushahid Khan
### Bertelsmann AG, Bielefeld, Germany

I still remember the cool sunny day in October when I was on my way to attend my first lecture on the B-it campus; a bit excited by the new experience, but the anxiety of being in a new place was quickly replaced by the warmth of a rich academic culture. As part of my degree, I had a chance to work with companies like Philips and Accenture which was a very good way to stay in touch with the IT industry. Now working for Lycos Europe, I find the classes in usability engineering and media technology very relevant in realizing the intellectual depth that I wanted to achieve from this program; I also attended a workshop on Intercultural Communication that I have personally found very useful in my current job where I regularly have to interact with people from different nationalities. The collaborative nature of the program also offered me a chance to explore the culturally diverse cities of Aachen and Bonn. The festivity of the Carnival and passion of the locals for the Football Worldcup will always be a cheerful memory for me. I would strongly recommend this program to anyone who wants to develop a specialization in media technology while enjoying a fun cultural voyage on the side.

### Suleman Shahid
### Philips Research, TU Eindhoven, Netherlands

I was born in Lahore, Pakistan, where I completed my schooling and undergrad studies. In B-IT Media Informatics. I specialized in "multimedia use and impact" and worked as a student research assistant in Fraunhofer FIT within wearIT@work, the largest European project on wearable computing, in collaboration with the Paris Fire Brigade. After finishing my masters, I joined the "Professional Doctorate in Engineering" degree program in the area of "User System Interaction" in Technical University Eindhoven, The Netherlands. In 2007, I moved to Philips Research where I am continuing my research in the area of "social and cross-cultural aspects of affective computing and affective games".

### Xiang Li
### RWTH Aachen University, Germany

Together with three fellow students, we joined the B-IT Media Informatics Program after taking a B.Sc. in Computer Science from Tsinghua University in Beijing, China. Together with my colleague Yong Li (an Erasmus-Mundus scholarship student within the program), we joined the model management research team in the group of Prof. Jarke in Aachen. We were pleased to have papers and demos about our master thesis results on schema merging and mapping published in leading international conferences such as CAiSE, ER, and VLDB. I now continue this research as a doctoral candidate within Aachen's UMIC Excellence Cluster, whereas Yong Li has taken a position with an Aachen-based software house as lead software engineer in their new office in Shanghai.



*Xiang Li (middle) and co-workers in the UMIC Excellence Cluster.*

# Master Program in Life Science Informatics



*Prof. Dr. Jürgen Bajorath, Life Science Informatics*



*Prof. Dr. Martin Hofmann-Apitius, Life Science Informatics*

The Master Program in Life Science Informatics (LSI) is offered by the University of Bonn and RWTH Aachen University in cooperation with the Fraunhofer Institutes of Scientific Computing (SCAI) and Applied IT (FIT). The degree is conferred by the University of Bonn. This interdisciplinary program educates the participants to successfully master the novel technical and economic challenges at the crossroads of biotechnology, medicine, pharmaceutics and computer science. The curriculum consists of three main blocks:

- Computer Science and mathematics for life scientists;
- Basic principles of Life Science Informatics;
- Biology of the cell and systems biology.

Major topics include biomedical database systems, data mining and machine learning, statistical genetics, drug design, medical imaging and visualization, computational neuroscience, computational modelling of regulatory and metabolic networks, cheminformatics, bioinformatics, molecular modelling, molecular biology, pharmaceutical chemistry, biotechnology and systems biology. The program emphasizes a profound understanding of biological structures (such as proteins, nucleic acids, genes, metabolic, neural networks and organisms) as well as the appropriate application of methods of computer science to this field. It also includes training designed to sensitize students to the ethical implications of emerging biotechnologies. This combination will enable the successful students to understand biological or medical problems and to find appropriate and valid solutions that bioinformatics can offer.

The program is characterized by a significant share of research lab courses embedded in both basic and applied research of the participating Fraunhofer Institutes FIT and SCAI as well in labs of CEMBIO (Center for Molecular Biology) and LIMES (LIfe and MEdical Sciences Research Biocenter Bonn). The final six months of the program are dedicated to the master thesis which can be done in cooperation with industry. Each student is assigned a professor as personal mentor.

Computer scientists with an applied focus in biosciences as well as biologists with a strong background in computer science have been in great demand in the last few years, and this is expected to continue in the foreseeable future. Graduates of the program are well prepared for the typical professional tasks in applied data analysis and data modelling, in industrial functional genomics, drug design and pharmacology. The Aachen – Bonn – Cologne – Düsseldorf region (ABCD region) is home to many prospective employers, including global players as well as highly specialized medium-sized companies.

On May 23, 2007 Professor Dr. Martin Hofmann-Apitius gave his inaugural lecture on Extraction of Information as a Basis of Modeling in Biomedicine. The lecture was delivered in the context of the Dies Academicus of the University of Bonn and was very well attended.

International recognition for the LSI program has been growing further this year: In 2007, 27 beginners were selected from over 100 applications. The accepted students come mostly from India, Eastern Europe, and China, but also students from some other areas, including Germany and Kenya, joined the program.



*Ms. Lu Tan won the Master Prize of the Gesellschaft für Biochemie und Molekularbiologie and is currently working as a funded doctoral candidate in the team of Prof. Bajorath.*

## B-IT Students report on their Life Science Informatics Research

### Enuo He
### Finishing LSI student

I was admitted to the Master program of Life Science Informatics coming from Nanjing University of Technology with a Bachelor's degree in Pharmaceutical Preparation. After one year of intensive and systematical study of informatics, including doing some lab exercise of data mining, neurobiology, cell biology, knowledge discovery etc. I was keen on learning some practical working of the theoretical knowledge with the belief that science will only become useful when its applications can be realized.

I applied to the European Bioinformatics Institute (EBI), Hinxton, Cambridge, UK and joined the Computational Neurobiology Group at EBI from September 2006 to February 2007. Then I continued my acquisition of practical and international experience at the California Institute of Technology in Pasadena from March to September 2007 in the Biological Network Modeling Center. Recently, I returned to B-IT to complete my Master's degree. The year of training and traveling offered an opportunity to develop my skills and makes me more competitive, along with providing the adventure and challenge of exploring different places and being exposed to another culture. What I like about B-IT is that it emphasizes both a comprehensive education and an international focus.

### Yuan Wang,
### B-IT Doctoral Candidate

I was admitted to the Master's Program in Life Science Informatics in 2004 with a Bachelor's degree of Engineering in Computer Science & Technology of Zhejiang University in Hangzhou, China. After completing my Master Degree in 2006, I joined the B-IT LSI group under Prof. Bajorath as a research assistant and doctoral candidate. My research focuses on similarity searching in computer-aided drug discovery. Metric analysis and method development are carried out as well. Three international publications have already resulted from my work.



*Incoming Life Science Informatics students 2007 and B-IT faculty at their welcome reception in the B-IT Building.*

### Tobias Gattermeyer
### Researcher at Fraunhofer SCAI

I joined the B-IT Life Science Informatics curriculum in 2005. Before, I was trained as a computer scientist and had worked in Singapore. In my master thesis at Fraunhofer SCAI, I developed an environment for the analysis of text mining results within the EU project @neurIST (www.aneurist.org). This environment, named "SCAIView" is a web application that uses full-text search, semantic search and ontologies for the visualization of text mining results and for knowledge discovery. In the context of @neurIST this environment is meant to link external knowledge (from scientific publications) to molecular and clinical data. Entities are searched in title and abstract of 15 Million citations in the PubMed biomedical document database. The system determines entities associated with a context, such as a disease. For example, the full-text search is "alzheimer's disease" and the system displays a ranked list of genes or proteins associated with that disease. I am currently continuing my research work as a graduate researcher in Fraunhofer SCAI.

# International Program of Excellence in Computer Science

*Prof. Dr. Joachim von zur Gathen, Computer Security*

*Prof. Dr. Stefan Kowalewski, Embedded Systems*

*Prof. Dr. Albrecht Schmidt*

The International Program of Excellence in Computer Science (IPEC) at B-IT offers compact courses primarily during the semester break and at the highest educational level. This results in faster studies and advanced quality in selected subject areas. These courses apply to a limited number of highly qualified students of the University of Bonn, the RWTH Aachen University and, in the future, other German or foreign universities.

Undergraduate IPEC courses are planned in a way that the time required for the bachelor degree will be reduced up to one year. Additionally there are cross-cutting courses that accelerate the master studies at the B-IT as well as regular summer and winter schools that are designated for selected topics of computer science. These courses are held in cooperation with international guest scientists. Applications of foreign students are welcome.

The expected impact of the Program of Excellence is not limited to a significant acceleration of undergraduate and graduate studies in conjunction with an international visibility. It also brings together outstanding students with internationally noted scientists and with fellow students from abroad and activates new forms of encouraging competition among students. The IPEC courses usually comprise a mix of lecture classes, seminars, and lab courses, such that students can make best use of the compressed time schedule. A full schedule of over 20 courses was offered during the semester breaks of the academic year 2006-2007.

As in the last years, special compact courses in cryptography were a big success. The Summer School crypt@B-IT in September 2007 – conducted jointly with the German national security institute BSI and worldclass researchers such as Gadiel Seroussi from HP Labs (Palo Alto, USA) invited undergraduate and graduate students and researchers to explore some fundamental areas of cryptography: security reductions for asymmetric systems, elliptic curve cryptography, and the Enigma crypto machine from World War II.



*Professor Seroussi types on an Enigma.*

Fostering early interest in computer science is an important challenge to reduce the shortage in ICT specialists taken up by IPEC as well: "22 February, morning, 05:20. Sleepy faces, that one usually sees only two and a half hours later, meet at the central station. Strange behavior… What was up? Some students just wanted to live their interest in math more intensely; at Schülerkrypto. […] It was possible to deal with the topic much more closely than ever possible in usual school teaching, and furthermore it was a lot of fun", writes a teacher from Neustadt. 194 high school students and 12 teachers learned at B-IT about secret messages, encryption and decryption. Everybody was asked to take up the role of James Bond and program RSA on the laptop built-in to Bond's BMW Z8. After lunch everybody decrypted answers from Moneypenny, set up a public-key infrastructure and exchanged encrypted messages with each other. In a game-like setting the students could experimentally find out how the main step in the encryption and decryption of RSA, namely the modular exponentiation, can be executed in a jiffy. And finally everybody could take home her personal visual cryptogram.

As both RWTH Aachen University and Bonn University have now begun a Bachelor's program in Computer Science, the role of IPEC will shift towards a more targeted support for the best undergraduate students from their first day on. A second direction of future activity will be the development of dedicated support for structured doctoral training in the spirit of the Graduate School proposal we made within the Excellence Initiative of the German government.

## First IPEC course invited to Nanjing



After nine successful Extreme Programming (XP) courses as part of the B-IT's International Program of Excellence (IPEC), B-IT was invited by Nanjing University of Science and Technology (NUST) to carry out the XP lab in China in July and August 2007. eXtreme Programming is based on the insight that the customer is often not able to give all specifications necessary to meet his needs in the beginning of the software development process. Instead, the software is developed in small steps by pairs of programmers and re-factored from time to time. The customer is ideally on-site, continuously follows the development process and gives feedback.

After a planning visit in May with Prof. Yan Han, Dr. Günter Kniesel and Daniel Speicher conducted the course for 23 days in July and August 2007. Students developed two products in two teams: a web based requirement tracking tool, and a graphical user interface for the JiST/ SWANS Adhoc Network Simulator. The good relations to the Nanjing University of Science and Technology were strengthened by a visit of Prof. Dr. Matthias Winiger and Prof. Dr. Armin B. Cremers on October 8, 2007. The participants took the opportunity to present the products of the lab and the certificates were handed out. Prof. Xiaofeng Wang, President of the NUST expressed his appreciation of this IEPC course with the first NUST's XP Summer School: "It was very successful and our students benefited a lot from it."

## CASC 2007

The 10th Workshop on Computer Algebra in Scientific Computing was held September 16-20, 2007. The CASC workshops aim at fostering interaction between researchers in the former Soviet Union and those in Western Europe. 50 renowned scientists joined at the B-IT and presented up-to-date research results. The proceedings appeared in the Springer Lecture Notes in Computer Science. The methods of Scientific Computing play an important role in research and engineering applications in the natural and the engineering sciences. General-purpose computer algebra systems like Mathematica, Maple, or MuPAD enable their users to solve symbolic manipulation, numerical computation, and visualization within a uniform framework. The intensive scientific discussions in the B-IT lobby were continued at the social events, which included a dinner boat trip on the Rhine from Bingen to Koblenz, and a guided tour of Bonn.



*Participants of CASC 2007.*

# Master Program in Autonomous Systems

*Prof. Dr. Gerhard Kraetzschmar, Educational Robotics*

*Prof. Dr. Paul-Gerhard Plöger, Autonomous Systems*

*Prof. Dr. Erwin Prassler, Robot Planning*

The Master Program in Autonomous Systems is offered by the B-IT Applied Science Institute (b-itAS) in the Department of Computer Science at the Bonn-Rhein-Sieg University of Applied Sciences. b-itAS works closely with the Fraunhofer Institute for Intelligent Analysis and Information Systems (IAIS) in implementing the program, which started in winter 2002. The program is managed by three professors (Kraetzschmar, Plöger, Prassler) and two teaching and research assistants (Nowak, Hartanto). Additional staff has been recruited for our European research projects XPERO and RoSta (Henne, Shakhima-rdanov, Hoffman, Juarez).

Students get a solid theoretical background in Autonomous Systems. Examples of lectures are Autonomous Mobile Robots, Control and Systems Theory, Robot Manipulation, Learning and Adaptivity, Hardware-Software Codesign of Embedded Systems, and Probabilistic Reasoning. The students may specialize in fields like System Design, Navigation, Sensors and Modeling, Computer Vision or Manipulation. The courses are combined with research projects at Fraunhofer IAIS or other approved institutions. The students learn to apply and extend their theoretical knowledge by building real systems. In 2006 this program has been fully accredited by ASIIN.

B-IT Autonomous Systems accepts students twice a year. In the academic year 2006-2007, a total of 38 students from 11 countries were admitted. 9 students have completed their degree in this year, summing up to 26 graduates in total so far; ten more graduations are expected before the end of the year. Recent graduates have taken industry positions in companies such as Infineon or ADA Software Group (India), or are now doctoral candidates at universities in Turkey, Austria, and Germany, including B-IT itself.

The three professors of the Autonomous Systems program are actively involved in many scientific activities, including memberships in technical



*Welcome reception for new students of Autonomous Systems with Prof. Gerhard Kraetzschmar (left).*

committees of IEEE, the RoboCup Federation trustee board, and numerous program committees of workshops and scientific conferences. The many activities of Prof. Kraetzschmar in the RoboCup to spread activities to other countries include visits as advisory committee member to Iran and China, and Egypt which may lead to further cooperation within b-it/AS as well.

Considering the swiftly rising demand for highly educated engineers on one side, and sluggish number of engineering students on the other side, raising the interest of young kids in science and technology has become an essential effort for engineering disciplines. Prof. Gerhard Kraetzschmar is the project coordinator for the EU-funded project Roberta-Goes-EU. This project internationalizes the successful Roberta concept developed at Fraunhofer IAIS to several European countries, including the United Kingdom, Sweden, Italy, Austria, and Switzerland. Roberta involves developing high-quality, gendered didactic material for teaching robotics in school, training teachers to use it, building a community network, and fostering participation in scientific competitions like RoboCupJunior or Jugend forscht. Roberta addresses both girls and boys, but devotes special attention to develop gendered material and raise the awareness of teachers concerning gender issues in teaching science and technology to girls.

## B-IT/Autonomous Systems wins bid to organize oldest robotics conference

At a meeting on Jeju Island in Korea, B-IT / Autonomous Systems represented by Prof. Erwin Prassler won a bid to organize the International Conference on Advanced Robotics ICAR 2009 in Germany. ICAR was established in 1981 as the first international robotics conference worldwide. ICAR takes place bi-annually and has hosted between 200 and 350 participants in the past years. The theme of ICAR 2009 will be "able robots", where "able" is the lexical intersection of cap-able, depend-able, measure-able, affordable.

## B-IT/Autonomous Systems pushes internationalization efforts

b-it/AS is working on a double degree program with the Intelligent Robots and Systems Master program at University of Örebro. The curriculum, which foresees two mobility paths, has been agreed on and all necessary agreements and decisions by committees have been taken. A similar effort is underway with the University of Verona. A proposal to receive funding from the Erasmus Mundus program was written by Prof. Gerhard Kraetzschmar and submitted jointly with University of Örebro and University of Verona. It was evaluated among the top 40 percent of submitted proposals. The consortium will not immediately receive funding, but the evaluation of the joint program warrants re-submission in Erasmus Mundus II.

The b-it/AS Master of Autonomous Systems program is a strong candidate for inclusion in the list of degree programs to be established at the PGUT Pakistani-German University of Technology in Lahore, Pakistan. The program is supposed to be a double degree program and planned to start in fall of 2008. Due to his involvement in the PGUT project, the DAAD called Prof. Gerhard Kraetzschmar onto a candidate selection committee, which evaluates Pakistani applicants for HEC government grants to obtain a Master and/or Ph.D. degree in Germany.

## B-IT/Autonomous Systems pushes measurability and comparability in robotics

The lack of a culture of experimentation and benchmarking has led to divergence rather than to convergence of robot technology. The robotics community has recently started a number of efforts to establish such a culture of experimentation, performance evaluation and benchmarking. B-IT/Autonomous Systems is actively pushing this endeavor. A first Master Thesis entitled "A Comparative Evaluation of Robotic Software Systems: A Case Study" was successfully finished by Azamat Shakhimardanov. A number of so-called "Best of Robotics" R&D projects are under way identifying and collecting best practice in various fields of robotics and making them available in a "Best of Robotics" library.

Also B-IT/Autonomous Systems, represented by Prof. Erwin Prassler, Prof. Gerhard Kraetzschmar, and M.Sc. Azamat Shakhimardanov, is organizing a workshop "Measures and Procedures for the Evaluation of Robot Architectures and Middleware" at the IEEE/RSJ Int. Conf. on Intelligent Robots and Systems in San Diego on Oct. 29, 2007 with contributions from all major players in the field.

## B-IT/Autonomous Systems pushes service robot applications and enters RoboCup@Home League

Since 2006, RoboCup has added RoboCup@Home to its roster of scientific competitions. RoboCup@Home is targeted towards service robot applications in home and office environments and has already attracted numerous new teams from highly-renowned universities; the world championships in 2006 and 2007 were won by a team from RWTH Aachen University. In 2007, a small team from b-itAS participated for the first time in RoboCup@Home. Despite delays in the delivery of the targeted platform and late availability of a substitute platform, the team led by Walter Nowak finished overall sixth. Particular attention found our ability to autonomously create a 3D-map and localize and navigate based on this map.



*In 2007 b-itAS acquired a new robot platform with a 5 degree-of-freedom „Katana" arm, including several sophisticated sensor systems and a powerful computing unit. The platform will serve for various projects concerning robot navigation and mobile manipulation.*



*The b-itAS team at the Robo-Cup World Championships in Atlanta, here the robot doing the Follow-And-Guide test together with team leader Walter Nowak.*

# B-IT Universities Institute

ABC – three letters that stand for a veritable "magic triangle": the region between Aachen, Bonn and Cologne, which is not only economically strong, but also a leader in science, education and research. The large number of research establishments based here make the area one of Europe's biggest and most important science landscapes. Almost 10 per cent of all German students – around 130,000 people – are studying at the Rheinisch-Westfälische Technische Hochschule in Aachen, the Rheinische Friedrich-Wilhelms-Universität Bonn and the Universität zu Köln, which together constitute one of the most important higher education locations in Europe. The three ABC institutions are closely linked and collaborate in many fields of teaching and research.

## University of Bonn

The University of Bonn is a research-oriented university with currently 30.000 students. Its research tradition of 200 years is closely linked to the names of Hermann von Helmholtz, Heinrich Hertz and Friedrich August Kekulé who carried out seminal work at the University of Bonn. This strong academic tradition has been continued until present with the more recent Nobel laureates Wolfgang Paul and Reinhard Selten. Bonn cooperates with numerous other universities and research institutions around the globe. The specializations it has developed enjoy worldwide recognition. More than 5,000 students from 130 countries are enrolled in Bonn. Their presence underlines the international character of the university and enriches both academic and social life in Bonn. Living up to its long tradition as a classical university with a full range of academic disciplines, the University of Bonn offers nearly a hundred different first degree programs. Students can choose from a wide and modern spectrum of subjects that allows a multiplicity of combinations.

## RWTH Aachen University

RWTH Aachen University was founded as a Polytechnic in 1870 with considerable support from local industry. In 1948 it was established as Rheinisch-Westfälische Technische Hochschule Aachen (RWTH), the Institute of Technology of the State of North Rhine-Westphalia. Today, RWTH is one of the most renowned technical universities in Europe, with around 30,000 students, of which more than the half are enrolled in engineering. More than 4,000 international students are enrolled, including around 900 Asian students. RWTH offers more than 65 first degree programs in Science, Engineering, Economics, Medicine and Arts and more than 20 graduate programs in Science and Engineering. The specific strength of RWTH's engineering education is the combination of education and advanced research. RWTH's engineering departments closely cooperate with national and international industries. Most of the engineering professors at RWTH held positions in industry before they became RWTH faculty members. The RWTH master programs educate engineers who are keen to engage in R & D, innovation, and entrepreneurship. In 2007, RWTH Aachen was elected as one of nine "elite universities" within the German excellence program. Under this program, RWTH receives a total of ca. 180 Mio. € for its strategic development, three excellence clusters, and a Graduate School. B-IT faculty are involved in two excellence clusters and the graduate school as well as the central strategy proposal.



*The spacious Hofgartenwiese is a major summer attraction on the University of Bonn campus.*

*Entrance of Birlinghoven Castle.*



*Virus hunters in "Epidemic Menace", a pervasive game developed in the European "Integrated Project on Pervasive Games – IPerG", working with Fraunhofer FIT's Augmented Reality environment.*

The Birlinghoven Castle campus has for almost 35 years been one of the largest and most influential computer science research sites in Germany. Since 2001, it is a member of the Fraunhofer Society of Applied Research. Today about 500 researchers work in the IZB institutes. That represents a quarter of the Fraunhofer ICT Group, Europe's largest IT research organization. The institutes collaborate closely with the European ERCIM network of national IT research centers as well as with leading research establishments in the USA, Eastern Europe and Asia. The campus also hosts one of the best-equipped Computer Science research libraries in Germany. Three IZB institutes contribute to the B-IT master programs Media Informatics and Life Science Informatics:

## Fraunhofer FIT

Fraunhofer FIT investigates human-centered computing in a business or engineering process context. The usability and usefulness of information and cooperation systems is optimized in their interplay between human work practice, organization and process. In Life Science Informatics the institute focuses on protein analysis, visual support for navigation in micro surgery, and assistive information technology. In Media Informatics innovative information visualization systems, mixed and augmented reality environments for industrial planning, pervasive gaming applications, and value chains for public-sector information services are main research topics.

## Fraunhofer SCAI

The Fraunhofer Institute for Algorithms and Scientific Computing (SCAI) engages in computer simulations in product and process development and is a strong partner in industry. The Department of Bioinformatics is doing applied research and development in the field of: Information Extraction / Semantic Text Analysis, Applied Chemoinformatics and Datagrid / Grid Infrastructure. Complementary to the data- and knowledge-driven approaches taken in the Department of Bioinformatics, the Department of Simulation Engineering focuses on chemical engineering by means of multi-scale simulations. Through gaining a deep understanding of the microscopic behaviour and mechanism of chemical systems, material and drug development is improved.



*Fraunhofer SCAI: Membrane-embedded receptors, like the prototypic rhodopsin shown at left, are pharmaceutically most interesting. The aim is to gain control over cellular response by designing new drugs.*
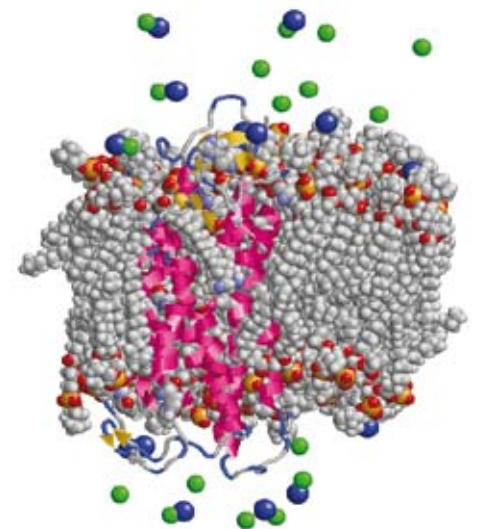
# B-IT Applied Science Institute

## Bonn-Rhein-Sieg University of Applied Sciences

Founded in 1995, the Bonn-Rhein-Sieg University of Applied Sciences significantly extends the range of applied research and teaching in the greater Bonn area. It specializes in business administration, natural sciences, engineering and computer science, strongly encouraging cooperation with industrial partners and a focus on use-driven and interdisciplinary research and teaching.

The three campuses at Sankt Augustin, Rheinbach and Hennef are well equipped with modern laboratories, studios, workshops and facilities for cooperative research. By 2005, the six departments will accommodate more than 4.500 students and about 120 faculty members.

The Department of Computer Science offers a Bachelor and a Master program in Computer Science and in cooperation with the Departments of Business Administration a Bachelor program in Business Information Systems. The Master program Autonomous Systems is offered by the b-it Applied Science Institute, a cooperation between the Department of Computer Science and the Fraunhofer Institute for Intelligent Analysis and Information Systems IAIS.



*Campus of the Bonn-Rhein-Sieg University of Applied Sciences.*

## Fraunhofer IAIS

Fraunhofer IAIS develops solutions that, by their intelligence, enable humans to take better decisions and that, by their autonomy, relieve humans in general and in particular extend the range of human actions. Knowledge computing and autonomous robots are the two core areas of the institute which have a history reaching back to 1998. Recently the IMK and AIS institutes merged and formed the joint institute IAIS.

One focal point of IAIS is to develop business intelligence solutions for integrated analysis of databases, multimedia- , text- , web- and geo-data (visualization, extraction of information, data mining) to support better decision-making. Logistics companies and one of the major European retail groups use IAIS systems for interactive support of location analysis and marketing campaigns. IAIS software simplifies generating and sharing ideas in small teams and large groups, e.g., for citizen participation in urban planning. Complex systems are modeled in IAIS with multi-agent systems that have been developed in telematics applications. In the field of autonomous robots, IAIS develops sensor-based, robust wheel-driven and walking mobile robots.

The institute is a leader in the research on sensor fusion of 3D laser-scanner data for the exploration of unknown environments. In addition to supporting explorative tasks, robots can be valuable educational tools: They combine solutions from mechatronics, computer science, and electronics that are major elements of engineering curricula. Here, IAIS provides its own robotic systems and related courses. Real-time simulation and control of non-linear systems, intelligent control systems as well as hard- and software integration round out the competence profile of the institute.

# General Information

## General Admission Requirements

- A first university-level degree (B.Sc., B.Eng.), as specified for the individual programs, with grades well above average is required. The Graduate Record Examination (GRE) is strongly recommended;
- All courses are held in English, thus fluency in English in vital. It is evaluated on the basis of TOEFL 550 paper-based, 213 computer-based, or IELTS 6.0;
- Working knowledge of German is necessary to take up some of culture that the Aachen – Bonn – Cologne region has developed over the last 2,000 years. A basic German language course must be completed until the end of the third semester.
- Admission is coupled to placement in the Fraunhofer lab courses and therefore strictly limited. Application deadline has been March 1 for Fall admission but may change from year to year; check www.b-it-center.de for current admission details.

## Fees and Finances

Tuition fee is 500-650 € per semester. In addition, a Student Union fee of 145 Euro per semester covers student activites, subsidized meals, and free public transportation in the region.

A student's monthly expenses, including study material, will be about 650 Euro. B-IT does not offer formal scholarships but several student assistantships are avaible on a competitive basis. For information on funding from German sources please contact the DAAD – German Academic Exchange Service www.daad.de.

## Studying in Bonn

Most of the teaching in B-IT is concentrated in Bonn and its eastern neighbor, Sankt Augustin. Newcomers to Bonn soon grow very fond of the city – a fact confirmed by thousands of students and academics, German and foreign, who have come here to learn, teach or research. Since the German Bundestag moved its seat and parts of the Federal Government to Berlin in 1999, Bonn attracted a number of international organizations, especially United Nations bodies, and some major corporations. Among others, Deutsche Telekom and Deutsche Post have their headquarters there. Now Bonn is evolving into an internationally recognized science region – with the university as one of the dynamic forces driving this change. In addition, Bonn offers a wide variety of attractions and amenities. The city's most famous son, Ludwig van Beethoven, is the star attraction of a lively and varied arts and culture scene. The city boasts an opera house, several theatres, concert halls and other venues, as well as a range of fascinating museums.