b-it

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

Annual Report 2004-2005

*Vice Minister
Dr. Michael Stückradt*

Prof. Dr. Gerhard Barth

Foreword by the Chairman of the B-IT Foundation

Founded in 2002 with financial support from the B-IT Foundation and from the state of North Rhine-Westfalia, the Bonn-Aachen International Center for Information Technology (B-IT) has pioneered the German strategy of regional excellence clusters. The structure of B-IT constitutes a prototypical form of cooperation between leading universities and research institutes. The master programs of B-IT highlight the strengthening of German post-graduate education in the competition for the best international students. B-IT's fields of study are closely linked to the economic transition of North Rhine-Westphalia from traditional industry to modern communication and media industries as well as life science industries and embedded systems. Even our traditional industries see an ever stronger influx of computing aspects through the emerging dominance of embedded systems.

In its third year of operation, B-IT has successfully begun to exploit its newly won local identity in the beautiful B-IT building on the banks of the Rhine River. The international students from over 40 countries worldwide have formed a lively community of learning, and several major scientific events increased the visibility of B-IT in the scientific community. The accreditation of the international Master Programs officially recognized the high standards achieved in a short time. The first graduates have meanwhile moved to interesting positions in research and industry.

I would like to thank my predecessor, Hartmut Krebs, and the management, faculty, students, and International Advisory Board of B-IT for the accomplishments so far. I wish B-IT continued success in the future.

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 me as Founding President. 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

In addition to one official meeting per year, several visits by individual members of the Advisory Council take place throughout the year. They are devoted to scientific presentations and informal discussions about specific issues. Emphasis in 2005 has been on getting to know the newly appointed holders of the B-IT endowed professorships. Strategic discussions will be held about the impact of globalization on B-IT curricula. Further topics will include the establishment of even better linkages to industry through internship programs, and future B-IT activities in continuing education and in doctoral studies.

The International Advisory Council will continue to actively support B-IT in its highly promising efforts towards the internationalization of elite applied computer science education in Germany.

Prof. Dr. Gerhard Barth
Founding President, International Advisory Council

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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 the future leaders in areas of particular economic relevance for the ABC region around Aachen, Bonn and Cologne, whereas its IPEC program provides special offerings for the brightest of the local undergraduate computer science students.

The academic year 2004-2005 was the second year of full-scale B-IT operation. About seventy master students currently join each year after a highly selective admission process; a total of about 180 students from 41 countries have studied here so far. Many of the first master theses were done in the context of highly visible projects and competitions. Applicant quality is continually increasing, fostered e. g. by international cooperation agreements with several governments and individual top universities. The transition from the German diploma to the Bachelor-Master system has also produced an increasing number of qualified German applications.

The enthusiastic young faculty and students proved a major factor in a successful accreditation audit for our Master Programs in Media Informatics and Life Science Informatics held in October 2004. Accreditation was granted officially in February 2005. Also in early 2005, two new professors, Joachim von zur Gathen (Computer Security, formerly University of Toronto and University of Paderborn) and Gerhard Kraetzschmer (Educational Robotics, formerly University of Ulm) joined the B-IT faculty, bringing the total of filled endowed professorships to eight.

Just in time for the start of the academic year, the long awaited move into the freshly renovated B-IT building on the banks of the River Rhine gave B-IT a local identity which further strengthened the sense of community among

B-IT main building

the students. Most classes are now held in this building, and two of the endowed chairs have been installing their research groups and laboratories there. A number of exciting lab teaching facilities were also set up in the meantime. The availability of the B-IT building also enabled us to become more ambitious in terms of hosting major national and international events, such as GI-Informatiktage, the GAMES Winter School, and the German national computer conference, INFORMATIK 2005.

After the 2005 NRW state elections, the new Vice Minister for Innovation, Science, and Technology, Dr. Michael Stückradt, became chairman of the B-IT Foundation Council. We combine our welcome with sincere thanks for the crucial support by former Vice Minister Hartmut Krebs in the formative first years of B-IT. The cooperation with the B-IT Foundation, represented by Hans Stender and Renate Zindler, and with the International Advisory Council headed by Founding President Prof. Gerhard Barth, continued to be excellent. We should also like to thank our assistant directors Dr. Jürgen Rapp, Dr. Alexandra Reitelmann, and Dr. Stefan Lüttringhaus-Kappel, also our former assistant director Dr. Hans Nissen who accepted a professorship at Cologne University of Applied Sciences. Most importantly, thanks are due to our B-IT students for their enthusiasm and excellent cooperation.

Armin B. Cremers, University of Bonn
Matthias Jarke,
RWTH Aachen University and Fraunhofer FIT
Kurt-Ulrich Witt,
Bonn-Rhein-Sieg University of Applied Sciences

B-IT in Profile

Prof. Dr. Armin B. Cremers

Prof. Dr. Matthias Jarke

Prof. Dr. Kurt-Ulrich Witt

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. Most courses take place in the beautiful B-IT building next to the former office of the German Chancellor on the banks of the River Rhine in Bonn. 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.
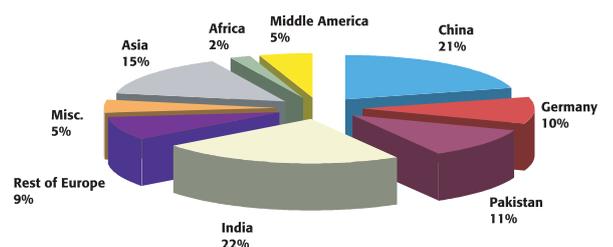
The B-IT Universities Institute offers English language Master of Science (M.Sc.) programs in Media Informatics and Life Science Informatics, whereas the University of Applied Sciences offers a Master Program in Autonomous Systems. The Master Programs prepare students for successful international careers 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.

After the founding treaty for the B-IT Universities Institute was signed in July 2003, the first full set of students was accepted into the master programs in September 2003. By the fall of 2005, the B-IT master programs have roughly reached their planned size of about 160 students, without compromising on admission quality. B-IT has succeeded in attracting very good students from all over the world (41 countries in all continents so far). First placements of finishing students in both research and business, in Germany and internationally, look highly promising. Strategic goals for the next years include an expansion of B-IT to the doctoral level and a component for industrial continuing education at a high quality level.

Home Countries of B-IT Students

China 21%
Germany 10%
Pakistan 11%
India 22%
Rest of Europe 9%
Misc. 5%
Asia 15%
Africa 2%
Middle America 5%

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The installation of an advanced computing and communication infrastructure in the B-IT building has largely been completed. Students are offered secure and efficient wireless LAN through a Personal Network Access Service (PNAS) infrastructure. In addition to general-purpose PC pools, a Macintosh Multimedia Design with a large interactive touch screen has been set up to foster group creativity among Media Informatics students. Moreover, we have embraced the trend towards more flexible classroom usage, and now provide a mobile Mac lab with 14 Powerbooks, a wireless base station, and a small printer on a mobile cart.

B-IT Foundation Council, faculty, and students met on October 18, 2004 to celebrate the opening of the renovated B-IT building.

Officers

Founding Scientific Directors
Prof. Dr. Armin B. Cremers,
University of Bonn
Prof. Dr. Matthias Jarke,
RWTH Aachen University
Prof. Dr. Kurt-Ulrich Witt,
Bonn-Rhein-Sieg University of Applied Sciences

Assistant Directors
Dr. Stefan Lüttringhaus-Kappel,
University of Bonn
Dr. Jürgen Rapp, RWTH Aachen University
Dr. Alexandra Reitelmann, University of Bonn

Coordinators/Advisors B-IT Study Programs:
Prof. Dr. Otto Spaniol
(RWTH Aachen University),
Media Informatics
Prof. Dr. Jürgen Bajorath (University of Bonn),
Life Science Informatics

International Advisory Council
Prof. Dr. Gerhard Barth,
Founding President

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Vice Minister, North Rhine-Westphalian
Ministry of Innovation, Science and Research
Hans Stender (Secretary)
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Rector, University of Bonn
Prof. Dr. Wulf Fischer
Founding Rector,
Bonn-Rhein-Sieg University of Applied Sciences
Dr. Ernst Franceschini
President, Bonn / Rhein-Sieg Chamber
of Commerce

B-IT's new mobile Mac lab: This setup can be used to turn any of the B-IT teaching rooms into a temporary computer lab space.

Events and Visits

A CampusGrid Workshop held in the B-IT Building in late 2005 discussed the potential of grid computing in NRW life science research.

B-IT Formal Foundations further strengthened

In the fall of 2004, the formal foundations of the B-IT study programs were further strengthened.

On Nov. 3, the accreditation agency for Engineering, Informatics, and Natural Sciences ASIIN conducted an in-depth accreditation audit of the master programs in Media Informatics and Life Science Informatics. The study programs as well as the enthusiasm of B-IT faculty and students were highly praised by the ASIIN audit team led by professors G. Engels (University of Paderborn) and J. Freytag (University of Applied Sciences Hamburg). After clean-up of some formalities, the accreditation was unconditionally granted in February 2005.

On Nov. 18, a B-IT Foundation Meeting was combined with a press conference on the occasion of the opening of the B-IT building. The B-IT Foundation decided on the further funding and enjoyed the facilities. In December 2005, the last part of the B-IT contract, defining the long-term cooperation between University of Bonn, RWTH Aachen University and Fraunhofer Society beyond the initial build-up period, was signed by the Rectors and the Fraunhofer Management Board.

Networking

The B-IT building also enabled new linkages into the region. On Sept. 7, 2005, the "Science and Research" subcommittee of the City of Bonn led by Angelica Kappel were informed about the B-IT study programs in their meeting in B-IT building and discussed further improvement of B-IT student housing opportunities. On September 12, 2005, B-IT co-organized the inaugural meeting of the Bonn Agricultural and Food Network (BAEN) in the B-IT building. BAEN integrates the activities of the University of Bonn, the City of Bonn, initiatives, authorities and institutions of North Rhine-Westphalia, the German Federal Government and the European Union in the field of agriculture and food science, as part of Bonn's transformation process into a city of science.

The linkage to international universities was further strengthened, especially with respect to China. The cooperation agreements with Jiangsu and Sichuan provinces were once again successfully used in the pre-selection of top students. Visits of the Rectorate of Qinghua University and of the Beijing Institute of Technology in Germany were complemented by a visit of B-IT researchers to universities in Shanghai, Shenzen, and Singapore. Several professors from Indian Institutes of Technology and from Victoria University (Australia) also helped increase the international network of B-IT, as did the first two stipend selections within the European Erasmus-Mundus program.

The effort to extend B-IT activities towards lifelong learning was continued by a number of industry and school-related events co-organized with institutes of Fraunhofer Birlinghoven. Industry conferences on the future of knowledge management in organizations, media usage and eLearning in schools, groupware in practice, and web accessibility drew several hundred practitioners and researchers, whereas press and TV were attracted by events on mobile gaming and educational robotics. B-IT also cooperates with the planned Fraunhofer Technology Academy which aims at continuing engineering education for highly qualified people.

Conferences

The GI Informatics Days annually bring together selected top master students of German universities and universities of applied sciences and their advisors, to present their work and discuss job perspectives in science and industry. In April 2005, this event was held for the first time in Bonn in cooperation with B-IT.

Prof. Jarke gave the opening keynote on "Human-Centric Computing" in Birlinghoven Castle to an audience of about 70 students and 50 advisors. In 2006, the Informatics Days will be held in the B-IT building.

Organized by a team directed by Prof. Cremers, the German Informatics Society GI held its annual meeting INFORMATIK 2005 in Bonn Sept. 19-22, 2005. More than 1300 IT researchers and practitioners attended the main Informatics Day and a large number of workshops, including for the first time a highschool event which drew almost 400 pupils and teachers. The conference ended with a boatride on the Rhine River which ended at the boat landing adjacent to the B-IT building where participants were given a farewell party. B-IT professors contributed to the conference organization by organizing workshops in the fields of groupware, life science informatics, and robotics.

The B-IT Foundation Council after a press conference on the occasion of the opening of the B-IT building on Nov. 18.

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 – Düsseldorf region is home to many prospective employers, including global players such as Philips, Deutsche 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.

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 research lab courses embedded in both basic and applied research of the participating Fraunhofer Institutes for Applied Information Technology FIT and for Media Communication IMK. 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;
- Fundamentals of Media Science and business;
- Media Informatics.

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. Recent master thesis topics include:

Predrag Stojadinovic: *Interactive Path Planning and real-time Motion Synthesis for Articulated Humanoid Characters in Virtual Environments*

Suleman Shahid: *User-Centered Requirements Engineering for Highly Situated Collaborative Activities: Early Prototyping of a Wearable Computing System for Fire Fighters*

Tian Gan: *Improving Schema Matching by Exploiting Semantic Information*

Alexandra Kahl: *Building an Internet Community for Cooperative Work and Information Sharing*

Sajid Rashid Khan: *Deployment and Evaluation of GMPLS Networks in Context of Scalability*

Sanjin Pajo: *Secure Direct Interaction Model for a Collaborative System*

In fall 2004, 35 students were admitted out of 130 applicants, whereas the fall 2005 incoming class comprises 39 new students from 17 countries. In each year, two applicants were awarded the prestigious Erasmus-Mundus stipends within our European Master of Informatics program that we are conducting jointly with the universities of Edinburgh (UK) and Trento (Italy).

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A team of Media Informatics students implemented BittyBuddy, an online virtual space intended to further strengthen the community of B-IT students with features such as profiles people finders, broadcast and private messages, photo albums, bookmark and file sharing, and with a forum of events and announcements.

REXplorer: scavenger hunt through the City of Regensburg

Pervasive Gaming

Computer and cell phone games are not only popular but also an increasingly important economic factor in the media industries. In Pervasive Gaming, the boundaries of traditional games are broken up to create new gaming worlds for players and spectators. Using electronic music, video, internet, portable computing devices, and smart phones are melted into a seamless environment that merge real and virtual environments.

B-IT students are involved in several large-scale European Integrated Projects at Fraunhofer FIT that are trying to make this vision a reality. In the "Epidemic Menace" demonstration event conducted in Birlinghoven on 25th August 2005 as part of the IPerG Integrated Project, eight test players in four indoor and outdoor teams received "anti-virus kits" consisting of PDAs, cellphones and mobile augmented reality material to identify a crazy scientist and the virus he had supposedly stolen and was threatening to use against mankind. Tracking systems based on GPS and WLAN supported team coordination and informed members about external factors

such as changing weather conditions. Music information gave players an indication of how close they were to a solution.

In a related case study, B-IT Master student Bilal Hameed is currently working on a research project at Prof. Borchers' Media Computing Group to turn a cell phone into a city tour guide and mobile game companion: REXplorer will let tourists of the City of Regensburg take part in a scavenger hunt that leads them through the medieval inner city. By completing challenges on the way ("Shoot a short video clip with your fellow travellers re-enacting the attack of the Stone Bridge!"), the visitors will be able to compete for the high score of the day. They will use smart cell phones to collect and "blog" their video clips and other results and send them to a central display in the city.

B-IT students are also involved in another European Integrated Project related to Media Informatics, addressing wearable computing in work settings such as production and emergency management, as well as in a number of industrial research projects e.g. with Deutsche Post.

B-IT's first two Erasmus-Mundus stipend students, Yong Li and Pei Tang, have now started their stay in Edinburgh, while two master students from Edinburgh are spending a guest semester at B-IT.

Master Program in Life Science Informatics

*Prof. Dr. Jürgen Bajorath,
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.

The majority of LSI students selected in fall 2003 have now successfully completed their Master Theses, for example:

Ninetta Kosswig: *Strategies for the Generation of Higher Order Protein Dictionaries for Text-Mining: Complex and Family Name Dictionaries*

Dominik Novotni: *Clustering of Gene Expression Time Series*

Xiaolei Zhou: *An Application of Data Mining Methods in Chemical Compounds' Classification and Regression Problems*

Varsha Arashanapalli: PDB vs. Swiss-Prot: *The Comparison of Two Protein Databases*

Sridhar Mahendrakar: *Test of Reliability and Efficiency of Two Middlewares Through Application of Two Large Scale Docking Tools*

One of them has already been accepted to PhD studies. Several of the 2004 incoming students have already received offers for their Master Thesis and have even been offered PhD studies after only completing their first year. Selected from 92 applications, fifteen new LSI-students from seven countries started Life Science Informatics studies in October 2005.

The B-IT Life Science Informatics Group

B-IT Professor Dr. Jürgen Bajorath has succeeded Prof. Dr. Rainer Manthey as study coordinator of the Master Program in October 2005. Professor Bajorath's research focuses on the development and application of novel methods for molecular similarity analysis, the exploration of biological or chemical structure activity relationships and virtual screening of large compound databases. Many of the methods developed in the group are applied to practical research problems in collaborations with the pharmaceutical and biotechnology industry. The Life Science Informatics group also participates in a newly formed DFG-funded Collaborative Research Center on Molecular Mechanisms and Chemical Modulation of Local Immune Regulation (SFB 704).

WISDOM:
The Story Behind a B-IT Master Thesis

In September 2005, the following press release was published by the CERN office in Geneva (Switzerland):

EGEE SPEEDS UP HUNT FOR NEW MALARIA DRUGS
The Drug Discovery application (project WISDOM) running on the Enabling Grids for E-sciencE (EGEE) production service aims to find potential new drugs to combat malaria, a disease which kills a million people per year and affects 300 million more. The number of malaria cases and deaths has increased in many parts of the world, mainly because the most widely used drug (Chloroquine) has been rendered useless by drug resistance, and because

the Anopheles mosquitoes that carry malaria have become increasingly resistant to common insecticides. In molecular biology research, parasite proteins have been identified which are potential targets for drugs against malaria...

In silico docking enables researchers to compute the probability that potential drugs will dock with a target protein – in this particular case that potential drugs will dock on the active site of one of the malaria parasite proteins. On a single computer, a study like this with 100,000 potential drugs would normally require six months to complete – but on the EGEE grid it was achieved in just two days.

A significant contribution to the success of the project came from Mahendrakar Sridhar, a B-IT LSI student. In his Master Thesis with Fraunhofer SCAI, Mahendrakar Sridhar deployed two docking applications, AutoDock and FlexX, on the EGEE grid. Together with our colleagues at the IN2P3 institute in Clermont-Ferrand, he managed to get more than 40 million individual docking experiments executed; the docking results alone accumulated to more than 11 Terabyte of data.

VS-Explorer, the software written for the analysis of large scale docking experiments, enables manipulation (like **merge** *and* **sort***) of lists larger than 400,000 lines. In addition, it allows visualization of the structure of all molecules loaded along with the list. This makes VS-Explorer ideal for users looking at large scale docking experiments from the biologists or chemists perspective.*

LSI student Dominik Novotni published two papers in the METMBS 03 and CASC 04 conferences under the guidance of Prof. Andreas Weber.

International Program of Excellence in Computer Science

Prof. Dr. Joachim von zur Gathen, Computer Security

Joachim von zur Gathen received his doctorate from the University of Zurich, Switzerland. He served on the faculty of Computer Science at at University of Toronto and on the faculty of Applied Mathematics at University of Paderborn prior to joining B-IT Uni Bonn as a full professor of Computer Security in December 2004. Prof. von zur Gathen has led several major national and international projects in the field of cryptography and is the Editor of the journal Computational Complexity.

Prof. Dr. Stefan Kowalewski, Embedded Systems

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.

In 2004-2005, the number of courses and participants in IPEC increased significantly over the year before, fostered among other aspects by the addition of Prof. Dr. Joachim von zur Gathen to the B-IT faculty. 16 courses were taught in the Winter School 2005 and 13 courses were taught in the Summer School 2005. Major topics included formal methods computer science, communication and security, computer graphics and chemoinformatics. In addition to traditional lectures, practical lab courses played a major role.

Experiences in the first years of B-IT have shown that many applicants for the unversity master programs, especially those coming from applied undergraduate programs, suffer from major gaps in their background knowledge of theoretical computer science, even if they appear otherwise highly qualified. To address this problem, B-IT IPEC has created a bridging course which aims at closing such gaps. The bridging course "Foundations of Computer Science" was held for the first time in September 2005 in a joint effort of four professors. In four weeks of full-time study, it covered topics from design and analysis of algorithms, linear algebra and modular arithmetic, automata to complexity theory.
The learning atmosphere in the course showed that a lot of communication and exchange of knowledge took place. The students appreciated the repetition as well as the new material and were enthusiastic in dealing with a wide bandwidth of objects and relations. Since this is one of the first events where new B-IT students meet each other in a new country, this is also a melting pot and an exchange platform for first experiences in a foreign environment.

The availability of the B-IT building also enabled IPEC to run, for the first time, a number of national and international events, including the GAMES Winter School, the GI Informatics Days, and parts of the German national computer conference, INFORMATIK 2005.

The B-IT Computer Security Group

The B-IT cosec (**co**mputer **sec**urity) group, headed by Prof. Dr. Joachim von zur Gathen, currently comprises Dr. Michael Nüsken as postdoc, and Volker Krummel, Laila El Aimani, and Jamshid Shokrollahi as graduate staff. The group's teaching focuses on various aspects of computer security, while its research addresses, in addition, questions of computer algebra, computational complexity, and finite field computations.

The teaching program of cosec aims to provide a broad background in modern cryptography and security, and also offers courses and seminars on more specialized areas, such as Electronic Cash, Efficient Cryptography, or Bluetooth Security.

The courses are geared towards B-IT Media Informatics and the IPEC. In the spring of 2006, the workshop 'Schüler-Krypto' 2006 for high school students will be offered with the aim to give a first insight into cryptography.

Cosec research focuses on cryptography and topics contributing to it. Elliptic curves provide the basis for various cryptographic systems, be it to encrypt an electronic document, to sign it, to authenticate oneself via an insecure channel, or to identify oneself to a communication partner. One major research topic is to accelerate the addition on these elliptic curves as much as possible using various techniques from hard- and software design. Our FPGA crypto processor can calculate a digital signature based on elliptic curves in 0.18 ms – the world record at the time of its construction.

The factorization of polynomials falls within the wider area of computer algebra and has applications concerning elliptic curves, but is a challenge in itself. The group holds the world record – factoring a polynomial of degree more than one million (over the binary field).

The GAMES Spring School

A Spring School on Infinite Games and Their Applications was organized on March 15–19, 2005 by Professors Wolfgang Thomas and Erich Grädel, both RWTH Aachen University, and I. Walukiewicz (CNRS, University of Bordeaux) in the context of GAMES, a European Network of Training and Research. The aim was to give young researchers intensive training in a rapidly developing theory of non-terminating games between several agents that can be exploited to give powerful methods for modelling, automatically verifying, and synthesizing reactive systems. Nine tutorials were given by international experts from France, Germany, Sweden, Switzerland, the UK and the US.

The scientific committee selected 45 participants from 13 countries: Austria, Belgium, Czech Republic, Croatia, France, Germany, Great Britain, Israel, Netherlands, Poland, South Africa, Spain, Sweden, The spring school benefited a lot from the exceptional location and setting that the B-IT offers. The B-IT staff helped in many ways with technical matters, catering, and administrative support. On the third day of the school, the afternoon was spent on a bus (and walking) tour to the old Drachenfels castle, to Schloss Augustusburg in Brühl and to the Cologne Cathedral.
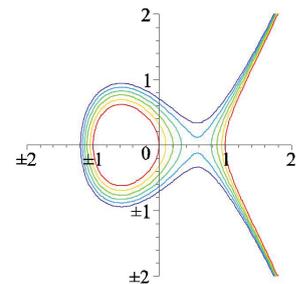
Elliptic curves provide the basis for various cryptographic systems.

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 Autonomous Intelligent Systems AIS in performing the program. The program started in the winter term 2002. It is managed by three professors (Kraetzschmar, Plöger, Prassler) and two teaching and research assistants (Nowak, Hartando).

Students get a solid theoretical background in Autonomous Systems. Examples of lectures are Control and Systems Theory, Real Time Systems, Computer Vision, Robot Manipulation, Distributed Systems, Planning, Reasoning and Control, or Machine Learning. The students may specialize in System Design, Sensors and Modeling, Navigation or Manipulation, for example. The courses are combined with research projects at Fraunhofer AIS. Thus the students learn to apply and extend their theoretical knowledge by actually building systems.

B-IT Automous Systems accepts students twice a year. In the academic years 2004 and 2005, a total of 39 students from 15 countries were admitted. Six of the students admitted in previous years have completed their degree so far. Master student Matthias Salmen co-authored a paper in the ICRA 2005 International Conference with his advisor, Prof. Plöger, and accepted a PhD research position in a research institute affiliated with RWTH Aachen University.

Out of the presently ongoing seven internal and three external Master theses listed below, four resulted in conference paper submissions.

Sven Olufs: *Vision-Based Probabilistic State Estimation Using Omnidirectional Cameras*

Stefan Cotourier: *A JavaSpace Client for Small Devices*

Abheek Kumar Bose: *Rapid Prototyping of Mobile Robots for Rough Terrain Using Evolutionary Strategies*

Ramineni Prasad: *Detecting Obstacles and Artifacts in Sewer Pipes Using Laser Strip Image Analysis*

Kai Pervölz: *Object Classification and Object Identification as a Combined Approach*

Florian Adolf: *Benchmarking Real-World Object Recognition*

Krishna Chandran: *Performance Comparison of a Smart Camera and a Passive Camera System*

During the last year Prof. Plöger moderated and chaired two workshops on the application and usage of robotics systems in educational programs, namely at GO 2005 in Paderborn and at the Annual GI meeting in September in Bonn. At the GI conference he organized and chaired the respective workshop.

Autonomous Systems students in front of the main building of the Bonn-Rhein-Sieg University of Applied Sciences

B-IT Educational Robotics

Gerhard Kraetzschmar received a Dr.-Ing in Computer Science from the University of Erlangen in 1996. His professional experience includes positions as research scientist at the Bavarian Research Center for Knowledge-Based Systems (FORWISS) and as research assistant professor in the Department of Neuroinformatics at the University of Ulm. His research interests span robotics, artificial intelligence, artificial life, and neuroinformatics. He founded and led for many years one of the top-rated RoboCup teams. In April 2005, Dr. Kraetzschmar was appointed Professor for Autonomous Systems at the Bonn-Rhein-Sieg University of Applied Sciences. At Fraunhofer AIS, he is involved in projects in educational robotics and leads a European research project in this area.

Prof. Prassler was appointed to be chair of the Standing Committee on Standards of the IEEE Robotics & Automation Society as well as to be Associate Vice President for Industrial Activities of the IEEE Robotics & Automation Society. In addition Prof. Praßler became a member of the ISO Expert Group on Standardization of Service Robots for Production, and he was appointed to be a member of the Expert Group "Feldafinger Kreis Forschen für die Internetgesellschaft: Trends, Technologien, Anwendungen".

The AIS/B-IT RoboCup Team

Early in 2005, b-itAS decided to spread the ROBOCUP idea beyond the immediate reach of the B-IT Master students to a wider student audience which also included Bachelor students in a Robotic Club at the Bonn-Rhein-Sieg University of Applied Sciences. The students participated in external performances like the tournament ROBOCUP German Open 2005 in Paderborn or a preliminary Dutch national competition organized by Philips at the Technical University Eindhoven. Scientific events co-organized by B-IT Autonomous Systems faculty included workshops at INFORMATIK 2005 in Bonn and at the main German AI conference KI-2005 in Koblenz. In an upcoming soccer-related event at the Fraunhofer office in Brussels, robotic soccer will be one of the main demonstration acts.

Helped by the new volunteers, the AIS/B-IT team reached quarter finals in the German Open, scored 4:1 in a friendly game to the Alemanniacs Aachen at KI-2005, and ranked second in the Netherlands. These results show a clear positive gradient. A near future step will now be to find a sustainable sponsorship for the team.

AIS/B-IT became the Dutch Vice Champion

At KI2005 in Koblenz, the match between AIS/B-IT Bonn and Alemaniacs Aachen was played for the first time ever in a very large gymnasium.

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.

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

Entrance of Birlinghoven Castle

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 the main research topics.

Fraunhofer IMK

The research and development activities of the Fraunhofer Institute for Media Communication IMK encompass all facets of the new media, including content design, production, distribution, and interaction. The key objectives of the IMK are to expand the range of potential and functionality of the new media, to study their creative and social possibilities, to develop innovative solutions and to open up new fields of application. Key topics are virtual environments, interactive TV, interface technologies, digital storytelling, management of multimedia content, web-based solutions and knowledge management.
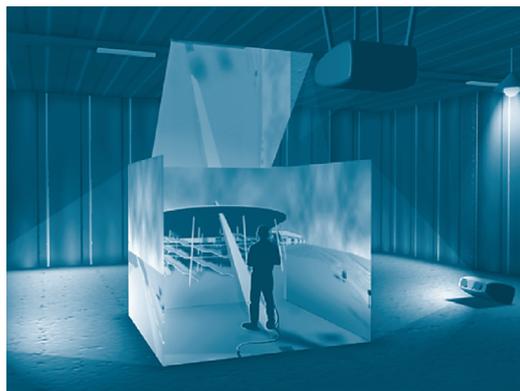
Advanced 3D projection technology at the Fraunhofer Institute for Media Communication IMK

Fraunhofer SCAI

Computer simulation in product and system development by means of mathematical methods and models helps to keep development time and costs low. The Fraunhofer Institute for Algorithms and Scientific Computing SCAI offers a wide spectrum of mathematical and IT methods and software developments geared to specific customers' wishes to solve not only application problems in industry but also problems in natural and engineering sciences. The research fields include simulation engineering, numerical software, optimization, bioinformatics, and web-based applications.

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 two campuses at Sankt Augustin and Rhein-bach are well equipped with modern laboratories, studios, workshops and facilities for cooperative research. By 2004, the five departments will accommodate more than 4.000 students and about 120 faculty members.

The Department of Computer Science offers a Bachelor and a Master program in Computer Science. 25 faculty members are teaching about 600 students; their research covers a broad range of applied computer science topics.

Fraunhofer AIS

Fraunhofer AIS 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 core areas of the institute that was founded in 1998.

AIS develops 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 AIS systems for interactive support of location analysis and marketing campaigns. AIS software simplifies generating and sharing ideas in small teams and large groups, e.g., for citizen participation in urban planning. Complex systems are modelled in AIS with multi-agent systems that have been developed in telematics applications.

In the field of autonomous robots, AIS develops sensor-based, robust wheel-driven and walking mobile robots. The institute is a leader in the research on sensor fusion of 3D laserscanner 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, AIS 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.

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

b-it Bonn-Aachen International Center for Information Technology

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 the 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.bit-center.de for current admission details.

Fees and Finances

Tuition fee is normally 650 Euro 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.