b-it
Bonn-Aachen International Center for Information Technology

Annual Report 2003-2004

Vice Minister Hartmut Krebs

Prof. Dr. Gerhard Barth

Foreword by the Chairman of the B-IT Foundation

The Bonn-Aachen International Center for Information Technology (B-IT) exemplifies the strategy of excellence clusters pursued by the German national and state governments. 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 postgraduate education in the competition for the best international students. B-IT's fields of study are closely linked to the economic needs of North Rhine-Westphalia that has seen a transfer from traditional industry and government to modern communication and media industries as well as life science industries in the last few years.

In the second year of B-IT operation, progress in reaching these goals has further accelerated in all important aspects for such an innovative enterprise: faculty hiring and student quality, international networking and infrastructure investments, formal recognition through accreditation and set-up of the internal organizational structure.

The third year has begun with another important event: the long-awaited move into the beautiful B-IT building on the banks of the river Rhine. This new local identity in the emerging United Nations sector of Bonn further strengthens the international character of the institution. I would like to thank the leadership and faculty of B-IT for the accomplishments so far, and wish B-IT continued success in the future.

Hartmut Krebs
Vice Minister of Science and Research NRW
Chairman, B-IT Foundation Council

The International Advisory Council of B-IT

The universities participating in B-IT have jointly established an International Advisory Council, whose mission is to ensure the relevance of B-IT's educational efforts for careers in the business world, to monitor B-IT's competitiveness in comparison with other leading institutions worldwide and to foster B-IT's further development by giving recommendations and guidelines.

The rectors of the participating universities have appointed me as Founding President. It gave us great pride to gain internationally renowned persons from academia and industry as members of the Council:

- Prof. Dr. Gerhard Fischer, Director of the Center for Lifelong Learning and Design, University of Colorado, Boulder
- Dirk Friebel, Head of Nokia Research Center, Bochum
- Prof. Dr. Oussama Khatib, Director of Robotics Lab, Stanford University, Palo Alto
- Prof. Dr. Thomas Lengauer, Director, Max-Planck-Institute for Informatics, Saarbrücken
- Prof. Dr. Hermann Maurer, Head of Media Lab, University of Graz

The first meeting was held in September 2004. Members of the International Advisory Council were given detailed reports by the directors of B-IT about past and present activities. Furthermore, future plans were presented and assessed. The overall goals of B-IT were agreed upon by the council. Several measures for further strengthening industrial links and worldwide competitiveness of the institute were suggested. In particular, ways for setting up an internship program for B-IT as well as for activities in continuing education were explored.

It was generally accepted that this institution is indeed a highly promising effort towards the internationalization of applied computer science education in Germany.

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

Bonn-Aachen International Center for Information Technology

b-it

Overview by the Founding 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, smoothing the transition from the traditional Diploma system to the Bachelor-Master system mandated by the European Bologna treaty. Supported by the B-IT Foundation, 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 offers special courses for the brightest local CS undergraduates.

2003-2004 was the first academic year of full-scale B-IT operation. About sixty students joined in the fall of 2003, another seventy were selected in a highly competitive process to start in 2004-2005. Students from 22 countries all over the world are now enrolled in B-IT. Recently, B-IT also saw the first graduations from the small initial pilot group of students.

An extremely important step has been the hiring of top faculty for the endowed professorships created by the B-IT Foundation. With Professors Bajorath (formerly Albany Molecular Research and University of Washington, Seattle, USA), Borchers (Stanford, ETH Zürich), and Kowalewski (Dortmund University and Bosch Research), three of the four full professorships have now been filled, likewise three of the five associate professor positions with Professors Plöger, Prassler, and Rose. This enthusiastic young faculty as well as the student quality proved a major factor in the successful recent accreditation audit.

An internationally competitive teaching institute such as B-IT requires strong international networking. In the spring of 2004, cooperation treaties of the NRW research ministry with its counterparts in NRW's two partner provinces Jiangsu and Sichuan in China were concluded. With a successful joint application with Edinburgh (UK) and Trento (Italy) in the new Erasmus-Mundus Program we also had a good start

B-IT main building, overlooking the Rhine

for networking within Europe. The formation of our International Advisory Council with representatives from business and international research will surely form a good basis for the next steps.

Despite all these successes, the lack of a stable place for teaching and working has been a major concern for teachers and students. The completion of the renovation in the B-IT building enabled us to start classes 'at home' just-in-time on October 11, 2004; we feel a decisive step has now been accomplished towards being a 'real' institute.

The list of people who have helped us to get thus far is too long to be mentioned here in full: the Foundation Council under the strong leadership of Vice Minister Hartmut Krebs, the International Advisory Council with its founding president Prof. Gerhard Barth, Professors Rainer Manthey and Otto Spaniol as chairs of the Study Program Councils for our international master programs, and the assistant directors and study advisors. Most importantly, we would like to thank our students for excellent cooperation in the sometimes challenging setting of a brand-new institution.

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, Bonn-Rhein-Sieg University of Bonn, University of Applied Sciences and the research institutes of the Fraunhofer Institute Center Birlinghoven Castle. An International Advisory Council with Prof. Dr. Gerhard Barth as its founding president advises on strategic directions of the B-IT study programs and links them with the business and international research community.

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.

The B-IT Universities Institute offers English language Master of Science (M.Sc.) programs in Media Informatics and Life Science Informatics, whereas the B-IT Applied Science Institute 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 Bonn University 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. In October 2002, the B-IT Foundation began its work by approving its first five-year funding plan, 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. Including the beginners of the 2003-2004 academic year, about 130 students are currently enrolled in the three B-IT Master Programs.

Home Countries of B-IT Students

Misc. 10%
Asia 7%
Rest of Europe 11%
Germany 5%
Pakistan 18%
India 28%
P.R. China 21%
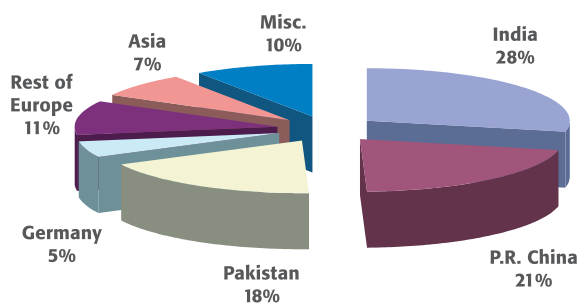
Nine endowed professorships funded by the B-IT Foundation have been established. In addition, professors from various departments of the partner universities, senior researchers from the participating Fraunhofer institutes, and cooperation partners from the application disciplines, including the DFG-funded Collaborative Research Center 'Media and Cultural Communications' contributed to a rich teaching program in B-IT. Nine endowed professorships funded by the B-IT Foundation have been established.

Media Informatics students flock around the Program Coordinator, Prof. Spaniol, and Prof. Borchers in front of the new 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. Hans W. Nissen, RWTH Aachen University
Dr. Stefan Lüttringhaus-Kappel, Dr. Thomas Bode, University of Bonn

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

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

B-IT Foundation
Hartmut Krebs (Chairman)
Vice Minister, North Rhine-Westphalian
Ministry of Science and Research
Hans Stender (Secretary)
Chancellor, Bonn-Rhein-Sieg University of
Applied Sciences
MinDir Dr. Hermann Müller-Solger
Federal Ministry of Education and Research
Prof. Dr. Dennis Tsichritzis
Board of Directors, Fraunhofer-Gesellschaft
Bärbel Dieckmann
Lord Mayor, City of Bonn
Frithjof Kühn
County Chairman, Rhein-Sieg-Kreis
Prof. Dr. Burkhard Rauhut
Rector, RWTH Aachen University
Prof. Dr. Matthias Winiger
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

Events and Visits

Minister Kraft signing the cooperation agreement with Jiangsu Province in Nanjing

Prof. Cremers welcomes first international guests in the newly renovated B-IT build-ing: (from left) Prof. Manwu Hu (Nanjing University), Mrs. Xueying Zhang (Nanjing), Prof. Feng Yu Liu (Nanjing University of Science and Technology) paying a counter visit from Jiangsu Province

International Networking

In pursuance of our goal to establish relationships with international partners in science and business, a number of activities were undertaken.

In February, Prof. Jarke accompanied Minister of Research Hannelore Kraft on a visit to China. During this visit, cooperation treaties for pre-selection and support of top students were signed with the Education Departments of NRW's partner provinces, Jiangsu and Sichuan. Moreover, discussions with the related federal ministries and visits at various individual universities led to further cooperations, in particular with Qinghua University, the top university in China. Several countervisits by the Chinese partners assisted in the successful implementation of the signed agreements despite the short time between the visit and the B-IT application deadlines. Among the students who join B-IT in the academic year 2004-2005, about a dozen have been selected with the help of these cooperation treaties.

In its new Erasmus-Mundus Program, the European Union promotes the joint activity of leading European university programs on the international market for higher education through attractive stipend programs for top international students. A double-degree program of B-IT Media Informatics with partner programs at the Universities of Edinburgh (UK) and Trento (Italy) was one of two successful computer science programs from the roughly 170 applications submitted for the first call of this program.

After careful preparation, the B-IT Universities Institute submitted – in July 2003 – the application for accreditation of the Master Programs in Media Informatics and Life Science Informatics with ASIIN, the internationally recognized German accreditation agency for engineering, computer science and natural sciences. The accreditation audit, held on November 3, 2004, was highly successful and earned B-IT strong applause both for its approach and for the quality of its faculty and students.

Scientific Events

As in the previous year, several symposia and distinguished guest lectures provided opportunities to expose B-IT students to the scientific and business communities in order to improve the linkage between research and teaching. In the sector of Media Informatics, symposia addressed Computer-aided Competence Management as an aid to personnel development (April 2004), and Future Virtual and Interactive TV (October 2004). In Life Science Informatics, symposia addressed Text Mining in the Life Sciences (October 2004) and HTS Data Analysis and Applied Chemoin-

formatics (November 2004). In the context of Autonomous Systems, a Symposium addressed Knowledge-Based Systems and Solutions for the Public Sector (April 2004), but more important-ly, many of the systems co-developed by B-IT students were demonstrated at external robotics events (see p. 15).

In addition, a large number of Distinguished Guest Lectures were held, among them:

The History of CSCW
Prof. Giorgio de Michelis, University Milano Bicocca (November 2003)

Generating Multimedia Presentations
Stefao Bocconi, CWI Amsterdam (February 2004)

Holistic Human-Centered Computing - A Vision for Business-Research Cooperation
Dr. Michael Brodie, Chief Scientist Verizon Inc., Boston, MA (May 2004)

eGovernment Strategies in China
Prof. Gan Renchu, Dean, Beijing Institute of Technology (June 2004)

Architecture, Design, Implementation, and Performance Evaluation Strategies for New Generation Search Engine
Prof. S.V. Raghavan, Indian Institute of Technology Chennai (September 2004)

The B-IT Building

Precisely on October 11, 2004, the starting date of the new academic year, the B-IT building in Bonn-Bad Godesberg finally opened its doors, following a renovation period of more than a year. Students and faculty alike expressed their happiness that a period of distributed classes, time losses through travel, and improvisation in terms of resource access, is coming to an end.

The B-IT building is situated in a large park over-looking the river Rhine. The building, the former 'embassy' of North Rhine-Westphalia to the German federal government, has office space for two large research groups, faculty coming in from Bonn and Aachen, several student com-puter rooms, five classrooms and six specialized student laboratories, plus numerous facilities for socializing and teamwork. It is located next to the former office of the German Federal Chancellor, now the Ministry of International Cooperation, and is embedded in an emerging network of United Nations institutions located in the southern part of Bonn, the former German capital and emerging science city. Bonn's fa-mous 'Museum Mile' is just a couple of hundred meters away, the headquarters of companies such as Deutsche Telekom and Deutsche Post, but also the Federal IT Security Institute (BSI) are within walking distance. Students have, in addition, access to the library and computing fa-cilities of the University of Bonn, the Fraunhofer Institute Center Birlinghoven Castle (where most lab courses continue to take place, about six kilometers away from the B-IT building), or even RWTH Aachen University.

The B-IT cafeteria is an attractive place between classes

Master Program in Media Informatics

Thomas Rose holds a Doctoral degree in Computer Science from the University of Passau. As a postdoc at the University of Toronto, he investigated repository technologies for engineering applications. Subsequently, he headed the department of business processes and telematics at the Research Institute for Applied Knowledge Processing (FAW) in Ulm, and is currently responsible for the business area Process Management and Decision Support at Fraunhofer FIT. In October 2004 he was appointed Associate Professor for Media Informatics at RWTH Aachen. His research interests include process management and 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's degree in Computer Science typically qualifies to participate in large software projects, the Master's 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.

The program is distinguished by its international orientation, its focus on IT competence, and its high level of integration of research and teaching. The course contents is structured according to the ECTS (European Credit Transfer System) and consists 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. Special courses on modelling of spatial and mobile aspects, and on usage, annotation, and retrieval of spatial data provide for a special focus in the important application domain Geographical Information Systems. The program also includes methodological aspects of designing media informatics systems from the perspectives of software engineering, usability, media design, and business requirements.

The final six months are dedicated to the master thesis that can be undertaken in cooperation with industry. Examples of recent Media Informatics-related thesis topics include: a cultural heritage internet community for the rebuilding of science in Afghanistan, the worldwide first webservice provider system implemented on a mobile phone, novel annotation systems for electro-acoustic music, and semantic analysis and navigation support for large multimedia movie repositories.

In fall 2003, the first full class of 35 students were admitted out of 94 applicants, in fall 2004, it was again 35 beginners out of 130 applicants altogether there are now 70 students from 21 countries. Two students were awarded the prestigious Erasmus-Mundus stipends.

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Designing Interactive Systems

Prof. Borchers with students during a project-centered, group-based studio class in the Media Computing Laboratory. Students share computers in groups of two, and the 'cell space' with their two peers behind them, to facilitate group work.

Prof. Jan Borchers' Media Computing Group conducts research in Media Computing and Human-Computer Interaction (HCI) that goes beyond today's graphical user interface and desktop metaphor. Grounded in Computer Science, the group develops and studies new interaction theories, techniques, and systems in the areas of interaction with multimedia, ubiquitous computing environments, tangible user interfaces, and HCI design patterns. Their mission is to make the Brave New World of ubiquitous multimedia technologies useful – by making it usable. Current research projects include conducting gestures for digital orchestra recordings, phonecams as user interfaces for large public displays, and a framework to support professional interactive jazz improvization.

The group offered two classes in Bonn this year. 'Designing Interactive Systems I' helped students develop a more humane approach to interactive technology. It covered basic human cognitive abilities, interactive systems that shaped the history of HCI, and principles of user-centered design, prototyping, and evaluation. A follow-up class covered the technology, from devices and window systems, to post-desktop and multimodal interfaces. All classes featured continuous, project-centered, group-based assignments, helping students to acquire essential social skills along the way. Additional classes were offered via video link from RWTH.

Localized Interactive Mobile Gaming

The gaming industry is one of the major players in Media Informatics. Linked to several large European projects in the fields of Mobile eLearning and Pervasive Gaming, a lab course at Fraunhofer FIT developed and evaluated technologies for augmenting the old children's game of 'Hide & Seek' by giving the players advanced PDAs to communicate and to find out the location of the other players. By offering better and technologically sophisticated amusement we hope to draw people from higher age groups into the game – which in turn is necessary to cope with the technical complexity of interaction and localization.

The students in the project created scenarios to work out the strategies of the game. Use cases showed the interaction of different role players with the system. Sequence diagrams were used to formalize the interactions as a basis for the functional specifications. A prototype using WLAN-based localization technology was developed and tested by a group of students on three floors of the Fraunhofer FIT building.

Student in an outdoor game created at Fraunhofer FIT

Master Program in Life Science Informatics

Jürgen Bajorath holds a Ph.D. in Biochemistry from the Free University in West Berlin. He worked in industrial research in the USA for nearly 15 years, since 2001 as a Senior Director at the Bothell Research Center of Albany Molecular Research, Inc., a company active in chemistry-based drug discovery and development. Since 1995, he also holds an appointment as Affiliate Professor of Biological Structure at the University of Washington. In November 2004 Jürgen Bajorath was appointed as Full Professor (C4) at the University of Bonn. His experience and interests include research and development in the CADD and chemoinformatics areas, characterization of therapeutic target proteins, and interdisciplinary drug discovery research.

The Master Program in Life Science Informatics, which started in the fall of 2002, is offered by the University of Bonn and RWTH Aachen University. 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 program is distinguished by its international orientation, by its focus on both science and IT competence, and by its high level of integration of research and teaching. 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, management and retrieval of information, data mining and machine learning, statistical genetics, drug design, medical imaging and visualization, computational neuroscience, computational modelling of regulatory and metabolic networks, and systems biology. The program emphasizes a profound understanding of biological structures (such as proteins, nucleic acids, genes, metabolic and neural networks) 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 adequate 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 for Applied Information Technology FIT and for Algorithms and Scientific Computing SCAI. The final six months of the program are dedicated to the master thesis which can be done in cooperation with industry. The course contents is structured according to the ECTS (European Credit Transfer System). 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 development, 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. In addition, with their strong focus on biomedical research, the University of Bonn and the University Hospital Bonn offer interesting opportunities to work closely with experimental researchers.

The first group of seven LSI students selected in fall 2003 has now reached their 3rd semester. Selected from a range of 80 applications received in 2004, fifteen new LSI students started their studies in this second year in which the program is being offered.

Campus GRID

The CampusGRID Bonn Aachen project involves the University of Bonn, RWTH Aachen University and the Fraunhofer Institutes FIT and SCAI in a distributed, virtual organization. It is prototypical of distributed resources and virtual collaboration, two key elements of the GRID computing paradigm.

GRID computing aims for a complete virtualization of resources, regardless of whether they are CPUs, storage or machinery (e.g. life science lab equipment). It is the basis for new approaches to address compute-intensive scientific problems involving large amounts of data in a distributed, virtual environment.

Using B-IT as an organizational framework, researchers from the computer science departments involved in the B-IT Universities Institute and scientists from most of the life science
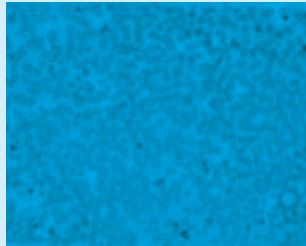
Automated image analysis of cell-based assays is increasingly needed in industry. Students may experiment with algorithms to detect cells (shown here) and to derive quantitative measures from the image.

institutes in Bonn and Aachen have teamed up in a project to implement Germany's first Life Science GRID, the *Campus*GRID Bonn Aachen. It focuses on the Life Science Informatics curriculum of B-IT and will provide a setting for teaching and research where LSI students work closely with researchers in the life and medical science institutes; building and evolving the *Campus*GRID, the students will get involved in scientific problems that arise in experimental life and medical sciences and that will be addressed by theoretical as well as applied computational biology approaches.

Dr. Martin Hofmann supervised the lab course on life science database management at Fraunhofer SCAI.

International Program of Excellence in Computer Science

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 courses coordinated with the bachelor programs planned in Bonn and Aachen 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 which accelerate the master studies at the B-IT as well as regular summer and winter schools which 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 perception. It also brings together outstanding students with internationally noted scientists and with fellow students from abroad and activates new forms of encouraging competition between 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. Courses taught in the Winter School 2004 and the Summer School 2004 include:

- Introduction to Databases (Jarke, Aachen)
- Design of Embedded Systems (Kowalewski, Aachen)
- Applied IT Security (Gärtner, Aachen)
- Digital Signal Processing (Clausen, Bonn)
- eXtreme Programming I, II (Cremers, Bonn)
- Analysis of Numerical Codes (Naumann, Aachen)
- Morphing and Blending Techniques (Müller, Bonn)
- Modeling and Visualization of Hair (Weber, Zinke, Bonn)
- Mobile Ad-hoc Networks and Internet Measurements (Martini, Bonn)
- Local and Personal Area Networks (Martini, Bonn)
- Erasure-Resilient Online Processing Systems (Karpinski, Bonn)
- Technologies for Web Application Development (Westfechtel, Aachen)
- Use Case-Based Application Development with Java (Lichter, Aachen)

Courses in the Winter School 2004 and in the Summer School 2004 were still held at different premises of the University of Bonn, RWTH Aachen University, and the participating Fraunhofer institutes, whereas externally oriented symposia (see p. 6) used mostly the facilities of Fraunhofer's Birlinghoven Castle.

The opening of the B-IT building has significantly expanded the possibilities. Besides other courses, the Winter School 2005 will include an international Winter School course on Games and Automata for Synthesis and Validation. In addition, B-IT will host the highly visible annual conference of the top German diploma/master students and their advisors with prospective employers under the auspices of the German Informatics Society (GI) which in previous years has been held in Bad Schussenried Monastery.

Integrated Teaching of Digital Signal Processing in IPEC

Prof. Michael Clausen and Dr. Meinard Müller have offered three closely inter-related courses within the International Program of Excellence (IPEC) at B-IT: In August 2003, they conducted a lecture titled Basic Concepts of Digital Signal Processing, followed by a lab course on 'Digital Signal Processing' in March 2004, and a seminar 'Morphing and Blending Techniques' in August 2004.

For the lab course and the seminar, students – most of them second or third year undergraduates – were carefully picked on the basis of face-to-face interviews. Nearly all of the admitted students were performing well above average, highly motivated and able to work accurately as well as independently. They showed a very good understanding of their demanding projects, concerning the theoretical background as well as the programming technicalities. Students appreciated the compact teaching units between the terms since they not only allowed them to concentrate on one class and one project at a time but also enabled them to get into much closer contact with the lecturers and fellow students than it is usually the case during the terms.

This example demonstrates how careful inter-linking of course offerings indeed achieves the desired acceleration effect. For example, one of the students has already fulfilled nearly all course requirements on the graduate level even though he has just finished his second year.

Continuing Education

Another important development direction enabled by the modularity of the B-IT programs is a stronger role the B-IT can play in Continuing Education, Technology-Enhanced Learning, and Lifelong Learning. In cooperation with the 'Coordination Center for Continuing Education in Information Technology in North Rhine-Westphalia' www.wwbit.nrw.de and with the CHE Center for University Development, an initial strategy for developing and marketing such offerings in a systematic manner has been developed and discussed with the International Advisory Council.

The initial step of this strategy involves the extraction of continuing education modules from B-IT's core competencies (Master Programmes, IPEC), the linkage of this content to the existing wwbit portal and the cooperation with initial reference customers from the region. In a second step, the ability to custom-tailor complex Corporate University offerings will be added which also include modules from partner institutions outside B-IT. In a third step, the formation of a separate legal entity as a joint venture in public-private partnership would be considered.

The strategy was submitted as an entry in the competition 'Universities in the Continuing Education Market' of the Stifterverband für die Deutsche Wissenschaft in spring 2004. It was evaluated to be highly target-oriented by the jury. Especially the strong potential of co-operation possibilities between the participating B-IT institutes was emphasized.

Complementing this activity, several B-IT partners have taken leading roles in the ProLearn Network of Excellence in Professional eLearning www.prolearn-network.org with the intention to strengthen the role of B-IT in the landscape of research and teaching in technology-enhanced learning in Europe.

Master Program in Autonomous Systems

Paul-Gerhard Plöger received his Ph.D. from University of Dortmund. He held research positions at University of Dortmund and at Fraunhofer AIS, where he designed and launched the Volksbot educational robot platform. In 2004 he was appointed as Associate Professor at Bonn-Rhein-Sieg University of Applied Sciences. His current research focuses on control and perception algorithms in robots, especially the application of recurrent neural networks and new analog VLSI vision sensors (silicon retinas). At Fraunhofer AIS he is responsible for the business area Application and Usage of Robots in Education.

Erwin Prassler received a Ph.D. in Computer Science from the University of Ulm. He has held research positions at the Technical University of Munich, University of Toronto and the Research Institute for Applied Knowledge Processing (FAW) in Ulm. At Gesellschaft für Produktionssysteme (GPS) in Stuttgart he headed the department for Project Management and Technology Transfer and coordinated a major national research project on Interaction and Communication between Humans and Intelligent Robot Assistents. In March 2004, Dr. Prassler was appointed as Associate Professor at the Bonn-Rhein-Sieg University of Applied Sciences where he works on topics such as planning, reasoning and control, robot manipulation and service robotics.

Students of the Master Program in Autonomous Systems and some of their mentors from Fraunhofer AIS in front of Birlinghoven Castle

The Master Program in Autonomous Systems is offered by the B-IT Applied Science Institute that is associated with the Department of Computer Science of the Bonn-Rhein-Sieg University of Applied Sciences and works closely with the Fraunhofer Institute for Autonomous Intelligent Systems AIS. The program started in 2002 and is managed by three professors and two teaching assistants. In 2004, Paul Plöger and Erwin Prassler have been appointed as new faculty members.

The program combines courses in Autonomous Systems with research projects at the Fraunhofer Institute AIS or a company in the region. In addition, students are individually mentored by a professor and a senior researcher. Thus from a solid theoretical background in Autonomous Systems the students learn to apply and to extend their knowledge by actually building systems. They are motivated to research in more depth by the problems they encounter in their projects.

The curriculum starts with lectures on the theoretical background of Autonomous Systems: Control and Systems Theory, Real-Time Systems, Computer Vision, Robot-Manipulation. In addition, general techniques such as introduction to scientific work and software team techniques are taught. In semester two and three, further lectures and courses such as Distributed Sys-

tems, Planning Reasoning and Control, Filters and Sensors or Machine Learning occupy only half of the student's work; the other half is devoted to projects that represent a specialization of the studies in one of the following six fields:

- System design
- Distributed and ubiquitous systems
- Planning, reasoning and control
- Sensors and modelling
- Navigation
- Manipulation

Example projects include behaviour programming for mobile robots, algorithms for active camera vision and laser scanners, three-dimensional object recognition, sensor developments, middleware for mobile devices, sensor networks, learning and neural networks, real-time control for mobile robots. Addressed application scenarios range from industrial automation in the textile industry to mobile robot challenges that are set up in the RoboCup initiative (see report on p. 15). Semester four is dedicated to the Master Thesis. In 2004, the first three students completed their thesis:

Martin Linden: Highly Dynamical Touchless Velocity and Length Measurement of Textile Yarns via the Laser Doppler Anemometry Method.
Ronny Hartanto: Making Dual Dynamics Office Navigation Behaviors Target-oriented.
Matthias Salmen: Echo State Networks Used for Motor Control.

The complete Master Program is structured according to the European Credit Transfer System (ECTS) and comprises 120 credit points. Admission is twice annually.

In 2004, from more than 130 applications, ten new students enrolled per semester. While the first students who started their studies in October 2002 obained their Master Degree (see below) and now pursue further research towards a doctoral degree, currently a total of 32 students from eight different countries and three continents are enrolled.

B-IT Excursion to the RoboCup World Championship Lisbon 2004

Since 1997 the RoboCup Federation (www.robocup.org) conducts yearly World Championships in robotic soccer. The events attract more and more attention from the general public and also from the scientific community. During the tournaments scientists from all around the world meet and discuss new technologies and recent developments relevant for autonomous mobile robots. Topics span a wide range from embedded systems, mechatronics, behavior-based robotics, complex wireless communication and new sensors to real-time data processing, data fusion, real-time color processing, machine learning, multi-agent systems and system integration.

This year the tournament took place from June 27 to July 6 in Lisbon, Portugal. The B-IT Master Program in Autonomous Systems sent two teams:

- The Robot Soccer team played in the so-called Middle Size League (MSL), where the participating robots have a maximum size of 50 by 50 cm. They support wireless communication but only allow for local sensing, i.e., all computing power, sensors and actuators are carried on-board.
- KURT3D competed in the Real Rescue League, where the task of the robot is to spot helpless humans in an artificial disaster environment.

Our MSL team faced 6 other German teams, and international competitors came from Portugal (5), Japan (3), two from Italy, Netherlands and Iran, one from China and Austria. The first round went well by winning two games, drawing another two and loosing just one. In the second round we won another game but lost two, thus we were out. Overall the team finished in 12th place.

The AIS/B-IT team presents its robots in a RoboCup technical challenge

KURT3D is vice champion in Robot Rescue; B-IT students are in the team

The rescue team, which participated for the first time, fared much better. There was a keen competition mainly with Japanese teams during the first round and then with two Italian teams. KURT3D finished in second place. The vice champion excelled through its true 3D environment object model gained from an innovative implementation of the iterative closet point algorithm.

In all, the participation of the two teams in RoboCup was a tremendous success. The students were introduced to this worldwide scientific community and had high impact and visibility during the tournament. It is hoped that the B-IT Master Program in Autonomous Systems can keep up to participate in RoboCup at such a high level.

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 Rheinbach 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.

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

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.

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.

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.