

b-it Bonn-Aachen
International Center for
Information Technology

Annual Report 2002 - 2003



Introduction



Hartmut Krebs

Foreword by the Chairman of the B-IT Foundation

The Bonn-Aachen-International Center of Information Technology (B-IT) has had a good start in 2003. Based on close cooperation of several universities and research institutes, it has focused its activities on fostering excellence in education.

B-IT does not just fill a gap left by the introduction of doctoral-level graduate colleges, but has its own specific profile of Bachelor and Master Programs that closely integrate 'conventional' courses and research lab courses for improved curricular efficiency.

This report documents the excellent achievements in the Academic Year 2002/2003.

I am confident that the solid stepwise process of building the institution and the quality of its education will continue in 2004. I wish to thank all involved people for their support and enthusiasm.

Hartmut Krebs
Undersecretary, North Rhine-Westphalian
Ministry of Science and Research;
Chairman of the B-IT Foundation

Guest Commentary

The merger of GMD and Fraunhofer-Gesellschaft has created a leading player in the European IT research. Thanks to GMD, Bonn/Birlinghoven is a location well-known in the international research community and thus highly attractive to top scientific talents from all over the world. And Bonn has attracted headquarters of telecommunication companies like no other German city.

All this gives B-IT a very good chance of becoming, through the cooperation of universities and research institutes, an international top institution that accepts the challenges in this key field and educates the men and women who push IT ahead with leading-edge research.

It is important now to seize this opportunity. The cooperation between RWTH Aachen University and University of Bonn, plus the Bonn-Rhein-Sieg University of Applied Sciences and the Fraunhofer Institutes, is an excellent vantage point.

One critical success factor is to make B-IT an international brand for top-level teaching and research. International orientation of B-IT is evident already in the first classes of students, and everybody involved, scientific community, universities, state and federal governments, should strive hard to make this novel educational institution a resounding success.



Dr. Uwe Thomas
Former Undersecretary,
Federal Ministry of Education and Research

Foreword by the Founding Directors

The Bonn-Aachen International Center for Information Technology (B-IT) is intended as a highly visible 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 programme provides special offerings for the brightest of the local undergraduate computer science students.

After a one-year preparation period, B-IT accepted a small initial set of students in the fall of 2002. Full operation has begun in the fall of 2003. The inaugural Annual Report in front of you, while focusing on the Academic Year 2002/2003, also reflects the founding history of B-IT and the plans for the recently started Academic Year 2003/2004. We hope that the report shows some of the excitement we feel about this important endeavour in research-integrated teaching innovation.

The founding of a new inter-university institute is a major undertaking that could not have succeeded without the help of many people. On the political side, all the members of the Foundation Council – federal, state-level, and regional government representatives as well

as the Rectors of the participating institutions – played a decisive role, most notably State Secretary Hartmut Krebs of North Rhine-Westphalia. The faculty and administration of the Computer Science departments involved, the B-IT Foundation Council Secretary Hans Stender as well as the leaders of the participating Fraunhofer institutes, willingly accepted the great challenge (and significant overtime work) of setting up such a novel institution; in particular, the assistant directors H.W. Nissen and S. Diepolder (RWTH Aachen University), S. Lüttringhaus-Kappel and T. Bode (University of Bonn) should be mentioned here. Last not least, we should like to thank our first-year students for bearing with the adventures related to setting up 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 main building, overlooking the Rhine

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 computer science students. After completion of the current renovation, most courses will 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.

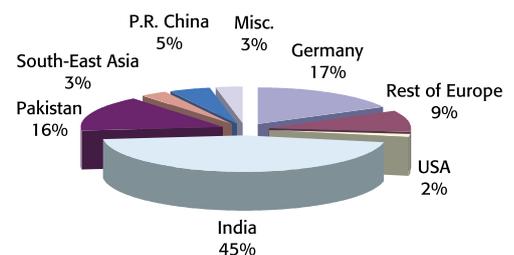
The B-IT Universities Institute offers English language Master of Science (M.Sc.) programs in Media Informatics and Life Science Informatics, whereas the University of Applied Sciences offers a Master Program in Autonomous Systems. The Master Programs prepare students for successful international careers 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 the 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. Participation of industry in the B-IT Foundation is welcome, with the aim of complementing B-IT's degree programs by continuing and executive education.

On October 7, 2002, the B-IT Foundation Council – headed by NRW State Secretary of Research Hartmut Krebs – approved an initial five-year funding plan. At the same time, the Rectors of the participating universities and the Fraunhofer Board of Directors signed a cooperation treaty which defines the ground rules of cooperation in B-IT. One month later, more detailed cooperation contracts were signed and the funding details approved for the year 2002-2003, while the first students were already attending B-IT courses. Until the end of the winter term 2002, the formal curricula definitions and examination rules had been approved by the participating universities for all Master Programs.

Home Countries of B-IT Students



In July 2003, the Rectors of RWTH Aachen University and University of Bonn signed the contract formally establishing the B-IT Universities Institute, which was actually the first joint venture of this kind in North Rhine-Westphalia and therefore a major legal challenge to get accomplished. Follow-up regulations, e.g. concerning cheap commuting of students between Bonn and Aachen, were gradually developed in subsequent months, as the first full wave of about 60 new Master students for the year 2003/2004 – selected from a large number of applicants from all over the world – joined the B-IT programs. In order to reach top potential applicants, written information materials were distributed since December 2002, and a web site was installed (www.b-it-center.de).

A broad range of courses is offered by members of the computer science departments in the participating universities, by senior researchers from the participating Fraunhofer institutes, and by cooperation partners from the application disciplines, among others the cultural research college 'Media and Cultural Communications' operated jointly by the universities of Aachen, Bonn and Cologne. In addition, altogether eight new faculty positions were created, three at the level of Full Professor (C4) at RWTH Aachen University and University of Bonn, five at the level of Associate Professor (C3) in the Bonn-Rhein-Sieg University of Applied Sciences and the participating Fraunhofer institutes. While these positions were already temporarily filled in the Academic Year 2002-2003, the first permanent positions were filled in October 2003.

Last not least, in August 2003, Rectors, Fraunhofer Board, and Ministry agreed to set up a joint international advisory board for B-IT. Prof. Dr. Gerhard Barth, former member of the Board of Directors, Dresdner Bank AG, agreed to serve as Founding President of this board.

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

Coordinators B-IT Programs

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(University of Bonn), Life Science Informatics
Prof. Dr. Otto Spaniol
(RWTH Aachen University), Media Informatics

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Prof. Dr. Gerhard Barth, Founding President

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Undersecretary, North Rhine-Westphalian
Ministry of Science and Research
Hans Stender (Secretary)
Chancellor, Bonn-Rhein-Sieg University of
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Bonn-Rhein-Sieg University of Applied Sciences
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Events and Visits



Undersecretary Hartmut Krebs in his opening address at the international symposium "Perspectives on Designing Digital Media"

International Networking

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

Five symposia were held at Birlinghoven Castle to discuss the B-IT curricula in Media Informatics and Life Science Informatics from different perspectives. In May 2002, the international symposium "Perspectives on Designing Digital Media. Cooperative Learning and Playing in Networked Environments" brought together researchers from renowned media labs such as MIT, University of Colorado, University of Michigan, Vrije Universiteit Amsterdam, University of Stockholm and others, to discuss how research and teaching in media informatics should be conducted in the future. In October 2002, in the symposium "Future of Corporate Knowledge", more than a hundred experts

from corporate human resource management, eLearning suppliers and researchers discussed the application of eLearning and mLearning concepts within companies. In the symposium "Text Mining in the Life Sciences", keynotes by renowned speakers from Novartis, IBM and TEMIS SA set the field for experts from the pharmaceutical industry, the health sector and biotechnology to discuss current applications of text mining in the life sciences and challenges for the life science informatics curriculum. In May 2003, a strategic symposium discussed diverse "Vistas on Computer Science" by Computer Science luminaries such as N. Wirth and M. Chandy. In October 2003, experts from SAP, Siemens, Philips and other companies plus researchers from Europe and the USA discussed the impact of a European research network on End-User Development on university education and industry.

In November 2002, the Directors of the Indian University Association visited B-IT to discuss exchange possibilities between B-IT and leading Indian universities. In return, in February 2003 Rector Rauhut and Prof. Jarke visited the Indian Institutes of Technology (IITs) in Chennai (Madras) and Kanpur, where they agreed on several joint activities, including a regular virtual IT colloquium to be held jointly via video conference starting with the Academic Year 2003. During visits of His Excellency T.C.A. Rangachari, Indian Ambassador to Germany, and of an industry delegation from Bangalore, student exchanges and cooperation with Indian software industries were discussed. A similar interaction has been started with several leading Chinese universities, initially focussing on Jiangsu, NRW's partner province.

In June 2003, Prof. Cremers presented the B-IT programs during the NRW-Russia Industry and Science Fair in Moscow.



Her Royal Highness Princess Maha Chakri Sirindhorn visits the B-IT stand at King Mongkut's Institute of Information Technology (Bangkok, Thailand), showing keen interest in our multi-lingual hypertext eLearning system for Talmudic studies

In September 2003, B-IT's Master Programs and eLearning activities were presented by Dr. Ralf Klamma (RWTH Aachen University) at the eLearning Conference and Fair in King Mongkut's Institute of Information Technology North Bangkok, Bangkok, Thailand.

In October 2003, the first B-IT Business Forum was conducted at the Bonn-Rhein-Sieg University of Applied Sciences in Sankt Augustin. Representatives from regional industry and government discussed the practical relevance of the curricula, the demand for highly educated students in applied IT, and possibilities for actual involvement of industry in the B-IT curricula.

The set-up of B-IT as an elite education institute in applied IT found keen interest in national and regional media.

B-IT Distinguished Guest Lectures

Besides its regular faculty, B-IT features guest lectures from distinguished teachers and researchers throughout the globe. Guest lectures held during the Academic Year 2002/2003 include:

Dr. Philip A. Bernstein, Microsoft Research: "Model Management", November 2002

Prof. Dr. Gerhard Fischer, University of Colorado: "Human-Computer Interaction and New Media: Research Challenges for the Future", March 2003

Prof. Dr. Hector J. Levesque, University of Toronto, "Joint Ability of Groups of Agents", June 2003

Prof. Dr. S.V. Raghavan, Indian Institute of Technology (IIT) Chennai: "QoS Studies in Multimedia Communication", June 2003

Prof. Dr. Mani Chandy, California Institute of Technology: "Information Technology Support for Crisis Management", September 2003



Project presentation at the B-IT Business Forum

Master Program in Media Informatics



Jan Borchers holds a PhD from TU Darmstadt. He worked as Acting Assistant Professor of Computer Science in Terry Winograd's Interactivity Lab at Stanford University and founded a Human-Computer Interaction Laboratory as Assistant Professor at ETH Zurich. In October 2003 he was appointed Professor of Computer Science and head of the new Media Computing Group at RWTH Aachen. He conducts research in new technologies and metaphors to interact with multimedia, smart rooms, and ubiquitous computing environments, and has been known to turn his research results into public interactive exhibits.



Stefan Kowalewski holds a Dr.-Ing. (PhD) from the University of Dortmund, Germany. He conducted research on formal methods for control systems design and hybrid systems theory and worked as a group manager in the Software Technology department, Corporate Research and Advanced Engineering, Robert Bosch GmbH. In November 2003 he was appointed professor for embedded software at RWTH Aachen University. His research focuses on model-based design and analysis methods for software-intensive embedded systems.

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 typical 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 curriculum 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. The course contents is structured according to the ECTS (European Credit Transfer System).

In 2002, 26 students were admitted but many of them could not get their visa on time. For 2003, the application deadline was therefore moved forward; 51 students were selected from a large pool of applicants out of which 37 actually began their studies in September/October. At the same time, new faculty members Jan Borchers and Stefan Kowalewski were appointed.



Students from the Entrepreneurship and New Media course demo their software to a critical student audience

As part of the Media Informatics Program a novel Applied Computer Science course that combines lectures and research lab work was designed and first held in the winter term 2003. Titled „Entrepreneurship and New Media“, it was organized in cooperation with three start-up companies in the ABC region.

At the core of this course is a close cooperation with local start-up companies in the new media sector to set up highly realistic labs where multi-cultural and multi-functional groups of students work on an innovative IT product development project.

As the appropriate agile software engineering methodology, especially for small and short projects, eXtreme Programming (XP) was chosen and collaboration was organized using the BSCW groupware platform. Extensive support for the students, e.g., lab facilities, software support, video taping & editing, was available. The course also included a number of coaching events: an intensive two-day XP tutorial; four formal reviews; presentation techniques workshops; video-based feedback analysis; entrepreneurship training. Coaching partners came from five units of RWTH Aachen University: the Department of Organizational and Industrial Psychology, the Database Lab, the Computer Science Lab, the Computing Center, and the Entrepreneurship Lab („Gründerkolleg“) and from the Institute of Business and Human Resource Management, University of Zurich.

The software developed by 17 students from 12 countries within the course was demoed as part of a public presentation of Computer Science research of RWTH Aachen University on February 10, 2003. It included:

- **Diagnostics42**
Together with bureau42 GmbH, a Sankt Augustin-based Fraunhofer spin-off in the field of corporate information management and e-learning, the students developed a questionnaire-based training gap analysis tool called Diagnostics42. This tool was also presented at the most important German eLearning fair, LearnTEC 2003 in Karlsruhe.
- **Online portfolio management**
Axigo, the Aachen-based financial tool development start-up, challenged the students with a XML-compliant generator for adaptive portfolio management tools used online. The students created tools in three different source languages: Dot.net C#, SVG, and Macromedia Flash.
- **Pixeltracker.com**
To detect copyright infringements of digital images on the web, the students developed the prototype of a subscription-based web service for a database of 360 million images (access to the database courtesy of Cobion AG).



The students in the Entrepreneurship and New Media course

Master Program in Life Science Informatics

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, pharmaceuticals 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 of 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.

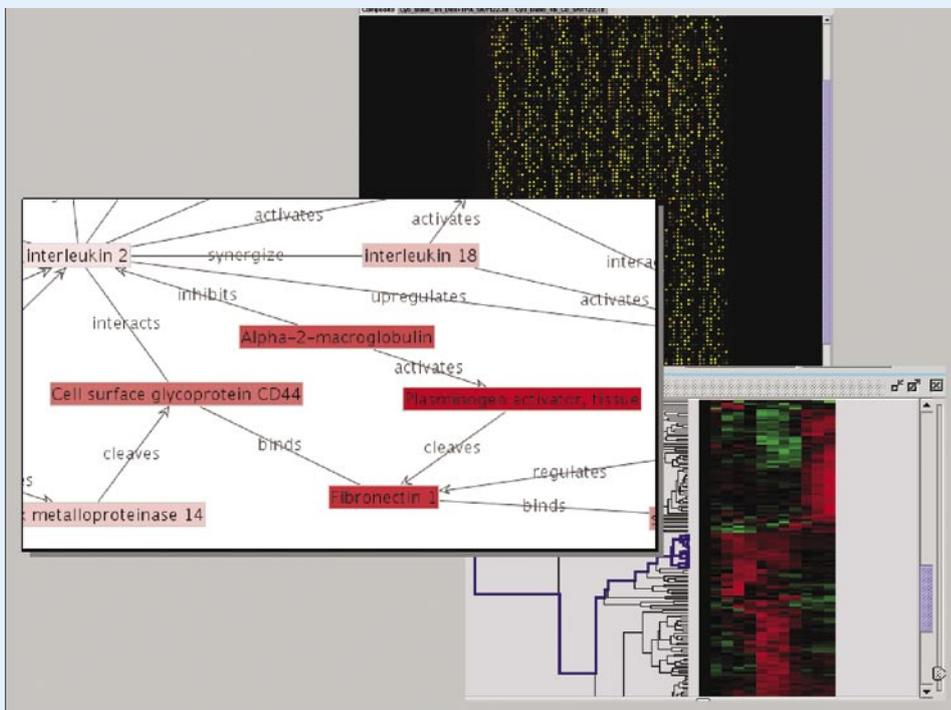
In 2002, a small pilot set of students began to study Life Science Informatics. For the fall of 2003, 15 students have been selected from a significant pool of applicants.

B-IT students in Life Science Informatics join research projects in the Department of Bioinformatics at Fraunhofer SCAI that address

- biomedical ontologies and data integration,
- information extraction and text mining,
- statistical modelling and analysis of biomedical data.

In a project with the Department of Neuropathology of the University Hospital Bonn advanced methods of statistical modelling are used to interpret microarray data. Combining statistical modelling with results of the institute's work on text mining delivers powerful support for hypothesis-generation.

The combination of semantic text analysis ("text mining") with laboratory data such as gene expression data provides a powerful means to analyze highly complex data (e. g. gene expression data) in a biologically meaningful way. Functional biological networks generated in this way reflect a first step towards the representation and modelling of complex biological processes and the molecular entities involved. Future work will focus on using this type of network representation for machine-based inference to support decision making for or against certain biological "targets" for intervention strategies. In the B-IT Master Program these tools will be utilized to support more effective learning. Also, Master theses will be directed towards testing and refining additional developments.



Functional network of proteins involved in cellular and structural remodelling processes associated with the development of epilepsy. The network server to clarify the semantic relationship between gene products. Data were generated by the group of Dr. Albert Becker, Department of Neuropathology, University Hospital Bonn. Visualization created using ToPNet, a visualization tool developed at LMU Munich in collaboration with 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 Studies

The offered courses are coordinated with the bachelor programs planned in Bonn and Aachen in a way that the bachelor degree will be attainable after only four terms of studying.

Graduate Studies

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.

In the winter term 2002/03 seminars and practical courses for selected students took place in the classes of the IPEC Winter School. These classes were temporarily held in the rooms of the organizing departments. At the time of this report the Summer School 2003 has successfully completed its lectures, seminars and intensive practice courses.

IPEC Courses offered in 2002/03

- Building 3D Models From Image Sequences, Prof. Klein, Bonn
- eXtreme Programming, Prof. Cremers, Bonn
- Mobile Ad-hoc Networks, Prof. Martini, Bonn
- Semi-structured Databases and XML, Prof. Jarke, RWTH Aachen
- Erasure-Resilient Online Video Processing Systems, Prof. Karpinski, Bonn
- Approximation Algorithms for Computational Molecular Biology, Prof. Karpinski, Bonn
- Artificial Intelligence, Prof. G. Lakemeyer, RWTH Aachen
- Gems of Theoretical Computer Science, Prof. Rossmannith, RWTH Aachen
- User-oriented System Design and Personalized Information Services for Nomadic Information Systems, Prof. Oppermann, Fraunhofer FIT
- Web Engineering, Prof. Gross, RWTH Aachen, and Dr. Pompe, SFB 427

A significant number of outstanding students participated in these courses. They showed in personal consultations a strong interest in compact courses in the semester breaks to accelerate their studies. To enable them to attain their degree faster the professors agreed to give additional courses in the semester break within the context of the Program of Excellence of the B-IT.



Close mentoring in the eXtreme Programming course



Participants in the eXtreme Programming course enjoy shared breakfast during class

Software Technology Lab "eXtreme Programming (XP)"

The Software Technology Lab is a compact practical course of four weeks with regular 8-hours working days, such that the participants and tutors practice intensive teamwork. It offers the same credits as practical courses with four hours per week during one semester.

Objectives of the course

XP is one of the recent "agile" methodologies of software engineering. It focuses on communication in the team, simplicity of solutions, systematic testing and readiness to change and improve.

This additionally offered course enables particularly skilled students to accelerate their studies specializing in software technology. This "sandwich principle" feasible within the context of the Program of Excellence provides the outstanding students with complete theoretical and practical knowledge in the area of software technology within only two semesters instead of three, as needed in the case of ordinary skilled students. This distinction and selective encouragement of the best is only feasible in the context of B-IT.

Requirements level

Completed intermediate diploma in computer science and successful participation in the lecture "Software Technology I" at the computer science department of the University of Bonn or an equivalent lecture of another scientific college.

Prof. Cremers was in charge of the Software Technology Lab which was advised by a senior software scientist (Oberingenieur) and a research associate. The advisors worked, according to the principles of eXtreme Programming, for the whole time (4 weeks 8 hours per day) together with the participants. Furthermore, significant efforts were necessary to prepare and wrap-up the course regarding contents, organization as well as setting up the hard- and software infrastructure.

Master Program in Autonomous Systems



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

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 two professors and two teaching assistants; some of the lectures are taught by international visiting professors.

The program combines courses in Autonomous Systems with an internship at the Fraunhofer AIS or at a company in the region. In addition, students are individually mentored by 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 the problems they encounter in their projects, and the individual mentoring transfers knowledge built in years of practical experience.

The curriculum includes Artificial Intelligence, embedded systems design, behavior-based robotics, machine learning and control theory for mobile robots. The use of distributed autonomous systems, how to develop embedded software and to program micro-controllers, self-localization and control architectures, mechatronics, mobile device programming using Java and Jini, the use of real-time systems, and team management are some of the topics covered.

The internship projects deal with a wide range of applications for scientific research and industrial development, e.g., behavior programming, using cameras for vision, using sensors in general and developing software for autonomous soccer-playing robots (Robocup). Among the current projects are: behavior development for office navigation using dual dynamics, design and implementation of motion control for the Robertino robot, development of signal processing using infrared sensors and laser scanners, open source vision systems, sewer pipe navigation and obstacle avoidance, team management in Robocup, machine learning in Robocup, and timing measurements for Echo State Networks in embedded systems.

The Master Program spans one and a half year. In the courses and project work of the first year up to 90 ECTS credit points can be earned. The third half year concludes the program, with lectures, the Master Thesis and an examination adding another 30 credit points.

Admission to the Master Programme in Autonomous Systems is twice annually. Five to twelve new students are admitted each semester. The third semester students, who started the program at the winter semester 2002, are writing their Master Thesis now as planned and well in time.

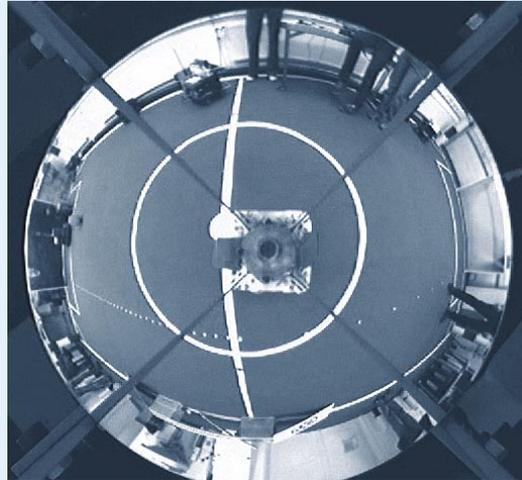


Soccer-playing robots in a training unit

In 2006 the Robot Soccer World Championship (RoboCup) will be held in Germany. A team of robots from B-IT will be one of the hot contenders. They are being developed and coached by a group of students from the B-IT Master Program in Autonomous Systems and researchers from the Fraunhofer Institute AIS.

In the annual RoboCup championships, R&D teams from all over the world present their latest, most promising prototypes of all the technologies that must be integrated to create autonomous mobile robots, e.g., embedded systems, mechatronics, behavior programming, WLAN communication, sensors and real-time evaluation of sensor data, sensor fusion, real-time color vision, machine learning, multi-agent systems and system integration.

One of the challenges for the R&D group from B-IT is to build a robust computer vision system capable of recognizing and surveying color-coded objects like the orange ball and the blue or yellow goal in the heat of a soccer match. Actually, this challenge has been chosen as one of the problems that the B-IT students work on in their research lab courses. It is typical of the way that real-world application problems and basic research topics are integrated in the Master Program in Autonomous Systems – and tackled



A robot's 360° view of a soccer field

successfully under the mentorship of the researchers at Fraunhofer AIS. Here, the problem was solved using an optimized data flow architecture. The very fast search for the ball exploits the fact that the ball has a size that does not allow it to 'drop' through a grid of white dots. As a consequence, only about 2% of all pixels in a picture need to be analyzed to find the ball.

The software has been integrated into the library of iconnect, Micro-Epsilon's software engineering environment (www.micro-epsilon.de). As this is marketed with the educational robot platform volksbot (www.volkbots.de) designed by Fraunhofer AIS, the software is available to a large user community.

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

A history of almost 200 years, over 38,000 students and an excellent reputation in Germany and abroad: the University of Bonn, with its strong academic profile, is one of the ten largest universities in Germany. While conscious of its long traditions, the University of Bonn is a modern research-oriented university that cooperates with numerous other universities and research establishments all over the globe. The specializations it has developed in teaching and research enjoy world-wide 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) [RWTH Aachen University], 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.



Prof. Dr. Burkhard Rauhut (Rector, RWTH Aachen University), Hannelore Kraft (Minister of Science and Research of North Rhine-Westphalia) Prof. Dr. Klaus Borchard (Rector, University of Bonn) after signing the contract of the Universities Institute of B-IT.



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. Systems designed and built in FIT support designers and engineers in real and virtual work environments, provide internet-based platforms for social as well as task-related interaction of learning communities and virtual teams. In Life Science Informatics the institute focuses on protein analysis, visual support for navigation in micro surgery, and assistive information technology.

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.



A group of visitors in IMK's advanced i-Cone 3D projection system

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 3.000 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

Knowledge computing and autonomous robots are the two core areas of research in the Fraunhofer Institute for Autonomous Intelligent Systems AIS.

The autonomous robotic activities of the Fraunhofer AIS concentrate on the prototypical realization of mobile, autonomous robots. Examples range from biologically-inspired walking machines to cooperating teams of robots and to robots used as educational tools. The design methodology is simulation-based, especially in cases of highly non-linear systems. Fraunhofer AIS designs and builds embedded systems in-house; control architectures are programmed using advanced software engineering paradigms. While real-time techniques are used to produce dependable systems, soft computing techniques like neural network learning and evolution are used in advanced controllers or to interpret sensor data streams.

Additional activities of the Fraunhofer AIS contribute to the development of a sustainable knowledge society, with competitive research in the field of IT leading to application-oriented concepts and bespoke solutions for industrial, scientific and governmental customers.

Fraunhofer AIS favors interdisciplinary and international cooperation. Research teams comprising computer scientists, neurobiologists, mathematicians and researchers from control theory elaborate new scientific findings across the individual disciplinary boundaries.

Information for B-IT Applicants

Detailed information and application materials for B-IT under www.b-it-center.de.

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 is vital. It is evaluated on the basis of TOEFL 550 paper-based, 213 computer-based, or IELTS 6.0;
- Working knowledge of German is necessary to take up some of the culture that the Aachen – Bonn – Cologne region has developed over the last 2,000 years. A basic German language course before the start of the program is mandatory unless a waiver is expressly granted upon individual application.
- Admission is coupled to placement in the Fraunhofer lab courses and therefore strictly limited.

Fees and Finances

Students have to pay a fee of about 125 Euro per semester to the Students' Union, which goes to support student activities and provides free public transport in the region.

A student's monthly expenses, including study material, will be about 650 Euro. B-IT or the participating universities do not offer any formal scholarships, but master students in good standing have a good chance to obtain student research assistant positions. 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.





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