



**b-it**

Bonn-Aachen  
International Center for  
Information Technology

**2020**

Annual Report

## Foreword by the Chair of the b-it Foundation



Annette Storsberg

Like most sectors of society, the Covid-19-pandemic is seriously challenging the international higher education system. In such a crisis, the international digitalization-oriented master and doctoral education pursued by the Bonn-Aachen International Center on Information Technology (b-it) with topics such as Life Science Informatics, Media Informatics, and Autonomous Systems around a shared data science kernel are more important than ever. Several research projects are directly contributing to preventing further spreading of the virus. The high impact of b-it was also emphasized by the international b-it Advisory Board.

The Ministry is glad to learn that the social media-based network set up by b-it has dealt very efficiently with this challenging situation. It offered successful bridging courses and even a virtual welcome party for the incoming students in the fall of 2020, even including those who could not yet physically arrive in North Rhine-Westphalia due to Covid-19-related travel restrictions.

Furthermore, b-it partners are actively contributing to the energy turn, specifically the structural change of the Rhineland coal mining area, e.g. by the new Fraunhofer Digital Energy Research Center, several award-winning blockchain projects in the public sector, and studies on the potential of quantum computing, offering further research opportunities for b-it students. This report once again demonstrates fascinating doctoral theses and the growing number of professorships achieved by b-it graduates.

The partner universities demonstrated their research leadership in different leagues of the robotics championship, which has become a major student attractor. We also congratulate b-it Founding Director Matthias Jarke who received the prestigious Peter P. Chen lifetime award in Conceptual Modeling as only the second German researcher. Beginning with the new academic year, Professor Jarke will hand over his responsibility

as RWTH Aachen's b-it scientific director to Professor Stefan Decker. The foundation is very grateful to Professor Jarke for his pioneering initiative towards the internationalization of German Computer Science education as early as 2001, declining an attractive offer from a top US university. Personally, I would very much like to thank Professor Jarke for his commitment to b-it and the outstanding services he has rendered the foundation.

Concluding, we would like to thank the b-it directors, study program coordinators, and especially the faculty and supporting staff for their additional efforts in difficult times, with best wishes for the future.

**Annette Storsberg**  
State Secretary at the Ministry of Culture and Science of the German State of North Rhine-Westphalia

Chair of the b-it Foundation Council

### b-it Mission Statement

b-it is an international center for information technology. It is jointly carried by the leading universities and research institutes of the information technology region Bonn-Aachen. At b-it, a team of excellent scientific leaders attracts the best students from all over the world. At the same time, b-it is a strategic partner of the regional economy.

At b-it, research and teaching form an integrated unit at the highest level. International orientation and diversity are a particular asset and strength of our institution. In our teaching, we build on the complementary strength of our participating institutions.

Graduates of b-it are sought after as specialists and experts, regionally and internationally. They transport know-how and innovation into science and economy.

We are shaping the digital change in a dialog between economy and society. Our focus is Data Science in the application areas Media, Life Sciences and Autonomous Systems.

## Officers

### Scientific Directors

*Prof. Dr. Stefan Decker, Prof. Dr. Matthias Jarke*  
RWTH Aachen University, Fraunhofer FIT

*Prof. Dr. Paul G. Plöger, Hochschule Bonn-Rhein-Sieg*

*Prof. Dr. Stefan Wrobel, University of Bonn, Fraunhofer IAIS*

### Coordinators b-it Study Programs

*Prof. Dr. Ulrike Meyer, RWTH Aachen University, Media Informatics*

*Prof. Dr. Jürgen Bajorath, University of Bonn*  
*Prof. Dr. Gerhard K. Kraetzschmar †*

*Hochschule Bonn-Rhein-Sieg, Autonomous Systems*

### Assistant Directors/Study Advisors

*Iman Awaad, M.Sc., Hochschule Bonn-Rhein-Sieg*

*Dr. Thomas Bode, University of Bonn*

*Arnab Chakrabarti, RWTH Aachen University*

*René Röpke, RWTH Aachen University*

*Dr. Alexandra Reitelmann, University of Bonn*

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## Report by the Scientific Directors

b-it offers highly selective graduate IT education to top international students in a unique cooperation between top research universities and the Fraunhofer Society. English-language Master Programs link Data Science and AI to Robotics, Media and Communications, and the Life Sciences. b-it graduates enjoy an excellent placement record in research and industry, as several examples in this report illustrate together with research opportunities by new b-it related research clusters.

Since many years, b-it has pursued active social media networking. A lively Facebook community of alumni, students, and newcomers proves particularly valuable in the CoVid19 pandemic which confronts incoming students with special obstacles and frequently changing travel regulations. Student advisors Dr. Alexandra Reitelmann, Iman Awaad, Arnab Chakrabarti and René Röpke deserve high credit for managing this complex process, culminating in our worldwide welcome virtual Welcome Party with over 100 participants and tempting samples from regional sights and cuisines. Our study coordinators Bajorath and Meyer dealt efficiently with the complex teaching and exam regulations in the new setting.

In late 2020, Professor Stefan Decker will take over the position of RWTH Aachen's b-it Scientific Director from b-it Founding Director Matthias Jarke after over 18 years. Prof. Decker held positions in Stanford University and at the University of Southern California, and led a research institute in Ireland, prior to joining RWTH Aachen and Fraunhofer FIT in 2015.

In September 2020, Emmanuel Müller resigned from his b-it funded professorship. His Data Science position will be re-filled as soon as possible. Special thanks go to our Foundation Board Chair Annette Storsberg, Manager Thomas Traennapp, and our Rectorates for steering the b-it Foundation through historically low interest rates.

Stay healthy and enjoy reading!

**Stefan Decker, Matthias Jarke**  
RWTH Aachen University and Fraunhofer FIT  
**Paul G. Plöger,**  
Bonn-Rhein-Sieg University of Applied Sciences  
**Stefan Wrobel,**  
University of Bonn and Fraunhofer IAIS



**Prof. Dr. Stefan Decker**  
RWTH Aachen University  
and Fraunhofer FIT



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



**Prof. Paul G. Plöger**  
Bonn-Rhein-Sieg University  
of Applied Sciences



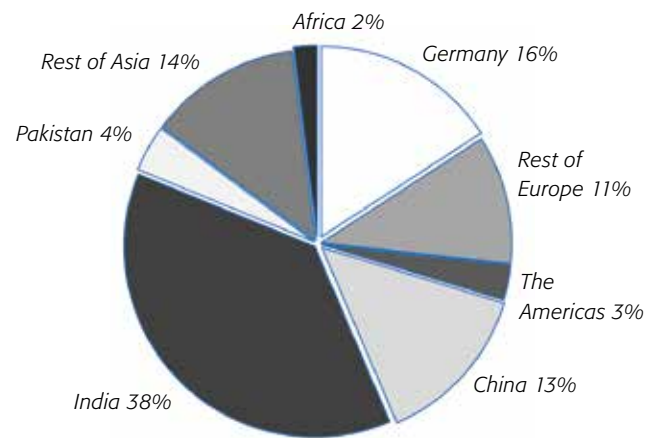
**Prof. Dr. Stefan Wrobel**  
University of Bonn and  
Fraunhofer IAIS

## b-it in Profile

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-Rhine-Sieg University of Applied Science (BRSU) and the research institutes of the Fraunhofer Institute Center Birlinghoven Castle.

b-it offers highly selective International Master Programs in Applied IT, as well as summer / winter schools for qualified undergraduate computer science students. The b-it Research School offers doctoral training. Since 2018, most courses take place in the newly erected b-it building on the Poppelsdorf Campus for Mathematics and Computer Science of Bonn University. 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



Home countries of new b-it students.

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.

For the participating universities, the b-it programs have also helped pave the way towards a smooth transition from the traditional German diploma system to the Bachelor-Master system following the Bologna accord; for example, the b-it master programs were the first to be accredited within the participating universities in 2004-2005, and re-accredited in 2010-2011. A comprehensive external evaluation in 2015 confirmed the very positive developments and stimulated a few new accents. The success of the b-it programs is also demonstrated by a very good placement record, both in science and industry.

b-it is financially supported by a 56 M€ Foundation initiated through the Bonn-Berlin program of the German federal government, as well as by matching NRW state funds.

*Due to the Covid19 pandemic a virtual Welcome Party for the incoming students was held on October 29, 2020.*



# Honors and Awards

## **Peter Chen Award 2020 for b-it Founding Director Prof. Matthias Jarke**

Initiated in 2008, the Peter P. Chen Award honors one person each year for his or her outstanding contributions to the field of conceptual modeling. The recipient will receive a plaque and a prize of \$2,500 sponsored by Elsevier Publishing Company, and be invited to give a keynote speech at the ER'2020 conference, which will be held in Vienna, Austria.

Prof. Dr. Matthias Jarke has worked in the field of Conceptual Modelling for over 40 years. The impact of his research contributions is demonstrated by his remarkable number of citations (over 20,600) and h-index (65). In 2013, he was recognized as an ACM Fellow (2013) for his "contributions to conceptual modeling, requirements engineering, metadata management, and computer science leadership in Germany". A notable impact of Prof. Dr. Jarke's work is that with his former New York University (NYU) Ph.D. student, Bala Ramesh. From 1993 onwards, they developed, formalized, and empirically validated the first comprehensive metamodels and reference models for the then novel field of requirements traceability. Their 2001 IEEE Transactions on Software Engineering paper became one of the five top-cited Software Engineering publications in the early 2000's and is still regularly referenced by researchers in the field.

Prof. Dr. Jarke has a long list of services to the research community, in conferences and journals. In particular, his group's CEUR series, started in 1995, has been the cost-free, open access outlet for over 2,500 important workshop proceedings. Prof. Dr. Jarke has graduated over 80 Ph.D. candidates and promoted the early careers of over 40 professors, not only among his students but also among postdocs and junior faculty. After Bernhard Thalheim in 2008, he is only the second recipient of the award working in Germany.

## **Prof. Jarke Named RWTH Fellow 2020**

Each year, the RWTH Fellowship recognizes two outstanding professors of RWTH Aachen University who combine a particularly strong research profile with special merits for the University as a whole. Rector and deans of RWTH Aachen have elected professors Christian Brecher (Production Engineering) and Matthias Jarke (Databases and Information Systems) as the RWTH Fellows 2020.

## **Three Awards in the eGovernment Competition of the German Chancellery**

On September 23, 2020, Minister of the Chancellery Helge Braun announced the awards in Germany's annual eGovernment competition where federal and state ministries as well as other governmental organizations present the most successful projects. In the category "Cooperation Projects", all three awards were given to projects which involved b-it partner Fraunhofer FIT:

- Shared first prize: "Network Digital Certificates", awarded to the NRW Ministry of Economics, Innovation, Digitalization, and Energy (MWIDE), for its project Blockchain4Education (led by b-it Professor Wolfgang Prinz)
- "Digitalization Strategy for Hamburg", awarded to Senate Chancellery Hamburg (supported in project eCultureCloud by Fraunhofer FIT under leadership of b-it Founding Director Professor Matthias Jarke)
- Third prize: "Blockchain for certificates of power of attorney and certificates of inheritance", Bavarian Ministry of Justice and German Chamber of Notaries (supported by Fraunhofer FIT, Professor Urbach, Bayreuth).



*Prof. Dr. Matthias Jarke.*

## Events and Visits



### **The Gerhard K. Kraetzschmar Memorial Symposium Draws Roboticists From Around the World**

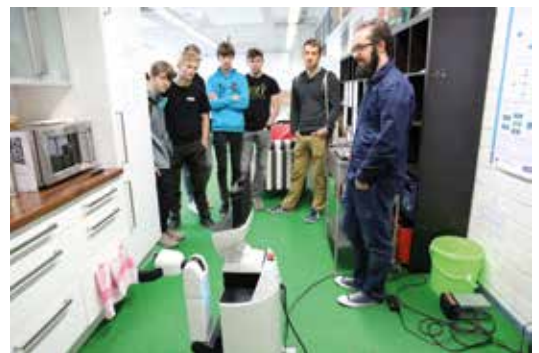
The week-long symposium of robotics talks to commemorate the life of Prof. Dr.-Ing. Gerhard K. Kraetzschmar (1961–2019) was held September 21-25, 2020, and featured talks from world-renowned roboticists, all close friends and colleagues of the Autonomous Systems professor who sadly passed away last year. They shared their photos, stories and memories as well as their research. Speakers included among many others Michael Beetz, Professor, University Bremen, Institute for Artificial Intelligence, and Itsuki Noda, Artificial Intelligence Research Center, National Institute of Advanced Industrial Science and Technology. The event was organized by Deebul Nair, and Paul Plöger.

During his talk, Prof. Iocchi made the surprise announcement that the World RoboCup Federation in recognition of his extraordinary contributions to RoboCup and to honor his memory created the “Gerhard Kraetzschmar RoboCup Distinguished Service Award” in 2021 to recognize the outstanding contributions of an individual for his/her exceptional leadership, service, and dedication that benefit RoboCup in any of its leagues.

### **RoboCup@Home Lab Open to the Public at the Tag der offenen Labore of the Computer Science Department**

In the b-it bots@Home laboratory, visitors were able to get up close and personal with the service robots Lucy and Jenny and could get an explanation of their working and programming principles. These two robots are specifically designed to support people in their home environments. For example, they can open drawers and door handles. Even seemingly simple tasks such as these are much more complex than usually expected, given the large variety of items a robot might need to deal with in a typical home environment.

The robot Bonnie, which is a logistics robot designed for transporting items such as carts in a hospital, was also shown in action. A large hospital environment poses various challenges on its own, such as narrow passageways, the presence of hospital employees and patients, as well as the constant change of scenery due to carts and beds being moved around the hospital. Visitors could discuss first-hand the specific design decision that need to be made when developing and programming such a robot, particularly related to safety and reliability.





(from left) Marcel Philipp, Lord Mayor of the City of Aachen; Prof. Matthias Jarke, Director Fraunhofer FIT; Prof. Ralf B. Wehrspohn, Executive Vice President Technology Marketing and Business Models of the Fraunhofer-Gesellschaft; Thomas Rachel, Parliamentary State Secretary in the BMBF; Prof. Stefan Decker, Director Fraunhofer FIT; Alexandra Landsberg, Head of Department of Structural Change Rhineland Territory (MWIDE); Prof. Ulrich Rüdiger, Rector of the RWTH Aachen University

## Opening Ceremony for Aachen's "Fraunhofer Center Digital Energy"

b-it partner institute Fraunhofer FIT, together with Fraunhofer FKIE and professors from the electrical engineering faculty and the computer science department have started a series of major projects around the questions of stability, economic feasibility and attractiveness, technical safety, and IT security of future digitized energy distribution networks. These form the starting point for the "Fraunhofer Center Digital Energy" which brings together the necessary team of electrical engineers, software, data and IT security specialists, all the way up to the level of changing business processes under novel business models accompanying the growing chances and risks of renewable energy. The Center will be hosted in a new building on the RWTH Aachen University Industry Campus Melaten.

In a ceremony held on April 28, 2020, BMBF State Secretary Thomas Rachel handed over a 5,1 M € grant for the first part of the initial planning and infrastructure set-up for the Center to the initiators and b-it Directors

Prof. Stefan Decker and Matthias Jarke. Speeches by several leading personalities from politics (including prime minister Armin Laschet), research management, and business at the ceremony (in German) as well as general information about the Center and its early projects can be found under [www.digitale-energie.fraunhofer](http://www.digitale-energie.fraunhofer).

## Workshop "Chemoinformatics and Artificial Intelligence"

On 24 October 2019, Dr. Pat Walters, Relay Therapeutics, Inc., Boston, returned for a second industrial workshop to b-it, invited by bit Professor Jürgen Bajorath. This time Dr. Walters focused on "Chemoinformatics and Artificial Intelligence". The workshop was very well attended by students from b-it. Besides the growing importance of Artificial Intelligence in the pharmaceutical industry, students were also very much interested in a career in the industry and in research topics in an industrial context. Dr. Walters provided the students with enlightening insights. This part of the workshops lasted more than two hours due to the many questions the students had on the topic.



# Research @ b-it



## UV-C Robots Against COVID-19

The UV-C robot is a novelty by KELO Robotics. It is currently being tested at H-BRS as part of the DIH-HERO ARODIS project. The goal is the disinfection of surfaces and the destruction of aerosols in the air that are contaminated with COVID-19.

The robot is a mobile platform equipped with 256nm UV-C lamps. UV-C light is an effective way to kill bacteria, viruses and germs. The robot moves slowly over the surfaces to be cleaned, such as walls, doors or tables, while the UV-C light can act on the surfaces and aerosols in the environment.

Although UV-C light is contained in sunlight, a maximum daily dose for humans should not be exceeded. For this reason, the system is equipped with a person detection function that switches off the lamps if people come too close. This allows the robot to operate safely even when people are present.

## New Projects for the MAS Group

The VeriComp (Verifiable Composition of Dynamics and Control Algorithms for Robot Motion) project proposes domain abstractions to automatically verify properties of control, kinematic and dynamic functions such that the development and safety analysis of robot motion applications becomes predictable.

The project is an Intergrated Technical Project within the EU-funded project RobMoSys.

The SAFEMUV (Safe Airframe Inspection using Multiple UAVs) project develops a process for systematic safety and robustness assessment of UAV teams underpinned by methods for the specification, generation and testing of collaborative inspection scenarios. The project is funded by the Assuring Autonomy International Program (AAIP).

The METRICS (Metrological Evaluation and Testing of Robots in International Competitions) project will organize challenge-led scientific robot competitions as clear, rigorous and effective evaluation campaigns. To this end, Hochschule Bonn-Rhein-Sieg will organize the HEART-MET (Healthcare Robotics Technologies – Metrified) competition which addresses tasks that may directly impact the user's well-being, in a complex and unstructured domestic environment.

## An Example of Promotion of Women in Research at b-it

Ms Shreya Kapoor joined the Life Science Informatics Program in 2018 with a Bachelor of Physics degree from Miranda House, University of Delhi, India. Shreya joined the group of Professor Thomas Schultz (Visualization and Medical Image Analysis group) as a master student. She received a STIBET I scholarship (issued by DAAD and the German Foreign Office) for 5 months to finalize her master thesis and prepare it for publication. Shreya will continue as fMRI data analyst at the Max Planck Institute of Cognitive and Brain Science in Leipzig.



Ms Shreya Kapoor.



## New “Quantum Machine Learning” Study Published by b-it Partner Fraunhofer and ML2R

Many tasks in the field of Big Data and Artificial Intelligence can only be solved with immense time and computing effort, even with advanced computer systems. Some problems are in fact so complex that they are almost impossible to solve with today’s computing capacities or their calculation would take years. A “quantum leap” is needed to take Artificial Intelligence and Machine Learning to a new level of development and to make the almost unsolvable solvable.

This is where computer technology based on quantum physical principles comes in. Quantum computing has the potential to overcome the fundamental limitations of classical digital computers. While a digital computer calculates with bits, a quantum computer works with qubits, which in contrast to the classical bits can assume not only one of two possible states, but also a superposition of both. Methods of Artificial Intelligence and Machine Learning can be adapted for quantum computers in such a way that they can pursue several solution paths simultaneously. This enables quantum computers to process large data sets in a single step, to detect patterns in data that classical computers cannot detect, and to deliver reliable results despite incomplete or uncertain data.

In the “Quantum Machine Learning” study, scientists provide insights into quantum computing, explain which physical effects play a role and how methods of Machine Learning and Artificial Intelligence can be adapted for the technology. In addition to the logical components, techniques for implementing the hardware of quantum computers are also presented. The study furthermore gives an overview of the current research and competence landscape, presents concrete

application areas and market potentials and assesses Germany’s position in international competition.

## Exhibitions App “Centre Guide”

Prof. Jan Borchers’ Media Computing Group launched the “Centre Guide”, a mobile iOS & Android app guiding you through the permanent and temporary exhibitions of the Centre Charlemagne, Aachen’s city museum. The app was launched on Oct 23, 2020, at the opening of a new temporary exhibition on Charles V, precisely 500 years after his coronation. The guide provides audio and written commentary in German, English, French, and Dutch, using an easy map-based interface. It’s also a great way to explore an exhibition before or after your visit: [hci.ac/centreguide](http://hci.ac/centreguide).

## Decision Support for Live Stock Efficiency and Animal Welfare

Digitalization of farming environments generates significant amounts of data. Yet, making sense out of these data is an open challenge. Within b-it, the group of Microsimulation and Econometric Data Analytics at Fraunhofer FIT conducted a series of Lab Courses on Data Visualization and Analytics supervised by Professor Thomas Rose. Recently, an analysis of live stock farming data has been conducted in order to improve production efficiency as well as animal welfare. Anchor point is a statistical model of causalities between production parameters and animal health as determined during inspections through veterinaries at slaughterhouses. Certain diseases such as lung events can be predicted with appropriate probabilities based on knowledge about environmental conditions and other production parameters. Hence, impacts of changes in animals’ living environment can be predicted and thus govern the production process with respect to animal’s health as well as economic and ecological efficiency.



Quantum computer. © IBM.



Exhibitions App “Centre Guide”.



Prof. Dr. Jan Borchers,  
Media Computing



Prof. Dr. Thomas Rose,  
Media Processes

### b-it Programs

## Master Program in Media Informatics

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

While a Bachelor degree in Computer Science typically qualifies to participate in large software projects, the Master degree provides the qualifications for project leadership. Graduates of the program in Media Informatics can be expected to be technically innovative, to work as system architects, and to manage large projects. Students who excel during their master program will also have the necessary qualification to pursue a doctoral degree in Germany or abroad.

The Master Program in Media Informatics educates the students to successfully meet the novel technical and economic challenges at the intersection of computer science, software engineering, next-generation communication systems, and the media. It is offered as a joint program of RWTH Aachen University and University of Bonn.

The program is characterized by a significant portion of lab courses embedded in research of the participating Fraunhofer Institutes for

Applied Information Technology FIT and for Intelligent Analysis and Information Systems IAIS. The degree is conferred by RWTH Aachen University. Cooperation partners from industry and research contribute to a rich teaching program.

The course contents are structured according to the ECTS (European Credit Transfer System) and consist of three main blocks: Computer Science and its mathematical foundations, Multimedia Technology, and Media Science and business aspects. Major topics include: Internet Infrastructures, Data Communication, Digital Interactive Media, Management of Information, Computer Graphics, Animation, Visualization, Speech / Image / Video Processing, Game Design, Security and Cryptography, Designing Interactive Systems, Cooperative Work Environments, E-Business, Knowledge Management, Virtual and Augmented Reality, and Software Engineering.

As in many other places, the CoVid19 pandemic is showing some negative influence in terms of delaying graduations, reducing applications and complicating visa procedures for incoming students. Still, 18 Media Informatics students have completed their degree in the academic year 2019-2020. The graduates quickly found interesting positions either as doctoral students in Germany and abroad, or in attractive companies. The incoming class of 2020 comprises about 20 students, selected from 143 applications. The new students come from 11 countries, and include 21% females and 79% males.

#### List of employers of MI Alumni

*(Universities & Research):*  
Airport Research Center GmbH, b-it, b-it Research School, Centro Nacional de Investigaciones Cardiovasculares, CERCER, Charité Berlin, Chinese Academy of Science, COSBI, Czech Technical, ETH Zurich, Fraunhofer FGAN, FIT, FKIE, FOKUS and IAIS, FSU Jena, Hasso-Plattner-Institut, HHI Berlin, Imperial College, INRIA, Institute of Molecular Medicine, Karlsruhe Institute of Technology (KIT), K. U. Leuven, Max Planck, Microsoft Research (Cairo), National University of Computer & Emerging Sciences, National University of Ireland Maynooth, National University of Sciences and Technology, Research Center Jülich, Robert Bosch Foundation, RWTH Aachen, Suez Canal University, Swiss Federal Institute of Technology, Uniklinik Aachen, Uniklinikum Bonn, Universidad Tecnológica de Panama, Universitätsspital Basel, University Clinic Carl Gustav Carus; Universities of Agder, Arab American Jenin, Asia and the Pacific, Atma Jaya Yogyakarta, Augsburg, Bahria, Bonn, Cambridge, Düsseldorf-Essen, Dresden, Duisburg-Essen, Edinburgh, Engineering & Technology Peshawar Pakistan, Ghent, Göttingen, Hamburg, Hasselt, Heidelberg, Houston, Oldenburg, Ireland, Maynooth, Iones Kepler, Kiel, Leipzig, Mainz, Münster, Paris, Rotterdam, Sud, Stuttgart, Tilburg, Tirana, Toronto, Trento, Tübingen, Washington, Waterloo, Western Australia, West Indies, Zurich; TU Darmstadt, TU Dresden, TU Eindhoven, TU Munich

## Can Sun



*Project Manager,  
Infineon Technologies*

After my B.Sc. from Beijing Posts & Telecom University, I was deeply attracted by the

international atmosphere, cross-disciplinary research, and technology innovation offered by b-it. During the Media Informatics studies, I went to ETH Zurich for a 6-month research change sponsored by the IDEA League, and got a UNITECH Fellowship diploma from TU Delft.

For my master thesis, I joined the Supply Chain Innovation Department of Infineon Technologies AG, later pursued major case studies for my Ph.D. thesis at RWTH Aachen University in the area of supply chain systems engineering and complexity modeling. Several of my publications have been highly recognized by the industrial world as well as the academic community.

In my current work as project leader at Infineon, I adopt the research results for large-scale multi-site supply chain re-engineering.

## Vinoth Pandian



*Web Developer and  
HCI Researcher,  
Fraunhofer IAIS*

Vinoth Pandian joined the Media Informatics program with a

IT Bachelor's Degree from Sri Krishna College, Coimbatore, and a Master in Philosophy & Religion from MKU, India. During his studies, he joined the User-Centered Ubiquitous Computing department at Fraunhofer FIT as a Student Researcher. He wrote his Master thesis on using Deep Learning to detect UI elements from freehand sketches with former b-it Graduate Sarah Suleri under supervision of Prof. Matthias Jarke. Currently, he works on large-scale EU Horizon

2020 research on Smart Grids, Industry 4.0, and the SPEAKER project, focusing on the interdisciplinary field of Human-Computer Interaction and Artificial Intelligence for his Ph.D. research. He has published several research papers on this topic at international conferences.

## Chatchavan Wacharamanotham



*Assistant Professor of  
Interaction Design People  
and Computing Lab,  
Department of Informatics,  
University of Zurich*

The b-it foundation contributed to my career

development in both during Master's and doctoral studies. During my master's study, the b-it Master in Media Informatics program enables me to benefit from academic expertise from three institutes (RWTH Aachen University, University of Bonn, and Fraunhofer Institute at Sankt Augustin). Simply having a broader menu of professors and researchers to learn from is a privilege over the traditional master program. The lab work at the Fraunhofer Institute also showed me the differences between research institutes and universities, which influenced my choice for academic career. Lastly, I also benefited from the fact that most of my classmates are international. Studying in this program gave me early experiences in working with people from different cultural backgrounds. Lessons learned from these experiences allow me to successfully collaborate with international peers in my research and other professional collaborations. During my doctoral study, the b-it foundation supported my research financially. More importantly, the b-it foundation also encouraged collaborations and exchanges of expertise among PhD students from the three institutes through meetups, workshops, and courses that cut across research fields. These interactions with peers from adjacent sub-fields of Computer Science are intellectually stimulating and broadened my perspective.

## List of employers of MI Alumni

(Business): 4tree GmbH, Ableton, Adecco Engineering & IT, Adecco Phaholyothin Recruitment Ltd., Adidas, Agfa Healthcare, Airbus, Alcatel-Lucent, Ancud IT Beratung, Ansaldo STS, ANSR Source, AOL, ARC International, ArcSoft, Avedas, Avid Technology, awato Software GmbH, Bank of Mexico, Bayer Technology Services, BCA Auctions, BCA Europe, Bertelsmann, Bertrandt Ingenieurbüro GmbH, BESA GmbH, Blimp.Mx, Bombardier Inc., Brainloop, BTC Business Technology Consulting, Capgemini, Capitaworld Platform Pvt. Ltd., CAS, CBC Cologne Broadcasting Center, Cellent AG, CGI, CIGNA, Cloudberrytec, CMLabs Simulations, Cognizant Technology Solutions, COMNEON, Contentteam, Crytek, CSC India, Daedalic Entertainment, Daimler, Deloitte AG, Delta Engine, Demax, Deutsche Bank AG, Deutsche Telekom, devolo AG, Dolby Laboratories, DP ITServices GmbH, Dynevo (Bayer), Ericsson, Euromoney Institutional Investors, European Computer Telecoms, Evimed Online, Exact Software, Facebook, Famous Group, Finantix Srl, Forth corporation, Fox Chase, Game Analytics ApS, GIVE.sg, Global Crop Diversity Trust, Goodyear, Google, Grandcentrix, GTT Technologies, Hewlett Packard Enterprise, HITS, Huawei, Humance, i22 internetagentur, IBM, IdeaObject Softwares, Ilypsys, IMC BV, IMC Financial Markets, Infineon, Inforcept Networks, Internet Company, IP Labs, iPharro Media, ISRA Surface Vision GmbH, ITBrainiacs, IVU Traffic Technologies, IW-One, Johnson Controls, Keynote SIGOS, Kisters, Kuveyt Turk Participation Bank, Lakshmi Technology and Engineering Industries, LHS Telekommunikation, Ligatus GmbH, Lufthansa Systems, Lycos, MarAnCon, Merck, Mastercard, MeVis Medical Solutions AG, Microsoft, Mobilab Solutions, moneymeets GmbH, Monsanto, Mobilizer, NAVTEQ, Nato Communications and Information Agency, Nemetschek AG, NeuroSky, Inc., Nexcom IT Services, Next Level Integration, Novartis, NTT Data, NVIDIA, Oando Plc, Oracle, Pater-sons, PCI Geomatics, Pepsi, Philips, Plinga, PricewaterhouseCoopers, Qiagen, Qosmotec Software Solutions, QSC, ReadSoft, Recognizer Group, Recommend, Roamworks Research & Development GmbH, Robert Bosch GmbH, Roche, S&P Capital IQ, Samsung Electronics, SAP, SD Inspiring Travel, sd&m, SE Consulting, Secat, Shell, SHS VIVEON, siCAT, Siemens, Siemens Healthcare, SIGOS, Simfy, Sogou Inc., Solnista, Solutions 4 Media, Sony, Steinberg Media Technologies, Sytel Reply, T-Systems, TeamViewer, Teleca, Telemotive, Tessella, Texas State - Health and Human Services (HHSC) Agency, Thomson Reuters, TravelTainment, Turk Telekom, Twitter, Vantage Labs, Viacom, vmware, Vodafone, Wacom Europe, Werum Software & Systems, Westwing Home and Living GmbH, Whowish, Widespace AB, Wieden+Kennedy, Workplace Systems, World Bank, Xerox Research Centre Europe, Yahoo!, Yieldlab AG, Zalando



## b-it Programs

# Master Program in Life Science Informatics



Prof. Dr. Jürgen Bajorath,  
Life Science Informatics



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

### List of employers of LSI Alumni

(Business): 4GATC Biotech, Accenture, Alcedo, Arbern GmbH, Asahi Kasei, ASI Data Science, Astra Seneca, BASF SE, Bayer, Bayer Monsanto, BenevolentAI, Clariant, Ericsson, carpooling.com GmbH, Clue Points, Comma Soft AG, Coty Germany, Curetis, Deutsche Post, DFind Science and Engineering, DHL, ecSeq Bioinformatics, Freeletic, Galileo Press, Gamomat GmbH, GAMOMAT Development GmbH, GATC Biotech, Generali Deutschland AG, Genestack, Glaxo Smith Kline, Hamilton Medical, HealthCare Global, Heraeus, Hoffmann-La Roche, Hype Innovation, IBM, IIT Bangalore, ITTM S.A., Interpretomics, KWP Inside HR, LabVantage Solutions Inc., Land of Lakes Inc., Leaf Bioscience, LHS Telecommunications, LinkTechnica, L'Oréal, MacKinsey, MarAnCon, Mastercard AG, Max Dellbrück Center Berlin, McKinsey, Medtronic, Miltenyi Biotec, Molecular Devices, Molecular Health GmbH, Molecular Connections Private Limited, Merck, Monsanto, msg systems ag, Nestlé Institute of Health Science, Novartis, Omnicom Media Group, Pfizer, parlamind GmbH, Postbank, Philips Research North America, ProfileXpert, Protagen AG, quintly Inc., real.digital, Recogizer, Sciex, Seasoon Information Technology, StepStone, Synechron Ltd., Syngene Ltd., United Brands Marketing, Tubs System LLP

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

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

of the participating Fraunhofer Institutes as well in labs of CEMBIO (Center for Molecular Biology) and LIMES (Life and Medical Sciences Research Biocenter Bonn). The final six months of the program are dedicated to the Master thesis which can be done in cooperation with industry.

Graduates of the program are well prepared for the typical professional tasks in applied data analysis, systems biology and data modeling, in industrial functional genomics, drug design and pharmacology. The Aachen-Bonn-Cologne-Düsseldorf region is home to many prospective employers, including excellent academic institutes and research driven companies. The regular and well attended meetings of the LSI Series "The ABC of Life Science Informatics" in the last years have contributed to strengthen ties with scientists of the region. Several interesting Master thesis have been carried out in collaboration with them. LSI students were also instrumental in this process. This has increased the visibility of the program considerably, also on a larger geographical scale.

This year 15 students successfully graduated from the program. Top students received excellent placements again. They started positions for example at ETH Zürich, as well as at the University of Nijmegen or in companies like Novo Nordisk, Denmark, or Dassault Systèmes, France.

About 25 new students from 11 countries ranging from China to Spain will take up their studies in Winter Semester 2020/2021 carefully selected from more than 160 applications.

## LSI Success Stories

### ASTGHİK SARGSYAN



joined the LSI program with a degree in Biotechnology from the State Engineering University of Armenia. She joined the group of Professor Hofmann-Apitius in 2020 as a student assistant working on “the COVID-19 ontology”. She is first author on a paper manuscript submitted to *BIOINFORMATICS* (Oxford University Press); this paper is currently under revision. It is likely that she will have a publication in one of the top-ranking bioinformatics journals even before she will start her Master thesis in the same group. Astghik exemplifies that motivated students get support from their academic teachers in the way they want and need it. Astghik’s examples also shows that a student and her academic teacher reacted to urgent medical and societal needs in focusing on research of the current pandemic.

### GEMMA LOUISE VAN DER VOORT



joined the LSI program in 2018 with a Bachelor’s degree in “Life Science and Technology from the Technical University of Delft, the Netherlands. She is currently carrying out her Master thesis in the group of Professor Dr. Thomas Schultz (Visualization and Image Analysis Group, Institute of Computer Science). During her studies she also attended the Summer School “Medizinische Bildverarbeitung” (Medical Image Processing) offered by Fraunhofer IAIS in Summer 2019. She is currently finalizing her master thesis. Her excellent scholar activities have always been complemented by her thoughtful social activities. She is the student representative of the current seniors as well as a leading organizer of the ErstiDay, an

orientation day for incoming students. During the pandemic, she additionally taught maths to a little girl who had problems in learning at home during the lockdown of the COVID 19 pandemic. Her parents were working remotely from home and were not able to help their daughter to the degree she needed it. The little girl finally – with Gemma’s – help found her way back to learning and understanding maths and sciences better. Gemma also participated in the “Hightech-Strategie 2025”, an initiative of the federal government. Within this initiative, she mentored German high school students, who were invited to a virtual conference in September 2020 to explain their views and ideas on innovative technologies. Gemma van der Voort exemplifies that b-it graduates combine scholar excellence with an understanding of societal needs.

### LAUREN NICOLE DELONG



joined b-it in 2019 with a degree in Biology from Salisbury University, Maryland, USA, as Fulbright scholar. Before this, she received a DAAD Rise scholarship for a research internship for undergraduate students at Hochschule Bonn-Rhein-Sieg. During this research internship, Lauren learned about the Life Science Informatics program. Having three universities under its umbrella, b-it makes switches between b-it university partners easier and offers students new opportunities. Changing to and studying in the Master Program of Life Science Informatics, Lauren then entered the group of Professor Holger Fröhlich at Fraunhofer SCAI in 2020 where she works on the topic of “AI COVID-19 Drug Target Prioritization” as student research assistant. Lauren is currently a junior in the LSI program and will be a senior in the same program in October 2020. Lauren’s examples shows that LSI students and their academic teachers react very quickly to medical and societal needs.

### List of employers of LSI Alumni (Universities & Research):

Berlin Institute of Health, Biotech Research & Innovation Centre (BRIC), b-it Research School, Boston Children’s Hospital, Centro Nacional de Investigaciones Cardiovasculares, Charité Berlin, Christian-Albrechts-Universität Kiel, Czech National Centre for Biomolecular Research, ELI Beamlines, European Molecular Biology Laboratory, ETH-Domain, ETH Zürich, European Bioinformatics Institute, European Bioinformatics Institute, Fraunhofer FIT, Fraunhofer IAIS, Fraunhofer SCAI, Fundación Centro Nacional de Investigaciones Cardiovasculares, German Center for Cancer Research (DKFZ), German Center for Neurodegenerative Diseases, German Institute of Human Nutrition, Hasso Plattner Institute, Heidelberg Institute of Theoretical Studies (HITS), Helmholtz Centre for Infection Research, Helmholtz Zentrum München, Hertie Institute for Clinical Brain Research, Hospital of the University of Bale, Hotkiss Brain Institute, IFOM, Imperial College London, King Abdul City for Science and Technology, Leibniz Institut für Ostseeforschung, Max Planck Institute for Biophysical Chemistry, Max Planck Institute for Molecular Biomedicine, Max-Planck-Institute for Molecular Genetics, Max Planck Institute for Neurological Research, Max Planck Institute for Plant Breeding Research, Max Planck Institute for the Biology of Ageing, Max Planck Institute Tübingen, Microsoft Research-University of Trento Centre for Computational and Systems Biology (COSBI), National Centre for Biological Sciences, National Centre for Biomolecular Research, National University of Ireland, National Technical University of Singapore, Philipps University of Marburg, Princess Nora Bint Abdulrahman University, Radboudumc – University Clinic Centre of the University of Nijmegen, Research Center Jülich, RWTH Aachen, South University of Science and Technology of China, Swiss Federal Institute of Aquatic Science and Technology, TU München, Twincore – Centre for Experimental and Clinical Research, University Clinic Gustav Carus Dresden, University College London (UCL), Western University, ZBMed, and the universities of Alberta, Amsterdam, Bonn, Bern, Cambridge, Cologne, Copenhagen, Dresden, Düsseldorf, Ghent, Kiel, Leipzig, Leon, Luxemburg, Macquerie, Mainz, Münster, Oxford, Sheffield, Tübingen, Utrecht, Western Australia, Vienna, Wageningen, Western Onatario, Würzburg, Zürich.



## b-it Programs

# Master Program in Autonomous Systems



*Prof. Dr. Paul Plöger,  
Autonomous Systems*



*Prof. Dr. Erwin Prassler,  
Autonomous Systems*



*Prof. Dr.  
Nico Hochgeschwender,  
Autonomous Systems*

The Master's program in Autonomous Systems is an international program, taught entirely in English, offering multi-faceted training in the fields of robotics and artificial intelligence. Various robot platforms are used for educational and research purposes, including the Care-O-Bot 3, and the youBot. The focus is on enabling and integrating the necessary intelligence behind the autonomous behavior of artificial agents rather than on the hardware-related aspects of robotics. Students get a solid theoretical background in autonomous mobile robots, advanced control methods, robot manipulation, learning and adaptivity, hardware-software co-design of embedded systems, probabilistic reasoning, and planning and scheduling. The courses are combined with research work conducted at the Fraunhofer Institute for Intelligent Analysis and Information Systems (IAIS) and other partner institutions.

Students take a number of core courses in the first semester as well as compulsory seminars, and practical courses throughout their studies. The Winter Semester 2012 saw the first students study under the new curriculum, which received ASIIN accreditation in April 2012. In addition to the accreditation certificate from the German Accreditation Board, the program got the special ASIIN accreditation label and the Euro Inf Label from the European Quality Assurance Network for Information Education (EQANIE). Students now choose one of two tracks to specialize in at the end of their first semester: the Intelligent Robots track and the Robot Systems Design track.

In the academic year 2020, 39 students joined the MAS program from an applicant

pool of 563 candidates. The MAS program has always attracted the interest of students all over the globe. The 13 different nationalities of the new 39 students is proof of this fact.

The program is offered by the b-it Applied Science Institute (b-itAS) in the Department of Computer Science at the Hochschule Bonn-Rhein-Sieg (H-BRS). b-itAS cooperates closely with the Fraunhofer IAIS in implementing the program, which started in the winter of 2002. Two dual degree programs exist with both the University of New Brunswick in Canada and the German-Jordanian University in Amman, Jordan.

The program is managed by three professors (Paul G. Ploeger, Erwin Prassler and Nico Hochgeschwender), two research associates (Iman Awaad and Alex Mitrevski) as well as researchers who have been recruited through various projects, namely: SciRoc, ROPOD, RoboLand, METRICS, SAFEMUV, VeriComp, E2X (E-Assessment), Robot Refurbishment, and Intelligent Human-Understandable Quality Control for Assisting Drivers in Testing of Vehicle Dynamics. These researchers are Roberto Cai Wu, Dr. Anastassia Küstenmacher, Alex Mitrevski, Tim Metzler, Patrick Nagel, Lakshadeep Naik, Deebul Nair, Minh Nguyen, Argentina Ortega, Sven Schneider, Maximilian Schoebel, Santosh Thoduka, and Djordje Vukcevic, Mohammad Wasil).

The faculty and staff are actively involved in many scientific activities, including memberships in technical committees of IEEE or in the RoboCup Federation trustee board, the euRobotics aisbl board, numerous program committees of workshops and scientific conferences such as IROS, ICRA, ICAR, ICMA, and AAMAS.

## MAS Success Stories

### ANGELA ENRIQUEZ GOMEZ



*Locomotec GmbH*

I graduated from the MAS program in 2020. After completing my bachelor's degree in Communications and Electronics Engineering, I wanted to join a master's program that would allow me to break into a career in the field of robotics and experience what is like to do research in an international community. The MAS program provided me with the tools I needed to gain knowledge and understanding of my field of studies and gave me the opportunity of contributing to the EU-funded ROPOD project, which aimed to develop a multi-robot system for logistics in hospital facilities. I was responsible for allocating and scheduling tasks to a fleet of robots. Currently, I am continuing my work on multi-robot systems and task allocation at a robotics company with offices in Sankt Augustin and Augsburg.

### SHWETA MAHAJAN



*Technical Consultant  
Artificial Intelligence team  
at Fujitsu*

I graduated with a M.Sc. from the MAS program in 2019. I chose to specialize in the Intelligent Systems track, which deals with Artificial Intelligence and Machine Learning for Robotics. During the course of my master's studies, I was a member of the b-it-bots RoboCup team and was also granted the Deutschland Stipendium. It was very exciting and surprising to be asked if I would like to represent the program in a portrait film! I had a great experience shooting the film at the university campus during my last few days as a master's student at H-BRS. After my graduation, I worked as a Deep Learning Intern at a startup in Berlin, and I currently work as a

Technical Consultant in an Artificial Intelligence team at Fujitsu, where I am able to apply my knowledge to real-world problems.

### ETHAN OSWALD MASSEY



*Lunar Rover Flight  
Software Engineer  
NASA Ames Research  
Center, California*

I applied to Autonomous Systems program at H-BRS with a dream to break into the aerospace robotics industry. During my time as an MAS student I gained foundational knowledge in the field of robotics alongside friends and peers from around the world. I had the chance to apply that knowledge while working on the ROPOD project, creating datasets, training and testing spatio-temporal models, and implementing a novel motor controller. After graduating in May of 2020, I am excited to be working on the VIPER lunar rover at the NASA Ames Research Center in California.

### ABHISHEK PADALKAR



*Researcher Institute for  
Robotics and Mechatronics,  
German Aerospace  
Center, Oberpfaffenhofen*

I am working in the field of restricted reinforcement learning for robot manipulation. I started my master's degree in Autonomous Systems at H-BRS in the summer of 2017. Joining this course was one of the turning points for my career. The program provided me with the state of the art knowledge in robotics and gave me the opportunity to apply it in real-life applications through various projects. I was an active member and leader of team b-it-bots RoboCup team which won the world championship title in the @Work League in 2019. The international exposure of this course introduced me to the potential research areas in this field.

### List of employers of MAS Alumni (Business):

*Ableton, Aeolus Robotics, Amazon, anessa, ANYbotics, ASIMOV Robotics, Banksoft, BitTwister Informationstechnik GmbH, BMW, Boston Consulting Group, Boston Dynamics, Cerence GmbH, Cerence Inc., CHRONEXT, cyber.con GmbH, Delphi, Wuppertal, DEUTA-WERKE GmbH, Elektrobot, ETAS GmbH, Exciera Technologies, Extor GmbH, Faro GmbH, Stuttgart, Fetch Robotics, Gade Autonomous Systems Private Limited, Google/Alphabet, GPS, IBM, Informatica, Ingen Robotics, Ingen Robotics, India, inmotion Software, KBR/NASA, KELO Robotics GmbH, Kuka Roboter GmbH, LMX, Locomotec GmbH, Lucid Motors, M2P Consulting, Magazino, MeasX, M-Files Corporation, NTT Data, Nuance Communications, Rapyuta Robotics, RBOT, Recognizer, Rethink Robotics GmbH, Rfrnz GmbH, Robert Bosch GmbH, RoBoTec PTC GmbH, Robots Alive Consulting, Shadow Robot Company, Siemens, Systemantics India, TBA Group, The MathWorks, TomTom, Trivago, Düsseldorf, vantago GmbH, VMware, xIndustry AI*

### List of employers of MAS Alumni (Universities & Research):

*Hochschule Bonn-Rhein-Sieg – Autonomous Systems Group – Graduate Institute, DFKI, DLR, FAST-NUCES, Fraunhofer FKIE, Fraunhofer IAIS, Fraunhofer SCAI, Freie Universität Berlin, Heriot-Watt University, Institut für Sicherheitsforschung, Instituto Superior Técnico (IST) – Universidade de Lisboa, Jacobs University, KU Leuven, LAAS-CNRS, National University of Computer and Emerging Sciences, Norwegian University of Life Sciences, Örebro University, Osnabrück University, Rhine-Waal University of Applied Sciences, RWTH Aachen, TU Delft, TU Wien, TUBITAK-UZAY Space Technologies Research Institute, TUBITAK-UZAY Space Technologies Research Institute, Universidad Anáhuac Mayab in Mérida, University Jaume I, University of Bielefeld, University of Bonn, University of Hertfordshire, University of Western Australia, Vienna University of Technology*

## 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 percent 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 about 35,000 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 200 different subjects and degrees. In 2019, the University of Bonn was elected as one of the 11 “elite universities” within the German excellence program, after having already received the record number of six “Excellence Cluster” grants in 2018.

### 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 45,600 students. RWTH offers 162 courses of study (undergraduate and postgraduate). The RWTH master programs educate engineers who are keen to engage in R & D, innovation, and entrepreneurship. Since 2007, RWTH Aachen was elected and re-elected three times as one of the “elite universities” within the German excellence program. In the current Times Higher Education Ranking, RWTH Aachen University is placed 99th among the several thousand evaluated universities.



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





Entrance of Birlinghoven Castle.

The Birlinghoven Castle campus is one of the largest and most influential computer science research sites in Germany. About 600 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. Three IZB institutes contribute to the b-it master programs Media Informatics and Life Science Informatics:

### Fraunhofer FIT

For over 35 years, the Fraunhofer Institute of Applied Information Technology Fraunhofer FIT has been conducting R&D on user-friendly smart solutions that blend seamlessly in business processes. Fraunhofer FIT is your partner of choice for digitization, Industry 4.0 projects and IoT solutions. In Life Science Informatics the institute focuses on image-based navigation systems, information-intensive optical instruments, visual information analysis, multi-parametric molecular sensor technology and diagnostics as well as bio-analogue analysis of changing images. In Media Informatics innovative information visualization systems, mixed and augmented reality environments for industrial planning, pervasive gaming applications, and value chains for public-sector information services are main research topics.

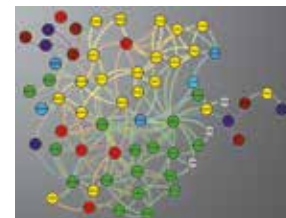


At Hannover Messe 2019, Fraunhofer FIT presented a system that uses AI-based image processing to monitor and evaluate, in real time, the situation and behavior of people, e.g. in a production setting. The system may be used, for instance, to automatically raise the alarm if a person is sitting or lying on the floor, indicating a dangerous situation.

### Fraunhofer SCAI

The Fraunhofer Institute for Algorithms and Scientific Computing SCAI combines know-how in mathematical and computational methods, with a focus on the development of innovative algorithms and their take-up in industrial practice – bringing benefits for customers and partners.

SCAI's research fields in Computational Science include machine learning and data analysis, optimization, multiphysics, energy network evaluation, virtual material design, multiscale methods, high performance computing, and computational finance.



Fraunhofer SCAI: A hormonal network underlying dementia and Alzheimer's disease.

SCAI's department of Bioinformatics offers its customers comprehensive services in information extraction (text mining) from the scientific literature and real world data sources such as electronic patient records (EHRs). Major applications of the team are the creation of a new knowledge space with analysis tools and information about COVID-19 ([covid19-knowledgespace.de](https://covid19-knowledgespace.de)) as well as modeling and mining in the context of neurodegenerative diseases like Alzheimer's or Parkinson's disease. Collaborative research and development projects deliver solutions to the pharmaceutical industry, the biotech industry and to the life science software industry. The department of Bioinformatics also takes part in the education of students of the Life Science Informatics curriculum of the b-it.

# b-it Applied Science Institute

## Hochschule Bonn-Rhein-Sieg

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

The three campuses at Sankt Augustin, Rheinbach and Hennef are well equipped with modern laboratories, studios, workshops and facilities for cooperative research. By 2020, the different departments accommodate more than 9,250 students.

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

## Fraunhofer IAIS

As part of the largest organization for application-oriented research in Europe, the Fraunhofer Institute for Intelligent Analysis and Information Systems IAIS is one of the leading scientific institutes in the fields of Artificial Intelligence, Machine Learning and Big Data in Germany and Europe. With its approximately 300 employees, the institute supports companies in the optimization of products, services, processes and structures as well as in the development of new digital business models. Fraunhofer IAIS thus shapes the digital transformation of our working and living environment.



*Hochschule Bonn-Rhein-Sieg.*

Fraunhofer IAIS is at the center of a strong research network. Since 2014, the Fraunhofer IAIS has been coordinating the Fraunhofer Big Data and Artificial Intelligence Alliance, which bundles the cross-sector expertise of more than 30 Fraunhofer Institutes in the fields of Big Data and Artificial Intelligence. It is also an important driver of the International Data Space initiative with more than 100 participating companies and organizations, which aims to create a secure data space that enables companies of all sizes and from different industries to manage their data assets confidently. In addition, there are long-standing close cooperations in research and teaching with the Excellence University of Bonn.

In 2018, Fraunhofer IAIS further expanded its strategic network and plays a leading role in important initiatives at state, federal and EU level. Fraunhofer IAIS is heading the Competence Platform for Artificial Intelligence in North Rhine-Westphalia KI.NRW. Together with the University of Bonn, TU Dortmund, and Fraunhofer IML, Fraunhofer IAIS is a leading partner of the Competence Center Machine Learning Rhine-Ruhr (ML2R) – one of four nationwide nodes for cutting-edge research and transfer in machine learning. At European level, Fraunhofer IAIS plays a leading role within the initiative “A European AI On-Demand Platform and Ecosystem” (AI4EU).

# General Information

## General Admission Requirements

- A first university-level degree (B.Sc., B.Eng.), as specified for the individual programs, with grades well above average is required. The Graduate Record Examination (GRE) is strongly recommended;
- All courses are held in English, thus fluency in English 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. Therefore, a basic German language course is offered before start of the program and during the first year.
- Admission is coupled to placement in the Fraunhofer lab courses and therefore strictly limited. Application deadline has been March 1 for Fall admission but may change from year to year; check [www.b-it-center.de](http://www.b-it-center.de) for current admission details.

## Fees and Finances

As of 2020, a student union fee of ca. 300 € per semester covers student activities, subsidized meals, and free public transportation in the whole state of North Rhine-Westphalia.

A student's monthly expenses, including study material, will be about 800 €-it does not offer formal scholarships but several student assistantships are available on a competitive basis. For information on funding from German sources please contact the DAAD – German Academic Exchange Service [www.daad.de](http://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.





Endenicher Allee 19 C  
53115 Bonn  
Germany

## **Directors**

Prof. Dr. Stefan Decker,  
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