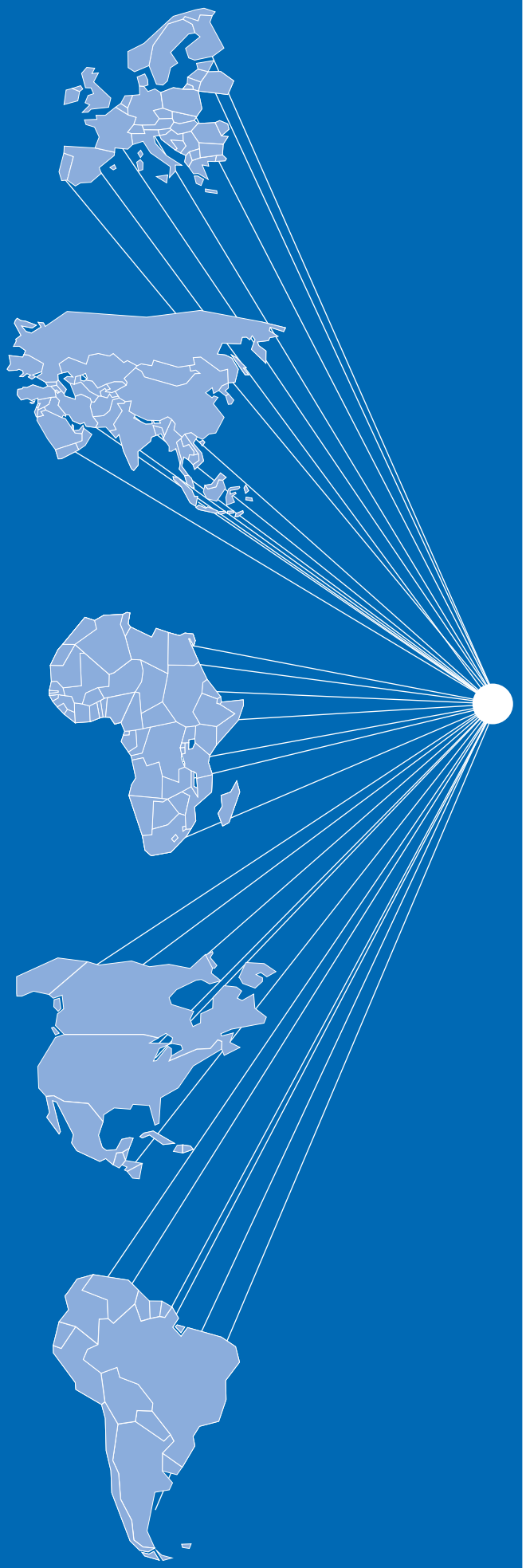

20 YEARS b-it

Bonn-Aachen
International Center for
Information Technology

Annual Report

2022

Foreword by the Chair of the b-it Foundation

Gonca Türkeli-Dehnert
State Secretary at the Ministry of Culture and Science of the German State of North Rhine-Westphalia.
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The recent past has provided us with many challenges – first the corona pandemic, followed by the war in Ukraine and the energy crisis. For overcoming these challenges information technology has become a substantial cornerstone: for example, the transition to renewable energy will require new IT solutions how to manage and secure our energy infrastructure. b-it is contributing to North-Rhine Westphalia's and Germany's future by educating the next generation of engineers and scientists to help build this infrastructure. In 2022 b-it is celebrating 20 years of b-it Master programs in applied computer science, able to attract a high number of international students in each program with a high quality of applicants and students with record number of applications in 2022.

It is with great pleasure that I chair the Council of the b-it Foundation while b-it celebrates its 20th anniversary. When b-it was set up by Professors Armin B. Cremers (University of Bonn), Matthias Jarke (RWTH Aachen University and Fraunhofer FIT) and Kurt-Ulrich Witt (Hochschule Bonn-Rhein-Sieg) in 2002 the core at the time was to establish a joint organization that combines the academic and technical excellence of several leading research institutions in the region.

This idea has been implemented in an impressive manner. b-it integrates research and teaching at the highest level, as shown again by the national and international recognition of b-it scientist over the last couple of years: the teams of Prof. Lakemeyer and the b-it-bots team from the Bonn-Rhein-Sieg University of Applied Sciences repeatedly finished among the top three contenders at the annual RoboCup World Championships – also in 2021 and 2022. Another success story of b-it: the Competence Center for Machine Learning Rhine-Ruhr (ML2R) will be transferred to long-term, institutional funding by the federal government and the state of North Rhine-Westphalia as the Lamarr Institute for Machine Learning and Artificial Intelligence. The excellence of research and scientific education at b-it is reflected also in the awards and prizes given to b-it students, scientists, and leading faculty – for example the AFCEA Studienpreis 2022 or a best student paper award at the International Conference on Enterprise Information Systems (ICEIS) 2022, among others.

Concluding, I would like to thank the b-it directors, study program coordinators, faculty, staff, and the b-it students for their contributions to making b-it such a resounding success.

Gonca Türkeli-Dehnert
State Secretary, Ministry of Culture and Science NRW
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.

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Prof. Dr. Paul G. Plöger, Hochschule Bonn-Rhein-Sieg
Prof. Dr. Stefan Wrobel, University of Bonn, Fraunhofer IAIS

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Prof. Dr. Jürgen Bajorath, University of Bonn
Prof. Dr. Paul G. Plöger, Hochschule Bonn-Rhein-Sieg

Assistant Directors/Study Advisors
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Dr. Thomas Bode, University of Bonn
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Report by the Scientific Directors

Prof. Dr. Stefan Decker
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

This is a special time for b-it: 20 years ago, the founding directors joined forces to bring together the universities and Fraunhofer Institutes to create an international powerhouse of education and research, here in our region. Their vision received strong support from the German government at the federal and state levels. Since then, b-it has offered three successful study programs attracting national and international students.

Many things have changed and evolved — but the core of b-it's mission has remained the same over the years. The state of North-Rhine Westphalia is to be congratulated for the vision and foresight they have shown in founding and supporting b-it for the past 20 years.

b-it, through its members, has been internationally recognized for numerous successful achievements — for example, the American Chemical Society lifetime Award given to Prof. Bajorath, various RoboCup World Championship titles awarded to both Prof. Lakemeyer's and Prof. Ploeger's teams, and many national and international industrial and governmental research contracts such as Prof. Borchers' projects with AirBus, Apple, ARD, the Vienna Philharmonic Orchestra, and the Boston Children's Museum.

We are proud of how well b-it did during and, hopefully, after the pandemic. The eager but careful return to campus life is effective and successful. For example, fully funded doctoral students from Brazil, China, Japan, and Italy have joined b-it since the removal of pandemic visa restrictions. We are especially grateful to our universities, who have supported b-it so well during difficult times.

We congratulate staff and students who have received awards during the past year - among them AFCEA awards, best paper awards, and DAADs awards. We also welcome our new Foundation Board Chair Gonca Türkeli-Dehnert and are looking forward to working with her to ensure a continued bright and fruitful future for b-it.

Finally, we thank our faculty and staff, and especially our students, for their contributions to making b-it a success over the past 20 years – and we look forward to the coming 20 years!

Stefan Decker,
RWTH Aachen University and Fraunhofer FIT

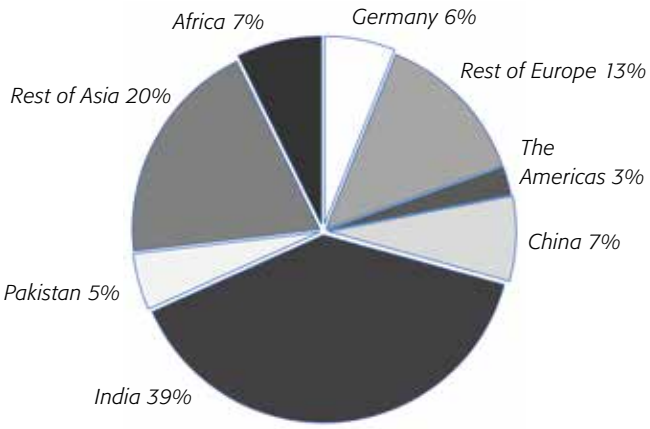
Paul G. Plöger,
Hochschule Bonn-Rhein-Sieg

Stefan Wrobel,
University of Bonn and Fraunhofer IAIS

b-it in Profile

The southwest of North Rhine-Westphalia (NRW) 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, Hochschule Bonn-Rhein-Sieg (H-BRS) and the research institutes of the Fraunhofer Institute Center Birlinghoven Castle.

b-it offers highly selective international master`s 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's programs is linked to, and conditioned upon, placement in research lab courses at the participating Fraunhofer institutes. Students in good standing are offered financial support during these lab courses.



Home countries of new b-it students.

The b-it Universities Institute offers English language Master of Science (M.Sc.) programs in Media Informatics and Life Science Informatics, while the b-it Applied Science Institute offers a Master of Science 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 Credit Transfer System (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. 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 academia 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.

Honors and Awards

AFCEA Studienpreis 2022 – top awards go to b-it students

The award winners: Arun Rajendra Prabhu (3rd from left) and Helena Balabin (2nd from right) with their thesis supervisor Prof. Dr. Paul Plöger (3rd from right). © AFCEA

For outstanding master theses in the fields of applied computer science, communications engineering and automation engineering, the Anwenderforum für Fernmeldetechnik, Computer, Elektronik und Automatisierung – AFCEA Bonn e. V. awarded two b-it students. For her master thesis "Multimodal Transformers for Biomedical Text and Knowledge Graph Data", Helena Balabin received the first prize, which comes with a prize money of 5,000 €. Second place and a 3,000 € prize money was awarded to Arun Rajendra Prabhu for his master thesis "An investigation of regression as an avenue to find precision-runtime trade-off for object segmentation".

Best Poster Award CAiSE '21

Dr. István Koren, Stefan Braun, Marc van Dyck and Prof. Dr. Matthias Jarke won the Best Poster Award at the 33rd International Conference on Advanced Information Systems Engineering (CAiSE '21) for their poster on Dynamic Strategy Modeling for Alliance-Driven Data Platforms: The Case of Smart Farming.

RoboCup@Home Technical Committee

Alex Mitrevski elected in the RoboCup@Home Technical Committee for 2021/22. The Technical Committee is in charge of defining the rules of the league and ensuring that the rules are followed during the competition.

Nomination for GI Award

RWTH Aachen University nominated the dissertation "Impact of Technological Support on Workload of Software Prototyping" by our alumna Dr. Sarah Suleri for the Gesellschaft für Informatik (GI) Dissertation Award. It had been graded "with distinction" and judged to be the best among the about 40 RWTH computer science theses of 2021.

Dr. Sarah Suleri

DAAD prize for Samuel Parra

Samuel Parra was awarded the DAAD prize for Outstanding Achievements by International Students at German Universities on 14 December 2021. Vice President Jürgen Bode awards the DAAD prize to Samuel Parra. The prize is endowed with 1,000 € and is awarded to students who, in addition to outstanding academic achievements, also demonstrate social or cultural commitment. Samuel Parra from Venezuela is a 4th semester student in the MAS program.

Vice President Jürgen Bode and Samuel Parra. © Dr. Wang Yi

Best Student Paper Award at ICEIS 2022

Thomas Osterland and Prof. Thomas Rose won the Best Student Paper Award at the International Conference on Enterprise Information Systems (ICEIS) 2022 for their paper "Scoring-based DOM Content Selection with Discrete Periodicity Analysis".

20 YEARS b-it

Bonn-Aachen International Center for Information Technology

b-it Foundation Council meeting in 2005.

2002: Hartmut Krebs Undersecretary, North Rhine-Westphalian, Ministry of Science and , Research, Chairman of the b-it Foundation…

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

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

b-it in a nutshell

The b-it foundation was established in 2002 for the promotion of master programs at an international scale in the realms of informatics: Autonomous Systems (AS), Life Science Informatics (LSI) and Media Informatics (MI) were selected as lighthouses for international studies.

The establishment of b-it has close ties with the move of the German government from Bonn to Berlin 20 years ago. Bonn, its metropolitan area and the state of North Rhine Westphalia (NRW), were awarded financial compensation for the massive flow of employment opportunities from the Rhineland towards Berlin as the new capital of Germany. A portion of this compensation was utilized for establishing the headquarters of German Postal and Telecom services in Bonn, other portions to set up the Bundeskunsthalle (Federal Art Gallery) and the Hochschule Bonn-Rhein-Sieg.

After this initial phase of huge investments, some remaining funds were earmarked to establish a center for international studies in order to attract high-profile students from abroad to Germany. Two state secretaries were driving forces to strengthen the region of Bonn-Rhein-Sieg as academic motors to generate sustainable growth (Uwe Thomas of BMBF and Hartmut Krebs of MWF.NRW).

The core idea proposed by the subsequent Founding Directors Armin Cremers, Matthias Jarke, and (a bit later) Kurt-Ullrich Witt envisioned a joint organization that combines the academic and technical excellence of the various research institutions. RWTH Aachen University, University of Bonn, Hochschule Bonn-Rhein-Sieg University of Applied Sciences, and Research Institutes of the Fraunhofer Society at the Campus Birlinghoven joined forces to establish three master programs in Applied IT, such that the organization was called the Bonn-Aachen International Center for Applied IT (b-it).

These nationally first cross-organizational academic programs were established and accredited as role models for the participating institutions. b-it was also the first example that combined institutions from academia with research institutes into one educational eco-system for the implementation of joint teaching programs. Continuous funding for b-it and its study program is provided by the b-it foundation, enabling the establishment of eight additional professorships to ensure high quality, plus a b-it building and a significant initial equipment grant.

20 years later, b-it is a vibrating place of inspiring study programs and research for international students focusing on engineering innovations as well as researching future challenges of basic research.

Former b-it building, overlooking the Rhine.

Socialization as anchor point of academic life

Socialization has always been a core element when starting academic years. Students typically come from places far away and they ought to become buddies each other as well as customize with European or German habits. The welcome reception has now a tradition of almost 20 years and even through corona we tried to maintain activities to get to know each other. Visits to the Christmas Market in Bonn and Cologne and tests of Printen (a delicious type of gingerbread produced by famous brands in Aachen) are vivid practices. There are also beloved memories of the Christmas parties in the wine cellar of the first b-it building, which happened to be the former embassy of the state of North Rhine-Westphalia to the federal government of Germany.

Premises of b-it

The first home of b-it was the former embassy of the state of North Rhine-Westphalia to the federal government of Germany. This place also has an outstanding tradition in German history, because it has been the home for the negotiations of the first German government by the Green and Social Democratic parties.

In parallel, extension of the campus of Hochschule Bonn-Rhein-Sieg started in Sankt Augustin as home of Autonomous Systems (AS). Since then, this campus has been continuously extended as prime example of the quality of teaching and research in the ABC region (Aachen, Bonn, Cologne).

International flavor of b-it

b-it has attracted students from many countries across the globe although – kick-started by early cooperation activities and scholarship programs e.g. from the European Erasmus-Mundus program -- there was always a strong community from Asia. More than 40 countries have been home of our students. The Master Programs certainly unveil different geographical centers of gravity and a lively productive diversity of widely different cultural backgrounds. The international diversity is amazing and results each year in a fascinating combination of food in the context of our student parties.

b-it Research School

In 2008, the b-it management successfully participated in a NRW state-wide competition for a doctoral training school in Applied IT, the b-it Research School. Its 15 doctoral scholarships were open not just for b-it master graduates, but also to applications based on several international calls. In addition, about 50 other doctoral candidates from partner universities and Fraunhofer institutes participated in the coursework. Already in the first five years, over 20 doctoral graduations, among them almost all 15 scholarship students, could be recorded.

After this initial phase, many doctoral funding opportunities arose from the successful involvement of b-it partners in DFG-funded doctoral training programs and IT-related Excellence Clusters. Therefore, doctoral training courses continue to be offered in the context of b-it in cooperation with those new funding programs.

Expectations of the founding directors

b-it Founding Directors Armin B. Cremers (University of Bonn) Matthias Jarke (RWTH Aachen University and Fraunhofer FIT), and Kurt-Ulrich Witt (Hochschule Bonn-Rhein-Sieg) in 2002.

Armin B. Cremers

Bonn, the former German capital and modern science region, together with its surrounding urban region Rhein-Sieg, has been perfectly prepared to become the home of an excellence cluster of university research and applications in information technology (IT).

One key local collaboration is with the Fraunhofer Society whose institute campus at Schloss Birlinghoven in Sankt Augustin near Bonn succeeds the former German National Research Center in applied mathematics and IT founded as GMD in 1968, originally as a spin-off from the University of Bonn. Through Fraunhofer this regional cooperation had been extended in an essential way to the RWTH Aachen University.

Computer Science with its various institutional and industrial collaborations is at the heart of our Bonn-Aachen International Center for Information Technology b-it. From the start, the concept of b-it has included the foundation of excellence programs at the intersection of computer science with the life sciences and media science. Based on an outstanding collaboration with the Hochschule Bonn-Rhein-Sieg in Sankt Augustin, a program in autonomous systems (robotics) has been included.

Specifically for Bonn, the University has strengthened its position towards Life Science Informatics as unique selling point. Several new professorships have been appointed to underpin this position. In addition, a focus in IT Security, both its mathematical aspects and its societal applications has been established whose outreach goes beyond institutional and industrial partnerships all the way to intensive and a sustainable cooperation with high schools from the entire region.

Matthias Jarke

Founding the b-it addressed three major challenges of the early 2000s. First, the late 1990s had witnessed a decline of the traditional influx of outstanding international student applications in Germany. By splitting the traditional German Diploma model into Bachelor and Master Programs, the Bologna reform of 1999 together with additional funding of new top professorships by the b-it Foundation enabled us to introduce the nationally first international highly selective master programs. In later years, acquiring highly competitive Erasmus-Mundus scholarships made us even more competitive via joint degrees with top European, but also Chinese and Indian institutions. Having an own building for the b-it education proved to be a key success factor for the challenging task of forming a lively and successful community of students from usually over 40 countries.

Second, the system of universities and large-scale federal research organizations operated almost disjoint from each other, missing many opportunities for research-oriented teaching, doctoral and post-doctoral joint research, and technology transfer. For example, when I became director of the then GMD FIT institute, FIT employed only seven (7!) research students along with more than 80 graduate researchers. Stimulated by b-it, this number has now increased tenfold, with several dozen b-it graduates getting doctoral degrees based on joint research between Fraunhofer, RWTH Aachen, and others. The b-it annual reports demonstrate quite a few cases of professorships and leading management positions in prestigious national and international universities or companies. Engineering this cooperation was also a huge legal challenge, as in Germany, the research organizations are federal while the universities are state-owned. Overcoming these obstacles was a pioneering effort whose success may have contributed a little bit to the later constitutional changes that enabled much larger-scale cooperations – such as the national Excellence Initiative in which b-it partners are also among the most successful institutions.

Third, with very few exceptions, there was still a very strict separation of curricula in computer science and key areas with very

strong and domain-specific needs for what we nowadays call digitalization. b-it therefore pioneered deep integration in carefully designed applied IT study programs, focusing on the then most critical domains of

- media and communications
- life science informatics, and
- cognitive robotics (autonomous systems)

in which all three participating universities could demonstrate their excellence by World Championship titles in the various RoboCup teams.

b-it has been continuously adjusting these initial foci according to emerging core digitalization challenges, such as cyber-physical human-machine interaction in Media Informatics, and Data Science as a core enabling methodology for all three master programs.

I am still grateful to state secretaries Krebs and Thomas, and my co-directors Armin Cremers and Kurt-Ulrich Witt to make this ambitious enterprise possible, and successful, despite numerous initial obstacles.

Kurt-Ulrich Witt

With an eye to significantly increasing its national and international visibility in research, the young Department of Computer Science at Hochschule Bonn-Rhein-Sieg (founded in 1996) established the international Master Program in Autonomous Systems whose funding was provided by b-it. We have fully met this expectation over the past 20 years.

Numerous partnerships have been established worldwide with leading institutions in the field of robotics and artificial intelligence. A large number of highly motivated students from all over the world have successfully completed the master program. The graduates have been offered interesting and challenging professional jobs and positions as developers and researchers; many have become scientists in renowned institutions, and a number have been appointed professors. As we move forward, I am sure that b-it, as a whole, will continue to evolve and innovate its leadership role to respond to the future needs of the world.

New b-it building in Bonn, Endenicher Allee, since 2018.

A look in the future

b-it b-it brought together excellent research and educational capabilities to attract high potential young professionals from all over the globe to b-it and its hosting universities and organizations and got them exposed to German culture, industry, and education, benefiting the region and the nation at large. Its core mission statement – "*We are shaping digital change in a dialog between economy and society. Our focus is Data Science in the application areas Media, Life Sciences and Autonomous Systems*." – still reflects the current needs of society.

b-it Is a living breathing organism powered by its enthusiastic staff and students. Like every other living organism, b-it will evolve. For example, establishing data infrastructures for sharing data is becoming a societal goal, and using those for AI (Artificial Intelligence) powered applications is one of the driving forces for the future. These will make their way into the curriculum of b-it and prepare the next generation of computer scientists for the challenges at hand.

Finally, there are still lessons that need to be learned from the corona pandemic – while we are glad that students can live and learn together, there are lessons to be learned and further adapted for b-it. We are sure b-it will keep its relevance in the future, and its students will be a driving force for the German economy and meeting the challenges of society and we are looking forward to work together with all stakeholders to make sure of it.

Events and Visits

Autonomous Systems Group at Hannover Messe 2022

The Autonomous Systems Group and KELO Robotics were present at the Hannover Messe 2022, together with the Zentrum Wissenschafts- und Technologietransfer (ZWT) that was recently founded at the Hochschule Bonn-Rhein-Sieg (HBRS). There, Prof. Prassler, Djordje Vukcevic, Natalia Quiroga and Malika Navaratna from The Autonomous Systems Group with Armin Shahsavari from KELO Robotics presented a novel mobile-manipulator robotic system that was recently released on the market. This system was initially designed and tested at HBRS as a research platform, and it represents a real example of a successful technology transfer from research at a University to a fully commercially-ready product for sale in a private sector.

Kickoff for Culture Domain within GAIA-X Hub Germany

On January 20, 2022, the (virtual) kickoff meeting of the working group Culture and Creative Industries within the GAIA-X Hub Germany brought together about 80 participants from politics (at federal, state, and city level), science, cultural institutions and associations, and creative industry representatives interested in promoting value creation and sharing by sovereign data exchange according to the principles developed by the International Data Space and the European GAIA-X initiative.

Speakers of the group include Prof. Matthias Jarke, Georgios Toubekis (RWTH Aachen University and Fraunhofer FIT), Dr. Dirk Petrat (BKM Hamburg), and Dr. Patrick Tomczak (acatech). After summaries of the initiative to set up a Data Space Culture in Germany, its intended functionalities, and basics of the planned GAIA-X Federation Services, a lively discussion brought up many important ideas and challenges concerning technical, economic, and socio-political issues which will be pursued in future bi-monthly meetings of the group.

Blockchain Convention 2022 attracts over 100 participants

For a comprehensive overview of the potential of blockchain technology, well over 100 representatives from industry and research attended the Blockchain Convention 2022 held in Hürth in June 2022. The conference was the largest attendance event organized by the Blockchain Reallabor to date.

Since 2020, the Blockchain Reallabor in the Rhenish coal mining district has been providing networking and consulting services fostering the technology's dynamic development – a development that is just now really picking up speed and could be a game changer in many markets. In addition to the latest technological developments, the conference discussed topics like Digital Identities, Decentralized Autonomous Organizations, or Sustainability, and looked at innovative use cases. Thirteen expert presentations provided in-depth insights into projects already underway and current blockchain applications. To cater for visitors with little prior experience with the technology, the Blockchain Convention offered a series of special basic tutorials, which attracted a large number of participants.

Numerous members of the Blockchain.NRW community used the conference as a welcome networking opportunity following up on the kick-off meeting in March 2022.

Research @ b-it

b-it students Say Limaye (above) and Marius Nißlmüller support workshop leaders Constanze Ritzmann and Daniel Wolferts at this year's Design Thinking Lab.

b-it Design Thinking Lab

The b-it Design Thinking Lab takes place every year during summer semester. The event is lectured by two researchers from the department of Human-Centered Engineering & Design of Fraunhofer FIT with deep theoretical knowledge and practical experience in the field.

Students start by researching on the UN's Sustainable Development Goals (SDGs). Later, they develop a digital product that fits these goals. To achieve this, they run through the five steps of the Design Thinking cycle (Empathize, Define, Ideate, Prototype, Test) and create a digital prototype. At the end of the lab, the students present their results in a product pitch in front of the lecturers and take us with them on their Design Thinking journey.

The last two Design Thinking Labs have shown great success: Six students are now employed as student research assistants and / or master-thesis-students at FIT and are able to apply their trained knowledge in national and international projects.

Thanks to the Design Thinking Lab, FIT was able to refine and expand their industry portfolio. The lab inspired the development of the Certified-Design-Thinking-Expert training among others, which has lately been accredited by the certifying office.

Europe Region Special Section of CACM co-edited by Prof. Jarke

Every three years, Communications of the ACM, the flagship journal of the world's largest computer science association, publishes a Special Section on important IT advances in a large world region. Professors Jessia Cauchard (Ben Gurion University, Israel), Matthias Jarke (RWTH Aachen University and Fraunhofer FIT), and Nuria Oliver (ELLIS Association, Spain) were invited by CACM Chief Editor Andrew Chien to edit the second Europe Region Special Section, published in April 2022 in volume 65, issue 4.

Six full papers on big trends and eleven short hot topic articles, selected from over 100 initial submissions, present highlights of recent research and innovation in Europe and Israel. Authors come from universities, research organizations including Fraunhofer and Jülich Research Center, and industrial start-ups and research centers. For example, papers with German co-authors demonstrate leadership in areas such as energy informatics, process management, trustworthy 6G communication, HPC cloud infrastructures, on-skin computing, European data spaces, and Internet of Production.

Fraunhofer FIT publishes white papers on Self-Sovereign Identity (SSI)

In early 2022, Fraunhofer FIT published a discussion paper on self-sovereign digital identities: "Mythbusting Self-Sovereign Identity (SSI)". Its authors join the current debate about SSI-based digital identities and discuss the added value of the technologies used from a scientific perspective.

© Alex Mitrevski

b-it bots: team @Work versus team @Home

In an internal b-it-bots contest, members of the @Work and @Home teams were competing against each other to find out whether youBot or Lucy were better at cleaning up a large pile of objects. In the competition task both robots were supposed to deliver objects to two different locations, depending on whether they were classified as industrial or domestic. In a best-out-of-four-runs scoring system, the youBot won the competition by a large margin.

The competition was above all a learning experience for all recent b-it-bots members. The activities of our team have suffered during the pandemic, but it was wonderful to see great working spirit from everyone.

Study by ABBYY and Fraunhofer FIT examines process digitization in companies

The study "Prozessdigitalisierung für das New Normal – Branchenübergreifende Studie zu Herausforderungen und Chancen der Prozessoptimierung" (Process digitization for the New Normal – Cross-industry study on challenges and opportunities of process optimization) examines the current state of digitized business processes in German companies. The result: most companies are not quite satisfied yet and see room for improvement. The study also provides an up-to-date overview of the extent to which modern process technologies are already in use and of the barriers that prevent further digitization of business processes and increased use of process technologies. Companies from the manufacturing, logistics, insurance and banking sectors were surveyed as part of the study.

Prof. Dr. Jan Borchers, Media Computing

Prof. Dr. Thomas Rose, Media Processes

List of employers of MI Alumni *(Universities & Research): Airport Research Center GmbH, b-it, b-it Research School, Centro Nacional de Investigaciones Cardiovasculares, CERTH, 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 Tecnologica 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, Ienes 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*

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.

A total of 23 Media Informatics students have completed their master's degrees in the academic year of 2021-2022. The graduates quickly found interesting positions either as doctoral students in German or foreign universities / institutes or in top IT companies. The incoming class of 2022 comprises 27 students selected from 238 applications from 10 different countries, where 52% of students are females and 48% are males.

News from Media Informatics Alumni

Irina Weiß-Avetisyan

After graduating as a B.Sc. math. from the Yerevan State University, Armenia, I was seeking for an international educational experience. The successful application process with DAAD back in 2007 left me not only with a full-funded scholarship, but also with invitations from six elite tech-universities. Nevertheless, the b-it "Media Informatics", being a talent incubator with the academic pools of RWTH Aachen, RFWU Bonn and Fraunhofer, suited my professional and academic vision the most.

By focusing on Digitalization and Process Management as well as HCI during my study course, I took a HiWi position with Prof Rose's team and worked on a semantic analysis-system design. This hands-on experience as well as the b-it environment triggered some entrepreneurial ideas and gave me the courage to persuade the dream of starting own company one day. By 2010 the Startup specializing on Business Process Digitalization and Cloud Integration, especially in the Rhineland-Region, was found by my husband and me.

Later b-it gave me yet another career kick, when during the discussions with Prof. Rose Blockchain was chosen as my master thesis topic. The gained fundamental knowledge from the research and participation at DLT Talents excellence program (FBS) opened a new application field for me. The idea of a female-only workshop arose, which focuses on women in leading management positions by providing them Blockchain Knowhow and enhancing their self-confidence by balancing the gender-inequality and supporting them during DLT-related fact-based decision making.

Thus, I can only encourage everybody, especially female students, to join the MI, be self-motivated and embrace the immense potential, which this program and the professors offer!

Selin Sezer

I started the Media Informatics program with a Bachelor's degree in Computer Engineering from the Istanbul Technical University, Turkey. During my studies, I joined the Blockchain Lab at Fraunhofer FIT as a student researcher. I wrote my Master's thesis on "Automated classification of smart contracts on Ethereum" under the supervision of Prof. Wolfgang Prinz and presented my results in Blockchain and Enterprise Systems Workshop within the 13th IFIP WG 8.1 working conference on the Practice of Enterprise Modelling (PoEM).

Due to the great variety of exciting projects, I continued as a researcher at Fraunhofer FIT after my graduation, and currently conducting my Ph.D. research on programmable money. The variety of courses in my study program has enabled me to not just focus on one topic but to explore my interests in different branches deeper, providing me with different perspectives in my career. I would recommend any motivated student to use their Master's thesis as an opportunity to get out of their comfort zone and grow.

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, Movilizer, NAVTEQ, Nato Communications and Information Agency, Nemetschek AG, NeuroSky, Inc., Nexcom IT Services, Next Level Integration, Novartis, NTT Data, NVIDIA, Oando Plc, Oracle, Patersons, PCI Geomatics, Pepsi, Philips, Plinga, PricewaterhouseCoopers, Qiagen, Qosmotec Software Solutions, QSC, ReadSoft, Recogizer Group, Recommind, 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

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): @Wise (Estonia), 4GATC Biotech, Accenture, Accura Gen, Alcimed, Aldi Süd, Arbern GmbH, ARBERN L.L.C-FZ, Asahi Kasei, ASI Data Science, Astra Seneca, atai Life Sciences AG, BASF SE, Bayer, Bayer Monsanto, BenevolentAI, bigspark, BiosolveIT, blue BEYOND GmbH, Boehringer Ingelheim, Bristol Myers Squibb, carpooling.com GmbH, Centene Corporation, Centogene, Clade Therapeutics, Clariant, Clue Points, Coca Cola HBC, Comma Soft AG, Comuny GmbH, ConfigCar GmbH, Coty Germany, Curetis, Dairy Data Warehouse, Dassault Systèmes, Deutsche Post, DFind Science and Engineering, DHL, Diapharm, DuPont, ecSeq Bioinformatics, Edelweiss Connect, Enhanc3d Genomics Ltd, Ennovation VC, Enveda Biosciences, epitome GmbH, Ericsson, ESSEC & MANNHEIM EXECUTIVE EMBA, Evotec, Fast Focus BV, Finsbury Glover Hering, Freeletic, Fresenius Kabi, F-Star Therapeutics Inc., G42, Galilleo Press, GAMOMAT Development GmbH, Gamomat GmbH, GATC Biotech, Generali Deutschland AG, Genestack, Genome Biologics, Glaxo Smith Kline, Hamilton Medical, HealthCare Global, Hearts & Science, Heraeus, Hoffmann-La Roche, Hype Innovation, IBM, IIT Bangalore, Interpretomics, IQVIA, ITTM S.A., Johnson & Johnson, KWP Inside HR, LabVantage Solutions Inc., Land O'Lakes Inc., Lead Berlin, Lead Discovery Center, Leaf Bioscience, LHS Telecommunications, LinkTechnica, L'Oréal, Lufthansa Cargo, MacKinsey, MarAnCon, Mastercard AG, Max Dellbrück Center Berlin, MBition, McKinsey, Mediengruppe RTL, Medsciences Biotech, Medtronic, Merck, Micro biolytics, Miltenyi Biotec, Molecular Connections Private Limited, Molecular Devices, Molecular Health GmbH, Monsanto, msg systems ag, Nestlé Institute of Health Science, Netcetera Software matters, Novartis, Novo Nordisk, numa, Nuvisan ICB GmbH, Octapharma, ok future, Omnicom Media Group, parlamind GmbH, Perkin Elmer Inc., Pfizer, Philips Research North America, Phillips, Postbank, PQE Group, ProfileXpert, Protagen AG, Publicis Group, quintly Inc., Rancho BioSciences, real.digital, Recogizer, Rewe, REWE Digital, Roche, RTL, SAATHII, Schlumberger, Sciex, Seassoon Information Technology, Siemens Digital Industries Software, Smart4Diagnostics GmbH, SOPHiA GENETICS, StepStone, SumUp, Syeneos Health, Synechron Ltd., Syngene Ltd., Synthego Corporation, The Janssens Pharmaceutical Company, Tubs System LLP, UBS, Union Chimique Belge (UCB Pharma), United Brands Marketing, Zerogravity*

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

Major topics include biomedical database systems, data mining and machine learning, statistical genetics, drug design, medical imaging and visualization, computational neuroscience, computational modeling of regulatory and metabolic networks, chem-informatics, 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.

Since its start in 2002, a total of 280 students graduated successfully from the Life Science Informatics program. About 29 students from Asia, Africa, Europe and the Americas will join the program in Winter Semester 2022/2023 carefully selected from more than 230 applications.

LSI Success Stories

PRAGYA MISHRA

Pragya joined the LSI program with a degree in Life Sciences and Biochemistry from St. Xavier's College in 2019. During her studies at b-it, Pragya worked as a student research assistant at Fraunhofer IAIS on benchmarking with object detectors. Pragya successfully completed her Master thesis in the group of Prof. Fuhrmann (Neuroimmunology and Imaging Group at DZNE, German Research Centre for Neurodegenerative Diseases) in 2022, jointly supervised by Prof. Schultz (b-it and Visualization and Medical Image Analysis Group, University of Bonn). In her Master thesis Pragya worked on the "Segmentation of Dendritic Spines in Stacked Multi-Photon Fluorescence Microscopy Images using Convolutional Neural Networks."

SANJANA SRINIVASAN

Sanjana joined the LSI program in 2020 with a Bachelor's Degree in Biotechnology from PSG College of Technology, Coimbatore, Tamil Nadu, India. She joined Professor Bajorath's group within b-it work study program. She is currently carrying out her Master thesis.

COLIN BIRKENBIHL

Colin Birkenbihl received a Bachelor's Degree in Biology from the University of Cologne in 2015. Besides his studies at the University of Cologne, Colin spent working intermittently at the Max-Planck Institute for Plant Breeding. He joined the LSI program in 2016 and completed his Master thesis in Fraunhofer SCAI. Then, he started his PhD thesis in the group of Prof. Fröhlich in Fraunhofer SCAI. Colin was part in the three large EU funded research projects AETINOMY, EPAD, and The VirtualBrainCloud, where he also lead one of the work packages. Colin received a best Paper award on the EPMA 2021. Since 01/2022 he is an editorial board member of the EPMA Journal. He was an editorial board member of the Journal of Alzheimer's Disease from 01/2021 – 01/2022. Colin has authored 17 publications in 3 years, among them 7 as first/last author. Several papers were published in high rank journals such as Alzheimer's & Dementia and npj (Nature Portfolio Journals).

JUSTUS BISTEN

Justus is a Biology graduate of the University of Bonn. Through his interest in Computer Science, he joined the LSI program in October 2020. Bevor and during his studies, he worked in different roles for DLR (Deutsches Zentrum für Luft und Raumfahrt, German Aerospace Centre). Justus is one of the LSI students who will join the b-it 20 Years poster session presenting one of his student research works under the supervision of Prof. Schultz.

ZEXIN LI

Zexin joined the LSI program in 2020 with a Bachelor's Degree in Marine Science from Sun Yat-sen University in Canton, China. During her studies in China, she was the recipient of a China National Scholarship (2018/2019). Zexin became part of the LSI work study program in the group of Prof. Fröhlich in Fraunhofer SCAI where she carried out her Master thesis with the topic "Investigation of Huntington's disease trajectories with artificial intelligence methods".

List of employers of LSI Alumni *(Universities & Research):* *Alan Turing Institute, Berlin Institute of Health, Biotech Research & Innovation Centre (BRIC), b-it Research School, Boston Children's Hospital, Centre for Molecular and Biomolecular Informatics (CMBI), Centro Nacional de Investigaciones Cardiovasculares, Charité Berlin, Children's Cancer Research Hospital, 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 IME, Fraunhofer ITMP, Fraunhofer SCAI, Fundación Centro Nacional de Investigaciones Cardiovasculares, German Center for Cancer Research (DKFZ), German Center for Neurodegenerative Diseases, German Institute of Human Nutrition, Harvard Medical School, 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, IIT Jodpur, Imperial College London, India University of Copenhagen, Institut Pasteur, Institute of Pysics of the Academy of Science of the Czek Republic, Karolinska Institut, King Abduly City for Science and Technology, King Faisal Specialist Hospital and Research Center, Leibniz Information Center for Science & Technology (TIB), Leibniz Institut für Ostseeforschung, Massachusetts General Hospital, Max Planck Institute for Biophysical Chemistry, Max Planck Institute for Heart and Lung Research, Max Planck Institute for Molecular Biomedicine, Max-Planck-Institute for Molecular Genetics, Max Planck Institute for Neurobiology of Behaviour, 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), MPI fo Cognitive and Brain Science, MPI for Molecular Genetics, National Center for Advancing Translational Sciences (NCATS), National Centre for Biological Sciences, National Centre for Biomolecular Research, National University of Ireland, National Technical University of Singapore, NIH, Nuvisan Innovation Campus Berlin, Philipps, Princess Nora Bint Abdulrahman University, Radboudumc – University Clinic Centre of the University of Nijmegen, Research Center Jülich, Research Institute for Farm Animal Biology, RWTH Aachen, SCK CEN (Belgian Nuclear Research Centre), South University of Science and Technology of China, Swiss Federal Institute of Aquatic Science and Technology, The Alan Turing Institute, TRON, TU München, Twincore – Centre for Experimental and Clinical Research, University Clinic Gustav Carus Dresden, Universitätsklinikum Schleswig-Holstein, University College London (UCL), University of Nebraska Medical Center, Western University, ZBMed, and the universities of Alberta, Amsterdam, Bonn, Bern, Cambridge, Cologne, Copenhagen, Dresden, Düsseldorf, Edinburgh, Ghent, Iowa, Kiel, Leipzig, Leon, Luxemburg, Macquerie, Mainz, Marburg, Münster, Oxford, Sheffield, Tübingen, Utrecht, Western Australia, Vienna, Wageningen, Western Onatario, Würzburg, Zürich.*

Master Program in Autonomous Systems

Prof. Dr. Paul Plöger, Autonomous Systems

Prof. Dr. Erwin Prassler, Autonomous Systems

Prof. Dr. Nico Hochgeschwender, Autonomous Systems

Prof. Dr. Sebastian Houben 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. Numerous robot platforms are used for educational and research purposes, including the Toyota Human Service Robot, 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 2022/23, 25 students joined the MAS program from an applicant pool of 423 candidates. The MAS program has always attracted the interest of students all over the globe, as can be seen from the 8 different nationalities of the new students.

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 four professors (Paul G. Plöger, Erwin Prassler, Nico Hochgeschwender and Sebastian Houben), two research associates (Iman Awaad and Alex Mitrevski) as well as researchers who have been recruited through various projects, namely: SciRoc, METRICS, SAFEMUV, SESAME, MigrAVE, E2x (E-Assessment), Robot Refurbishment, and Intelligent Human-Understandable Quality Control for Assisting Drivers in Testing of Vehicle Dynamics. These researchers are Dr. Anastassia Küstenmacher, Alex Mitrevski, Tim Metzler, Deebul Nair, Minh Nguyen, Argentina Ortega, Sven Schneider, Santosh Thoduka, Djordje Vukcevic, and Mohammad Wasil.

The faculty and staff are actively involved in many scientific activities, including memberships in technical committees of IEEE as well as numerous program committees of workshops and scientific conferences such as IROS, ICRA, ICAR, ICMA, and AAMAS.

MAS Success Stories

JASMINE PADHYE

Data Science Consultant, Machine Learning Reply GmbH

I joined the Autonomous Systems Program in 2018 as I wanted to explore the field of robotics. MAS gave me cool opportunities to explore my interests in areas like NLP, Computer Vision as well as Fault Detection and Diagnosis in the time series domain. This freedom helped me land a job as a data science consultant at Machine Learning Reply GmbH where I get to work across a wide range of industries. The courses helped me build my strong technical foundation, and the projects helped me get hands-on experience.

HERUKA ANDRADI

Perception Software Engineer, X-Laboratory Rotterdam

I joined the MAS program due to my fascination with robotics and, in particular, the areas of perception and navigation. It was a great pleasure to learn and grow alongside like-minded students and faculty members that shared my passion for robotics. Apart from the interesting coursework, the program also provided me with the opportunity to be a member of the b-it-bots team as well as to work for the ROPOD project. This prepared me to face the challenges that arise when applying theory to practice. I am now working as a perception software engineer in the Netherlands, where I contribute towards the development of robotic systems that enable faster installation of offshore wind turbines.

VENKATA SANTOSH MUTHIREDDY

Computer Vision Engineer, Ubica Robotics GmbH

I am a 2021 graduate of the MAS program. Prior to joining it, I was part of the Robotic Platforms and Systems group at TCS, India. The study buddy program and foundation course are two distinct elements of MAS that helped me to become a well-rounded professional. I was also actively contributing to the b-it bots@ Work team and got an opportunity to organize the foundation course for the SS 2020. The close-knit community of MAS helped me improve my technical skills. This has helped me achieve my career goals. At my current position, we develop, produce and sell autonomous robots for generating digital twins for brick-and-mortar retail stores.

HAMMAM ABDELWAHAB

Research Scientist, Fraunhofer IAIS

I joined MAS in 2019 with a control engineering background. I graduated in 2022 with lots of experience in the fields of robotics and machine learning throughout the courses, the R&D project, and the Master's thesis work. I chose to pursue my career in machine learning, and now I'm a research scientist in Fraunhofer IAIS as part of the Machine Learning Operations (MLOps) Team, that takes the results of machine learning research and deploys them into production environments. As an MAS Alumni, I'm glad to have been able to contribute to real-world industrial projects using what I learned during my studies.

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, DEUTA-WERKE GmbH, Elektrobit, ETAS GmbH, Exciera Technologies, Extor GmbH, Faro GmbH, Stuttgart, Fetch Robotics, Gade Autonomous Systems Private Limited, Google/Alphabet, GPS, IBM, Informatica, Ingen Robotics, India, inmation 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, Recogizer, 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 33,000 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 4,500 students from foreign 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 47,200 students. RWTH offers 170 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 147th 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 about 40 years, the Fraunhofer Institute of Applied Information Technology Fraunhofer FIT has been conducting R&D on applying computer science to the digital transformation of society with main locations in Birlinghoven, Bayreuth and Aachen. Methodologies developed in FIT combine the two areas Human-Computer centric research and Data centric research and applying them to areas of societal importance such as Digital Energy, Digital Health, and Digital Business – with a special focus on infrastructure and applications of data spaces as an emerging corner stone of the digital society. FIT his housing the NRW Blockchain Center, the Fraunhofer W3C representation, the Fraunhofer Personnel Certification Authority, and playing a leading role in the Fraunhofer Center for Digital Energy.

Birlinghoven Castle campus: One of its strategic goals is helping to shape the development of 5G applications and their ecosystems for SMEs. Companies can use our 5G campus network that implements the latest network standards to test the viability of innovative services based on 5G functionality before wider roll-out of 5G technology. We work closely with our clients in the iterative processes of developing and testing 5G infrastructures. The application fields we focus on include production and remote maintenance, BIM processes in construction, mobile edge computing, the Internet of Things, and mixed reality.

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.

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) 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 2022, the different departments accommodate more than 9,500 students.

The Department of Computer Science offers a bachelor's in computer science, another in Cybersecurity and, in cooperation with the Departments of Business Administration, a bachelor's program in Business Information Systems. At the graduate level, the department offers a master's in Computer Science and another in Visual Computing and Game Development. The master's program in 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.

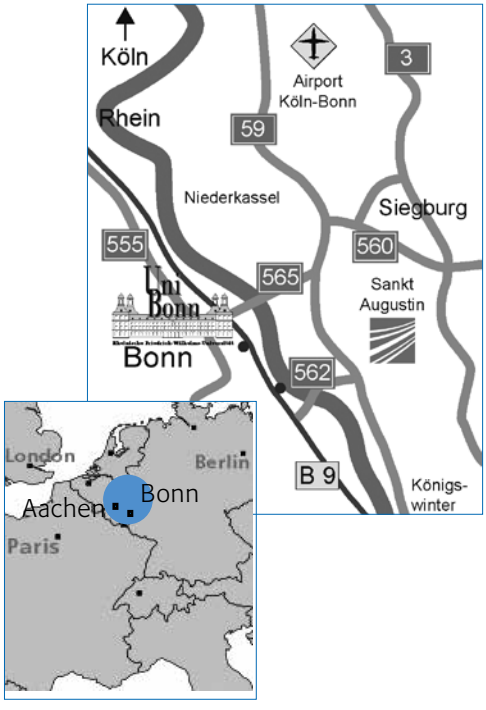
Fraunhofer IAIS is at the center of a strong research network. Since 2014, the Fraunhofer IAIS has been coordinating the Fraunhofer Big Data and Artificial Intelligence Alliance, which bundles the cross-sector expertise of more than 30 Fraunhofer Institutes in the fields of Big Data and Artificial Intelligence. 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. Depending on the particular b-it program, a proficiency level of B2 or B2+, per the Common European Framework of Reference for Languages, is required.
- Working knowledge of German is necessary to take up some of culture that the Aachen – Bonn – Cologne region has developed over the last 2,000 years. 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 for current admission details.



Fees and Finances

Semester fees of around 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 €. b-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.

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 has 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.

20 YEARS b-it Bonn-Aachen International Center for Information Technology

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