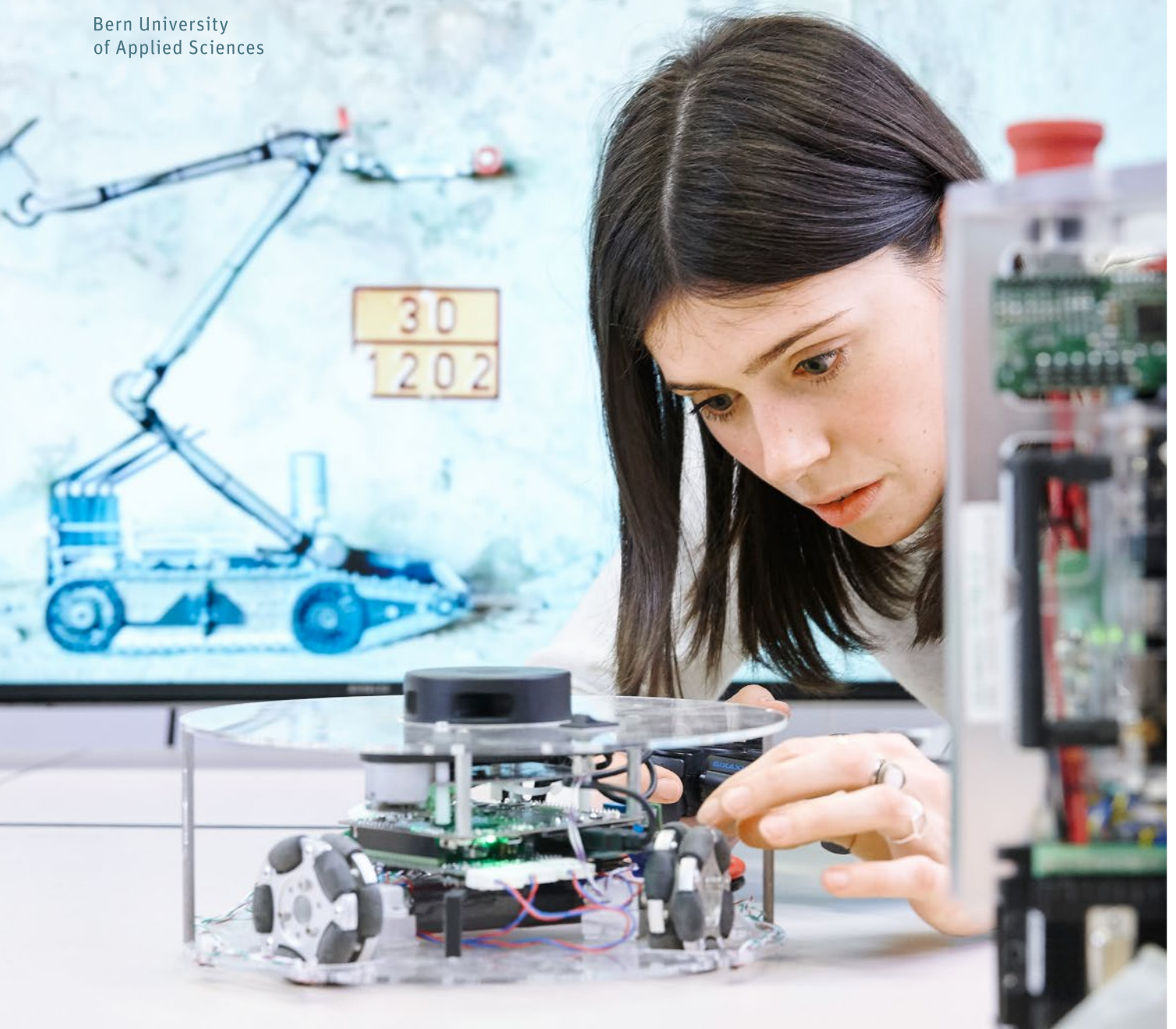Bern University
of Applied Sciences

Engineering and Information Technology

Research and Development – Together with Industrial Partners

Content

Research Creates Knowledge

Bern University of Applied Sciences is an application-oriented university. Teaching, continuing education, research and development and services are all part of its repertoire.

ti.bfh.ch/statistic

Bern University of Applied Sciences, Engineering and Information Technology BFH-TI is networked: it offers seven Bachelor's and two Master's degree courses in ten institutes of teaching and research. The bridge between basic research and product development is in a very close collaboration with basic economy. The focus being on technologies in Sports and Medicine, Energy and Mobility, Digital Society and Security, Smart Industrial Technologies, and Engineering & Business Innovation.

Economic Research and Development Thanks to Active Industrial Partnerships

The list of partnerships and co-operation ranges from A to Z, such as Axiamo, RUAG and SBB and Ziemer Ophthalmic Systems AG. Thanks to a solid network and productive cooperation, numerous awards have been won. Consider our research – based teaching. BFH continues to achieve significant results of high quality and awards of highest credentials. Individual credit should be given to: the medal won at ETH's Cybathlon; the nomination for the Swiss Medtech Award; the bronze medal of the "Blackjacks" team at the World Championships for Autonomous robots; the Ypsomed Prize for a micro-dosing system (this research team have established "ReseaTech") Macrobiotics, Printing Technology, Internet Security, Medical Information, Vehicle Safety, Energy Research, and Sports have also attracted various spin-off companies.

Applied research takes place in institutes which offer a broad range of services. Thanks to our flexible cooperation model, we are able to start research and development projects within a few weeks.

"Of tantamount importance is a high R & D quality in selected areas of competence, especially those in close cooperation with industry: this is interdisciplinary thinking and acting required to meet the challenges of today's economy and society. Thanks to our educational opportunities as well as our R & D, we are able to position ourselves as Part of the European Higher Education and Economic Area."

Prof. Dr Lukas Rohr, Head of Department, BFH, Engineering and Information Technology

Applied Research and Development – in practice

Modern societies increasingly demand interdisciplinary approaches. Thus we strive for further expansion of cooperation in industry. Our competence centers are forward-looking and dynamic. Like no other university type, the Swiss Universities of Applied Sciences are predestined to combine theory and practice.

Numerous lecturers and employees devote themselves to applied research. Faculty experts work within the institutes in diverse research groups, whose results are also later used in teaching and training. R & D as well as teaching and training are highly practical, market and application-oriented.

A near-infrared laser or mitral valve repair?

Whatever the focus, The Bern University of Applied Sciences maintains an intensive exchange of research expertise and knowledge with industrial partners. This gives companies access to excellent research infrastructure thus ensuring development of key technologies for the future. Ultimately, the use of a wide range of research and economic networks is an asset for everyone.

Research is characterized by the following factors:
– BFH research is applied in line with market trends.
– The aim is the development of prototypes and transfer in technology.
– Close cooperation between industry and trade respectively.
– The assignment of rights of use is usually to an economic partner.
– Focus is on key technologies of the future.
– An extensive network and multidisciplinary pool members is used.
– Research is regionally focused and internationally relevant.

Versatile Ways of cooperation

The BFH provides application and market-oriented research services for companies and public institutions. The variants of the cooperation are diverse. Companies and organizations are working together with BFH to develop solutions and methods for diverse issues. In addition, BFH offers a wide range of services – ranging from analysis of the use of research infrastructure to comprehensive studies.

For instance, the Institute for Human Centered Engineering HuCE is equipped with a modern infrastructure for fast prototyping in the mechanical and electronic field. This includes a 3D plotter laser welding machine, ASIC dye and wire bonders as well as an SMD / BGA pick system. Thanks to this highly modern landscape, industrial prototypes can be produced in-house.

Collaboration

Cooperation through technology transfer is achieved through numerous events and thus the transfer of technology from industry to industry is supported. Initial contacts can take place in various ways: face-to-face meetings; InnoTalk seminars; workshops and trade fairs; conferences and conventions. This is a broad spectrum in which partnerships can be created quickly and easily.

Economic and Practical Approach

Biel is a network location of the Switzerland Innovation Park (SIP). The Bern University of Applied Sciences Biel runs within the park the BFH Centre for Technologies in Sports and Medicine as well as the BFH-CSEM Energy Storage Research Centre. Both aim to pursue applied research and to implement an accelerated technology transfer into industry.

"Contact us or meet our experts face-to-face at various upcoming events. Cooperation will benefit all parties involved: your company, society and the University of Applied Sciences."

Peter Brunner, Head of Research and Development, BFH, Engineering and Information Technology

In collaboration with Swisstom AG, BFH has developed a device that optimizes the parameters for artificial respiration. The EIT belt, created by a student Andreas Waldmann, helped pave his way into the professional world. Using Electrical Impedance Tomography, an innovation was started that was transformed into a successful product by our industrial partner.

Institute for Human Centered Engineering HuCE
in collaboration with Swisstom AG.

"SwissTrolley plus" is one of the Swiss Federal Office of Energy (SFOE) Lighthouse Projects and was developed in cooperation with the BFH. The objective was the realization of a purely Swiss electro-mobile vehicle with sustainable components and controls.

Institute for Energy and Mobility Research IEM
in cooperation with the Swiss Federal Office of Energy SFOE,
as well as the Zurich transport companies and Hess AG.

At Cybathlon, an international competition organized by the ETH Zurich, differently-abled competitors use Bionic Assistive Technology, created in the world's best research labs, in all six disciplines. The sole Swiss participant in the group cycling required electric muscle stimulation (FES), using the BFH specially developed Cyba-Trike that was a medal winner among the top teams.

Institute for Rehabilitation and Performance Technology IRPT
in collaboration with the Swiss Paraplegic Center SPZ.

In the "Internet of Things" (Internet of Things, IoT), devices and sensors communicate directly with each other via the World Wide Web and every other application. The IoT thus opens up completely new perspectives for business, research and private benefit. The "Internet of Things" will support people soon with a wide range of activities. The BFH invites industry and private individuals to gain experience themselves with this new technology. For this purpose, it provides its LoRaWAN (Long Range Wide Area Network) infrastructure.

Bern University of Applied Sciences
in cooperation with diverse business partners.

Collaboration

Current challenges in society and the economy demand innovative solutions, fast results and a wide range of applicability. Industrial and public organizations contact Bern University of Applied Sciences and thus gain access to specialist knowledge.

Successful implementation of collaboration with industrial partners

Student projects*
The model of flexible cooperation with industry and business is successfully implemented in student projects:

Semester Projects, Bachelor Thesis, (Industry sponsored) Master Thesis	Weeks to months	Costs are at the expense of the Client

Contract Research and Services
The BFH-TI faculty carries out mission-oriented research and provides a wide range of services for our clients, such as exclusive use of BFH-Infrastructure and research publications:

Planning, Coaching, Tests, Expertise, Analysis: done by experts	Weeks to months	Prevailing Prices

R & D Collaboration**
The BFH-TI provides services in Applied Research and Development:

Public Aid: medium and large-sized projects with KTN, SNF or EU	Months to years	Partly public funding

*Book (ti.bfh.ch/book) provides an annual overview of all theses. This is a collection of concise market-orientated interrogations into the fascinating world of current technology.

** The Project Data Bank of BFH (pdb.bfh.ch) comprises current and completed projects. Therefore, insight into current research is gained – including information of project details, and the why and wherefore of teams and partners.

BFH Centres

The increasing complexity and networking in science, business, politics and society is related to the profiling of centres. This way, leadership through innovative and interdisciplinary approaches is secured and expanded. The BFH-TI inputs its know-how into the following three centres.

bfh.ch/bfh-centres

Technologies in Sports and Medicine
bfh.ch/humantec

The BFH Centre for Technologies in Sports and Medicine researches and develops application-based in the fields of: micro-technologies in performance; rehabilitation; medical technology and prevention. Researchers set themselves goals: to maintain, rehabilitate or promote physical and coordinative performance in everyday life, in work and sports; and to support medical diagnostics. The center is in a network of national and international research institutes, companies and hospitals.

Contact:
Prof. Dr Marcel Jacomet, Head of the BFH Centre for Technologies in Sports and Medicine and the Institute for Human Centered Engineering HuCE
Phone +41 32 321 62 41, marcel.jacomet@bfh.ch

Energy Storage
bfh.ch/energy

The BFH-CSEM Energy Storage Research Centre researches and develops solutions for the storage of electricity for energy supply and mobility. These approaches enable the integration of renewable energies from decentralized electricity production into the Swiss utility network and the substitution of fossil fuels in transport. The aim is to exploit the potential of sustainable energy sources such as photovoltaics and wind. The Center is participating in the Swiss Competence Centers for Energy Research (SCCER), which the Confederation has set up in the course of energy transition.

Contact:
Prof. Dr Andrea Vezzini, Head of the BFH-CSEM Energy Storage Research Centre
Phone +41 32 321 63 72, andrea.vezzini@bfh.ch

## Digital Society
bfh.ch/digitalsociety

The BFH Centre for the Digital Society addresses the concrete challenges of digitalization of economy and society, using inter-discipline approaches. Therefore, to efficiently develop practical solutions, the multi-disciplinary teams of the Center work together long-term and are closely linked.

Contact:
Prof. Dr Reinhard Riedl, Head of the BFH Centre for the Digital Society
Phone +41 31 848 34 34, reinhard.riedl@bfh.ch

"BFH-TI has lent substantial support to Ziemer through assisting both in the evaluation of new technologies for future products and through aiding specific development tasks which require state of the art engineering skills."
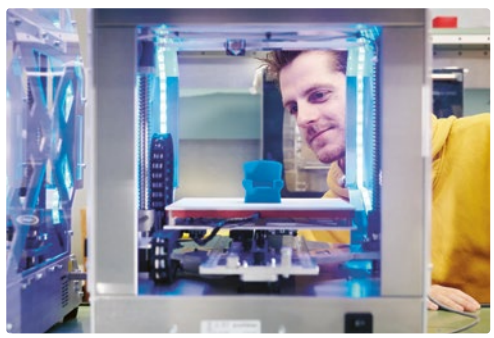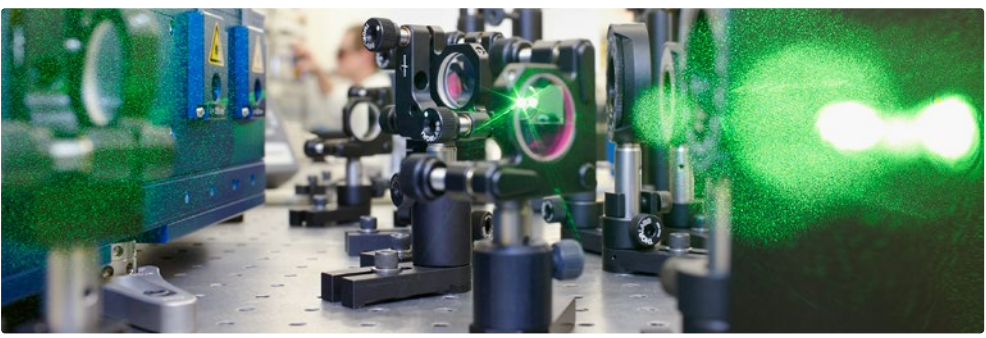
Dr Christian Rathjen, Vice President Technology & Strategy, Ziemer Group
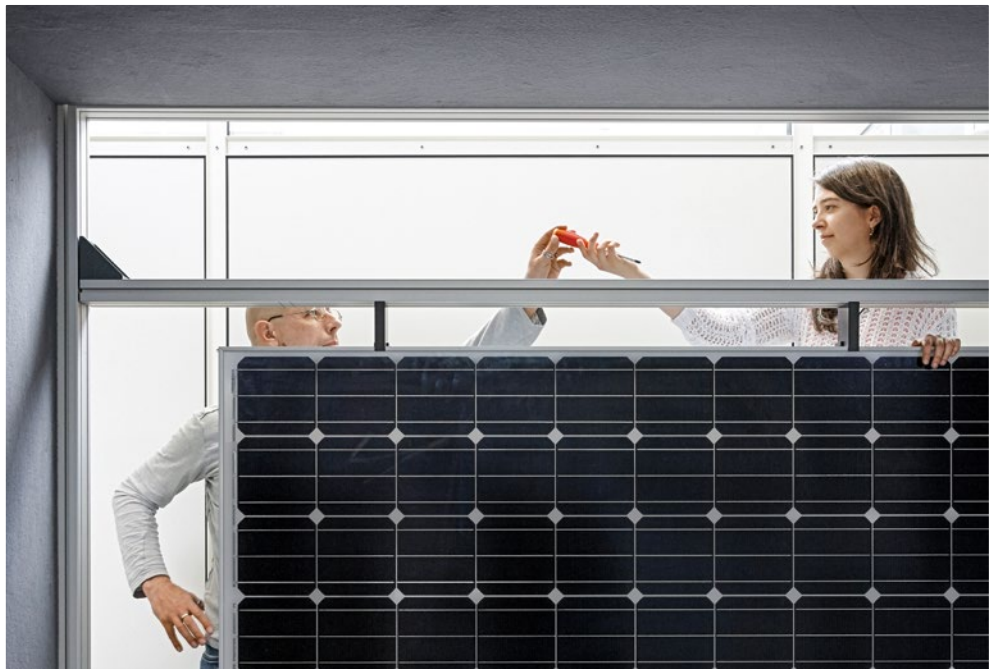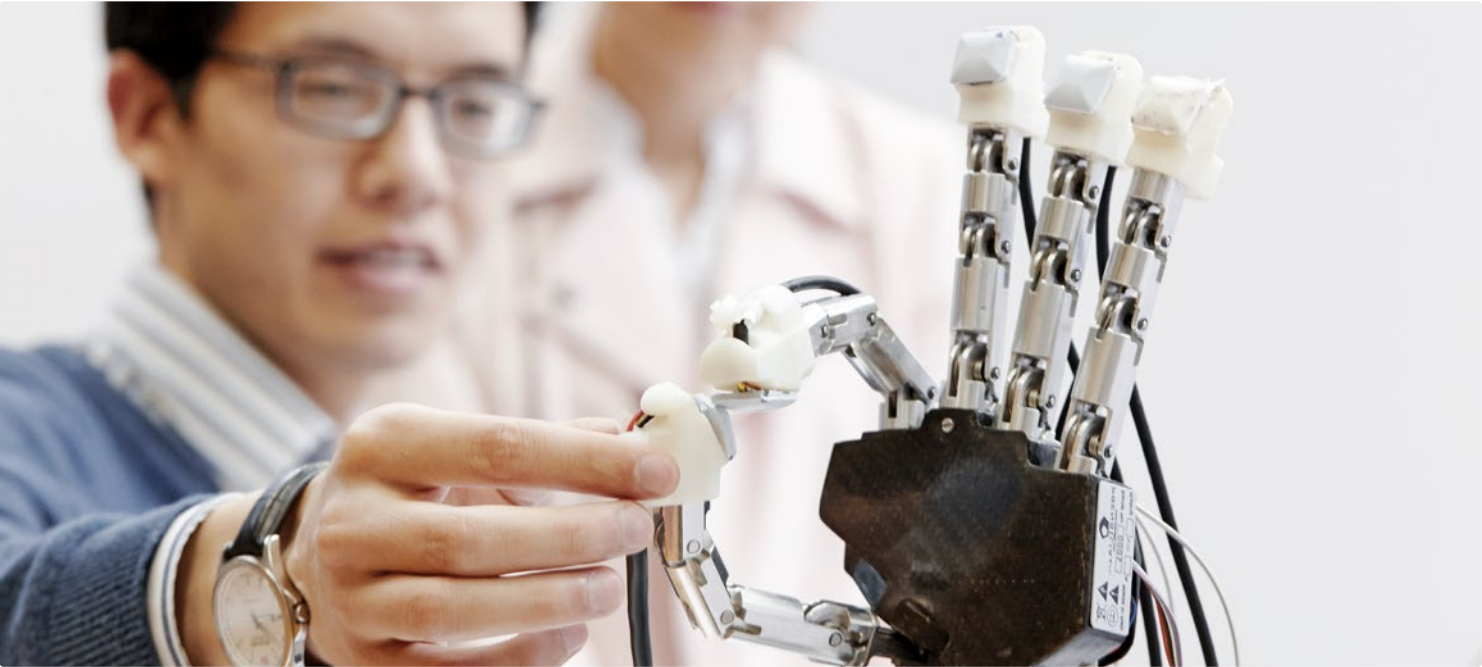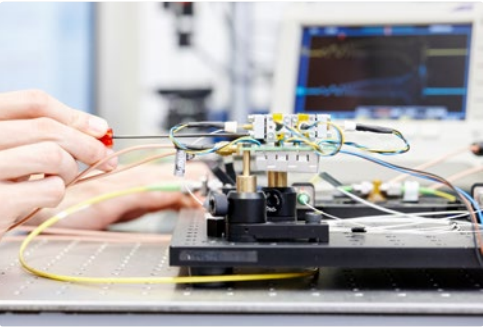
Institutes

Applied research takes place in institutes offering
a broad range of competencies.

Institute for Applied Laser Surface Technologies ALPS

ALPS develop new processes and techniques for energy-saving manufacturing and modification of materials and their analysis.

alps.bfh.ch

Core competencies
– Micro processing with ultra-short laser pulses
– Changes in the properties of boundary layers with heat or laser
– Fiber technology: from fiber production to material processing
– Manufacture of thin films using PVD and CVD methods
– Application of plasma technology for surface modification
– Material and surface analysis
– Production of components by means of selective laser melting

Research Groups
– **Applied Fiber Technology:** generation, amplification and transport of short and ultrashort pulses using fibers
– **Laser Surface Engineering:** laser micro processing with short and ultra-short laser pulses
– **Materials Technology and Heat Treatment:** tailoring microstructures and materials properties by heat and thermochemical treatments
– **Plasma Surface Engineering:** modification of surfaces and deposition of thin coatings by using plasma technologies
– **Thin Films and Surfaces:** modification of surfaces in the nanometer range by means of thin coatings, lithography and etching as wells as by plasma treatments in the clean room

Contact head of the institute:
Dr Patrick Schwaller, Professor of Surface Physics
Phone +41 34 426 43 61, patrick.schwaller@bfh.ch

"Small – yet effective – structures: we modify surfaces, by treating them with laser pulses and applying thin coatings."

Institute for Human Centered Engineering HuCE

In HuCe, we see new technologies and Know-how for the interdisciplinary development of innovative products for applications in the field of medical technology and performance sports.

huce.bfh.ch – The Institute for Human Centered Engineering HuCE is part of the BFH Centre for Technologies in Sports and Medicine.

Core competencies
– Development of miniaturized systems from proto-type to ready-for-production micro technologies
– Research; analysis and implementation of hardware algorithms in FPGAs and ASICs; microelectronics
– Complex control, signal and image processing
– Computer perception and virtual reality simulation
– Research in Optical Coherence Tomography (OCT)
– Sensors and sensor networks
– Development of biometric authentication algorithms
– Certification according to ISO 13485 for the design and production of MedTech devices

Research Groups
– **HuCE – BME Lab:** medical technology; bio-mechanics; intelligent medical instruments; sensors; biomedical signal processing and analysis
– **HuCE – cpvrLab:** image processing; medical image analysis; haptics; biometrics and authentication

– **HuCE – microLab:** hardware algorithms; micro-electronics; signal processing; controlling; fast prototyping; low-power and high-speed ASIC design; research into esophageal electrocardiography; ISO 13485 certification for cardiovascular apparatus design for electrophysiological investigations
– **HuCE – optoLab:** optics; Optical Coherence Tomography OCT
– **HuCE – roboticLab:** microrobotics; mechatronics
– **HuCE – scienceLab:** numerics; statistics; data-mining;

Contact head of the institute:
Dr Marcel Jacomet, Professor of Microelectronics
Phone +41 32 321 62 41, marcel.jacomet@bfh.ch

"What is unique for young development engineers is the moment when their ideas and their creative power lead to a useful and successful project."
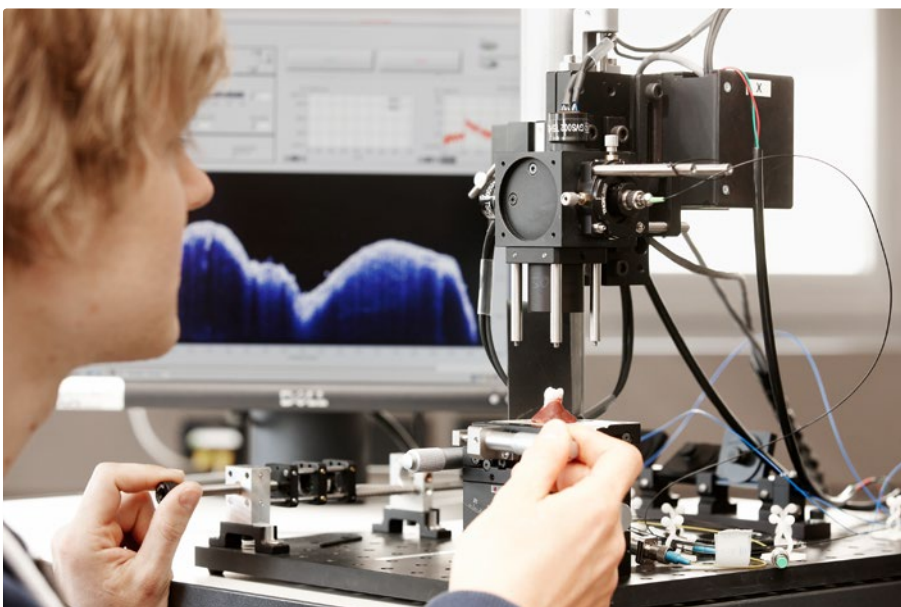
Institute for Intelligent Industrial Systems I3S

Contact I3S at BFH for all problems related to modern industry. In our interdisciplinary team, there are specialists for every link in the process chain. I3S ensures that each industrial process is optimized, intelligently networked – from the sensor to the vibration-free positioning.

i3s.bfh.ch – The Institute for Intelligent Industrial Systems I3S is part of the BFH-CSEM Energy Storage Research Centre.

Core competencies
- Design and expansion of industrial networks
- Development of mobile embedded systems
- Development of hardware and software for control systems with high real-time requirements
- Optimization of mechanical structures with FE and modal analysis
- Creation of control algorithms with state models and predictive optimization
- Development of active damping with piezoelectric actuators

Research Groups
- **Mechatronic systems:** process optimization, vibration and its damping, robotics
- **Communication systems:** Industrial networks, Industrial Internet of Things (IIoT)
- **Embedded systems:** sensor nodes, hard real-time, ultra-low energy, miniaturization

Contact head of the institute:
Dr Norman Urs Baier, Professor of Control Engineering and Mechatronics
Phone +41 34 426 68 42, norman.baier@bfh.ch

"Specialists – at every link in the process chain – ensure that each of our optimized industrial processes is smart."

Institute for Medical Informatics I4MI

The I4MI is the first Swiss Institute for Medical Informatics to build bridges at the interface between medicine and computer science thus making digitalization of the health care system a benefit to mankind.

i4mi.bfh.ch – The Institute for Medical Informatics is part of the BFH Centre for the Digital Society.

Core competencies
- eHealth Switzerland: Construction, Conception, Implementation, Evaluation
- ICT workflow analyzes target / actual comparison, work shifting, requirement engineering
- Patient-focused design and design of intuitive user interfaces
- Modulation and prototypical development of new applications in the field of mHealth
- Installation and testing of Ambient Assisted Living applications and software components in the medical informatics laboratory
- Information Management, Data Analysis, Big Data in Health Care

Living-Lab
Designed to be a place for research and education, the "Living-Lab" in the I4MI is an entirely unique lab in the German speaking area. It is completely realistic: hospital (with operating room, intensive care, ward) and doctor's surgery; physiotherapy and pharmacy; federal offices, insurers and logistics; even a virtual family in their 2-room apartment. All of which impressively show the information flows in the health care sector. EHealth, information systems (KIS, RIS, PIS, LIS, AIS), apps and sensors communicate around the documentation of the treatment and lifestyle data of the virtual Brönnimann family. This lab allows the visualization of the most important processes in the health care system and the analysis of information applications to support them with sensors, cloud solutions, Web 2.0 technologies and automation. By analyzing these technologies and testing them using simulated applications, the Internet of Things (IoT) is introduced into Health Care (Health 4.0).

Contact head of the institute:
Serge Bignens, Professor of Medical informatics
Phone +41 79 340 22 51, serge.bignens@bfh.ch

"Despite the growing use of information solutions and increasing complexities, patients and employees in the future health care system will feel good."

Institute for ICT-Based Management ICTM

ICTM helps its customers to find efficient and effective solutions at all levels of management. Together with its external partners, the institute develops holistic concepts and systems for the digital future of Switzerland.

ictm.bfh.ch – The Institute for ICT-Based Management ICTM is part of the BFH Centre for the Digital Society.

Core competencies

– Development of ICT solutions for management of enterprises and administrations
– Establishment and expansion of e-business concepts and applications
– Implementation of knowledge in the area of Identity and Access Management (IAM) as well as of electronic identities and signatures
– Conception, implementation and evaluation of data-oriented desktop, web and mobile applications
– Provision, analysis and visualization of structured and unstructured data (data science)
– Combining classical business intelligence methods with geographic information systems (GIS)
– Management of export-oriented companies
– Development and application of management methods for the analysis of business models as well as corporate ecosystems
– Application, evaluation and coaching in agile and holistic innovation methods, e.g. Lean Startup, Design Thinking
– Strategy development in the context of digital transformation; Change Management

Research Groups

– **Information and Data Engineering:** modelling, managing and analyzing information data; realization of distributed information systems on the web with current mobile technologies
– **E-Government:** Leadership tools and processes for the federal state
– **Identity and Access Management:** Electronic Identities and IAM Solutions for the eSociety of Switzerland
– **International Management:** Management of export-oriented companies
– **Business Ecosystem Management:** Development of management methods and tools for the analysis, modeling, simulation and validation of enterprise ecosystems.

Contact head of the institute:
Dr Annett Laube-Rosenpflanzer, Professor of Computer Science
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"Our interdisciplinary research team conceives and creates holistic ICT solutions for the eSociety of Switzerland."
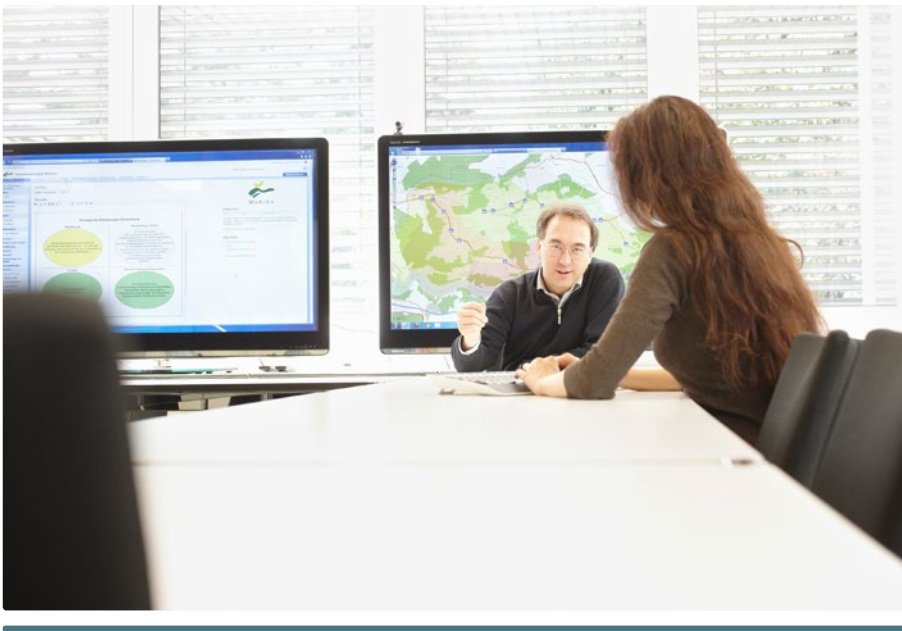
Institute for Print Technology
IDT

In cooperation with partners, IDT develops and optimizes processes and systems for functional and graphical printing and dosing technologies for applications in the areas of biotechnology, food and process technology.

idt.bfh.ch

Core competencies
– Highly accurate micro dosing and fluid management
– Application, coating of functional surfaces as well as pre- and post-treatment
– Development of micro-valves for printing and highly accurate dosing of high and low viscous fluids
– Development of matched systems of printing inks and varnishes and UV / VIS lamps for their curing
– 3D printing (medicine, food, design)
– Digital large area printing
– Development of fluid measurement systems for process optimization, e. g. drop-watching
– Combined electromagnetic, mechanical and fluidic simulation (multi-physics) of valves and pressure systems
– Development and assembly of inkjet systems, including pre-processing and post-processing

Research Groups
– **Life Science:** food, cell cultivation, medical technology
– **Enabling Technologies:** textile, design, restoration, production

Contact head of the institute:
Karl-Heinz Selbmann, Head of Printing Technology
Phone +41 34 426 43 29, karl-heinz.selbmann@bfh.ch

"We bring printing technology into new fields of application and create unconventional solutions for industry."

Institute for Energy and Mobility Research IEM

IEM's research focuses on the current topics of electrical energy, storage and converters, energy supply and distribution as well as general energy-efficient mobility.

iem.bfh.ch – The Institute for Energy and Mobility Research IEM is part of the BFH-CSEM Energy Storage Research Centre.

Core competencies
– Design and characterization of electrochemical energy storage and fuel cells
– Design and testing of photovoltaic systems and their individual components
– Modeling of electrical supply networks
– Design and optimization of power electronics for energy converters
– Design and construction of electrical machines and drive systems
– Accredited performance and emission testing of vehicles as well as analysis of the toxicity of exhaust gases
– Accredited testing and characterization of vehicles in the area of active and passive safety
– Electrification of niche vehicles

Laboratories
– **Batteries and storage systems:** life cycle tests and qualification of individual cells, battery systems and battery management as well as their integration into mobile applications such as hybrid and electric vehicles
– **Photovoltaic systems:** quality assurance of plants as well as testing of invertors and batteries and integration of photovoltaic into building shells
– **Electricity networks:** simulation and analysis of stress profile, voltage quality and oscillation behavior of power distribution networks
– **Electrical machines and drive systems:** design and construction of electrical machines and power electronics

– **Combustion engines and exhaust-technology:** Operation of engine and roller test stands for tests and research on combustion engines and their exhaust emissions
– **Power electronics:** design, optimization and control of energy converters to increase energy efficiency, dynamic behavior and cost reduction

"Only the ideas of resourceful engineers bring the vision of energy transition down to earth."

– **Vehicle mechanics and safety:** tests for development and characterization of vehicles; ISO-certified test tracks for braking, noise measurements and mobile tire testing laboratory; various crash systems for the investigation of occupant safety and the effect of protective nets
– **High voltage:** high voltage and high current generators for testing components and devices for their operability or electromagnetic compatibility
– **Hydrogen systems:** research on the cost-effective production of hydrogen, its efficient use in fuel cells and optimal combination of fuel cell systems with electrochemical power storage
– **Vehicle electronics:** acquisition, analysis and simulation of vehicle operating data; application of modern communication and networking technologies in the area of mobility

Contact head of the institute:
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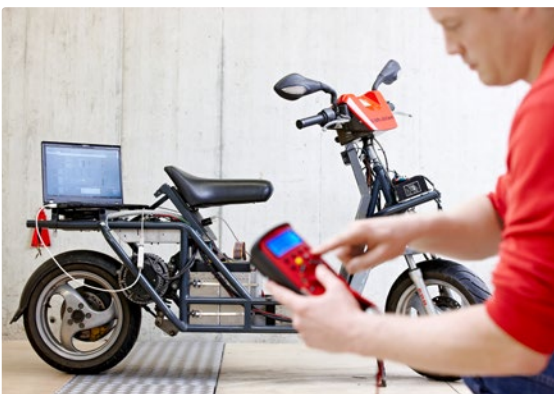
Institute for Risks and Extremes i-REX

Analyze, model, predict, classify! i-REX helps with investment decisions, risk assessments, predictions of hazards and extreme events, or in the design and control of industrial processes.

irex.bfh.ch

Core competencies
– Models of risks and extremes in nature, industry and finance.
– Implementation of risk management methods
– Support for study planning
– Extraction of relevant signal features for the prediction or classification of particular neuro-cardio-vascular occurrences or pathological conditions
– Detection and indoor localization of smartphones in the 2G, 3G and 4G standard

Research Topics
– Unsupervised and supervised learning from signals: classification, localization, predictions
– Experimental planning and data analysis: descriptive and close statistics, risk assessments, forecasts

Contact head of the institute:
Dr Daniel Bättig, Professor of Mathematics
Phone +41 34 426 43 26, daniel.baettig@bfh.ch

"We are a team of engineers, economists, physicists and statisticians and support our clients in modeling risks, optimizing processes and analyzing data."
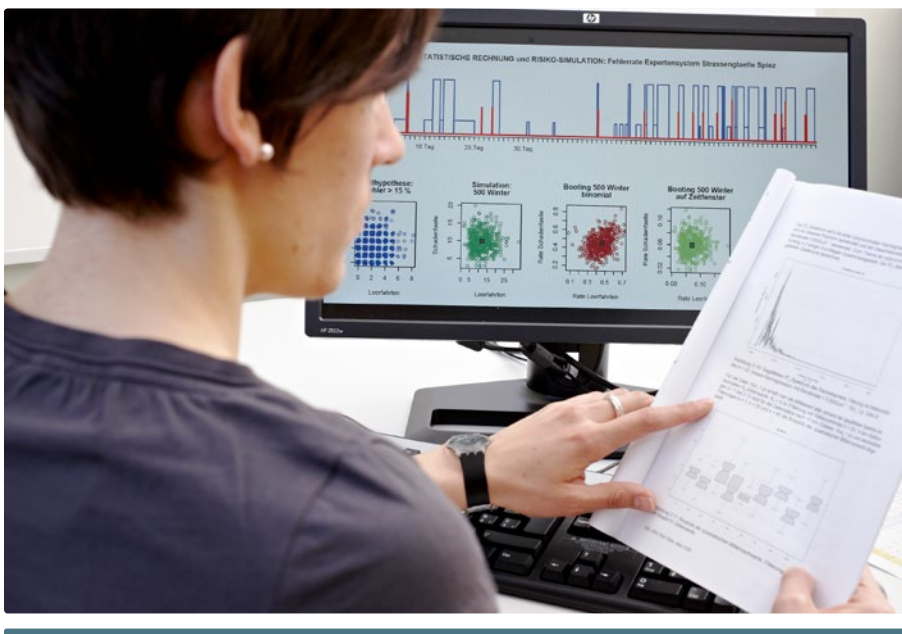
Institute for Rehabilitation and Performance Technology IRPT

IRPT research projects are carried out hand in hand with industrial partners and leading neurology rehabilitation clinics. The work is highly interdisciplinary. New products are developed for industry and for clinical applications.

irpt.bfh.ch – The Institute for Rehabilitation and Performance Technology IRPT is part of the BFH Centre for Technologies in Sports and Medicine.

Core competencies
– Cardiopulmonary and musculoskeletal rehabilitation
– Neurological adaptation and recovery
– Rehabilitation Robotics
– Novel drivetrains for cycling systems
– Functional electrical stimulation
– Micro- and whole-body vibration
– Treadmill automation
– Cardiopulmonary training and testing protocols
– Feedback control and signal processing

Research Groups
– **Rehabilitation Technology:** We develop new technical devices and expand the functionality of existing products. These are used in clinical situations to rehabilitate people with various neurological issues, including stroke and spinal cord injuries.

– **Sports Engineering:** Our work is focusing on advanced feedback control methods for treadmill automation. Its intensity is monitored during training and test purposes by observing heart rate, oxygen intake or metabolic rate. We also develop high-precision positioning algorithms. Applications on the treadmill are available for walking, racing and cycling.

Contact head of the institute:
Dr Kenneth Hunt, Professor of Rehabilitation Technology
Phone +41 34 426 43 69, kenneth.hunt@bfh.ch

"We combine cutting-edge technology with high-performance sports to optimize the rehabilitation process. We help people reach their full potential."

Research Institute for Security in the Information Society RISIS

RISIS designs, develops and implements new techniques and instruments for IT security in the information society.

risis.bfh.ch – The Research Institute for Security in the Information Society RISIS is part of the BFH Centre for the Digital Society.

Core competencies
– Design, implementation and security testing of cryptographic systems
– Malware analysis and reverse engineering
– Security engineering in the domains of IP, web intelligence, forensics, and mobile applications
– Privacy-by-design such as secure e-voting, e-ticketing, and road pricing systems
– Working with large sensitive datasets, e. g., in medical applications
– Secure "Internet of Things"

Research Groups
– **Security Engineering Lab:** Development of novel techniques and tools for improving and analyzing the security of IT systems in the domains of web intelligence and forensics, security in IP, malware analysis, and reverse engineering
– **E-Voting Group:** Design and development of verifiable e-voting systems
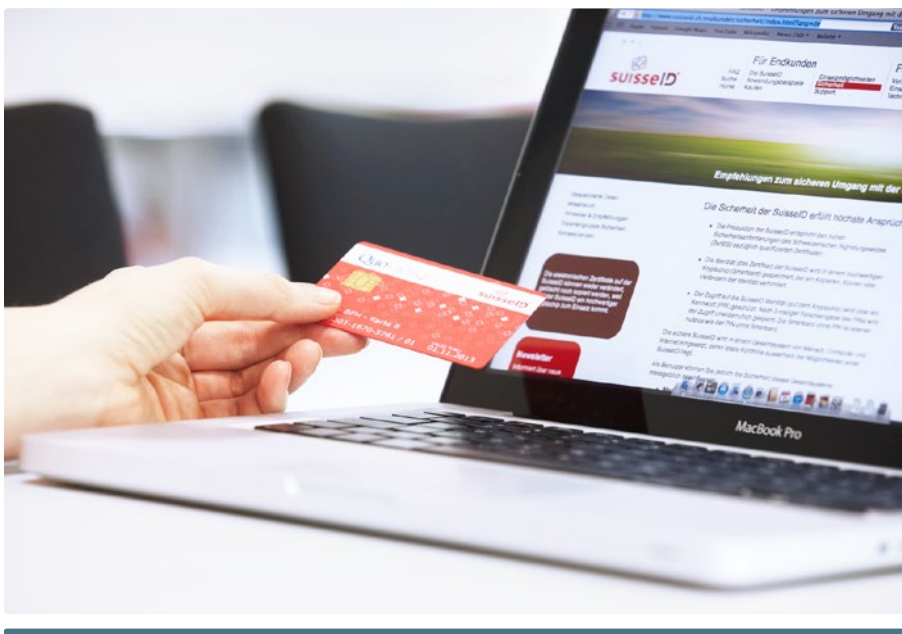– **Security and Privacy Group:** Development and promotion of privacy-enhancing technologies

– **Wireless Communications and Secure Internet of Things:** Establishment of a generic sIoT platform aiming at a high reuse factor for IoT projects, provisioning of low-energy, low bandwidth connectivity among actors and sensors

Contact head of the institute:
Dr Eric Dubuis, Professor of Computer Science
Phone +41 32 321 63 18, eric.dubuis@bfh.ch

"IT security is the prerequisite for the sustainable development of information society."

swissuniversities