

THE 2022 PROFILE & HIGHLIGHTS

Innovation Powerhouse

We are Austria's largest Research and Technology Organisation (RTO) and participate in the world's premier league in many infrastructure topics. This makes us a powerful development partner for industry and a top employer in the international scientific scene.

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MISSION STATEMENT

The AIT Austrian Institute of Technology is the largest non-university research institute in Austria, leading the way in innovation and playing a key role at a European level as the research and technology institute that focuses on the major challenges of the future, such as decarbonisation and digitisation, as well as on the key infrastructure topics of the future.

Seven specialised Centers conduct research in the fields of Energy, Low-Emission Transport, Health & Bioresources, Digital Safety & Security, Vision Automation & Control, and Technology Experience. These research areas are complemented by expertise in the field of Innovation Systems & Policy.

As a national and international hub at the interface between science and industry, AIT enables innovations thanks to its scientific and technological competencies, experience in markets, close connection to its clients, and an excellent research infrastructure.

As an Ingenious Partner to industry and the public sector, AIT plays a central role with regard to advising on future challenges and developing disruptive technologies. In doing so, AIT pursues a research approach that is based on a comprehensive knowledge at system level. We not only want to understand systems, but actively design them.

Around 1,400 employees throughout Austria conduct research on the development of the tools, technologies, and solutions for Austria's economy which will keep it fit for the future according to our motto: Tomorrow Today.

Today, AIT is at the very forefront in many areas.



Peter Schwab,
Chairman of the AIT Supervisory Board,
member of the Management Board of voestalpine AG

When the AIT Austrian Institute of Technology was newly founded from its predecessor organisations in 2007, a true success story began. Thanks to its consistent strategic orientation towards central research topics from the areas of infrastructure and the major challenges of the future, in particular digitisation and decarbonisation, the Institute has grown to become a constant in research, technology development, and innovation, as well as an important partner for the economy in Austria and Europe. Today, AIT is at the very forefront in many areas – with research being already at the top or very close to it.

AIT sees itself as a partner of business and industry to drive innovation. Since the complexity of the topics and the rich variety of the disciplines in the industry nowadays are very high, conventional methods quickly reach their limits. Problems must be considered in depth and the fundamentals must be understood thoroughly in order to find solutions. The industry needs this input and access to new methodology from outside – and AIT is the best partner for this.

A case in point: At voestalpine, it is often a matter of very precisely controlling highly complex processes with

very many influencing parameters. This can only be done with scientific methods and procedures. To achieve this, the company needs a research institute like AIT that has been conducting in-depth research on these topics for years and at the same time aims to implement the findings – and that also commands the necessary critical mass.

With the current AIT Strategy 2021+ "Research and Innovation for a Sustainable and Competitive Position in the Digital Age", AIT is in an absolutely precise position for the coming years. Infrastructure, climate change, resource conservation, digitisation, sustainability, security, health and many more: AIT's research activities are playing out in these big topics, where we're all going to need a lot more progress. AIT has an impact in all these fields of action; AIT offers new solutions. This in turn makes AIT even more attractive for researchers: When you work in these areas, you help make our world a better place. You are part of the solution.

AIT thus also makes an important contribution to the business location: Austria is a high-price and high-wage country. This means that you need a corresponding performance that jus-

tifies the high wage costs – this is only possible through innovation. We have a great many medium-sized companies in Austria that are world market leaders in their field. These companies can only get to the top and stay there if they constantly innovate. If you don't, others will overtake you. In a way, you're doomed to innovate and do research – but that's actually the wrong way to put it, because innovation is motivating and innovation is fun!

INNOVATING INFRASTRUCTURE SYSTEMS

SECTORAL DEVELOPMENT

Global influencing
Factors

Sectoral Structure and
Stakeholders

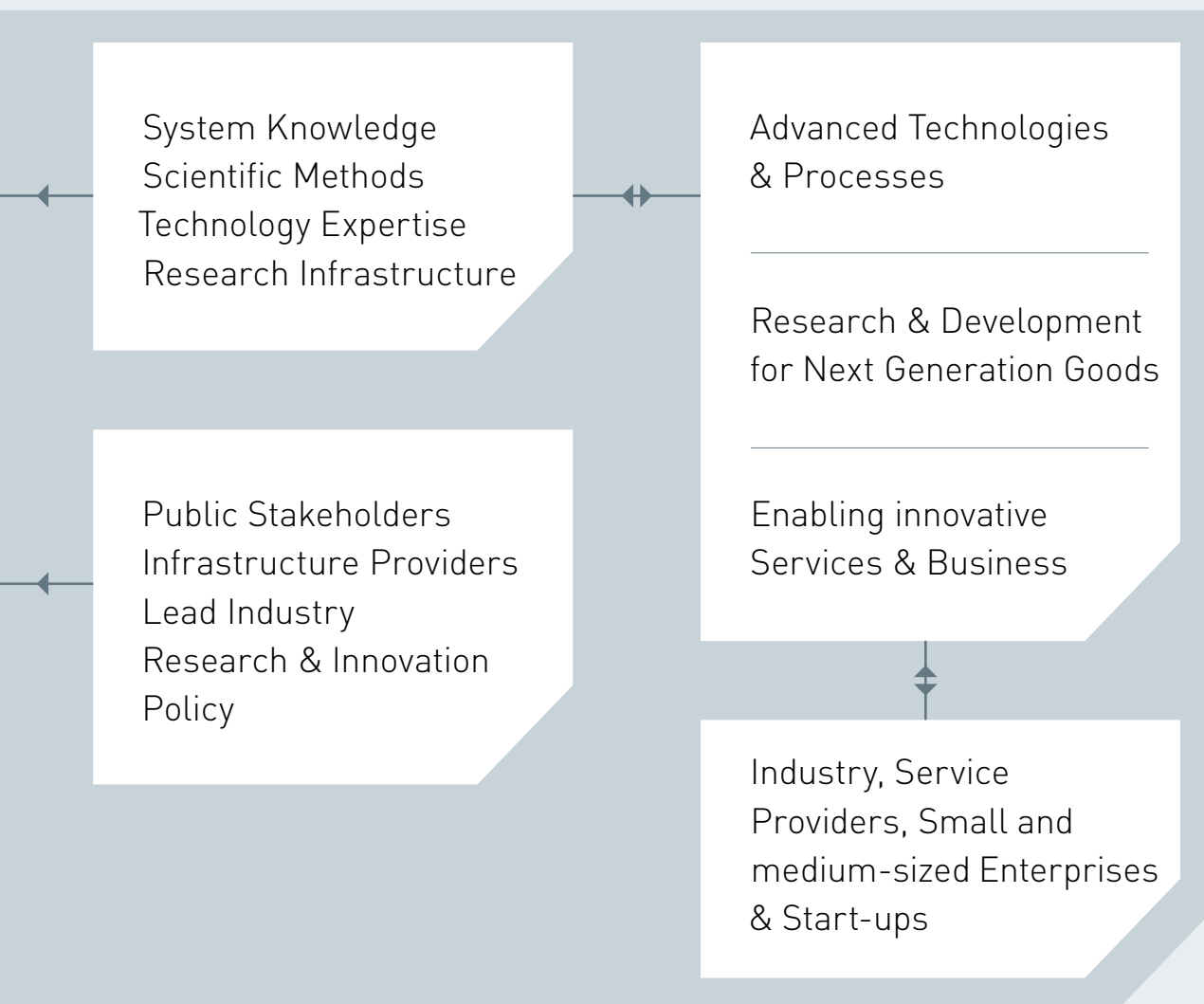
Policy targets
e.g. Grand Challenges

Key Enabling
Technologies

INNOVATION NEEDS OF INFRASTRUCTURE SYSTEMS

System Scenarios & Strategies

Providing Scenarios and
Strategies based on
sectoral Knowledge,
System Needs and
Technological Options



SOLID RESULTS DESPITE THE CORONA CRISIS

AIT Managing Directors Anton Plimon and Wolfgang Knoll on AIT's new strategic orientation and current research topics at the AIT Austrian Institute of Technology.

The corona epidemic naturally poses great challenges for research institutions as well. How have these been mastered at AIT?

Anton Plimon: The Corona crisis has had us face great uncertainties. Hence, we budgeted carefully during the planning period and had to manage many imponderabilia. In the course of the year, however, it became clear that AIT is crisis-proof and that we were able to carry on almost seamlessly where we left off in the past. Thanks to the extremely high commitment of the employees, the operational excellence, and the high degree of digitisation at the institute, it was possible to keep the project business in full operation.

Wolfgang Knoll: For us, the recent past was also strongly marked by the elaboration of a new strategy for the coming years. In doing so, we received valuable support from our Strategic Research Advisory Board (SRAB) with its six renowned experts from top international institutions. We are particularly pleased that the SRAB has provided us with a rock-solid report card for what we have jointly built up over the past years.

How was the last AIT business year?

AP: AIT presented a sound balance sheet for the first year of COVID-19, with well-filled order books. The result before taxes shows a very satisfactory

result despite the difficult conditions. With regard to contract research, we were even able to increase revenues slightly above the previous year's level. The past year was also very satisfactory in terms of incoming orders: We were able to almost completely match the level of the previous year. The good incoming order situation also caused a further increase in order backlogs.

WK: We can also report good results in scientific terms. The number of patents granted has risen strongly, as has the impact factor of publications in scientifically referenced journals. This is proof of the high scientific altitude that AIT has reached by now. It is also very pleasing that the number of habilitated AIT employees continued to grow in the previous year.

How could this be achieved?

WK: An essential basis for AIT's success are our highly trained and motivated employees. The AIT Group has about 1,400 employees. They come from more than 50 countries. In this context, we are pleased to receive positive evaluations from the company's internal "Work Environment Survey", which, with a participation rate of 79%, reveals positive developments both compared to the external benchmark and to the results of the two previous surveys. There is intense competition between research organisations worldwide for the best minds. In order to attract top people to AIT

and keep them here, we have to offer our researchers the best conditions.

As already mentioned, this year marks the start of a new strategy period at AIT. What are your plans?

AP: AIT is taking the next big step in its corporate development with precisely tailored research priorities from the new strategy "Research and Innovation for a Sustainable and Competitive Position in the Digital Age". The prerequisite for this new strategy is a rock-solid foundation that has been worked on hard and resolutely over the past years. On the one hand, in the coming years we will build on the critical mass already achieved in selected performance fields, and we are pursuing the goal of establishing a long-term position among the European research leaders. On the other hand, we are investing in selected key technologies and establishing corresponding technological expertise in order to succeed in new markets with changing value chains.

What are the thematic fields?

WK: Over the next years, we will focus in particular on four thematic priorities. Firstly, Digital Resilient Cities: There is a clear need for innovation in the areas of climate, energy, and mobility in urban and regional planning. These include measures to combat climate change, e.g. through more efficient use of energy in the private



AIT Managing Directors Anton Plimon (on the right) and Wolfgang Knoll

and industrial sectors, the restructuring of mobility systems or more intensive citizen participation. The second key area is Advanced Technologies for Low Emission Transport: It is all about a holistic approach to low-emission transport technologies. This includes, in particular, electric drive systems for vehicles, including the development of innovative battery technologies, as well as the development of light metal materials for this industrial sector which is so important in Austria. The third priority is the area of sustainable energy systems: The "energy transition" requires a stronger coupling of the different energy sectors (electricity, heat, gas or industry, households, agriculture), e.g. with the help of innovative heat pumps. A systemic approach that increasingly uses digital technologies (simulation, data analytics) can increase the reliability, efficiency, and sustainability of energy

systems. And we are also investing heavily in the area of AI-enabled Sustainable Automation and Robotics: Innovative automation concepts make goods production more flexible, robust, productive, safe, and efficient. Future automation systems will not replace humans, but aim to improve collaboration between humans and machines.

What is AIT's contribution to the major societal challenges in the area of climate change and digitisation?

AP: These topics are also very closely related to the expectations and visions of our two owners, the BMK (Federal Ministry for Climate Action, Environment, Energy, Mobility, Innovation and Technology) and the VFFI (Association for Research and Innovation of the Federation of Austrian Industries). The "Shareholder Vision" states that AIT supports business and society,

particularly in the areas of digitisation, decarbonisation and other challenges of climate change. These topics are at the top of the political and social agenda, hence one of AIT's guiding principles has been sustainability for some time now – in all its aspects. This ranges from the generation and integration of renewable energy and increasing energy efficiency, via sustainable mobility systems and greener and healthier methods of food production, all the way to more efficient production technologies and supply chains, and the way we think, plan and construct buildings and cities.

This year marks the end of the term of Supervisory Board member Hannes Androsch, who, with and thanks to the new management team, has put the once crisis-stricken predecessor organisation back on track since 2007. What is planned now for the new era?

AP: We will continue to invest in our unique laboratory infrastructure, which is one of AIT's unique features and a central basis for cooperation with companies. In keeping with the thematic priorities, we will be investing around EUR 25 million in the laboratory infrastructure at AIT alone over the next three years. Examples include the battery lab, the energy research labs, and the labs at the Leichtmetallkompetenzzentrum Ranshofen labs.

AIT's activities have recently been expanded in provinces such as Vorarlberg. What exactly is planned?

AP: Since the AIT relaunch in 2008, the original location in Seibersdorf has developed into a strong network with a focus on Vienna. Thanks to new partnerships, further locations were set up or expanded in Lower Austria and in the industry state of Upper Austria (Profactor in Steyr and LKR in Ranshofen), in addition to the established locations. AIT also conducts further activities in Styria, Carinthia, Tyrol, and Salzburg. And now also in Vorarlberg, where we have founded a joint venture with the Vorarlberg University of Applied Sciences to expand the Digital Factory Vorarlberg GmbH. This inter-company research institution sees itself as a bridge builder between science and industry. The research priorities of the Digital Factory Vorarlberg are cloud-based manufacturing systems, data science and Artificial Intelligence, wireless technologies and cybersecurity.

AIT has already been active in Upper Austria for some time, especially since joining Profactor in Steyr. What has already been achieved so far?

WK: Profactor is an important component of our activities in the field of robotics already mentioned earlier: Within the framework of an AIT light-house project, AIT brings together outstanding expertise under the direction of Prof. Andreas Kugi and Andreas

Vrabl, led by our Center for Vision, Automation & Control in cooperation with ACIN at the Vienna University of Technology, our Center for Technology Experience, Profactor in Steyr as well as other university partners.

An important topic, especially for research organisations, are the employees. How does AIT plan to attract the best minds?

WK: A particularly important initiative to attract and retain the best minds at AIT is our Principal Scientist Programme. The strong anchoring of outstanding researcher personalities as Principal Scientists at AIT is another important step towards the realisation of excellent flagship projects and international networking. For example, the first PhD student was recently accredited at Tufts University in Boston, where Matthias Scheutz – who was appointed Principal Scientist last year – works. Philipp Schneider, Professor of Biomedical Imaging at the University of Southampton, and Thomas Zemen, who is setting up a research focus on "6G-based communication systems", were also recently appointed Principal Scientists. Additional Principal Scientist appointments are planned. PhD students also make a significant contribution to the scientific excellence of AIT. The AIT PhD programme was restructured as well in order to do justice to this important role and to respond to the increasing competition between national and international PhD programmes and graduate schools for the "best minds". In addition to an attractive framework programme of training, mentoring, and networking events, key elements are the establishment of the PhD Coordinator and the Thesis Committee made up of AIT and university supervisors, which accompanies the students through joint and regular monitoring of their progress.

AIT has launched a large-scale Gender & Diversity Programme a while ago. What has already been achieved, what still needs to be done?

AP: In recruiting, we have achieved the goals we set ourselves. In the further development of our careers in the company, however, the generally known "glass ceiling effect" can be observed for us as well. Based on experience and analyses of the previous years, strategies have been developed, structures and decision-making bodies have been set up, and procedures and processes have been defined which aim at sustainably ensuring equality within the company. A gender officer was appointed for this purpose. A gender action plan with 42 concrete measures was developed as well.

LOCATIONS

A STRONG NETWORK

Since the AIT re-establishment in 2008, the original location in Seibersdorf has developed into a strong network at other locations with a focus on Vienna – in each case in the vicinity of universities or clients. Through new partnerships, in addition to the established locations, further locations were set up or expanded in Lower Austria (in Tulln and Wr. Neustadt), in Upper Austria (Profactor in Steyr and LKR in Ranshofen) and now also in Vorarlberg (Digital Factory). AIT also conducts further activities in Carinthia, Tyrol, Salzburg, and Styria.



FOCUS OF THE CENTERS

Energy

- Electric Energy Systems
- Integrated Energy Systems
- Energy Conversion and Hydrogen
- Digital Resilient Cities
- Sustainable Thermal Energy Systems

Low-Emission Transport


- Electric Vehicle Technologies
- Transportation Infrastructure Technologies
- Light Metals Technologies Ranshofen
- Battery Technologies

Health & Bioresources

- Medical Signal Analysis
- Bioresources
- Digital Health Information Systems
- Molecular Diagnostics

Digital Safety & Security

- Security & Communication Technologies
- Sensing & Vision Solutions
- Data Science & Artificial Intelligence
- Cooperative Digital Technologies



Seven Centers conduct networked research and innovation in central, strategic research topics of infrastructure and the major challenges of the future, such as decarbonisation and digitisation. With this clear positioning, AIT is striving for research and technology leadership in these areas. There is a lot of cooperation between the Centers, utilising synergies and establishing comprehensive system competence.

Vision, Automation & Control

- Assistive & Autonomous Systems
- Complex Dynamical Systems
- High-Performance Vision Systems

Innovation Systems & Policy

- Digital Innovation
- Foresight & Institutional Change
- Policies for Change

Technology Experience

- Experience Contexts and Tools
- Experience Business Transformation



On the Way to a Climate-Neutral Future

Leonore Gewessler, Federal Minister for Climate Action, Environment, Energy, Mobility, Innovation and Technology (BMK)

Climate protection and the energy transition are necessary to ensure that future generations will also find a world worth living in. Both are closely interconnected with questions of the infrastructure of the future and an innovation and research policy that creates the setting for green innovation. They touch on the opportunities offered by digitisation, on secure communication, on protection against cyberattacks and on "smart production". All these topics are focus areas of research and development at the AIT Austrian Institute of Technology.

An ambitious and comprehensive climate and energy policy will contribute to strengthening Europe as a research and innovation location. Austria is to play a key role here and become a climate protection pioneer: With climate neutrality 2040, we have established an ambitious plan and are also consistently working on setting the course correspondingly.

The commitment to a climate-neutral future is the joint responsibility for us all. Companies of all sizes, from start-ups to multinationals, will contribute. In order to achieve climate neutrality in 2040, we will replace the combustion of heating oil, coal, and fossil gas for the provision of heating and cooling with climate-friendly alternatives.

Energy efficiency will be significantly improved. Mobility systems are changing and the expansion of public transport will play a key role. More and more people are living in cities which are thus confronted with new challenges for urban and infrastructure planning. Digitisation opens up new fields of action and issues whose opportunities, but also risks, we are just getting to know.

We need innovations that open the door to new economic models. The focus on systems as opposed to individual, small-scale solutions plays a central role here. The Federal Ministry for Climate Action, Environment, Energy, Mobility, Innovation and Technology (BMK) considers the AIT Austrian Institute of Technology a key partner for achieving the climate targets.

As a key hub in the international and national RTI system, AIT takes on an important function providing support in mastering major challenges such as climate protection, energy transition, the future of mobility, urbanisation and the Smart City. After all, the aim is to enable a "Green Deal" for Austria's industry and trade. With the AIT Austrian Institute of Technology, we can count on an ally in this regard.

AIT: Important strategic partner for the great transformation of the coming decade

Isabella Meran-Waldstein
Head of Research, Technology & Innovation
Federation of Austrian Industries (IV)



Austria – like almost all other countries in the world – is facing major challenging transformations, which were massively accelerated by the COVID-19 crisis. These are reflected in the ever-increasing digitisation of all areas of life, from health via education to mobility. The digital transformation is also having a particular impact in the area of production, where it is leading to major changes in existing value creation processes and chains and is spurring the development of new, data-based business models. Digitally advanced companies can benefit from a digital dividend that manifests itself in increased turnover, more investments, and a higher appeal for employees. At the same time, the green transformation, which defines climate and nature protection as well as the transition to a resource-efficient and competitive economy as a clear goal, poses challenging tasks for us that can only be solved together.

The essential basis for solving these challenges is formed by research, technology, and innovation. By combining research and production in Austria and Europe, our resilience in strategically important areas can be improved. At the same time, the opportunity arises to bridge potential bottlenecks in value chains, to expand key technologies, to increase resource

efficiency, and to benefit from the advantages of digitisation. Furthermore, highly innovative, technology-based and digitally active companies can strengthen their own competitiveness – and thus that of the research location – through the development of technologically sophisticated products and innovative services.

In order to best utilise the existing potential, decisive action is required now. On the political side, a clear frontrunner course must therefore be pursued with investments in our future, ranging from Austria's participation in important EU initiatives, first and foremost in the new Horizon Europe research framework programme, to the expansion of national RTI funding. What is needed is a consistent and bold implementation of the "technology offensive" anchored in the RTI strategy, which will make Austria a key player with visible technological competence. At the same time, the application and intelligent use of digital technologies should be pushed more strongly as an additional innovation driver in Austria as a production location.

The AIT Austrian Institute of Technology has been a key strategic partner of the Austrian innovative industry for many years. Through its manifold bridging functions between science

and industry, research and education, AIT is an indispensable lead partner in Austria as well as in Europe. In particular when it comes to successfully mastering the double transformation as a research and production location in Austria on the way to more resilience, more competitiveness, and more innovation.

PERFORMANCE & OUTPUT

The AIT laboratories use state-of-the-art technology and equipment and form an essential prerequisite for successful applied research and development. Here, the foundations for products, services, and solutions for tomorrow are laid, tested, and brought to series production readiness. The large research infrastructure is one of AIT's major unique selling points and provides added value for customers and partners.



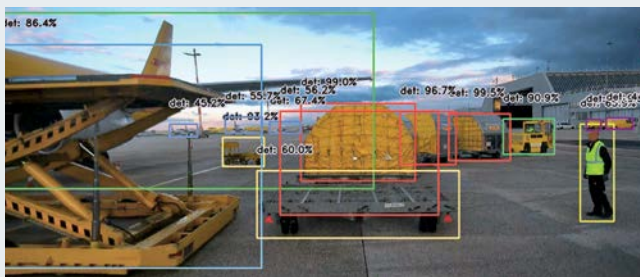
Search for biomarkers in plants

The AIT labs in Tulln enable the most important molecular biological and protein/enzyme-based biochemical techniques to be performed. This enables us to develop new technologies and tools for improving plant quality: genetic marker systems for plant breeding – using state-of-the-art technologies (genomics, transcriptomics, phenomics) together with subsequent integrative bioinformatics data analysis. These methods allow e.g. working with an intersection of genotype and phenotype. This allows also those genes to be identified that are associated with certain traits (characteristics). The markers developed in this way are used for a wide variety of genotyping purposes and inquiries. A DNA bank with an integrated data management system is available for long-term storage of biological material at the AIT site in Tulln (www.dnabank.at).



City Intelligence Lab – digital urban planning

The City Intelligence Lab (CIL) has been an integral part of AIT's expertise in the field of "Digital Resilient Cities" for several years. The lab is an interactive platform for exploring new forms and technologies for the urban planning practice of the future, and follows the approach of a co-creative development – joint creation of new knowledge. The platform is supported by the latest digital planning tools using Big Data and Artificial Intelligence (AI). Using digital technologies, the CIL enables complex relationships to be made tangible and the residents to be directly involved in the planning process. It therefore is a valuable decision-making aid for developing answers to the central challenges of urbanisation and climate change. The CIL is now being expanded to include mobility topics and aspects of behavioural research.



Automation in air freight

In the foreseeable future, automated vehicles will navigate on the apron of airports to transport goods between loading ramps and cargo planes. As part of the AUTILITY project, AIT researchers and partners have developed a carrier vehicle that performs many tasks automatically with the help of combined sensor data and Artificial Intelligence methods. The multi-functional vehicle platform was tested at Linz Airport and on the Digitrans test tracks in St. Valentin, where an outdoor sprinkler system, one-of-a-kind in Europe, is set-up. This will allow the concepts developed in this project to be tested also in adverse weather conditions.



Biometrics for a secure digital identity

At AIT, systems for personal identification and access control are developed that use state-of-the-art technologies to ensure fast and secure access and border controls. One result is the successful development of contactless fingerprint biometrics for mobile use via smartphones – a globally unique system for the rapid and highly precise establishment of identity. Moreover, AIT leads and coordinates large national and international projects in which the EU's high data protection and privacy requirements are complied with at the same time. AIT also works very closely with UN organisations in this area.



Understanding Artificial Intelligence

Artificial Intelligence will significantly change our social and economic life. The EU project "Co-Change", coordinated by AIT, addresses some of these changes, e.g. algorithmic decision-making. In the AIT Machine Learning Lab, experts from the fields of technology, data protection, privacy, ethics, and law consider the optimal framework conditions for using Artificial Intelligence in the future.



Infrastructures for RTI policy

RISIS ("Research Infrastructure for Research and Innovation Policy Studies") is a pan-European research infrastructure for the support of empirical innovation research. It increases the quality of the design and evaluation of research, technology, and innovation (RTI) policies in Europe through a radically improved information base. RISIS is highly relevant for research, design, and evaluation of RTI policy in Europe. AIT is a core partner of RISIS, which is currently in a second development phase and continues to be supported by the EU Research Framework Programme. RISIS II focuses on new functionalities and services in harmonized databases on RTI activities, such as address-based geocoding, or the ability to apply own thematic classifications to the data sets through semantic techniques.

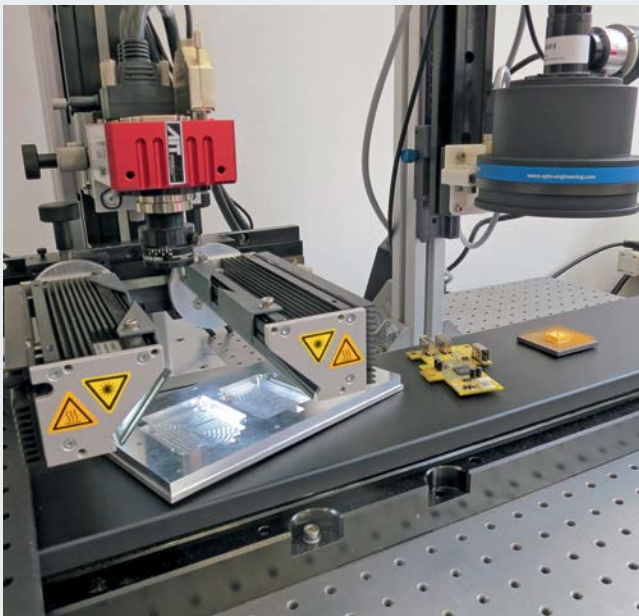
NEFI – New Energy for Industry

The innovation network NEFI – New Energy for Industry pursues the approach of decarbonising the industrial energy system with the help of key technologies "made in Austria". Formed around a consortium consisting of AIT Austrian Institute of Technology (coordinator), Montanuniversität Leoben, the Upper Austrian Energy Saving Association and the Upper Austrian location agency Business Upper Austria, NEFI brings together a wide range of experience in the field of energy research and project implementation. The continuously growing consortium with more than 100 partners from companies, research institutes, and public institutions is currently developing technological and systemic solutions in 17 projects that enable the energy transition in industry. The Climate and Energy Fund supports the NEFI projects with a total of 21.5 million euros, endowed with funds from the Federal Ministry for Climate Action, Environment, Energy, Mobility, Innovation and Technology (BMK).



Bioaerosol lab

The bioaerosol lab at the AIT site in Tulln is equipped with a unique bioaerosol chamber. It enables the creation and maintenance of a controlled environment of airborne microorganisms in defined numbers and uniform distribution. In this environment sampling devices and methods can be reproducibly tested and validated. Due to the COVID-19 pandemic, scientists are currently placing a particular focus and emphasis on the development and validation of efficient strategies for the detection of airborne viruses and the testing of air and surface disinfection. Furthermore, detection methods for biological particles from the air – pollen or plant material, fungi, bacteria, spores and viruses – are being developed.



Machine Vision Lab

For robust high-performance vision systems, image acquisition, scene illumination, and image processing algorithms must always be well-coordinated. To this end, in the Machine Vision Lab, test setups are quickly realized using a large number of available components to examine the suitability of possible solutions. This way, the latest research ideas can be implemented for the first time, while realizing the development of prototypes for the industry at the same time.



RoadSTAR

The driving labs from the AIT fleet "RoadSTAR" record all parameters of the road essential for the road maintenance operator or expert in a single crossing, without obstructing traffic flow. This increases the longevity of the road while at the same time increasing road safety. Surface damage and cracks in the road surface are visually recorded by the "RoadSTAR" driving lab. The parameters to be measured and analysed comprise the road surface grip, the macrotexture, the transverse flatness and the longitudinal flatness. The examination of all traffic safety relevant condition characteristics takes place as part of the (standard) accreditation. This allows e.g. independent examination of building contract provisions at the time of acceptance or before the end of the warranty period.



Shock and vibration testing of components

AIT boasts many years of know-how as an independent ÖVE/ÖNORM EN ISO/IEC 17025 accredited test centre for shock and vibration testing and environmental simulations. Items undergoing testing such as electronic and electrical parts, equipment, machinery and systems as well as superstructures for vehicle components will be subjected to stress and tested using two electrodynamic shakers, possibly also in combination with a climate chamber. We advise our clients on selecting appropriate test procedures, we offer the competent and client-oriented execution of such tests, and we issue accredited test certificates. Shock tests of up to 100 g are possible.



Technology Experience Lab

The AIT Technology Experience Laboratory is a flexible laboratory environment that enables holistic user experience study. The existing lab was modernised in 2020 and adapted to future challenges. The lab was expanded and the existing rooms were restructured: The Context.lab offers the possibility to evaluate products and interaction concepts in simulated contexts. With the MR.lab, a dedicated space was created to design and investigate mixed reality projects. The Idea.lab accommodates focus groups and co-design workshops in a pleasant atmosphere. The Maker.lab is a creative area for building prototypes. The Office.lab is a "classic" usability and user experience lab for evaluating systems. Apart from the spatial expansion, the lab was also strategically supplemented: In the area of multi-level measurement, competences and tools were developed that allow for measuring UX as holistically as possible.



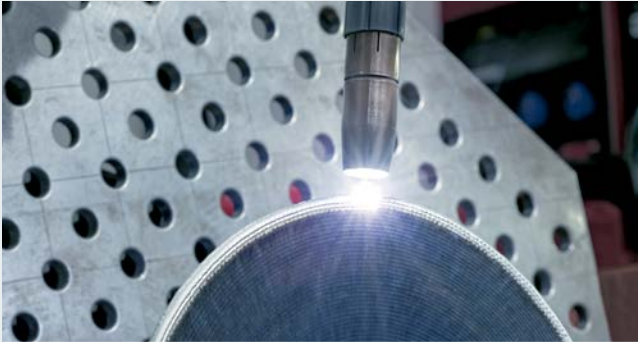
High-tech in the fight against fake news

The dissemination of disinformation is a serious threat: Fake news influence decisions, lead to uncertainty, build public discontent, and destabilize society and democracy. The tool-based detection of fake news is very difficult – but great progress is being made: At AIT, media forensic tools are being developed that are based on Artificial Intelligence and allow users to make an initial assessment of the credibility of text, image, video or audio material on the internet. In targeted experiments conducted in the IT labs at AIT, around 85 percent of fake news in articles were correctly classified with this method.



Mobile lab can save lives

Motorcyclists are particularly at risk in road traffic. Whether or not an accident happens depends in most cases on two things: the road conditions and the behaviour of the driver. A measuring motorbike developed by AIT together with the Vienna University of Technology helps to decisively reduce the risk of accidents: As a moving lab, it identifies danger spots that can be made safer before anything happens.



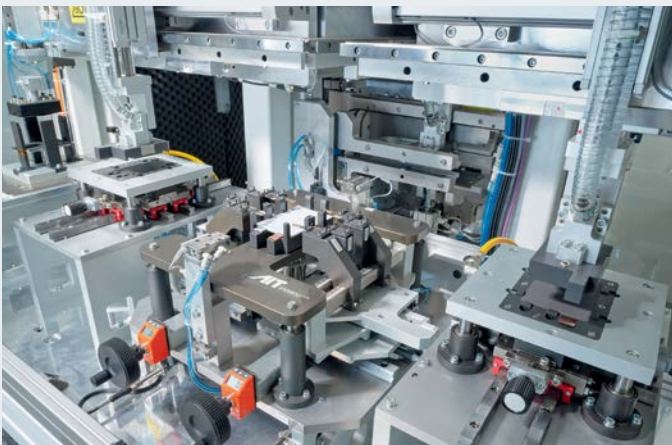
Additive Manufacturing Lab

So-called "wire-based additive manufacturing" is considered one of the most promising methods of 3D printing with light metals. In the Additive Manufacturing Lab at the LKR Leichtmetall-kompetenzzentrum Ranshofen, new alloys for welding wires are being developed on the one hand, and on the other hand, welding equipment is adapted in such a way that it enables component manufacturing by direct metal deposition from welding wires at comparatively high buildup rates and theoretically unlimited component size. The Additive Manufacturing Lab – which is constantly being expanded – is the basis for numerous cooperation projects with industry, including the recently launched COMET project We3D. The objective is to find new applications for the technology, e.g. in the automotive sector, aerospace, or mechanical engineering.



The microbiome of plants

Plants are associated with microbial societies, called microbiomes, which interact closely with their host plant. In AIT's labs, these microbial communities are studied by microbiome, genome, metagenome, and transcriptome analyses including bioinformatics and statistical evaluation. This makes it possible to explore the molecular mechanisms of the interaction between microorganisms and plants. Also, high-resolution microscopy methods are used to study the microbial colonisation behaviour of plants. In order to develop specific microbial applications to improve plant traits, extensive plant trials are also conducted in climate chambers, glass and wire houses under (semi-)controlled conditions. Where field trials are necessary, local plots are available through partners.



Battery Research Pilot Line

AIT is one of the few research institutions worldwide that can cover the entire value chain from battery research to battery production under one roof. Thanks to a dry room and a state-of-the-art research pilot line, AIT experts are able to produce lithium-ion pouch cells with regard to industrially relevant processes. The Battery Lab is now being expanded to include facilities for solid-state batteries.



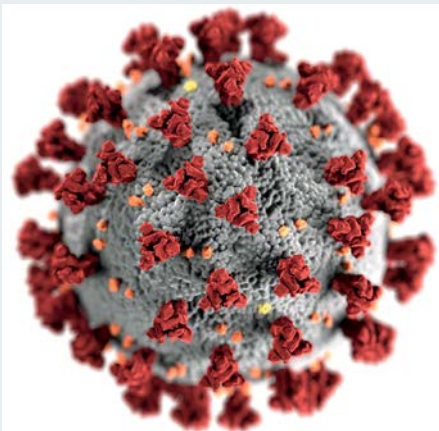
Aerial Systems Lab

In the Aerial Systems Lab, experts from the Center for Vision, Automation & Control are developing technologies for autonomous, unmanned aircraft – from air traffic management for remote towers to the development and operation of various flight platforms and through to flight simulators for collision avoidance systems. In addition to outdoor test environments, there is also an indoor flying area with a safety net and a high-performance development infrastructure. The focus of the work is on the autonomy of future unmanned aerial vehicles and their integration into civil airspace, air traffic management, the protection of critical infrastructures against threats from the air, as well as other airborne applications – such as for forestry and agriculture and, with real-time situation image acquisition and evaluation, for crisis and disaster management.



Direct current in the lab

By expanding the labs for DC currents on the order of 80 kA and higher, AIT creates an efficient and high-performing validation platform for manufacturers of DC components and DC systems. Direct current networks at medium and low voltage level, photovoltaic systems, storage systems, batteries for electric vehicles and new types of switchgear will play an important role in the future energy system. Already today, renewable electricity from offshore wind farms with high-voltage direct current transmission is moving across long distances to the mainland with low losses, e-vehicles are quickly charged with direct current, and data centres are efficiently supplied with direct current. The DC Lab in the Center for Energy is the largest lab of its kind in Austria. This lab infrastructure is particularly important for European developers and manufacturers of power electronic components.



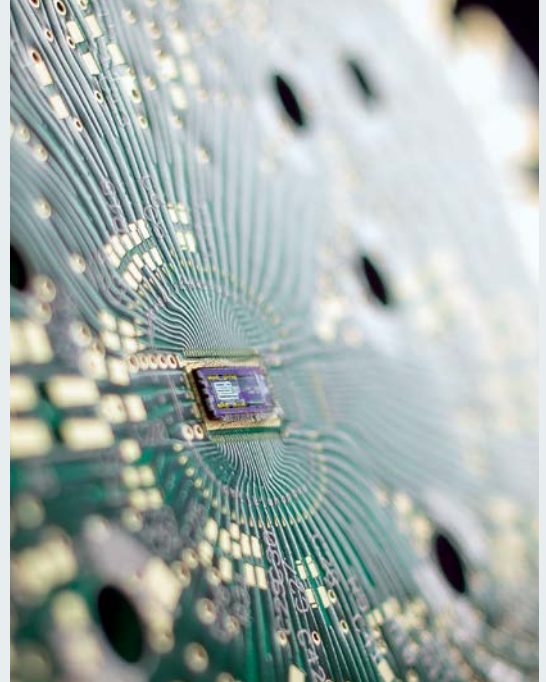
Innovative diagnostics: Corona tests and more

The focus of the work in the Molecular Diagnostics Lab is on non- or minimally-invasive diagnostics – i.e. primarily analyses in body fluids (liquid biopsy). Point-of-care solutions are developed for human and veterinary medicine. Research is conducted in the areas of e.g. diagnostic biomarkers, innovative biosensors or biological barriers – both in the area of fundamental research as well as in application-related research with industrial partners. This high level of competence has made the lab one of the first official Corona test labs in Austria which is also used for AIT-internal PCR tests. In cooperation with partners, a highly sensitive antibody test against SARS-CoV-2 was developed as well.



Use of waste heat from industrial processes

Two-thirds of the energy required by industry in Europe is used to provide process heat – e.g. in syntheses in the chemical industry, in forming metals, in firing bricks, or in drying agricultural products and foodstuffs. Of this, 77 per cent are currently covered directly by fossil fuels. At the same time, industrial processes also generate a great deal of waste heat. However, using these is not easy because their temperature is too low for many applications. This has changed now: As part of the EU research project DryFiciency, high-temperature heat pumps were developed, commissioned, and tested in industrial environments under the leadership of AIT. In doing so, the focus was on industrial drying processes that require process heat of up to 160°C. Three demonstrators were developed together with partners – two in Austria (Wienerberger and Agrana), one in Norway. Using these, it could be shown in practice that the use of heat pumps is a genuine alternative: In comparison to natural gas, industrial heat pumps have the potential to increase energy efficiency by up to 80 per cent, reduce CO₂ emissions by up to 80 per cent, and cause up to 20 per cent lower production costs. The technology attracts a great deal of interest from industry: At the online final conference of the DryFiciency project, more than 200 participants seized the opportunity to learn about the innovation first-hand.



Well encrypted with the help of quanta

What was once a theoretical exercise by quantum physicists is now becoming reality: Thanks to the use of quantum encryption methods, an absolutely secure communication that cannot be eavesdropped on or hacked will be possible in the future. The AIT Austrian Institute of Technology is playing a leading role in making this technology suitable for everyday use. AIT is developing the necessary technical equipment, miniaturising it to the size of optical chips and programming the corresponding software for it. The aim is to create small and compact terminals that can be easily used by users who have a fibre-optic connection. AIT also plays a leading role in major European projects for the introduction of quantum encryption, such as the EU-wide EuroQCI initiative, in which corresponding networks are being established to make a significant contribution to Europe's data sovereignty.

TOMORROW TODAY WITH YOU

As an expert and knowledge organisation, AIT strives to attract and retain the best minds. A central focus of its corporate strategy lies in promoting diversity and equality..



"Considering and integrating all the facets of any development from an early stage is only possible with mixed teams, ones which are interdisciplinary, gender diverse, and intercultural."

Gender equality is an integral part of the company's identity and is expressed in our endeavours to promote women and support their personal and professional development.

Julia Himmelsbach and her colleagues are working to design technologies which meet the wishes and requirements of all consumers: "There must be a spirit of equality in the development of technology, while the developments themselves must embody a spirit of diversity," she is convinced.



Employees are the most important resource in any organisation, especially during times of intense international competition. This particularly applies to AIT, a research and technology organisation that assumes a prominent role on the international innovation stage. "Science is becoming increasingly multidisciplinary. It requires interdisciplinary teams which adopt different approaches in order to consider and integrate all facets of a development from an early stage. This is only possible by working in teams which are interdisciplinary and intercultural, as well as gender diverse," explains Elke Guenther, Head of the Center for Health & Bioresources, and currently Gender Equality Officer at AIT. Consequently, the topic of Gender & Diversity has always been an inte-

gral part of the AIT identity and also plays an important role in the current AIT Strategy 2021+ "Research and Innovation for a Sustainable and Competitive Position in the Digital Age".

Gender equality is integral to the AIT strategy

Gender equality is an integral part of our identity, together with equal opportunities, fairness, open communication, empowerment, and active participation in designing processes and structures. It is a clearly defined AIT objective to provide special support for women and to assist them in their personal and professional development. This is regarded as a management task and is supported across all hierarchical levels. "Through its ongoing Gender & Diversity initiatives,

AIT is actively working to retain its female talent, creating an environment that supports women in their careers and empowers them to enhance their skills and competencies," says Guenther.

Concerted implementation of the gender strategy

The AIT gender strategy is based on quantitative and qualitative analyses including the AIT Gender Monitor, the Work Environment Survey, and gender pay gap reports. As an integral part of the corporate strategy, the issue of Gender & Diversity is given top priority: For purposes of implementation, the management appoints the Gender Equality Officer from among the management/line function for a period of two years. The Head of Recruiting &



AIT has launched a programme to promote female managers: 19 participants are actively enhancing their leadership skills, networking, and receiving input from external experts on their continued development.



"Promoting women and strengthening their competences to prepare them for leadership roles is a clear management task," stress AIT Gender Equality Officer Elke Guenther (left) together with her deputy Marie-Theres Raberger.

HR Development acts as their deputy, ensuring continuity when a new Gender Equality Officer is appointed. A Gender Office and an AIT Gender Task Force have also been established, and provided with the necessary resources by AIT. The different formats and measures are always designed to involve all company units and employees.

Equality plan with concrete measures

The current AIT Gender Equality Plan for the years 2021 to 2022 contains concrete measures in the areas of organisational culture, work-life bal-

ance, gender balance in leadership and management, recruiting and employer branding, career development and qualification, gender training, and the integration of gender dimensions in research.

AIT is currently running the AIT Female Leadership Development Programme, a special development programme for female junior managers and project leaders designed to promote their career development.

"Promoting diversity is a clear component of AIT's corporate strategy, and the programme occupies a central

position in this regard. It promotes the development of the participants on an individual basis, while at the same time providing 'communication points' for positioning the issue within the company, initiating dialogue and creating a basis for further joint development," explains Marie-Theres Raberger, Head of Recruiting & HR Development and Deputy Gender Equality Officer.

Women in Research

Another key activity in the field of Gender & Diversity is the communication

focus on "Women in Research". Here the top achievements of female AIT experts and the fields they work in are presented in external and internal public relations work. Women researchers are given more space and opportunities to have their say. They not only demonstrate the cutting-edge research undertaken at AIT but are also role models for colleagues and younger researchers. At the same time, great attention is paid to the gender-sensitive wording of internal function and role descriptions. The focus is on the tasks rather than the prerequisites. This is designed to motivate women to take an interest in internal career paths and to increase the proportion of qualified female applicants for vacancies at all levels within the organisation's hierarchy.

Gender dimensions in research

Integrating gender dimensions is now also an obligatory part of European and national research funding. The inclusion of gender dimensions in research and innovation content promotes the development of new ideas, eliminates gender bias, and

increasingly integrates societal needs. Gender aspects are incorporated into the conception, description and implementation of research projects – particularly in the composition of project teams and the orientation of project goals. When it comes to the concrete composition of teams, both the absolute number of women and men in the team and their hierarchical positions and incomes are relevant. This is an increasingly important criterion for evaluating submitted projects. AIT also considers gender dimensions with respect to the content of research projects. For example, one expert in this field, Julia Himmelsbach, is researching how men and women behave differently in football stadiums. This has direct implications for the way technologies are designed and used to support fan experiences. "Technology should be fair to everyone," she emphasises. Further examples of systematically considering gender and diversity aspects in AIT research topics are provided in the fields of Molecular Diagnostics (Diabetes), Clinical Diagnostics & Therapy Support (Cardiovascular Diagnostics), Innovation

Systems & Digitalisation, Data Science for Public Security (e-Commerce), and Integrated Mobility Systems.

Excellent promotion of women

In 2020, the AIT Equality Measures Programme was awarded the "equal-itA" seal of approval for in-house women's advancement by the Federal Ministry for Digital and Economic Affairs. This seal distinguishes companies that promote women, ensure gender equality within the company, promote women's careers and make women visible.

Further information about the Gender & Diversity Initiative and the current Equality Plan can be found at <https://www.ait.ac.at/en/career/diversity>.

Ingenious Partner @ AIT

Optimally developing the talents and skills of our employees is a primary concern for AIT. Career models that comply with international standards promote development of the workforce as a whole, as well as supporting individual career paths – across all job profiles and levels:

- Management
- Research Engineering & Expert Advice
- Science
- Support
- Technical Services



More information: <https://www.ait.ac.at/en/career/workait>

COMMITTED TO EXCELLENCE

Current scientific papers show the high research competence at AIT.



Anja Dakić,
Center for Digital Safety & Security

In order to improve road safety, control units of advanced driver assistance systems (ADAS) will exchange data wirelessly with neighbouring vehicles in the future. The quality of data transmission is influenced by a variety of effects. This paper presents an accurate real-time system-level simulation for multi-vehicle communication scenarios to support the development and testing of networked ADAS systems. The so-called "frame error rate" (FER), which is determined by several radio channel parameters, is determined. The FER data is stored in a table and queried at system level during the runtime of the real-time simulation. This methodology was validated using empirical measurement data from a road junction.

A. Dakić, M. Hofer, B. Rainer, S. Zelenbaba, L. Bernadó, and T. Zemen: **Real-time vehicular wireless system-level simulation**. IEEE Access, vol. 9, February 2021



Dejan Nickovic,
Center for Digital Safety & Security

Despite a lot of research, there are still major challenges in the area of fully autonomous driving. The same disillusionment applies to many other areas where autonomous Cyber-Physical Systems (CPS) may be useful. In this joint work of industry and science, the most important technical challenges were worked out using the example of highly automated vehicles (HAV). These are: realising continuous, ex-post system improvement; dealing with uncertainties and incomplete information; verifying HAV via machine learning; and prediction. By focusing on these challenges, the authors hope to help overcome disillusionment with HAV realisation.

N. Marko, E. Möhlmann, D. Nickovic, J. Niehaus, P. Priller, M. Rooker: **Challenges of engineering safe and secure highly automated vehicles** <https://arxiv.org/ftp/arxiv/papers/2103/2103.03544.pdf>



Tilman Barz,
Center for Energy

Latent heat storage systems with solid-liquid phase change materials (PCM) are characterised by high energy densities and, in the ideal case, by the isothermal nature of the storage process. Novel economic storage designs are based on compact gas-liquid heat exchangers in which the gas side is filled with PCM. These highly optimised devices are established technology, e.g. in air conditioning and engine cooling. Together with industrial partners, AIT develops prototypes for heating and cooling applications in buildings. Commercial paraffins that exhibit a complex non-isothermal phase change behavior are used as PCMs. It has been possible to develop efficient data-driven numerical models for an accurate prediction of their phase change behaviour.

T. Barz, J. Emhofer: **Paraffins as phase change material in a compact plate-fin heat exchanger-Part I & Part II**. Journal of Energy Storage, 33 & 34 [2021], 102128 & 102164



Christopher C. Mayer
Center for Health & Bioresources

Blood pressure is an important health factor for all people, especially those with pre-existing conditions. Already a few years ago, a team of researchers of the AIT Center for Health & Bioresources focusing on cardiovascular diseases discovered that there is a non-linear (U-shaped) relationship between 24-hour systolic blood pressure or pulse pressure and mortality in dialysis patients – in other words, that both low and high blood pressure lead to a poor prognosis for those affected. Further investigations using the pulse wave analysis perfected at AIT have now shown that there is also a correlation between the change in blood pressure from day to night ("dipping") and mortality in dialysis patients. It could be shown that heart diseases, such as cardiac insufficiency and atrial fibrillation, have an influence on these associations. This is an important finding for the management of hypertension in dialysis patients.

C. C. Mayer et al.: **Heart Failure and Atrial Fibrillation Modify the Associations of Nocturnal Blood Pressure Dipping Pattern with Mortality in Hemodialysis Patients**, *Hypertension* 76(4) (2020), 1231–1239



Tanja Kostic,
Center for Health & Bioresources

Microbiomes (communities of all microorganisms in a given habitat) play a crucial role in the life and health of plants, animals and humans. Microbiomes can also be used specifically for innovations, e.g. to produce goods more sustainably. In order to drive research and innovation in this field, a number of powerful international consortia with AIT participation have been established in recent years. Together, a recommendation for measures was developed to exploit the potential for microbiome innovations as fully as possible. Suggestions include more interdisciplinary research, stronger international cooperation, the creation of "Microbiome Centers" as new research infrastructures, long-term investments, clear legal regulations and increased communication between research, politics, authorities, industry, and users in order to increase public trust and acceptance of the new technologies.

K. D'Hondt, T. Kostic et al: **Microbiome innovations for a sustainable future**. *Nature Microbiology* 2021 Feb; 6(2):138–142. doi: 10.1038/s41564-020-00857-w



Thomas Scherngell,
Center for Innovation Systems & Policy

Creating new knowledge is a central driver for innovation and thus for creating competitive advantages. However, this correlation cannot be captured well using conventional methods – because until now, people have mainly focused on the quantitative dimension of knowledge production, such as the number of patents, neglecting the fact that not all knowledge has the same value. This changes with the newly introduced concept of "knowledge complexity": This is based on technological diversity and, at the same time, the uniqueness of a region's patent portfolio – because more complex knowledge is more difficult to replicate and therefore offers a higher competitive advantage. The calculation of this index using regional patent data from European metropolitan regions shows that with the new calculation method, different regions in Europe are further ahead in the production of complex knowledge which is so important for innovation than those which would result from conventional approaches.

N. Pintar, T. Scherngell: **The complex nature of regional knowledge production: Evidence on European regions**, *Research Policy*, online 6 January 2021, 104170



Tobias Glück,
Center for Vision, Automation & Control

In order to remain competitive, there is a huge demand for highly integrated intelligent components and subsystems in the manufacturing industry. As part of several research projects with Festo SE & Co. KG, scientists from the Complex Dynamical Systems research group at the AIT Center for Vision, Automation & Control and the the Automation and Control Institute (ACIN) at TU Wien have helped to develop the control strategy for a two-stage pneumatic valve that can be used universally. Until now, a separate solution had to be developed for each individual application. With the new valve, a single valve block now serves a large field of applications while at the same time resources can be saved. The innovative valve block consists of four main stage poppet valves driven by piezo-electrically actuated pre-stage valves and includes pressure sensors and a powerful computing unit.

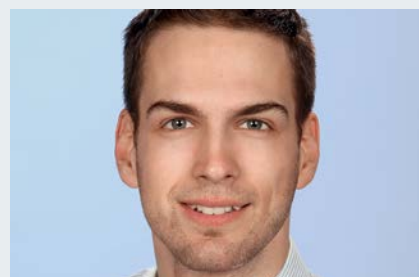
T. Glück, D. Büchl, C. Krämer, A. Pfeffer, A. Risle, L. Hägele, A. Kugi: **Modeling and control of a novel pneumatic two-stage piezoelectric-actuated valve**, *Mechatronics*, Volume 75 (2021), 102529



Karoline Alten,
Center for Low-Emission Transport

An important aspect for the attractiveness and acceptance of public transport in cities is the minimisation of noise emissions. Due to the wheel-rail interaction, the rolling of the steel wheels on steel rails including elastic components in the system, there is a vibration excitation in the frequency range that is perceptible and audible for humans, caused by an uneven rail surface. The aim of the research work is to use instrumented control vehicles to create a noise and vibration map. This then allows the identification of emission hotspots and degradation monitoring of the network from a vibro-acoustic point of view. Depending on the rail head error to be determined, selected parameters such as bandpass level, fast-weighted maximum level or loudness are included in the assessment, which can subsequently also be used to train classification algorithms, as described using the example of the Vienna tram network.

K. Alten, A. Fuchs, W. Wehr & R. Wehr: **Vibro-acoustic condition monitoring of tram rails using instrumented passenger vehicles**. *e & i Elektrotechnik und Informationstechnik* volume 138, (2021), pages 190–196



Markus Makoschitz,
Center for Energy

Photovoltaic, wind power or battery storage systems are typically operated in partial or low load conditions (weather conditions, surface contamination, etc.) for a certain period of time. Therefore, minimizing electrical losses under various load conditions helps improve the average overall energy performance. The paper evaluates different types of circuit enhancements based on wide band gap semiconductor technologies (silicon carbide SiC, gallium nitride GaN). It could be demonstrated that for an inverter with an additional low-load SiC MOSFET or GaN transistor power stage, the semiconductor losses of the overall system can be significantly reduced in that specific area of operation. Furthermore, it was shown that the switching frequency of the optional circuit expansion can be selected independently compared to that of the main converter. This results in an additional degree of freedom in circuit design.

M. Makoschitz, S. Biswas: **Light Load Efficient Silicon Power Converters Based on Wide Bandgap Circuit Extensions**. *Applied Sciences*, 10 (2020), 4730.



Quynh Ngyuen,
Center for Technology Experience

Virtual Reality (VR) training has become increasingly important for police first responders. To further improve the training experience, VR systems must be able to simulate the experiences of police officers "in the field". This can be done by adding reality-based stressors. In order to include stressors in VR, the concept of so-called stress cues is introduced. Given the complexity of the field of work, a co-creation process was chosen that allows creative collaboration with people from police organisations. The stress cues give trainers new opportunities in VR training, e.g. by actively intervening in the training. The trainee experience is enhanced through customisable trainings based on real-time stress measurements and additional information for training feedback.

Q. Nguyen, E. Jaspaert, M. Murtinger, H. Schrom-Feiertag, S. Egger-Lampl, M. Tscheligi (2021) **Stress Out: Translating Real-World Stressors into Audio-Visual Stress Cues in VR for Police Training.** In: Ardito C. et al. (eds) Human-Computer Interaction – INTERACT 2021. Lecture Notes in Computer Science, vol 12933. Springer, Cham. https://doi.org/10.1007/978-3-030-85616-8_32



Johannes Huemer,
Center for Vision, Automation & Control

Mechatronic systems often consist of several components and subsystems that can exhibit pronounced non-linear dynamic behaviour. To achieve the desired behaviour of the system over the entire operating range, non-linear control algorithms are widely used. The holistic evaluation of the behaviour of the resulting control loop is rarely a trivial task even for experienced control engineers. In the course of a research project, representative evaluation metrics were systematically selected, analysed and prepared for the best possible integration into existing development processes for both human and machine interpretation. The systematic, multidimensional approach to control evaluation has already been used in practice on an electrohydraulic valve from Robert Bosch GmbH. A control concept developed at AIT was evaluated on the test bed and the improvements achieved over the existing solution were analysed.

J. Huemer, M. Gurtner, P. Zips, A. Trachte, A. Kugi, Multi-Dimensional Control Performance Assessment for Mechatronic Closed-Loop Systems, 2021 European Control Conference (ECC), (2021), pages 2479–2484



Johannes Österreicher,
Center for Low-Emission Transport

With the increasing importance of Li-ion batteries, the analysis of lithium content in samples is becoming more and more important. However, this measurement is not possible using conventional methods (energy dispersive X-ray spectroscopy/EDS), in part because the characteristic X-rays emitted by lithium under an electron beam are low energy and are absorbed by the windows of conventional detectors. A team led by Johannes Österreicher (LKR Leichtmetallkompetenzzentrum Ranshofen) has now discovered a new method that allows low lithium contents to be measured for the first time using a standard scanning electron microscope. Here, conventional EDS is combined with the so-called "Quantitative Backscattered Electron Imaging" (qBEI) method, which measures the backscattering of electrons. The combination of these two detection methods now allows the quantitative and spatially resolved detection of lithium. A patent application has already been filed for the process.

J. A. Österreicher, C. Simson, A. Großalber, S. Frank, S. Gneiger: Spatial lithium quantification by backscattered electron microscopy coupled with energy-dispersive X-ray spectroscopy, Scripta Materialia, 194 (2021), 113664

INGENIOUS PARTNER

The research services of AIT experts for our clients and partners meet with great international recognition. This is reflected by numerous awards and distinctions. This also contributes to AIT being a first point of contact in major multilateral projects.



Patrik Aspermaier wins Falling Walls "Ticket to Berlin"

The goal of Patrik Aspermaier's project "BEAR technologies" is the digitisation of smell: a low-cost sensor is being developed that, in combination with Artificial Intelligence methods, forms an "electronic nose". This would allow the digital world to access another sensory perception. With this business idea, AIT researcher Aspermaier took part in the I.E.C.T. Summer School on Entrepreneurship, in which researchers, post-doc, PhD and Master's students were taught ways to commercialize – such as how to protect ideas, explore markets, raise funds, form a team, and learn to sell their idea. Of all Summer School participants, five were given the opportunity at the Alpbach Technology Symposium to win a ticket to the prestigious "Falling Walls Venture" conference in Berlin in November. Aspermaier seized this opportunity: He prevailed against a very strong competition with his idea.



6G network: Safe, Reliable and Energy-Saving

The mobile network connection of people, but also of machines and physical objects (Internet of Things – IoT) is irresistibly advancing. In order to sustainably provide highly reliable communication for industrial control systems, robots, autonomous systems, etc. in the course of the digitisation of our society, further technological developments are required: In order to research the next generation of mobile communications, a new 6G research focus was established at AIT in the Center for Digital Safety & Security. With the appointment of Thomas Zemen as Principal Scientist, AIT has entrusted an internationally recognized expert with the further development in this future-critical research field. The aim is the development of communication systems with short latency (maximum 100 microsecond delay) and high reliability (over 99.999%). 6G systems also reduce energy consumption and increase competitiveness. Zemen graduated with honours in electrical engineering/communications engineering from the Vienna University of Technology in 1998, followed by a doctorate in 2004 and habilitation in 2013. From 1998–2003, Zemen worked at Siemens Austria, and until 2014 he headed the "Signal and Information Processing" department at the FTW Research Center Telecommunications Vienna. Zemen has been conducting research at AIT since 2014 – since recently as Principal Scientist.



AIT researchers sweep up awards at the Future Zone Awards

After the Future Zone Award was cancelled the year before due to the pandemic, the awards were made up for in autumn 2021: AIT won twice with Anita Graser (Center for Energy) and Sebastian Egger-Lampl (Center for Technology Experience): together with PwC and the Samariterbund, Sebastian Egger-Lampl is the winner in the category "Smart City Project". The focus was on the Corona simulator they developed: It can calculate the risk of infection in buildings and gives recommendations for effective protective measures. Anita Graser is a Data Scientist at the Center for Energy and researches methods for analysing and visualising movement data. She won in the category "Women in Tech": This category honours exceptional female founders, researchers and leaders.

Winfried Neuhaus receives the Hugo Junker Award

Together with colleagues at the Martin Luther University Halle-Wittenberg, AIT Principal Scientist Winfried Neuhaus (Center for Health & Bio-resources) has developed a blood-brain barrier (BBB) model for research about Alzheimer's disease. It is assumed that the BBB is functionally altered at the beginning of the disease and that this condition keeps deteriorating. These disease dependent changes of the BBB are also essential for treatments, since drugs have to cross the BBB to reach the central nervous system. The newly developed BBB models are based on blood samples from patients and can be used to research disease mechanisms and the effectiveness of drugs. The team was awarded a "Hugo Junkers Award for Research and Innovation from Saxony-Anhalt" in the category "Most Innovative Basic Research Projects" for their work.



AIT ranks among the top of German-language economic geography

In ZitArt 2020, the publication and citation ranking of German-language economic geography published every 4 years, researchers from the AIT Center for Innovation Systems & Policy are very prominently represented in various positions: Senior Scientist Thomas Scherngell is among the top 12 in the person ranking of citations; Senior Expert Advisor Susanne Meyer appears in the top group among authors born after 1980; a paper by Doris Schartinger is in 7th place among the most cited publications in German-language economic geography. At the top of the ranking is the Center's long-time collaboration partner Manfred M. Fischer (Professor Emeritus WU Vienna). Overall, this shows on the one hand the large intersection between economic geography and innovation research as an important element in the Center, and on the other hand the central role that some of the Center's female researchers have been able to assume in this research field in recent years – both on a national and international level.

<https://www.iwkg.uni-hannover.de/de/forschung/zitart>



Angela Sessitsch is among the "Highly Cited Researchers".

For the fourth year in a row, Angela Sessitsch, Head of Competence Unit Bioresources at the AIT Center for Health & Bioresources, is among the most frequently cited researchers worldwide. Scientific papers published and cited between 2010 and 2020 were used for the analysis of Clarivate Analytics. The 6,602 listed scientists from 60 countries, including 43 from Austria, thus rank in the top one percent in their scientific field. In addition to her role at AIT, Angela Sessitsch is Vice President of the ÖGMBT – Austrian Association of Molecular Life Sciences and Biotechnology.



Early Career Researcher Award for Thomas Klein

Thomas Klein, researcher at the LKR Leichtmetallkompetenzzentrum Ranshofen (Center for Low-Emission Transport) received the "Early Career Researcher Award" in the category "postdoctoral researchers" at the 17th International Conference on Aluminium Alloys (ICAA17). The ICAA is one of the most renowned conferences in the aluminium sector. In order to understand the physical phenomena in "wire-arc additive manufacturing" – a promising 3D printing technique with metals – he is currently expanding AIT's international research network, including through collaborations with the Helmholtz Zentrum Hereon or DESY (Deutsches Elektronen Synchrotron [German Electron Synchrotron]), with the Universidade Nova de Lisboa and the Montanuniversität Leoben.

Photovoltaics: Multiple award-winning research

Researchers from the AIT Center for Energy were able to achieve top scores in the "Mission Innovation Austria" (MIA) competition: In the "Resilient Energy Systems" category, the "Erigenia" project conducted by AIT together with Fronius took first place. In the research project led by Stefan Übermasser, a method is being developed for short-term forecasts of photovoltaic (PV) systems.

In the "Next Generation" category, Bernadette Fina prevailed with her dissertation "On the Profitability of PV Sharing in Residential Energy Communities", in which she deals with the economic evaluation of energy communities in multi-apartment buildings and between different buildings.

DEKRA Award for "AIT Mobility Observation Box"

In order to promote sustainable mobility, it is particularly important to increase the road safety of non-motorised road users. An effective tool is the AIT Mobility Observation Box, which enables the recording and objective assessment of traffic infrastructure and conflict situations. To achieve this, movement patterns of all road users are recorded and an AI calculates the probability of an accident for car drivers, pedestrians, cyclists and all other road users. For this development, the AIT traffic safety team led by Peter Saleh and Klemens Schwieger was awarded the prestigious DEKRA Award 2021 in the category "Safety in Traffic".



AIT Poster Award for detecting fake news

The winner of this year's AIT Poster Award, Mina Schütz (Center for Digital Safety & Security) has developed a method that checks German-language social media postings and news articles e.g. for their authenticity. Second place among the 14 diploma, doctoral and junior scientists from six AIT Centers who took part in the competition this year went to Christian Kapeller from the AIT Center for Vision, Automation & Control (high-performance inspection systems for battery foil surfaces), while third place went to Ulrike Ritzinger from the AIT Center for Energy (reliable and sustainable delivery services). The AIT Poster Award, which has been held annually since 2010, has already supported more than 250 young talents.



"Nature"-Cover: Control in the quantum world

The research groups led by Andreas Kugi, professor at the TU Wien and co-head of the AIT Center for Vision, Automation & Control, and quantum physicist Markus Aspelmeyer (University of Vienna) have succeeded in controlling quantum motion on a hitherto unparalleled scale. This was reported by the science magazine "Nature" as a cover story on 15 July 2021. In the process, a tiny glass sphere was stabilized in such a way that its kinetic energy corresponds to a temperature of five millionths of a degree Celcius. This was achieved using a newly developed control method in which the movement of the glass sphere is precisely measured using microscope technology and an electric field is controlled in real time to counteract any movement of the glass sphere.



Manfred Tscheligi receives prestigious IFIP TC13 Pioneer Award

Manfred Tscheligi, head of the AIT Center for Technology Experience and professor at the University of Salzburg, was awarded the prestigious IFIP TC13 Pioneer Award together with five other researchers from Europe and the US for globally outstanding contributions to the field of human-computer interaction. TC13 is an international committee of the International Federation for Information Processing (IFIP) concerning Human-Computer Interaction issues. The IFIP TC13 Pioneer Award recognises globally outstanding contributions to the development of the field of Human-Computer Interaction. This also includes recognised publication activity. Manfred Tscheligi investigates diverse aspects of the interplay between humans and computers in order to enable desired interactions and develop desirable future scenarios.

TOMORROW TODAY

Our partners and customers benefit from conferences and events which AIT (co-)organises and complements with top-class contributions. In this way, it is possible to extend the knowledge lead.

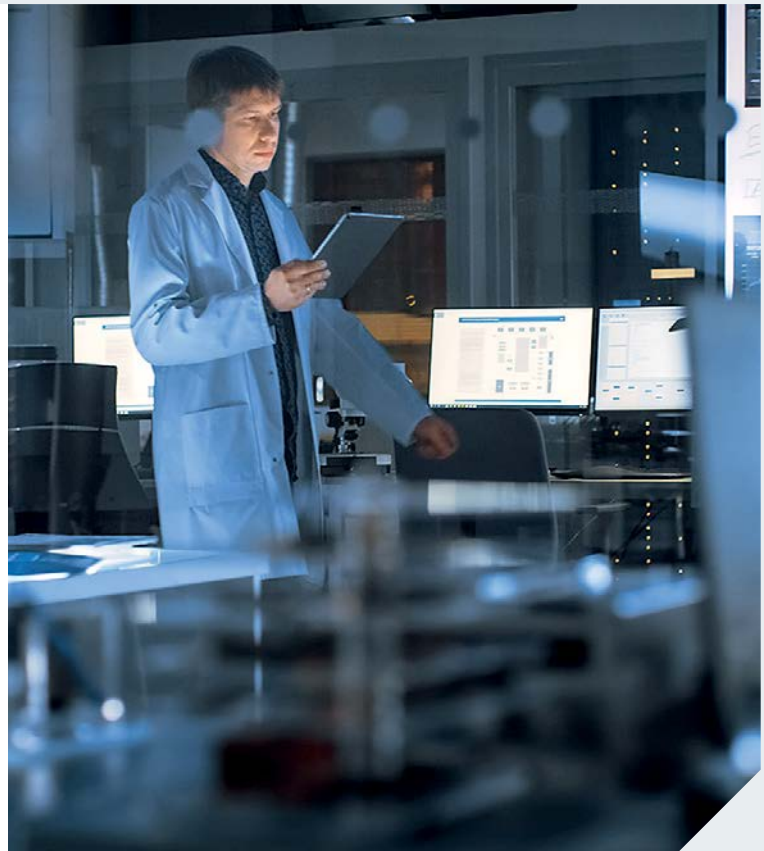


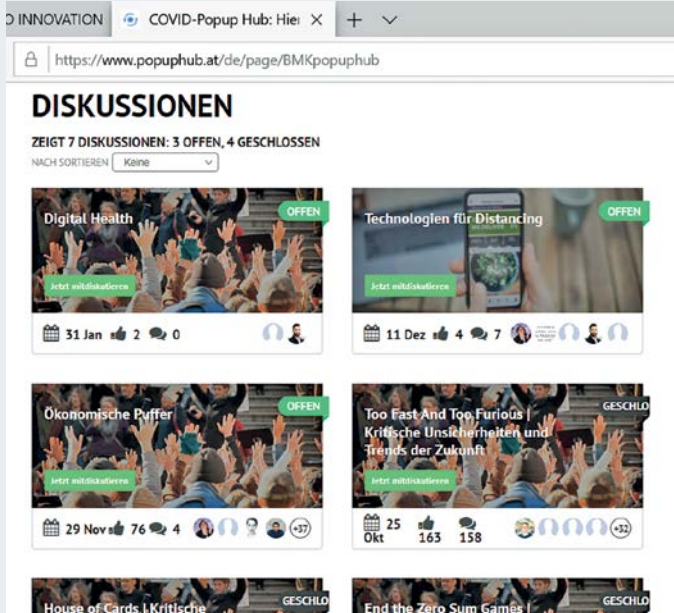
How startups tick

Where do most startups get launched? How are they financed? What is the composition of the startup ecosystem in Austria? These and many other questions are answered in the annual Austrian Startup Monitor. "The Austrian Startup Monitor helps to collect and continuously analyse information on the development of Austrian startups," explains AIT project manager Karl-Heinz Leitner. For the 2020 edition, "Green Startups" were examined in depth for the first time. It was found that the pursuit of ecological goals is an overriding objective for 36 percent of all startups surveyed. These are founded more often by women than by men and are an important generator of jobs: Green Startups currently employ around 7,300 people in Austria. In the coming year, the Green Startups aim to create almost 7000 new jobs.

International Data Science Conference (iDSC21)

Hosted by the AIT Austrian Institute of Technology in virtual format, the 4th edition of the annual Data Science Conference iDSC21 focused on the latest development and technology trends that would not be possible without well-founded data science. This concerns areas such as Artificial Intelligence, the Internet of Things (IoT), but also Industry and Production 4.0, and also enables advances in data mining, data analysis, and data communication. On the one hand, this is about the controllability of highly complex technological system landscapes, on the other hand, it is about the cyber-physical protection of our increasingly merging and interacting digital networks as well as the targeted greening of these industrial backbones.





Thinking ahead in the crisis

At the height of the Corona crisis, AIT played a leading role in the digital "COVID Pop-up Hub". This was a think tank to discuss issues raised by the Corona crisis. In the digital discussion room, which was open to all interested parties, the main topics of debate were distancing, digital health, state intervention and economic issues. The innovative format made it possible to bring together diverse experiences and include different stakeholders. The objective was to learn together from the crisis and to find new relevant issues and solutions in order to create a more resilient future.

Training for defence against cyberattacks

In September 2021, the Kuratorium Sicheres Österreich [Board of Trustees for a Secure Austria] (KSÖ), together with the AIT Austrian Institute of Technology, organised a transnational cybersecurity simulation game in which the defence against cyberattacks was realistically simulated in a hybrid form for the first time. In the "Cyber Range" developed by AIT, a realistic training scenario was simulated in which a group of individuals attack a fictional international pharmaceutical company which has a key role in combating a pandemic, using cyber- and information-focused attacks. The task of the eight participating teams was to recognise the attacks, report them to partners and authorities, and ward off the attack together. This training on technical and communicative processes provided valuable experience for emergencies.

The "AIT Cyber Range" is also used e.g. by the International Atomic Energy Agency IAEA as a training environment to ensure a high level of cybersecurity in critical parts of nuclear power plants. Austria also uses it to conduct large-scale exercises to train for the event of a cybercrisis – analogous to classic large-scale exercises in crisis and disaster management.





AIT at the EXPO in Dubai

The Austrian pavilion at the Expo 2020 in Dubai – which was postponed to the winter of 2021/22 due to Corona, but nevertheless retained its name – was a showcase of Austrian innovative strength not least because of its architecture and the materials used. Its interior also created space for all aspects of domestic research, development, and creativity. 53 selected innovations that reflect the Austrian spirit of invention were on display – from traditional companies via start-ups and SMEs all the way to research institutions. AIT was also well represented: Workshops included a presentation of the City Intelligence Lab, an excellent innovative high-tech platform for the urban planning of the future. But other subject areas too, such as interesting developments in mobility or security research, were shown to a global audience in Dubai.

International Digital Security Forum

Digital security concerns us all! That is the most important message of the "International Digital Security Forum" (IDSF) which – due to Corona – took place virtually in Vienna at the end of 2020. More than 500 participants from over 40 countries from the walks of politics, administration, business, and research discussed how the security of our data and digital systems might be improved under the general topic "Security in times of pandemics and major global events". The exchange of information and the formation of cross-sector partnerships are of central importance here. The conference, organized by the AIT Austrian Institute of Technology and WKÖ AUSSENWIRTSCHAFT AUSTRIA in cooperation with go-international, a joint initiative of the Federal Ministry for Digital and Economic Affairs and the Austrian Federal Economic Chamber, brought central organizations and high-ranking personalities to the table – from Federal Chancellor Sebastian Kurz and Ministers Margarete Schramböck, Karl Nehammer, and Elisabeth Köstinger to Vladimir Voronkov (UN Office of Counter Terrorism) and Arne Schönbohm (German Federal Office for Information Security).





Light Metal Days: Driving force for innovations

At the 11th Ranshofen Light Metal Days, everything revolved around decarbonisation and digitisation – not least the virtual event format itself as well. 13 top-class speakers and keynote speakers presented the latest research results in materials science, process technologies and future technologies such as "additive manufacturing". The latest edition of the Ranshofen Light Metals Days once again proved its leading role as a platform for the holistic consideration of the latest research results with high quality standards for the scientific lectures. The sessions on materials development and characterization, process development (experimental and numerical), on the future technology of "Additive Manufacturing" and the clear commitment to R&D as a driver for innovation, even in times of crisis, inspired the participants.

Digital Events

The Corona pandemic has shown that events and conferences in particular are undergoing fundamental changes. At the AIT Austrian Institute of Technology, we tried out, developed, and introduced different event formats within a very short time frame. There were both purely digital and hybrid formats – each with their own specific requirements. Cases in point are the Sustainability Conference (IST2020), the Alpbach Technology Symposium 2020 and 2021, the International Digital Security Forum (IDSF) or the AIT Financial Statement Press Conference. The experiences gained – e.g. which event format is most suitable for a particular purpose, or the resource requirements behind the different formats – were collected and compiled as AIT Workshop Guidelines.



CENTER FOR DIGITAL SAFETY & SECURITY

More than 200 experts at the Center for Digital Safety & Security work on key technologies of digitisation in order to build the most modern information and communication technologies in an energy-efficient, highly secure and reliable way and to use them according to a wide range of requirements.



Digitisation has changed the rules of the economy and many mechanisms of our society at an impressive pace. This transformation process is gaining further momentum through the networking of numerous physical objects (Internet of Things). These developments unlock huge potential for new applications, business models, and added value streams. At the same time, however, we have all already become dependent on technolo-

gy platforms to such an extent that our economy, our social life, and our government administration have become unthinkable without functioning digital infrastructures.

Mastering digital technologies has therefore become a fundamental requirement for business and society. Digital technology must be developed and designed with the highest possible availability, with the best possible security against the most diverse threat

scenarios, with the lowest possible consumption of resources, and with a focus on data protection in the service of people.

Strong international network

The Center's research activities build on strong networking with globally leading universities and research institutions, but also with international organisations such as the United Nations or the International Atomic En-

"A secure digital technology is the foundation for our social and business life."



Helmut Leopold
Head of Center for Digital Safety & Security

ergy Agency IAEA, as well as with the European innovation system (EU Commission, EU agencies and authorities in the EU member states). The Center thus also acts as an effective link for Austrian industry and public authorities to international innovation ecosystems.

Organisation and focal points

The research agenda of the Center is organised in four Competence Units: The Sensing & Vision Solutions area addresses next-generation sensor systems for the protection of critical infrastructures and works on biometrics technologies for future digital identity management. The Data Science & Artificial Intelligence area focuses on Artificial Intelligence (AI), Big Data and data science, as well as blockchain technologies. This concerns e.g. how decisions made by an AI system can be explained – an important prerequisite for being able to use AI-based technologies in a sensible and safe manner. In the Cooperative Digital Technologies area, AIT experts work on future IT architectures and technologies – with a focus on distributed and virtualised IT systems, data ecosystems, the Internet of Things and smart applications for the environment, e-government as well as for public safety and crisis & disaster management.

The Security & Communication Technologies competence area focuses on the one hand on central requirements for the reliability and security of digital technologies for the operation of critical infrastructures and production systems, cybersecurity systems and state-of-the-art encryption technologies; and on the other hand on new Digital Enabling Technologies such as hardware-related software development, photonic semiconductor technologies, radio systems of the future (6G), and quantum technologies.

Data protection and digital sovereignty for users

All these activities are strongly focused on data protection and privacy. With the great expertise in the development of methods, architectures, tools and technologies, the Center for Digital Safety & Security makes an important contribution to European data sovereignty, in order to ensure the highest possible protection of data in technical solutions through "security and privacy by design" approaches. For instance, smart encryption methods are being developed to prevent the misuse of personal data. The latest AI methods are used to protect online users from abuse.

Safety & Security by Design

As digitisation progresses, the topic of security becomes a fundamentally essential issue. Especially in the industrial sector, reliability and operational safety have always been important design criteria. This is now being increasingly complemented by the aspect of cybersecurity. Methods and tools are being developed at AIT to take safety and security requirements into account in the design phase, so that safety precautions can be taken at an early stage in accordance with the principle of "Safety & Security by Design". This will become an important competitive aspect for digitisation in the automotive and industrial sectors. In order to actively participate in creating important framework conditions for the deployment of future digital technologies, the constant exchange with technology users and authorities as well as the active discourse with the public are an essential guiding function for the Center – so that technology acceptance, legal requirements and ethical guidelines can be taken into consideration in the technical system design from the very beginning.

CENTER FOR HEALTH & BIORESOURCES

The mission of the approximately 200 researchers in the fields of health and bioresources is to improve the quality of life and the environment against the backdrop of demographic changes, dwindling resources, and changing lifestyles.

The activities of the Center for Health & Bioresources, which has developed into a recognised partner at the regional, national, and international level in the fields of health and bioeconomy in recent years, are guided by the motto "One Health". This means that human health cannot be considered alone, but rather always in conjunction with the health of plants, animals, and the environment. The "One Health" concept has gained much importance recently, since the interactions between humans, animals, and the environment have changed due to a variety of factors such as population growth, aging societies, climate and environmental changes, and the ever-increasing movements of people, animals, plants, food and feed. These developments have also favoured the emergence or re-emergence of many infectious diseases, such as the COVID-19 pandemic. There is therefore a great need for the development of appropriate systemic solutions and strategies at the interface between the fields of health, environment, and bioeconomy in order to address these global challenges.

By linking the health sector with bioeconomic aspects under the umbrella of "One Health", we are addressing not only human and animal diseases, but also their health status – and not only the improvement of individual plant systems, but also the quality and safe-

ty of food, and thus the health of all humans and farm animals, within the framework of a bio-based and circular economy.

Within this framework, we see our task as improving the quality of life and the environment in the face of demographic change, the growing world population, the limitation and scarcity of resources, as well as the increasing individualisation of consumers and patients and a changing lifestyle. With our scientific reputation, our technological expertise, our deep un-

derstanding of system and partner requirements as well as of the necessities for implementing our solutions in practice, we contribute to the "Grand Challenges" and the "Sustainable Development Goals" set by the EU and the WHO. Together with our partners and clients, we want to make a significant contribution to the development of relevant technological and scientific solutions to improve the health status of the population and make better use of biological resources.



"In biomarker research, AIT is among the leading RTOs in Europe."



Elke Guenther,
Head of Center for Health
& Bioresources

Plants and microorganisms

In the field of bioresources, a current research focus is the microbiome – the community of all microorganisms (viruses, bacteria, archaea, unicellular eukaryotes, fungi) in a given habitat. The focus of interest is the colonisation of plants with microorganisms and their mutual interactions (holobiont). The growing understanding of the interconnectedness of microbiomes in environmental and food systems has the potential to support the sustainable production of food, feed, and bio-fuels and at the same time to promote the principles of the circular economy. Digital technologies play an important role in the research and application of this knowledge – e.g. for a circular agriculture or improvements in food production.

Health research according to the "4P" principle

Digitisation is also one of the cornerstones of the Center's activities in the health sector: Cases in point comprise the development of telemedicine systems, such as telemonitoring for people with cardiac insufficiency or for people who are in home quarantine because of a Corona infection. Central focal points are the search for biomarkers, the development of biosensors, and decentralised "point-of-care" solutions for diagnostics as well as research into biological barriers.

Medical research is embedded in the "4P" concept:

- preventive: Regular monitoring of the health status can prevent the outbreak of diseases through timely intervention.
- predictive: With the help of big data analyses and modern diagnostic methods, situations with significant health risks can be predicted.
- participative: Systems are being developed that make patients active participants in healthcare.
- personalised: Therapies are adapted to people's individual needs – e.g. by developing specific biomarkers.

Integrated into large European networks

Since last year, the AIT Center for Health & Bioresources has also been a member of two of the eight innovation communities of the European Institute of Innovation & Technology (EIT). One of these is EIT Health, which aims to leverage the innovation potential of cutting-edge research for health technologies for health care, diagnosis, and prevention and to implement it for rapid market entry. This network has around 150 partners from industry, applied research, universities, hospitals and health care providers; around 1,000 startups are also affiliated. Six Innovation Hubs have been set up

so far for the regional anchoring of the European network, including in Stockholm, Paris and Mannheim. Another Innovation Hub is now being founded in Austria on the initiative and under the coordination of AIT. On the other hand, AIT is also active in the EIT Food innovation network, which is Europe's leading innovation and technology initiative in the agricultural and food sector, and is committed to more sustainable, healthier and more trustworthy food.

CENTER FOR LOW-EMISSION TRANSPORT

At the Center for Low-Emission Transport, fundamentally new technologies for more efficient vehicles and transport systems are being developed. The focus is on electric drives, lightweight construction, and efficient use of the transport infrastructure.



The Center for Low-Emission Transport occupies a leading position in the Austrian innovation system and a key role in Europe as an RTO focusing on the key transport infrastructure issues of the future. The Center realises fundamental innovations for the next generation of sustainable transport technologies through research and technology development in combination with a high-quality research infrastructure. The Center's unique selling point is its holistic approach to low-emission transport technologies for people and goods

– from sustainable and energy-efficient manufacturing via low-emission usage and maintenance all the way to aspects of the circular economy comprising transport vehicles and infrastructure. The Center's approximately 150 employees cover a wide range of research competences: numerical engineering tools for modelling and simulation as well as experimental research for characterisation and validation of material development via industrial processing, process and component monitoring all the way to prototyping.

Technologies for electric vehicles

Research in the Electric Vehicle Technologies Competence Unit focuses on the development of innovative methods, models, and tools for the construction of efficient and reliable electric powertrains. A key research area here is research in batteries as energy storage devices. The experts have a state-of-the-art battery lab at their disposal for the development of the next generation of batteries, including a pilot production plant, which is currently being expanded to include a lab for promising sol-

"In our battery research, we cover the entire system chain from battery development via materials research all the way to battery production."



Christian Chimani,
Head of Center for Low-Emission
Transport & Managing Director LKR

id-state batteries. Research is also being conducted on the simulation of vehicle systems (e.g. to improve energy and heat management) and on components and control algorithms for power electronics. By combining many existing competencies, the overall system of energy storage and energy consumers and their interaction can be better addressed. Recently, the development of some purely electrically powered vehicles has attracted attention – such as the EMPA-TRAC, an innovative commercial vehicle with a modular structure; or, in collaboration with KTM, a two-wheeler specifically for the young and older generations in urban areas (EMotion project). A further focus is on the development of methods for purely electric and hybrid aircraft that can be powered by both combustion fuels and electric energy.

Innovative light metals

The work in the Light Metals Technologies Competence Unit at the LKR Leichtmetallkompetenzzentrum Ranshofen revolves around the development and processing of lightweight high-performance materials for vehicles of the future as well as the design and production of vehicles and components. Lighter vehicles consume less energy, cause lower emissions and increase the range. Using highly specialised material investi-

gations and simulation methods, the researchers are investigating and developing new types of light metal materials (such as aluminium and magnesium alloys) as well as methods for their shaping. A separate research area is what is known as "wire-based additive manufacturing", which is one of the most promising methods of 3D printing with light metals.

What distinguishes this Competence Unit is that it covers the entire light metal process chain, from alloying expertise via casting and forming know-how all the way to process and lightweight construction experience, accompanied by simulation tools for all processes. Not only are the materials designed according to customer requirements in this way, but the further processing steps are also optimised at the same time – in order to create new lightweight materials with advanced properties for future applications.

Secure and efficient infrastructure

In accordance with the Center's research approach, the Competence Unit Transportation Infrastructure Technologies also has a great deal of experience in modelling and simulating transport infrastructures, combined with experimental sensor technology and characterisation in order to capture and understand all interrelationships and interactions.

The focus here is on decarbonising the transport system and extending the life cycle of infrastructure facilities. The research in this area is concerned, on the one hand, with the development of measurement methods for noise and vibration effects for monitoring the transport infrastructure (roads, railway networks, bridges, buildings) in order to ensure a highly resilient, resource-efficient and safe transport network. On the other hand, methods for the precise determination of the condition of the transport infrastructure and the assessment of safety risks, including the development of measures, are being worked on. A fleet of specialised measuring vehicles (RoadSTAR, RoadLab or Motorcycle Probe Vehicle) which regularly check the condition and safety of the Austrian road and rail networks is operated for this purpose.

CENTER FOR VISION, AUTOMATION & CONTROL

The digitalisation and automation of production processes, the development of assistance systems and autonomous machines as well as the inline quality assurance of industrial products through high-performance inspection systems are the focus of the Center for Vision, Automation & Control.

The pressure on industry to invest more in digitalisation and automation is increasing. Automation is also one of the key technologies to achieve the two top priorities of the European Commission: On the one hand, the EU economy is to be made sustainable (Green Deal), and on the other, Europe is to be made fit for the digital age. The Center for Vision, Automation & Control supports the industry with customised, intelligent automation solutions in this endeavour. With increasing quality, production costs are to be minimised and energy and resource efficiency are to be increased. In doing so, the

human is placed at the centre of our developments. Around 100 experts are researching autonomous machines and assistance systems, high-performance quality inspection systems, mechatronics and robotics, as well as intelligent production systems. The vision is to support people in their work through advanced automation concepts and to design the industrial future. In this process, a close synergetic linkage of in-depth scientific methods and technological expertise is maintained. The portfolio encompasses the entire spectrum from consulting via medium- and long-

term strategic research cooperations all the way to the development of prototypes and the support of industrial implementation and application.

From sensor to decision

The aim of the Center is to cover the entire chain from capturing information by means of sensor systems via sensor fusion, combining physics-based models with machine learning and data analytics, using this information in fault detection and isolation, optimisation and control, all the way to high-level decision-making in components, systems and processes – in



short: from the sensor to the cognitive decision of an autonomous system. The requirements of the market are systematically incorporated into the research programme from the very beginning. This means that the research results are used in our customers' products, services and processes and thus help to consolidate and expand the position of the industrial partners in the market.

Three research groups – one goal

The Assistive & Autonomous Systems research group deals with sensing, navigation and decision-making functions for assistance systems and for the autonomous operation of vehicles, machines and aircraft. These are based on sensory perception, environmental modelling, machine learning for object recognition and scene understanding, as well as scenario-based simulations and tests. The scientists in the Complex Dynamical Systems research group are working on intelligent mechatronic drive systems that can be easily commissioned, reconfigured and adapted to changing operating conditions. They are also researching the automation of commercial machines and vehicles as well as the real-time optimisation and control of continuous production systems. The core competence of the High-Performance Vision Systems research

group is the holistic design of robust image-processing-based sensor systems for real-time inspection and quality assessment, with a particular focus on highest performance in terms of speed, resolution, complex shapes or difficult surface properties. Depending on the task and research question, the experts work hand in hand to provide partners from industry and science with tailor-made concepts and sustainable solutions.

Key partnerships and top researchers

In recent years, the Center has established a number of institutionalised key partnerships with scientific institutions. There is a close connection and strategic coordination of the scientific agenda with the Automation and Control Institute (ACIN) of TU Wien, in particular through Andreas Kugi, who heads both institutions. In 2020, the Center succeeded in attracting Matthias Scheutz, Director of the Human-Robot Interaction Lab at Tufts School of Engineering in Boston, USA, as Principal Scientist. He is an expert in Artificial Intelligence, cognitive modelling, human-robot interaction, and natural language understanding. Recently, we have succeeded in bringing Philipp Schneider, Professor of Biomedical Imaging at the University of Southampton, UK, to the Center as Principal Scientist. Schneider has excellent

expertise in the field of high-resolution 3D imaging, image processing and quantification methods, with a particular focus on biological and medical applications.

Collaboration between humans and machines

Future automation systems should be designed to serve and support workers and adapt to their needs. Through automation, heavy, monotonous and dangerous tasks can be outsourced to the machine; at the same time, people can focus on their strengths: the combination of cognitive skills, dexterity, creativity, innovative spirit, problem-solving skills and communication skills. In order to be able to combine the respective strengths, new concepts of collaboration between human and machine ("Industry 5.0") are therefore being developed.

"Our intelligent automation solutions serve people and the environment. They increase resource and energy efficiency and ensure product quality."



Andreas Kugi, Andreas Vrabl (r.)
Heads of Center for Vision, Automation and Control

CENTER FOR TECHNOLOGY EXPERIENCE

The users of digital technologies take centre stage: The Center for Technology Experience focuses on the interaction between humans and technology, the human-centred design of systems and the design of advanced human-machine interfaces.



We humans do not just use technology, we live with it. More than ever before, digital technologies affect us on an intellectual, but also on a sensual and emotional level. Due to the rapid spread of digital technologies – such as artificial intelligence, robotic systems, and virtual reality – it is becoming increasingly important to consider a human-centered view of technology.

Successful digitisation must support people. An essential prerequisite for successful innovation is an optimally designed interaction between people and technology. The needs of people must be taken into account in all steps of the value chain. This approach poses many challenges for the successful design of new products, technologies, and services.

The Center for Technology Experience focuses intensively on interactions between humans and machines, on the interfaces in between and on the so-called "user experience", the experience of using technologies. In order to achieve this, numerous new methods and processes are being developed along the entire value chain, which are being applied systematically and methodically in various contexts and

technology fields. This ranges from autonomous driving to collaboration between humans, machines and robots (Industry 5.0), from the design of innovative learning environments to online shops and computer games. The Center is the leading institution in the field of "Human Centered Design" in Austria and a partner of many renowned companies. The researchers are supported in their work by the Technology Experience Laboratory (ALT X Lab) that is unique of its kind.

Methods for measuring the experience

The Competence Unit Experience Contexts and Tools researches contextual and situational phenomena as well as innovative methods and tools for the provision of appropriate solutions. In the research field Experience Measurement, methods are being developed for measuring, modelling, and optimising the experience and use of technologies. An important goal is to achieve a deep understanding of human diversity (e.g. for people with visual impairment) so as to be able to realise diversity-conscious human-centred design. The Capturing Experience research area is concerned with innovative examination methods and solutions that enable

a responsible human-machine relationship. What is being sought is an interaction framework for improved cooperation and coordination between people and technology, in particular in the context of automation.

Designing digital transformation processes

The Competence Unit Experience Business Transformation focuses on new concepts and strategies for supporting organisations in digital change processes and on the transformation of business cases by using future interaction concepts. The research field Human Centered Business Innovation is to create foundations for the development of new digital ecosystems. The focus on users and customers enables their integration into the development of new digital solutions (co-creation) as well as the successful and sustainable introduction of innovations. The Future Interface Design research area is particularly concerned with the development of optimised interfaces that increase the usability of new types of technologies for non-tech-savvy people and help users solve their daily challenges conveniently. The basis for this is to more or less "humanise" the increasingly complex technologies and inter-

actions through novel interfaces and design strategies.

Next-Generation Human Centricity

The current research work at the Center can be summarised under the keyword "Next-Generation Human Centricity". This means that the latest findings of basic research, which today looks at the human being much more closely than ever before, are processed in a structured way and channelled into a methodology so that they can be applied. This concerns, e.g., the economic and social framework conditions under which technologies are developed, such as people's changing value orientation (e.g. with regard to sustainability or diversity) or new communication, working and learning environments – also as a consequence of the Corona crisis.

"The human experience is a key factor for the quality and the success of digital solutions."

Manfred Tscheligi,
Head of Center for Technology Experience



CENTER FOR INNOVATION SYSTEMS & POLICY

How do innovations come about? How does this change societies? And how can we already actively participate now in shaping future changes? The Center for Innovation Systems & Policy provides answers to these questions and develops future scenarios – and it is an important think tank and advisor for politics, for companies and research institutions.

The Center for Innovation Systems & Policy is a leading institute in Europe for innovation and policy research. It is particularly concerned with the analysis and research of innovation activities and with the design of social and technological change. In doing so, it is important to harness the potential of emerging technologies (e.g. digitalisation or Artificial Intelligence) to address societal challenges (such as decarbonisation, pandemics, or positive socio-economic development). The key tasks of the Center are, on the one hand, providing constructive, science-based advice and support for RTI-related (RTI = research, technology, and innovation) policy-making and strategy development in Austria and Europe, as well as for other research and innovation stakeholders. On the other hand, transdisciplinary transformation processes with the inclusion of a wide range of players and stakeholders (e.g. companies or cities) are to be accompanied and supported. Moreover, the Center contributes to the further development of knowledge in the field of innovation studies and policy research at the highest scientific level.

Innovation dynamics

The research field Innovation Dynamics and Modelling deals with the quantitative analysis and modelling of innovation systems. The data infra-

structure required for this is maintained at the Center and further developed in close cooperation with European partners. Research focuses on collecting, maintaining, and processing new types of data on RTI activities (micro-level structured data, unstructured data from the Internet), on the development and application of new network-based indicators for tracking and evaluating system transformations, and on advanced methods of modelling, simulation, and visualisation. The research results flow directly into projects for national and European clients. I.

Digitalisation and decarbonisation

The research field Innovation Systems and Digitalisation deals with new patterns of innovation and challenges in industrial transformation resulting from new technological opportunities (digitalisation, AI) and demanding societal requirements (such as decarbonisation). Research focuses on the impact of this on innovation practices, business models, new production models (e.g. circular economy, value chains) and new industrial dynamics (e.g. green start-ups). A major topic here is the relationship between social responsibility and industrial strategies – in other words, how social and ecological ambitions can

be integrated into RTI processes at an early stage.

Insights into possible futures

The research field Societal Futures addresses the increasing need for ethical and social engagement in the context of emerging technologies and a growing awareness of uncertainties and disruptive events. This involves, e.g., observing emerging developments with foresight projects and researching the longer-term transformation potential for society resulting from advances in science and technology (such as quantum communication or personalised medicine) or new social developments (e.g. the digital divide).

Building on research into how technologies interact with society and lead to social and ethical debates and conflicts, procedures, protocols or guidelines are developed for dealing with them.

Finally, the research field Innovation Policy and Transformation promotes the understanding of political instruments aimed at accompanying transformative systemic change. The scientific foundations for a future-proof design of RTI policy and related policy areas are being developed in the process. This includes, e.g., the design of a policy mix of instruments for a mission-oriented RTI policy. An-

“The achievements of AIT contribute to pursuing strategic and visionary paths into the future and thus shaping the future.”



Matthias Weber,
Head of Center for Innovation
Systems and Policy

other focus is on monitoring, evaluating, and steering longer-term policy initiatives as well as newer and more agile practices to increase the chances of success of ambitious political goals.

Numerous partners at home and abroad

This type of research is in high demand both among clients from industry and the public sector, as shown, for example, by a long-term framework con-

tract with the European Commission for the provision of “Foresight on Demand” services. Together with partners, the Center supports the Austrian Parliament with foresight studies and impact assessments of important future technologies. A concept for an agile research and innovation policy was recently developed for the German Federal Government. The Center is also a leading partner in the preparation of the annual Austrian Startup

Monitor. Close contacts and cooperation with universities at home and abroad are maintained in all research areas.



AIT/Bösendorfer (2)

CENTER FOR ENERGY

More than 250 experts are working on the energy system of the future at the Center for Energy. The range of topics is oriented towards three central future fields: Public energy supply systems, industrial energy systems, and cities and the built environment.

The Center for Energy develops solutions for the innovative energy supply of tomorrow. The energy sector is undergoing a drastic process of change that requires a new cross-sectoral approach. In this regard, innovations for the sectors of industry & commerce, buildings, and mobility play a central role on the path to climate neutrality. An integrated approach to the energy sources electricity, heat, and gas is indispensable to ensure an optimised, efficient and safe operation of the energy system of the future.

Research and application

The increased integration of renewable energies, the decarbonisation of industrial processes and plants as well as innovative technologies and solutions for resilient cities are the key research fields in the Center. Furthermore, new and alternative forms of mobility, electrification of road transport, and the optimised use of transport infrastructure are important elements for decarbonisation. The strengths of the Center are based on its high level of research and application expertise: Many years of experience, scientific excellence and worldwide networking of experts as well as the high-quality laboratory infrastructure create clear competitive advantages for our clients and partners such as industrial companies, energy suppliers, technology providers,

cities and municipalities as well as research institutions.

High quality lab infrastructure

AIT's SmartEST Lab (Smart Electricity Systems and Technologies) and the High Power Laboratory provide a laboratory infrastructure for electrical energy technology components that is unique in Europe. Since direct current (DC) will also become increasingly important at the medium and low-voltage level in the future (photovoltaics, storage systems, batteries for electric vehicles, etc.), the labs will be expanded for DC currents in the order of 80 kA.

The City Intelligence Lab, an international flagship lab for the urban planning practice of the future, is an interactive platform for exploring new forms and technologies for urban planning practice and follows the approach of a co-creative development – joint creation of new knowledge. This lab, in which e.g. climatic influences in urban planning can be simulated, is now being expanded to include mobility aspects.

The Industrial Energy Systems domain, which deals with issues surrounding the transformation of the industrial energy system and the integration of renewable energy sources into the existing power and heat system of the process industry, will be further strengthened with a planned

"Virtual Industry Lab" in which industrial energy systems can be simulated and visualised in real time.

Decarbonisation in industry and buildings

An important research area is industrial heat pumps, which can be used to convert low-temperature waste heat back into usable process heat of significantly more than 100°C. To this end, demo systems have also been designed and installed in industrial companies in the recent past. Another focus is the decarbonisation of the building sector. In order to increase the share of renewable energy in buildings, building technology for heating, ventilation, and air conditioning is being investigated and corresponding energy concepts are being developed. The researchers are also working intensively on Building Information Modelling (BIM): There, planning of buildings is carried out completely digitally in a common model, and the data is further used along the entire process chain in the construction and operation of buildings.

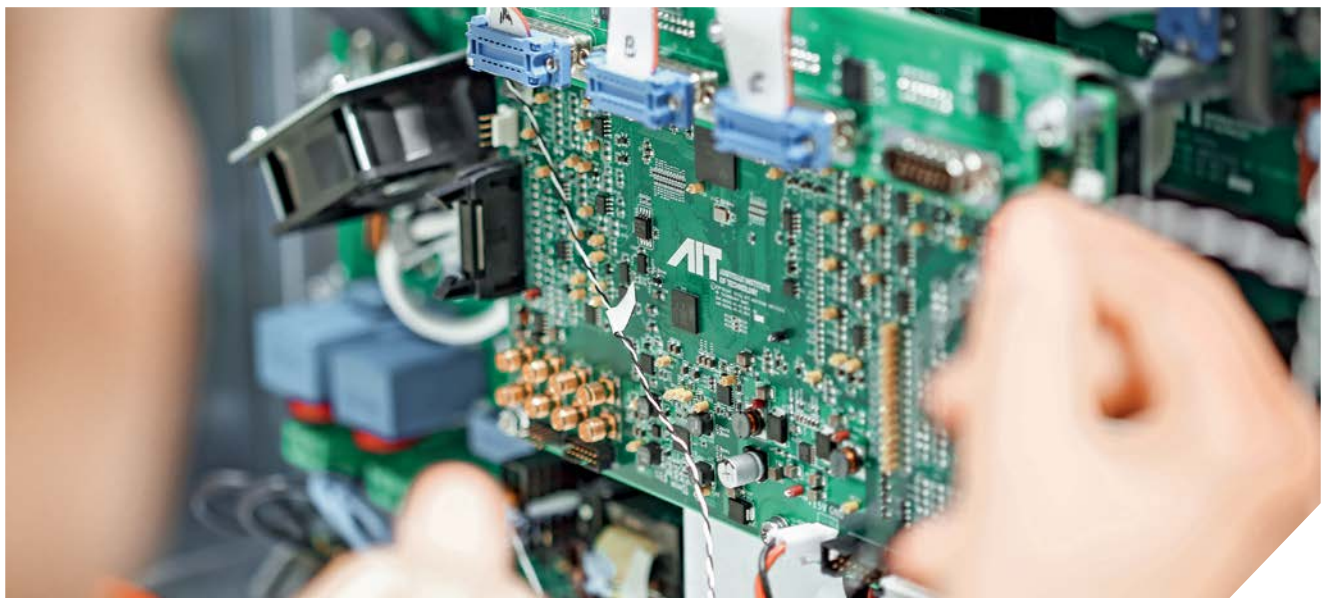
Hydrogen in the context of sector coupling

In the new Competence Unit Energy Conversion & Hydrogen (ECH), research is being conducted together with strategic partners on hydrogen technologies in the context of sector

"With our high-quality and specific lab infrastructure, we offer our partners innovative and applied research services."



Wolfgang Hribernik,
Head of Center for Energy



coupling, building on existing competences for selected energy conversion technologies (e.g. solar cells, OLEDs, etc.). The topic covers a broad spectrum and is oriented towards two focal points: On the one hand, it is about the integration of hydrogen technologies and synthetic gases in the energy infrastructure for efficient sector coupling, taking into account energy industry aspects. On the other hand, the material and energetic use of hydrogen in industrial processes is being researched for the decarbonisation of industry.

In the research field Power Electronics & System Components, power electronics solutions are developed

for the power grid of tomorrow. A key strategic goal is the integration of new power semiconductors such as silicon carbide and gallium nitride in order to expand the field of application to medium voltage. A high-performance infrastructure for ultra-fast charging of electric vehicles is being developed as part of a scientific pilot project. The optimised use of energy also contributes to the decarbonisation of the mobility sector. In the research field Integrated Transport Optimisation, the focus is on optimised and resource-efficient transport planning (e.g. for delivery routes for parcel delivery services).

For the rail network, the strategic and operational planning of route networks and optimised rail operations are supported. Further areas of examination are the ideal composition of vehicle fleets and optimal locations for charging stations and hydrogen filling stations.

STAY IN CONTACT

The AIT Austrian Institute of Technology is Austria's largest non-university research facility and is present on many media channels and platforms on a daily basis.

AIT BLOG: RESEARCH EXPLAINED FOR ALL

On 13 February 2020, the AIT Austrian Institute of Technology started its new research blog. AIT is thus expanding its communication mix and addresses a broad public in order to convey the topics of research, innovation, and technology development in an exciting and understandable way. Currently, two to four blogs are published monthly in which the work and services of the highly qualified AIT experts can be experienced in a tangible way. More-

over, the AIT research blog is intended to illustrate the particular benefits of industry-related research for society. The spectrum of topics ranges from climate protection and innovation via digitisation all the way to decarbonisation.

Link to AIT Blog: www.ait.ac.at/blog



THE MAGAZINE FOR PARTNERS AND CLIENTS

The magazine for AIT partners and clients is published three times a year and addresses decision-makers from research, industry, and education. It addresses all key stakeholders of the Austrian innovation and knowledge system.

THE PROFILE & HIGHLIGHTS

The AIT yearbook, which presents and showcases current research highlights and issues, vividly presents a representative cross-section of AIT research topics and developmental focus areas.



ALPBACH TECHNOLOGY SYMPOSIUM

The AIT Austrian Institute of Technology and ORF Radio Österreich 1 are long-standing organisers of the Alpbach Technology Symposium. "The Review" summarizes the most important statements, lectures, breakout sessions and topics of the Alpbach Technology Symposium.

At www.ait.ac.at/efatec you will find a compact review of the Technology Symposium 2021 and the Yearbook 2021 "Discussing Technology" entitled "Human Centered Innovation" for free download.

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In social media, too, AIT is considered one of the appreciated addresses for all those interested in RTI. Current topics and the researchers working on these issues at AIT are presented in the form of information prepared in a popular science format.

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ARTTEC @ AIT



Since 2016, the ARTTEC art programme at the Alpbach Technology Symposium, organized by the AIT Austrian Institute of Technology, has been showing the many similarities between art, technology, and science. AIT is happy to enlist the support of professionals here – with partners such as Ars Electronica Linz, the MAK – Museum of Applied Arts, and the University of Applied Arts. In autumn 2018, ARTTEC was also brought directly to AIT – more specifically, to the foyer of the headquarters at Giefinggasse 4. Under the name ARTTEC @ AIT, creative and interdisciplinary exhibitions with international artists broaden the perspective of employees and guests at our location.

Berlin-based mixed-media artist Chris Noelle was the first artist-in-residence at AIT. Under the title "Deceleration", he used spirography to address the constant changes in society and technology. Concurrently, the video project ONE was realised: In a one-minute clip for

each, Chris Noelle interprets the research of the various AIT Centers in an artistic way.

The second artist-in-residence, Judith Fegerl, focuses on the topic of energy. In the installation "reservoir", twelve copper and aluminium plates were placed in glass containers filled with salt water in the AIT foyer and electrically connected. After three months, the plates were removed from the salt water bath, processed, and hung on the wall in pairs: The resulting structural changes in the material were clearly recognizable.

In the project "capture", Fegerl used the AIT research infrastructure: In the Center for Energy's high-voltage lab, she chased lightning bolts and arcs through various sand mixtures. Due to the great heat, the sand partially melted and solidified in jagged pipes, so called fulgurites. Moreover, old lightning rods were reactivated by lightning.

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