

THE MAGAZINE

FOR PARTNERS AND CLIENTS

02/22

EU project KNOWING

What works how in climate mitigation?

Paper of the Year 2021–2022

AIT study on blood-brain barrier
receives award

“The New Europe”

25–27 August: Alpbacher
Technology Symposium 2022

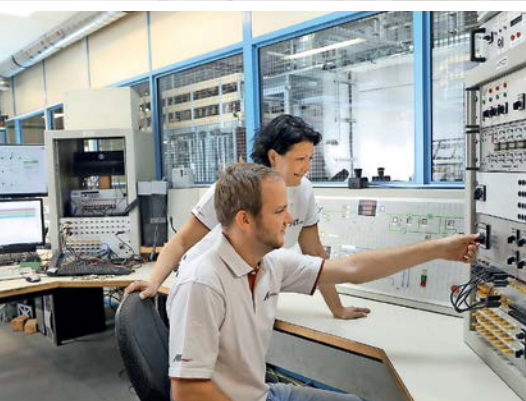
AIT invests a record amount

More than 30 million EUR for state-of-
the-art research infrastructure

Idea of the year

AIT Mobility Observation Box wins
Ö3 Traffic Award

Photos: AIT [2], AIT/Krischanz, AIT [2] LKR/Lang



RECORD INVESTMENTS IN RESEARCH INFRA- STRUCTURE

The AIT Austrian Institute of Technology is currently investing more than 30 million EUR in the expansion of unique laboratories, gearing up for European research competition.

The activities of the AIT Austrian Institute of Technology are based on three pillars: firstly, a high level of expertise in concrete applications and technologies; secondly, cross-sectoral systems

competence; and thirdly, state-of-the-art equipment in its labs. "With a unique research infrastructure that's competitive on a European scale, you play in the league of the best and support industry

as a strong partner," as AIT Managing Director Anton Plimon recently put it at the annual financial results press conference. And: "Innovation creates the decisive competitive advantage, helping to overcome the critical challenges." With a tailwind from the good results of the past years and the record level of incoming orders, AIT has initiated the largest investment programme it has seen in a long time: "More than EUR 30 million is currently being invested in a new research infrastructure in ongoing projects," says Alexander Svejksky, CFO of AIT. The main infrastructure areas in which the investments will flow are:

Energy research: New DC Lab

In energy research, which has been pursued for many years, AIT already has excellently equipped laboratories such as the SmartEST lab or the high-current lab for the development and testing of electric grids or components. In addition to the ongoing expansion of these labs, 3.2 million EUR have now been invested in a new direct current lab (DC Lab): Direct current is becoming increasingly important for areas such as photovoltaics, electricity storage, electric vehicles or data centres. No less than 30 tonnes of steel and 50 tonnes of copper were used in the new DC Lab to establish an infrastructure for researching and



The switchgear is the heart of the DC Lab, which consists of two parts: There are four transformers on the upper floor. The lower floor contains rectifiers that generate direct current from alternating current. Both floors are designed for very high currents of up to 80 kiloamperes and 75 megawatts of test power.



"Innovation creates the decisive competitive advantage, helping to overcome the critical challenges."
Anton Plimon, AIT Managing Director



In so-called "wire-based additive manufacturing" (WAM), wires made of high-strength aluminium, magnesium and titanium alloys are processed into light metal components in a 3D printing process at the LKR Leichtmetallkompetenzzentrum Ranshofen.

further developing DC grids and DC innovations that is unique in Austria.

**Battery research:
Solid State Battery Lab**

AIT can build on 15 years of expertise in battery research. This research refers to several time horizons and technologies. At the existing battery lab, today's Li-ion batteries are being further developed in terms of their safety and performance; research is also being conducted into new materials to replace critical substances (e.g. cobalt) as well as into environmentally friendly manufacturing processes. In the long term, completely new materials are being developed and tested to replace lithium (e.g. magnesium). In addition, around five million EUR are now being invested in a new lab for solid state batteries. These batteries do not require liquid electrolytes, which greatly increases safety and longevity. In order to build solid-state batteries, new

materials (polymers, ceramics, different types of glass) are required, and these are currently being developed and will be brought to industrial production in a specialised pilot manufacturing facility during the next few years – building on the experience from the existing Research Pilot Line.

**Light metals:
new materials and 3D printing**

At the LKR Leichtmetallkompetenzzentrum Ranshofen, high-strength aluminium, magnesium and titanium alloys that

are very light while meeting the highest stability requirements, as well as efficient, sustainable manufacturing processes have been developed for years. These materials are further processed into special wires that can finally be processed into light metal components in a 3D printing process. In "wire-based additive manufacturing" (WAM), wires are melted with the help of an adapted welding robot and applied to a substrate in layers. In this way, even larger components with a complicated structure can be manufactured quickly and

AIT Balance Sheet 2021

Operating performance: 171.79 million EUR

Profit before tax: 5.83 million EUR

Order level: 193 million EUR

Employees: 1,400 (from more than 40 countries)

All details on the annual financial statement 2021: www.ait.ac.at/media



"The development of the impact factor shows that AIT's scientific altitude continues to rise and that we are at the forefront of research in the areas relevant to us," explains AIT Managing Director Wolfgang Knoll.

Wolfgang Knoll, AIT Managing Director

Impact factor increased strongly

As the annual "Scientific & Performance Indicators" show, the impact factor of publications by AIT researchers has risen sharply recently: In 2021, it climbed to an all-time record of 1,347.9. There are two very positive trends behind this: For one, the number of publications in scientifically referenced journals with an impact factor has increased by almost a fifth to 288. And for another, the impact factor per publication has further increased: It is now almost 5 – whereas it was only slightly above 3 five years ago. The number of publications with a very high impact factor in particular has increased significantly. "This shows that AIT's scientific altitude continues to rise and that we are at the forefront of research in the areas relevant to us," explains AIT Managing Director Wolfgang Knoll.



In the area of radiopharmaceuticals, which Seibersdorf Laboratories has been operating very successfully for many years, the portfolio of therapeutic products for medicine is being expanded through a new building and new lab infrastructure.

cost-effectively. Around two million EUR are currently being invested in the corresponding facilities.

Expansion of the Seibersdorf Laboratories

At the AIT subsidiary Seibersdorf Laboratories at the Seibersdorf location (Lower Austria) too, two major investments are now underway: firstly, the electromagnetic compatibility (EMC) lab is being expanded and extended at a cost of around 5.3 million EUR. Already today, this lab is one of the leading facilities in Europe, e.g. for testing radio antennas. The idea is to be able to test even larger test objects in the future and to develop and establish new and faster measurement methods.

Secondly, the very successful radiopharmaceuticals area will be expanded by 14.7 million EUR through a new building and new lab infrastructure. This will expand the portfolio of therapeutic products in medicine to keep up with the dynamics in this field.

Know-how for the future

"AIT sees itself as a strong partner for industry in research topics that extend

years into the future. In many cases, it fulfils the requirements of cutting-edge research. In the areas of research, development, and innovation, companies are more dependent than ever on the best collaboration in order to acquire the know-how they will need in the future," emphasised AIT Supervisory Board Chairman Peter Schwab at the press conference.



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

AIT DEVELOPS CLIMATE MITIGATION MODEL

The model developed in the EU project KNOWING will enable a realistic "big picture" of practical climate protection and adaptation measures for the first time.

The time period for achieving the EU's climate targets is getting shorter and shorter. Simultaneously, the consequences of climate change are becoming more and more noticeable. Extreme weather events are becoming more frequent, and soil fertility is changing.

There are already many models that describe measures against warming as well as adaptation measures. These models are typically designed for individual sectors, such as land use or transport. However, they do not take into account the effects on other sectors, such as agriculture, or rebound effects or reciprocal effects. As a result, they create a distorted picture of the situation. For instance, the calculations must take into account that adaptation measures, such as flood protection walls made of reinforced concrete, also have a CO₂ impact during construction.

What is missing to date is a model that shows the "big picture". In the EU research project "KNOWING", a modelling framework is now being developed, tested, and applied under the leadership of the AIT Austrian Institute of Technology. For the first time, it presents the effects between climate mitigation and climate change adaptation as a holistic model – across sectors. "We want to enable an integrative view of the effects and interactions of climate mitigation and adaptation measures in order to know how we can achieve the goals and adapt ourselves in the best possible way," explains KNOWING project manager Alexandra Millonig, Senior Scientist at the



Heat, drought, or floods: the impact of climate change is obvious.

AIT Center for Energy. The project is planned to run for four years, with 17 international partners and around 70 employees involved during the course of the project. The funding volume of the EU project (GA Project 1011056841) is 6.2 million EUR.

Concrete paths towards the climate goal

The project is developing a modelling framework centred on a so-called system dynamics model, which describes reciprocal effects between individual systems. With the help of demonstrator regions across the whole of Europe, the framework calculates transformation pathways that contain suitable bundles of measures for specific application areas with regard to adaptation to climate impacts. A specially developed decision support tool then enables cities and regions to select specific transformation paths and measures. This is accompa-

nied by digital training for stakeholders and businesses so that they can best adapt to the changed framework conditions resulting from the measures. Furthermore, it is planned to create an app and information hubs for the general public to inform them why the measures are necessary.

A case in point: Agricultural adaptations to climate change and sustainable production require investments and new skills in dealing with changing conditions and agricultural products. Regions can use the tools to create targeted framework conditions for the transition. This means, for example, anchoring climate-relevant aspects in future lease contracts by specifying alternating crop rotations that improve soil fertility and prevent erosion. Farmers can thus be trained in a timely manner.

www.knowing-climate.eu

AIT: RESEARCH YOU CAN TOUCH AT THE LONG NIGHT OF RESEARCH 2022

Decarbonisation and digitisation were the central topics with which the AIT Austrian Institute of Technology participated in this year's "Long Night of Research" on 20 May. After Austria's largest event for science education had been held as an online-only format in 2020 due to Corona, Austrians with a thirst for knowledge flocked to the "real" offerings again in droves this year: In the end, 135,000 visitors were counted at 2,500 stations at 280 locations.

Within the environment of the Federal Ministry for Climate Action, Environment, Energy, Mobility, Innovation and Technology (BMK), AIT showed innovative methods of urban planning of the future for making cities more resilient in

Vienna's CAPE 10, gave insights into current battery research, and proved that waste heat from industry or geothermal energy can be used sensibly with heat pumps.

At the AIT site in Tulln (Lower Austria), the public was shown the important role microorganisms play as helpers for plant growth and how important diversity is. In addition, AIT experts presented methods for increasing digital security and designed ideal "makerspaces" together with the visitors.



GREENING AT THE AIT LOCATION SEIBERSDORF

The onset of spring saw the start of an unusual project at the AIT location in Seibersdorf (Lower Austria): Eight hectares of green areas at the long-standing research location will become natural meadows by changing the measures they are looked after, offering a future habitat for numerous native species of plants and insects. There, nature can develop in a way that is typical for the natural habitat location. This is not only a benefit for nature, but also for the local employees, who gain rest and recreation zones directly at their own workplace.

A first inspection by the landscape conservation association Thermenlinie-Wienerwald-Wiener Becken already revealed a rich variety of flowers after the first spring, which in turn is the source of life for many insects. It can be seen from these plants that the individual areas are very diverse – ranging from very dry, gravel-rich areas to more nutrient-rich and vigorous meadows. This increases diversity.



CHRISTIANE GROHER WINS AIT POSTER AWARD 2022

The annual competition promotes the entrepreneurial spirit of young scientists at AIT.

Innovative research is not an end in itself – it needs economic exploitation potential in order to benefit the general public. In order to anchor the know-how for this in young researchers at an early stage, AIT organises the annual AIT Poster Award. This year, 12 diploma students, doctoral students and junior scientists from six AIT Centers took part in the competition, which is organised in cooperation with Lower Austria's tech incubator accent and the venture capital fund tecnet equity. Christiane Groher from the Center for Low-Emission Transport won first place for her work on the service life of lithium-ion batteries (LIB). The PhD student is working on additives that reduce or prevent degradation reactions in the electrolyte responsible for transporting the lithium ions between the anode and cathode. Specifically, she is analysing complex gas mixtures in LIBs that can arise during the formation and overcharging of cells, and is trying to improve the safety, service life, and



Presentation of the AIT Poster Awards 2022 (from left to right): Hans-Peter Blahowsky (AIT Startup Coach), Wolfgang Knoll (AIT Managing Director), Lukas Neidhart (AIT), Christiane Groher (AIT), Daria Liakhovets (AIT), Doris Agneter (Managing Director tecnet equity), Michael Moll (Managing Director accent Inkubator GmbH)

performance of LIBs through new electrolyte compositions. Lukas Neidhart, who is also working on improving the electrodes in LIB at the Center for Low-Emission Transport, took second place: The overlaying of several electrode layers is to increase the energy density. The third place winner is Daria Liakhovets, who at the Center for Digital

Safety & Security is working on "Hate Speech" on the Internet. She is working on AI-based methods to detect hate speech and conspiracy theories on the Internet. "For us, support also means making our young talents aware of the economic potential of their projects as early as possible," stresses Wolfgang Knoll, AIT Managing Director.

AIT WINS Ö3 TRAFFIC AWARD

Great success for the AIT road safety team with Anna Huditz, Peter Saleh, Klemens Schwieger, and Michael Aleksa: The Mobility Observation Box, an AI-based system for recording and objectively assessing traffic infrastructure and conflict situations, won the Ö3 Traffic Award in the category "Idea of the year". The AIT researchers received the prize at a gala event attended by Climate Protection Minister Leonore Gewessler, Minister of the Interior Gerhard Karner, ORF Radio Director Ingrid Thurnher and Ö3 station boss Georg Spatt. The AIT Mobility Observation Box had previously won the prestigious German DEKRA Award 2021 in the category "Safety in Traffic".



FOCUS ON PERFORMANCE

Digital Safety & Security #IDSF22 brings together digital community



From 31 May to 2 June 2022, Vienna's MuseumsQuartier became an international stage for digital security topics. Organised by the AIT Austrian Institute of Technology in partnership with the ARGE Sicherheit und Wirtschaft (ASW) of the Austrian Federal Economic Chamber, the "International Digital Security Forum" (#IDSF22), certified as a "Green Event", offered a three-day programme with more than 100 renowned speakers from all over the world.

Following the motto "Secure Digitalization for a Safe, Green and Sustainable Future", more than 250 people attended the conference on site and over 500 from a total of 41 countries participated online. "It's about mastering our technologies in a sustainable way. A global, sustainable dialogue between research, industry, and authorities is a necessary basis for shaping digitisation in such a way that it also corresponds to our goals and values," explained Helmut Leopold, Head of AIT Center for Digital Safety & Security and initiator of the IDSF.

Altogether, 15 sessions and ten keynotes were dedicated to a wide range of R&D topics in conjunction with the policy design of digital security. The IDSF was accompanied on all three days by an exhibition of innovative Austrian SMEs as well as globally active companies from the digital sector.

Videos and select presentations:

www.idsf.io

Health & Bioresources Projekt InChildHealth studies indoor air quality



The quality of indoor air has been insufficiently studied so far. Dose response relationships for biological material in the air are also missing to date – this is particularly important for children. The EU project InChildHealth funded with 8 million EUR now aims to investigate determinants of indoor air quality and their health effects on children and derive measures to improve indoor air quality and reduce the burden of disease. InChildHealth is a highly interdisciplinary project that combines the expertise of 15 partners from the fields of health, environmental technology and social sciences. The focus is on airborne chemicals, particles, microorganisms, and physical parameters in the air of schools, homes, and in sports halls. The AIT Center for Health & Bioresources is participating with two Competence Units: A team led by Winfried Neuhaus (Molecular Diagnostics) is focusing on developing a cell line based toxicity assessment pipeline to decipher the dose-response relationship of biological aerosols. And a team led by Clara Pogner (Bioresources) and Ivan Barisic (Molecular Diagnostics) is focusing on the detection of pathogens in the air and the development of faster and more accurate detection methods.

Energy Study: Cooling needs of buildings will increase until 2050



It's getting hotter in Austria. With heat-wave days above 30°C and tropical nights above 20°C becoming more frequent every year, the demand for cooling buildings is increasing significantly as well. A study by the AIT Austrian Institute of Technology in cooperation with the Energy Institute at the Johannes Kepler University Linz and the Institute for Energy Systems and Electric Drives at the Vienna University of Technology on behalf of the Climate and Energy Fund (funded by the Federal Ministry for Climate Action, Environment, Energy, Mobility, Innovation and Technology – BMK) now shows that the cooling energy demand could increase almost tenfold by 2050 if no passive cooling measures are taken. Using data on building cooling, climate data, and an Austrian model on existing real estate, several scenarios were examined that represent realistic development trajectories from today's perspective.

One main conclusion from the study: We must prepare buildings and our energy system now to keep the additional cooling demand low in the future. Building shading, component activation, and night ventilation, for example, are effective. The study authors recommend that such measures to reduce the cooling demand be integrated into the existing tools for reducing the heating demand – for example in the building regulations or in funding criteria. So, when windows are replaced for thermal insulation, the installation of roller shutters could be promoted.

Health & Bioresources Successful completion of MicrobiomeSupport



Microbiomes – the communities of microorganisms – can be found everywhere and have a critical impact on the health of plants, animals, humans as well as the entire environment. In the EU project MicrobiomeSupport, coordinated by Angela Sessitsch, Head of Competence Unit Bioresources at the AIT Center for Health and Bioresources, intensive work has been done over the past four years to coordinate, structure, and advance international research and innovation in the field of microbiomes – with the primary goal of ensuring a long-term sustainable value chain for food and feed. The aim here is to create high-quality alternatives to conventional approaches to health and food management in order to ensure long-term food security and self-sufficiency. Among other things, the project developed measures to standardise research methods internationally, reduce regulatory hurdles and simplify the commercialisation of microbial products. More than 150 stakeholders from science, industry and politics came together for a conference in Brussels from 27 to 29 June 2022 to mark the successful conclusion of the project which highlighted economic, health and environmental aspects of microbiomes.

www.microbiomesupport.eu

Digital Safety & Security AIT is security partner of IAEA



The AIT Austrian Institute of Technology has been appointed by the International Atomic Energy Agency (IAEA) as the world's first IAEA Collaborating Centre for Information and Computer Security for Nuclear Security. On 10 May, Lydie Evrard (IAEA Deputy Director General and Head of the Department of Nuclear Safety and Security), Anton Plimon (AIT Managing Director, left) and Helmut Leopold (Head of AIT Center for Digital Safety & Security) signed a four-year programme to build awareness and competence around cybersecurity for nuclear safety in IAEA Member States. The core elements of the collaboration are the cybersecurity core competencies established at AIT in the area of control systems for critical infrastructures and the implementation of special training and education courses on computer security for industrial control systems in the AIT Cyber Range. This is a flexible IT simulation environment for cybersecurity trainings. At the AIT Cyber Range, IT infrastructures and communication processes can be simulated realistically and the detection and defence against a wide range of cyberattacks can be trained. The AIT Cyber Range thus makes it possible to train individually simulated extreme situations even in critical infrastructures where "real" tests are not possible in the real world for safety or cost reasons.

<https://cyberrange.at/>

Innovation Systems & Policy Presentation of the Austrian Startup Monitor 2021



The annual Austrian Startup Monitor, compiled under the direction of Karl-Heinz Leitner (AIT Center for Innovation Systems & Policy), shows that Austria's startups are encouragingly resilient and agile in the pandemic. Young companies in the fields of finance, e-commerce or "software as a service" in particular were able to use the digitisation fuelled by COVID-19 as a tailwind. At the same time, start-ups in the tourism industry or in the offline services segment were – unsurprisingly – hit particularly hard by the ongoing pandemic situation. All in all, these young and innovative companies employ more than 25,000 staff. In 2022, too, four out of five start-ups will hire additional people, creating well over 10,000 new jobs. Start-ups are not only a key driver of economic growth and employment, but they are also increasingly addressing social problems: by now, almost every second start-up addresses a social or environmental challenge. In order to successfully shape social and ecological change, it is indispensable to actively apply the knowledge generated in the university environment. "Nearly one quarter of Austrian start-ups have their origins in an academic institution and are pioneers of technological change," explains Karl-Heinz Leitner.

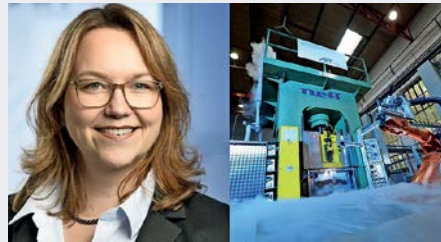
<https://austrianstartupmonitor.at/>

Innovation Systems & Policy
Effects of digitisation on critical infrastructures



The quickly advancing digitisation and its effects on critical infrastructures challenges security policy and the corresponding public agencies, as many supply systems are interconnected. Digital technologies can pose both a great potential for risk and more opportunities for security. A monitoring and governance model to support decision-makers in the area of critical infrastructures is being developed in the IKKRITI project (duration 2020–2022). "We analyse the effects of digitisation on critical infrastructures by integrating technology & trend monitoring, scenario creation and technology impact assessment," explains project manager Eva Buchinger from the AIT Center for Innovation Systems & Policy. This makes it possible to prioritise technologies and trends in terms of security strategic control capability and to systematically explain their opportunities, risks and challenges. Options for action are then explored and piloted using the examples of "ID Austria" and "WarnApps" with the Ministry of Labour and Economy and the Ministry of Defence. The IKKRITI project, which is funded under the Austrian security research programme KIRAS, was recently presented as an Austrian "best practice" at the EU-wide Foresight Network of the European Commission by the Austrian Federal Chancellery and met with great interest.

Low-Emission Transport
Data T-Rex: Optimisation of metallurgical phenomena



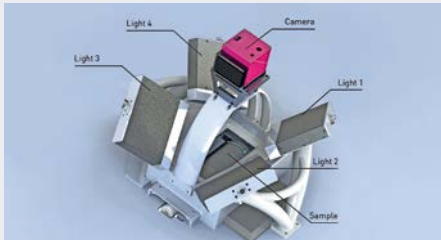
The aim of the Data-T-Rex project is to develop sustainable, intelligent, and self-optimising manufacturing processes for high-quality light metal products. The focus is on the data-based optimisation of forming and heat treatment processes based on the metallurgical phenomena of recrystallisation, texture, and residual stresses. A wide variety of manufacturing routes are considered – from casting processes to forming processes to various heat treatments. Data-T-Rex offers the possibility to apply new tools to existing data through machine learning. In addition, interactions between the process steps can be shown, such as the connections between casting, homogenisation, extrusion, and heat treatment. The development of data-based process chain optimisation for light metal products contributes to more efficient and sustainable production, since the optimisation of manufacturing processes avoids waste and saves energy. "Sustainable optimisations in metal processing are possible where there is perfect interaction between material and process. The application of Artificial Intelligence in combination with highly innovative material characterisation offers particularly great innovation potential," explains project manager Carina Schögl from the LKR Leichtmetallkompetenzzentrum Ranshofen.

Technology Experience
More safety for autonomously driving trucks



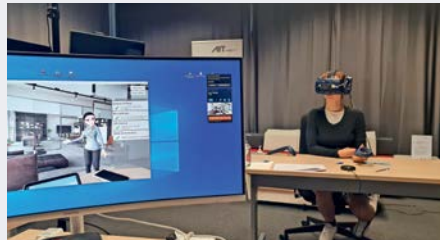
Higher capacity utilisation, increased efficiency, cost reduction of the logistics and supply chain, improved safety – the expectations regarding autonomously driving trucks and automated freight traffic in the transport and logistics industry are enormous. However, the weather still remains a major hurdle: The autonomous systems are not able to work safely and well in all weather conditions. The Horizon 2020 project AWARD (All Weather Autonomous Real logistics operations and Demonstrations; Grant Agreement No. 101006817), funded with almost 20 million EUR, is dedicated to this challenge. In order to create realistic scenarios, the AIT Center for Technology Experience analysed the requirements of the users and developed a prototype of a TeleOperationStation for remote monitoring. With it, test persons can steer and control a remote-controlled vehicle from the first-person perspective via headset in a miniature traffic environment. "To fuel our imaginations, we built our own little city out of paper and constructed a small, remote-controlled car equipped with sensors for the TeleOperationStation prototype," explains Peter Fröhlich, AWARD coordinator at AIT. Furthermore, AIT is developing a technical fleet management system with optimisation models and a configurable user interface for the efficient use of automated vehicles in logistics applications.
<https://award-h2020.eu>

Vision, Automation & Control xposure:photometry detects even smallest surface defects



Automated optical surface inspection for quality control is an integral part of industrial manufacturing processes. However, existing 3D inspection methods are hardly capable of handling high transport speeds of the objects to be inspected. Moreover, conventional two-dimensional scanning methods tend to misinterpret dirt or imprints as defects – while not recognising actual three-dimensional defects such as scratches, burrs, holes, or wrinkles. Here, AIT xposure:photometry technology offers a major advance: By combining very fast photometric stereo imaging and intelligent camera technology, it is now possible to detect even smallest 3D structures on the object surface, even if the surfaces to be inspected have challenging material properties – i.e. if they are metallic, reflective, dark, or grainy. With this technology, even smallest 3D defects – e.g. on high-quality surfaces such as battery foils – can be detected very quickly without obstructing the production process. It is also suitable for inspecting three-dimensional quality features such as embossing or Braille printing on packaging, or gravure printing on banknotes, and it is also used to inspect rails.

Technology Experience Executive training in Virtual Reality (VR)



Interest in interactive training in Virtual Reality (VR) is growing steadily, which is why the "Virtual Skills Lab" project is looking at the question of how such training can be applied in the context of organisations. Users are confronted with an NPC (non-player character) in a virtual office scene. Their interaction is based on speech recognition and conversational Artificial Intelligence (AI). With the possibility of adopting the perspective of the respective other, the focus is on training social skills and overcoming social fears. AIT took over the evaluation of the user experience and the associated human-centred design for this project (FGG Ideen Lab 4.0, No.: 872573). "It was exciting for us to experiment with different representations of the dialogue partners. In other words, what is the effect of negotiating with a woman, a man, a comic book character, etc.?" Equally revealing was that we achieved similar ratings for a 'Real Word' role-playing game and the VR role-playing game. This confirms the assumption that VR role-playing games can create learning environments similar to those we are already familiar with," explains Georg Regal, project coordinator at AIT. Building on the research findings, projects are being planned in the area of representation and impact of the NPCs. <https://www.facebook.com/Virtual-Skills-Lab-828754797504991/>

Low-Emission Transport High-tech reinforcement in the maintenance of towpaths



Around 500 kilometres of embankment paths – 320 kilometres of which are asphalted and 260 kilometres marked as the Danube cycle path – demand the constant attention of viadonau. They are responsible for upkeep and maintenance of the path, and they now get help by the latest laser scanning and camera technology from the AIT Austrian Institute of Technology. Based on findings from a pilot phase launched in 2020 regarding methods of digital path detection, the use of laser scanning and a learning AI, customised software is now being used to monitor the towpaths. Using AIT's so-called "Roadlab", equipped with high-quality laser scanning and camera equipment, viadonau's entire network of towpaths will be scanned this year with high precision. Moreover, high-resolution 360-degree images are recorded. This allows the condition of all asphalted paths to be recorded with unprecedented accuracy while also taking into account the needs of cyclists and factors that affect riding comfort (such as root bulges and pavement edges). Furthermore, ground markings and traffic signs as well as the clearance gauge are recorded to determine whether obstacles such as branches protrude into the path. The data will be evaluated by Artificial Intelligence developed at AIT and migrated into a separate management system. www.viadonau.org

SCIENCE FOR MANKIND

A contribution by Hannes Androsch to this year's Alpbach Technology Symposium.

Science, research, and technology are a consequence of basic human traits and needs, in particular our curiosity. And it therefore comes as no surprise that human history is characterised by discoveries, developments, inventions and their practical implementation. This enabled man to overcome natural limitations. The intelligent use of technical equipment have enabled us to e.g. do agriculture and keep animals. Inventions also change the way people live together and have a great influence on the development of culture. That is why one also speaks of a "co-evolution" of people, technology, and culture. Innovations thus fundamentally change the conditions of life, which in turn changes the framework conditions under which evolution takes place. This applies to plants and animals that are trying to adapt to the changed environmental and

climatic conditions as well as to humans themselves. This influence on our development will probably become even stronger in the future – in biological, but even more so in cultural and economic terms. Technology has also become an essential factor of prosperity and power: Those who are ahead of the game in the development of future technologies are leaving their mark on the world. This raises many questions that urgently need to be resolved. In any case, science must be there for us humans, must serve our well-being and prosperity and must not endanger them. For one, we must clarify the relationship between humans and machines. For another, it is up to us to create the conditions so that science, research, and technology continue to help us master our major problems in the future.



You can find the entire essay "Wissenschaft für den Menschen" [Science for mankind] by Hannes Androsch, the doyen of the Alpbach Technology Symposium, here: www.ait.ac.at/efatec



EVENTS

14–15 September 2022

IKT Security Conference

The aim of the conference at the Exhibition & Congress Center (Reed Messe Wien) is the further training of IT security experts and the exchange of practical experience. <https://seminar.bundesheer.at/>

14–15 September 2022

SHOTPROS Final Conference

The successful EU project SHOTPROS (grant agreement No 833672), in which innovative Virtual Reality training systems for the police are being developed, will be completed with a conference in Ranst (Belgium) entitled "VR for Police: Drive the police into the future". <https://vrandpolice.eu/shotpros-final-conference-save-the-date/>

6–7 October 2022

12th Ranshofener Light Metal Days

The 12th Ranshofener Leichtmetalltage [Light Metal Days] at the Mozarteum Salzburg are held under the motto "Green Processes & Sustainable Materials". The topics are digitisation and decarbonisation in the area of process and material development as well as the material characterisation of light metals. lmt.ait.ac.at

13–14 October 2022

NEFI conference

At the second NEFI conference (New Energy for Industry) in the Redoutensälen in Linz, the necessary changes for a climate-friendly industry will be discussed. Concrete solutions and interim results from the 17 NEFI projects will be presented. www.nefi.at/conference

19 October 2022

20th Security Conference Krems

At the 20th Security Conference Krems 2022 under the title "A new world disorder?", international experts will discuss perspectives on security after 20 years of the Security Conference. www.donau-uni.ac.at

25–27 October 2022

IT-SA Expo & Congress Nuremberg

The IT-SA in Nuremberg is Europe's largest trade fair for IT security; central topics are in particular cloud and mobile security, data and network security, and securing critical infrastructures and Industry 4.0. AIT shows the latest security solutions for IT technologies. www.itsa365.de/de-de/it-sa-expo-congress

TECHNOLOGIES AS THE KEY TO CRISIS MANAGEMENT

This year, the technology community met in Alpbach from 25 to 27 August under the main topic "The New Europe".



Corona crisis, climate change, inflation, biodiversity loss, energy crisis, the war in Ukraine and other geopolitical tensions have massive economic and social impacts – from a shift in the terms of trade and thus prosperity in different regions through to social tensions that may threaten democracy. An important solution for overcoming these crisis phenomena are technologies that enable or facilitate the necessary transformation. This is the starting point of this year's Alpbach Technology Symposium which took place from 25 to 27 August as part of the European Forum Alpbach under the main topic "The New Europe". After two years in which the debates were held virtually or in hybrid mode due to Corona, the technology community met again for real in the Tyrolean mountains. The plenary sessions topics ranged from info- and cyberwar via energy transition and modern health technologies all the way to securing global value chains, and the geopolitical role of technologies. The challenges for politics in coping with the multiple crisis and the role of the arts in the transformation were also discussed. Content sessions on areas such as

confidence, climate protection (mobility, industry), the merging of humans and technology, and Artificial Intelligence offer more in-depth information. In keeping with long-standing tradition, the Technology Symposium is being organised by the AIT Austrian Institute of Technology and ORF Radio Ö1 in cooperation with the European Forum Alpbach. The project team consists of Dr. Martin Bernhofer (ORF Ö1), Michael H. Hlava and Claudia Klement (both AIT). The Steering Committee of the Alpbach Technology Symposium 2022 includes Hannes Androsch, Wolfgang Knoll (AIT Scientific Director) and Ingrid Thurnher (Radio Director ORF). The scientific partner of the Alpbach Technology Symposium 2022 is the Helmholtz Association of German Research Centers. The BMK (Federal Ministry for Climate Action, Environment, Energy, Mobility, Innovation and Technology), the BMBWF (Federal Ministry for Education, Science and Research) and the Federation of Austrian Industries are strategic partners.
www.ait.ac.at/efatec
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Yearbook of the Alpbach Technology Symposium 2022: Applying AI

Artificial Intelligence is no longer just a topic for the future. Rather, AI methods are permeating more and more areas of our life and work. And they also enable great advances in science, research, and technology development. Using numerous examples of concrete applications, including from the AIT Austrian Institute of Technology and other domestic research institutes, the yearbook for this year's Alpbach Technology Symposium shows where we currently stand in terms of AI application in various fields. This ranges from useful tools for our everyday lives to the design of future autonomous machines that work closely together with humans, through to their use in healthcare and urban planning. It becomes clear how the most diverse AI methods can be used in a way that makes sense – and in which areas it would be better to do without them. These examples are complemented by interviews with leading research personalities such as Helga Nowotny, Andreas Kugi, and Ross King. The ecological impact of AI as well as the role of the new technology in the arts will also be discussed.

CLIMATE CHANGE LEADS TO MORE FREQUENT LANDSLIDES

AIT researcher Philip Leopold was among the lead authors of a "Nature" publication that investigated the influencing factors on catastrophic damage after heavy rain events.

Landslides are a natural hazard that pose a great risk to buildings and infrastructure (such as roads or bridges), especially in a mountainous country like Austria. However, they are difficult to predict because it depends on a great many factors whether a slope starts to slide during heavy rain or not. This includes the type and intensity of precipitation, soil moisture, and land use. Add to that the fact that all these factors are changing due to climate change.



The starting point for the study was a heavy rain event in June 2009, which led to many landslides in the region around Feldbach. Based on this data, a detailed model was created that contains all relevant factors influencing such natural disasters.

Data collected during heavy rainfall event

A group of researchers with AIT participation has now found that global warming is leading to a massive increase in landslide risk: In a scenario with a temperature increase of four degrees, the risk of landslides could increase by 45 percent. If global warming is limited to the Paris targets, the increase in risk is ten percent. In part, this risk can be compensated for by creating or maintaining resilient and climate-adapted protective forests.

The trigger for the study which has now been published in "Nature Communications Earth & Environment", was a heavy rain event in June 2009 in south-eastern Austria, during which more than 3,000 landslides occurred in the district of Feldbach alone, causing enormous damage. At the time, many researchers, including geologist Philip Leopold who works at AIT, collected a lot of data on these incidents. This provided the scientific community for the first time with a comprehensive data set on the many aspects of landslides. It was subsequently evaluated in a number of research projects, including those funded by the Climate and Energy Fund.

Model enables critical infrastructure protection

The models used to link the various factors that are essential for landslides were co-developed at AIT; they are now being further developed at the University of Jena by Raphael Knevels, among others, who wrote his diploma thesis at AIT. Other collaboration partners include the Wegener Center for Climate and



Philip Leopold is a technical geologist and conducts research at AIT on the topic of natural hazards and threats to critical infrastructure, such as roads, bridges, and buildings. He is currently Business Developer at the Competence Unit Transportation Infrastructure Technologies at the AIT Center for Low-Emission Transport.

Global Change at the University of Graz (lead author), Joanneum Research, and the Helmholtz-Centre for Environmental Research in Leipzig. Research on natural hazards is embedded in AIT's extensive activities to protect critical infrastructures such as roads, bridges, buildings, energy and communication networks.

Related publication: D. Maraun et al. "A severe landslide event in the Alpine foreland under possible future climate and land-use changes"; Nature Communications Earth & Environment (2022) 3:87. DOI: 10.1038/s43247-022-00408-7
Link to the study: <https://www.nature.com/articles/s43247-022-00408-7>

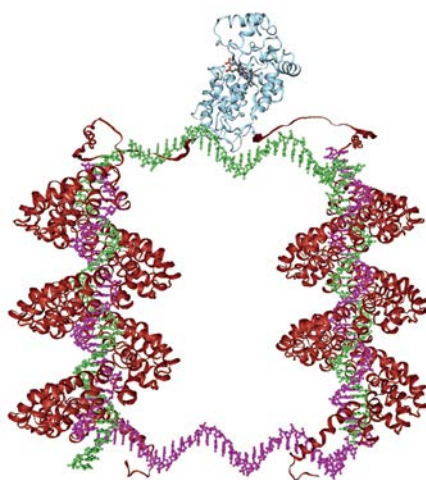
CATANA CALCULATES THE STRUCTURE OF BIOMOLECULES

As part of an EU project, AIT researchers are working with partners from Croatia and Italy to develop a powerful tool that will enable a highly sensitive, rapid, and cost-effective detection method for infectious bacteria.

Most bacteria around us are harmless or even beneficial to humans. However, some bacteria, such as salmonella or coli bacteria, can cause illness. Therefore, it must be ensured that e.g. water, beverages and food are free of them. Conventional tests either take a long time or are very expensive. A research group led by the AIT Center for Health & Bioresources has set its sights on a better solution: The EU project MARILIA is developing a rapid, highly sensitive, and at the same time cheap detection method based on recombinant proteins that are linked to DNA strands: As soon as pathogenic bacteria are detected, these molecules change their structure – and this can be detected by simple measurements. The decisive factor here is that the biomolecules specially designed for this purpose have exactly the right structure. "These structures are too complex to build them without help from computers," explains project leader Ivan Barisic, a researcher at AIT's Molecular Diagnostics Unit. "By calculating the structures on the computer, it is possible to greatly reduce the necessary work in the lab," says Barisic. This saves a lot of time and money.

Proteins and DNA in the computer

One important part of the MARILIA project was therefore the development of a correspondingly powerful software. According to Barisic, the tools available so far have weaknesses and are not comprehensive enough for the concrete task in the MARILIA project. The result of this research work is the CATANA system, which was recently presented to



The highly specific detection of pathogenic bacteria requires complicated biomolecules in which proteins and DNA structures are linked together. These can be designed and displayed on the computer with the help of the new CATANA software package. This saves a lot of time and tedious lab work.

the professional world in the renowned journal "Nucleic Acids Research". CATANA includes a tool for three-dimensional modelling and manipulation of complex biomolecules in real time, as well as visualisation at multiple levels of detail – down to the atomic level. Besides user-friendly data import and export functions, a new data format has been established that can subsequently also be used for molecular dynamics studies. Also integrated was "AlphaFold", an Artificial-Intelligence-based tool that predicts the exact three-dimensional structure of a protein on the basis of the amino acid sequence with unprecedented quality. CATANA is designed as a web-based application, the software itself runs on a server at AIT and is freely accessible to



"We have developed a user-friendly, web-based modelling tool to design and manipulate proteins, DNA and DNA nanostructures," reports Ivan Barisic, Senior Scientist in the Molecular Diagnostics Competence Unit of the AIT Center for Health & Bioresources.

scientists all over the world as an open source solution. The plan now is to develop the system into a commercially viable application and offer it on the market through a spin-off company. CATANA can be of great benefit, e.g. in developing medicines.

<http://catana.ait.ac.at/>

Related publication:

D. Kutak et al: CATANA: an online modelling environment for proteins and nucleic acid nanostructures. *Nucleic Acids Research*, 2022 1, <https://doi.org/10.1093/nar/gkac350>

Link to the study: <https://academic.oup.com/nar/article/50/W1/W152/6584434>

Scientific Papers

AIT Study Blood-Brain Barrier among the "Paper of the Year 2021–2022"

There are reports linking SARS-CoV-2 infection and effects on the human nervous system. However, it is unclear what exactly causes these neurological symptoms. These problems could be caused by direct SARS-CoV-2 infection of the brain. The big question is whether the virus is able to pass through the blood-brain barrier. Using a human blood-brain barrier cell culture model, an international group of researchers with major participation from the AIT Center for Health & Bioresources has now been able to identify mechanisms that were found to be consistent in both human biopsy material and the cell culture model upon infection with SARS-CoV-2. SARS-CoV-2 was also able to infect the cell culture model from the blood side and could be detected on the brain side after incubation. This suggests an intrusion into the central nervous system. By blocking the known docking sites of the virus, the infection in the cell culture model could be significantly reduced. This model could be used for medical drug screening in the future. The journal "Stem Cell Reports" listed this SARS-CoV-2 study in the list of the best publications of 2021–2022 ("Best of 2021–2022").

S. Krasemann et al.: "The blood-brain barrier is dysregulated in COVID-19 and serves as a CNS entry route for SARS-CoV-2"; Stem Cell Reports, Volume 17, Issue 2, 8 February 2022, Pages 307–320

Wireless communication with unprecedented reliability and low latency

The paper presents the results of the implementation and testing of a wireless solution intended as a direct one-to-one replacement for communication cables in fast industrial control loops. With a very low cycle time of 8,000 frames/second on each unidirectional link, frame error rates in the range of one error per billion

frames have been measured under the channel conditions in industrial production halls. As a result, an unprecedented combination of high reliability and low latency in fading channels has been achieved. Only easily accessible and affordable components were used to build the transceivers. Frequency diversity and spatial diversity are achieved through coded orthogonal frequency-division multiplexing modulation (OFDM) and 2x2 multiple-input multiple-output (MIMO) transmission. The replacement of cables with the developed wireless solution opens up possibilities ranging from simplified reconfigurability and reduced maintenance costs to the introduction of completely new production processes that are not currently possible yet.

G. Kail, H. Muhr, J. Gila, M. Schiefer, R. Hladik, M. Hofer, S. Zelenbaba, and T. Zemen: "A highly reliable ultralow-latency wireless solution for industrial control loops: Design and evaluation"; in Asilomar Conference on Signals, Systems, and Computers (ASILOMAR), hybrid conference, Pacific Grove (CA), USA, November 2021.

Cost-effective lab-on-a-chip solution for integrated optical biosensors

The sensor group of Rainer Hainberger, Senior Scientist in the Molecular Diagnostics Competence Unit of the AIT Center for Health & Bioresources, has developed a laser diode-pumped lab-on-a-chip concept that is able to detect biomolecules in liquids at low cost and without additional markers. The measurement procedure can be used to check various liquids for certain molecular biomarkers in medical or environmental tests. During the measurement by interferometry using integrated optical waveguides, the change in optical path length is quantified. The key here is the precise alignment of the laser beam to the waveguide input for coupling the light. This repeatedly led to problems in previously used measurement configura-

tions. The solution now implemented at AIT avoids this through the realisation of a narrow-band laser light source directly on the chip. The result is a measurement method that is easy to produce and use and could in the future also be applied in every general practitioner's office in order to obtain results directly on site in a short time.

Florian Vogelbacher, Tim Kothe, Paul Muellner, Eva Melnik, Martin Sagmeister, Jochen Kraft, Rainer Hainberger: "Waveguide Mach-Zehnder biosensor with laser diode pumped integrated single-mode silicon nitride organic hybrid solid-state laser"; Biosensors and Bioelectronics, Volume 197, 2022, 113816, DOI: 10.1016/j.bios.2021.113816

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