JOANNOVUM

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Focus
Green and Digital Transformation

JOANNEUM RESEARCH

INTERVIEW

IN FOCUS

EDITORIAL

Foto: JOANNEUM RESEARCH / SalonDeluxe

Heinz Mayer
CEO JOANNEUM RESEARCH

Let's invest in sustainable technologies and make the world greener!

This edition of our scientific magazine is dedicated to the green and digital transformation. The path to achieving the goals of the European Green Deal is still a long one and needs the collaboration of everyone while exhausting all technological opportunities. This transformation can also only be achieved by employing digital technologies. JOANNEUM RESEARCH not only focusses on sustainability inside the company and drives digitalisation processes forward to increase efficiency and improved use of resources, but we also offer technological solutions for industry and business on the path towards a green transformation.

Let's all grasp this opportunity and invest in sustainable technologies to make the world greener!

Our Zukunftskonferenz (Conference for the Future) that took place on 15th November 2023 was held under the motto "Green and Digital Transformation". We presented our latest research results, innovations, and solutions on the path towards the green transformation and were able to welcome two high-profile keynote speakers to the podium.

Heinz Mayer

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An Interview with Heinz Mayer, CEO of JOANNEUM RESEARCH: More sustainability as a result of digital transformation?

»It requires tenacity«

Foto: JOANNEUM RESEARCH / Bergmann

At last, there is movement and determination in the process of acting against climate change and its consequences. The EU's Nature Restoration Law has been passed, industry is breaking out in a new direction, urban cycle lanes are busy, and large technology providers find themselves in a run to launch the first comprehensive mobility app on the market with the intention of changing our mobility behaviour in the long term. This is the background for our interview with Heinz Mayer (CEO of JOANNEUM RESEARCH) where we ask what opportunities the digital transformation brings to enable and support sustainability.

What are the large technological trends driving the transformation? Artificial intelligence is certainly the main trend. This methodology has been around for a long time, but it is the increase in computing power and the availability of data that has allowed AI to gain such enormous momentum. There is also still a lot of opportunity in the field of sensors and the field of mobility is also unbelievably dynamic: There is a lot of investment, modernisation, and expansion in the public domain. There are huge endeavours in the field of individual transport to bring resource optimisation and increased efficiency into vehicles. That is transformation! Fifteen years ago, electro-mobility was just hovering on the side lines. Now we see increased market penetration. Communication technologies are also transformation drivers. Improved communication in those areas in the world that are hardly connected has positive effects on the use of resources such as the reduction in travel distances. Mega-constellations of satellites offer long-term advantages for this. These consist of a large number of satellites that are arranged as a network in space and enable services such as communication, internet access, earth observation, and more. This is all important for frictionless and cost-saving communication in remote or sparsely populated areas since the laying of fibre-optic cables would simply be too cost-intensive.

What role does digitalisation play in the process of making the world greener? It is obvious that the green transformation can only exist with the support of technologies. Innovation and technology need to move more in the direction of sustainability. There is a lot going on, but there is still room for improvement regarding the optimisation of resources and efficiency. One huge challenge is embedded in the answer to the question how energy can be made available and controlled in a more resource-efficient way – so-called power electronics are needed. A second lies in the monitoring of our resources and their resilience, for example the monitoring of our forests as a research focus in our research group Remote Sensing and Geoinformation. We have decades of expertise in the field of environmental monitoring which we continue to expand upon. A third challenge that I see is to create the highest possible and efficient return of resources in the sense of a functioning circular economy, for example smart recycling or automated material recognition. We lead the field in characterisation of material flows with multi-spectral sensors, in the research and implementation of new, bio-based, recyclable, or compostable materials, or in the evaluation of lifecycle-based sustainability (LCA).

What obstacles need to be overcome along this path? The time factor is definitely an obstacle. The development of technology is time-intensive and requires tenacity, from the concept through implementation and product development. Very often, large developments do not progress as quickly as necessary due to the small structuring of programs in Austria and Europe. What is actually an advantage in the aspect of respecting individual approaches is simultaneously a stumbling block if large problems are to be solved.

Numerous approaches to solve the issues of efficiency and resource-protection are based on digital representations of reality - digital twins. What advantages do they bring with respect to sustainability? Digital twins increase transparency. They are used in areas such as mobility for example in vehicles, in production, in medicine, and in the environment. The latter are generated using remote sensing technologies both geometrically and radiometrically. The results are terrain models that can be used in time sequences to analyse changes in the environment. Forests and temperature development in cities can be monitored and insights gained over a certain time period. Digital twins are also important for the carbon-capture process, which is the process where an attempt is made to separate out CO2 and make good use of it before it reaches the atmosphere. Using the example of forestation, at least two research questions can be derived from this: what effects do large-scale deforestation activities have on the climate and vice versa how does the changed climate affect the forest system?

How can artificial intelligence contribute to sustainability? For example, we are currently conducting research into mobility behaviour, automatic waste material recognition and recycling, and the analysis of the Earth's surface using remote sensing. The individual analyses are largely based on AI, or to be more precise, machine learning. Generally speaking, artificial intelligence is a useful approach to solving problems where complex processes are at work.

Both digitalisation and the transition to new technologies such as e-mobility will increase the demand for energy. Where will the energy for all this come from? That is a core question that is causing many a headache. There is no answer yet. It is perhaps possible with conventional energy generation, but counter-productive from an environmental perspective. It is currently not possible to cover the energy demand with renewable energies. This means that we have to significantly reduce our energy consumption or find new ways to produce energy. But that in turn needs an appropriate ramp-up from the concept, via planning permission, construction processes, all the way to execution: this could take decades.

In your opinion, what is necessary to achieve the climate goals? Technology openness and, of course, tenacity. As a community, we are often far too lackadaisical in our approach. This why politicians are under pressure and would like to act quickly and as a result of the urgency prescribe technologies. In my view, this is not the optimum approach as not all technologies and their impacts on the ecobalance have been completely thought through, for example regarding their energy requirements.

So where is JOANNEUM RESEARCH in relation to the green and digital transformation? Our research is applied, and we align ourselves with the European missions and the main topics that are derived from them so that we can contribute to overcoming the great challenges in the fields of environment, climate, health, society, production, and digitalisation. Within the scope of our strategy process development that we underwent last year, our competences were further bundled and made fit for the transformation. The resulting definitions for our business units health and care, mobility, policies and society, production and manufacturing, safety and defence, environment and sustainability, and space mirror the effectiveness of our competence in the specific sectors. Digitalisation plays a crucial role in our business units and results in sustainable ecological impacts in many fields. Regarding the green transformation, we have many years of experience in the areas of remote sensing, environmental data acquisition, material sciences, green photonics, circular economy, and lifecycle analyses.

On a scale from 1 to 10, what is the level of your personal green transformation? I see myself at 5. My goal is to save more energy and to use fewer resources.

Foto: JOANNEUM RESEARCH / Bergmann

+++NEWS+++
Contract Extension:

LOCATION WEIZ

After more than 20 years of excellent research performance, it is official: JOANNEUM RESEARCH's Institute MATERIALS in Weiz will remain a permanent fixture for cutting-edge research.

FORSCHUNGSTHEMEN AM STANDORT

- Q Hybrid electronics and structuring
- Q Light and optical technologies
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We deliver initial solutions for the entire value chain from the concept to prototyping via miniaturisation, integration, and material optimisation: large-scale micro and nano structures, bio and chemo sensors, optical technologies, functionalised surfaces, and laser processes.

More:

Hot in the City

TEXT: ELKE ZENZ

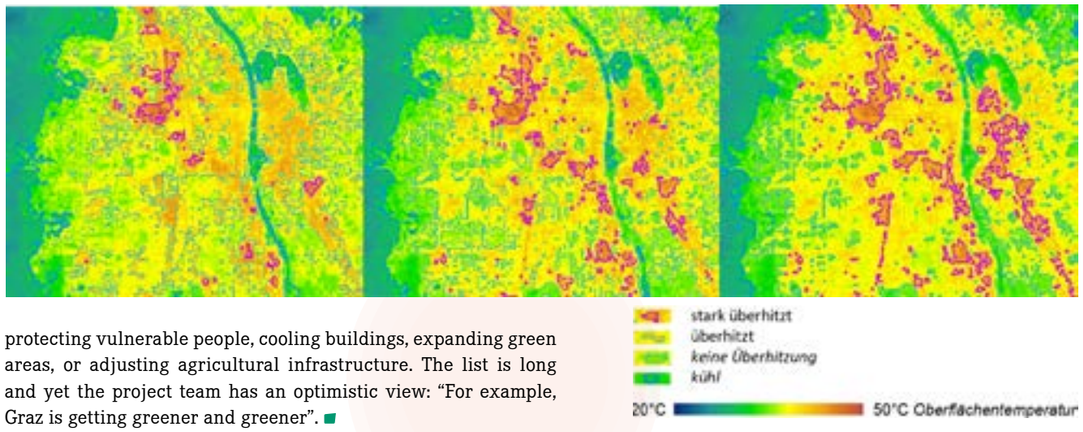
Climate change is here. It will get hotter. The population is suffering from the high temperatures, particularly in cities. Specialists from LIFE, HEALTH, and DIGITAL are researching a range of methods to localise and evaluate hotspots to assess their impact. The results are a series of recommendations for city administrators and the population to cool the hotspots and hence increase the quality of life.

The Viennese heat action plan shows how the city's temperatures have developed over the past decade. In the period 1961 to 1990, Vienna experienced an average of 9.2 days of heat wave with the highest temperature of over 30 degrees Celsius. From 1991 to 2020, the average was 20.1 days of heat wave. It is a similar picture in all cities in Austria: In Graz, the number of heat wave days between 1961 and 1990 averaged 4 per year increasing in the period 1991 to 2020 to 17. The rising trend is clear. At night, city temperatures fall significantly less resulting in so-called "tropical nights" where the temperature does not fall below 20 degrees. This cause a range of problems for the population, above all in the areas of health and productivity. These are the facts, but what happens next and how can we respond to the situation?

Hot spots

The project "UHI detect" (Urban Heat Islands detect) is designed to result in the foundation of a pan-European transferable monitoring and forecasting system that makes it possible to perform detailed analysis for both large-scale and local areas of heat loading and heat waves. Judith Köberl from LIFE is responsible for the project and explains that "We are investigating the suitability of surface temperature data gained from satellite information for merging with socio-economic data and health data as a basis for heat vulnerability indices and hence useful as an information and decision-making tool in the health sector." The basis for this are standardised and publicly accessible data from satellite remote sensing. The project has been running for over a year and the first trends can be recognised. Heinz Gallaun is the responsible person from DIGITAL. He works on evaluations of thermal data to create standardised time sequences. "We have been evaluating thermal data from the Landsat satellite since 2000 alongside data from the international space station. We also process thermal data recorded by aircraft. This data is of a higher resolution but cannot be converted to time sequences. The mixing of methods promises the most useful results since heat islands are not just an urban problem but are also a burden in rural areas. The aircraft-based recording of thermal data tends to mainly occur over larger cities with breaks of several years in between recording, whereas satellite recordings of thermal data are available with breaks in between of just a few days", the researcher explains. The remote sensing data delivers exact information regarding how the surface has developed in the long term both spatially and temporally: Where a lot of construction has occurred and where generous areas of green are available. This helps the researcher to localise so-called hot spots and cool spots.

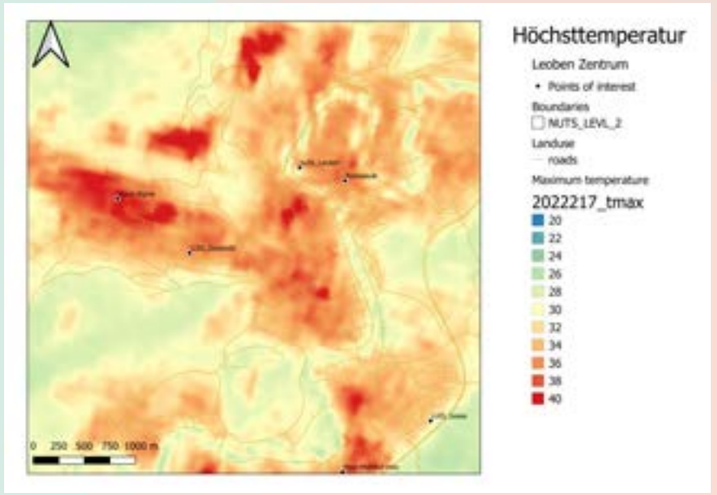
This is the point where the LIFE and HEALTH team join in." in the second part of the project, the focus will successively transition to possible areas of application and use-cases such as the health sector and also on which additional data, overlaps, and processes are necessary. All in all, we expect that the project will results in the foundation for a monitoring system of heat loading that represents a valuable information base for a range of different areas of application such as preventative health care, space planning, or agriculture", Köberl explains. This information as the basis for decision-making is called climate services. They are an important topic worldwide and one that will accompany us for many years to come as there is still a lot to do regarding climate change, such as protecting vulnerable people, cooling buildings, expanding green areas, or adjusting agricultural infrastructure. The list is long and yet the project team has an optimistic view: "For example, Graz is getting greener and greener". ■



Did you know?

KLAR! – Climate adaptation in greater Leoben

The climate and energy fund is currently supporting 89 Austrian regions via the KLAR! program to alleviate the damage resulting from climate warming and to exploit the emerging opportunities. Leoben, a region around the river Mur, is one of them and the 6 councils are collaborating together with Michael Brenner-Fließer from LIFE to produce a catalogue of measures designed to mitigate the effects of heat islands based on data from the LandSat satellite remote sensing system. After calibrating the surface temperatures with the air temperature, the result is a detailed heat island map in a 30 x 30 metre grid with which the problematic areas can be identified, and regional measures worked out. It turns out that the reasons for hotspots are mainly large, sealed surfaces such as main squares and large car parks. Michael, a sociologist, then discusses measures with the population that are suitable for a cooling down. Rediscovering a piece of nature will be unavoidable. Trees throw shade, improve air and water quality, and the leaves also have a cooling effect due to water evaporation. On top of all this, passers-by can enjoy the view and soothe their souls. The suggestions are documented in 20 possible measures and 5 of them will be destined for implementation in a concrete roadmap. ■



Help with Dementia: Digital Activation Training

TEXT: ELKE ZENZ

The study "multimodAAL", a cooperation between JOANNEUM RESEARCH, the Medical University Graz, the Austrian Red Cross, and the companies digitAAL life GmbH and HS&I HealthSystemIntelligence, has now been successfully completed. The results showed unambiguously that cognitive activation training using digital applications stimulates memory performance in the elderly and delays the progression of dementia.

The multimodAAL project gathered results over a period of three years and the results are now available. The goal was to develop a flexible, personalised, low-cost, and technical solution for a holistic training system, involving mental, physical, and social aspects. The solution was to take cognitive and physical performance data into account and carefully follow lifestyle influencing factors. The system is aimed at supporting the elderly in early stages of dementia and to maintain their level of performance for as long as possible. The 6-month study phase is now complete, and the results show that the global performance of all test subjects could be maintained and did not deteriorate. "We work intensively with technologies that help the elderly or the impaired and we are proud that all of us in the project consortium were able to achieve such good results. This enables us to help many people maintain their quality of life", Silvia Russegger, the project manager at JOANNEUM RESEARCH's DIGITAL institute stated.

Digital Data Analysis Recognises Early Stages of Alzheimer

"We can derive objective, quantifiable characteristics of biological and physiological processes from biomarkers. Within the scope of research into dementia, we are interested in the estimation of scores of neurophysiological screening instruments from easily obtainable digital data describing daily behaviour. This enables the definition of early warning systems that indicate the first symptoms of dementia. This provides more space for timely treatment", Lucas Paletta, an expert in the field of human-centred computing in the DIGITAL institute said. Digital biomarkers are data processing techniques. "We determined that the subjects themselves get involved the most at the beginning of the training and get through up to 2 topics per day. This intensity drops exponentially to just one topic per day", Christiane Aschlener from Austria's Red Cross said.

Study Details

The study that was carried out was a so-called mixed-method study. The design of the quantitative part was a randomised control test (RCT), the qualitative part took the form of supplementary interviews (individual interviews and focus groups) with content analysis. The study was conducted in Styria and all participants with Alzheimer dementia originated from domestic environments, supported living, or care homes. Fifty-three people with Alzheimer dementia were recruited until the end of the study. A total of 26 of the participants could be included in the study and after study terminations a final sample of 23 participants remained. The neurological and neuropsychological examinations, blood sampling, interview of relations, and the MRT scans were carried out by the Medical University of Graz under the management of the Neurology Department.

Recyclable PCB Board Based on Paper

TEXT: PETRA MRAVLAK

Imagine electronics could be disposed of just like paper and recycled? That is exactly what the MATERIALS and LIFE institutes at JOANNEUM RESEARCH focussed on within the scope of the CircEl-Paper EU project.

Measuring blood sugar levels via the skin, a package with integrated time and temperature indicator, or a greetings card that plays music: All these things require electronic components. These are PCB boards with elements such as sensors, chips, capacitors, and resistors. These boards are normally made out of a fibreglass-polymer composite material with circuitry based on copper and a range of other metals. Of the 12 million tons of electronic waste produced every year in the EU; only 42 percent is properly collected and recycled (source: World Economic Forum). On a worldwide basis, this figure is only 17 percent (source: Global E-Waste Monitor 2020). The goal of the EU project "CircEl-Paper" is therefore the manufacture of functional PCB boards based on paper technology so the functional electronics can be disposed of via conventional paper recycling processes and even recycled. This would reduce recycling costs and facilitate the recovery of valuable materials.

Research into new materials and their suitability for circular economies

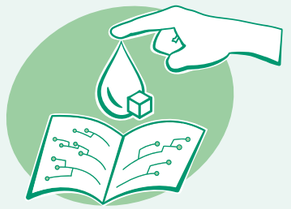
The MATERIALS institute whose focus lies on sensors, photonics, and manufacturing technologies conducts research into the development of suitable materials since the cellulose-based substrate that is hoped to replace conventional PCB boards will have to conform to the requirements of the electronics industry. "We develop additives, i.e., supplements, that make the paper stable and compatible with conventional integration processes. We also develop inks for the printing of conductive paths as well as passive components such as capacitors, resistors, and isolators", the project manager at the institute, Oliver Werzer, reports. "We also look into scalable processes that permit the coating of these new materials on a PCB board made of paper and enable the rapid application in industry. The highest priority is laid upon the use of resource-conserving and environmentally compatible materials and processes. The materials used are meant to increase the separation of the components and their reusability; bio-based alternatives are also being evaluated."

The researchers at the LIFE institute, the institute for climate, energy systems, and society, closely examine the suitability of the newly developed materials for a circular economy and take a holistic view of the sustainability of the manufacturing processes and the reuse of the materials used with a lifecycle analysis (LCA), in other words from the cradle to the grave. Sara Carniello is the project manager and says that detailed LCA studies and the evaluation of suitability for circular economies are not standard for such complex technologies. They require both profound knowledge of the materials and technologies as well as the further development of the methodology, particularly for the evaluation of circular economy suitability. The suitability and sustainability of the different approaches developed within the project are evaluated at an early stage and considered by the consortium in the selection and further development of the technological options."

JOANNEUM RESEARCH is represented by its LIFE and MATERIALS that has been working on the CircEl-Paper project since September 2022 and covers the entire value chain. Other participants are research facilities, academic partners, and production companies: the Fraunhofer institute for silicate research as project coordinator, the Swedish research institute RISE, the Italo-French paper producer Fedrigoni, the French VFP Ink Technologies, the PCB manufacturer Malmö Mönsterkort in Sweden, and Grenoble INO, Graduate Schools of Engineering and Management, University Grenoble Alps. The diverse range of application possibilities of the paper-based PCB technology is to be demonstrated using three use cases from the fields of medicine, logistics, and entertainment electronics: Using sensors to measure the blood sugar levels on the skin, the packaging of an integrated time-temperature indicator, and play music from greeting cards. ■

Results from the CircEl-Paper will significantly reduce the environmental footprint of lifestyle gadgets such as electronic greeting cards.

A controlled temperature is important for food transport or vaccination monitoring and is therefore indispensable in modern logistics. Thanks to CircEl-Paper, the sensors can be recycled as paper along with the packaging without hesitation



In the future, sensors for blood pressure and other physiological indicators will consist of paper. This will conserve resources during production, facilitate recycling, and reduce the environmental impact.

The performance of electronics and their cost-effective production means that they are being used more and more widely. This results in a huge use of material and creates a large amount of electronic waste. This makes it even more important to reuse valuable resources. The CircEl-Paper project pursues a holistic approach to reduce the ecological footprint; resource-conserving manufacturing processes are being developed that are able to produce powerful and above all reusable electronic circuits on paper.

Illustrationen: JR / Veitlmeier

Project Manager

Oliver Werzer is a physicist and has been conducting research into piezo- and triboelectrical materials, pharmaceutical preparations, organic semiconductors, and printed electronics for over 20 years.

Projekt Manager

Sara Carniello is a technology developer specialised on the evaluation of the sustainability of electronics and new technologies.

More:

Gone is Gone? Not Really.

TEXT: ELKE ZENZ

Austria consumes an above average amount of resources. This year, the amount of natural resources available for a year was consumed by the 6th of April (source: Umweltbundesamt). This is why solutions are needed to help use resources more sustainably and to exploit the ecological and economic opportunities of the circular economy.

Austria produces around 70 million tons of waste per year and a third of it is recycled (source: Umweltbundesamt). The value of materials resulting from waste separation is high with metals and rare earths in high demand. The technological leaps between subsequent generations of devices and systems are becoming shorter and each new product generation uses increasingly scarce resources. This is why it is important to make optimal reuse of the limited resources in a circular fashion. And to do so with the lowest possible use of energy and preparatory materials. An indispensable basis for this is an automated assessment of value and contaminants: which is exactly what the team centred around Harald Ganster and Gerhard Jakob at DIGITAL are working on in the Hyperspectral Imaging Lab. 3D cameras, UV cameras, imaging spectrographs, NIR, and multispectral cameras are used for the research.

These devices enable different plastic types to be separated as well as is normally only possible with materials that are very different from each other such as wood and glass. Gerhard Jakob manages the laboratory and explains "It was simply necessary to filter out the raw materials from the recyclable material streams in order to maximise the reuse of our waste". He has been working at JOANNEUM RESEARCH for more than 28 years and built up the Hyperspectral Imaging Lab together with Alfred Rinnhofer. "Our approach to these challenges is the measurement of the recyclable material streams using hyperspectral means because differences between the materials can be represented in a range of spectra." Harald Ganster, project manager at DIGITAL, explains that our lab uses highly specialised cameras in wavelength areas to see what the human eye cannot. This makes material characteristics apparent that cannot be recognised with standard cameras. We have the entire light spectrum available as a measurement signal: from ultra-violet below 400 nanometre wavelengths up to medium wave infra-red of 5400 nanometres. This is a clear unique differentiator for the Hyperspectral Imaging Lab."

AI in the Circular Economy

The end of the road is reached when the characterisation of complex material flows is no longer possible even with modern sensors. This is where artificial intelligence comes in: huge potential is expected in the fusion and multidimensional data analysis of all real-time capable sensors combined with AI algorithms. The AI-supported image recognition is based on the use of machine learning and neural networks to identify patterns and features in images and to recognise objects or content. This enables faster and more precise sorting, reduces human error, and optimises the use of resources. Hence it contributes to an increase in efficiency and the improvement in the environmental impact of recycling.

Current Projects

KI4ResOpt is a complex project where research is being conducted into AI-driven product and material characterising. Harald Ganster explains that "the goal is to develop new methods to help characterise the composition of complex recyclable material streams of all kinds. When defining the methods, we take the different transport mechanisms such as conveyor belts, free fall, or tipping into account". The subject is not only researched in a laboratory environment but also on sites such as recycling depots and tips, in refuse collection vehicles, and scrap sites. Intelligent sensor technologies and data analysis is used to find the broadest possible solution valid for material characterisation

KI4ResOpt is funded by the Austrian Federal Ministry for Environment, Energy, Mobility, Innovation, and Technology (BMK). The projects InSpecScrap and KI-Waste are funded by the region of Styria using the grant scheme "Zukunftsfonds Steiermark" (Future Funds Styria). The circPlast-mr project is funded by the BMK within the 1st tender of the FTI Initiative Circular Economy.

Foto: JOANNEUM RESEARCH / Bergmann

during the material's lifecycle.
Project manager Harald Ganster explains that "we use AI in the InSpecScrap project in an innovative material characterisation with which spectroscopic methods automatically evaluate contaminants and the quality features of scrap. This allows us to create a basis for the optimisation of the composition of the scrap regarding the steel quality requirements. Steel waste is necessary as an important secondary raw material in the production of steel. Steel is a valuable material due to its variety of applications in the construction industry and in the production of vehicles and machines. The use of scrap as a raw material in the raw steel production is not only an advantage with regard to resource-conservation but also has an exponential reduction in CO2 emissions. Steel from scrap production is up to 75% less CO2 intensive that steel from primary raw materials. In addition, steel production with scrap steel has further advantages such as lower acidification and photochemical oxidation.
The flagship project circPLAST-mr, with a total of 22 partners, is focussed on improving plastic recycling and the KI-Waste project focussed on the basics of optimisation and modernisation of the recycling process in the waste management sector. Here too, AI methods were merged and analysed using time series data generated by image recognition.
The scientific partners in the overall research field include the Technical University of Graz, the Know-Center, the University of Leoben, and the JKU Linz. The implementation of the developed technologies will be done by national and international business partners. ■

Our scrap is the source of raw material for the future, but only knowledge of its composition renders reuse possible. Hyperspectral imaging makes tiny differences in the material visible and transforms scrap into pure and separable raw material.

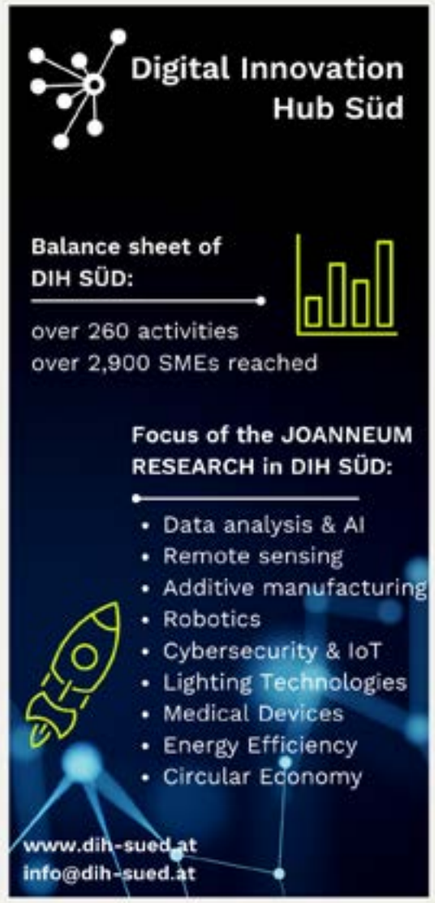
— Matthias Rüther, Director DIGITAL

Foto: JOANNEUM RESEARCH / Bergmann

The line-based hyperspectral and 3D data acquisition is performed with: VIS+NIR line camera LED lighting, 3D light sectioning system, SW/NIR imaging spectrograph 1000-2500 nm, SW/NIR Spectrograph with SW/NIR camera 1000-1700 nm, VISNIR Spectrograph with CMOS camera 400-1000 nm.

More information in the multispectral camera here

DIGITAL SUCCESS WITH DIH SÜD!



FFG Das Land Steiermark LAND KÄRNTEN

DIHSÜD Digital Innovation Hub

Thanks to the strong partner structure of DIH SÜD, it´s possible to increase the competitiveness and innovation degree of SMEs and to prepare them optimally for the challenges of the digital future.

One example of the very successful cooperation with JOANNEUM RESEARCH is the innovation project of Hannes Fassold, Senior Researcher at Institute DIGITAL. The project focuses on the possibilities and the use of artificial intelligence for SMEs as this technology has a huge potential for small and medium-sized enterprises. The aim is to tap the potential of artificial intelligence for the sectors tourism, production, services, crafts and trades. JOANNEUM RESEARCH is conducting a comprehensive study that examines concrete use cases and problem solutions to determine the potentials of artificial intelligence for SMEs.

Overall, this success story shows that the partnership between JOANNEUM RESEARCH and DIH SÜD is making a significant contribution to advancing the digital transformation in small and medium-sized enterprises and strengthening them for their digital future.

Here you can find our events.

Foto: JOANNEUM RESEARCH/Bergmann

Think BIG

TEXT: PETRA MRAVLAK

Whether carpenter's workshop, mason's yard, pharmaceutical company, or food industry: Digitalisation and automation can open up opportunities in larger markets even for smaller companies.

Cobots and industrial robots are omnipresent at the JOANNEUM RESEARCH's ROBOTICS institute in Klagenfurt. This is where tailored solutions are crafted for the automation required by companies in order to react flexibly to market demands. The institute's director, Anton Scheibelmasser, explains that "this has the effect of counteracting the dependency on companies from the Far East and increases the competitiveness of domestic companies". The past few decades have seen industrial production as well as SME-structured production relocate abroad in increasing numbers, particularly to China. In the past, lower labour costs and standards were the driving force and today it is often the knowledge of production processes. China is also the first address to turn to for the development of pilot product series as they are comparatively easy to order via known B2B platforms. This path is no longer the prerogative of larger companies but also suitable for single-person trading companies. Manufacturers in Europe have almost no chance to win contracts in this environment. The COVID pandemic and the war in Ukraine have not only increased the dependency on Chinese production capacity but also made it clearly visible.

Flexible Production as a Means Against Dependency

According to Scheibelmasser, "automated solutions in flexible manufacturing environments can counteract these dependencies. They enable domestic companies to quickly react to flexible batch sizes and also to a range of product versions". This is why the ROBOTICS team has extended their focus from the research field of robot safety and sensors towards their application-oriented use in production. The automation expert Christian Oswald has been given the responsibility of building up the new research field. He describes the activities of the new field as "we accompany companies with consulting, simulation of automation systems, and the integration of robots in their production lines and collaborate with them to create tailored automation solutions within the scope of joint research projects." The institute will be successively expanded over the coming years and the number of employees is planned to double by 2027.

Enhancing the value of human labour

It is too short-sighted to say that digitalisation and automation will cause the loss of jobs, say Scheibelmasser and Oswald with conviction – particularly regarding the blatant shortage of labour. Automated solutions are actually better regarded as leverage for increased productivity and as a consequence for the increased qualification of employees. An example is that CNC-controlled manufacturing centres in a metalworking shop are not a replacement for qualified employees: CNC machines have been in use for decades and yet expert workers who can operate them are always in short supply. According to Oswald, "at the end of the day, automation and digitalisation contribute to the maintenance and even creation of jobs in Austria. If domestic production is competitive, then companies will not relocate abroad.".

Here in the ROBOTICS Solution Centre, we are working on application-oriented robotic and automated systems for companies with the aim of making them resilient for the challenges of the future.

More information on ROBOTICS
joanneum.at/robotics

3 questions to...

ANTON SCHEIBELMASSER, DIRECTOR ROBOTICS INSTITUTE

How do companies benefit from a collaboration with the ROBOTICS institute?
We work together within the auspices of research projects to create solutions that are exactly tailored to their requirements. This benefits companies of every size and from every sector, but particularly SMEs as they often do not realise the opportunities that exist.

Why are automation and digitalisation so important?
Experience over the past few years has shown that the use of robots can compensate for the omnipresent shortage of labour and can replace delivery chains from the Far East with domestic production.

What foci are there?
Apart from the established research fields such as robot safety and safety-evaluated sensors, our focus will increasingly lie on their application-oriented use in production automation. People can be trained to use the latest robots and automation systems, the feasibility tested on flexible robot workbenches, and the burden of unintentional contact measured between robot and human.

project manager

Foto: JOANNEUM RESEARCH/Fischer

Christian Oswald studied Mechanical Engineering and Business Economics at the TU Graz and worked in the automotive industry and in the field of robotic start-ups.

Environmentally Friendly Coating

TEXT: PETRA MRAVLAK

Whether it is an anti-stick frying pan, functional clothing, dirt-repellent wash basin, or water-repellent wallpaper, equipping domestic objects with special functions is normally done by coating them with per- and polyfluoroalkyl substances (PFNAS), or so-called "forever chemicals". The associated problem is that micro and nano particles from these materials remain persistent and enrich themselves in the environment and in the food chain. This is why the MATERIALS institute in Niklasdorf is researching into bio-based and sustainable alternatives. Carina Hendler, a chemist by profession and technical employee at the institute says that "our focus is on functional coating, for example one that endows the surface with easy-to-clean effects, electrical conductivity, wear and abrasion resistance, low friction, corrosion protection, and anti-bacterial or anti-viral properties. We use bio-based and renewable sources as far as possible in our basic materials and for coatings that do not have a toxic impact on the environment during their manufacture or use." Examples of these materials are bio-based polymers, wood-based raw materials as well as graphite, soot, or layered silicate materials.

Atmospheric pressure plasma coating

The Niklasdorf site also uses a special coating method: atmospheric pressure plasma coating. As the name suggests, this is performed under normal atmospheric conditions. Plasma is known as the 4th aggregate state of matter alongside solids, liquids, and gases, and is used as an energetic source to activate chemical reactions. A chemical substance known as a monomer is introduced. This means that the substance exists in many small and individually isolated, independent molecules. In the plasma, these monomers form long chains and are deposited on a substrate. In contrast to other methods that often use harmful solvents to wet the surface, atmospheric pressure plasma technology does not employ such chemical substances. The coatings applied by this method are very thin (10 nm–20 µm) and can be used in a large range of different applications.

This is the case for solar modules for photovoltaic plant. Reinhard Kaindl, project manager at MATERIALS reports that "there is a lot of expectation in lead-free tin oxide perovskite thin layer solar cells". Over the next few years, such solar cells will be developed in Niklasdorf and Weiz within the framework of an EU project coordinated by the TU Graz using an environmentally friendly and energy-efficient roll-to-roll method, and atmospheric pressure plasma and laser technology.

Research is also being conducted on coatings for bio-based decorative materials in interior areas such as in cars, planes, and also for interior architecture. Project manager Jürgen Lackner says that "these coatings have to feature the lowest possible tendency towards dirt adhesion that results in a high and long-term utility value and be easy to clean. Our aim is therefore to develop fluorine-free superhydrophobic, easy-to-clean, surfaces. Of course, this means using natural waxes and fatty acids instead of non-degradable perfluorocarbon.

Contact: carina.hendler@joanneum.at

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Andreas Niederl (left) is a Senior Researcher and Nicholas Katz (on the monitor below) is a Data Scientist in the POLICIES research group "Regional Policies and Site Economics".

The process of digitalisation is omnipresent in the economy. The direction of public discussion, however, is determined by euphoria around the technological opportunities and fear of "technological unemployment" as the transition is causing disruption in nearly all walks of life. It all began with the process of digitalisation years ago and is now becoming increasingly greener.

CHANGING LABOUR MARKET

Technological and societal changes always have an impact on the labour market. The mega-trends such as the green and digital transformation influence leisure time and the labour market on two levels. The digital transition has accompanied us for decades now and is having a significant effect on the demand for professions. For example, the demand for labour with sound IT skills or with technical focus is increasing, while the demand for professions focussing on manual routine jobs is falling. New jobs are also being created. On the other hand, the activity profiles of the jobs is changing continuously and with increasing speed. Numerous activities are being digitalised and reconsidered. In addition, there is the requirement to design current processes more sustainably. The green transition opens up new opportunities and needs new ideas. And data is required in order to increase the efficiency of energy and resource use. It is just at this interface between digital and green transformation that research has a role to play. Andreas Niederl, Key Researcher at POLICIES, the institute for economic, social and innovation research explains that "we are developing monitoring systems that are important as the basis for decision-making for institutions and the political domain. The mutual goal is to localise business site opportunities and possibilities that result from the green and digital transformation". For example, the team around Niederl is working together with AMS and the regional governments of Styria and Carinthia. "One of the challenges is the availability of suitable data. A monitoring system can only be of use if it is based on easily available, and also accepted data", Niederl explains further. There are several methods available such as the secondary analysis of internationally available monitoring systems, analyses of job descriptions, and of labour market data.

One example is the job market analysis based on job adverts: the AMS job barometer. Nicholas Katz, Data Scientist at POLICIES, explains that "we work with a comprehensive dataset that summarizes Austrian online job adverts in a normalised form. So-called crawlers search through relevant web sites looking for job adverts, access the information, and store it in a filtered form. Machine learning models are then applied that make the best possible classification of job information and the required competencies." This data can be displayed as developments on the domestic job market according to counties. "We forecast how high the significance of these jobs will be in the near future and show which competencies are in particular demand, or will be in the future", Katz says.

The mutual goal is to determine opportunities and possibilities for the business sites.

Andreas Niederl, Senior Researcher POLICIES

Sabine Putz heads the department for Labour Market Research and Profession Information at AMS.

3 questions for...

SABINE PUTZ, AMS ÖSTERREICH

The AMS job barometer shows the number of job adverts in Austria, and this reflects the demand for labour. There are concerns, particularly in the context of digitalisation and automation, that jobs will be lost. Despite this, the AMS job barometer shows a remarkable increase in job adverts in the past few years. How do you interpret this development?
The current strong demand for labour is based on several parallel developments: on the one hand, the Corona epidemic restricted the growth that until then had been continuous, which created a noticeable recovery effect. On the other hand, people born during the years of high birth rate are leaving the labour market for retirement and need to be replaced. The awareness of the necessity for the digitalisation of processes has prevailed as a trend for the future and use cases now exist in almost all businesses. And lastly, the propagated green transition has been fired up by the energy bottleneck and companies are not only thinking about energy efficiency but also link this topic more comprehensively with digitalisation. In order to be able to use this innovation push constructively, companies want to extend their teams with recently trained employees.

The AMS job barometer illustrates the high demand for professions in the fields of IT and software development: a direct consequence of digitalisation. Apart from these experts, which general changes have you noticed in the requested competencies through digitalisation?
In the meantime, digitalisation has penetrated into the majority of professions, whether they are in production, in the large services sector, or in agriculture. Almost all employees are supported in their job by digital tools that need operating. Basic digital competence is a must almost everywhere and at the same time, the topics of data security and data protection are increasing in importance.

The green transformation requires a change in the methods used to manufacture products and offer services. Where are particular opportunities in the labour market due to the green transformation?
The green transition has arrived in almost all sectors. Of course, the energy sector is very prominent and where public awareness is also bundled. Just as important though is the construction sector where it is important to optimise buildings in accordance with new requirements whereby the typical construction jobs and also ancillary businesses are relevant. Energy efficiency has been a huge topic in the manufacturing sector for a long time, but which has still increased in relevance; the circular economy in combination with digitalisation are the big topics of the future. In actual fact, all other sectors are also involving themselves with the green transition whether they be from the retail, administration, or agricultural side. All these businesses are now under pressure to expand their expertise with freshly trained employees or via the further training of existing manpower.

Transformation on Rails

TEXT: ELKE ZENZ

Around 70 experts and shapers of the future followed JOANNEUM RESEARCH's invitation extended by their CEO, Heinz Mayer, to participate in a "Rail Forum" at the research institute's headquarters in March. The focus of the event from the series Forum JOANNEUM RESEARCH was on the green and digital transformation of rail traffic.

The volume of goods and the number of passengers transported by rail is increasing continuously. Operators and suppliers are under pressure to adapt infrastructure to the current demands. Digitalisation together with research and development play a major role in this. During the event, the speakers sketched the view of the mobility transition that is currently in full flow. This view represents a promising start for a successful transformation of mobility driven by digitalisation. Sabine Wimmer, Head of Infrastructure at Wiener Linien, presented her company's digital facility management that offers significant added value in the area of cost-efficiency and maintenance. The 3D model of the infrastructure including GIS localisation and database was constructed directly in the company with aim of "creating a basis to facilitate successful planning. But even if one has good plans, at the end of the day, the temporal and economic components have to be aligned", Wimmer said.

Digitalisation is to be used to increase rail capacity. This requires measurement data. Filip Kitanoski from the Virtual Vehicle Research GmbH spoke about the issue with data gathering: There is an inconceivable amount of data available, but the point is the identification of the relevant measurement data. In his view, there is "a huge need for standardisation. We need to know how to use digital artefacts. And this requires technologies to uncover exactly the right data that corresponds to the problem statement."

Bertram Ludwig works in the ÖBB Holding company and is responsible for the coordination of R&D within the company. He spoke about the current challenges facing the traditional Austrian company whose transport services are in increasing demand. The research strategist is aware that "we need to increase capacity, productivity, and quality". A digitalisation process is essential for this. "We are working intensively on digital solutions for actions such as coupling. This is just as important as transferring existing expertise to the next generation. Even this needs digitalisation", Ludwig says. The ÖBB Holding is a partner in both large national research projects, such as TARO (Towards Automated Railway Operation) that deals with the automation and digitalisation of rail systems, and in European initiatives such Europe's Rail Joint Undertaking.

Alexander Prix from Siemens Mobility GmbH offered a change of perspective and presented a supplier's view how rail vehicles can save energy in the future and permit more capacity in transport. Prix explained that "the minimisation of CO_2 emissions, customer friendliness and robustness have priority in the development process". He underlined the importance of data, which he described as the "fuel for digital twins". Prix is convinced that "as a commercial operation, the added value of digitalisation is important. This means that maintenance needs to be optimised, wear and energy consumption need to be reduced". He used the example of the high-speed train Velaro Novo built by Siemens as an example of what predictive maintenance can offer and how rail vehicles can use less energy.

The series of talks was rounded off with a presentation by Matthias Rüther, Director of DIGITAL – the institute for digital technologies at JOANNEUM RESEARCH, listing the opportunities arising from the creation and use of digital twins. Rüther described his offer as data production and said that in order to increase efficiency by using existing data, this data must "ruthlessly standardised, stored, and made available in a linked form". The continuous update is achieved using cutting-edge sensors.

Rail Forum: Alexander Prix (Siemens), Heinz Mayer (JOANNEUM RESEARCH), Bertram Ludwig (ÖBB), Sabine Wimmer (Wiener Linien) and Matthias Rüther (JOANNEUM RESEARCH) from left to right.

Foto: JOANNEUM RESEARCH

Digital Inequality:

What causes it and what to do about it

Not everyone can (or wants) to use the opportunities offered by digitalisation. Digital technologies are not neutral products. They rather reflect the ideas, values, and concepts of those who developed them. This creates the danger that (unconsciously) products and technologies are developed ignoring the needs and experience of large swathes of the population. In 2021, only 19 percent of all IT specialists in Austria were female, corresponding to the EU average (EU- ROSTAT 2021).

Shaping digitalisation successfully means developing it together with those people for whom its use is intended and to appreciate their diversity. The study "Digital Inequality" by Sybill Reidl et al. (POLICIES) illustrates how inequalities are created by the forming of technologies and how development processes can be designed to be more inclusive. Technology developers thus gain pragmatic insights into proven procedures and action paths along the typical core process paths of technology development.

More:

tips

This is how we can contribute to help ensure opportunities offered by digital technologies are open to everyone:

- The needs of potential users are identified and analysed in the analysis phase
- In the concept phase the requirements are derived using the results from the analysis as a basis and participative, concrete approaches are sketched out that consider the different everyday and life experiences of potential users.
- In the development phase, the resulting concept is implemented and, ideally, a prototype is developed for testing and evaluation by a range of users.
- Once the product has been introduced to the market, it may be necessary to make corrections and to correct failures. It is important to maintain communication with users to generate feedback. In some case, training may prove to be effective.

Green Coating Technologies for Flexible and Organic Photovoltaic

The use of photonics, the technology of light, helps reduce energy consumption since no additional energy needs to be applied. Organic and flexible electronics is a low-cost and sustainable solution that can be used for applications such as wearables. These are sensors that measure vital statistics and are used in medicine, elderly care, and in sport.

GreenOPVSolutions is a trailblazing project in which we conduct research into efficient and environmentally friendly technologies in the field of renewable energy. The focus is on flexible, organic i.e., plastic-based photovoltaic (OPV) as a promising approach. The idea is to tap into the inexhaustible energy supply provided by the sun while placing particular emphasis on sustainability during production of the technology.

The project lays the basis for future environmentally friendly OPV technologies through the use of solvent-based manufacturing processes, ecologically compatible materials, and the eschewing of energy- and cost-intensive technologies. The overall goal is the manufacturing of flexible and efficient solar modules that can be produced in an environmentally friendly and resource-conserving manner. To reach this goal, the project team is pursuing several innovative approaches: First, new polymers are to be developed that enable the use of environmentally friendly solvents, in the best case, water instead of chlorinated solvents. Second, solar cell contacts are to be replaced by printed electrodes. Third, resource-conserving laser processes will be developed to connect the solar cells to enable efficient and rapid manufacture. The research is interdisciplinary in the form of a cooperation between the MATERIALS institute at JOANNEUM RESEARCH and the Institute for Chemical Technology of Materials at the TU Graz. Together the research will drive the transition towards more sustainable and environmentally friendly energy sources and make an important contribution in the fight against climate change.

More

»WHAT MAKES YOUR JOB **WORTHwhile**?«

TEXT: MAIKE RINDLER

We put this question to several of our colleagues in the spring of 2023. Over the course of our employer branding campaign »SINNvoll!«, they told us of the added value they saw in their research work and why it was worth making a career in research

In the spring of 2023, we posed this question to several of our colleagues. They responded within the scope of our employer branding campaign »SINNvoll!« and told us which added value they could see in their research work and why it was worth pursuing a career in research.
We put our young colleagues into the spotlight by posting current research topics such as acoustic detection of flying objects, bio-based surface coating, or remote sensing for environmental protection in reels on Instagram, Shorts on YouTube, on info screens, and in radio interviews. Our young researchers can be seen on placards at over 40 tram stops in Graz.
The aim of the campaign is to appeal to the much talked about Generation Z. JOANNEUM RESEARCH is an attractive employer and although research is a meaningful and future-relevant activity it is still a challenge to reach Generation Z. Still, we have managed to increase our visibility in the target group. The amount of feedback, external as well as internal, was quite positive. Not only did people interact on social media but even colleagues “in real life” expressed their enthusiasm for their job. The atmosphere behind the camera was excellent: from the initial concept to final implementation, the Corporate Communications Department got the entire campaign up and running. The initial idea to generate enthusiasm for our mutual and future-relevant activity was successful. We shone at the Fifteen Seconds Festival 2023 not just with content but also with a new look. We were not only able to show our special characteristic of a diverse range of expertise and the mutual goal to better meet the challenges of our time, but also the joy involved in the work itself. That is the point, we are all relevant for the future.

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We were busy spreading #sciencelove on Instagram.


Shooting behind the scenes with Bernhard Bergmann.


Martin Blass shows his worthwhile workplace in the acoustic laboratory at the DIGITAL institute.


Sabine Suppan demonstrated her enthusiasm for worthwhile workplaces with a selfie.


Behind the scenes with Petra Miletich preparing to film at the DIGITAL institute.

The Big Transition

KARIN TAUSZ

We are undergoing a transition. The green transformation and its twin digitalisation have arrived in all walks of life. We at the FFG provide more and more support and help accelerate this development together with our owners, BMAW and BMK: In 2022, 64 percent of grant money went into climate-relevant projects – an increase of 18 percent compared to the previous year. At the same time, half of the grant volume went into digitalisation projects. Many of these projects are digital and green – hence twins. There is a lot of interest on the part of our grant beneficiaries for the transformational grants – on all levels from start-ups via SMEs up to large companies. Since 2021, we have awarded over 1.6 billion Euros of grants for digital and climate-relevant research and development.
The new transformation offensive put in place by the Ministry of Economic affairs promises a total of 300 million Euros up to 2026 and 48.7 million Euros have already been granted. The Climate and Energy Fund provides around 47 million Euros for a range of projects covering the field of sustainability, all handled by the FFG. These include the FTI initiative for a Circular Economy, the Initiative Zero Emission Mobility, and the Austrian Climate Research program. And not forgetting the project grants in the fields of climate-neutral cities, energy research, and clean energy transition.
It is well-known that if you want to go further, you will need well-built roads. This is also true for the digital transformation. High performance networks create the necessary foundation and ensure Austria’s long-term international competitiveness. Almost 900 million Euros has been spent on broadband grants since 2021. These funds are used to perform the step-by-step connection of local authorities, companies, schools, universities, and homes to the >1-Gigibit data highway.
And whoever wants to achieve big things will need good partnerships. This is why the fight against climate change is at the core of Horizon Europe. The FFG acts as the national contact and fosters this with comprehensive portfolio of information and consulting. It is worth it. Over 600 million Euros have already been poured into Austrian research projects from the EU grant program.


Foto: Susanne Einzenberger

Karin Tausz is CEO of the FFG and is an experienced strategist and innovator in fields such as mobility, and urban and regional development.

The Digital OP-Check

Foto: iStock

The HEALTH institute has developed a digital solution to improve OP safety in a partnership with the Styrian Health Institute (Steiermärkischen Krankenanstaltengesellschaft, KAGes).

The introduction of this digital system is a milestone in surgical safety with the goal of minimising risks associated with surgical interventions, ensuring transparency, and minimising the administrative burden placed on employees. Teams from JOANNEUM RESEARCH and KAGes have been developing a digital solution for the paper-based "Surgical Safety Checklist " developed by the WHO since 2008. Unfortunately, these analog checklists demand increased time effort and can also not be easily integrated in existing workflows. In contrast, the new digital solution can be easily implemented in existing workflows and uses automated data sharing to avoid redundant documentation, offers a modern and user-friendly interface, is mobile, and brings consistent transparency for all participants. It thus provides optimal support for a quality-assured OP preparation process in accordance with WHO safety criteria

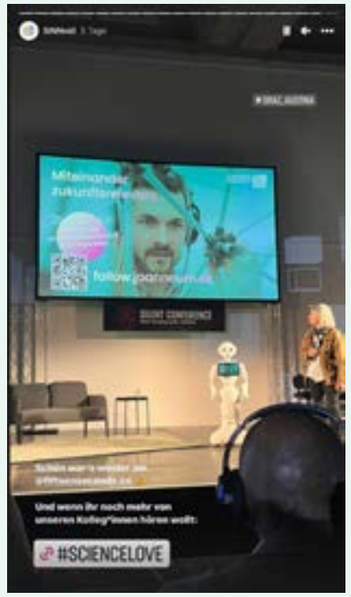
The digital OP process support "OP Check" was ready for a pilot trial in two OP areas towards the end of 2022. The trials took place in the LKH Deutschlandsberg hospital and in the University Clinic for Neurosurgery at the LKH-Univ. Klinikum Graz hospital. "We now have enough data and feedback to enable us to enter the final product development stages", said Franz Feichtner, Director of HEALTH. He added that "from September 2023, the digital OP Checklist will be rolled out in all surgical units at the LKH-Univ. Klinikum Graz hospital and then subsequently to all KAGes facilities in Styria. A maintenance and support contract has also been drawn up with the KAGes for routine operation. In the future, we want to make the product accessible to other hospitals and their operators."

Gerhard Stark, Chairman of the Board at KAGes emphasises that "The digital OP check contributes to an increase in safety in the OP process while reducing the burden in employees. Existing data is reused, and all relevant information is instantly available to all participants independent of the location. The entire OP process is therefore more transparent and streamlined in accordance with our LEAN hospital strategy".

The research group Digital Healthcare Solutions at JOANNEUM RESEARCH HEALTH is responsible for product development. The dynamic team is specialised on the development and clinical validation of ICT-based systems for medical decision and workflow support and creates software as a medical product.

Feichtner underlines that "the excellent cooperation between JOANNEUM RESEARCH and KAGes shows that the opportunities for the digitalisation of hospital process flows is far from exhausted. Our goal is to achieve easier data transfer, improve interprofessional cooperation and support, and empower system-relevant professional groups."

Fifteen Seconds Festival



Fotos: JOANNEUM RESEARCH

JOANNEUM RESEARCH's expertise trailer informed interested parties about jobs and the latest technologies.

Top left: Silvia Russegger from DIGITAL is a specialist for Digital Care and presented how the social robot Pepper can alleviate the daily burden.

Top: COREMED-Director Lars-Peter Kamolz participated in the panel discussion "Too old to be your Customer?"

#science

JR-Procurist Helmut Wiedenhofer (l.), sustainability expert Gerfried Jungmeier (centre) and Sabine Suppan (Marketing MATERIALS) at the Sciencetalk on JOANNEUM RESEARCH's booth

DEMOCRACY NEEDS A PROTECTIVE DIGITAL UMBRELLA*

TEXT: PETRA MRAVLAK

Deep Fake
Image or video created by artificial intelligence that appears to be authentic, but isn't

Cyber weapon
Software that disturbs processes in IT systems or connected systems, or destroys them through modification

Lightweight Cryptography
Cryptographic procedures that are particularly suitable for use in resource-constrained environments such as RFID tags and sensors

Post-Quantum Cryptography (PQC)
algorithms that can withstand attacks by quantum computers

Quantum computer
They use Qubits as a measure of computing power. They are not tied to two states like bits in classic computers and can therefore process more data in fewer Qubits.

Generative AI
Artificial intelligence that creates new content from existing data (text, images, music, audio, video) or destroys them through modification

Cryptography
The science of encrypting information

* **The Europäische Forum Alpbach** "Bold Europe" was held from the 19.8. to 2.9.2023. The sessions organised by JOANNEUM RESEARCH took place within the framework of "Europe in the World Days" on the 28.8.2023. Hannes Ernst (Top-Concept Management Beratung GmbH) moderated the event.

More:

How can democratic values in Europe and the western lifestyle by protected from massive (digital) threats by authoritarian powers? These questions were the subject of an expert discussion during a session organised by the JOANNEUM RESEARCH at the European Forum Alpbach.

Digitalisation and the Internet have made our world smaller and changed it in a radical way, with all its positive and negative impacts. Everywhere on earth can be reached virtually at any time. Freedom and democracy seem to be suffering a global downfall. Polarisation and the rise of authoritarian policies can be observed that is coupled with disillusionment and loss of trust in democracy, classic media, and science by citizens. Social media has its contribution and disinformation, deep fakes, and generative AI are triggering this development. A working group organised by JOANNEUM RESEARCH at the European Forum Alpbach brought experts from a wide range of disciplines together to highlight the dangers of the new digitalised world and the opportunities provided by protective shields.

Crime and the dissolving of geographic boundaries

Robert Lamprecht, CEO of KPMG said that "we will be remembered as the first generation in the history of mankind that lived in both the real and online worlds". The internet is the best and the worst thing in our lives: It has changed the private sphere and also criminality. Crime used to be local but now the virtual space knows no geographic boundaries nor distances. Cybercrime is a lucrative business model. The Internet has even provided a dimension of warfare that follows new mechanisms: Cyberweapons are effective, affordable, and their use can be denied. In contrast to physical weapons, cyberweapons can be employed covertly. The danger that western organisation and companies are attacked is increasing with the number of armed conflicts worldwide, Lamprecht said.

Deep fake and generative AI

Gerald Hesztera, Department Head for Strategy, Security Policy, and Coordination at the Federal Ministry of the Interior reported that digitalisation has strengthened organised crime: Instead of rigid organisations, now networks of small independent groups in different countries join forces for a short time with the aim of accruing money and power. The next huge threat: Deep fakes. If the boss' "real" voice on the telephone demands the transfer of funds (CEO fraud) or the granddaughter asks for money via a video call (nephew trick) then differentiating between genuine and fake is very difficult. Generative AI such as ChatGPT also helps criminals achieve their goals faster: All it needs is one person to create propaganda perfectly in many different languages and registers. For states, this means that even they need to employ the services of AI in the fight against criminality and fake news. In doing so, it would be useful to work together with NGOs and civil authorities. In Austria, this consists of a cooperation with Minikama, a platform for the uncovering of Internet fraud and fake news.

Sovereignty and the success of fake news

Democracy, freedom, and sovereignty are the basic building blocks of western societies. If sovereignty is understood to be the legitimate control a country has over its own affairs within its borders, free from external influences and interventions, then this appears to be increasingly difficult in our globalised world: According to the European Sovereignty Index, the sovereignty of the EU is particularly low in the field of technology, for example in raw materials, semiconductors, data storage, and marine cables. Disinformation is a danger for freedom and autonomy because it works. Daniel Wurm, advisor in the Ministry of Defence, said that "fake news spreads faster, further, and deeper than real news, even though social media are not completely trusted". Achieving more sovereignty has become an even more important topic for the EU precipitated by the war in Ukraine. "Reaching full sovereignty is hardly possible, new concepts are needed to work out shared sovereignty", Wurm said.

Technological Protective Shields

The protection of sensitive data is just as important for private people as it is for companies and public institutions. Quantum computers pose new challenges for the safe and encrypted transfer of data as conventional protective measures no longer work in the quantum world. Suvi Lampila from the SSH Communications Security Corp is therefore working on post-quantum cryptography (PQC). "Such cryptographically relevant computers do not yet exist, but the endangered data does. The data can be stored by attackers and encrypted at a later date. This is why work is being done on quantum-safe solutions with PQC. They can fight against the current threat of key exchange in existing networks. One thing is clear, "The quantum typhoon will hit land sooner or later and we need to be prepared for it". Maria Eichlseder, assistant professor at the TU Graz, is also working on safe, cryptographic algorithms. She provided an overview into their complex architecture and the development of cryptographic standards that are essential for the internet and also for small devices such as sensors in cell phones and medical devices (Lightweight Cryptography). ■

Green and Digital Transformation – Mobility of Tomorrow

STEFAN ERLACH

Increasing numbers of people live on our planet and the need to be mobile is growing rapidly: Mobility is forecast to increase threefold globally by 2050, 70 percent of the world's population will live in cities and metropolises. And yet the transport sector already accounts for more than 30 percent of global energy demand.

Faced with climate change, how can these demands be met while being organised in a CO2-neutral and resource-conserving manner? The answer is provided by railways. Although railways are already one of the most sustainable and powerful forms of transport, intensive research is being conducted into improving the existing services. Siemens Mobility for example has registered a total of 130 patents over the last three years in Austria alone. A strong and innovation-friendly domestic market in the long-term is required to ensure that these inventions can be experienced in everyday operation permitting improvements to be achieved. It provides a strong base for later export and ensures that the green transition can accelerate.

The future of rail transport will be determined to a large degree by digitalisation: fully automated systems, Cloud services, software algorithms, and the implementation of artificial intelligence will transform fixed assets such as routes, stations, and trains into modern assets. Most of all, complex systems such as the rail system will need open and digital business models for the interaction and communication of a range of partners and stakeholders. The open business platform Siemens Xcelerator is an example of how the resilience and agility of the entire system can be improved.

In the global Competence Centre for Chassis and Pantographs in Graz, we are working intensively on resource-conserving construction procedures such as lightweight technologies and depend heavily on the digital twin that saves time and money in our R&D work. This is how the results of our innovation can reach market maturity faster. We are also developing increasingly powerful possibilities of predictive maintenance of our vehicles and components.

Research and development work are the key for the green transformation. A close exchange of ideas amongst the best minds leads to a productive cooperation and better results. We are very proud and happy to have the privilege of working with sources of high-value expertise such as JOANNEUM RESEARCH, the TU Graz, and the University of Leoben.

We can solve the issues facing us and keep our Earth as a planet worth living on if we begin to show courage and move the high demand for mobility to sustainable railways. This will also boost the economy: jobs in the significant Austrian rail industry and our location in Graz Eggenberg are green jobs and hence "worthwhile jobs". This is why we should take the opportunity to motivate people to work in the rail vehicle industry. I am convinced that we at the Graz site are well prepared to meet these future challenges - with the expertise from the universities as well as the expertise in the rail industry itself – and we will exploit the opportunity to change to green mobility in the best possible way.

Foto: Thomas Lebelseder

Stefan Erlach
is Vice President Bogies & Pantos at SIEMENS Mobility GmbH.

Publications

Every year, researchers at JOANNEUM RESEARCH publish around 200 articles in expert journals, books, or proceedings. They give almost 250 scientific lectures per year and supervise around 60 dissertations. A selection:

Bild: Wehaplstock

LOCA2: The role of energy efficiency in the transformation to climate neutrality using KMU in Carinthia as an example

Andreas Christian Meltzer, Martin Beermann, Gerfried Jungmeier I 13. internationale Energiewirtschaftstagung TU Wien 2023, Conference of the Innovation Network "New Energy for Industrie" NEFI 2022

The decarbonisation of the energy supply for European industry represents a substantial challenge for the next decades. A far-reaching expansion of renewable energy generation is required to replace the fossil energy carriers currently used. A use-case in the industrial region of Lower Carinthia was sketched out that requires the goal of climate-neutrality on several levels: On the one hand, the substitution of fossil fuels is crucial to achieve the climate goals by 2030. On the other, comprehensive efficiency improvement measures are necessary to ensure future demand does not exceed the scope of the possible expansion. The focus is on the reduction of the so-called useful-energy demand. The dynamic lifecycle analysis method was used to determine transformation paths towards climate-neutrality for the industrial region alongside an investigation into possible contributions of energy efficiency and the conversion of energy supply to renewable sources. The results of the study indicate that the introduction of radical product and process innovation can maintain the extra demand for renewable energy sources at a low level.

AI-supported forest inventor: Deep learning for improved individual tree detection from LiDAR data

Sead Mustafic, Manuela Hirschmugl, Roland Perko, Andreas Wimmer I IGARS 2022, 2022 IEEE International Geoscience and Remote Sensing Symposium

Digitalisation has found its way into the field of forest inventories with the so-called digitalisation of forests. If a forest is to be maintained and protected effectively, every tree needs to be identified, localised, and observed over a period of time, just as its vertical structure does. Conventional satellite data is not accurate enough for this. The DeepDigitalForest project uses laser scanners carried by planes to create particularly dense 3D point clouds (100-400 points instead of the usual 2-8 points per m2). The goal is now to detect individual trees in the 3D point clouds using artificial intelligence so that forest inventory parameters can be derived from them. The process can be completely automated so that even very large areas can be analysed. The monitoring of forest areas is increasing in importance in times of climate change so that its impact can be countered.

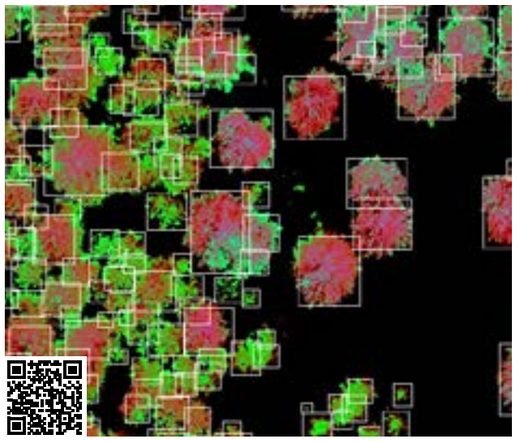
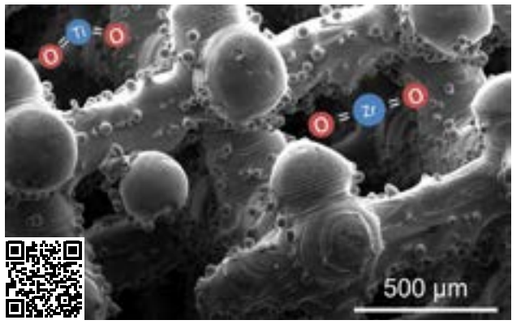


Bild: JOANNEUM RESEARCH



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Atomic layer deposition of oxide coatings on porous metal and polymer structures fabricated by additive manufacturing methods (laser-based powder bed fusion, material extrusion, material jetting)

Reinhard Kaindl, Thomas Homola, Armando Rastelli, Albin Schwarz, Aivar Tarre, Dietmar Kopp, Anita Maria Coclite, Michael Görtler, Benjamin Meier, Bernd Prettenthaler, Maria Belegratis, Jürgen M. Lackner, Wolfgang Waldhauser I Surfaces and Interfaces Volume 34, November 2022, 102361

Five different 3D printed, porous metal- and polymer structures were investigated as examples that had been coated with three different oxides using atomic layer deposition. Porous metal- and polymer structures are popular research objects as they have a range of possible applications in medicine and also for the generation and transformation of energy. For example, artificial porous bone structures can be produced that are very similar to natural ones and can repair and even replace damaged bone. Microbial fuel cells are able to produce energy from wastewater using bacteria in porous structures or vice versa as electrolysers to produce valuable CO2-neutral methane gas using renewable energy completely without the use of fossil materials. The topicality and necessity for research and new ways in these areas are also underlined by current social trends: keywords medical emergency and energy transition.

Effects of spermidine supplementation on cognition and biomarkers in older adults with subjective cognitive decline

Claudia Schwarz, Gloria S. Benson, Nora Horn, Katharina Wurdack, Ulrike Grittner, Ralph Schilling, Stefanie Märschenz, Theresa Köbe, Sebastian J. Hofer, Christoph Magnes, Slaven Stekovic, Tobias Eisenberg, Stephan J. Sigrist, Dietmar Schmitz, Miranka Wirth, Frank Madeo, Agnes Flöel I JAMA Netw. Open. 2022;5(5):e2213875.

This investigation looked into the effect of long-term use of spermidine as a food supplement on memory performance and change in biomarkers in older people who reported subjective cognitive decline. Over a period of 12 months, the 100 participants were given either a spermidine-enriched food supplement or a placebo. No significant change in memory performance was detected. However, explorative analyses did show positive effects on verbal memory and on inflammatory mechanisms that need to be validated in future studies that use higher dosages. Spermidine is found in body cells and is associated with cell growth and triggers the body to detoxify itself.

Foto: Freepik.com

Create Enthusiasm for the Future

HENRIETTE SPYRA

"Yes, we need enthusiasm for the future" read a recent headline in the Swiss magazine Republic. In times of multiple crises and rapidly spreading fear, this headline shows how necessary it is to counter this fear with the important desire to create a positive future. And all this under the auspices of the green and digital transformation headline that has taken central stage in this edition of the Joannovum. What do these multiple crises and transformation mean for the BMK's research and technology policy embedded in the context of climate-, energy-, environment-, and mobility policy? The concrete benefit that research, technology, innovation (RTI) is designed to overcome social challenges is positioned clearly at the centre – from the climate crisis to the exploitation of AI or security of supply (whether energy or microelectronics). More focus and impact in our research topics is indispensable here. Which key technological developments need unconditional support to achieve technological sovereignty? How can RTI provide an impulse for system transformation? Which new stakeholders outside of science and business need to be mobilised? Which new instruments are needed? How does RTI policy and results align with other policies such as green industry policy? And above all: How should administrative structures be (re) configured to be able to answer all these questions well in a complex context of transformation?

As the section Innovation and Technology in the BMK, we are currently undertaking a change process with the goal of making our mission's focus more strategic and effective. This mission addresses climate-neutral cities and our topics of circular economy and production, energy transition, mobility transition, digital and key technologies, space and aviation technologies, cooperation structure as well as innovation, competitiveness, and internationalisation. We are developing new initiatives such as pioneer cities and AI4Green. We are working on an improved combination of research and implementation grants such as for the transformation of industry (via the climate and energy funds) or the national implementation of the Chips Act together with the BMAW. And above all: We are establishing new working methods ourselves to get silos dancing. Because enthusiasm for the future needs to be shaped.

Foto: Luiza Puiu

Henriette Spyra is Head of Section III "Innovation and Technology" at the BMK. She has many years of experiences working in the fields of technology and innovation.

News shots

All news online available:
www.joanneum.at/en

Delegation from Saxony

Just recently, a delegation from Saxony visited us in Graz and Weiz to inform themselves at MATERIALS about flexible and printed electronics. We presented how our research infrastructure made solutions and scientific services possible, which included green photonics, structured (biometric) surfaces, piezoelectric sensors, energy harvesters. The trip was organised in conjunction with Silicon Alps Cluster and supported the initiation of new cooperation.

Foto: JOANNEUM RESEARCH

Foto: Jack Coleman

SFG Future Day

This year's SFG Future Day was held under the motto "Flexible Today. Productive Tomorrow" and considered the question how adaptable a company has to be in order to develop successfully in the future. Silvia Russegger from DIGITAL participated in the panel discussion with the title "Rethinking Digitalisation – Goal-oriented instead of an end in itself". The director of MATERIALS, Paul Hartmann, Business Developers Daniele Cozzi and Rüdiger Tinauer presented 3D printing technology and together with Procurist Helmut Wiedenhofer sounded out possible collaborations,

Status Report on Cyber Security 2023

Around 80 interested parties were present on the 8th May to hear a presentation about the current state of security in cyberspace. Robert Lamprecht, Director of Cybersecurity der KPMG, summarised the study results for 2023. These show once again that the greatest threat enabling data theft or manipulation is the human. Speakers from politics, business, and research followed on from the opening presentation. The event was moderated by JR CEO Heinz Mayer and Robert Gfrerer, CEO of Silicon Alps Cluster.

Foto: JOANNEUM RESEARCH

Hanna Wilhelmer from the Federal Chancellor's Office spoke of the Europe's position on Cybersecurity.

Foto: JOANNEUM RESEARCH / Bergmann

AKUT – Acoustic Tunnel Monitoring Now Operative in the Czech Republic

AKUT® will go live in Brünn and Prag by the end of 2023. The two city tunnels Pisarky and Blanka represent the first pilot projects in the Czech Republic using the technology developed by DIGITAL. Our reliable sales partner in the Czech and Slovakian Republics is Powerdynax s.r.o. The increasing traffic volumes mean that the importance of tunnel safety is growing resulting in an increase in investment in new safety installations by Czech motorway and tunnel operators.

99th Digital Dialog Focusses on Wood

Wood is a very important raw material for the site and, in view of the current discussion regarding the environment, is an excellent alternative in many economic sectors. This innovative, sustainable, and high-tech material of the future took centre stage at the 99th Digital Dialog in March. Photo from left to right: Alfred Rinnhofer (JR), Thomas Krenke and Bernadette Karner (Innovationszentrum W.E.I.Z.), Wolfgang Knöbl (Weitzer), Thomas Puster (Holzcluster), Martin Karner (Weitzer) und Heinz Mayer (JR)

Foto: Weitzer Parkett

Foto: JOANNEUM RESEARCH

Medal of Honour for JR Procurist Erwin Kubista

Erwin Kubista has worked at JOANNEUM RESEARCH for many years and has always used his expert competence and expertise for the good of the company. He left a lasting imprint of science management in the company and the location itself. LH Christopher Drexler awarded him with a medal of honour in March as a deserving employee of a company closely associated with the county. Photo from left to right: JR CEO Heinz Mayer, Landeshauptmann (LH) Christopher Drexler, JR Procurist Erwin Kubista, BR Ferdinand Golja

Major Research Expansion: Laboratory for Digital Twins in Carinthia

The county of Carinthia has invested a million Euros in the construction of the Digital Twin Lab in Klagenfurt. The building of the lab is expected to occur quickly. The entire site will be completed by 2027 and will employ ten people and have 100 square metres of laboratory and 130 square metres of offices. Digital twins represent a copy of reality and replace models and prototypes. Photo from left to right: JR-CEO Heinz Mayer; LH-Stv.in Gaby Schaunig, LH Peter Kaiser, DIGITAL-Direktor Matthias Rüther

Foto: JOANNEUM RESEARCH / Bergmann

Research from A to Z

An overview of topics covering society and sustainability

PALONA: Highly Automated Military Driving

The PALONA project is funded and financed within the defence research program FORTE by the Federal Ministry of Finance and the Austrian research grant company.

Robotics and automation in vehicles now also play a major role in military applications. Vehicles have to negotiate difficult terrain without crew to ensure more safety for soldiers. This permits the safer supply of exposed troops and increase the throughput of logistics; and higher risks can be taken with the transport. It also makes it possible to provide relief safely to civilians after a catastrophe. These vehicles are called unmanned ground vehicles, or UGVs and also help reduce a soldier's payload. A project consortium under the management of JOANNEUM RESEARCH addressed military logistics: "PALONA – is a German acronym meaning passive, infrastructure-independent vehicle self-localisation for navigation". The project's aim was to investigate how suitable localisation and environment-aware approaches can be implemented for highly automated military off-road driving. Automated trucks will make a significant contribution to the safety of troops in the future.

Foto: JOANNEUM RESEARCH

The project resulted in a versatile, mobile sensor system consisting of 8 cameras, an inertial measurement unit (IMU), and a mobile computer. Tests were carried out on military training grounds.

Any questions?

If you are looking for a reliable partner to help with your research questions or want to know more details about our technologies, just call us:

JOANNEUM RESEARCH

info

JOANNEUM RESEARCH has its headquarters in Graz and offers innovation and technology services in the field of applied research.
As a research company belonging to the counties and regions, our research expertise shapes the long-term and human-centric development of our modern society and industry. Our multi-disciplinary teams work in versatile and innovation-friendly structures while adhering to the highest social and scientific standards
As a research institution equipped with a public mandate, JOANNEUM RESEARCH thus assumes the role for the identification and generation of solutions for socially relevant challenges such as climate change, energy supply, digital transformation, mobility, civil and military safety, and also social change.

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