

JOANNOVUM

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Focus on **Space**



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EDITORIAL

I am pleased with this special edition of our JOANNOVUM dedicated to the topic of "Space". Space represents an important and extremely exciting field of research that is inseparably connected with the location in Styria.



Photo: JOANNEUM RESEARCH / Bergmann


JOANNEUM RESEARCH is able to draw on many years of experience in space and satellite technology that reach back to the year of 1968. Austria's membership of ESA in 1987 also helped us with a boost in space technology. A special highlight was certainly JOANNEUM RESEARCH's participation in the "Austromir" mission in 1991.

Heinz Mayer
CEO
JOANNEUM RESEARCH

For decades now, today's DIGITAL institute that I was privileged to have led for many years has been providing cutting-edge research in satellite communication and navigation, wave propagation, remote earth sensing, and space experiments. Our activities in space technology are supplemented with the development and prototype construction of space-capable experiments. Our customers include in particular ESA and NASA as well as numerous other renowned institutes and companies. Today, JOANNEUM RESEARCH employs around 40 experts in this field with a project turnover of approximately €3.2 million. The most recent example that captured media attention was the landing of the "Perseverance" Mars rover. Together with VRVis, the team at DIGITAL developed the 3D processing and visualisation mechanisms that will be used to generate the 3D models for the geological interpretation of the surface of Mars from 2021 to 2022. The transfer of technological developments into products such as the Tracking Receiver together with CPI Vertex demonstrates the high level of innovative power within the team.

We are particularly honoured to have top class guest commentaries from Andreas Geisler, Head of FFG's Aeronautics and Space Agency, and Margit Mischkulnig, Head of Space Activities in the government ministry BMK.

Follow us into the expanse of space research!



***Our contribution
towards mastering the
huge challenges of our
time is research.***

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Space

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Images have been arriving from Mars since February 2021. And being processed in Graz.



*"Our strength lies
in our technical
competence"*

– Michael Schönhuber

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Pioneering Work From Austria

TEXT: ELKE ZENZ

A team of specialists in JOANNEUM RESEARCH has achieved pioneering work in the field of satellite communication: For the first time, satellite signals can be received in the W-band.

Radio frequencies and bandwidths are a hotly contested resource the world over. They are mainly used for terrestrial applications like mobile phones, TV and many others. The required bandwidth resulting from these application effect also the satellite domain, where the bandwidth needs for traditional satellites and the new mega-constellations, is enormous. Now, for the first time in Graz, satellite signals at 75 GHz from an altitude of 500 kilometres have been received on the roof of JOANNEUM RESEARCH. The signals are transmitted by the W-CubeSat that was launched on the 30th of June 2021 into polar orbit as a part of the payload aboard a Falcon 9 rocket from Cape Canaveral. The aim is to transmit 75 GHz (W-band) and 37.5 GHz (Q-band) signals and generate new knowledge of atmospheric attenuation during the propagation of radio signals at such high frequencies.

New Data Highways

The required capacity for data transmission today is continuously increasing. All over the world, research is being conducted on new data highways for digital consumption. Alongside increasingly strict regulations, use is being made of higher and higher frequencies. New frequencies are now being tested in order to connect the new, powerful satellites to the internet. This sounds simple, but it is actually complex since the short wavelengths are heavily affected by weather events and not every frequency range is suitable for transmission. Michael Schmidt, telecommunications engineer, and expert for space communication at DIGITAL, explains, "In a way, there is a competition to see who can make use of the very high frequencies."

Breaking New Technical Ground

While the so-called Ka and Ku band frequencies (20/30 and 12/14 GHz) are already heavily occupied, there are several research activities and experimental satellite payloads in the Q/V band ranges (40/50 GHz). The W-band (71-76 GHz for satellite communication) was, until recently, considered to be a long way off. As Schmidt said, "Although there have been attempts by international players, no results have been published so far." The team of researchers in Graz, together with the international team, have been conducting pioneering work with the signal reception and the start of evaluation phase: "The measurement phase starts now with the first signals that we receive from the W-CubeSat. We need to understand the new band in order to use it to its full potential. The results will make it possible to create models that will enable the planning and dimensioning of future satellite links and to run them efficiently", project manager Schmidt reports. "We have broken new technological ground and are at the forefront in Europe", Schmidt enthused. The development of the W-CubeSat took place in Finland. The mini satellite can be seen from Graz five to six times per day.

International Collaboration

The receiving antenna was developed by the project partner Luis Cupido Technologies, the satellite by Reaktor Space Lab, Fraunhofer and VTT Technical Research Centre of Finland, and the received data is evaluated by the team at JOANNEUM RESEARCH, who also lead the project, and the University of Stuttgart.



Photo: Novel View

Financing

The project was financed by the Federal Ministry for Climate Protection, Environment, Energy, Mobility, Innovation and Technology to the tune of approximately one million Euros after a competitive international ESA tender. The Austrian contribution is thus the largest in the project consortium. The countries of Finland, Germany, and Portugal also support the project with a total of two million Euros. ■

Michael Schmidt has been working in the field of satellite communication for over 25 years and is a participant in many ESA projects. Under his leadership, satellite signals were successfully received in a new band for the first time.

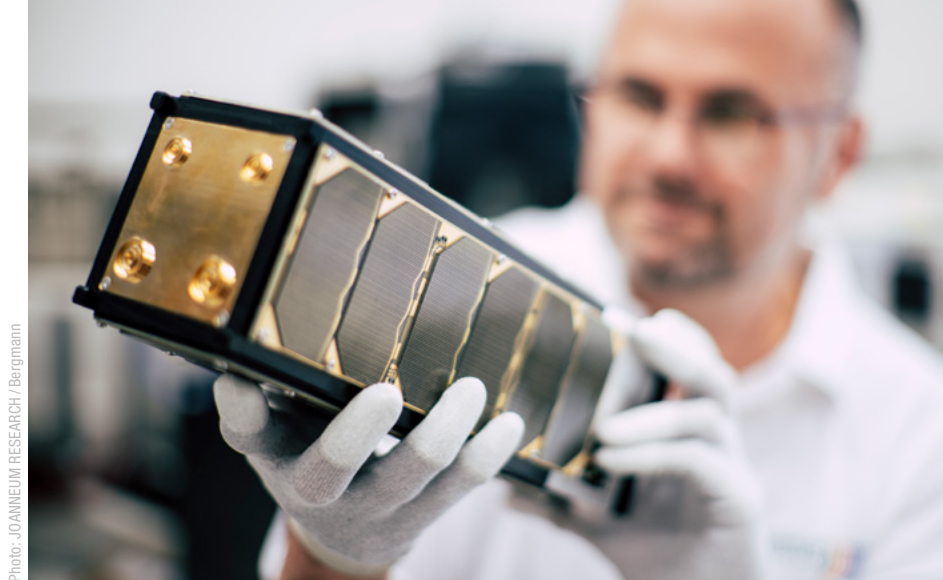


Photo: JOANNEUM RESEARCH / Bergmann

Spotlight on Eveline Greschitz

What are you currently researching and what is your area of expertise? At the moment my work focuses on our two Alphasat ground stations in Graz at the "Hilmwarte" and on top of our office building in Steyrergasse, and our W-CubeSat ground station. I am monitoring the ground stations and implement new experiments and data evaluations. I developed the mission control software (MC SW) and the GUI (graphical user interface) for the W-CubeSat ground station. The software calculates the visibility of the W-CubeSat over Graz, controls the beacon receiver and the antenna accordingly, collects data and stores it in hourly HDF5 files. The time between W-Cube-Sat passes is used to receive beacon signals from the Alphasat satellite or the W-CubeSat test transmitter on the "Hilmwarte". For the MC SW and for a part of the data evaluation we use a software package developed in-house called SpaceCommSIMU in whose further development I also participate.

How did you become a researcher? While I was at grammar school, I was interested in informatics and passed my A-levels in,

something that was quite exotic at the time. In 1993 I graduated from the test study program in Telematics, with specialisation in Telecommunication and Electronics. Since I have always been fascinated by space, I accepted a job offer at the former Institute for Applied System Technology of JOANNEUM RESEARCH under the leadership of "space guru" Willibald Riedler. My first project was to develop the autonomous control software for the ACP (Aerosol Collector and Pyrolyzer) experiment on the Huygens probe which was a part of the NASA/ESA Cassini/Huygens mission to Saturn.

What was your greatest success? I am especially proud of the successful landing of the Huygens probe on Saturn's moon Titan in January 2005. Particularly because our ACP experiment with my control software on board worked flawlessly on the descent to Titan. It is really something special to know that a part of my work is now lying on the surface of Saturn's moon Titan within the Huygens probe, and that the very same probe is described in Stephen W. Hawking's first children's book "George's Secret Key to the Universe".

How does it feel to be a part of such pioneering work? Of course, it fills me with pride! But I have always been lucky, even in my past projects, to be confronted with interesting tasks to fulfil and to take innovative paths.

What else have you planned in your field of research? In the next few years, if all goes well, we will collect data from the W-CubeSat and evaluate it together with data from our weather station and the radiometer supplied by ESA in order to compare the measured atmospheric attenuation in the W-band with the forecast values from the ITU (International Telecommunication Union).

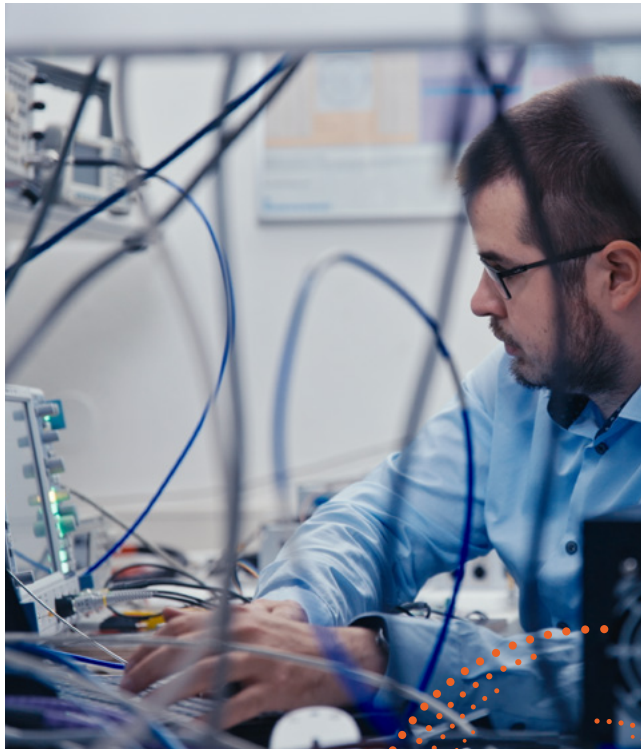
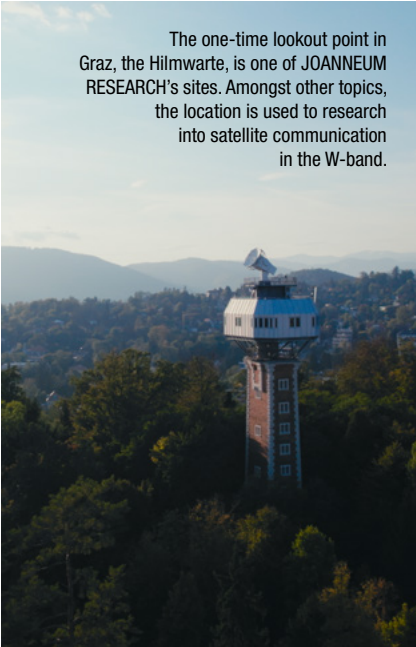


Eveline Greschitz has worked as a software developer at JOANNEUM RESEARCH for 28 years.

Photo: JOANNEUM RESEARCH / Schwarzi

Bytes, Hertz and Space Technology

The one-time lookout point in Graz, the Hilmwarte, is one of JOANNEUM RESEARCH's sites. Amongst other topics, the location is used to research into satellite communication in the W-band.



Right: Balazs Ferenczi checks the specification of the monopulse tracking receiver in the "Software Defined Radio" laboratory. What that is and how it works is described on page 39.



Photos: Novel View

Top: The antenna for the W-band ground station is located on the roof of the JOANNEUM RESEARCH offices in the Steyrergasse in Graz and it was the first ground-based site to receive a radio signal from a satellite.

Right: Above Graz's roofs, there is also a radiometer for Alphasat and W-CubeSat experiments. The system measures the atmospheric damping of a range of radio frequencies.



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Click here for the **image film** **Space and Communication Technologies.**

The World's Unique Rainfall Measurement Device

TEXT: ELKE ZENZ

In 1991, a research team at JOANNEUM RESEARCH developed the first 2D Video Distrometer (2DVD). The 2DVD measures the outline, profile and fall speed of precipitation particles and is also one of the most successful products from the domain of Styrian space research that is exported worldwide. The European Space Agency (ESA) was one of the first customers in the 1990s.

Customers today are mainly international research institutions in Europe, USA, Japan, India, and China. JOANNEUM RESEARCH partners local technology marketing compa-

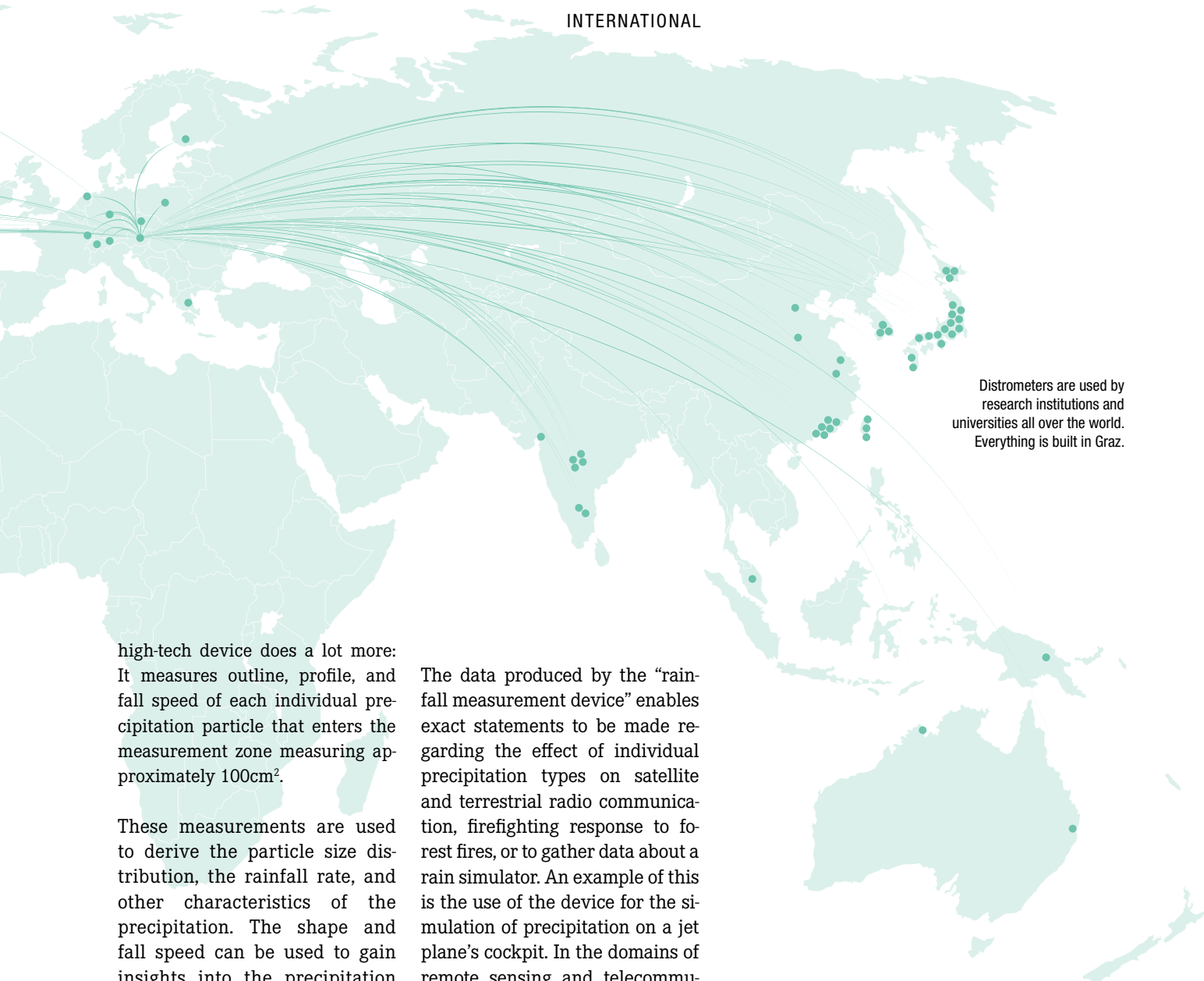
nies who then carry out service and maintenance work.

At first sight, the device appears unassuming and unspectacular, but it is able to measure precipitation with a surface of 90 x 90cm with the height of an office desk. Of course, the device not only measures the amount of precipitation: In the words of Michael Schönhuber, research group leader at JOANNEUM RESEARCH, "a simple bucket could do that". The



Photo: JOANNEUM RESEARCH/ Bergmann

Günter Lammer and his colleagues recently built seven distrometers ordered by Beijing Keytech Technology that soon will be delivered to China.



Distrometers are used by research institutions and universities all over the world. Everything is built in Graz.

high-tech device does a lot more: It measures outline, profile, and fall speed of each individual precipitation particle that enters the measurement zone measuring approximately 100cm².

These measurements are used to derive the particle size distribution, the rainfall rate, and other characteristics of the precipitation. The shape and fall speed can be used to gain insights into the precipitation particles (rain, hail, snow, or mixed forms of precipitation). Large rain drops (> 3mm) tend to deviate from a spherical form and can be lenticular. This is important when measuring precipitation with radar systems. The successful Styrian product costs around €45,000, depending on the equipment level.

The data produced by the “rain-fall measurement device” enables exact statements to be made regarding the effect of individual precipitation types on satellite and terrestrial radio communication, firefighting response to forest fires, or to gather data about a rain simulator. An example of this is the use of the device for the simulation of precipitation on a jet plane’s cockpit. In the domains of remote sensing and telecommunications, 2D-Video Distrometers are used by NASA for the “Global Precipitation Measurement Program” (GPM) and by the United States Department of Energy for the “Atmospheric Radiation Measurement Program” (ARM). The components and the precision parts for the 2DVD are manufactured by a Styrian company. ■

Factbox

The technology is complex: Two cameras record 55,000 lines per second with an exposure time of < 20 microseconds each. The extremely accurate cameras, meanwhile twice as fast as in the 90s, can acquire a rain drop at a distance of 70cm. That is equivalent to a taking a sharp image of a 30cm football from one and a half kilometres away. Based on this technology, engineers in Günther Lammer’s team have developed a second product line: The first 1D-video distrometer has been delivered to the College of Charleston in the USA.



Michael Schönhuber leads an outstanding and international team in Graz and is proud to have attracted experts from Portugal, Serbia, Hungary, and Iran.

SPACE TECHNOLOGY FOR EVERYDAY USE

Michael Schönhuber leads the research group Space and Communication Technology in DIGITAL. He and his team are well networked in the sector and enable new bandwidths, signal processing, and navigation technologies that have become an integral part of our everyday lives. INTERVIEW: ELKE ZENZ

Styria is known as the hotspot for Austrian space research for over thirty years. What about international visibility?

The international visibility within the academic world is very good. Above all in Europe for example, where Graz and JOANNEUM RESEARCH have a very good reputation with ESA. This reputation naturally extends beyond ESA. Whether it is the Rutherford Appleton Laboratory (UK), the German Aerospace Centre or prominent European universities, we are known as competitor and also as a partner. Of course, the other domestic research institutions such as IWF, the Austrian Academy of Sciences, the TU Graz or the University of Graz all contribute to the international visibility. Beyond Europe, things become a little different. Our 2D-Video distrometer that we build in small volumes are used at NASA. We also have orders from Asia. From the general public's point of view, we are only known in certain contexts such as the launch of the W-CubeSat or the image processing from the Mars rover.

Space topics such as the landing of the Mars rover or space tourism have recently enjoyed broad media coverage. What makes space topics so attractive?

That lies in the excellence and uniqueness of the research. Above all though, the topic of space still holds enormous fascination for a society overloaded with information. We try to look outside the box, so to speak, and attempt to answer the question of what lies out there.

You and your team have been outstandingly innovative, key words here are W-CubeSat, 2D-Video distrometer, or the infrastructure at the Hilmwarte. What is next, what is your vision?

For many decades now, we have been following a red line. Even if we try to be successful with niche products, our focus is always on signal processing that is being made faster and the bandwidth wider. We are currently starting two related projects in this respect with a total project volume of €900,000. The output

is a platform whose users will be able to test wideband, faster signal processing. Our second passion is navigation. Here too, we intend to produce products in small volumes. This is very important for us regarding the level of self-financing and commercial success.

You lead a successful and international research group. What makes your team so strong?

Our strength lies in the academic expertise, that is the prerequisite. And we are very good at localising current needs. We are always asking ourselves the questions, where can we have an effect, in which areas could we enter small volume production, and which niches could we use. The team spirit makes me very proud. We are a really good "we".

Sustainability, the big topic: How do space technologies and sustainability fit together?

Our group deals mainly with satellites and navigation services, so space technology for everyday use. And this leads us to sustainability, since these technologies enable international online meetings to be held easily for example, without the need for a person to take a plane. Satellite communication can reach every location on Earth. And navigation technologies shorten distances.

Let's assume that space travel could be made possible and easy. What would you like to see and experience?

I would think that the view of our Earth from space is something absolutely special. If you could see the Earth as a globe, then your horizon would definitely change. And I would also like to experience weightlessness. ■

Schönhuber is the author of numerous publications and scientific supervisor and trainer for many diploma candidates, interns, and apprentices.



Photo: JOANNEUM RESEARCH/Schwarzl

Success Stories

Mutual trust and consistency characterise successful projects in the field of space, which are often long-term. We asked our partners for feedback on mutual projects. Read here how we are distributed throughout the globe:



Photo: CPI Vertex Antennentechnik

Gerbert Lagerweij
Director Marketing & Sales at CPI Vertex Antennae Technology

The long-term cooperation between CPI Vertex Antennentechnik and JOANNEUM RESEARCH is a truly successful story. Michael Schmidt and his team have always been able to deliver us with tailored solutions within the shortest time that we have been able to use worldwide. For example, JOANNEUM RESEARCH's Monopulse Tracking Receiver is being used in all continents and is working to the full satisfaction of our customers. We wish to continue the collaboration with JOANNEUM RESEARCH and look forward to working together on projects in the future.

Alberto Ginesi

Head of the Telecommunication Telemetry, Tracking and Command, T&C Systems & Techniques Section of the Technical and Quality Management Directorate, ESA

The collaboration with JOANNEUM RESEARCH has always been successful and I have always appreciated the commitment and the technical competence of the team. In the course of recent projects JOANNEUM RESEARCH built a system demonstrator for multibeam satellite systems allowing to examine potential techniques that aim to boost the system capacity. The project results contributed very well to the next generation of satellites which keeps Europe in the leading role of satellite communication. Within ESA the team of DIGITAL is known for their excellent cross layer knowledge and we look forward to future projects together.





Jim Bell
Principal Investigator,
Mars 2020 Mastcam-Z
Investigation, Professor in
Earth & Space Exploration,
Arizona State University

The contribution of the JOANNEUM RESEARCH Space Robotics & Instruments Team to the Mars 2020 mission (e.g. leveraging the mission's technology abilities in 3D vision processing, instrument data fusion and visualization, participation in Mastcam-Z instrument-wide physical meeting, giving presentations about science & technology) substantially brings forward the Mars 2020 mission and helps to fulfil the requirements of the National Aeronautics and Space Administration as well as that of operational duties in the course of European & US-funded R&D projects.

JOANNEUM RESEARCH
*has been in a cooperation
with VRVis for more
than 10 years.*



Photo: VRVis

Christoph Traxler
Area Coordinator - Smart Worlds
VRVis Centre for Virtual Reality and
Visualisation Research - GmbH

JOANNEUM RESEARCH and VRVis have been working closely together for more than 10 years now. The cooperation started with the "ExoMars PanCam" space project with ESA. After a few years, this first collaboration resulted in PRO3D, an interactive viewer for the virtual exploration and geological analysis of 3D reconstructions of planetary surfaces. Thanks to the cooperation and the wide network of planetary scientists at NASA and ESA who regularly used PRO3D, we receive valuable input for our research into geospatial visualisation. Apart from space, we also have joint projects for tunnel monitoring, where many of these methods can be transferred to the Earth.

*Within ESA the team of
DIGITAL is known for
their excellent cross
layer knowledge and we
look forward to future
projects together.*

– Alberto Ginesi



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Marco Barrera
 Program Manager of the ExoMars Rover
 Operations Control Center, ALTEC S.p.A. Italy

The JOANNEUM RESEARCH Space Robotics & Instruments Team is an ongoing valuable partner of ALTEC. Our long-lasting successful cooperation includes the preparation for the ExoMars 2022 Rover mission, where JOANNEUM RESEARCH is setting up the 3D vision ground processing chain for the Rover stereo cameras PanCam, NavCam and LocCam that will run in the ALTEC data processing environment of the Rover Operations Control Centre (ROCC) located in our premises in Turin, Italy. Based on their experience, JR is also providing support to the ROCC Mars Terrain Simulator (MTS) – an indoor analogue facility needed to validate the ExoMars Rover operations in a representative environment – with the development of the SW generating the MTS arena digital elevation model (DEM) and with the periodic MTS cameras calibration.

The JOANNEUM-RESEARCH-Team is a well-known player in European space robotics, having insight into state-of-the-art 3D vision, visualisation, data fusion and camera calibration technology, and provide us with a profound set of tools and flexible maintenance and support to make us well-prepared for ExoMars mission operations in 2023, and activities beyond.

The JOANNEUM-RESEARCH-Team is a well-known player in European space robotics.



Photo: Barrera

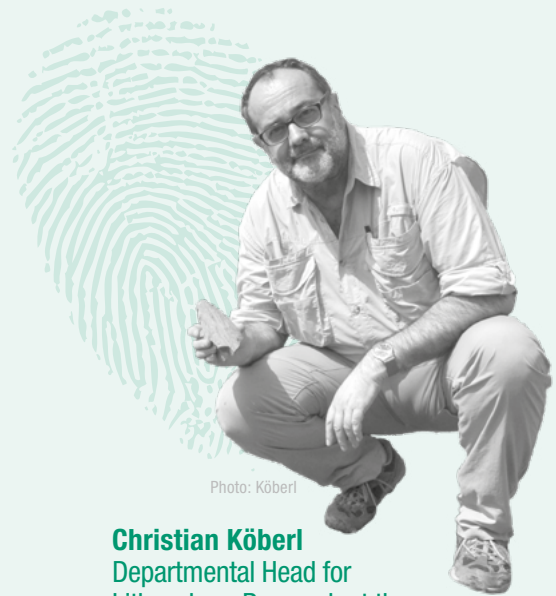


Photo: Köberl

Christian Köberl
 Departmental Head for
 Lithosphere Research at the
 University of Vienna

We have been working together with JOANNEUM RESEARCH for well over six years. The initial question was which scientific issues could be resolved through the use of the PRO3D program within the scope of Austria's participation in the Mastcam-Z camera for the Mars-2020 NASA mission. Of course, this is a huge and broad topic, and since my research expertise at the University of Vienna dealt above all with impact craters, their recognition, the impact processes, and their products, we very quickly found an exciting subject. We carried out analog investigations on so-called shatter cones, both in the laboratory as well as in the field in Ethiopia in order to test the program in comparison with Mars images.

51

PROJECTS

are currently being run in the field of space at JOANNEUM RESEARCH. The spectrum is wide: from software development, via image processing, up to remote sensing and signal processing.

40

EXPERTS

contribute with their expertise in the research field space. They are internationally well-connected and sought after.

3,2

MILLION EURO

project turnover was acquired in 2020 in the research field space. Project partners are national and international players such as NASA, ESA, and smaller, local, technology providers.


 An artistic illustration of the HERA mission. A large, dark, irregularly shaped asteroid is the central focus. To its left, a satellite with a large yellow antenna and solar panels is shown. To its right, another satellite is visible. In the background, a smaller asteroid is shown. The scene is set against a dark, starry space background.

HERA – A Divine Mission

TEXT: RENATE BUCHGRABER

Photo: ESA - ScienceOffice.org

A favourite theme in Hollywood's catastrophe films feature asteroid impacts with the resulting annihilation of humanity. Experts in Styria are working to ensure that this does not happen.

For the first time, a joint mission by the US space agency NASA and the European space agency ESA, with contributions from JOANNEUM RESEARCH, will try to divert asteroids with the typical size that pose danger. And Gerhard Paar, expert for Mars and simulations is a part of the HERA mission.

Hera, the name of the Greek queen of the Gods, was selected by ESA for the second part of the mission. In the first part of the mission, also called "Dart", NASA will guide a space probe into a collision with an asteroid such that the impact changes the asteroid's orbit. The asteroid, called Dimorphos, is actually a

secondary body in the Didymos binary asteroid system, which make up around 15 percent of all asteroids. With its diameter of 160m, it has a size such that its impact would be dangerous for Earth's inhabitants.

In the second part of the HERA mission, a European probe equipped with a camera will be brought into orbit around the asteroid. If everything works out according to plan, one goal is that the crater caused by the "Dart" can be visualised. This is where the team around Gerhard Paar and Piluca Caballo come in. Their job is to measure Dimorphos and the larger Didymain in 3D during

the approach to see the effect of the diversionary manoeuvre on Didymain. "There is an assumption that, for example, rock fragments from the moon will land on the main body, which we can also measure. We expect further insights into the dynamics of the impact." The expectations of a successful diversionary manoeuvre by the probe are high. An impact by an asteroid with a diameter of 160metres would destroy a city the size of Vienna. ESA is investing €130 million in the mission, funded in a small part by Austria. ■

SEARCHING FOR CLUES ON MARS

TEXT: RENATE BUCHGRABER

Have you ever dreamt of journeying to Mars? Our technology and expertise can take you to this unknown world, virtually of course, and free of charge. Since it landed in February 2021, the Perseverance Mars rover has been transmitting images from the surface of Mars on a daily basis in unheard of quality. The image processing experts in the “Space Robotics and Instruments” teams at DIGITAL prepare these images for NASA and thus also for the public in 3D.

The images that our researchers Piluca Caballo Perucha and Gerhard Paar see for the first time are those of an unknown world. They use software called PProViP to process the images captured by the panorama camera Mastcam-Z that is attached to the rover. The software for the visualisation, PPro3D, was developed together with the Viennese COMET centre VRVis and the close collaboration continues. The team creates three dimensional models and visualisations of the surface from stereo image pairs, which are then used for rover navigation and for geologists to investigate and interpret the red planet, its rocks and rock strata with millimetre precision in 3D. "They are image pairs, in other words stereo images, so that we can see spatially just as the human does. We can scan the surface pixel by pixel and create three-dimensional models from those scans resulting in a separate three-dimensional surface for each stereo image pair. Several of these stereo models are then seamlessly merged. Distance information is also stored for every image point", the team leader Gerhard Paar explains.

The team also supported the NASA team in the Malin Space Science Systems (MSSS) headquarters in California with

the design and calibration of the camera. "The difference to cameras previously employed on rovers and also on satellites and landers is the zoom lens. It allows the selection of the best resolution according to the task at hand. The zoom mechanism in combination with the focussing to sharpen the image at a certain distance is a masterpiece by the MSSS engineers. The suitability for operation in space itself requires special solutions, e.g., heating because it is very cold on Mars, special protection against dust and penetrating sunlight. A so-called calibration target on the rover is also very important, which is recorded several times a day to correct atmospheric light influences", Paar explains.

From the beginning

Gerhard Paar has been working in the field of image processing software for use in space for more than 30 years: First it was the processing of satellite images, then landing simulations of unmanned probes. The first "real" project was "Beagle 2", a probe from the European Space Organisation ESA's Mars-Ex mission in 2003. This was followed by several EU projects in the field of space exploration robotic vision where our researcher met Jim Bell from the Arizona State University

who as the principal investigator coordinates the Mastcam-Z team. In the current project, Gerhard Paar has the status of a Mastcam-Z co-investigator.

A glance into the future shows that further space missions are in the pipeline and that "Perseverance" is a successful milestone on the path of knowledge. The team will play a crucial role in the evaluation of image data from future space missions such as the European-Russian project Exo-Mars 2022/2023 and the HERA mission to two asteroids around 2027. The team of researchers is already busy preparing with the panorama camera for the European rover Rosalind Franklin for the Exo-Mars mission. "This rover will be able to drill two metres down and the combination with ground measurements using radar is particularly exciting," is Gerhard Paar enthused.

Read more about the mission in the log-book on the following pages.

Where is the Mars rover now?

On Sol 298 (Mars days after the landing), Perseverance had driven almost three kilometres and just completed collection of its sixth sample and is now approaching the western edge of the Jezero delta.

Which particular challenges or even hazards need to be overcome?

The greatest challenge in the past few weeks was a fundamental update of the Rover software. This has to be done with the greatest care, in particular to keep the communication stable while the Rover was practically subjected to a brain transplant.

The Mastcam-Z team was not affected by this process. Otherwise, the marscape covered so far has been uneventful, however taking samples does create nerve-wracking moments. The first sample dissolved into dust during the drilling process, which we could confirm by measuring the volume of the resulting crater. And a while ago, a rock extraction process resulting in the stone moving which led to the premature abortion of the operation.

Is the camera working as planned?

Mastcam-Z is working perfectly and delivers images practically every Sol for a range of different tasks. All mechanisms (zoom, autofocus, filter selection) are in nominal working order. Recently, work began to measure the spatial direction (“dips and strikes” in geological jargon) of the surrounding rock formations using our 3D-evaluations and the 3D-viewer PRo3D from VRVis. This will show how separate outcrops of rock are related in their geological structure.

Is there a way to intervene if some functionality is sub-optimal?

The rover has numerous mechanisms available to it that can recognise irregularities and switch off activities in extreme cases whether it is in a component or also via the entire system. This ranges from temperature anomalies, excessive mechanical stress, and software faults up to conflicts

between sensors (e.g., if the laser beam from an active analysis instrument hits the robot arm). Numerous such anomalies have already occurred, were automatically recognised on-board, and thanks to the pre-programmed reaction mechanisms, no damage has been caused. The transmitted data and simulation mechanisms in the control centre at JPL (Jet Propulsion Laboratory) have enabled the problems to be replicated and solved in all cases and the nominal state to be reattained. In all the cases I am aware of, Mastcam-Z has not been directly involved in any anomaly.

Were you able to implement your idea of linking image data even across different cameras and satellite images?

Just recently, we were able to successfully superimpose our Mastcam-Z 3D models very precisely over the satellite terrain models – on a daily

If evidence of earlier life on Mars were to be found, and if our mechanisms were a part of it, then that would be the greatest reward ever.

– Gerhard Paar

basis and automated. Using PRo3D from VRVis, it is possible to visualise and analyse this data in all resolution steps from sub-mm sand grains in front of the rover up to the horizon 10 kms away in real-time. This capability gives us a worldwide unique differentiator. The geological analysis of larger areas is either possible for the first time or significantly easier than before. Austrian work with 3D evaluation of the image data up to visualisation will remain active until at least the end of 2022. Scientific supervision is provided by Christian

Follow the route and discover the current whereabouts of the rover:



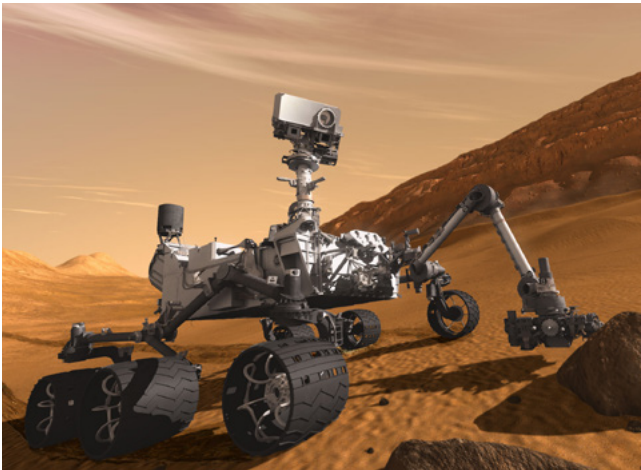


Photo: NASA/JPL-Caltech

The Mastcam-Z is located along with other instruments on a two-metre-high mast that can rotate through 360 degrees. The system has a so-called stereo camera: Two cameras are mounted with a separation of 24 centimetres. This enables an image to be captured from two slightly offset perspectives.

Köberl from the University of Vienna and the Austrian Academy of Sciences, an impact-specialist, and partners from Great Britain (Imperial College London), who interpret the 3D data geologically and exploit it academically in terms of joint publications with JOANNEUM RESEARCH and VRVis. The research contributions for the participation in the Mars-2020 and Exo-Mars missions receive grants from ESA and the Austrian BMK ministry in the projects of the “Austrian Space Applications Programme” 885326 “WIBSTAC”, and 882828 “Pan-Cam- 3D-2021”. ■

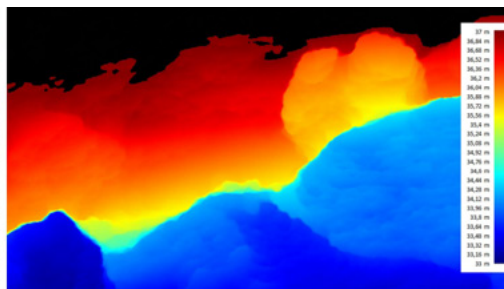
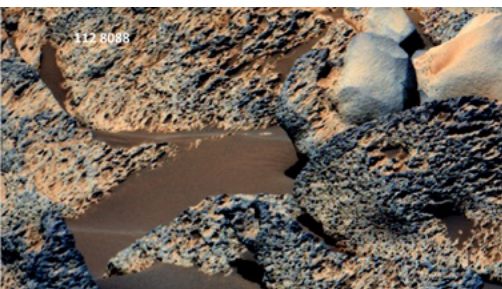


Photo: NASA/JPL/CalTech/MSSS/ASU/JR

Left: Section from the Mars 2020 Mastcam-Z Sol 112 sequence 8088 panorama. From the image alone, it is not clear whether the coarse and smooth structures originate from the same rock formation.

Right: The distance image calculated from the stereoscope show clearly that both coarse and smooth structures are present on a continuous rock (orange, right of centre).

Spotlight on Piluca Caballo Perucha

Did a particular experience awaken your enthusiasm for remote sensing? Cartography has fascinated me since my childhood. As a child, I enjoyed looking at a book my parents had about the main cities in Spain. I was impressed that so much information about a city could be collected on a single page. What really awakened my enthusiasm during my bachelor studies on topography (1996 in Madrid) was when we mapped “Reccopolis” on a large scale. Reccopolis is one of the largest and most important Visigoth archaeological sites in central Spain that was declared an archaeological park in 2005. The survey took place at the same time as an archaeological dig. It was such an exciting time for me. This experience awoke in me an interest in other civilisations and the mapping of places nobody previously knew were inhabited. The enthusiasm for the extrapolation to other planets grew as I was writing my master’s thesis in Geodesy at JOANNEUM RESEARCH.

What have been your personal moments of success in this Mars mission? Without a doubt it was the launch in July 2020 and the Perseverance’s landing in February 2021. I used the photos taken during landing to reconstruct the last few kilometres of the flight path and the area around Jezero crater. Of course, it is a moment of personal success every time I can support the team with my photogrammetric knowledge.

Women are a minority in space research. How do you feel about that? Fortunately, in my professional environment, ability is more important than gender or origin.

Would you like to be the first person and first woman to fly to Mars? I don’t like flying and only do it for very important reasons. If I consider the risks, the flight-time, and the atmospheric conditions in which I would have to live when I got there, then that it isn’t worth

it. Wearing a mouth-nose mask for eight hours a day is nothing compared to the equipment necessary to live on Mars. Anyway, I find it unbeatable living on the Earth.



Photo: JOANNEUM RESEARCH / Schwarzl

Piluca Caballo Perucha is reaching for the stars. She has been involved in research in the field of industrial instrumentation, sensors and robotics at the DIGITAL institute for over 20 years. The qualified Geodesist was born in Spain and completed her Master studies in “Space Sciences” with focus on remote sensing. She is currently a part of NASA’s Mars 2020 mission. Her next project participations will be the European space mission ExoMars 2022/23 and the HERA mission.

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Space: More State, More Private Investment

COMMENTARY BY ANDREAS GEISLER

Almost every day there is news of another achievement in space. The space-related economy is expected to grow from 370 to over \$1000 billion per year in the next 10 to 15 years. A major part of this growth is expected to come from private investors with new business models: New Space.

The current list of 95 spacefaring nations, led by the USA, “European Space” (ESA, EU, individual states), China, Russia, Japan, and India currently invest around €90 billion in public funds. The funds are predominantly invested in “upstream” activities such as satellites, rockets, and ground-based infrastructure for science, exploration, and astronauts, together with satellite systems for meteorology, Earth monitoring, navigation, and communication.

The public investments are the basis for the largest share of the “space cake”, the so-called “downstream” sector made up of receivers and numerous applications which account for 75% of the value added. This growth market is attracting private investors and companies seeking to prospect for “data gold” for innovative applications. Small satellites are being constructed at a rapid speed using cost-effective components

from the automotive and aerospace industries together with high levels of vertical integration and test procedures, including setbacks, that stimulate the construction of rockets in the private sector. In 2020, almost \$7 billion per year, however less than 10% of the public funds, have been invested privately, also in Europe and Austria, in upstream space companies; the major part (\$4 billion) in the big four: SpaceX, Blue Origin, Virgin Galactic, and OneWeb.

Once the companies have established themselves, the state once again plays a major role as a procurer for products and services and as a regulator for the limited resource Space. More than 3,000 inactive and 4,500 active satellites must be protected from collision and the number is increasing daily.

Austrian stakeholders are involved in the most of the space-related value chains. This is where the maxim for the new Austrian space strategy 2030 “Humans, Climate, Economy” and its implementation by the FFG agency for aerospace travel come from: More state, more private investment for sustainable development on Earth and in space.



Andreas Geisler leads the FFG's Aeronautics and Space Agency and is the chairman of the general assembly of the European Space Policy Institute.

Tracking Bark Beetles



TEXT: ELKE ZENZ



Bark beetles are enjoying a rapid rise in population size thanks in part to climate change. They are a serious plague putting pressure on domestic forestry. The team around Janik Deutscher tracks down bark beetles using satellite images.

The forests of central Europe are suffering from an increase in storm and drought events caused by climate change which in turn leads to a fall in their resistance to insect attacks. This is because trees seal their “wounds” with precious resin. The production of resin requires water. If there is a lack of water due to a long-term drought, then the trees are no longer able to heal themselves and parasites such as bark beetles find themselves facing open invitations in domestic fir tree forests.

Recent years have seen record amounts of damaged timber caused by bark beetles. The consequences are on one hand economic losses for the Austrian and European forestry industry to the tune of several hundred million Euros, and on the other damage to the social and ecological function of our forests. Usually, the unbeloved bark beetles are detected using pheromone traps or simple inspection. These terrestrial methods have the disadvantage of only providing single points information and are not able to provide area-related information to identify current levels of parasite attack. Thus, rapid identification of new beetle attacks and information regarding the spatial distribution is not possible.

Satellite images deliver information about the parasites

“The European earth observation satellite ‘Sentinel 2’ delivers the data that we need to locate the bark beetle”, explained Janik Deutscher, project leader of “BEAT IT!”



Janik Deutscher is a geographer and senior researcher in the research group Remote Sensing and Geoinformation with a focus on satellite-based forest monitoring.



The project name results from “Bark Beetle Detection from Space”. In the previous project called “AlpMon”, the researchers were able to show that it was possible to identify and interpret changes in the satellite images of forested areas. “This is the only way to introduce bark beetle monitoring on a wide scale using satellite-based earth observations and thus be able to closely follow the spread of parasites over time”, Deutscher says.

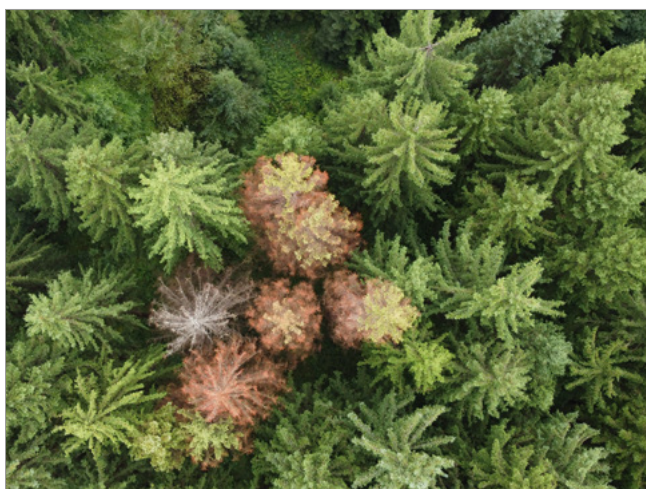
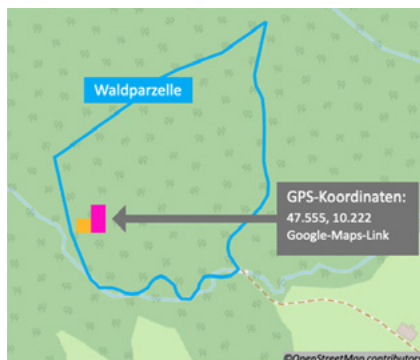
What are the steps in the project? “The project “BEAT IT!” consists of the development and test of new methods of analysis for the area-based detection of bark beetle infestation based on satellite imagery. Our goal is to detect the spatial infestation quickly and thus support the optimal planning of targeted counter-measures”, the geoscientists explains. New remote sensing methods and forest services are being tested in the project together with the IT companies Cloudflight and Umweltdata GmbH.

The development of methods concentrates on three topical areas: Improved classification and separation of damage causation in forests, rapid detection of new areas of bark beetle infestation that comes close to a “real-time” component, and risk modelling using artificial intelligence (AI) methods and current satellite images. “We simultaneously test new methods of time-series analysis. This will help to simplify the classification of damage”, the project manager explains. The methods will be validated in recently infested areas including those of the Austrian Federal Forestry company (Österreichischen Bundesforste AG) and the forestry operation Seilern-Aspang.



Warning from 24.08.2021 with the following suspicion:

- Bark beetle infestation of 0.02 ha
- Vitality decrease of 0.01 ha



Left: Visual rendering of a bark beetle infestation detected by a satellite image time-series in the summer of 2021.

Right: The damaged trees from an image taken by drone

In Germany, a collaboration with the start-up company Waldstolz is working on services for private forest owners who are unable to inspect their forests regularly on site. The changes in the forest detected by satellite are reported as a warning that includes coordinates, a description of the suspicion, and a map. A pilot phase in the Bavarian Allgäu discovered a first early warning with suspected bark beetle infestation that proved to be correct. “I didn’t have the forest lot on my radar as I only pass through that area every three years. I immediately initiated logging and the containment prevented further larger damage”, Albert Müller, a private forest owner in Oberallgäu, stated.

“Reading” the satellite images

“The Sentinel-2 data include multiple frequencies in the visible and infrared spectrum. The resolution is 10 x 10m”, Janik Deutscher explains. The satellite delivers images of the same location every six days. The images are then

processed and stored. The team in DIGITAL, the institute for information and communication technology within JOANNEUM RESEARCH, subsequently analyses the temporal sequence. The type of tree can be identified by changes in the pixel colour resulting from the season. “The same system can be used to detect bark beetles. Trees that are infested change their colour and are thus recognisable as irregularities. We can detect damaged trees but not the parasite”, Deutscher explains.

This procedure is adversely affected by bad weather as clouds render the satellite photos useless. At higher elevations, any snow interferes with the interpretation of the satellite images. And yet the researchers are not deterred: “It is particularly important to recognise an infestation as soon as possible. In the real world this means that on-site inspections are not replaced if larger damage is to be

avoided. The advantage is that satellite images can be used to be more targeted and use less time and resources to find affected areas”, Deutscher says. Monito-

The goal is to use artificial intelligence in order to make a prediction.

– Janik Deutscher

ring the actual situation is however not enough: Artificial intelligence methods will make predictions in the future possible. Where will the next affected area be? ■

The Universe and Us

Graz is home to three large research institutions dealing with the topic of space: The IWF of the Academy of Sciences (ÖAW), the TU Graz, and JOANNEUM RESEARCH. This cooperation, with roots in the previous century, continues to prove itself as being the guarantor of success for domestic space research.



Photo: JOANNEUM RESEARCH/Schwarzl

Otto Koudelka has been hosting the international UN/A-Symposium for many years and follows in the footsteps of Willibald Riedler.

Space Applications for Food Systems

The 27th UN/A Symposium

The 27th annual symposium held by the United Nations and Austria took place from the 7th to 9th of September 2021. The international symposium by the United Nations Office for Outer Space Affairs with the title “Space Applications for Food Systems” was held within the scope of the United Nations’ program for space applications and was organised by JOANNEUM RESEARCH and the TU Graz. The top-class lectures and discussions were dedicated to the topic of space applications for food systems. The concept deals with the activities associated with the production, processing, transport, and consumption of foodstuffs. The diverse range of possible application of space solutions regarding food systems were presented and discussed. The participants, particularly representatives from developing countries, were offered the possibility to learn the latest about instruments, strategies and approaches that can be adapted to the regional, national, or local context. Due to the pandemic, the event was held virtually. The event was supported by the Federal Ministry for Climate Protection, Environment, Energy, Mobility, Innovation and Technology (BMK), the city of Graz, and Austrospace.

BioPlat-EU: Dedicate underutilized land to sustainable energy harvesting

Within the scope of the BioPlat-EU project, which has just recently been completed, underutilized land in Europe is to be used for sustainable energy production. Marginal, unused and contaminated (MUC) areas that are not or cannot be used for food or feedstock production, and do not function as leisure areas or bio-diversity buffers to be used for the production of bioenergy. These areas are identified from a range of satellite data such as high-resolution COPERNICUS-sentinel time-series data and results from previous projects such as the high-resolution layers. Contaminated areas are derived from maps of heavy metal contamination of European soil. The identified MUC areas are prepared and available to stakeholders in a user-friendly web portal (<https://webgis.bioplat.eu>) and can be evaluated according to defined sustainability criteria. This makes it possible to test scenarios for the cultivation of various energy crops in these areas, and to model and compare the effects.

This project was funded by the European Union’s H2020 research and innovation program within the scope of the grant agreement No. 818083. www.bioplat.eu



Photo: www.bioplat.eu/about

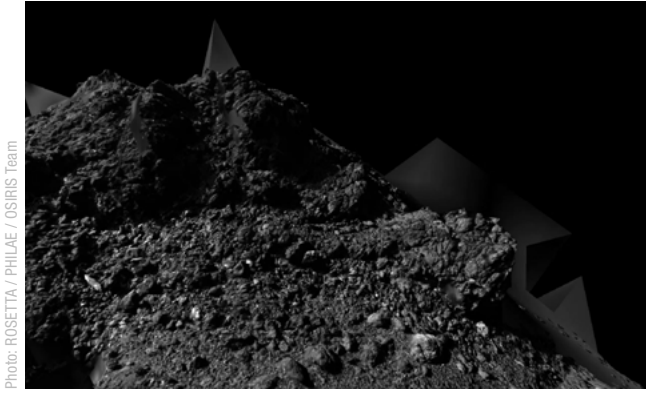


Photo: ROSETTA / PHILAE / OSIRIS Team

Churyumov: A Comet Made of Foam

As part of international research work, our 3D image processing experts from the “Space Robotics & Instruments” team helped discover and prove the existence of primordial ultra-soft ice inside a comet. Piluca Caballo Perucha and Gerhard Paar created a 3D model of the comet’s surface using the mechanisms of 3D image processing. The discovery was published in a Nature article on the 28th of October 2020 with visualisations and a video by Piluca Caballo Perucha.

The Nature article entitled “The Philae lander reveals low strength primitive ice inside cometary boulders” compiled new results from an international research team. Data was collected by the ESA Philae probe on 67P/Churyumov-Gerasimenko using instruments including the COmetary SAMpling and Composition (COSAC) instrument. The data contributes to a better understanding of the history of life on Earth. The publication is co-authored by Piluca Caballo Perucha and Gerhard Paar, both from the DIGITAL institute at JOANNEUM RESEARCH.

The video showing a simulated fly-by over the relevant region was created using supporting methods from VRVis (Centre for Virtual Reality and Visualisation Research GmbH). The methods used were successfully trialled in research work for the 3D reconstruction of planetary surfaces in Mars and asteroid missions. For example, the 3D vision procedures for the evaluation of the panorama images are being made available for NASA’s Mars 2020 (Perseverance rover) and ESA’s ExoMars 2022 rover (landing in Spring 2023).



More information on
3D reconstruction for
comet research



Link to the publication “The Philae
lander reveals low strength primitive
ice inside cometary boulders”

Space-Supported GNSS Resilience

Every modern satellite itself relies on position determination using signals from the global navigation satellite system. Some of these satellites even use these signals to determine information in the change in ice coverage at the poles, the height of ocean waves, and the state of the atmosphere.

Unfortunately, these signals are very weak and susceptible towards disturbance by other radio-based services (such as radar). Threats to GNSS such as jamming and spoofing are also being observed more often. Even deliberately transmitted disturbance signals and artificially generated “fake” satellite signals have been observed. The possible consequences on the variety of satellite transmissions and the resulting risks are being investigated by a consortium consisting of RUAG Austria and OHB Digital Solutions GmbH under the leadership of JOANNEUM RESEARCH in order to create techniques to mitigate the risks under consideration of a range of scenarios. The insights from the research will subsequently flow into the design of future space-based GNSS receivers.

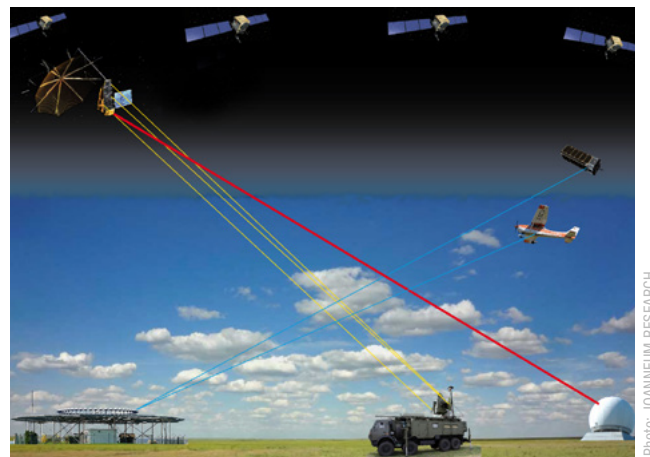


Photo: JOANNEUM RESEARCH

Researchers at DIGITAL are busy working on how to recognise disturbance signals and determining which strategies are possible to protect critical GNSS applications in order to increase the safety of critical infrastructure.

RESEARCH COOPERATION

An opportunity for businesses

During our research work, we depend upon collaboration and synergies with national and international partners from science and industry, from start-ups and SMEs up to internationally active corporations and institutions. We support companies and public bodies with their research and innovation projects and act as a competent partner in the search for solutions to complex tasks.

The cooperation can reach from feasibility studies and simple measurement contracts, R&D services, via large and complex research and development projects, up to multi-year strategic partnerships. Openness, trust, and professionalism are important to us and form the building blocks of a successful research and development cooperation.

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Space Meets Business

All news is available online under www.joanneum.at/en

A high-level get-together took place during the opening of SpaceTech 2021 within the scope of the Graz Autumn Trade Fair (30th of September to 4th of October 2021). The keynote was held by Toni Tolker-Nielsen, acting director of the European Space Agency's Earth Observations Programme. He presented the goals of the Earth observation program and informed the participants of the structure and use of the Earth observation data provided by ESA for business and society. CEO Heinz Mayer participated in the two rounds of discussions. As a part of the accompanying exhibition, JOANNEUM RESEARCH presented details on processing images from Mars, the tracking receiver, and the W-CubeSat.



From left: Armin Egger (CEO Messe Congress Graz), Günter Riegler (Councillor Graz), Toni Tolker-Nielsen (Director of Earth Observation ESA), Heinz Mayer (CEO JR), Wolfgang Baumjohann (Director for the Space Research Institute, ÖAW)

Right: GEPE (Geometric Pancam Emulator) for the 3D evaluation of stereo images

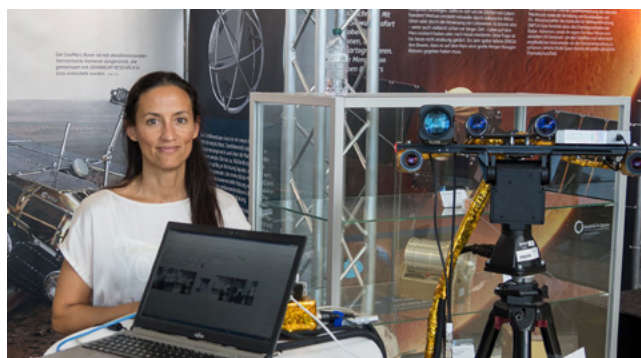


Below: The mobile mapping system on the JR vehicle could be viewed as a part of the navigation field of interest. The system is used to generate maps for the testing of highly autonomous driving functions.

Photo: mcg/Martin Wiesner



CEO Heinz Mayer gave a talk in the panel "Downstream" and joined in the round of discussions "awareness of space research and increase of commitment and investment in space technologies."



Piluca Caballo Perucha from the DIGITAL research group "Machine Vision and Applications" demonstrated GEPE-Geometric Pancam Emulator for the 3D evaluation of stereo images.

Austria's Space Strategy 2030+

COMMENTARY BY MARGIT MISCHKULNIG

The Federal Ministry for Climate Protection, Environment, Energy, Mobility, Innovation and Technology (BMK) is Austria's space ministry and, in this function, presented the Austrian space strategy for 2030+ this Autumn. The strategy was formulated in an open innovation process by the space department in the BMK together with the Agency For Air And Space Travel (ALR) within the FFG and with the broad inclusion of stakeholders as well as national and international experts.

The strategy is the basis for Austria's engagement with the European Space Agency (ESA), with programmes on the EU level, in particularly within the scope of the space program and the research framework program Horizon Europe, with the European organisation for the use of meteorological satellites (EUMETSAT), and the alignment of our national space program (Austrian Space Applications Programme, ASAP) and beyond also for Austria's positioning within space diplomacy at the United Nations level.

The space strategy that was presented enables the BMK to pursue six goals: (1) Sustainability is to be anchored more firmly on earth and in space; (2) The Austrian space sector is to be strengthened and this value created in Austria; (3) Austrian competence in space sciences and exploration, and in space-based geoscience is to be expanded; (4) Space-based data and services are to support the green and digital transformation of our society and economy, and make significant contributions to the implementation of climate neutrality by 2040; (5) Space-relevant training opportunities are to be secured in the long-term; (6) The effect of using tax monies in the space sector are to be transported externally towards the general population.

One of our visions for 2030 is that space is an integral part of daily life and fascinates as an area for research and knowledge. That is why we have retitled our strategy "People, Climate, Economy": Space is there for all".



Margit Mischkulnig has been head of department for space-related affairs in the Austrian BMK since 2017. She is an economist and specialises in macro- and micro-economics.

Blind GNSS: Signals From All Satellites

The use of navigational data in everyday life is very versatile. Whether the data is used in a car's satnav or used in a cell phone to find a restaurant. But what would happen if the reception of satellite data were to be disturbed, as for example in cities due to narrow streets and high-rise buildings? **TEXT: ROMAN LESJAK**

This may not be critical if you are a pedestrian, but autonomous vehicles or package delivery services using drones could suffer far-reaching consequences or even cause human injury. It is therefore essential that localisation technologies function reliably in such applications. In order to improve satellite-based localisation, approaches are currently being taken on a worldwide basis to make use of previously unused satellite signals for localisation. Scientists working with Roman Lesjak on the project "Blind GNSS" in the research group Space and Communication Technologies at DIGITAL in Graz are looking at the feasibility of an omni-directional antenna with extremely high passive gain.

How does it work?

The targeted combination of antenna elements can significantly increase the antenna gain of satellite signals via beam-forming. The use of an omni-directional antenna is an alternative to a directional mirror antenna (e.g., "satellite dish") and has the advantage of being able to receive an arbitrary number of satellite signals with high gain. Roman explains that "this project merges current trends in the domain of satellite navigation and telecommunications technology in an antenna array using SDR-platforms". The aim of the project is to receive chip



Photo: JOANNEUM RESEARCH / Lesjak

sequences from bandsread satellite signals with enough power to be able to estimate them blindly. Furthermore, "while these chip sequences are known for GNSS, we are now working on making unknown satellite signals available for localisation and navigation. One outlook is also going in the direction of mega-constellations such as OneWeb or Starlink." The feasibility is currently being investigated using (un)known GNSS signals.

This project is being conducted in cooperation with the Universität der Bundeswehr München and the SME IGASPIN GmbH based in Graz. The project is being led by JOANNEUM RESEARCH who are also responsible for the construction of the antenna platform. ■

Omni-directional, high-gain GNSS-Antenna with 40 antenna elements (in Gold) on the roof of JOANNEUM RESEARCH in Graz

Factbox

The "Blind GNSS" project

The project consortium agreed upon an array size of 40 antenna under consideration of the project requirements and the budgetary framework. The aim of the implementation was the use of cost-effective, commercially available, standard products. A very high quality and simultaneously cost-effective GNSS antenna could be found in the form of the Tallysman VSE6137. The satellite signals are received by the 40 antenna elements and digitalised by 20 twin-channel SDRs (software defined radios). This produces 5,600 Mbytes of data per second than need to be decimated in real-time.



Roman Lesjak has been working on the topics of satellite-based and multi-sensor localisation and GNSS vulnerability for more than ten years.

News

All
news is available
online under
www.joanneum.at/en

EBSCON 2021

Experts from JOANNEUM RESEARCH presented their expertise in the field of electronic-based systems at the EBSCON 2021 on the 3rd of November. CEO Heinz Mayer spoke in the panel “cyber security.” The hybrid event with 250 participants was held under the motto “Building Bridges for Tomorrow” and provided new food for thought. This enabled bridges to be built between business and research as well as between the real and virtual event worlds.



Photo: Ebsscon - Silicon Alps



Photo: ECSEL-Austria/Kurt Keimrath

European Industrial Policy

Wolfgang Polt, Director of POLICIES, presented the results of a study for a new European industrial policy and the implications for Austria at the annual meeting of ECSEL Austria on the 18th of October. Polt and his team are specialised on policy consultancy, whereby the current focus is on mission-oriented innovation and industrial policy. The study “New European Policy for Industry, Innovation and Technology,” compiled together with WIFO and eutema, was commissioned by the board for research and technological development.

Start-Up Fair

CEO Heinz Mayer participated in an expert panel on the topic of working worlds between digitalisation and automation. The discussions at the start-up fair on the 9th of October covered topics such as the sociological impact of digital colleagues, the ability of humans and machines to form teams, and the limits of digitalisation and automation. Procurator Erwin Kubista was the contact for topics such as spin-offs, joint ventures, and technology exploitation.



Photo: mcg/reming



Photo: JOANNEUM RESEARCH / Schwarzl

Fifteen Seconds Festival

On the 1st of October 2021, JOANNEUM RESEARCH institute directors Paul Hartmann and Lars-Peter Kamolz held two talks in Lendhafen, one of many stages at the Fifteen Seconds Festival. Claudia Winkler presented the company's diversity program at the pre-event.

Ars Electronica – A New Digital Deal

“Let’s dive and get to the bottom of ocean pollution,” at least this could have been a slogan expounded by the CHIMERA robot advertising participation in the next mixed-reality study of the ROBOTICS project “CoBot Studio”. As a part of the Ars Electronica, the project partners took the audience live in Deep Space 8K as well as via live stream in a virtual oceanic research station to present and demonstrate live the unique research possibilities of this inter-disciplinary project.



Photo: vog.photo

30 Years Austromir

On the 2nd of October 1991, the spacecraft “SOJUS TM-13” blasted off for a six-day flight as part of a Soviet-Austrian project, AUSTROMIR. For the first time ever, an Austrian, Astronaut Franz Viehböck, had the opportunity to participate in manned spaceflight and carry out experiments in micro-gravity. On board was technology from JOANNEUM RESEARCH: The then Institute for Applied System Technology at JOANNEUM RESEARCH was instrumental in the success of the project. The overall project management was carried out by the Federal Ministry for Science and Research. Willibald Riedler, who was also the head of the Institute for Applied System Technology at JOANNEUM RESEARCH, was the scientific lead of the AUSTROMIR project. This strengthened the city of Graz’s reputation as the capital city of space. Graz continues to be a hotspot in space research today.

In 2016, the scientifically valuable AUSTROMIR material was made available to the Austrian Space Forum. This year marks the 30th anniversary of the mission and the aftereffects can still be



felt. For example, the project “Videomir” was carried out at JOANNEUM RESEARCH, at the time, a completely new satellite video conferencing system. Up to today, Franz Viehböck is not only the first, but the only Austrian who made it into space. We must wait and see if commercial space travel, as it is being currently propagated, will ever come to fruition.

Photo: JOANNEUM RESEARCH/Buchgraber



Kick-Off Event JOANNEUM RESEARCH Strategy 2023 – 2027

The kick-off event for the development of the “JOANNEUM RESEARCH Strategy 2023 – 2027” took place on the 6th of December together with representatives of the owners, the committees, and the management of JOANNEUM RESEARCH. The goal is to make something even better from something that is already very good. CEO Heinz Mayer presented how the process would run, the owner representatives Minister Barbara Eibinger-Miedl, Deputy-Governor Gaby Schaunig, and Michael Gerbavits, Managing Director at Burgenland’s business agency presented the research orientation of the three states. Martin Wiedenbauer, chairman of the board, and Gerald Schöpfer, chairman of the scientific board, provided statements from the committees regarding the strategic development.

Career: Procurator Renate Reinisch

Renate Reinisch has been appointed overall procurator for group operations at JOANNEUM RESEARCH and together with a further procurator represents the company. Renate Reinisch has been in the company since 1995 and successfully heads the department for finances and controlling.



Photo: JOANNEUM RESEARCH/Schwarzl

Photo: JOANNEUM RESEARCH/Schwarzl



Career: HEALTH Director Franz Feichtner

The HEALTH institute has been particularly successfully managed by Thomas Pieber and Frank Sinner for many years. In January 2022, Franz Feichtner, who previously held the position of Deputy Director, will succeed Franz Sinner, who will remain within the company in the role of Vice-President Regulatory & Strategic Affairs. Thomas Birngruber has been appointed the new Deputy Director.

Best Employer

In a survey conducted by the company “MARKET Institut”, JOANNEUM RESEARCH was awarded 2nd place in the category “Fair Working Conditions”. The study evaluated numerous relevant criteria from the point of view of the labour market and drew a comprehensive picture of leading Styrian companies from a statistically reliable basis. The sub-categories to be investigated were allocated to 5 chapters that included working condition and employee satisfaction, the areas future fitness, regional relevance, and reputation. The survey interviewed around 2,600 people relevant to the labour market in Styria.



Photo: MARKETINSTITUT



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JOANNEUM RESEARCH, CAMPUS 02, IT Community Styria, KÄRNTEN logos



Satellite Communication: Eye to Eye with Malaysian Monkeys

TEXT: MICHAEL SCHÖNHUBER

Satellite communication systems are heavily impaired by atmospheric phenomena, particularly at higher frequencies (Ka-band and higher), especially in tropical and equatorial regions. Precipitation can be extremely intensive in such areas and the zero-degree line is significantly higher than in temperate latitudes resulting in a longer path length through the rain. Measurement campaigns to measure the transmission quality in the Ka-band are being carried out at two locations in Malaysia to help study the conditions for satellite radio transmission. This work is being conducted by JOANNEUM RESEARCH and commissioned by ESA. The measurements took place over a period of 6 years from the middle of 2015 to 2021. Satellite beacon signals were continuously received alongside explanatory meteorological data logs and precipitation measurements. The data was analysed, and it was shown that the results permit-

ted improvements of the corresponding International Telecommunication Union (ITU) models. Accordingly, JOANNEUM RESEARCH has made the statistics over these 6 years available to ITU. The work was also presented at international expert conferences.

Alongside the immediate challenge of carrying out measurements over years in a tropical climate, there were also unexpected and unique events. For example, the splash guard mat of a 2D-Video Distrometer was destroyed by wild monkeys. But thanks to the excellent cooperation with the University Teknologi Malaysia and the Universiti Tun Hussein Onn Malaysia, all these issues could be easily overcome. The results are of interest for satellite operators who are planning new satellite connections in tropical climates. JOANNEUM RESEARCH has not only proved its outstanding levels of competence to ESA but has also built up a formidable reputation in the relevant sector. The project was awarded after a competitive tender by the BMK, and the financing was provided by the FFG within the scope of an ESA project.



NEW AND EXCLUSIVE:

Monopulse Tracking Receiver

In the field of radio communication, moving transmitters (e.g., satellites in low earth orbit) need to be tracked with highly directional antennae in order to maintain data communication. The method employed to do this is called “monopulse tracking”. This technology is well known from radar technology and only requires on transmitted pulse to carry out the focussing of the antenna on the transmitter. This naturally also works with continuous signals as are present in satellite communication. The “Monopulse Tracking Receiver” developed by JOANNEUM RESEARCH enables fast and robust tracking of the transmitter/satellite. The implementation is achieved using “software defined radio technology”. The device was developed for company VERTEX ANTENNENTECHNIK GmbH and is sold exclusively by them.



Specifications:

- Input Frequency Range: 50 – 2200 MHz
- Mode: Coherent and Non Coherent
- Mode: Coherent and Non-Coherent Bandwidth up to 160 MHz
- Max carrier acquisition time < 1s
- Tracking delay < 10 ms (typical <7 ms)
- Carrier acquisition search range up to 4 MHz

Contact:

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Research from A to Z

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Research Against Illegal Forest Clearing

The topic “Forest” is moving into the foreground in the global fight against climate change. There is a wide spectrum of research approaches into resilient forestry and into the limitation of mismanagement. Forests are our planet’s lungs, and they deserve to be protected better. Austrian research makes a contribution.

Forests are our planet’s lungs and they are worth protecting. Austrian research is making its contribution.

INTERVIEW WITH JANIK DEUTSCHER

Illegal forest clearance is a part of the inconsiderate way humans deal with the valuable forest resource. What can an Austrian research company do against it? The research group “Remote Sensing and Geoinformation” at JOANNEUM RESEARCH has been working for many years on the operational application of forest monitoring. Satellite data enables us to automatically detect forest activities and derive indicators for a sustainable forest industry. The team working on the FFG project EO-EnForCe are currently developing and testing it for timber certification. Certification systems such as FSC und PEFC promote the environmentally and socially responsible management of forests. Local inspections during the certification process are normally logistically difficult and cost intensive. Satellite evaluations could be a cost-effective alternative in the future.

Can these new approaches be used internationally? The global availability of satellite images, in particular those from the European Sentinel missions, make the applications globally applicable, in principle. However, regional adaptations of the models are necessary due to the very different types of forest and agriculture. At the moment, 86% of the approximately 500 million hectares of certified forest area (FSC+PEFC) lies in Europe and North America. There are hardly any certified forest resources in tropical countries. Depending on the region, an estimated 50 to 90% of forest clearance is currently illegal. Our goal is therefore to reduce the logistical effort required for timber certification and, in the long-term, to increase the share of certified forest areas in the tropics.

Do you see any hope for a more sustainable handling of timber? I think that, in the meantime, we are all aware of the social significance of global forest resources, particularly in the context of global warming. Just recently, 100 countries who attended the UN Climate Conference in Glasgow (COP 26) have set themselves an ambitious target: To stop further clearance by 2030 and to maintain important forest eco-systems. A budget of 16 billion Euros of public and private money has been mobilised for this purpose. I think this is an important signal. But each and every one of us can contribute of course: Buying only those products labelled FSC and PEFC that tell us we are purchasing wood products from certified forest businesses.

Any other questions?

If you need a reliable partner for your research questions, or would like to know more about our technologies, then contact us here:

JOANNEUM RESEARCH

Forschungsgesellschaft mbH

info

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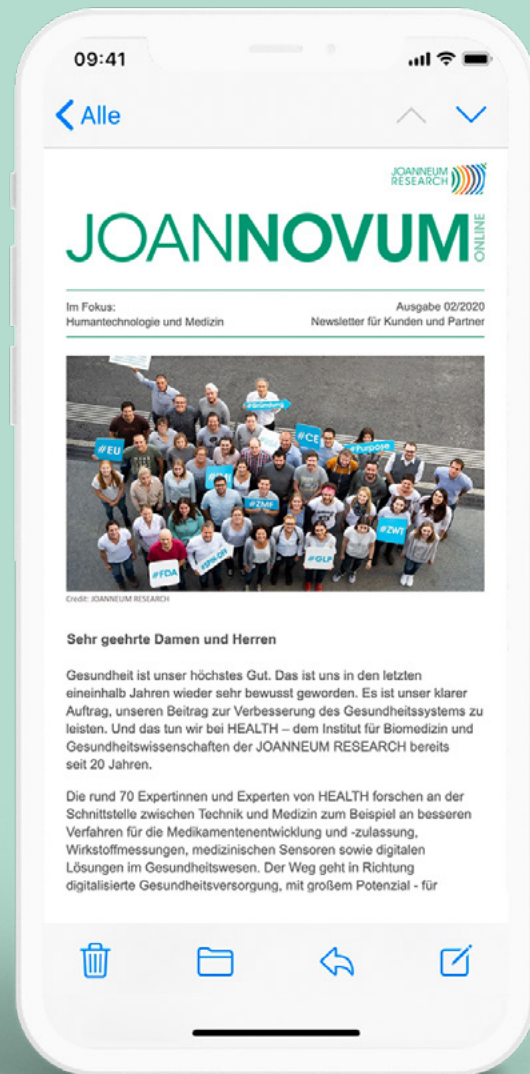
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