JOANNEUM RESEARCH DIGITAL

DIGITAL

Institute for Digital Technologies

SHAPING THE FUTURE, TOGETHER

JOANNEUM RESEARCH Forschungsgesellschaft mbH

JOANNEUM RESEARCH develops solutions and technologies for business, industry and public authorities over a wide range of sectors and conducts applied cutting-edge research on an international level.

The company makes a significant contribution towards safeguarding the economic success of the region and assumes a key role in the transfer of technology and expertise into the economy.

Owners

80,75 %
State of Styria

14,25 %
BABEG Carinthian Agency for Investment Promotion and Public Shareholding

5 %
Wirtschaftsagentur Burgenland GmbH

Certifications

ISO 9001
Requirements for quality management systems

ISO 14001
Environmental management systems

ISO 13485
Medical devices – Quality management systems – Requirements for regulatory purposes

ISO 14644
Cleanrooms and associated controlled environments

ISO 17025
Accredited test laboratory ROBOTICS Evaluation Lab

GLP
Good Laboratory Practice

Numbers – Data – Facts

around **500** employees (from over 25 nations)

7 research units

6 locations

around **50** million Euro of research services per year

Corporate Film

DIGITAL.
NETWORKED.
INTERACTIV.

»My vision is to strengthen the importance of digital innovations on a regional and European level and to make the impact on the value creation of our customers even more visible.«

Dr Matthias Rüther
Director

DIGITAL

Institute for Digital Technologies

DIGITAL is a pioneer and reliable partner in the fields of **digital innovation and transformation** and develops **high-tech solutions** that function reliably and robustly in practical use under rough conditions.

The scientific and technological foundation of the institute is formed by **multi-sensor systems** where precise measurement systems are developed employing cutting-edge sensors and where new insights are gained using **artificial intelligence** methods.

Digitalisation affects all areas of everyday life and business. DIGITAL focuses on the business sectors industry, mobility, telecommunication and space, security and defence, environment and climate protection, culture and creativity as well as care and health, where specific applications knowledge has been acquired over many years.

DIGITAL considers itself an enabler of innovation that supports companies with the development of new services and business models. Components from DIGITAL's portfolio can be found in many customer products and processes. Numerous DIGITAL products such as AKUT®, 2D-Video Distrometer, UHDmaps®, VidiCert® and imdas pro® are internationally recognised as market leaders in their areas.

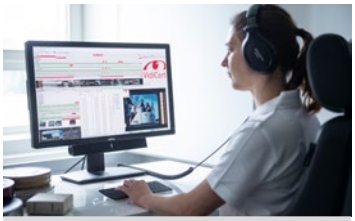
Business Units

Industry

Mobility

Security and Defence

Care and Health



Culture and Creative Industries

Environment and Climate

Space

Mobility

We develop and investigate intelligent systems that increase safety in various areas of mobility. This includes applications for road traffic, but also rail traffic and off-road.

The combination of competences out of the areas of acoustic and visual sensors including the associated signal processing with technologies from remote sensing and navigation foster innovative solutions that are developed up to market maturity.

Focus of our research

- Intelligent traffic monitoring
- Highly automated driving
- Traffic infrastructure – recording and monitoring

Key innovations

- **AKUT® Acoustic tunnel monitoring**
  Complete system for the classification of noise in a road tunnel in order to detect anomalies in real-time and alert the tunnel management. All motorway tunnels in Austria of danger classes 3 and 4 are equipped with it.
- **UHDmaps®**
  Creation of ultra-high-definition maps (UHDmaps®) of road infrastructure for the testing of automated driving functions
- **vislvis® Visibility measurement**
  Camera-based visibility measurement for the reliable and precise estimation of visibility conditions at airports
- **Audiovisual traffic monitoring**
  Automatic monitoring of neuralgic traffic nodes in order to recognise near-miss accident situations and derive safety measures from the data
- **Operational reliability of traffic cameras**
  Automatic monitoring of large camera networks in order to immediately recognise outages

More Information

Industry

We focus on the application of various sensor technologies to help industry to achieve greater efficiency and conserve resources while maintaining flexibility in production.

Optical and acoustic sensors are combined into intelligent sensor systems to enable high-precision measurements and to gain new insights into the observed products and processes from the data streams with the help of artificial intelligence.

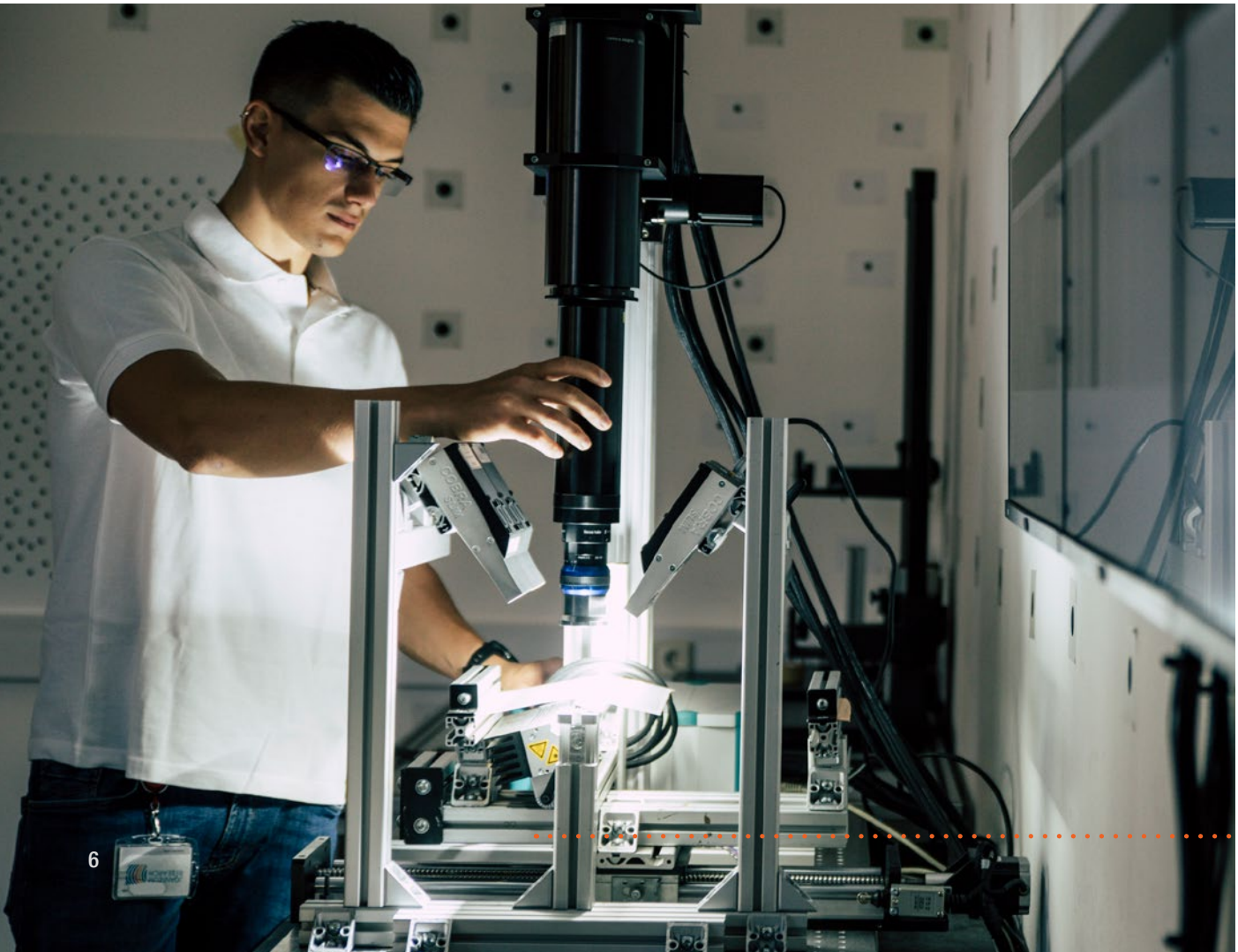
Focus of our research

- Quality assurance using intelligent sensor technology
- Plant monitoring
- Sorting waste material
- Human-machine interaction

Key innovations

- **Wire inspection**
  Surface check in real-time at very high speed (up to 100 m/s)
- **Quality control for batch size 1 production**
  Optical checks and measurement of profiles to support batch size 1 production, e.g. in the production of wooden doors
- **Multimodal machine monitoring**
  Observation and evaluation of machine states by combining a range of sensor signals
- **Predictive maintenance**
  Vibroacoustic sensors for the timely recognition of maintenance needs

More Information



Care and Health

We develop digital, sensor-based solutions to meet current societal challenges such as workload, ageing populations and dementia. In this way, we enable low-threshold assistance systems that are suitable for everyday use to counteract the increasing need for care and the overburdening of the health-care system.

Digital measurement systems can be used for early detection of risk factors and for target group-specific personalisation of applications. The digital analysis of mental and physical stress is used specifically for screening procedures and training analytics both in real environments (at home, at work) and in simulation environments (VR/AR).

Our Human Factors Laboratory enables studies to be conducted that measure human factors such as attention level, stress, emotion and behaviour in a range of different application areas.

Focus of our research

- Cognitive activation and rehabilitation
- Mental and physical performance diagnostics
- Training systems for emergency services
- Early detection and monitoring of dementia
- Decision support for behaviour modification

Key innovations

- **Slowing down neurocognitive disorders**
  Development of a playful, tablet-based training for targeted mental and physical activation for people with Alzheimer‘s disease
- **Social robots for care**
  Use of a multi-sensory, social robot platform to motivate people with dementia to perform daily training exercises in an entertaining way
- **Measurement of stress factors**
  Simulation environment using virtual reality and wearable bio-sensors to evaluate the mental and physical fitness and health of first responders
- **Virtual training for mental health**
  The application of multi-sensory mindfulness training showed positive effects on mental resilience and can be used to analyse mental abilities at the same time.

More Information

Security and Defence

More Information

We develop tailored solutions that ensure security both in cyberspace and in the real world and avoid or hamper attacks intended to disrupt critical infrastructure in transport, energy supply and industry.

We create individually aligned security concepts that are oriented on real attack points. Decades of experience in the development of applications for safety-critical infrastructure puts us in a position to transfer the results of research into components for productive use.

Our research cooperation with the Austrian Armed Forces enables us to work on the security of Austria and its citizens.

Focus of our research

- Cyber security
- Secure communication and navigation solutions
- Military information management
- Autonomous mission vehicles
- Disaster management
- Drone detection and localisation

Key innovations

- **NBC information system**
  Information and reporting system for the Austrian Armed Forces enabling them to recognise hazardous areas and initiate appropriate measures or trigger alarms
- **Network mapping**
  Development of methods and tools for the security-related analysis of IT networks
- **IoT security**
  Ensuring trustworthy interaction of devices, machines and networks while guaranteeing the integrity, authenticity and confidentiality of information and intellectual property
- **Countermeasures against unmanned aerial vehicles**
  Acoustic sensors for the detection and localisation of unmanned aerial vehicles (UAV) in real-time for the protection of critical infrastructure
- **Crowd monitoring**
  Approximation of crowd density and movement at mass gatherings from video data in order to ensure the safety of the participants

Environment and Climate

More Information

We evaluate remote sensing data to monitor the environment and develop situational awareness systems for disaster control.
For this purpose, we develop algorithms for image evaluation, process chains for data pre-processing and the generation of 3D information from stereo image data. In addition to data from optical sensors, signals are also processed from SAR (synthetic aperture radar) and Lidar (light detection and ranging).

Focus of research

- Natural hazards (hazards and soil settlements)
- Climate change, forest monitoring and biodiversity
- Validation of Copernicus products
- Circular economy (recycling, waste sorting)

Key innovations

- **Environment monitoring**
  Procedures and algorithms for the derivation of parameters over a range of levels, from forest inventory for the monitoring of forest damage and biodiversity to tropical forest monitoring for the initiative REDD (Reduction of Emissions by Deforestation and Degradation)

- **Disaster management**
  Services for the acquisition of the degree of natural disasters for disaster management such as the generation of a hazard indicator map for the movement of gravitational mass, for example during landslides and rockfalls as well as monitoring of ground settlements

- **Aeroplane/drone supported sensor platform**
  Multisensory platform for the acquisition of optical data, thermal data and laser scanner data as an optimal basis for environmental monitoring and disaster management

- **Data processing**
  Software packages developed in-house enable process chains for geocoding, the derivation of 3D information from stereo data, SAR interferometry and for object-based image classification and change detection

Space

More Information

For decades, we have been at the cutting-edge of applications, measurement devices and processes in the space and telecommunication sector. This includes the optimisation of satellite transmission at extremely high radio frequencies as well as in the optical domain and the reliability of satellite navigation reception.

We also develop algorithms for the three-dimensional analysis of image material from interplanetary space missions. These technologies can also be used for high-precision measurements on earth.

Focus of our research

- Satellite and terrestrial broadband communications
- Satellite navigation
- Radar technology and wave propagation
- Development of space-grade hardware and software
- Space robotics

Key innovations

- **Q/V band analyses**
  Our Q/V band and satellite ground station is just one of three comparable stations worldwide. The associated research activities represent a major step towards the later use of these ultra-high frequencies for satellite communication.
- **Mars robot Perseverance**
  Three dimensional evaluation of stereo images from the Mars robot Perseverance, whose high resolution of the 3D visualisations contribute to an understanding of the geology
- **Monopulse tracking receiver**
  Signal processing for the real-time tracking of antennas to ensure optimum signal quality for moving transmitters such as satellites and aircraft
- **2D video distrometer**
  A highly precise measurement device for the analysis of precipitation based on imaging sensors, used by more than 100 renowned organisations worldwide

Culture and Creativity

We research into solutions for the long-term preservation of cultural heritage and the design of new, interactive media format that exploit the possibilities of modern entertainment electronics.

Focus of our research

- Documentation and inventory
- Quality assurance when digitising film and video
- Media production and monitoring

More Information

Alongside the technical solutions, we also offer the necessary competence and experience to advise on migration concepts, to optimise working processes, and to develop customer-specific solutions.

Key innovations

- **Product family imdas pro®**
  With over several hundred installations in the German-speaking market, “imdas pro” counts as one of the leading solutions for the documentation of cultural objects.
- **VidiCert®**
  Software solution for automated quality assessment in order to ensure the highest digitisation quality for film and video collections
- **BrandDetector**
  Automatic calculation of the “Brand Attention Factor” during television transmissions based on the size, duration and position of company logos
- **Authoring tools for 360° video**
  Development of an end-to-end production tool set for the creation of 360° videos with novel 3D storytelling elements

Technological Competence

The expertise of more than 100 researchers in various areas of information and communication technologies, built up over decades and continuously developed, forms the basis for our innovative solutions of the future.

Intelligent Sensor Systems

We are proficient in sensors from the fields of imaging, radar, video and acoustics and develop complete processing systems for industrial use. In alignment with customer and project requirements, we integrate state-of-the-art artificial intelligence and machine learning approaches.

- Machine vision and 3D data acquisition
  - Lidar, stereo, time-of-flight, light section, mobile systems
  - Line scan camera systems up to 200 KHz recording speed
  - Highest resolution down to the sub-micrometre range
  - Multi-spectrum from UV via VIS, NIR SWIR to MWIR
- Acoustic sensor systems for real-time processing
  - Array technology for the 3D localisation and classification of sound sources
  - Acoustic MEMS sensors for embedded systems and integration in products
  - Foil-based acoustic sensor technology (PyzoFlex) for direct printing on free-form surfaces
- Complete measurement and quality assurance systems-sensor, computer, integration, algorithms
  - 24/7 operation in industrial and traffic-related environments
  - Multisensory processing of up to 512 sensors in parallel
  - Support for all embedded platforms
  - Server-based solutions
  - GDPR-conform data processing

Communication

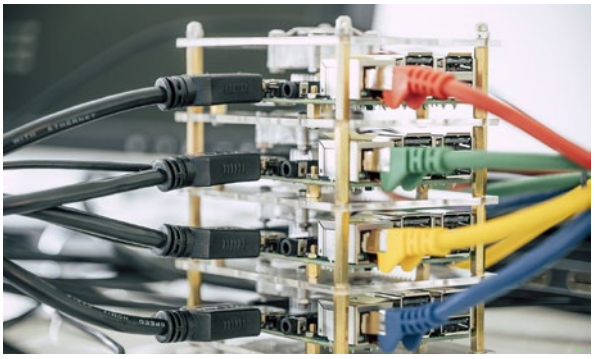
We do research on wave propagation and the properties of new frequency bands in satellite communication, as well as coding methods. For optimal solutions, we always focus on the jointly consideration of all layers of data communication.

- Use of „software defined radio“: integrated development environment for high-performance simulation, emulation and integration of new communication solutions
- Rapid prototype development and low volume mass production for digital radio communication
- Design and construction of instrumentation for satellite communication
- Development and construction of antenna tracking systems for antennas for the optimal reception from moving transmitters such as satellites and aeroplanes
- Detection of band-spread signals – such as control signals between a drone pilot and a drone
- Detection of changes in the electromagnetic spectrum
- Construction of mobile signal analysis systems, such as measurement vehicles of the European Space Agency (ESA).

Localisation and Navigation

We contribute to increasing the robustness and reliability of applications based on global navigation satellite systems (GNSS). We support all common systems, such as NAVSTAR GPS, GLONASS or Galileo.

- Vulnerability testing of GNSS receivers
- Interference detection in GNSS frequency bands
- Ray-tracing approaches and multi-path channel modelling for the investigation of multi-path effects with GNSS
- Robust multisensory localisation with visual odometry and inertial navigation
- Quality assessment of navigation solutions
- Equipping of vehicles with instrumentation for localisation, navigation and their validation



Information Technologies

State-of-the-art expertise enables the development of efficient, secure and robust ICT modules for challenging customer requirements.

- Demand-oriented data evaluation and analysis software
  - Artificial intelligence, machine learning
  - Supervised learning
  - Smart learning with little data
- Cyber security services
  - Security by design
  - Threat modelling
  - Penetration testing
  - CISSP and CSSLP certification
- System design and software engineering
  - Edge to cloud solutions – combined calculation at the sensor (low-latency) with powerful cloud infrastructure
  - IoT systems – networked sensors and real-time information provision
  - Track and trace systems – digitisation of the environment with RFID
  - Multi-platform software development - source code portability for roll-out on multiple target environments
  - Quality management system according to ISO 9001

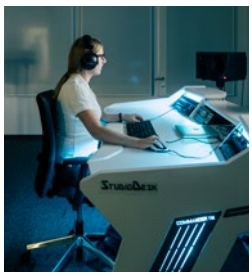
Research Infrastructure

A cutting-edge laboratory infrastructure is essential for the rapid deployment of studies and laboratory prototypes as a foundation for the successful development of products and services.

Digital Twin Lab
Sensor systems for measuring the environment and automated creation of high-precision digital models of the real world, such as high-resolution reference maps (UHDMaps®)

Image Processing Laboratory
Optical instrumentation and machine vision for the monitoring and control of industrial processes

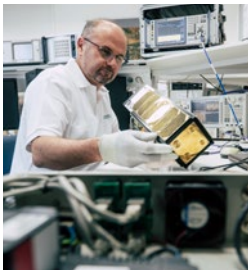
Acoustic Laboratory
An acoustic laboratory equipped according to international standards



Satellite Ground Station
Investigation of wave propagation characteristics of future frequency bands such as the Q/V band on the “Hilmwarte” in Graz.

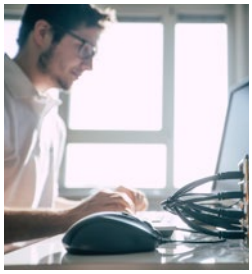
Antenna Platform
Various reception facilities on the roof of the Steyrergasse site for testing innovative satellite solutions. (W band LEO Antenna, GNSS Antenna Network, Radiometer)

Space Technology laboratory
Development of space-grade systems and prototypes



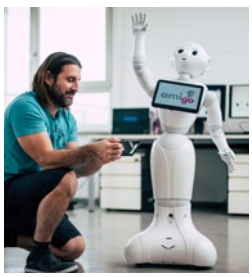
IoT Innovation Space
Internet of things prototype development for the optimisation of industrial processes – wireless sensor networks and data analytics

CTTC – Cyber Test and Training Center
Simulation and analysis of processes in conjunction with cyber-attacks on networked systems



Human Factors Laboratory
Combination of biosensors with virtual worlds in order to measure human behaviour, stress levels and emotions when using technical systems

Social Robot Pepper
Robot equipped with sensors for the development of innovative social interactions



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