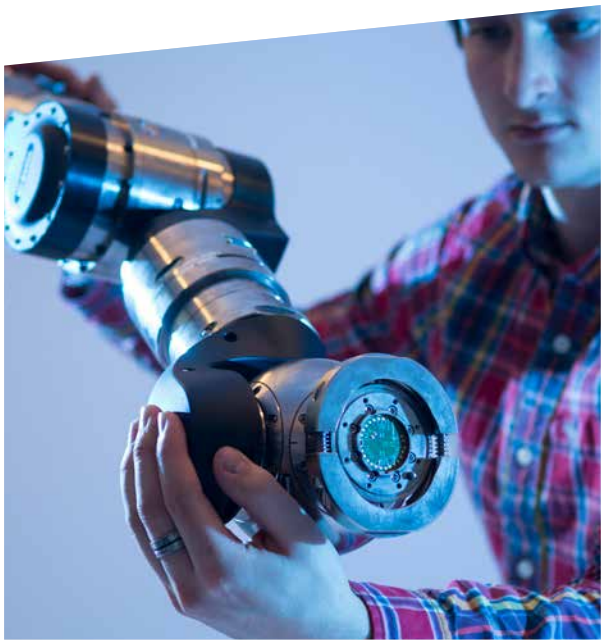
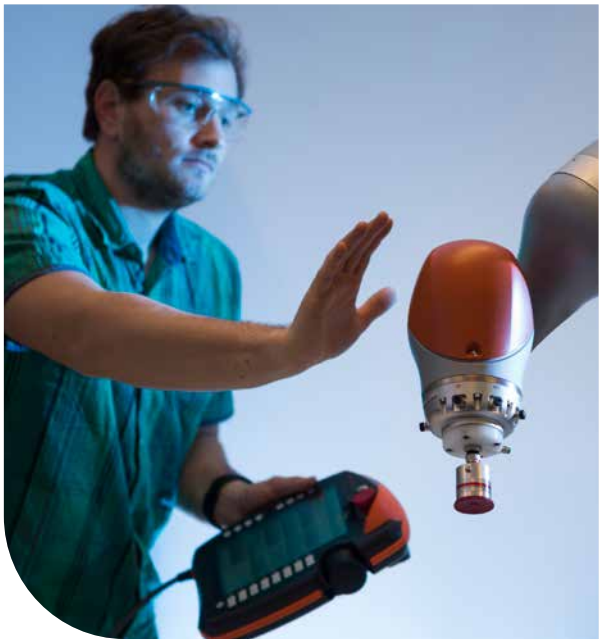
JOANNEUM RESEARCH ROBOTICS

ROBOTICS

Institute for Robotics and Mechatronics





THE INNOVATION COMPANY

JOANNEUM RESEARCH ROBOTICS

"The fields in which we research and their associated infrastructure enable us to carry out pioneering research work and provide solutions to problems and scientific services tailored to the needs of the economy and industry."

Dr Michael Hofbaur, Director

Contact

JOANNEUM RESEARCH
Forschungsgesellschaft mbH

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ROBOTICS –
Institute for Robotics and Mechatronics

In its varied and interdisciplinary forms, robotics will have short and long term effects on important areas of our business and everyday life, as well as on classical industrial production. JOANNEUM RESEARCH utilizes ROBOTICS to address the current needs of the economy for applied research on technologies, which interface between the digital and the real world.

The specialist fields of mechatronics and robotics in general and research in the area of human-robot collaboration in particular, in view of their interdisciplinary and mechatronic structure, represent a promising extension to the research portfolio of JOANNEUM RESEARCH. JOANNEUM RESEARCH can thereby provide industrial partners with important assistance and comprehensive support during the development of innovative manufacturing processes while increasing their willingness to invest in new, groundbreaking and research-intensive technology fields.

ISO 9001:2015 certified

JOANNEUM RESEARCH ROBOTICS

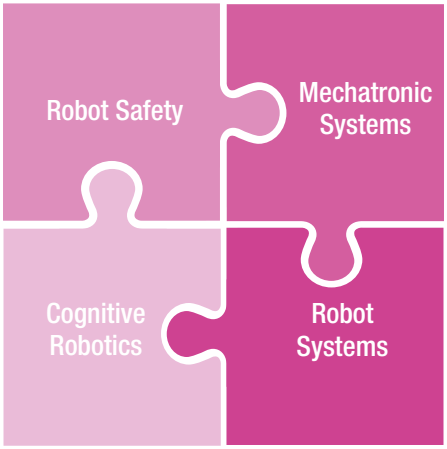
Innovation through ROBOTICS

Robots represent an essential component of industrial automation. However, their broad application is currently restricted to high-volume manufacturing methods. Their cost-efficient use in manufacturing processes with smaller batch sizes and higher levels of added value, as occurs in particular in small and medium-sized enterprises, has its limitations because of the costly process configurations involved (in particular robot programming) and the current incompatibility between robot-based and manual manufacturing systems.

This is why the task of overcoming these limits through research and development in the specialist areas of robotics and safety and production technology lies at the centre of the research and development work at the institute.
In this respect, the institute's technical orientation is directed on the one hand to the challenging R&D problems of modern robotics while at the same time being subject to continual refinement on the basis of ongoing requirements analyses from commerce and industry.

Focal points

- International standards and their application in the R&D context
- Functional safety
- System's monitoring and diagnosis
- Safe and highly reliable sensors and actuators



- Control theory and automation
- Dynamic path planning of complex mechanisms
- Redundant and modular robot systems
- Context-dependent compliant control

- Artificial intelligence & cognitive systems
- Safety-oriented perception
- Human-robot interaction
- Dynamic task planning

- Safety-related system and software development
- Real-time systems and technical informatics
- System's security and integrity
- Runtime monitoring and verification

What we offer

Our combination of ultramodern equipment and infrastructure together with the broad spectrum of subject areas and expertise at our institute enable the development of pioneering solutions and the provision of innovative scientific services.

These solutions and services go beyond classic system integration and incorporate the specialist areas of sensitive and collaborative robotics with particular attention to robot safety and modern automation technology ultimately extending to artificial intelligence.

Cognitive Robotics

In traditional robot applications the robot is separated from the environment while working on a recurring task in a clearly specified activity space. In contrast, modern robotic applications require the reliable execution of varied tasks in a significantly less pre-specified, open working environment.
Such functionality cannot be achieved sufficiently with classical control approaches in automation technology. The scientists of the research group “Cognitive Robotics” therefore focus on application-oriented Artificial Intelligence methods for controlling modern robots. These technologies, which are essential for innovative and in particular future robotic systems, supplement classical control systems with superior decision-based control functionality and are thus intended to enable robot systems to operate autonomously, robustly and especially safely.

- Collaborative human-robot interaction
- Safety-oriented perception
- Machine task planning and execution
- Machine learning

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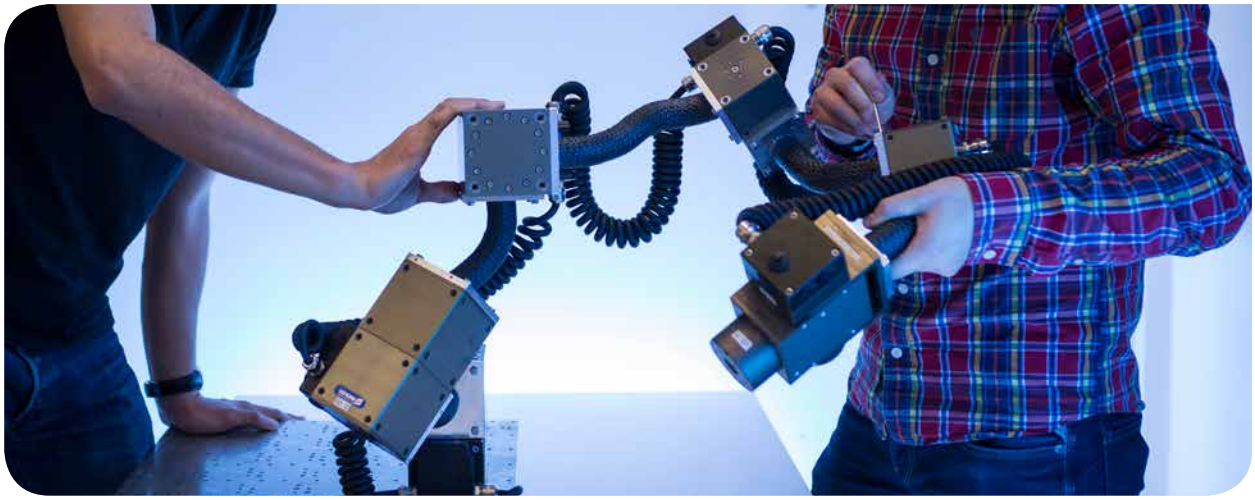

Mechatronic Systems

Robots distinguish themselves from classical automated machines by their flexibility and versatile application, and are therefore consistently realised as complex mechatronic machines. This interdisciplinary (mechatronic) structure with elements from mechanical engineering, electrical engineering, and information technology requires sound interaction and operation of these specialist disciplines. On the other hand, partial aspects of mechatronics can also be applied for classical tasks of automation. The range of activities of the research group “Mechatronic Systems” therefore comprises basic technologies and fundamental sciences of mechatronics in order to provide innovative mechatronic mechanisms for robotics on the one hand, as well as for novel applications in automation on the other hand.

- Redundant and modular robot systems
- Safety-compliant mechatronic mechanisms and robots
- Dynamic motion planning of complex mechanisms
- Control theory and automation

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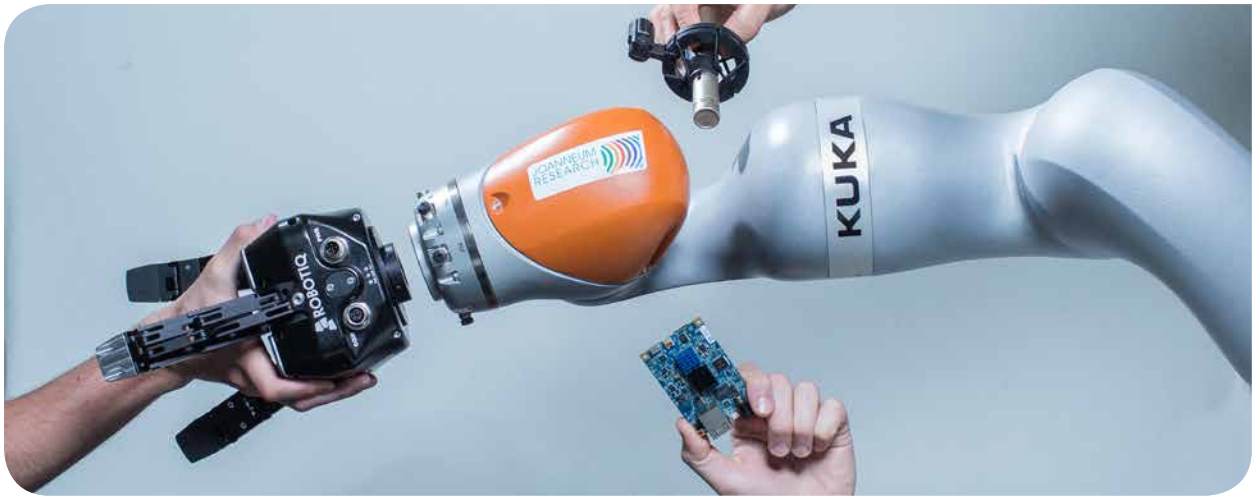

Robotic Systems

Besides the classical robot mechanism and its control electronics, state-of-the-art robot systems comprise a variety of further components, as, for example, diverse sensors, distributed and networked computing units and interacting software modules implemented thereon. Furthermore, a robot system is often also embedded in a larger system context, so that many aspects, like interfaces, real-time requirements of communication and computer technology, system security, and reliability, must be observed. This increasing complexity of the robot systems requires new systems engineering approaches for the entire lifecycle of such a system in order to ultimately guarantee the demanded flexibility, reliability, and security of the robot systems.

The focal points of the research group Robotic Systems therefore lie in the following areas:

- Software and systems engineering for robotic systems
- System security and security architectures in production systems
- Reliability of robot systems
- Embedded, distributed, and real-time systems
- Software quality of robotic software

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Reference projects

Reference project CollRob

The project "CollRob – Collaborative Robotics", sponsored by the bmvit (Federal Ministry for Transport, Innovation and Technology) is being implemented together with the JOANNEUM RESEARCH Institutes DIGITAL and MATERIALS. The aim of the project is to research and develop new methods and applications for collaborative robots. The institutes' own robotics laboratories provide an ideal environment for the validation and testing of scientific approaches.

Reference project RedRobCo

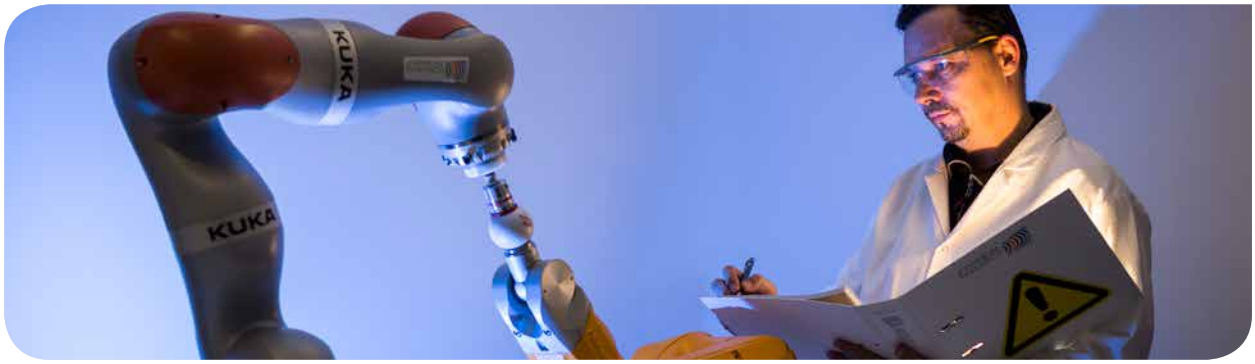
"RedRobCo – Control of Redundant Robots" – a project funded by the bmvit – places the focus on the optimal and safety-based control of serial and mobile robots. Here, special attention is placed on the kinematics of redundant manipulators and their ambiguous movement possibilities. Apart from optimising the aspects of time, energy and/or precision, essential in robotics, the aim is also to guarantee the inherent safety of such systems.

Reference project ROMELO

In cooperation with Magna Steyr and the DIGITAL institute the industry-oriented research project "ROMELO – Robot-Human-Logistics" focuses on investigation of collaborative robotics systems in order to find out how they can be used beneficially in assembly halls. In the course of the project, workstations with integrated sensitive robots have been developed in order to represent human-robot collaboration with practical use cases in an assembly environment. The evaluation and implementation of reasonable MRK applications with safe robot technology in the real operating environment encompass the entire realization process. In addition, topics such as secure gripping technology, image processing and robust kinematic path planning in an environment which is not completely deterministic, play an essential role for a successful implementation.

Reference project MMAssist II

The national flagship project "MMAssist II" is part of the FFG program "Production of the future" that focuses on assistance systems in the context of human-machine cooperation. Together with project partners from R&D as well as industry and service-suppliers, modular and reusable assistance systems for future human-focused jobs in production companies are researched and implemented.
In this project the ROBOTICS institute is responsible for the analysis of assistance tasks considering safety and security for identifying and detecting security vulnerabilities at early stages. In addition to the elaboration of measures for the security and safety of health care systems, the research work also focuses on the increase of the sustainable physical safety of employees.



JOANNEUM RESEARCH ROBOTICS

Infrastructure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Lightweight robots

A wide variety of manufacturers of ultramodern lightweight robots (such as Schunk, ABB, Universal Robots, KUKA) are used for the research and development work at the institute. They form the basis of applied R&D work with partners from industry, commerce and research.


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Industrial robotics

Exemplary industrial robots form the basis for innovative industrial robotics at the interface between classic industrial manufacturing and collaborative and smart production. Here, the work at the institute focuses on the system- and task-oriented optimisation of industrial robot systems.

5

Photos: [1]SCHUNK 9-axis robot LWA 4S; [2]ABB IRB 1400 (YuMi); [3]Universal Robot UR3 lightweight robot; [4] KUKA LBR iiwa R800 - sensitive 8-axis lightweight robot; [5] STÄUBLI TX40 - industrial robot system

Infrastructure

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Special robotics and mobile systems

The special modular and redundant robotic systems developed at the institute enable research in pioneering mechanisms and systems for flexible manufacturing. Apart from innovative manipulation and grasping concepts, these mechanisms and systems also include mobile platforms for intelligent logistics and mobile manipulation.


4

Photos: [1] Mobile sensitive manipulator CHIMERA; [2] mobile modular robot platform; [3] Haptic feedback device Force Dimension Sigma 7; [4] Adaptive robot hand Robotiq 3-finger gripper

Infrastructure

Measurement and calibration systems

When it comes to the calibration of complex robot systems and the safety-related verification of innovative robotic solutions, the institute, apart from high-precision optical systems, is also equipped with measurement systems for the application of force and pressure complying with ISO/TS 15066. Such measurements can be performed both at the institute and at the customer's site.

Innovative sensor and actuator technology for smart robots

The basis for the smart application of ultramodern manipulators is a comprehensive environment perception and situation assessment system. Ultramodern optical sensor technology for the detection of persons and multi-object grasping as well as innovative sensor and actuator systems for gripper systems for industrial applications round off the application-oriented infrastructure available at the institute. The institute is also equipped with mobile systems for the development and verification of application-oriented robotic systems for use at the customer's site.

Photos: [1)]Force and pressure measurement complying with ISO/TS 15066; [2)]Optitrack – vision-based tracking system

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