

Testbed for Industry 4.0

CIIRC CTU in Prague



Introduction

The Testbed for Industry 4.0 at the Czech Institute of Informatics, Robotics, and Cybernetics Czech Technical University in Prague ([CIIRC CTU](#)) is an integral part of the European Centre of Excellence [RICAIP](#) (Research and Innovation Centre on Advanced Industrial Production) as a research and experimental workplace is the core asset for the exploitation of results of multiple research projects. The main objective of RICAIP is to build a unique research facility for the development and testing of innovative solutions for advanced and fully integrated industrial production and processes for smart factories.

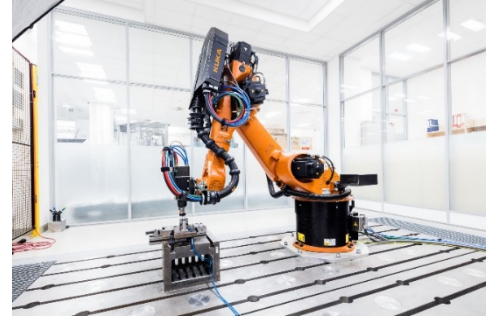


Facility

The Testbed for Industry 4.0 in Prague is composed of unique equipment situated within two floors of the CIIRC CTU building. Testbed combines different technologies as additive manufacturing, machining, laser processes, production metrology, robotic manipulation, intelligent conveyor systems, human-robot cooperation, automated warehousing and others. Thanks to the flexible interconnection of universal production tools and a sophisticated control system, the same resources can be used to execute different operations, which are scheduled optimally as needed.

The basis of Testbed is a flexible production line for concurrent production of several product types in a series of variants. It is composed of a reconfigurable assembly line with 4 robotic stations, where automatic assembly of products composed of parts delivered with a flexible conveying system can be done. The conveying system contains loading and unloading stations for the interaction with the environment and a camera for the recognition of the parts.

Testbed for Industry 4.0 comprehends technologies for manipulation and logistics (Kuka robot, 6-axis industrial robot, Montrac conveyor), production cell for machining (multifunctional machine tool), workplace for human-robot cooperation (robots for handling and machining and for working with humans – Kuka robot, mobile wheeled robots, and collaborative industrial manipulator) and control system for Testbed (Siemens Simatic control system, Profinet communication system and OPC UA). There is also a 3D Printing Center associated with Testbed, consisting of industrial-grade 3D printers with various technologies (MJF, FDM, Polyjet, laser sintering) for printing from plastic and metal. The entire Testbed for Industry 4.0 serves primarily for research, development, teaching and collaboration with industrial partners in testing innovative solutions for advanced and fully integrated industrial production and processes for intelligent factories.



Distributed Production

The Testbed for Industry 4.0 is based on a multi-agent platform for distributed manufacturing systems. The multi-agent functionality serves in the scope of the local Testbed of CTU-CIIRC but is capable to be extended to other lines and testbeds, utilizing the common data, digital and security platform layers.

A planner for flexible manufacturing serving as a tool that combines manufacturing and internal-logistics operations. The planner can work in a central manner as a means for planning/ coordinating operations of several machines/units, but also in a distributed manner utilizing the multi-agent platform for negotiating the task and capacity distribution among related resources.



A simulation model of the production in Tecnomatix Process Simulate was created to test the production plan and other scenarios before the actual production is started. Testbed also contains a separate room with individual machining devices (machining robot, hybrid machining device for additive and subtractive manufacturing). Manufacturing execution systems (in-house developed as well as industrial-grade) connected a customer portal and automatic planner of operations to perform flexible production of simple cars.

Further Development

In Testbed for Industry 4.0, the following extensions are planned:

- Connection to AR/VR to combine local and remote assistance, combined with simulations and real-time data processing;
- Automatic warehouse to deliver parts automatically to the production to model just-in-time delivery;
- Mobile robots to connect other production cells to the production line;
- Additional high-speed and flexible conveyor/robot system with high speed robots and visual guidance for pick and place operations
- Metrology equipment for characterisation of process and machine tool behavior.

Video Testbed for Industry 4.0

Video RICAIP

RICAIP - Research and Innovation Centre on Advanced Industrial Production

RICAIP is an international distributed research Centre of Excellence (CoE) dedicated to Industry 4.0. The RICAIP Centre is hosted at CIIRC CTU with the direct participation of its four Czech and German founding partners – CIIRC CTU, CEITEC BUT, DFKI, and ZeMA.

RICAIP focuses on research in robotics and artificial intelligence (AI) for advanced industrial production. In order for the concept of distributed production to be simulated and practically verified, RICAIP creates a basic functional infrastructure in the form of the RICAIP Industrial Testbed Core.

The backbone of this infrastructure consists of the Testbed for Industry 4.0 at CIIRC CTU in Prague, the testbed at the CEITEC BUT institute in Brno, and the joint testbed of DFKI and ZeMA in Saarbrücken.

RICAIP has been realized in two phases within the EU Horizon 2020 WIDESPREAD Teaming Calls, while in the second one, it was evaluated as the 2nd best project in 2019. RICAIP thus received support from EU and national resources in the total amount of EUR 48.25 mil for the period 09/2019-12/2026.

More information: www.ricaip.eu

CIIRC CTU – Czech Institute of Informatics, Robotics, and Cybernetics

CIIRC CTU is a modern scientific and research institute of the Czech Technical University in Prague which brings together excellent research teams, young talents and unique know-how to push technological boundaries and build on the best of Czech tradition in technical education. The focus of CIIRC CTU's research work focuses on four basic pillars: industry, energy, smart cities and a healthy society, both in basic and applied research. CIIRC CTU was founded in 2013 starting its full operation in newly built facility in 2017. The Institute currently has nearly 300 employees working in 8 research departments complemented by four centres, incl. Testbed for Industry 4.0. CIIRC CTU is a founding partner and coordinator of the RICAIP, one of the largest running EU projects in the field of AI and Industry 4.0.

CIIRC aims to concentrate on a cutting-edge research in the fields of computer science, robotics, cybernetics, artificial intelligence, machine learning, optimization, automated reasoning, machine perception, computer vision, intelligent, distributed and complex systems, automatic control, computer-aided manufacturing, bioinformatics, biomedicine and assistive technologies and related areas. It is the home of two ERC grant holders in AI and three large Excellent Teams projects combining Robotics, Machine Perception, Machine Learning, Computer Vision and Automated Reasoning. CIIRC's groups have obtained research funding from Amazon, Google, Facebook, Porsche, Skoda Auto and other companies and CIIRC teams regularly place high in competitions ranging from Amazon Alexa Prize, to autonomous car competitions and world championships in Automated Reasoning. CIIRC CTU creates a unique ecosystem of academic-industrial cooperation in which it uses diversified forms of project financing from national, European and private sources.

More information: www.ciirc.cvut.cz