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Executive Summary

Using state-of-the-art infrastructure and maximizing economies of scale will enable EDIH CTU to provide support for pilot projects and innovative services to larger groups of SMEs and public administration entities. This document identifies the infrastructure that will help to meet the EDIH CTU objectives, particularly in the following services:

- Equipment and infrastructure rental
- Lab & Testbed tours
- Testing, validation, and demonstration.

The document contains a list of infrastructures that will be updated over time, and the principal terms and conditions.

Project Summary:

The EDIH CTU represents a major European Digital Innovation Hub in the Czech Republic in the field of Artificial Intelligence (AI) and Machine Learning (ML) transferring trustworthy solutions and services to the industry, health, transportation and energy sectors. The EDIH CTU, with its vision "Inspire & Make the Czech AI-driven Industry", aims to become the innovation and technology leader in providing professional AI/ML services for the local SMEs, small mid-caps and public sector organizations with respect to their digital and green transformation. The strong consortium partners representing academia, the business sector and key associations of enterprises in the Czech Republic provide sufficient know-how, expertise and state-of-the-art experimental facilities to serve the needs of the public and private sectors at the national and also international level. The major focus is on promoting digital transformation adoption, providing high-quality services, education and knowledge sharing, pursuing ecosystem development, and establishing strong inter-EDIH collaboration. The consortium builds upon already existing partnerships in AI and manufacturing enabling best practice sharing, expertise exchange, and joint activities seeking far-reaching synergies thus strengthening the far-reaching impacts of the European network of EDIHs.

List of Abbreviations and Acronyms

5G	the fifth-generation technology standard for broadband cellular networks
5G SA	5G StandAlone
AGV	Automated Guided Vehicle
AI	Artificial Intelligence
AR	Augmented Reality
CNC	Computerized Numerical Control
CTU	Czech Technical University in Prague
DH	Denavit–Hartenberg (parameters)
DX.Y	Deliverable No.
EDIH	European Digital Innovation Hub
EDIH CTU	European Digital Innovation Hub at the Czech Technical University in Prague
EU	European Union
GG	Good Game
GPU	Graphics Processing Unit
HMI	Human-Machine Interface
HM	Hybrid manufacturing
HP	Hewlett Packard
HSS	High-speed steel
ICT	Information and Communication Technologies
KMP	Kuka mobile platform
KUKA	Keller und Knappich Augsburg
LAB	Laboratory
LIVS	Laboratory of Intelligent Embedded Systems
LMD	Last Mile Delivery
MES	Manufacturing Execution System
MQL	Minimum Quantity Lubrication
NETMON	Network Monitoring
NG	Next Generation
ML	Machine Learning
PLC	Programmable Logic Controller
RAM	Random Access Memory
RCMT	Research Center of Manufacturing Technology

R&D	Research&Development
RGBD	Red Green Blue Depth
RTLS	Real-time location system
SAAS	Software As A Service
SMEs	Small and Medium Enterprises
TPA	third-party administrator
UX	User eXperience
VDA	German Association of the Automotive Industry
VDA 5050	a standardized interface for AGV communication
VR	Virtual Reality
YOLACT	You Only Look At CoefficientTs

1. Introduction

The EDIH CTU comprises several workplaces equipped with high quality and extensive physical infrastructure including, e.g., Testbed for Industry 4.0 - the very first multi-site/distributed research and experimental manufacturing facility in Europe for advanced industrial production. The EDIH CTU also has facilities and technical equipment for conferences, workshops and seminars, and available coworking spaces.

The EDIH CTU responds primarily to the needs of SMEs and the public sector that need to undergo digital transformation and implement technological solutions with AI elements in practice to remain competitive within EU value chains. However, the problem of these entities is often the reluctance to implement new solutions stemming from the fact that they are unaware of novel technological possibilities or do not have sufficient competencies and financial resources. The EDIH CTU offers a vast portfolio of services through which end users can test and apply technological solutions otherwise not affordable. The aim is to provide the maximum possible support to end users by using synergies of consortium partners possessing relevant expertise and infrastructure. The EDIH CTU services and infrastructure will be offered at a maximum viable discount for SMEs and public sector entities. Service and infrastructure prices follow the actual market prices and current practice and are subject to a Consortium Agreement among EDIH CTU partners. The table below lists the main offered infrastructure that covers a variety of specific topics derived from the competencies of the EDIH CTU consortium.

The Terms and conditions for the use of technical infrastructure are defined according to the defined rules of each infrastructure provider, where individual rules are specific to each infrastructure provider. All these Terms and conditions are specified in detail according to the internal rules of each infrastructure provider. All use of the infrastructure within the EDIH Consortium will be carried out only based on a validly concluded contractual relationship. All use of the infrastructure within the EDIH CTU project will be made only on a contractual basis.

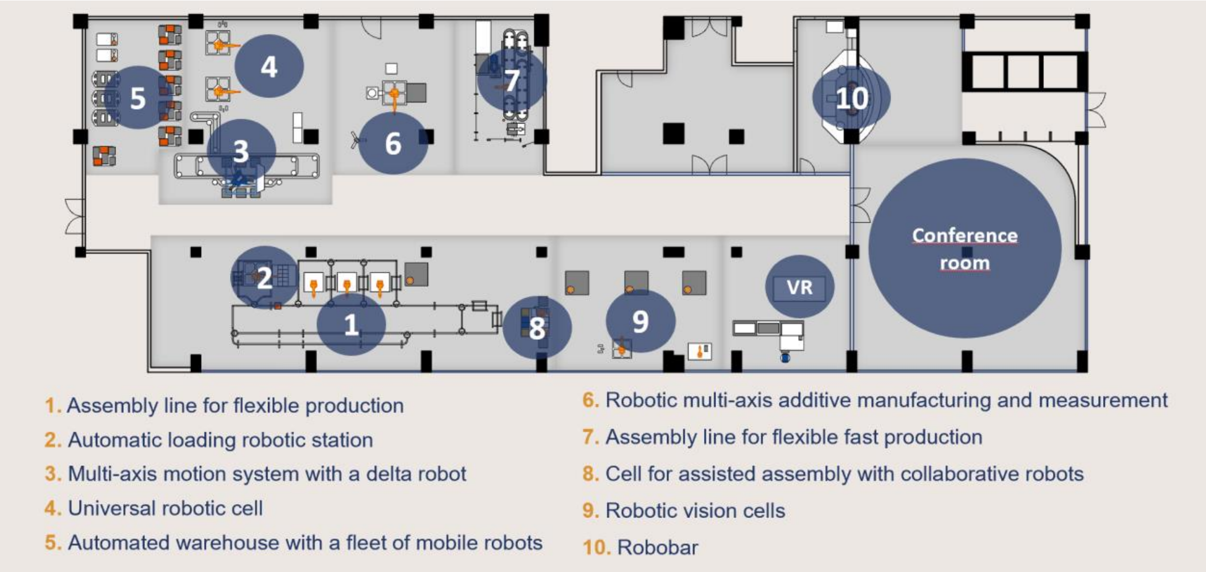
1. Purpose: The technical infrastructure is intended in particular for research, experimentation, and test purposes only.
2. Access: Access to the technical infrastructure is limited to authorized personnel only. Users must have valid identification and authorization from the infrastructure provider.
3. Safety: Users must comply with all internal safety guidelines and procedures when operating the technical infrastructure. Any unsafe practices or actions may result in the revocation of access.
4. Responsibility: Users are responsible for any damage caused to the technical infrastructure during use. Users must report any damage or malfunction to the laboratory management immediately.
5. Usage Time: The technical infrastructure may only be used during designated hours of operation. Users must vacate the premises promptly after their allotted time.
6. Data: Users must comply with all internal data management and security protocols set by the infrastructure provider. Any unauthorized use or distribution of data is strictly prohibited.
7. Compliance: Users must comply with all applicable laws, regulations, and ethical standards in the use of the technical infrastructure. Failure to comply may result in the revocation of access and legal action.
8. Liability: The infrastructure provider shall not be liable for any damages or losses incurred by users in the use of the technical infrastructure.

9. Modification: The infrastructure provider reserves the right to modify or amend these terms and conditions at any time. Users will be notified of any changes in writing.
10. Termination: The infrastructure provider reserves the right to terminate access to the technical infrastructure at any time and for any reason deemed necessary.

By using the technical infrastructure, users agree to abide by these terms and conditions. Failure to comply may result in the revocation of access and legal action.

2. List of equipment

2.1 Part I: Robotics and Flexible Production



Source Testbed for Industry 4.0

2.1.1 Assembly line for flexible production

The Flexible Assembly Line boasts a multi-agent-based monorail distribution system, a computer vision-enabled warehouse robot, and an on-demand component supply system facilitated by autonomous guided vehicles. The Manufacturing Execution System oversees the conveyor distribution, and robot operations, and optimizes the allocation of tasks to robots. The multi-agent control scheme forms the basis of a decentralized production configuration, which promotes modularity, facilitates the customization of production to meet customer requirements, enables the spatial separation of production machines, and incorporates the logistics chain and distribution channel model. The controlled production line can be easily expanded by connecting additional machines and production lines, allowing for the emulation of distributed production within a compact space to evaluate individual sub-concepts.

2.1.2 Automatic loading robotic station

- Substitution of hard-coded positions with an intelligent vision system and robot control;
- Inbound warehouse parts scanning, detection, identification and bin picking;
- Automatic multiple-view camera calibration process;
- Parts pose estimation by open-source libraries with a mono-vision system;
- Automatic end-effector to camera transformation estimation.

Assembly line for flexible production together with Automatic loading robotic station makes the production line with a conveyor and robots. It also includes the possibility of supplying parts from the automatic warehouse via autonomous robotic trucks. The conveyors and robots themselves can be controlled either from a central production control system or through a multi-agent system, with the individual machines (conveyor, robots, but also autonomous robotic supply) representing separate autonomous agents. The multi-agent control presented in this way is the basis of a distributed production configuration, which contributes both to modularity and easy adaptation of production to customer requirements, spatial separation of production machines, and also the inclusion of logistics chain and distribution channel model. Additional machines and production lines can be connected to such a controlled production line and distributed production can be emulated in a small space to verify individual sub-concepts.

The demonstration presents a way how to control mobile robots in logistics when they share an operating space such as a crossroad. Whenever two mobile robots meet at a crossroad, one of them stops because of its safety features to avoid a crash. Often a manual intervention of an operator is needed to restart the robot after the common space is cleared. The presented solution introduces an independent control layer that monitors the position of the robots and intentionally stops one of them before entering the common space if the other robot is already in. After the common space is cleared the robot, which was stopped, is commanded automatically to continue its operation. The localization system RTLS by Siemens is used to monitor the position of the mobile robots, and KUKA KMP mobile robots are used to perform the demonstration. The interface of the control layer allows visualization over a web page and integration into other logistics/manufacturing planning and control systems. It also allows connecting other types of mobile vehicles.

2.1.3 Multi-axis motion system with a delta robot

Delta robots are used for applications where fast operations are required. Developed in cooperation with industrial partners, this five-axis Delta robot in Testbed enables synchronization of its movements with the movement of the pallets on the conveyor. Researchers designed and fine-tuned a kinematic and dynamic model to compare the behaviour of a real robot with the expected ones and to identify differences through machine learning algorithms.

This serves as a basis for machine operation diagnostics, so-called condition monitoring. The dynamic model is used for feedback control based on the force exerted on the robot's end effector. The robot operates on an industrial 5G network and enables fast transmission of large amounts of data. Therefore, the integration of a neural network and computer vision could be implemented in the robot system. 5G SA communication is used to transfer the image from the camera to the server (edge device) and transmit the necessary position data back to the robot in real-time. The experiment also uses augmented reality for predictive maintenance using a HoloLens kit connected via the campus 5G SA network.

2.1.4 Universal robotic cell

Pick & Place

- Robust and easily deployable pick and place architecture;
- Sorting packets into bins based on their size;
- Using data from Intel RealSense RGBD camera, detect and classify objects and estimate optimal grip pose using CV methods and point cloud processing;
- Instance segmentation using YOLACT architecture;
- Tracking the belt using the rotary encoder.

2.1.5 Automated warehouse with a fleet of mobile robots

The warehouse is equipped with three autonomous trolleys and two mobile collaborative robots from KUKA for transporting parts between production facilities and collaborating with humans. Basic logistics shall be handled through a Fleet Management system designed to manage autonomous vehicles performing intralogistics operations.

Cooperative control of mobile robots in logistics has been developed for the situation when they share an operating space such as a crossroad. Whenever two mobile robots meet at a crossroad, one of them stops because of its safety features to avoid a crash. Often a manual intervention of an operator is needed to restart the robot after the common space is cleared. The presented solution introduces an independent control layer that monitors the position of the robots and intentionally stops one of them before entering the common space if the other robot is already in. After the common space is cleared the robot, which was stopped, is commanded automatically to continue its operation.

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Warehouse fleet

- KUKA Mobile Platform AGVs capable of lifting up to 600 kg objects and moving shelves between workplaces;
- KUKA Mobile Robots are equipped with a collaborative robot that can handle different objects/workpieces and also cooperate with an operator at the workplace.

Warehouse Fleet manager

- Processes requests for transportation of shelves or workpieces between workplaces and warehouse;
- Interface for multiagent communication;
- Aiming for VDA 5050 standard;
- Navigating AGVs using an offline map and real-time data from laser scanners and RTLS system;
- Automatic charging control of AGVs.

2.1.6 Robotic multi-axis additive manufacturing and measurement

The workplace uses a medium-sized industrial robot and positioning equipment for additive production. The positioning device expands the production possibilities of the workplace with the possibility of printing without the necessity to use material supports. At the same time, the positioner enables the production of even structurally complex parts. Thanks to this, it is possible to save time during production both during the printing of supports and during their subsequent removal. In addition, the programmer has more options for how to produce a given part, especially in the case of rotating or symmetrical parts. An important role in the developed solution is played by a laser tracker, which has several uses. It can be used to ensure higher accuracy of manufactured parts, but it can also be used in combination with a special reflector on the robot to accurately measure parts with a touch probe.

The positioner extends the possibilities of 3D printing, in particular offering support-free printing and manufacturing of complex design parts. The key component is the laser tracker, which has several uses. In particular, it can be used to ensure higher precision of the produced parts. Our solution is ready for a wide range of additive technologies and materials. For testing purposes, we currently work with a Prusa MK3 extruder, but the workplace can also be equipped with another type.

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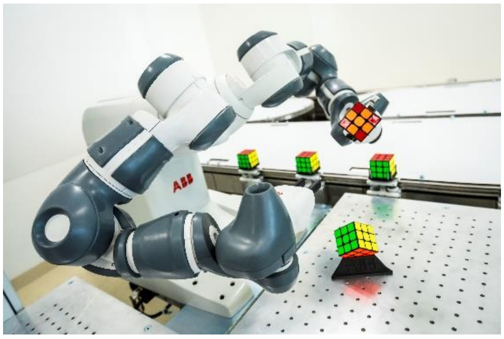
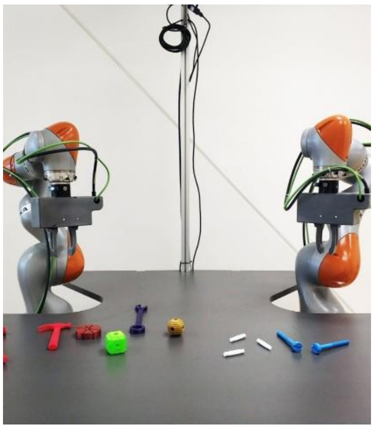
2.1.7 Assembly line for flexible fast production



The workplace incorporates several technologies that contribute to flexible production. The conveyor trolleys are controlled independently of each other, allowing their movement to be adapted to the needs of the specific product they are transporting. In addition, it is possible to synchronise the movement of the trolley with that of the robot, allowing the robot to manipulate the part on the trolley without the trolley having to stop. This feature contributes to reducing the length of the production cycle. The collaborative robot, which is part of the workstation, offers the flexibility to work with a human on a specific assembly operation and, thanks to the installed industrial camera, can react to the actual conditions and characteristics of the part being handled. These sub-features make the robotic workstation ready for a range of tasks that may be defined in the future, demonstrating the principles of flexible and modular manufacturing.

2.1.8 Cell for assisted assembly with collaborative robots



- It consists of two collaborative robots, five cameras with pose estimation and object detection, a voice assistant, and an HMI;
- With the help of a voice assistant, a worker can give orders to robots;
- Execution of orders implemented using planning with collision detection;
- This workspace helps to push the boundaries in the collaborative and multi-arm robotics field;
- Cameras algorithms can recognize the position of objects and human hands in 3D;
- Planning the simultaneous movement of two robots accurately and safely for the worker.

2.1.9 Robotic vision cells

Checkers

- Collaborative robotic workplace for playing checkers;
- Fully autonomous in the perception of its surroundings and decision-making;
- A robotic cell consisting of a collaborative robot with a gripper, a computer vision system and an HMI is controlled by PLC;
- AI game algorithm contributes to fast decision-making and the robot's high win rate;
- Objects recognition adaptive to different lighting conditions.

Hand-guided robot

- KUKA collaborative mode for hand-guide leveraging;
- Neural network and computer vision edge-computing on the GPU server;
- Precise real-time localization of objects;
- 5G SA network for stable and low-latency connection to GPU server;
- Homography transformation for surface representation using visual markers.

Robotic cell for screwing bolts using a camera

- An industrial robot is equipped with an automated screwdriver and camera;
- The digital twin of this cell pre-generates a robotic program for each object;
- The camera is then used to correct the position of the screws to be screwed when the object is not aligned with the prepared position.

2.1.10 Robobar

In addition to the two collaborative robots, the Robobar in Testbed for Industry 4.0 also uses the functions of other devices, including a liquor conveyor, fruit feeders, an ice feeder and more. It's all connected via a common industrial communication platform.

The entire site uses industrial components to provide a stable platform for software implementation and covers several advanced technologies. HP Multijet Fusion 3D printing technology was used to produce a unique conveyor, grippers, as well as a safety rubber gripper cover on the robots. The visualisation of the ordering system uses the latest technology from PLC manufacturer Siemens to enable a faster and more efficient development process. When an order is placed, the customer is assigned an order number, which is then displayed on the TV above the robot. This workstation pushes the boundaries in collaborative robotics in food service operations.

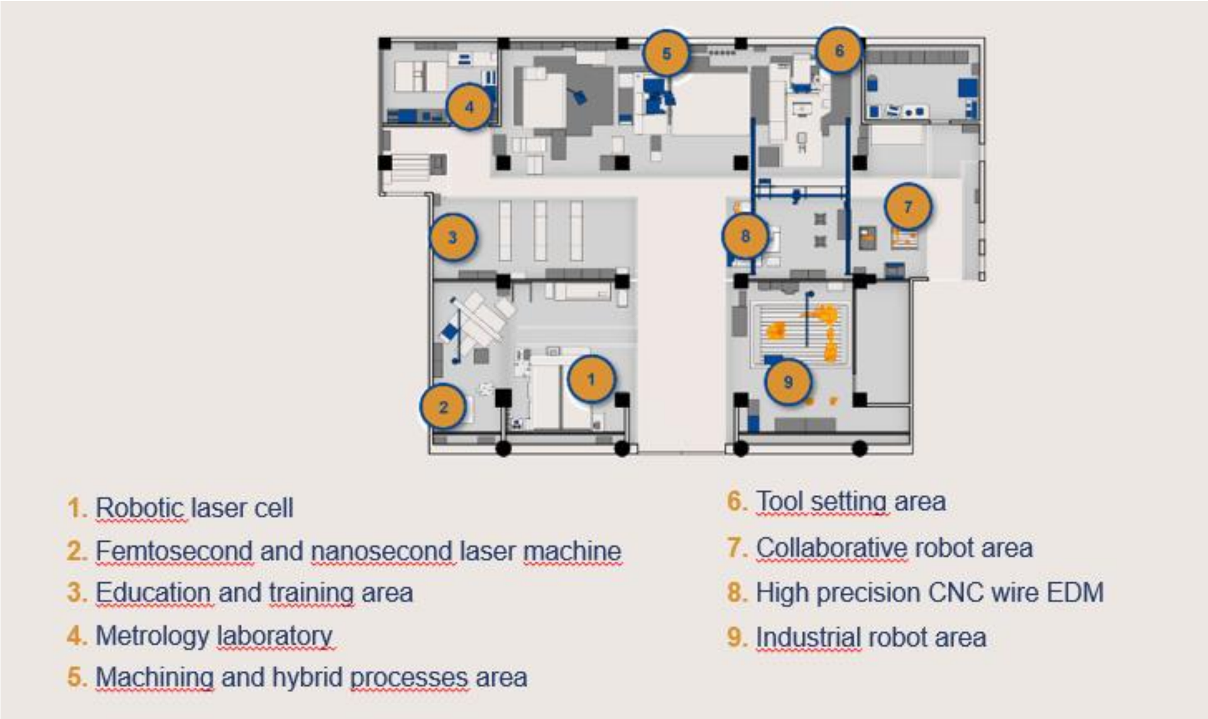
2.1.11 Virtual reality

- It is possible to explore the Testbed for Industry 4.0 assembly in virtual reality and use features such as teleportation, object measurement, drawing in space and moving objects;
- Virtual reality is also used to simulate a production line where you need to verify the reach of robots, collision control and more.

2.1.12 CP Factory

Festo CP Factory is a set of standalone modules that can be interconnected to build a demonstration of a production line. Each of the modules has independent control, which is connected to an above-laying Manufacturing Execution System (MES), which orchestrates the whole production. There are various use cases suitable for education starting with the low-level control of individual stations and their peripheries, through robot control to the higher-level production control and configuration. Additionally, we provided a connection to a cloud solution, which extends the existing MES system and shows how data acquisition and further processing and analysis can be one in a cloud environment.

2.2 Part II: Robotics and Production Technologies

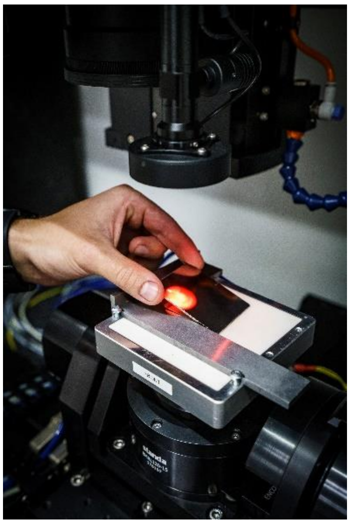


Source: Testbed for Industry 4.0

2.2.1 Robotic laser cell

- Compact robotic cell with a positioner and linear axis designed for laser heat treatment, laser cutting, LMD-wire, and LMD-powder;
- LMD-wire and LMD-powder are used in the meaning of additive manufacturing;
- A digital twin is used to generate the robot program;
- Currently used for mold repair.

2.2.2 Femtosecond and nanosecond laser machine

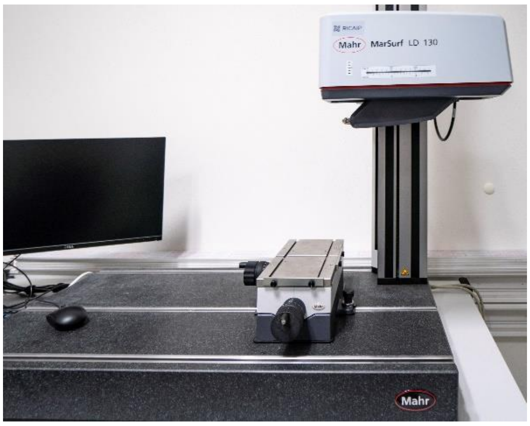


- Laser micro-processing using nano-, pico- and femtosecond laser;
- The range of applications for this equipment is wide and it is currently used to develop and modify inserts for CNC tools;
- The laser can be used to sharpen inserts and achieve better properties during the machining process.

2.2.3 Education and training area

- The laboratory is managed by researchers and developers who are part of the RCMT (Research Center of Manufacturing Technology) and the Department of Production Machines and Equipment at Czech Technical University;
- Students of this department have a unique opportunity to study and subsequently work with modern equipment;
- The laboratory includes a teaching room where students work on semester projects and theses.

2.2.4 Metrology laboratory



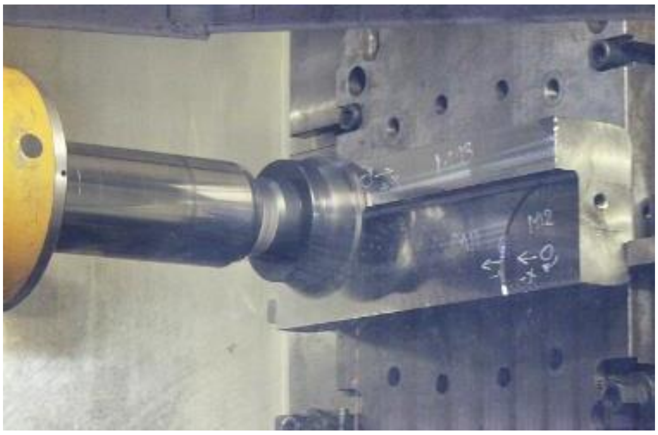
- The metrology laboratory is equipped with a coordinate measuring machine, a microscope and a roughness meter;
- This equipment is mainly used for R&D activities involving inspection and characterisation of workpieces after additive and subtractive manufacturing.

2.3 Machine and hybrid processes section

2.3.1 Hybrid manufacturing technology

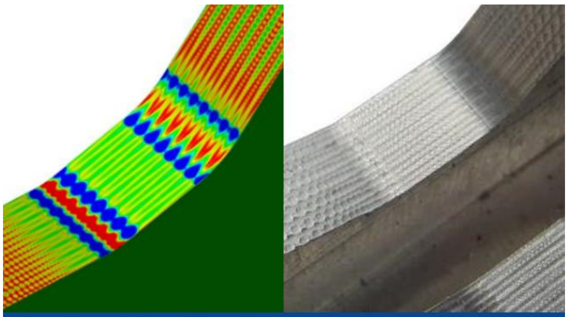
- Hybrid manufacturing (HM) combines additive and subtractive processes in one working space of the CNC machine;
- The research focus is on the effective implementation of HM processes;
- Applications include a solution for the production of new parts, partial material addition on the part and workpiece repair applications;
- Machining of difficult-to-cut materials using cryogenic and MQL cooling.

2.3.2 Smart machine tools



- The smart machine tool is equipped with additional sources of inputs for feedback;
- The intelligence of the machine tool is based on predefined algorithms and current process data;
- Autonomous reaction to unexpected situations is a current research goal;
- Research areas involve physical and virtual sensors; process characterization using machine and process signals; a collaboration of real machine tools with their digital twins.

2.3.3 Digital twin and production process virtualization


Virtual machining
(workpiece digital twin)

- Machine tool Digital Twin is an effective instrument for predicting and optimizing the results of the machining process;
- Workpiece Digital Twin is a result of the complex simulation of the machine tool – process interaction, including the dynamic behaviour of the machine tool and the workpiece and detailed visualization of the manufactured part;
- Our research goal is mastering this concept for everyday practical implementation.

2.3.4 Tool setting area

- CNC tool pre-setter with an integrated printer of pre-set results;
- High-performance shrink-fit machine for tools with intelligent NG coil;
- Tool dynamic balancing machine for balancing tool holders on 1 and 2 planes;
- Automatic tool feed by AGV directly to the machining centres;
- Automatic cut-off machine with variable spindle speed and variable automatic feed for metallographic cutting;
- Hardness tester.

2.3.5 Collaborative robot area

With the growing demand for collaborative robotics in special applications, where the full potential of this technology is being exploited, use-case solutions are being developed for our industry partners.

2.3.6 Industrial robot area

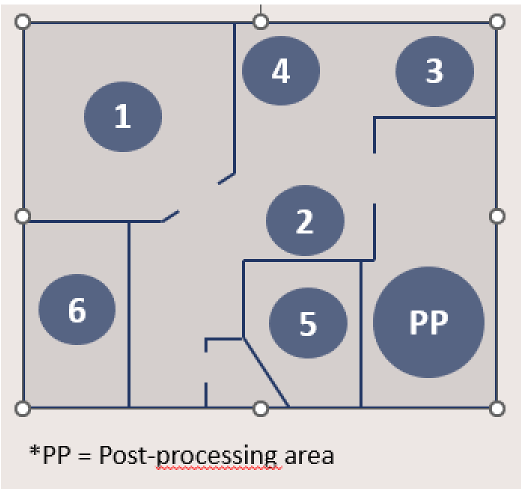
- The laser tracker is used to investigate the accuracy of large industrial robots with a focus on calibrating DH parameters and refining their repeatability;
- Once sufficient results have been achieved, work will be carried out on large-scale additive manufacturing of plastics.

Robotic machining

- Industrial robots are equipped with machining spindles and are used to test the machining of aluminium-based materials;
- Research and development here are carried out about machining process parameters, types of the workpiece and tool materials, vibrations transmitted to the robot and the accuracy of the parts produced;
- The results of this testing can then be transferred to the industry to meet the requirements of our customers.

2.4 Additive manufacturing laboratory

Production Equipment



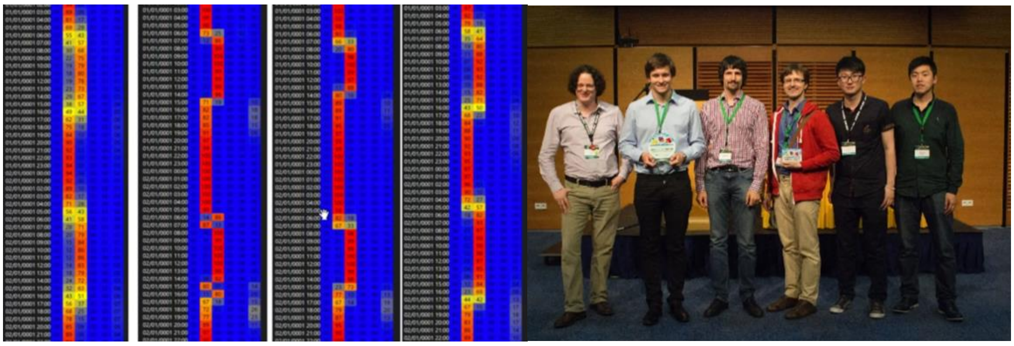
1. HP Multijet Fusion 4200, Workspace: 380 x 284 x 380 mm, materials PA12, TPA
2. Desktop Metal Studio System, Workspace: 305 x 200 x 200 mm, materials 17-4PH, copper, HSS
3. Stratasys Polyjet J750, Workspace: 490 x 390 x 200 mm, multi-material option
4. Stratasys Fortus 450mc, Workspace: 406 x 355 x 406 mm, materials ASA, ABS
5. Trumf TruPrint 1000, Workspace: 100 x 100 x 100 mm, materials stainless steel
6. Robotic multi-axis additive manufacturing, Workspace: 600 x 600 x 1000 mm, plastic and metal materials for filament extrusion

2.5 DATA Analysis and Management

2.5.1 DATALAB

In the DataLab, we study all the steps that lead to a better understanding and gaining knowledge from data, i.e. from data collection from different systems to data pre-processing and analysis, modelling and visualization to the application of machine learning and artificial intelligence. The main research topics include data mining algorithms and machine learning (e.g., segmentation, classification, prediction, suggestion, and detection of anomalies) and the possibilities of their scaling and efficient design.

In addition to basic research, we also support applied research, in which we connect DataLab members with industry partners in different fields. We offer a wide range of interesting topics that need to be explored, either in research projects or course projects and theses. We also take part in international competitions and hackathons in the field of machine learning. The lab's activities are closely linked to the research group Computational Intelligence and Machine Learning (ML-CIG).



2.5.2 GPU-LAB

The GPU lab is equipped with the most up-to-date GPU cards, ready to be used for testing a solution you are looking into.

2 GPU Servers: 12 core + Geforce 2060TI, 12 core + Tesla K40.

2.5.3 GGLAB

The GG LAB has all you need to test the gamification effects of your AI-based solution. Lidar sensors, double projection facilities and the necessary computing power.

2.5.4 LIVS-LAB

The LIVS LAB is equipped with humanoid robots ready to be uploaded with your AI-based solution and validated in real-life situations.

2.5.5 NETMON-LAB

The NETMON LAB focuses on using AI algorithms to identify and actively manage potential risks within the network flow in your network. There are several specific solutions focused on risk mitigation and the LAB is also piloting process-based solutions targeted to maximize the security of the network whilst sustaining its throughput.

2.5.6 UX-LAB

The laboratory of user experience is equipped with eye-tracking sensors and connected infrastructure which is needed to assess the UX aspects of your AI-based solutions.

2.5.7 SAFETY-LAB

Focuses on product safety and can imply its infrastructure and expertise to support your efforts in the search for a safe and reliable AI-based solution.

2.5.8 Image Processing Lab

The Image Processing Laboratory – ImproLab – was established in 2017. It combines academic expertise with applications from practice and it provides solutions to problems not only for students but first for companies. The laboratory has technical equipment for research projects and teaching in the field of capturing visual information. We aim to improve the quality of teaching in the field of data processing and create an environment for the application of theoretical knowledge in practice.

The laboratory has a wide range of equipment for machine vision. This includes industrial camera sensors, high-speed cameras, line scan cameras, depth sensors, thermographic cameras and laser and ultra-light distance meters. In addition to classical computers – PCs, we also use mini-PCs, single-board computers, and microcontrollers.

Cameras

The laboratory is equipped with industrial matrix cameras from Basler. The cameras differ from each other in the connection option – GigE/USB 3.0, resolution, frame rate or chromaticity – monochromatic/colour. The cameras are compatible with C-mount lenses.

Thermal cameras

There are 4 thermal cameras available. The WIC from Workshell – a stationary LWIR thermal camera intended for accurate temperature measurement in laboratory or industrial conditions, WIRIS 1st gen – a thermal camera for unmanned aerial vehicles. The last two cameras in the picture are FLIR Tau 2 and FLIR Boson (the smallest one) – longwave infrared thermal camera cores for embedded devices.

Lights

Lighting is an essential part of image acquisition, so there are plenty of types to choose from. Spotlights, bar lights and ring lights with different wavelengths. There is also one spotlight and one bar light where the colour of the lighting can be set by RGB channels. We can also find a UV ring light, a red ring darkfield light, a bar light console, a coaxial light, a green telecentric light, a red or white backlight and finally, a dome with a diameter of 21 cm for homogeneous illumination.

Intense lights

Sometimes the small lights are not enough, and you need to use something more intense. There are several lights from Effilux and Chromases which are used with line scan cameras due to their high intensity and the possibility of active cooling. The most intense light is tunnel light for homogeneous illumination. The laboratory is also equipped with a few large bar lights, where the beam angle of individual LED lights is adjustable with the use of lenses.

Lenses

When it comes to lenses, there is also a lot to choose from. We have a wide range of lenses from Kowa and Computar that differ in focal length, sensor size and other parameters. If no lens meets the requirements, an adjustable lens from Schneider Kreuznach can be used – first from the right – and assembled from sub-components according to the magnification and working distance you need.

Line scan cameras with lenses

Compared to a matrix camera, a line camera captures only 1 line of pixels but with an incredible frame rate (dozens of kHz). It is often used in industry for the control of endless products on a conveyor belt, such as unwinding rolls of paper, glass or textiles. We have 3 types of Basler line scan cameras which differ in resolution and frame rate. There are 3 types of Kowa lenses suitable for cameras with different focal lengths.

Special cameras

The depth camera from Intel is an excellent solution not only for 3D scanning and facial recognition, but can also be utilized in robotics or VR, depending on the field of view. Basler TOF depth cameras work on the principle of measuring the time of flight of reflected light from the scanned object. This attribute enables instant acquisition of 3D and 2D images. The UV camera from jAi is sensitive to wavelengths of 400 nm and less. A high-speed camera is used to capture events that are too fast to be captured by the naked eye or other devices. The frame rate of the high-speed camera which can be used in Improlab is 253 fps with 2500 x 2000 px resolution. One of the most precious pieces of equipment in the laboratory is the laser camera C2-2040-GigE from Automation Technology. The camera is used for an accurate profile measurement in 3D by laser triangulation.

Telecentric lenses

There are 4 telecentric lenses available in Improlab, which can be applied to a variety of use cases. Telecentric lenses provide an orthographic projection, providing the same magnification at all distances, and low distortion. Due to those attributes, telecentric lenses become a key component for high-accuracy gauging applications. Lenses that are in the lab differ in having a fixture for a coaxial light, in the depth of field or magnification.

360° view lenses

360° view lenses from Opto Engineering are considered one of the most valuable pieces of equipment in the lab. The lenses are divided into two categories: for inner and outer inspection. The two biggest lenses in the picture have been made for outer inspection. The innovative design of the pericentric lens (the biggest in the picture) allows one camera to see the top and lateral surfaces of an object in perfect focus all in one image. The second biggest lens provides 8 different views from different angles due to a system of mirrors. Hole inspection lenses have been developed for the inspection of holes and cavities from the outside. On the other hand, borescope lenses have been developed for the inspection of cavities from the inside.

2.6 Part IV: IT Infrastructure

Applied AI needs innovators and people with conceptual thinking. These two factors produce specific demand on ICT-level infrastructure services be it high volume storage, GPU computing or parallel processing needing to be available scalable on demand to students in their studies and under different research projects.

These needs have brought a wide discussion on the future of ICT infrastructure services 5 years ago. And now, we can announce our conceptual design is being effectively used, showing the advanced advantages over, or – compared to – similar, broadly used solutions.

Our key ICT infrastructure services are the Computing Cluster, Application Cluster and Storage Cloud. In addition to that, we can offer consultations and demonstrations showing the advanced design and configuration of the infrastructure allowing for today's much-needed variability, scalability, sustainability and finally power optimization.

Computing Cluster, Application Cluster and Storage Cloud facilities are bookable per request up to client needs. For projects with requirements exceeding ordinary sizes, project-oriented work is supported with timewise booking of the needed infrastructure.

The following paragraphs show our services available through EDIH CTU in further detail.

2.6.1 Application Cloud Solutions Testing

Our ICT infrastructure enables transparent, dynamic, and scalable creation of SAAS virtual machines where piloting of individual solutions can be provided for costs comparable to Amazon Web Services and Azure cloud, however with better access to administering tools and services.

2.6.2 Computing Cluster

The FIT SuperNode computer is a specific device with optimized equipment. Among large RAM memory storage, there are 16 GPU cards with enough power to run AI-specific algorithms available which can be used simultaneously if needed.

2.6.3 Data Storage Cloud

Key ICT infrastructure components are different sizes/latency storage services. These are provided as hot connections to virtual servers on demand in most capacities an SME AI-based solution should ever require.

2.6.4 Planning AI Supporting Architecture Design

Consultations on ICT infrastructure design, planning and sustainable financing that express our experience from the past 5 years developing scalable and sustainable infrastructure are available on request.