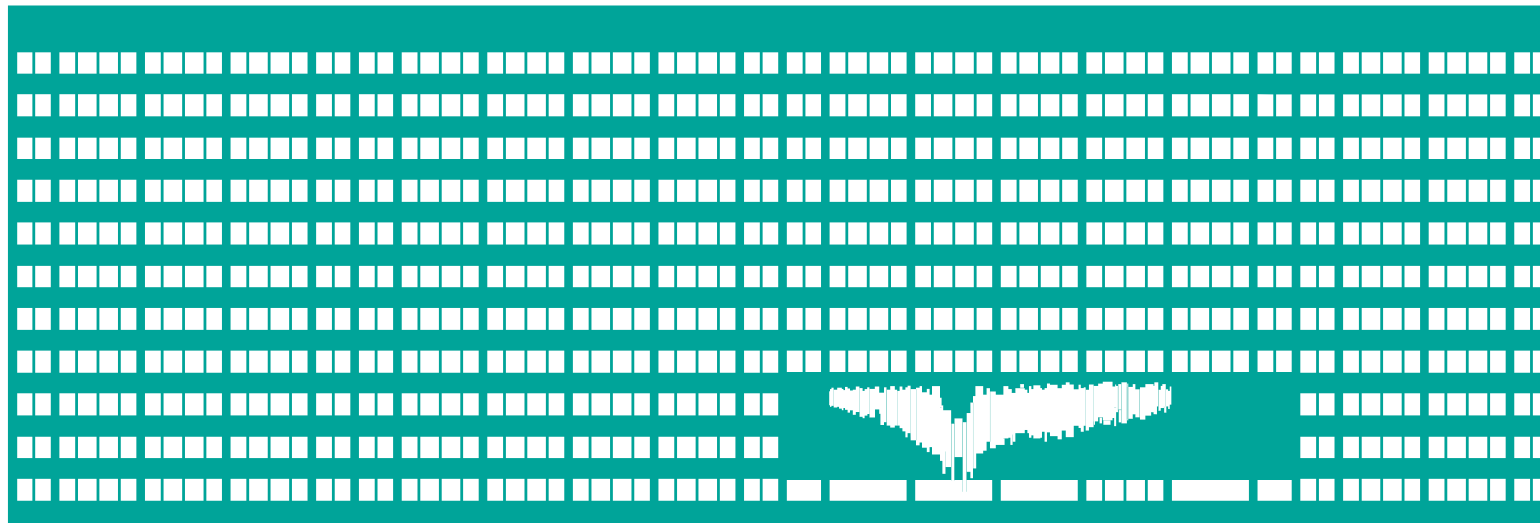


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OF OSTRAVA



www.vsb.cz

Robotics and Mechatronics. Research Cooperation Between Research Groups and Industry.

Václav Krys

Content

- 1) Brief introduction of our University
- 2) Overview of solved robotic projects
- 3) Current research projects
- 4) Robotic infrastructure at VSB - TUO
- 5) Areas of possible cooperation

1) Brief introduction of our University



Moravian-Silesian Region

- There are 3 universities
- It is close to Poland and Slovakia
- The centre of the region is the City of Ostrava
- Ostrava has around 300 000 inhabitants



Main regional industry partners

- Siemens
- ABB
- Continental
- Varroc
- Brose
- Třinec steelworks
- Tatra
- Brano
- VOP

7 Faculties

VSB TECHNICAL
UNIVERSITY
OF OSTRAVA | FACULTY
OF CIVIL
ENGINEERING

VSB TECHNICAL
UNIVERSITY
OF OSTRAVA | FACULTY OF ELECTRICAL
ENGINEERING AND COMPUTER
SCIENCE

VSB TECHNICAL
UNIVERSITY
OF OSTRAVA | FACULTY
OF SAFETY
ENGINEERING

VSB TECHNICAL
UNIVERSITY
OF OSTRAVA | FACULTY OF MATERIALS
SCIENCE AND TECHNOLOGY

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OF ECONOMICS

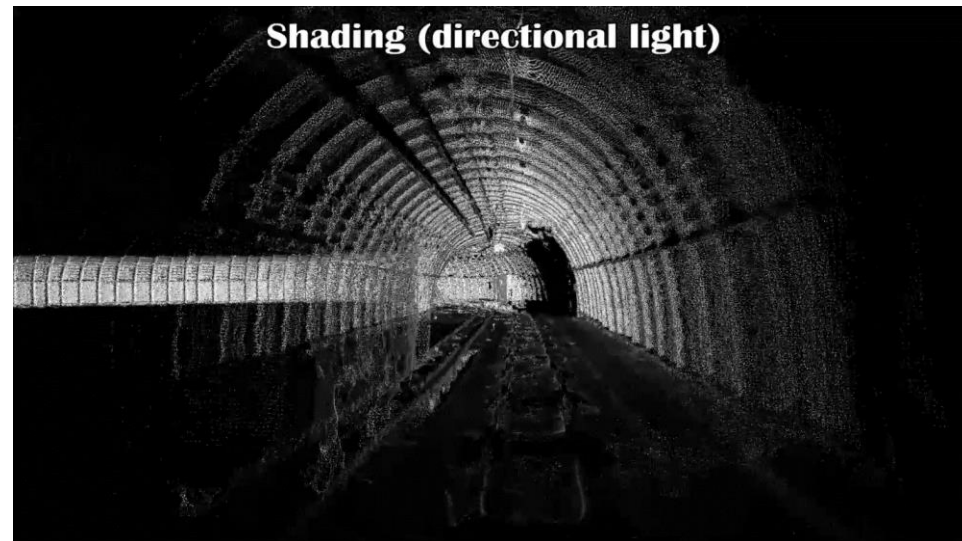
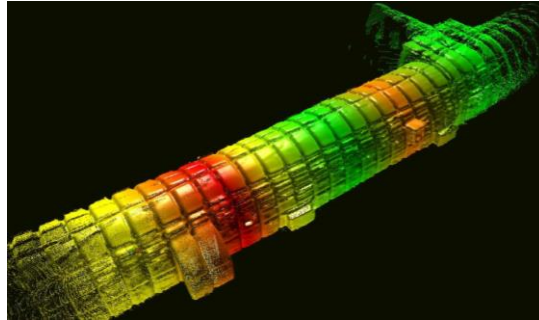
VSB TECHNICAL
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OF OSTRAVA | FACULTY
OF MINING
AND GEOLOGY

VSB TECHNICAL
UNIVERSITY
OF OSTRAVA | FACULTY
OF MECHANICAL
ENGINEERING

2) Outcomes of finished projects

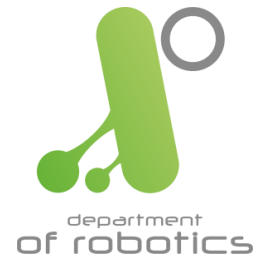
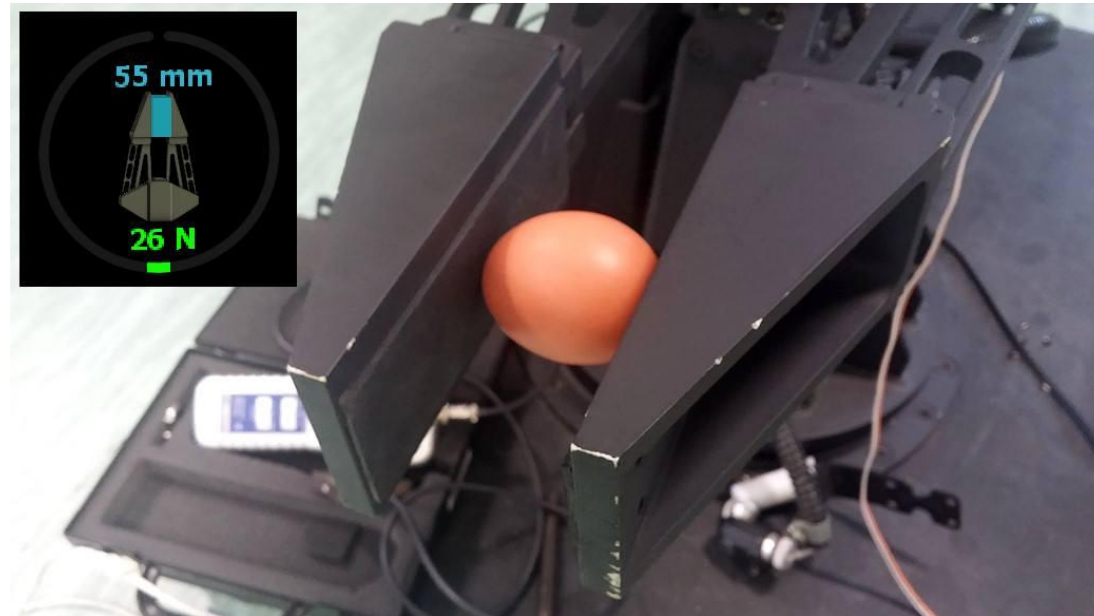
2.1) Telerescuer

- Goal: Develop a system for virtual teleportation (virtual immersion) of rescuers to the subterranean areas of a coal mine that have been closed due to a catastrophic event.
- EU programme of the Research fund for Coal and Steel
- 2014 – 2017
- Operating in explosive environment – ATEX.
- Poland, Spain, Austria, Czech Republic



2.2) TAROS

- Development of a **manipulator for military mobile robot 6x6 WD, 1.5 ton.**
- Control system for the teleoperated manipulator with automated functions.
- Precise control of the gripping force.
- HMI based on virtual reality.
- 2014 – 2016

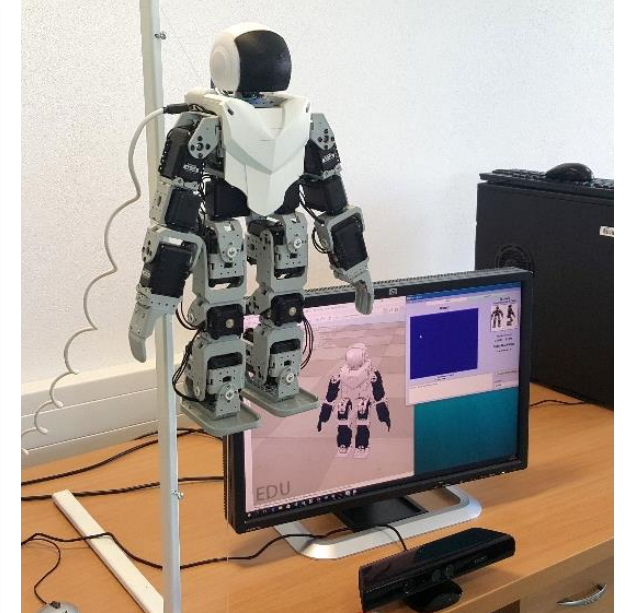
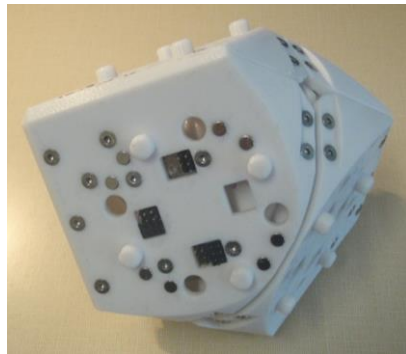
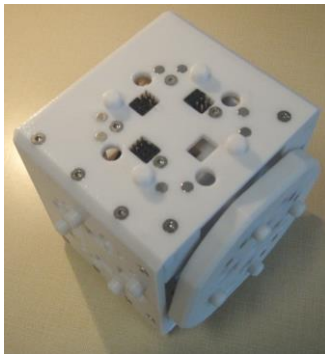
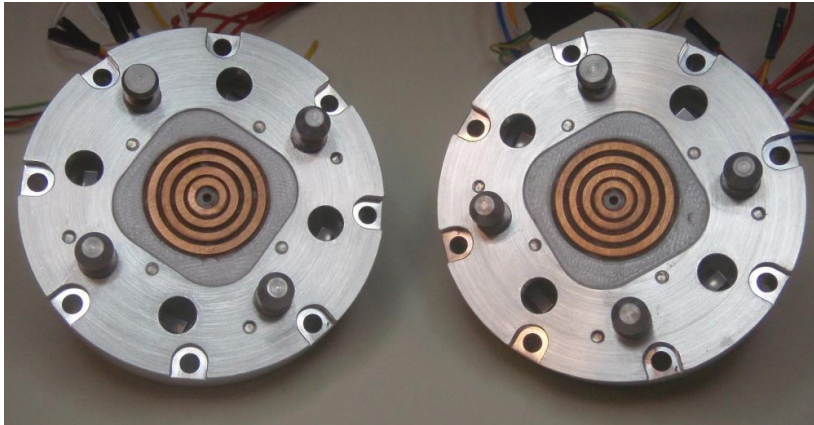
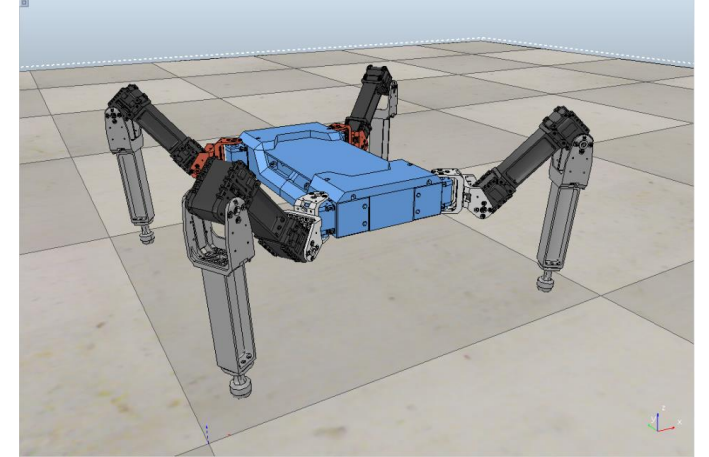
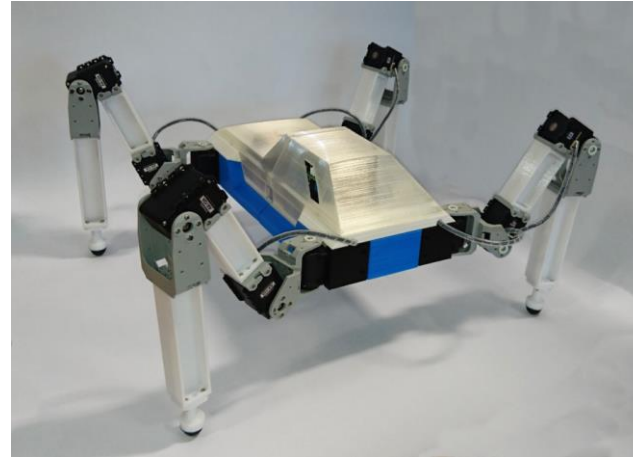


2.3) Detector

- Development and verification of a SW tool for cardboard boxes detection in a ship container.
- Preliminary step for the development of an automatic container unloading system.
- 2018



2.4) Other realized projects

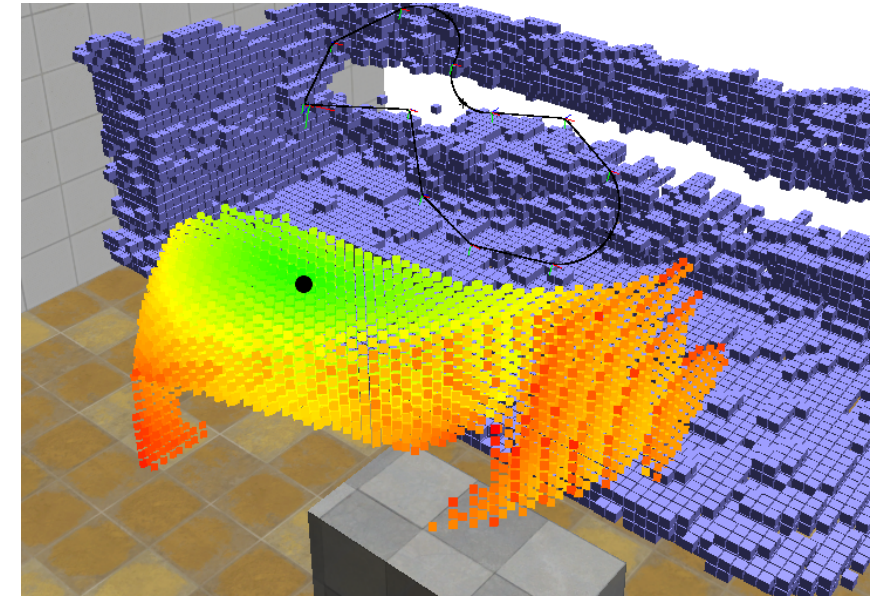
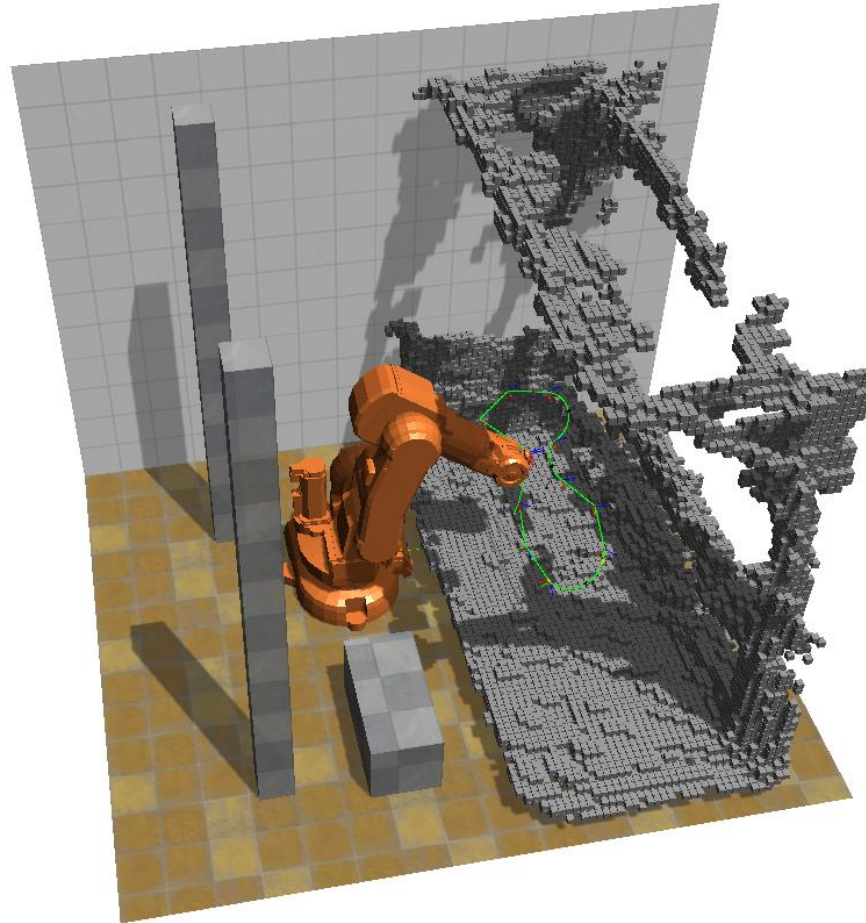


3) Current research projects

3.1-1) Research Centre of Advanced Mechatronic Systems

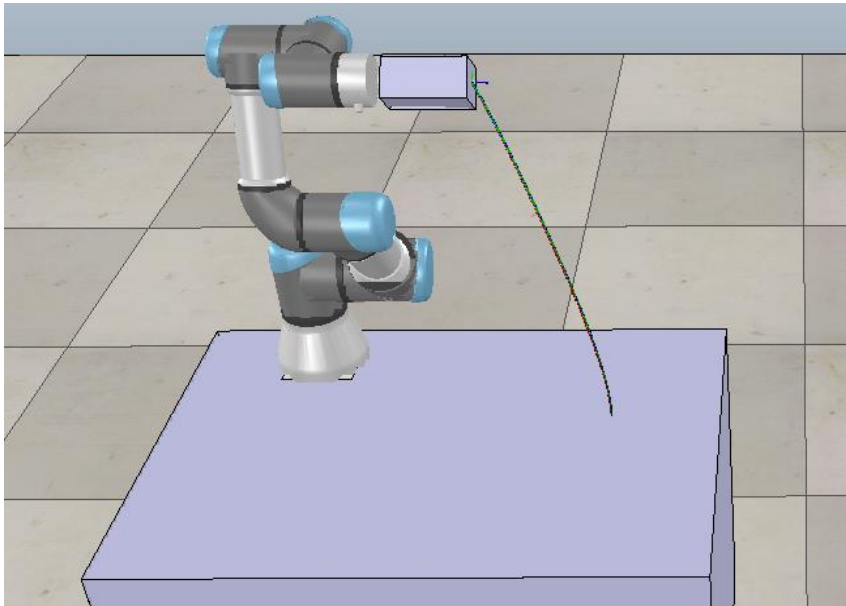
- Project in the frame of the Operational Program Research, Development and Education - EF16_019/0000867.
- 2018 – 2022
- Conceptual design of robotic manipulators.
- Topological design of robotic arms.

Selection of an appropriate robot from a database and **optimization of the robot base placement** according to given trajectory based on kinematic parameters.



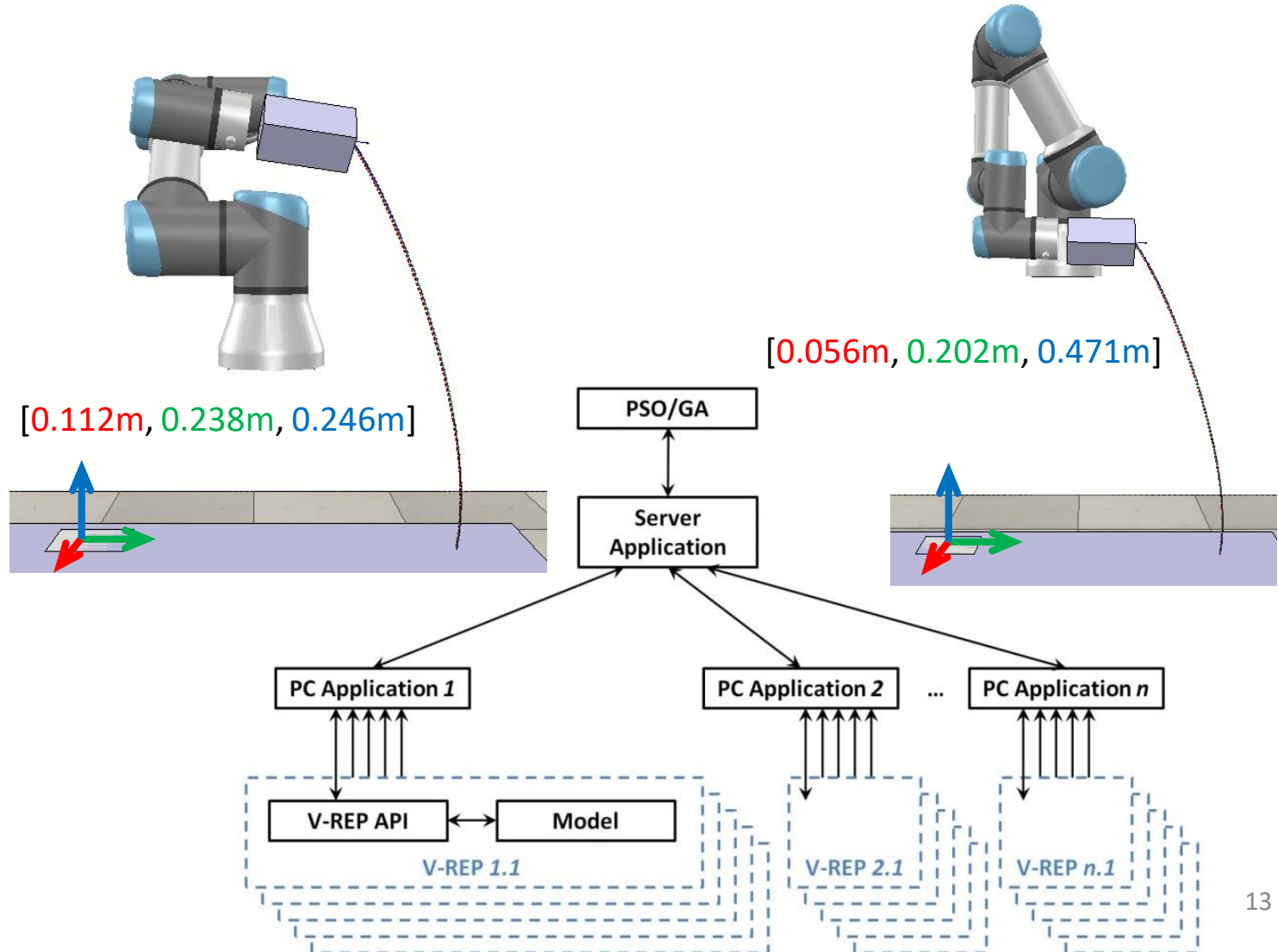
3.1-2) Research Centre of Advanced Mechatronic Systems

Optimization of manipulator base placement according to a given trajectory based on dynamic parameters. PSO and GA were tested for the optimization.



PSO - 8.94% lower drives torques

GA - 6.97% lower drives torques

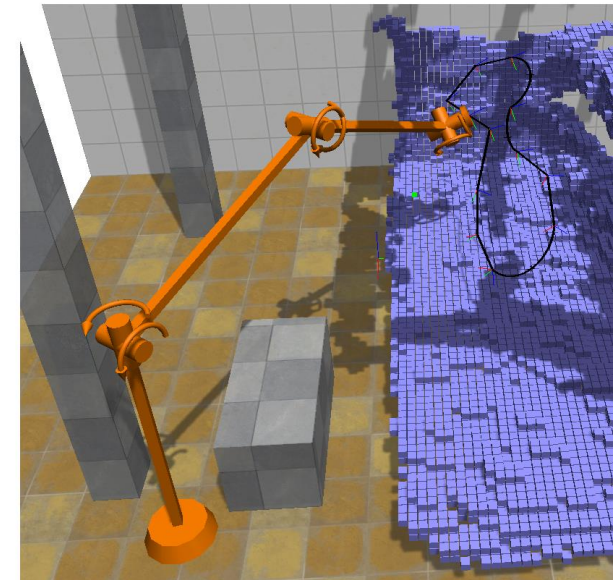
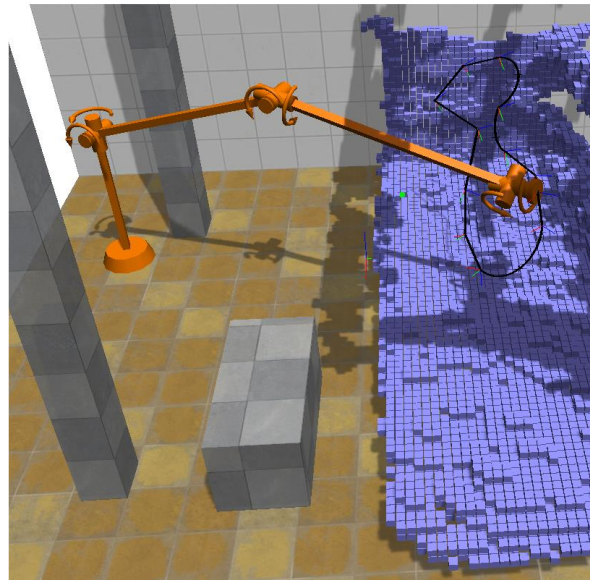
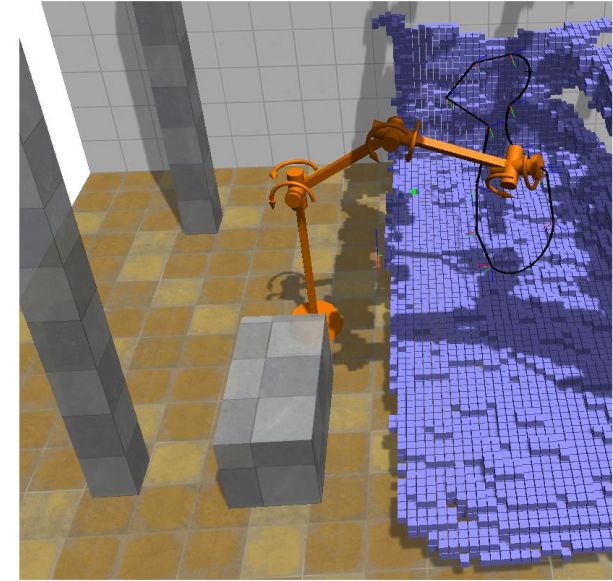
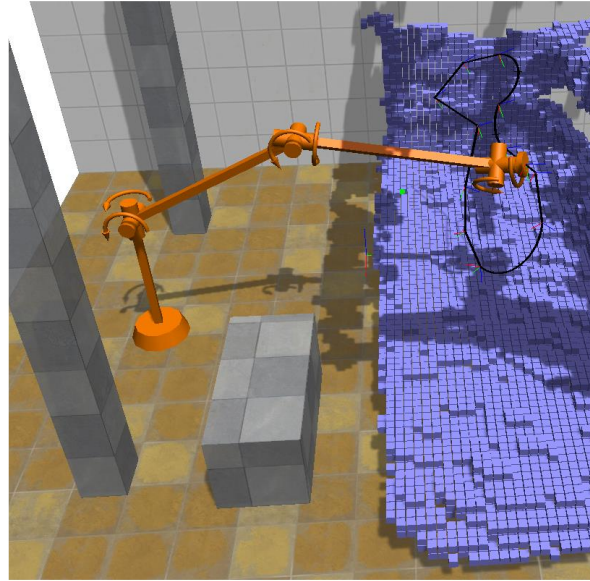


3.1-3) Research Centre of Advanced Mechatronic Systems

Synthesis of manipulator kinematic structure based on kinematic parameters.

Automatically suggests the smallest manipulator for the given trajectory, while keeping the defined fixed manipulator base position.

The **kinematic structure** is based on the common structure of many industrial robots (ABB, Kuka...).

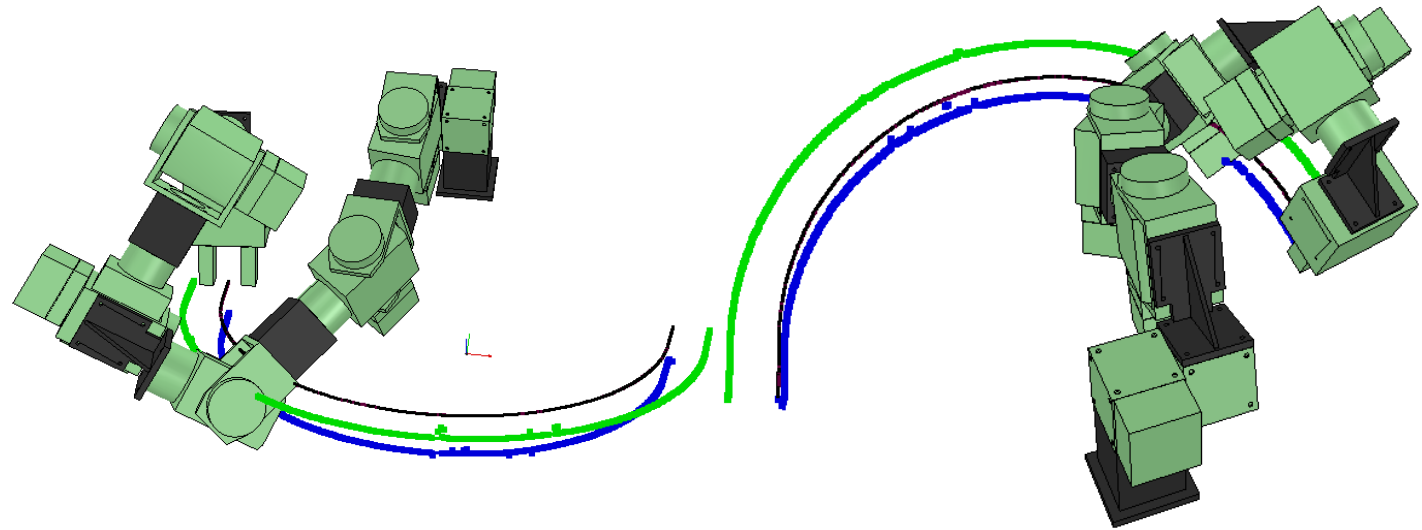


3.1-4) Research Centre of Advanced Mechatronic Systems

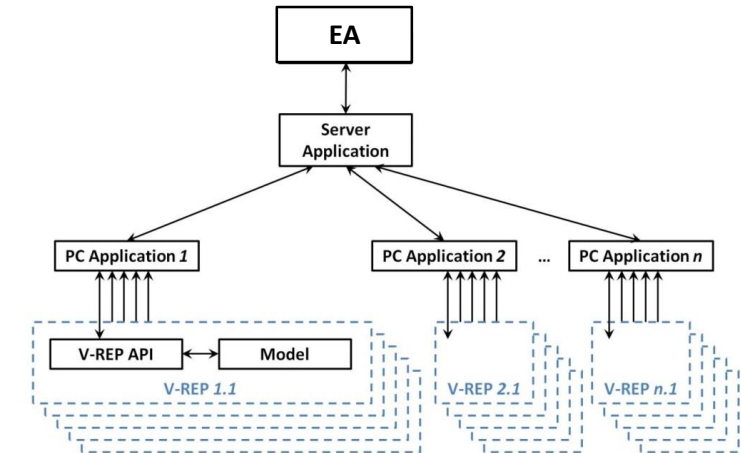
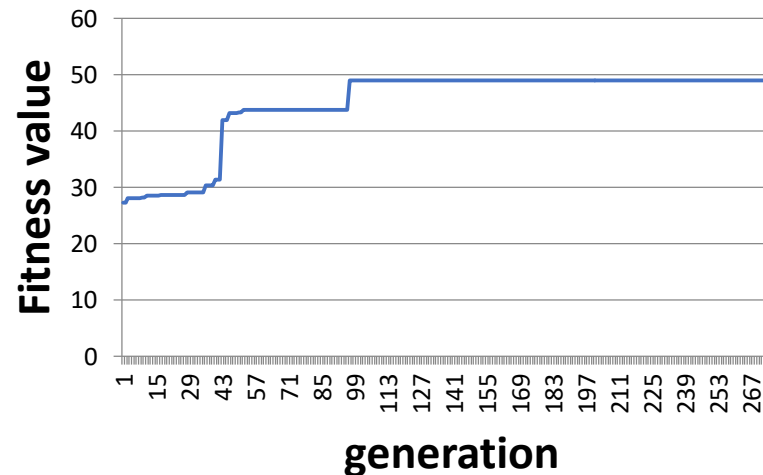
Synthesis of optimal manipulator kinematic structure for given task based on dynamics parameters.

Evolutional algorithm is used for the synthesis.

- Computational time - 16 hours
- 279 generations / 50 descendants
- 11 DoF
- 1 x PR70, 5 x PW70 (Schunk)
- Maximal possible fitness value is 56.25



fitness value 49.014



3.2) DMS Project

Research activities focused on Industry 4.0 and robotics with companies based in agglomeration of Ostrava. Research topics:

- Big data analysis
- Autonomous and collaborative robots
- Digital Twins
- Artificial Intelligence
- Smart systems and IoT
- Cyber security
- Functional safety and risk analyses in robotics
- 2018 - 2022



3.3) Cobots

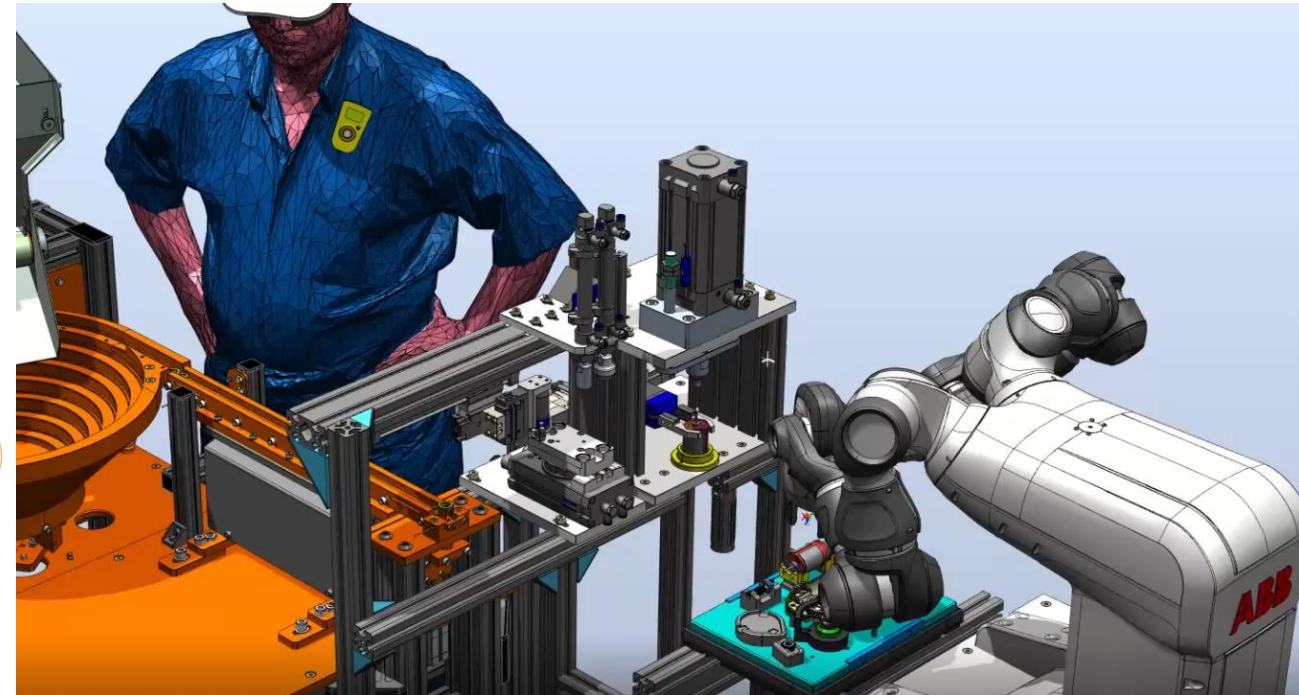
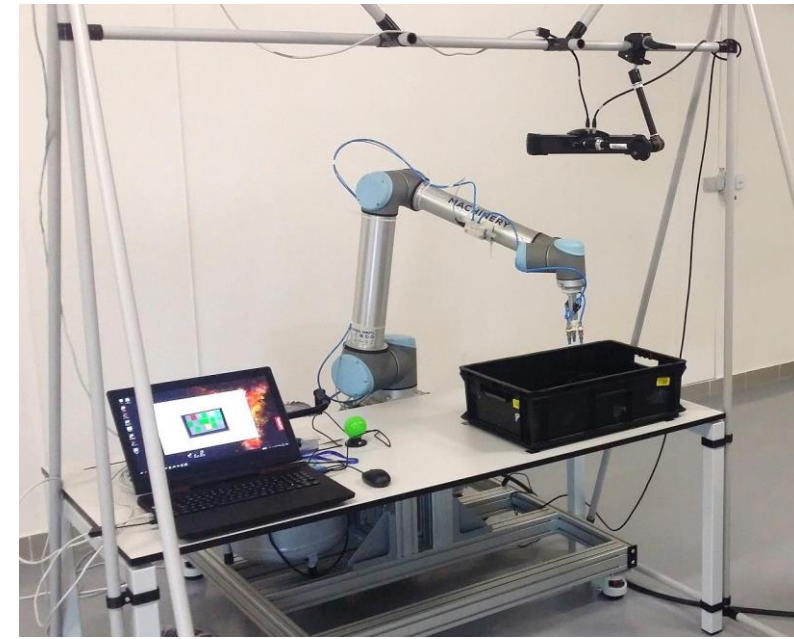
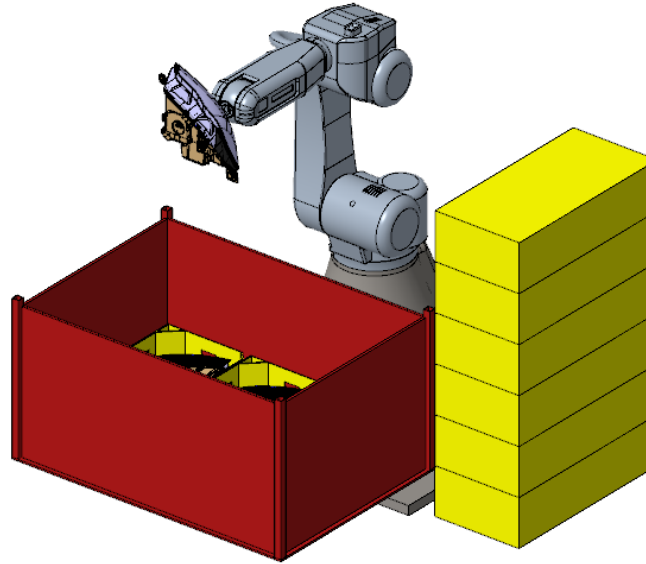
Development of robotized cells with cobots for automotive companies.

Packaging of head lamps – Varroc.

Assembly operations – Brano.

Machine feeding with parts from bins – Continental.

2018 - 2019



4) Robotic infrastructure at VSB - TUO

4.1) Robotics Centre

1x ABB IRB 1660ID

1x ABB IRB 1600

2x ABB IRB 1200

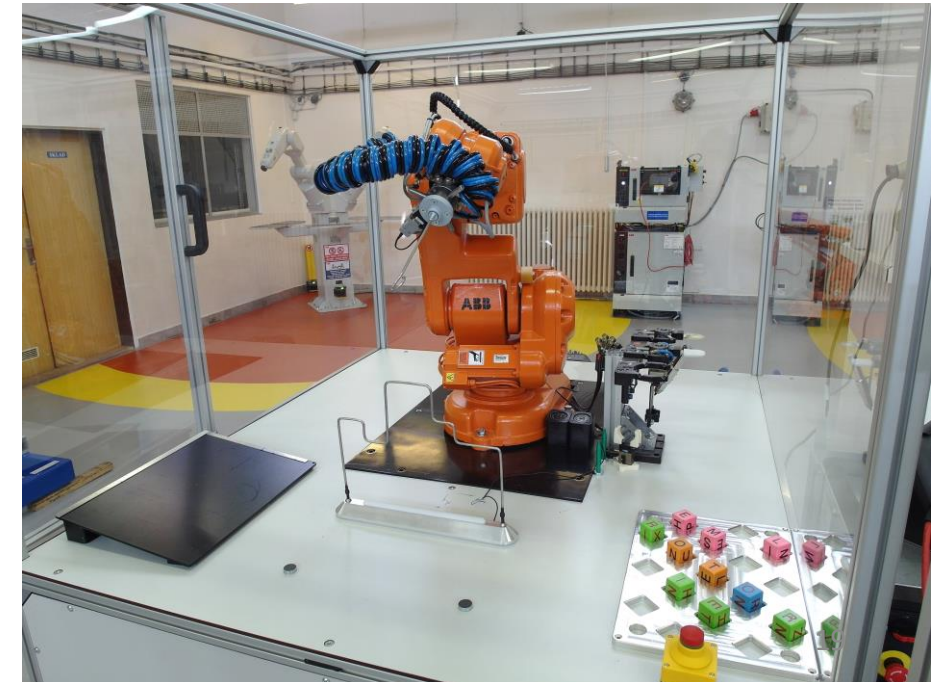
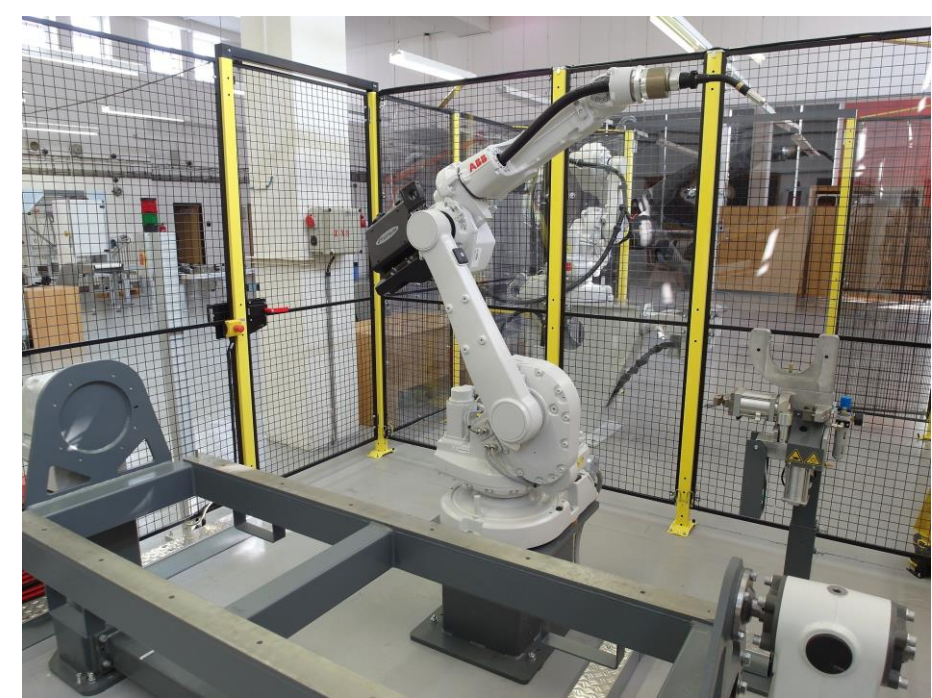
1x ABB IRB 360

3x ABB IRB 140

2x Mitsubishi RV2-AJ

1x ABB IRB 14000 YuMi

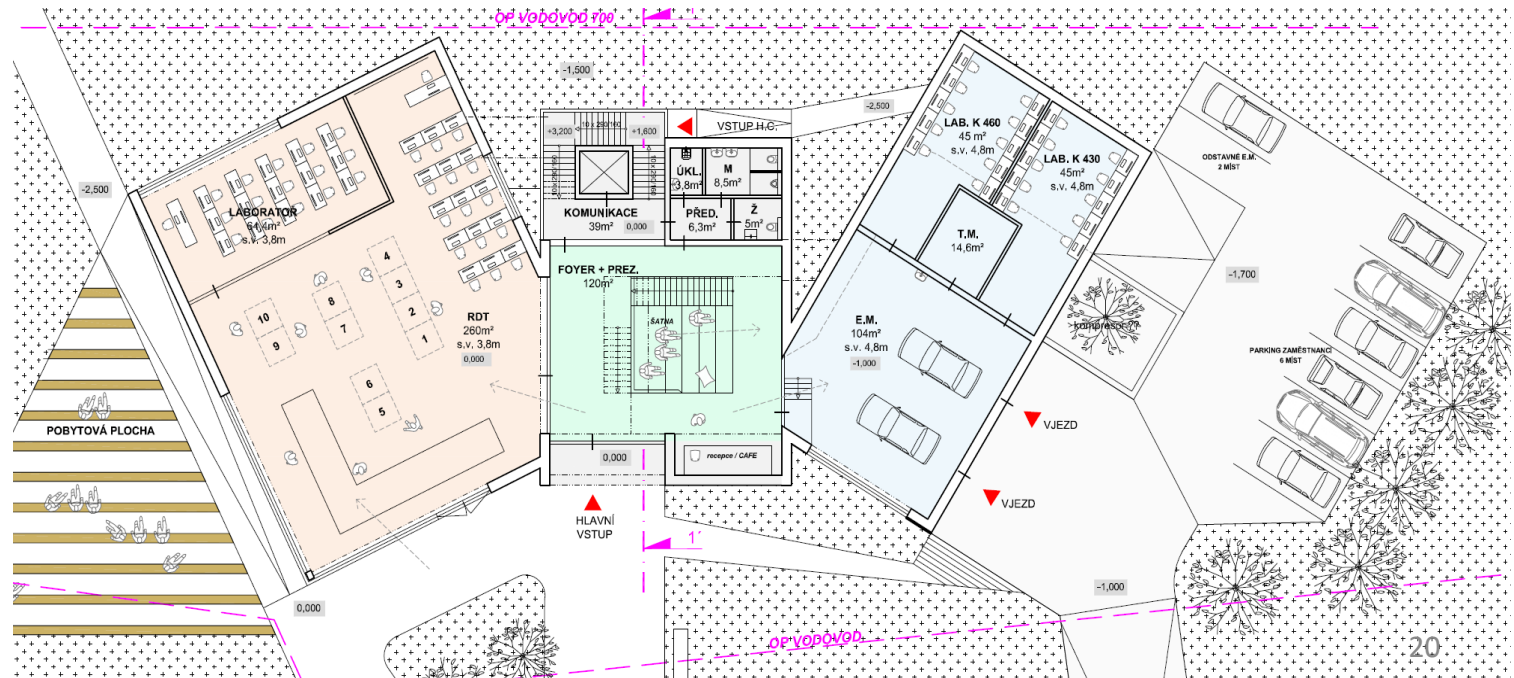
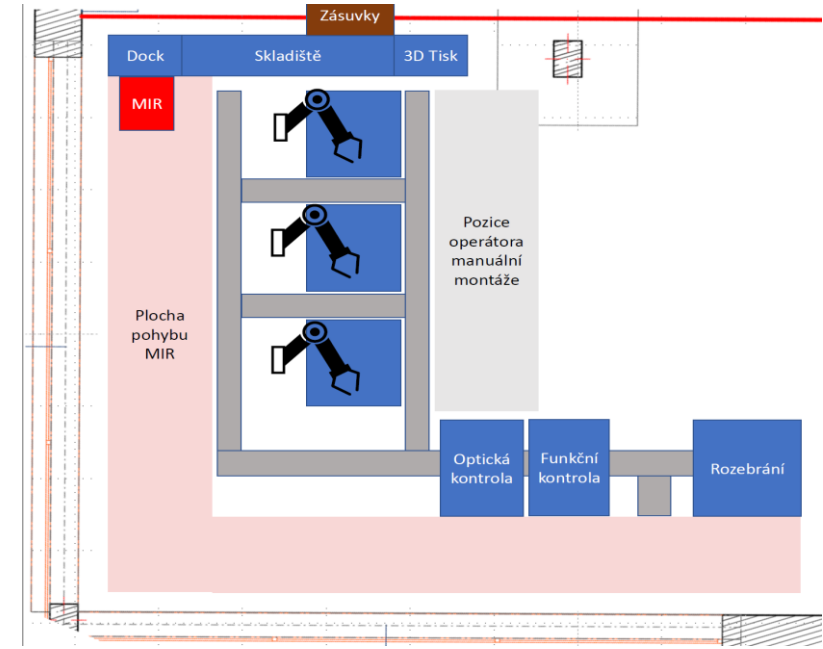
1x UR3



4.2) CPIT TL3 – Smart Factory

Educational TestBed:

- Digital Twin / Virtual Commissioning
- Cyber Security
- Predictive Maintenance
- Picture/3D Recognition
- Mobile robots for logistic
- Virtual/Augmented reality
- Part of TestBed net – Prag (ČVUT), Brno (VUT)
- Opening: 31. 1 . 2020



5) Areas of possible cooperation

5) Possible cooperation

- Tools for design and optimization of robotic cells and production lines
- R&D of mobile robots and their subsystems
- Modular robotics
- Machine perception – object recognition
- Neuronal networks and machine learning

Thank you for your attention

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