VSB TECHNICAL UNIVERSITY OF OSTRAVA | FACULTY OF MECHANICAL ENGINEERING | DEPARTMENT OF ROBOTICS

Department of Robotics
R&D Outputs and Current Activities

Václav Krys

Content

1) General information about the department
2) Overview of solved robotic projects
3) Current research projects
4) Robotic infrastructure at our department
5) Possible topics for future projects or cooperation

1) General information about the department

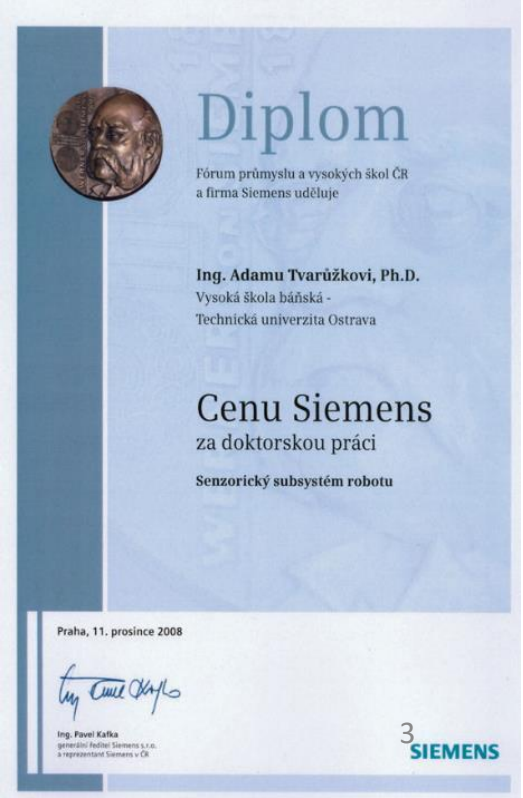
department
of robotics

Department of Robotics

- Our study programs are:
  - Robotics – Bachelor (3 years)
  - Robotics – Master (2 years)
  - Robotics – Doctoral (4 years)
- We participate on study programs:
  - Mechatronics – Bachelor (3 years)
  - Mechatronics – Master (2 years)

5x Werner von Siemens awards (2000, 2008, 2010, 2012, 2019):

- 2x best diploma thesis
- 3x best Ph.D. thesis



Diplom

Fórum průmyslu a vysokých škol ČR
a firma Siemens uděluje

Ing. Adamu Tvarůžkovi, Ph.D.
Vysoká škola báňská -
Technická univerzita Ostrava

Cenu Siemens
za doktorskou práci

Senzorický subsystém robotu

Praha, 11. prosince 2008

Ing. Pavel Kafka
generální ředitel Siemens s.r.o.
a reprezentant Siemens v ČR

SIEMENS

Department of Robotics - staff

- 2 professors and 3 associate professors:

	prof. Dr. Ing. Petr Novák **Head of Department**	office: A740 phone: 3595
	prof. Dr. Ing. Vladimír Mostýn	office: A738 phone: 4257
	doc. Ing. Zdenko Bobovský, Ph.D. **Deputy Head of Department**	office: A839 phone: 5309
	doc. Ing. Tomáš Kot, Ph.D.	office: C201 phone: 9363
	doc. Ing. Milan Mihola, Ph.D.	office: A840 phone: 5445

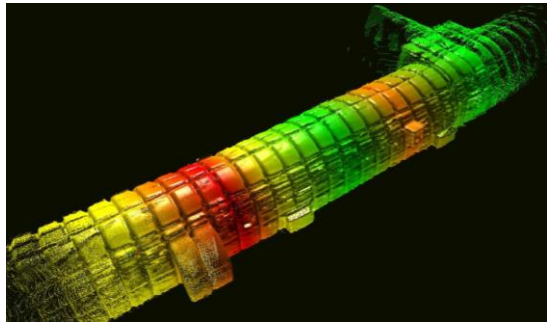
- 8 Lecturers (5 Ph.D. students)
- 6 Researchers (4 Ph.D. students)

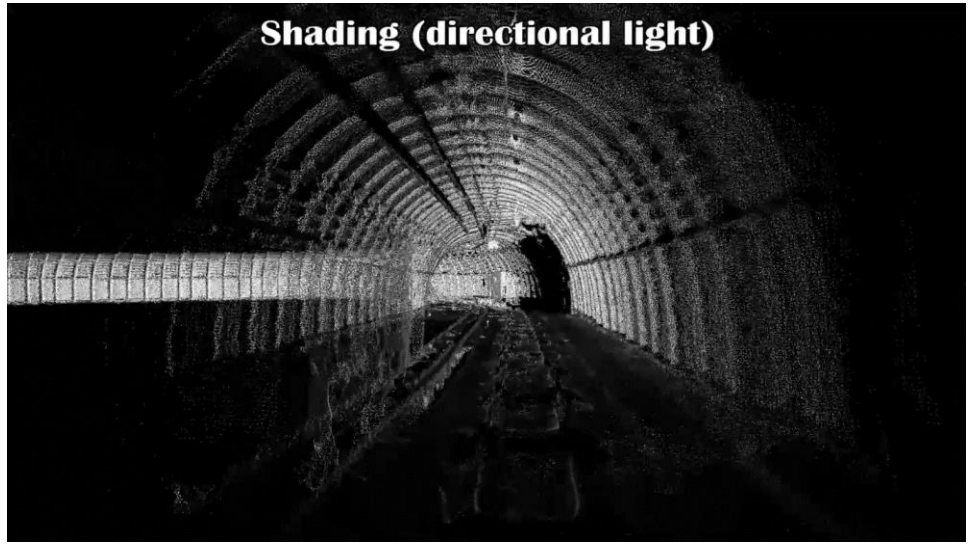
department of robotics

2) Outcomes of finished projects

2.1) Telerescuer

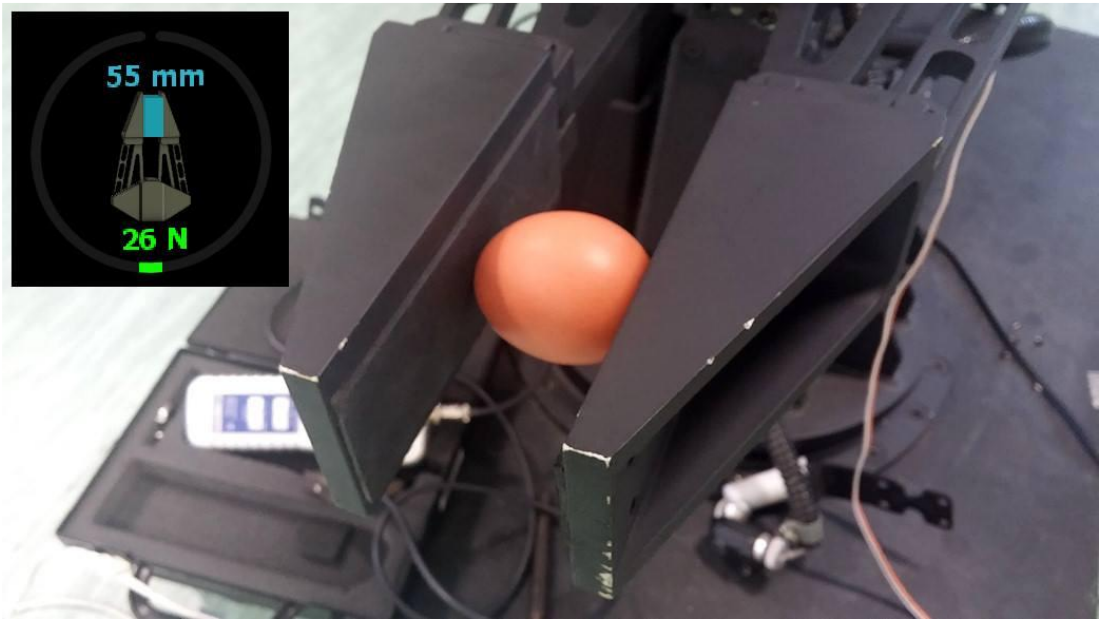
- Goal: Develop a system for virtual teleportation (virtual immersion) of rescuers to the subterranean areas of a coal mine that have been closed due to a catastrophic event.
- EU programme of the Research fund for Coal and Steel
- 2014 – 2017
- Operating in explosive environment – ATEX.
- Poland, Spain,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





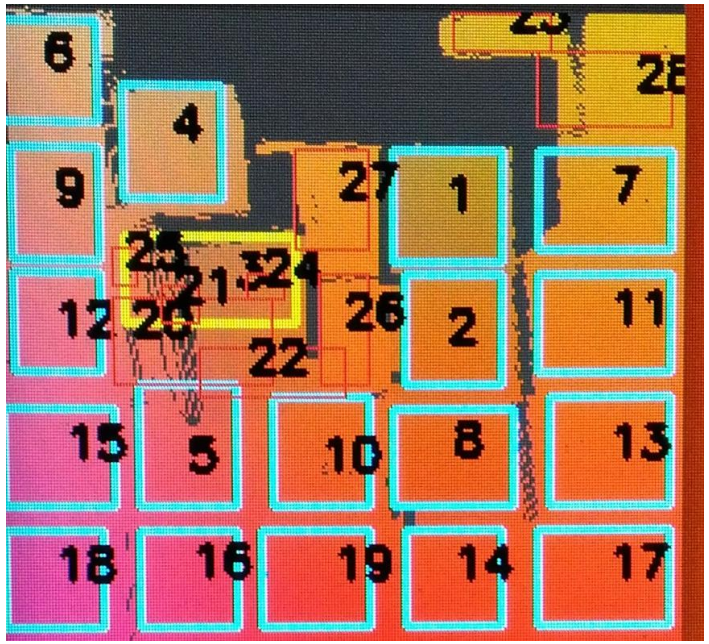
2.2) TAROS

- 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



ADLER CZECH A.S.

VSB TECHNICAL UNIVERSITY OF OSTRAVA department of robotics

2.4) Cobots

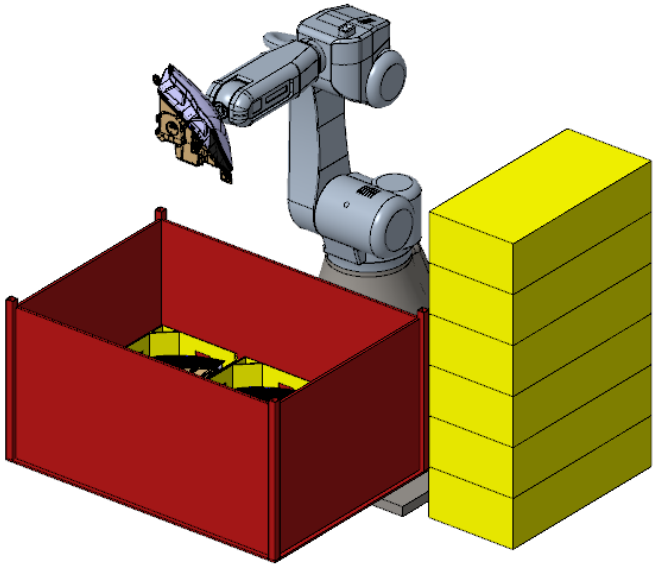
Development of robotized cells with cobots for automotive companies.

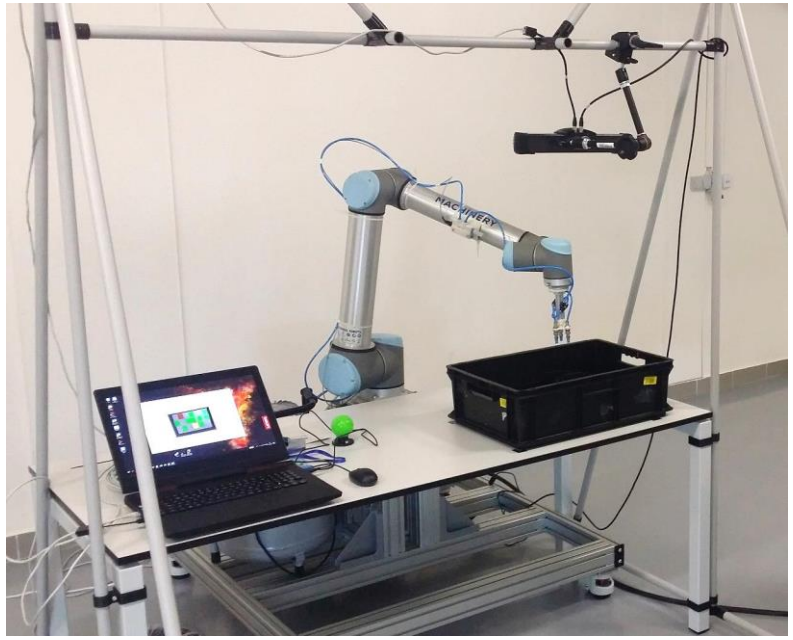
Packaging of head lamps – Varroc.

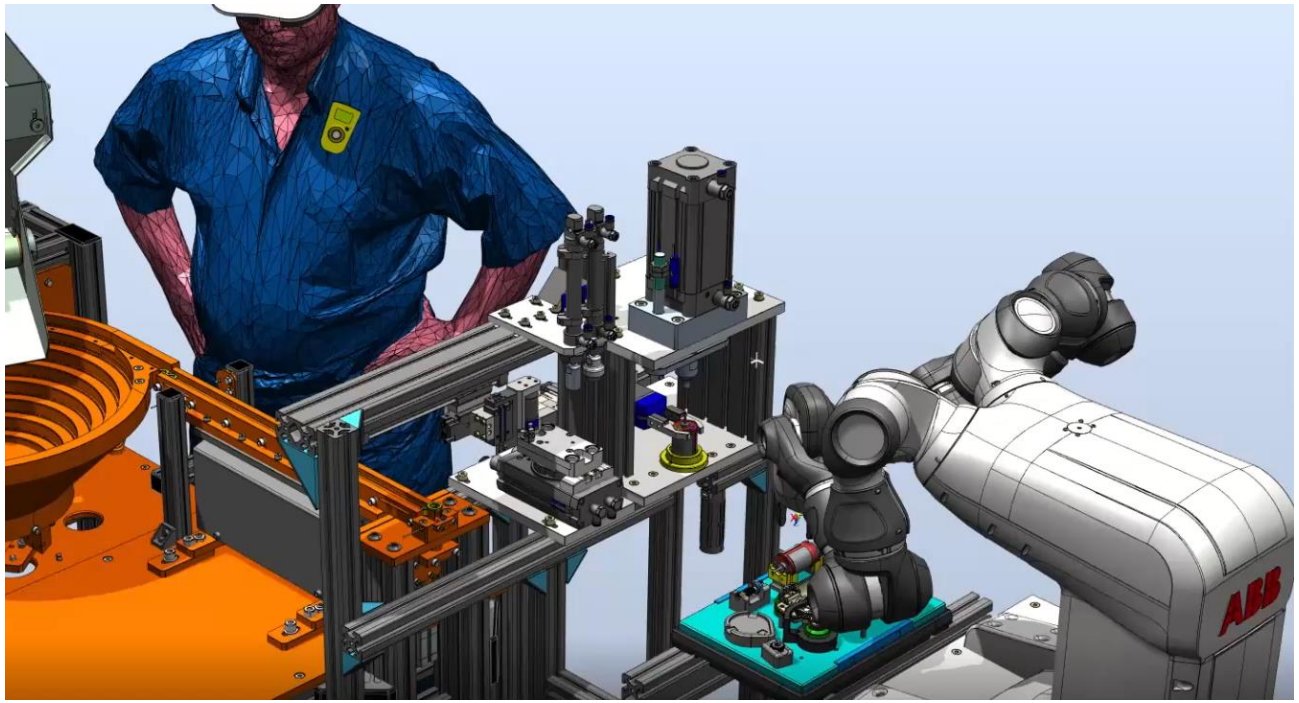
Assembly operations – Brano.

Machine feeding with parts from bins – Continental.

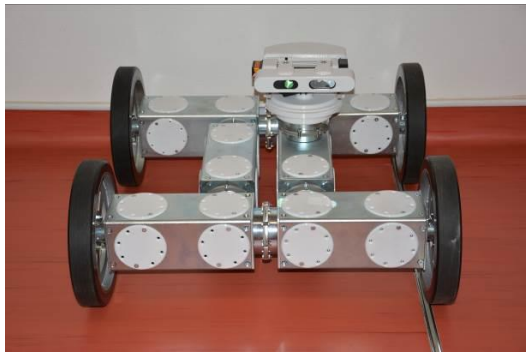
2018 - 2020

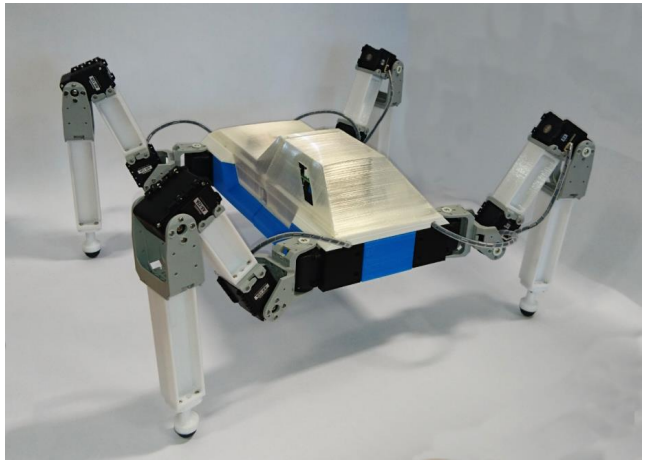


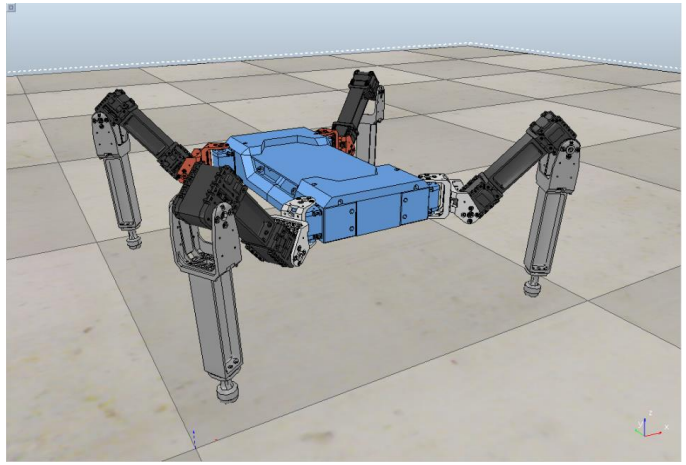


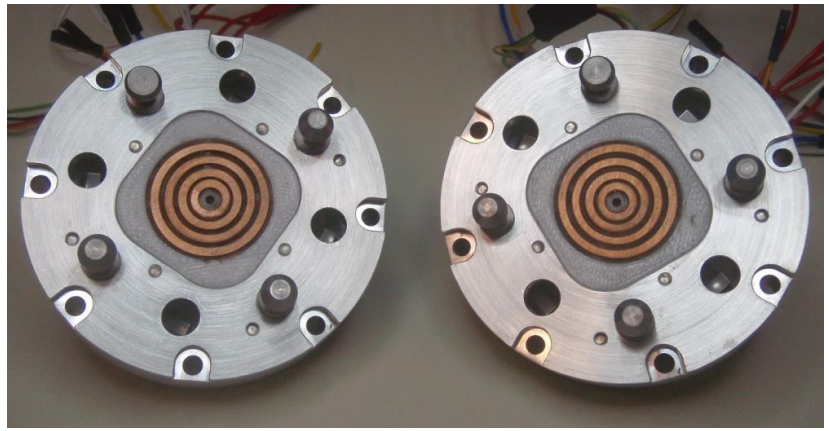


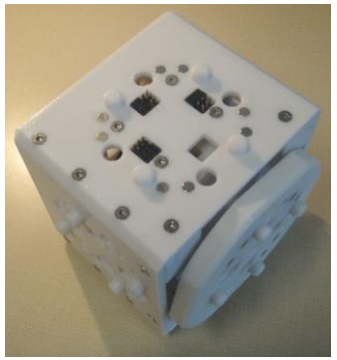
2.5) Other realized projects

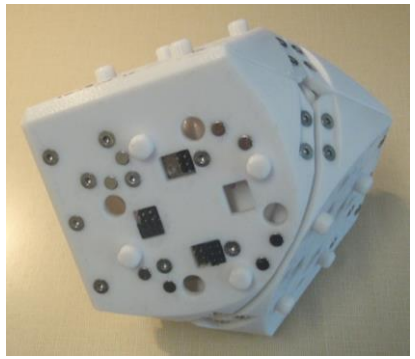


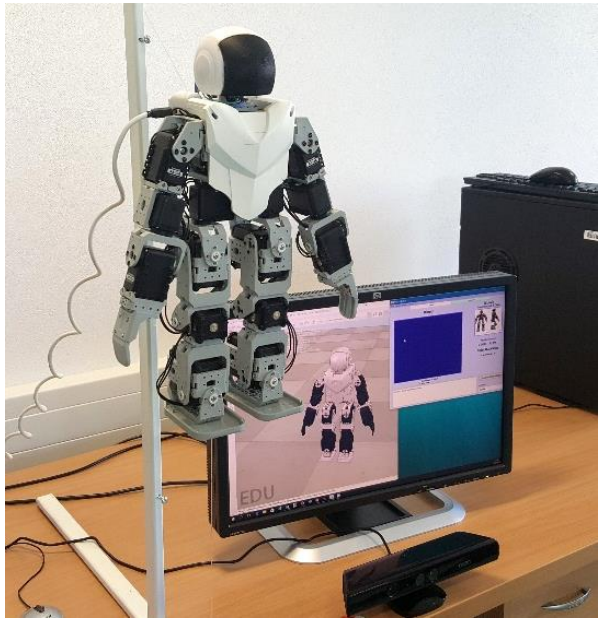










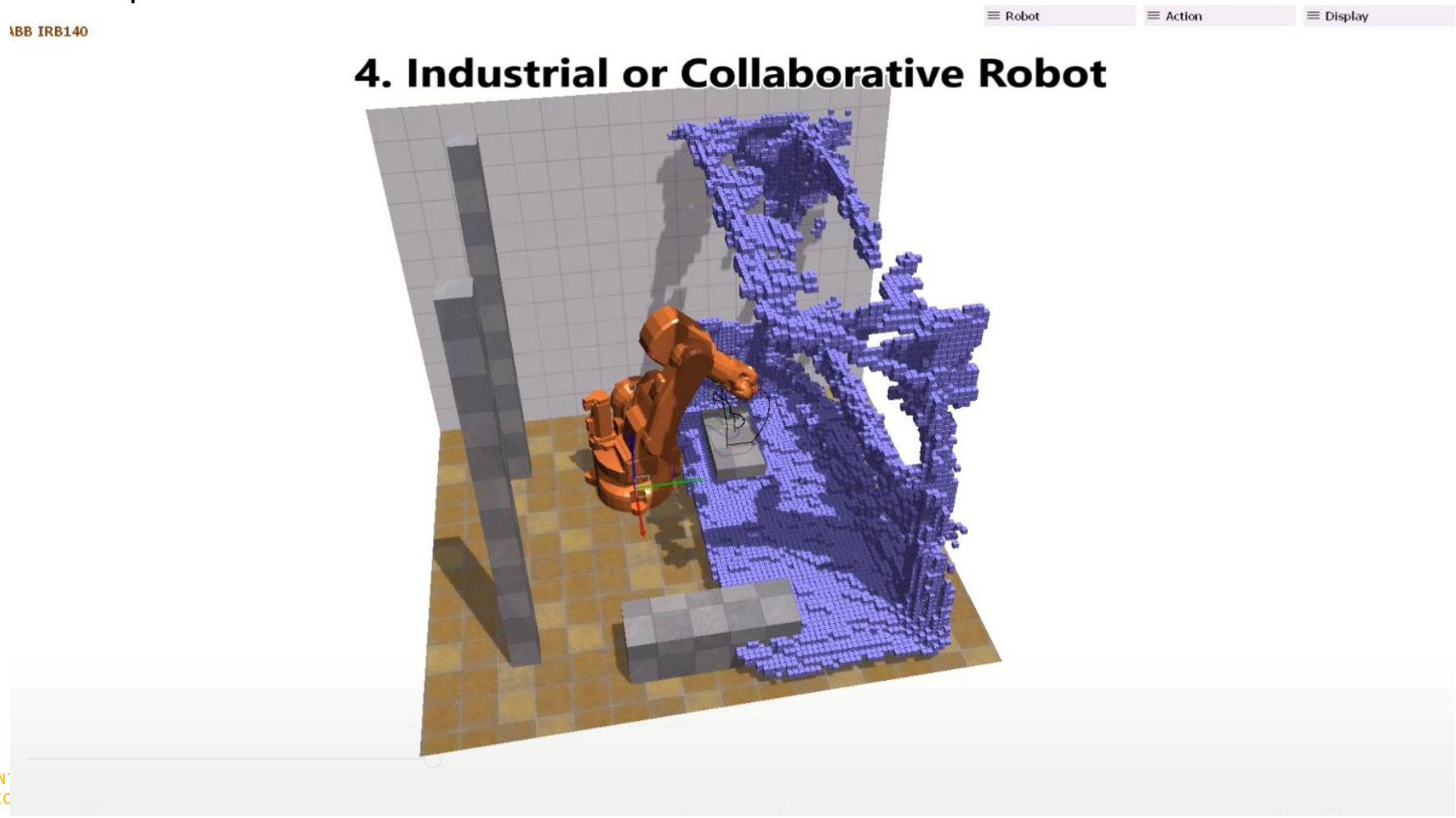


3) Current research projects

3.1-1) Research Centre of Advanced Mechatronic Systems

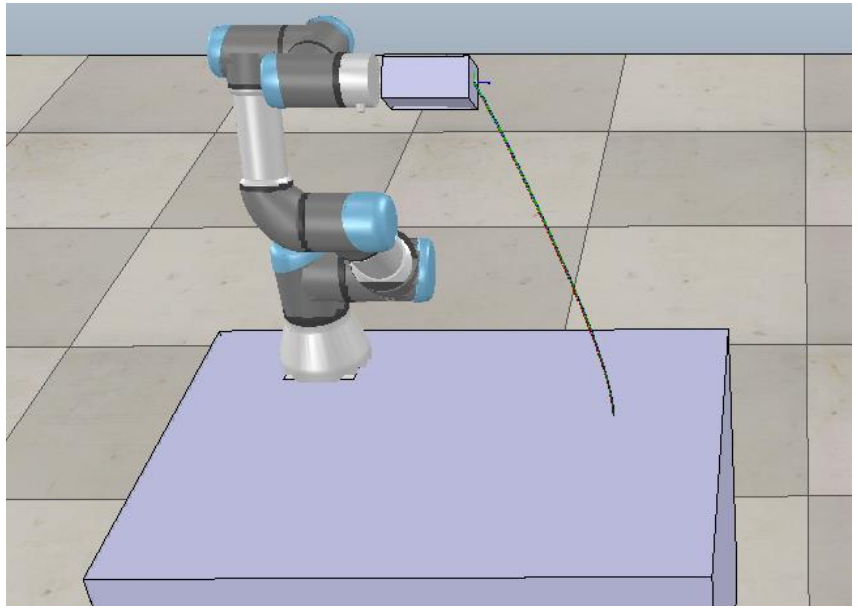
- Project in the frame of the Operational Program Research, Development and Education - EF16_019/0000867.
- 2018 – 2022
- Conceptual design of robotic manipulators.
- Topological design of robotic arms.

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



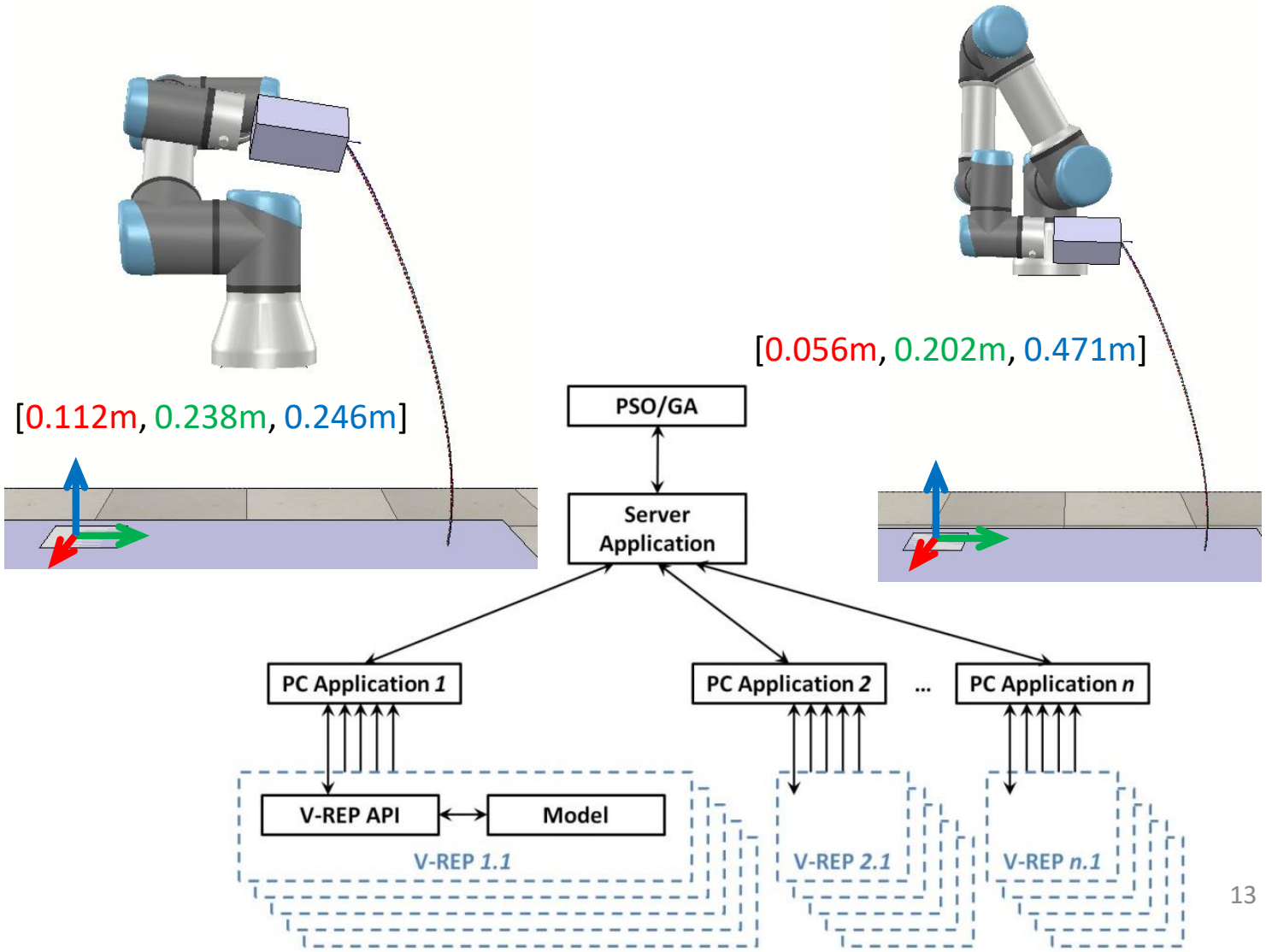
3.1-2) Research Centre of Advanced Mechatronic Systems

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

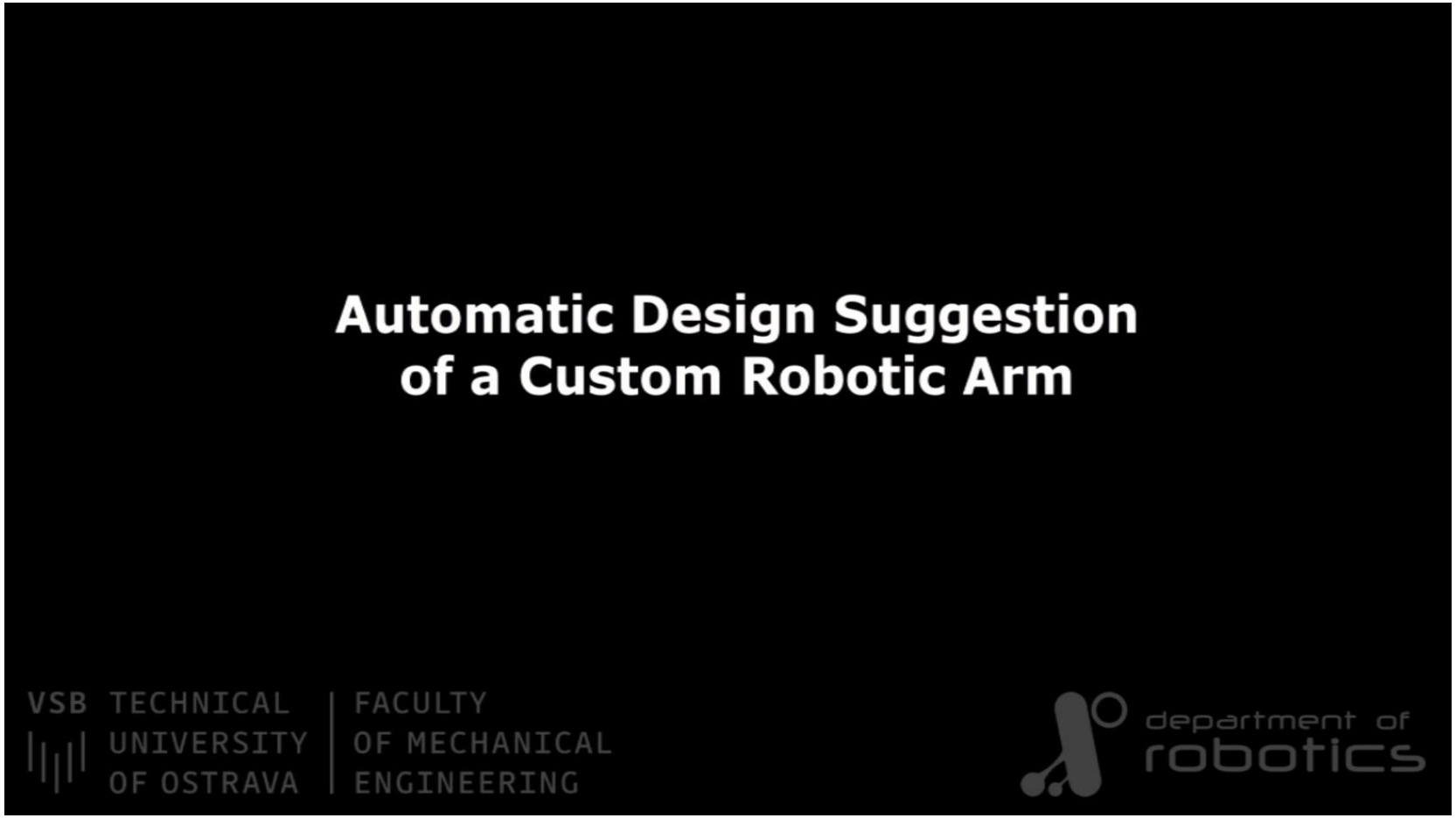


3.1-3) Research Centre of Advanced Mechatronic Systems

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…).

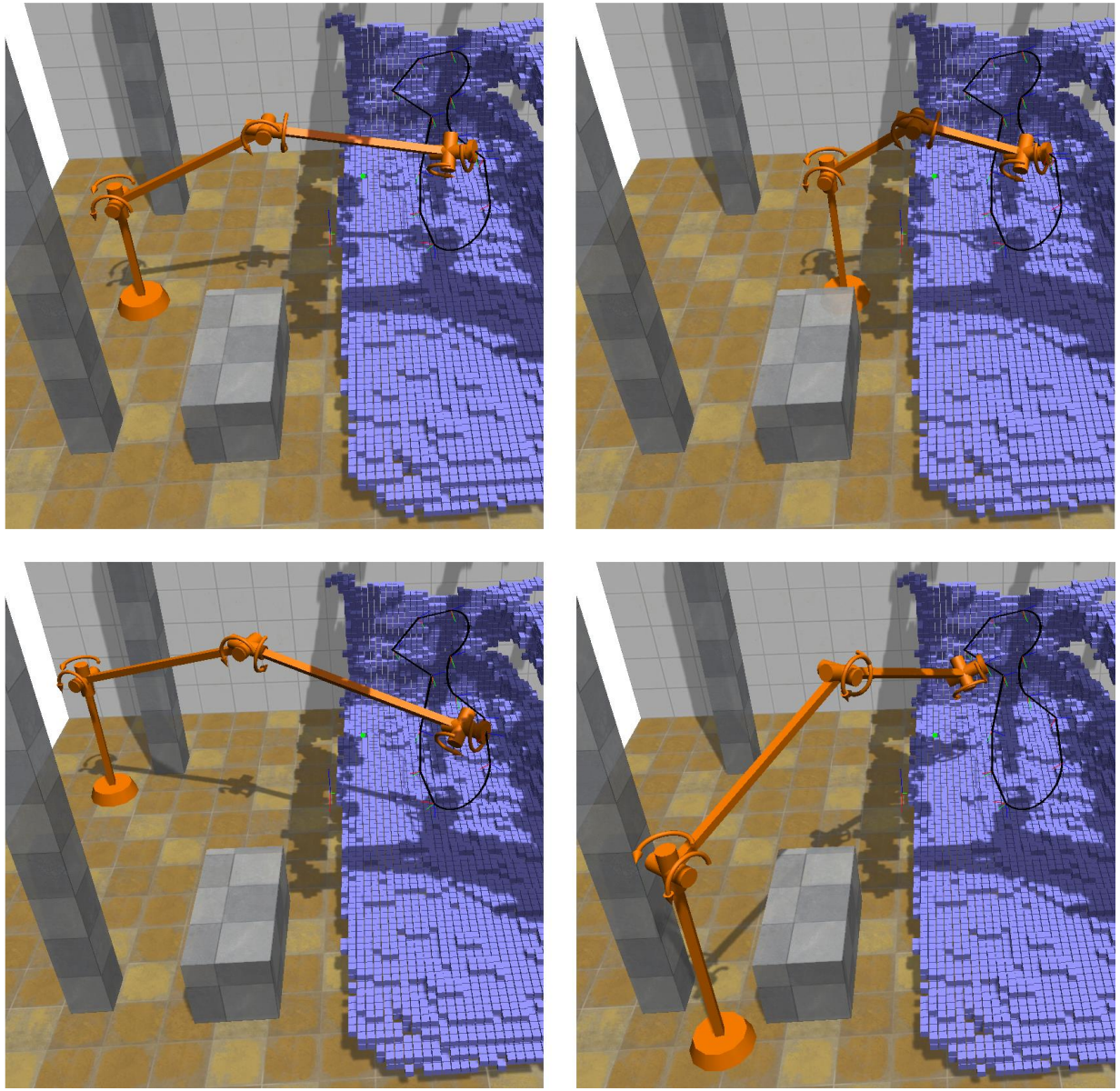


3.1-3) Research Centre of Advanced Mechatronic Systems

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…).

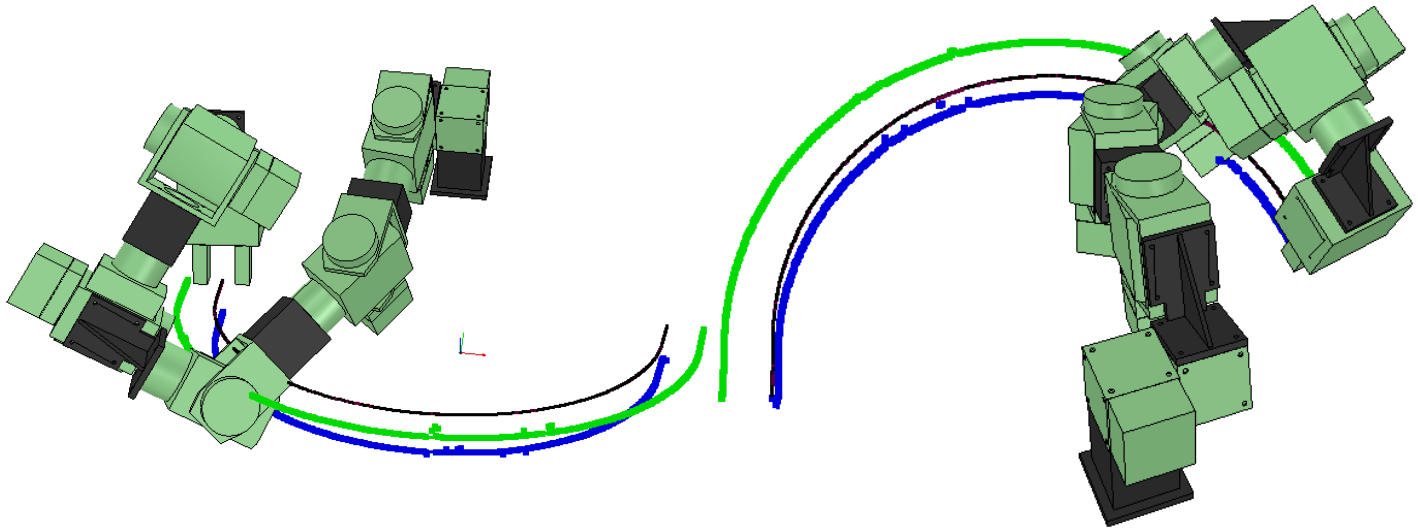


3.1-4) Research Centre of Advanced Mechatronic Systems

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

Evolutional algorithm is used for the synthesis.

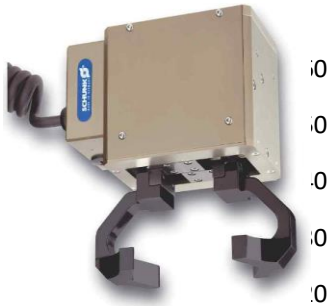
Manipulator is generated from Schunk modules PR70 and PW70.



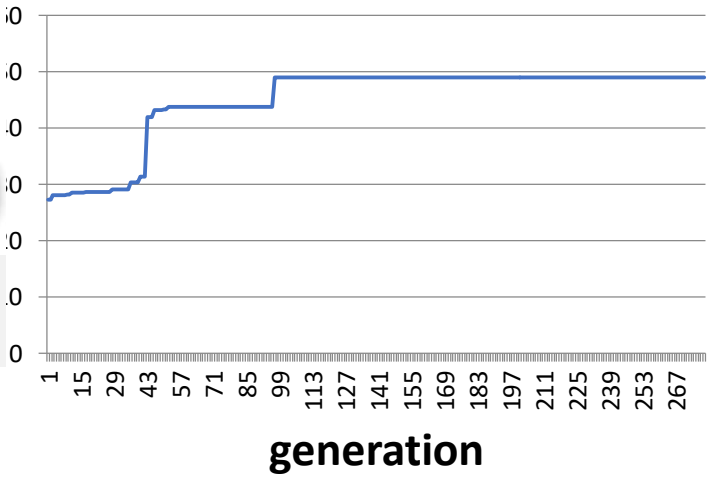
fitness value 49.014

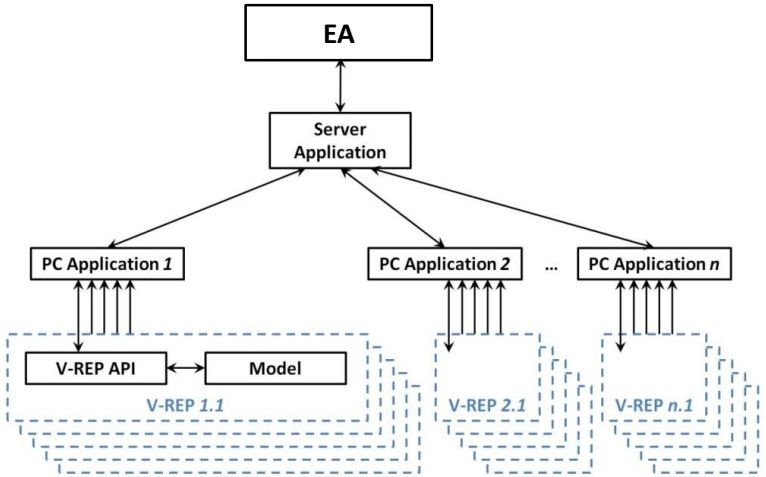
Module Schunk PR90 a PR70 (1 DOF)

Module Schunk PW70 (2 DOF)



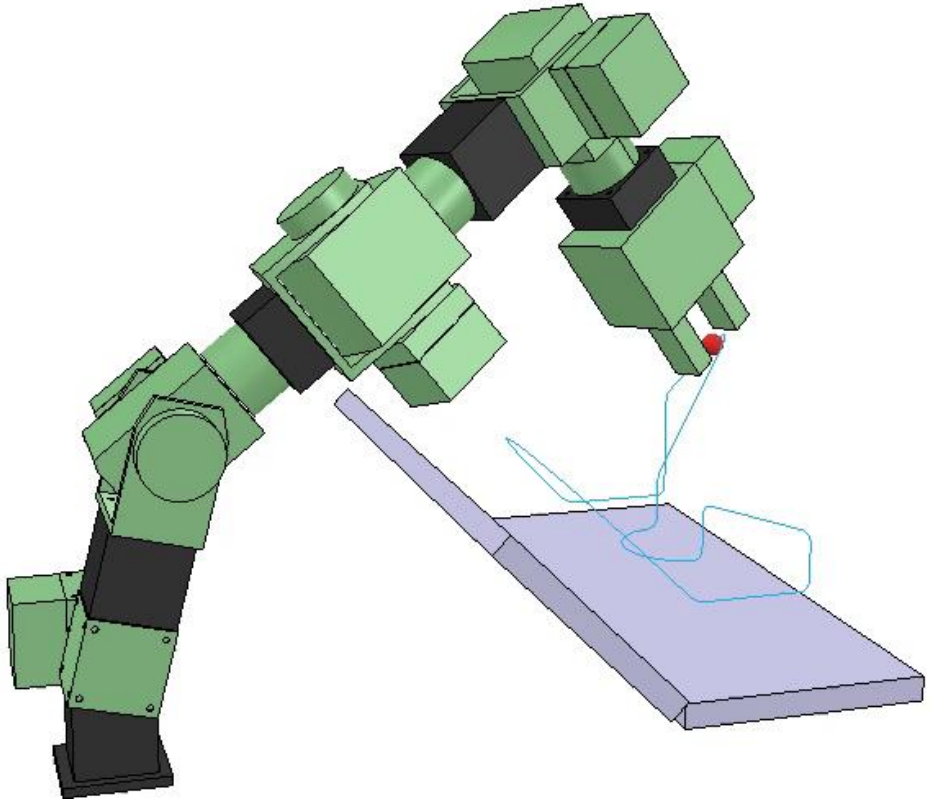
Efector Schunk PG-70

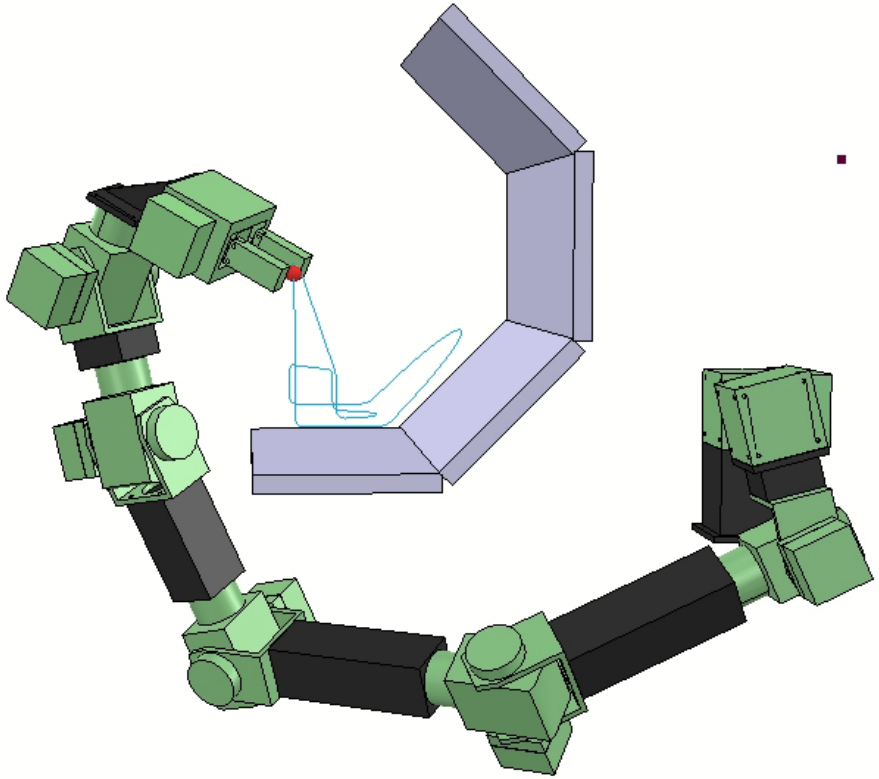




3.1-4) Research Centre of Advanced Mechatronic Systems

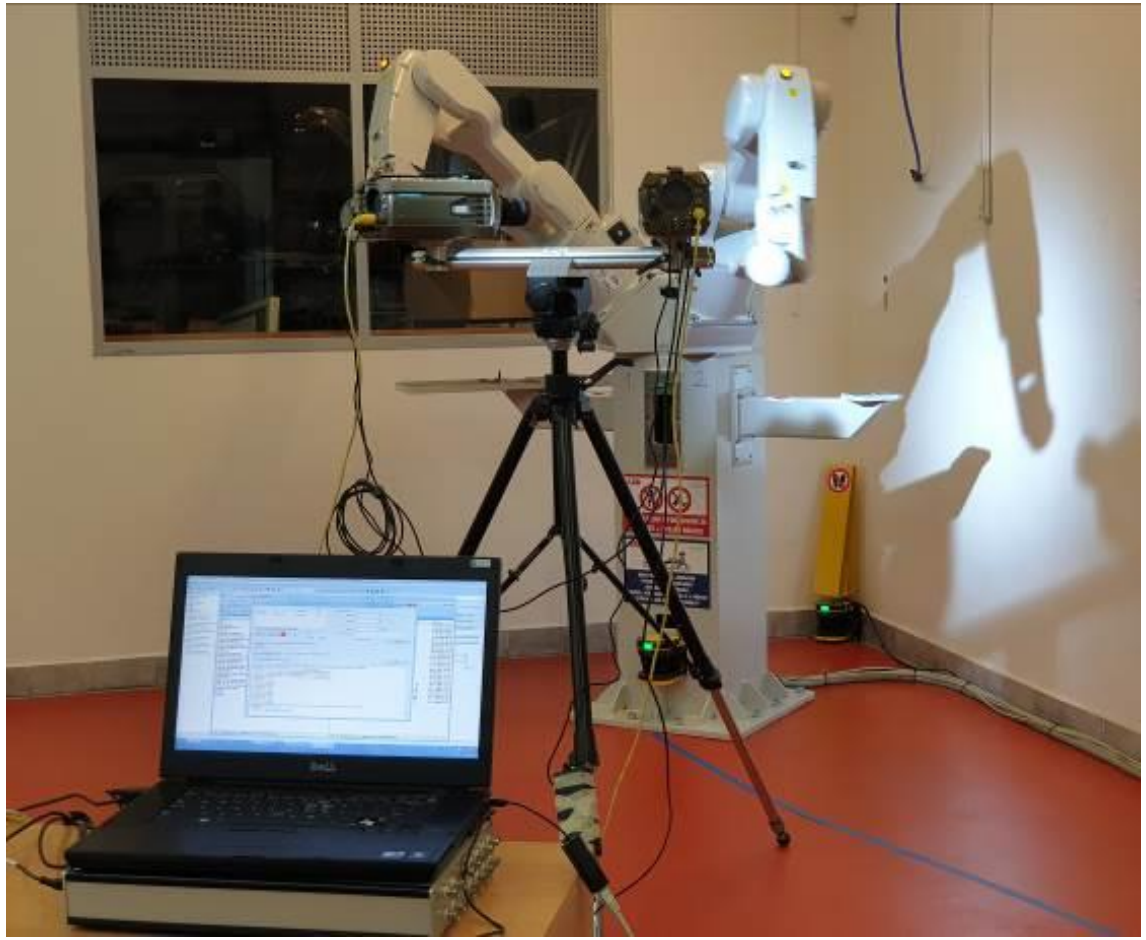
Condition to fulfil the required TCP position on the trajectory, collision objects and multiple connection links

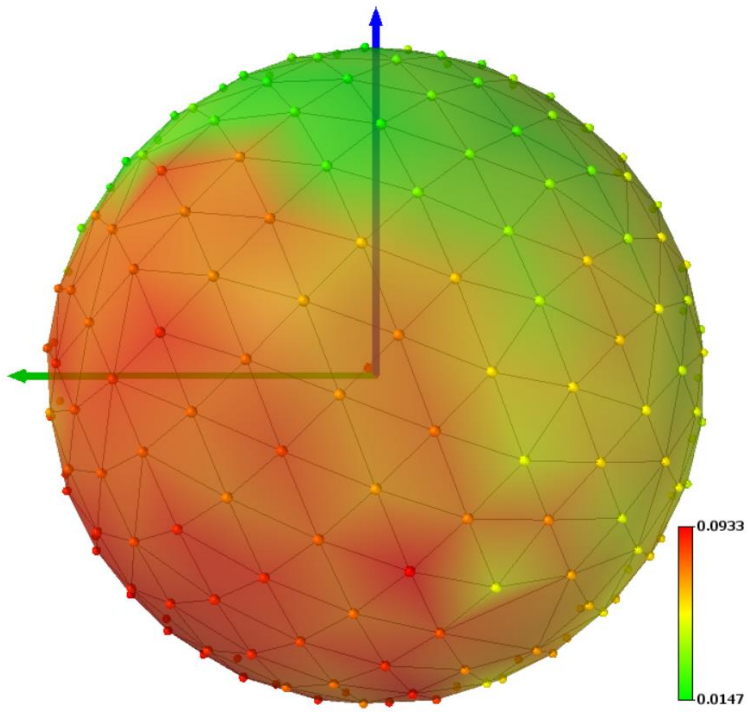




3.1-5) Research Centre of Advanced Mechatronic Systems

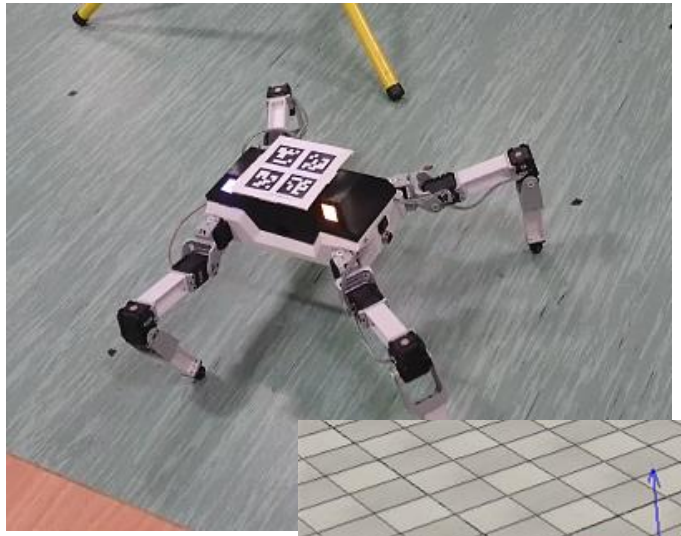
Improve repeatable positioning accuracy

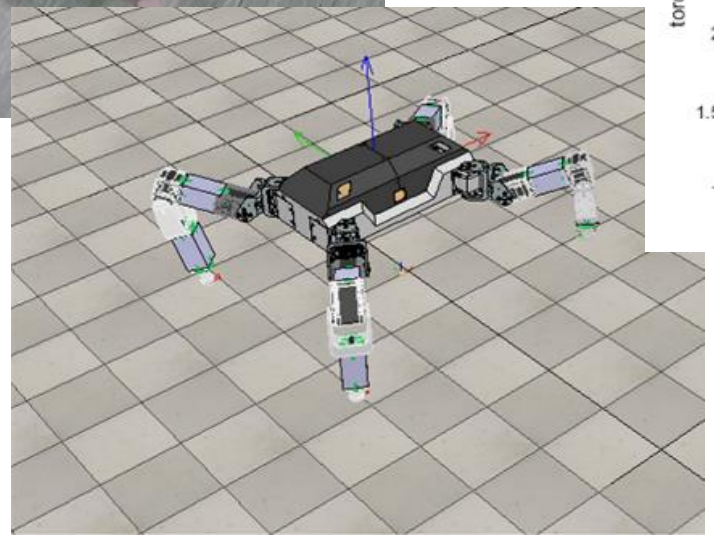


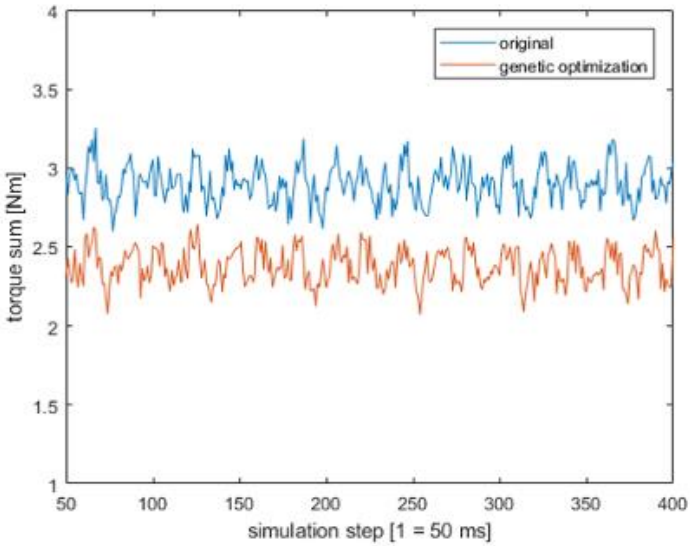


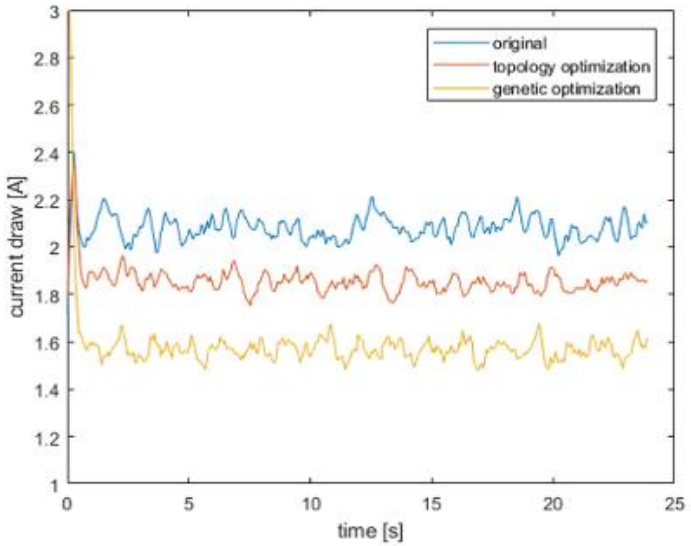
3.1-6) Research Centre of Advanced Mechatronic Systems

Using genetic algorithms in design and optimization of mobile robot kinematics









3.2) Research Platform Focused on Industry 4.0 and Robotics in Ostrava Agglomeration 2018 - 2022

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

- Research of physical principles, technical and program resources for on-line optimization of the robot trajectory in a dynamically changing environment with obstacles.
- Research of technical instruments for assisted assembly with a collaborative robot.
- Research of technical and program instruments for inspection of 3D shapes of components during production and manipulation.
- 2018 - 2022

VSB TECHNICAL UNIVERSITY OF OSTRAVA

SIEMENS

brose

Fraunhofer IWU

HELLA

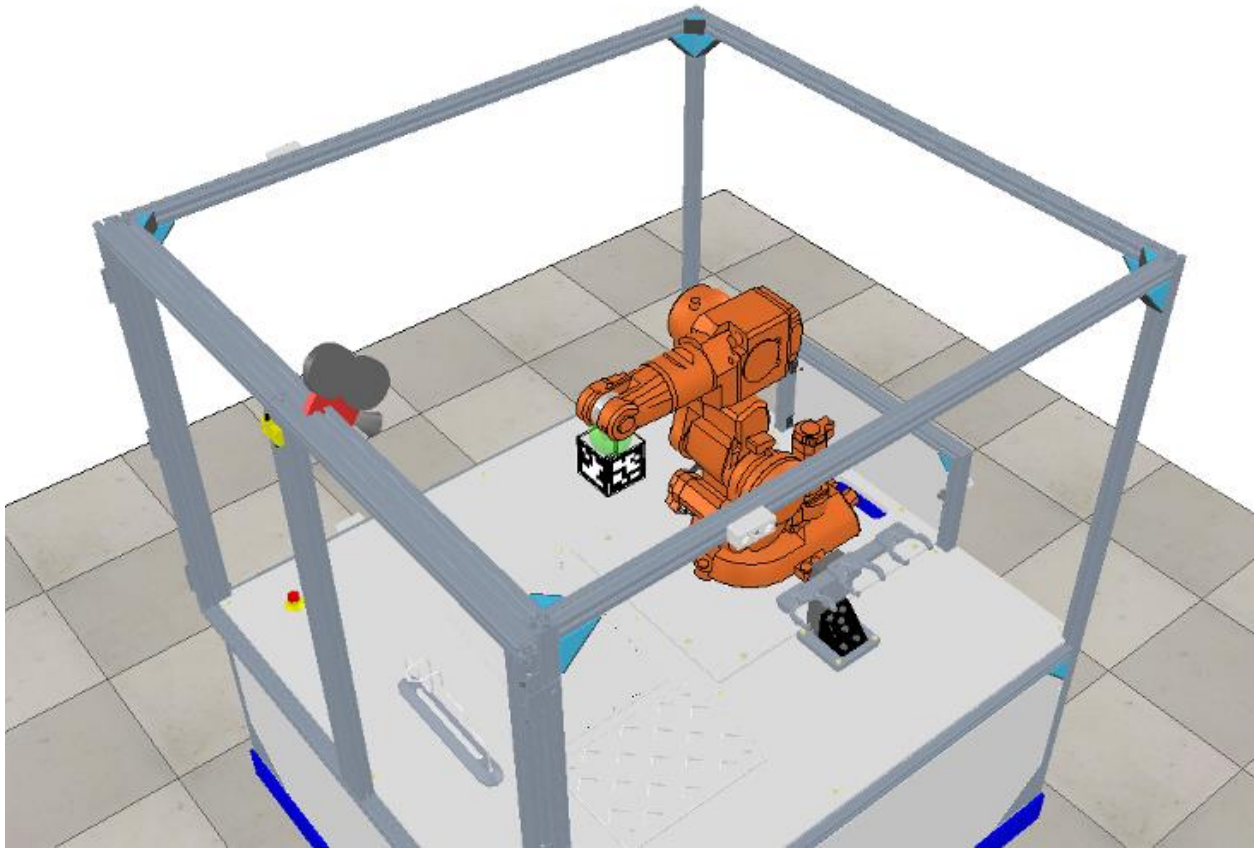
MORAVSKOSLEZSKÝ AUTOMOBILOVÝ KLASTR

MSIC

VOP CZ

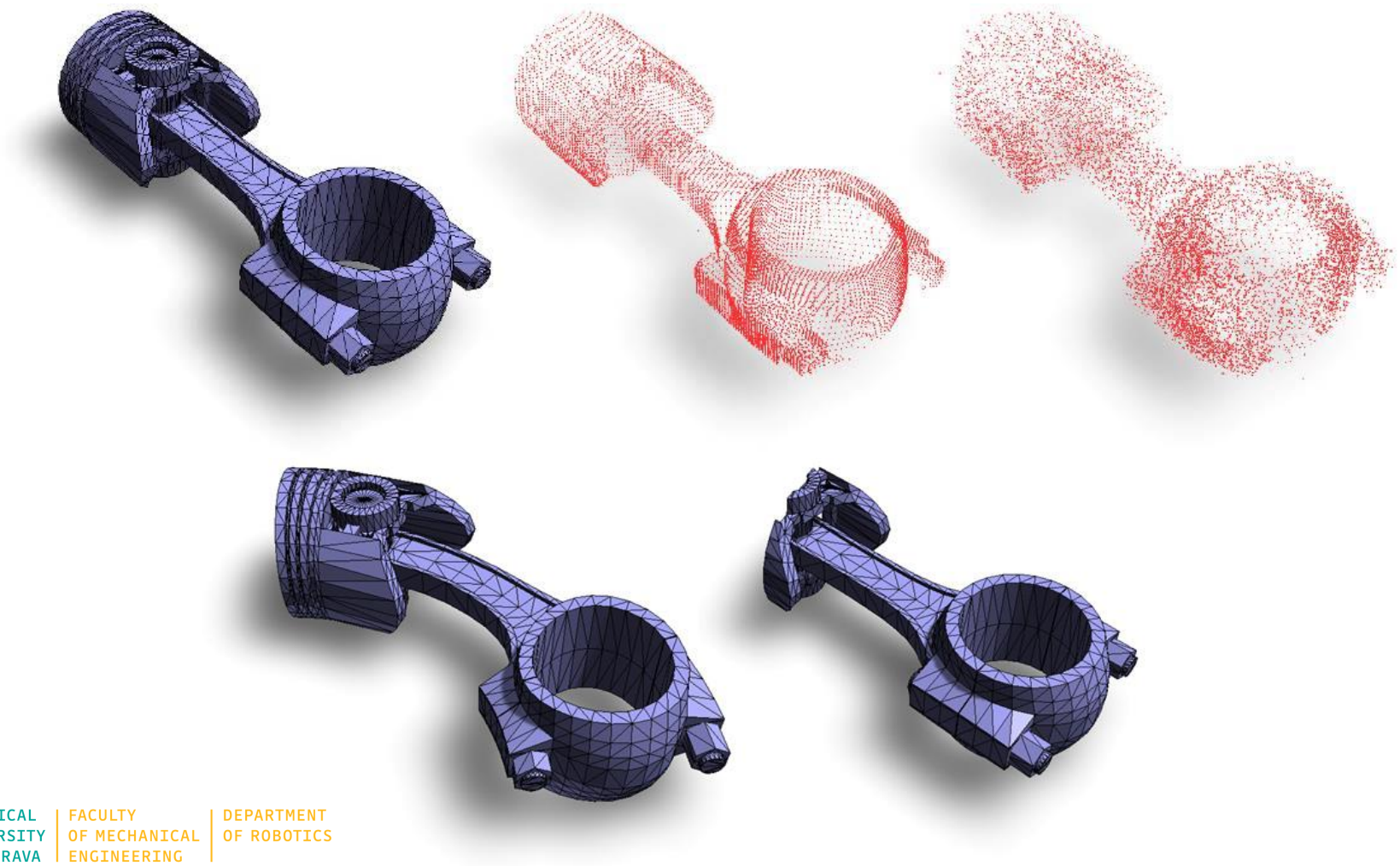
3.2-1) Research Platform Focused on Industry 4.0 and Robotics in Ostrava Agglomeration 2018 - 2022

Detection of camera position and orientation in manipulator coordinate



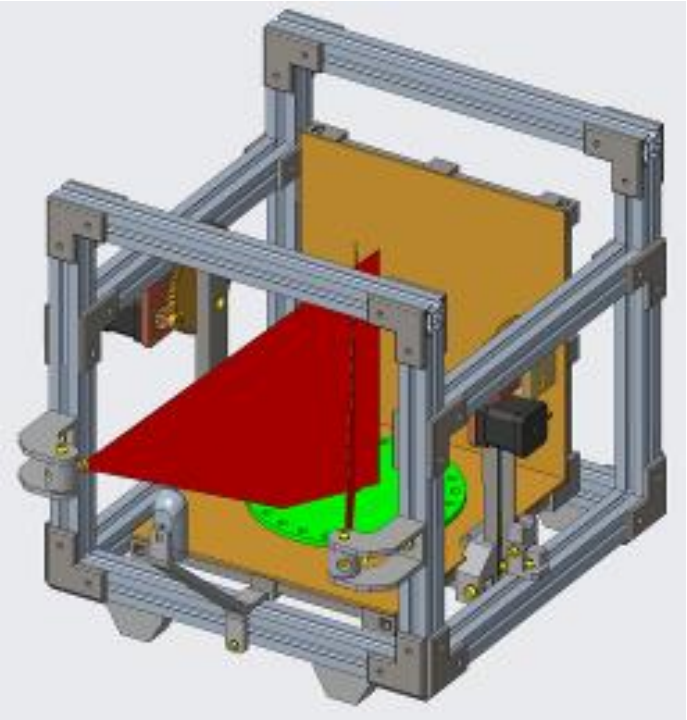
3.2-2) Research Platform Focused on Industry 4.0 and Robotics in Ostrava Agglomeration 2018 - 2022

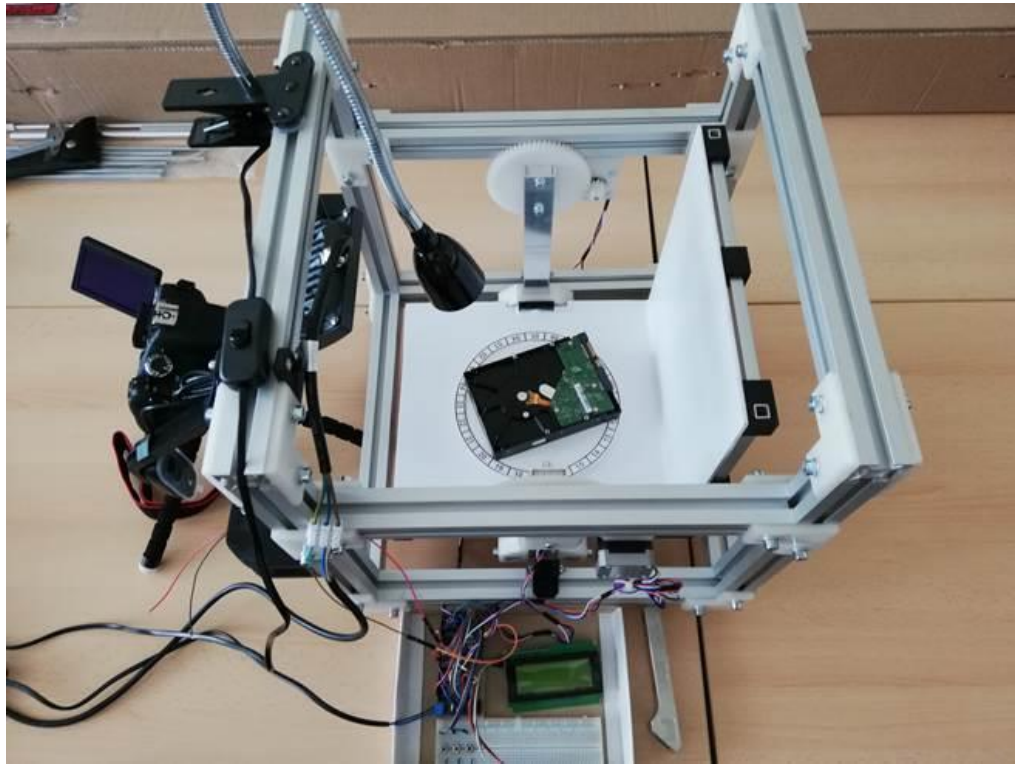
System for identifying a part (3D object) based on a 3D scan



3.2-3) Research Platform Focused on Industry 4.0 and Robotics in Ostrava Agglomeration 2018 - 2022

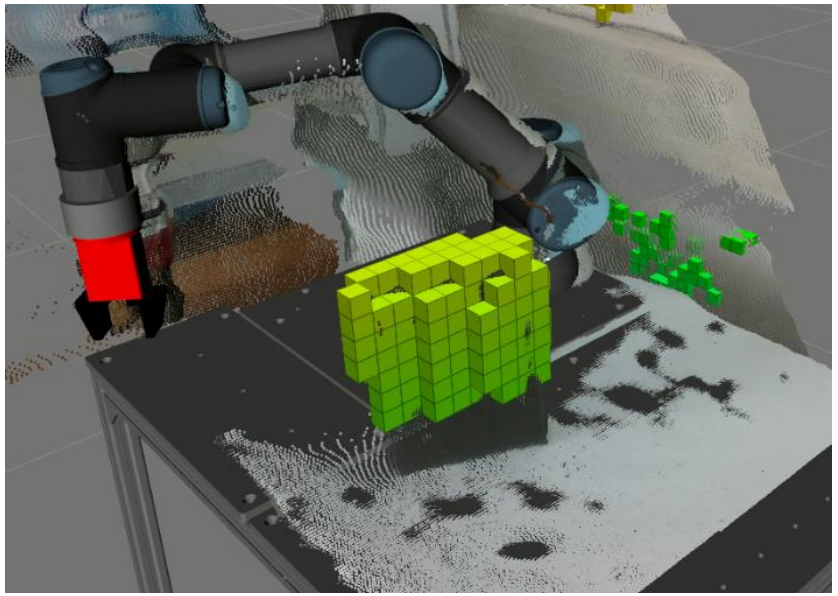
Creating 3D models of objects using photogrammetry technologies and 2D laser scanner.

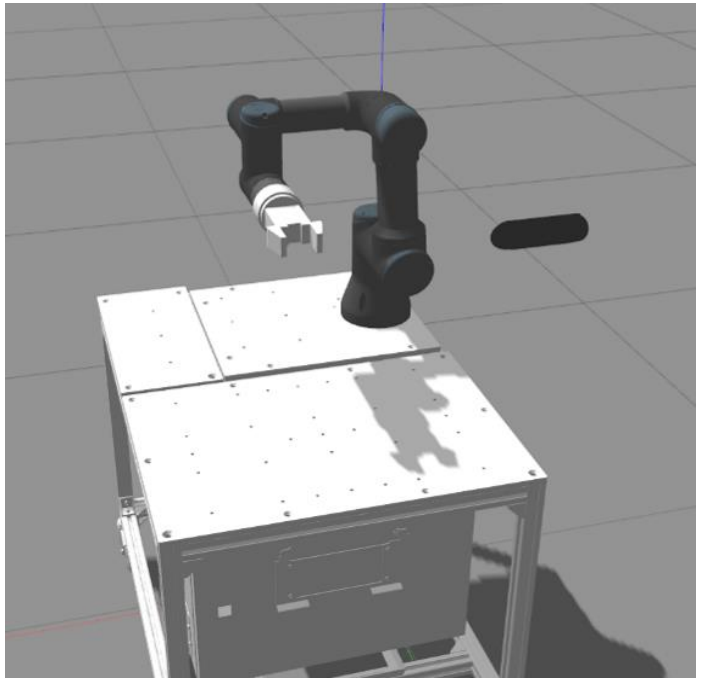


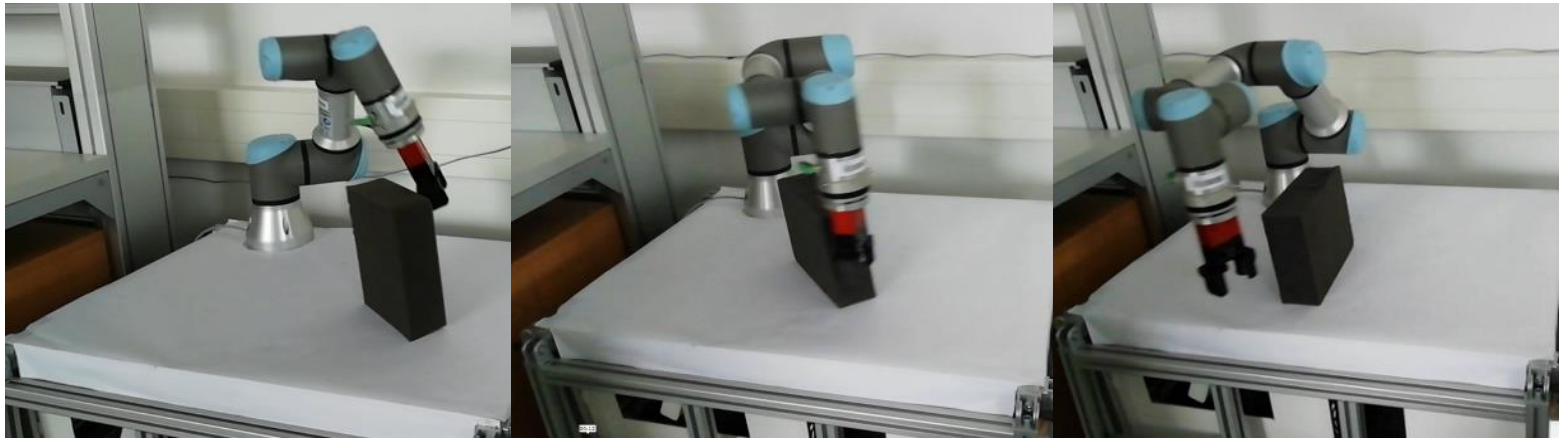


3.2-4) Research Platform Focused on Industry 4.0 and Robotics in Ostrava Agglomeration 2018 - 2022

Dynamic path planning for industrial robot.

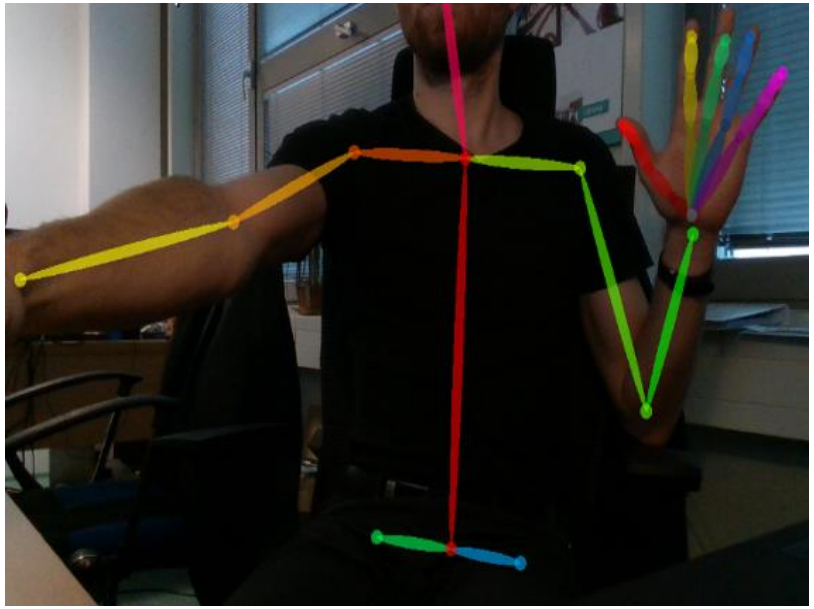


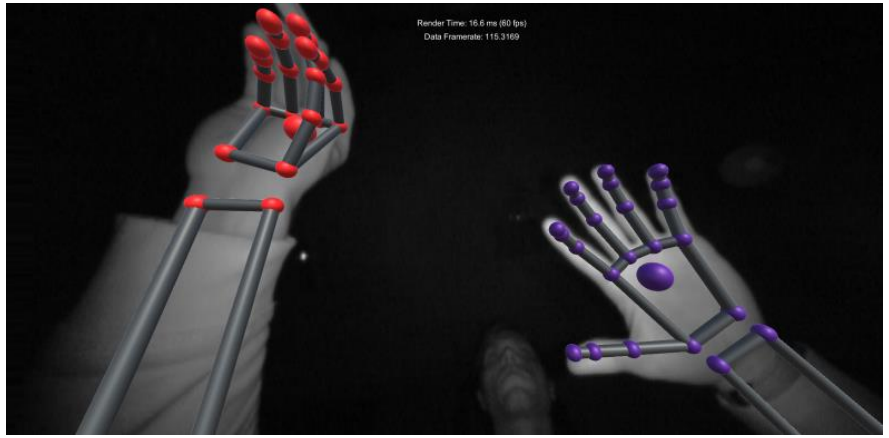


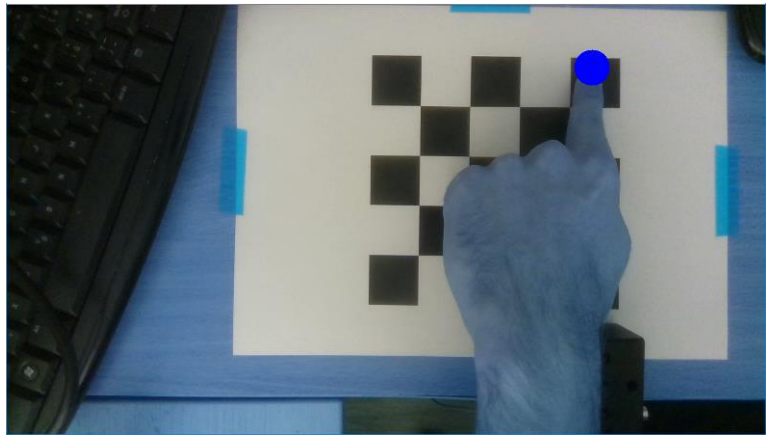


3.2-5) Research Platform Focused on Industry 4.0 and Robotics in Ostrava Agglomeration 2018 - 2022

Research of methods for assisted assembly with collaborative robot.







3.3) National Competence Centre of Mechatronics and Smart Technologies for Mechanical Engineering

- Mechatronics, Smart Technologies and Digital Twins.
- Cobots – workplace with dynamically moving obstacles. Their detection, description and on-line avoidance.
- SW tool for a selection of an applicable robot (industrial or collaborative) for given task and workstation layout.
- 2019 – 2020
- More information: http://www.nccmestec.com/en-index.html

4) Robotic infrastructure at our department

4.1) Industrial Robotics

1x ABB IRB 1660ID

1x ABB IRB 1600

2x ABB IRB 1200

1x ABB IRB 360

3x ABB IRB 140

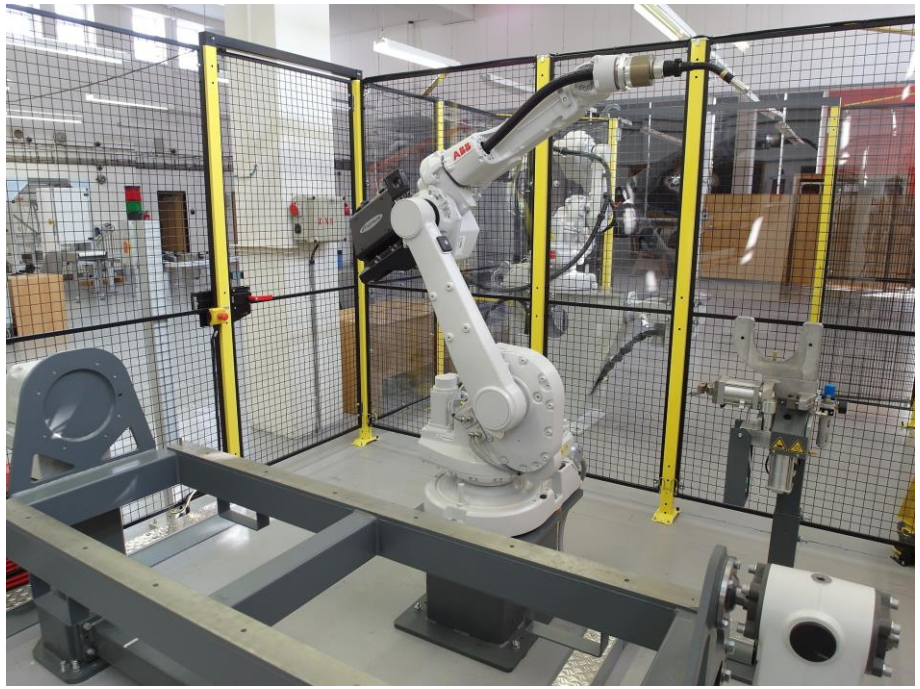
2x Mitsubishi RV2-AJ

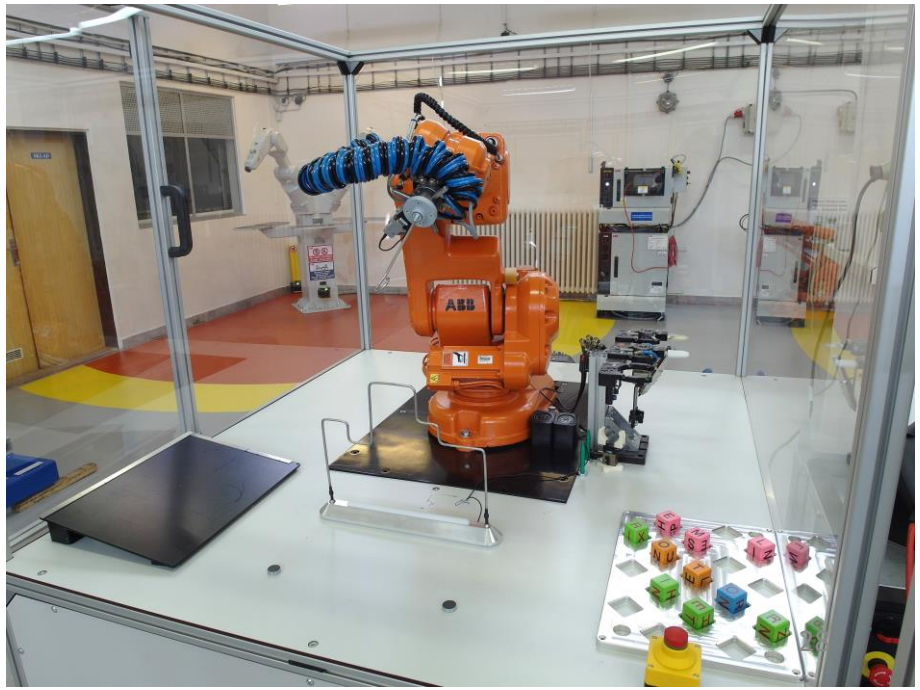
1x ABB IRB 14000 YuMi

1x UR3

1x UR3e

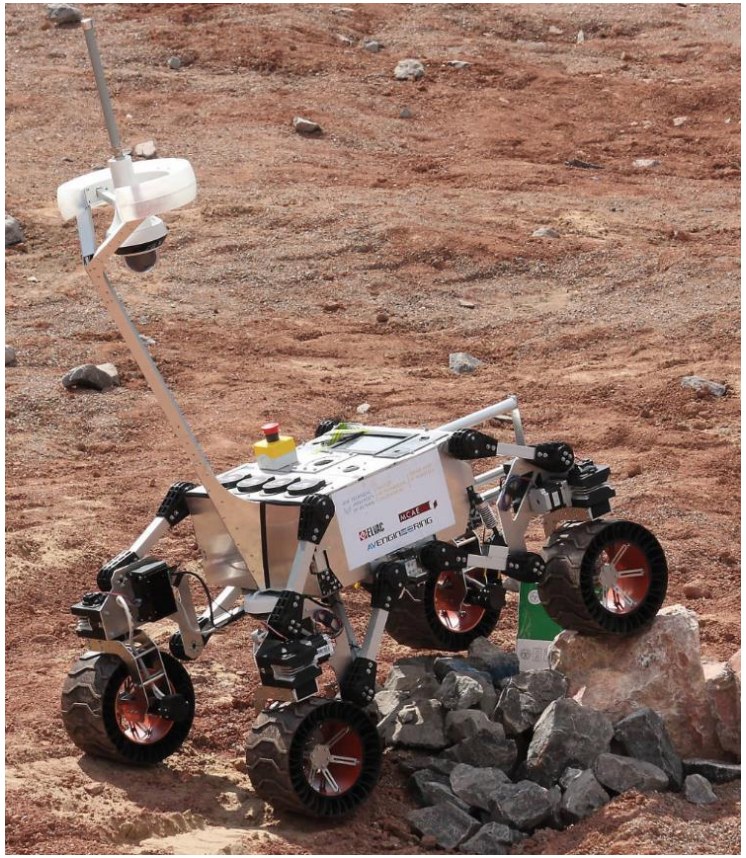
1x UR10e

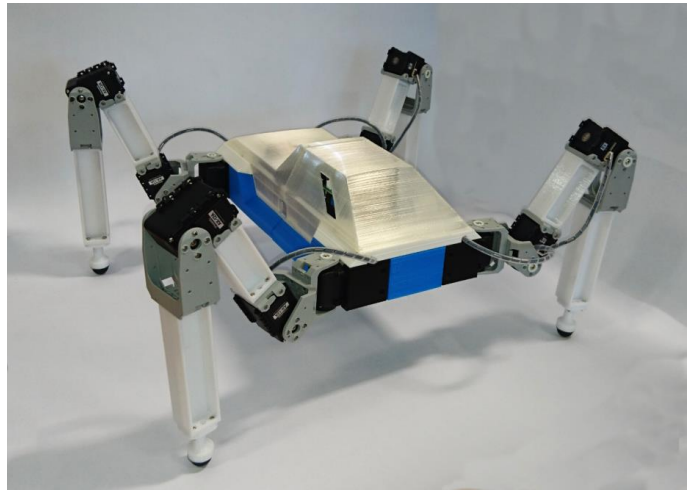


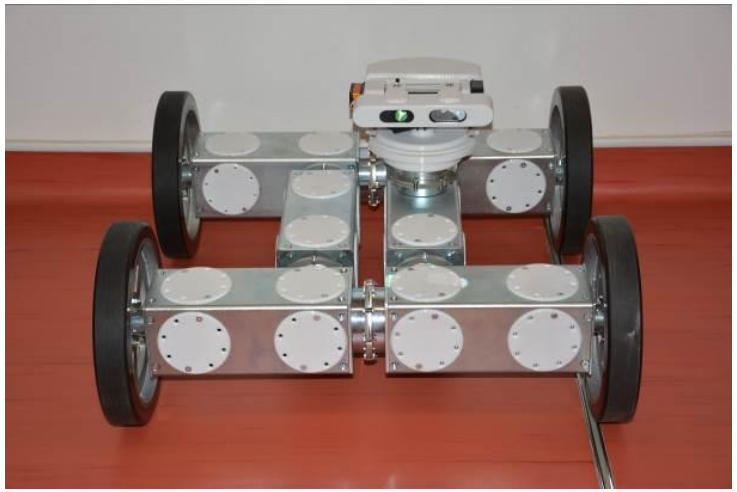


4.2) Service robotics

1) MR Hercules
2) MR Marvin
3) MR Viper
4) Rover K3P4
5) Modular robot







5) Possible topics for future projects or cooperation

5.1) Possible topics for future projects

- Tools for design and optimization of robotic cells and production lines
- Tools and methodologies for robotic manipulators accuracy enhancement
- Optimization cost/fitness function development
- Automated system for containers un/loading
- Machine perception – object recognition
- Motion planning in dynamic environment
- Robot control by gestures
- Collaborative robotics

5.2) Support of our competition team

- Our team RoverOva – ERC Competition (http://rover.vsb.cz/)
- 5th place in 2018
- 3rd place in 2019

VSB TECHNICAL UNIVERSITY OF OSTRAVA | FACULTY OF MECHANICAL ENGINEERING | DEPARTMENT OF ROBOTICS

Thank you for your attention

Václav Krys

+420 597 325 310

vaclav.krys@vsb.cz

http://robot.vsb.cz