CEITEC

Central European Institute of Technology

BRNO | CZECH REPUBLIC

BRNO UNIVERSITY OF TECHNOLOGY

Industry 4.0 at CEITEC Brno University of Technology

CEITEC – Research Institute Overview

- 6 partners – Universities in Brno
- 600 researchers
- 7 research programmes
- 63 research groups
- 25,000 m^2 of new laboratories
- 10 core facilities
- Budget (eligible cost): EUR 208/ USD 275 mil.
- Start of research activities: Q1 2011
- Startup phase completed: Q4 2015
- Now in full operation

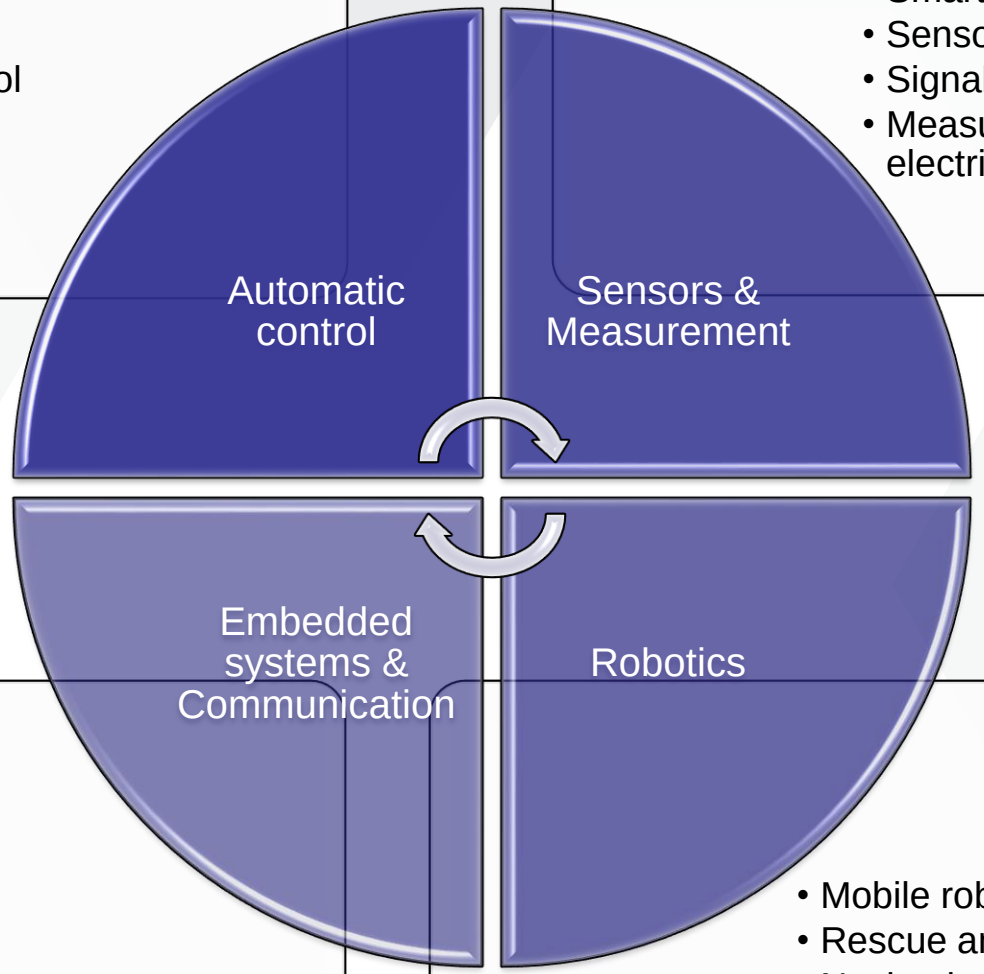
- We are a part of CEITEC – Brno University of Technology

Cybernetics in Material Science

50 researchers

- Algorithms
- Industrial processes control
- Drives and Power Systems Control

- Smart sensors
- Sensors design using new materials
- Signal processing
- Measurement of electrical and non-electrical quantities



- Wired and Wireless Industrial communication
- High-performance embedded systems
- Computer Vision

- Mobile robotics, telepresence control
- Rescue and Reconnaissance systems
- Navigation and self-localization systems

Running projects

- H2020 I-MECH – design of control and monitoring platform for drives and complex mechatronic systems
- H2020 AutoDrive – development of control systems for fail-operational drives, robots surrounding sensing
- H2020 SILENSE – ultrasound sensors, gesture control, diagnostics
- H2020 SECREDAS – security in communications in industrial systems

- RICAIP is key project for construction of infrastructure suitable for next level of Industry 4.0 technologies research

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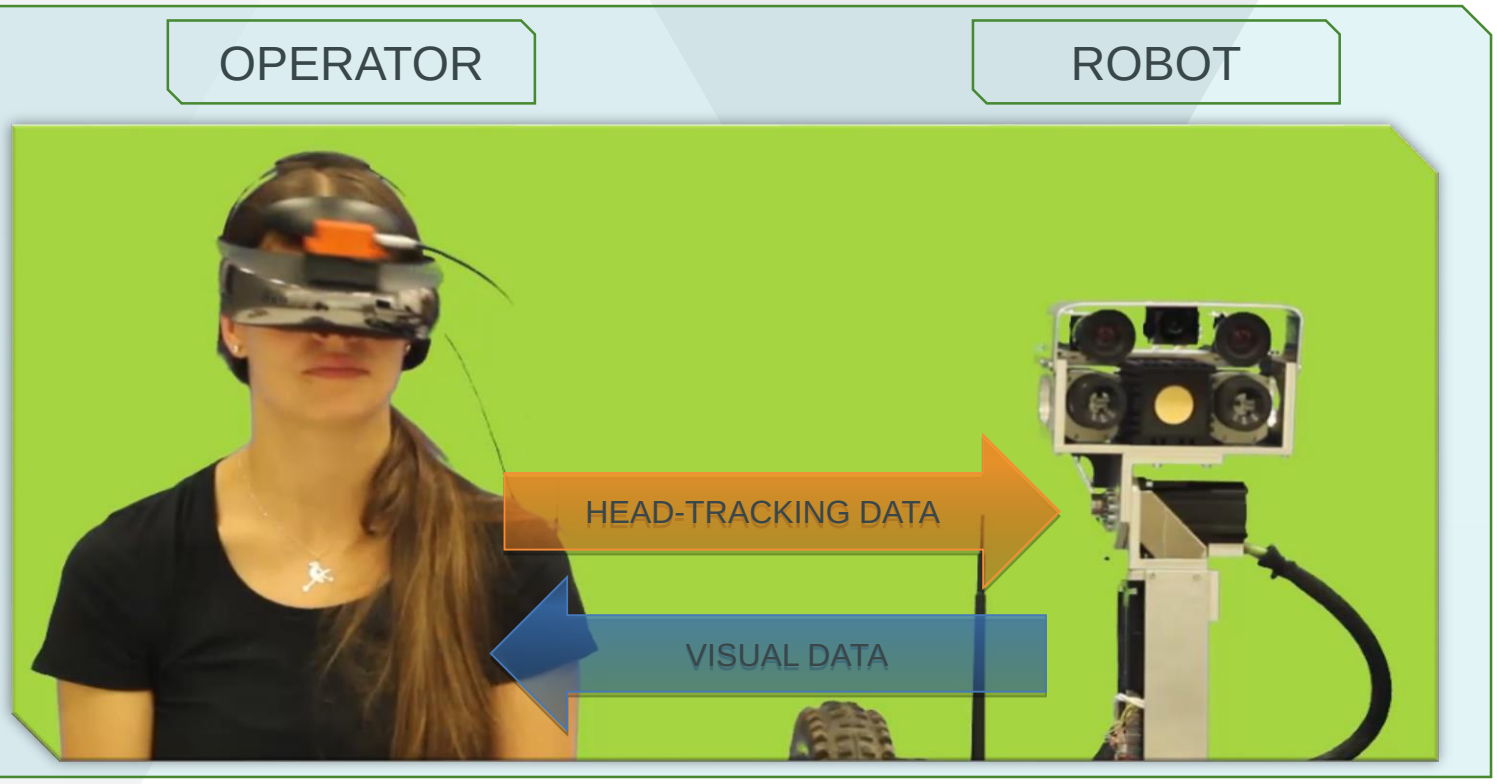
Robotics and Artificial Intelligence

Reconnaissance Robotics

- GENERAL RECONNAISSANCE
- CBRNE
- SEARCH FOR VICTIMS/CRIMINALS
- MULTISPECTRAL MAPPING
- ENVIRONMENT MEASUREMENT
- AUTONOMOUS AREA GUARDING

Augmented Reality & Visual Telepresence

OPERATOR SHOULD FEEL TO BE IN THE ROBOT'S PLACE



- remote control, inspection
- mission planning

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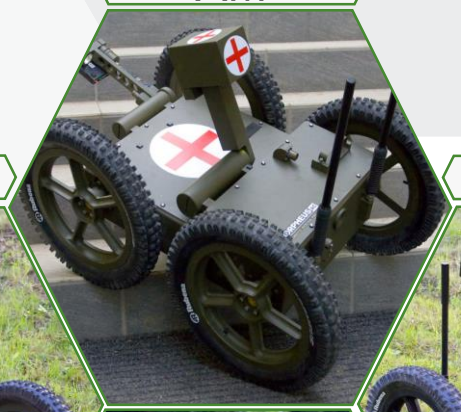
Orpheus Robots

X1

AC-P

AM



EXP

AC2

X3

X4

X2

AC

HOPE

XTA

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MORPHEUS

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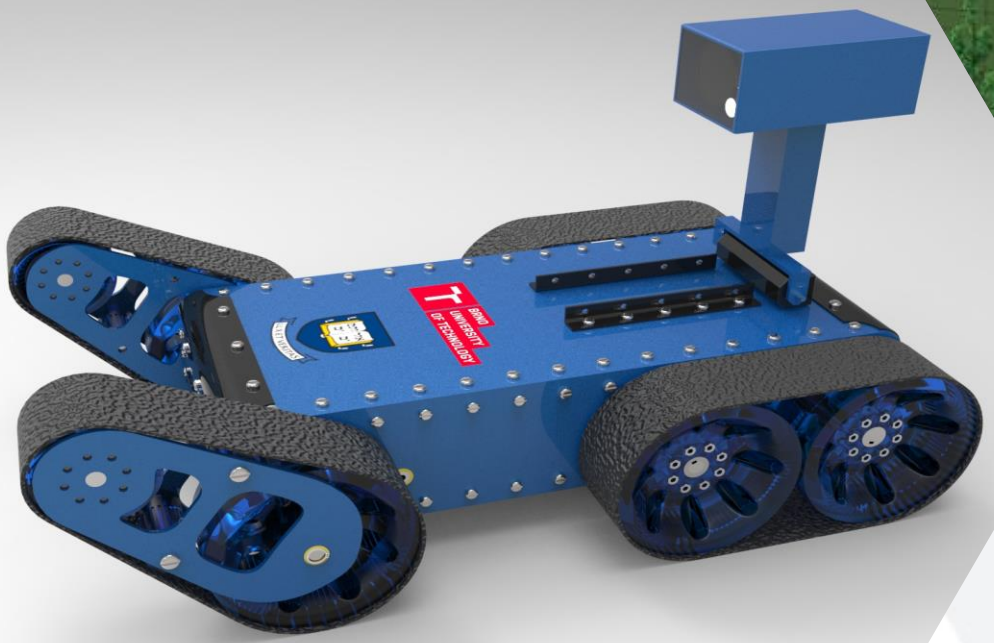
SCORPIO mkII



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Small Testbed at CEITEC

RICAIP

Research and Innovation Center for Advanced Producation – H2020 teaming project

Consortium:

- CEITEC, CIIRC – Czech Republic
- DFKI, ZeMA - Germany

GOAL: Build new centre of excellence in I4.0

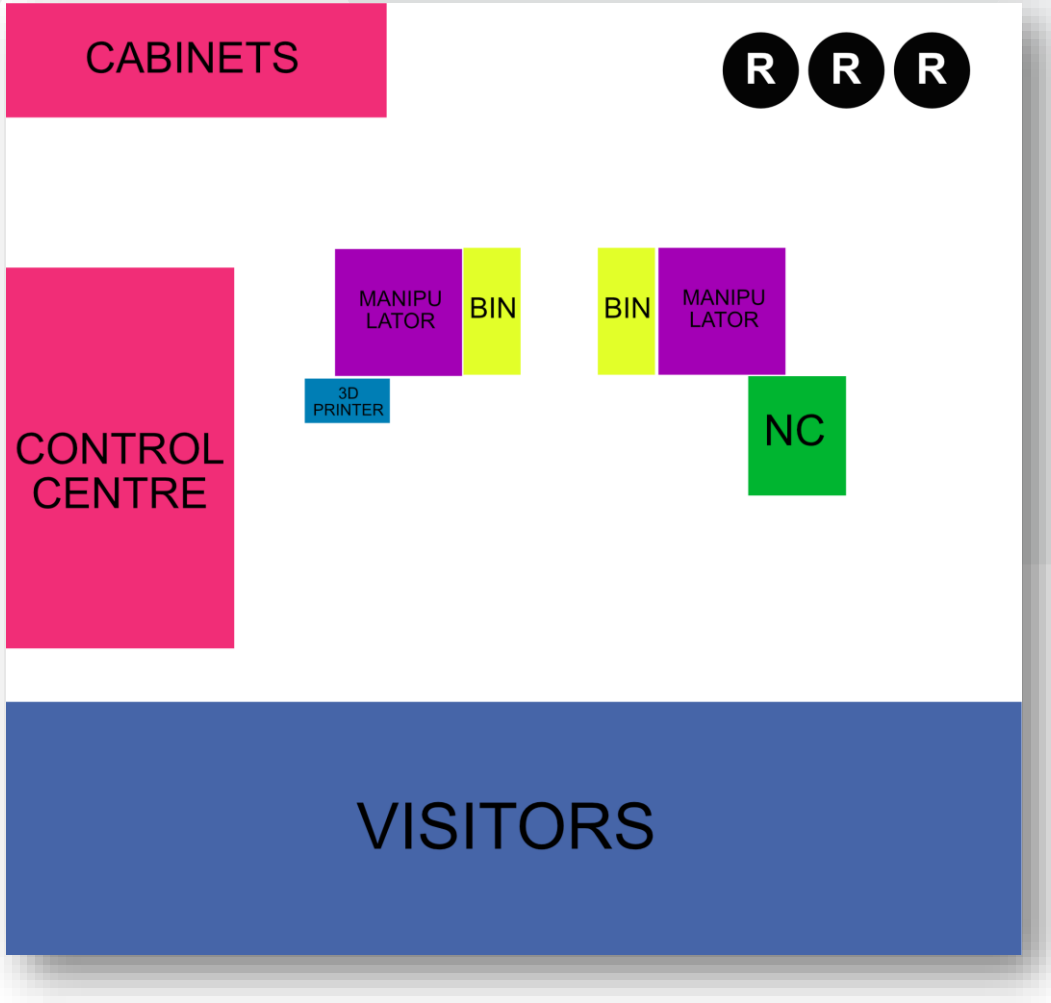
During 1st stage – build small testbed, 2nd stage – 4 big testbeds

1st Stage Testbed at CEITEC

- Under construction
- Expected start of operation – May 2018
- Close cooperation with Intemac company
- Planned connection/integration
  1. Intemac production cell
  2. Testbed at CIIRC
  3. Integration within BUT

Testbed Demonstrator

- additive technology (SLS 3D print) together with subtractive technology (NC milling cutter)
- flexible manufacturing process – the whole manufacturing chain as well as individual machines may be reprogrammed in real-time
- all machines and workpieces are localized in 6DOF – ready for augmented reality
- conveyor belt is not necessary – omnidirectional mobile robots



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NC Milling Cutter

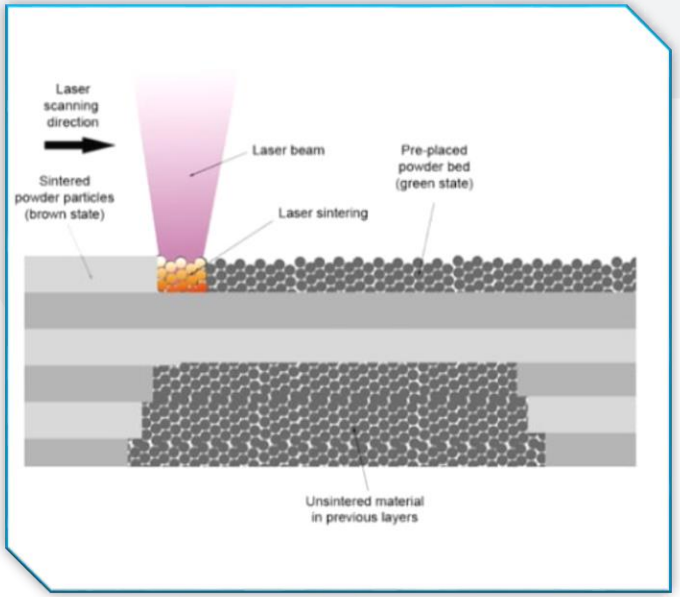
SolidVision SLV EDU

- 3-axis
- power supply 230V AC
- geometrical precision 0.05mm
- max material size 365x400x200 mm
- small outer dimensions
- custom control software

3D Printer

Sintratec S1

- SLS - selective laser sintering technology
- maximum print volume 130x130x180 mm
- Sintratec powder – polyamide (nylon), particle size 0.06mm
- no support needed, no problems with support excising
- powder is reusable (limited number of cycles)



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Industrial Manipulators

- Various manipulators can be used

FANUC LR Mate 200iD

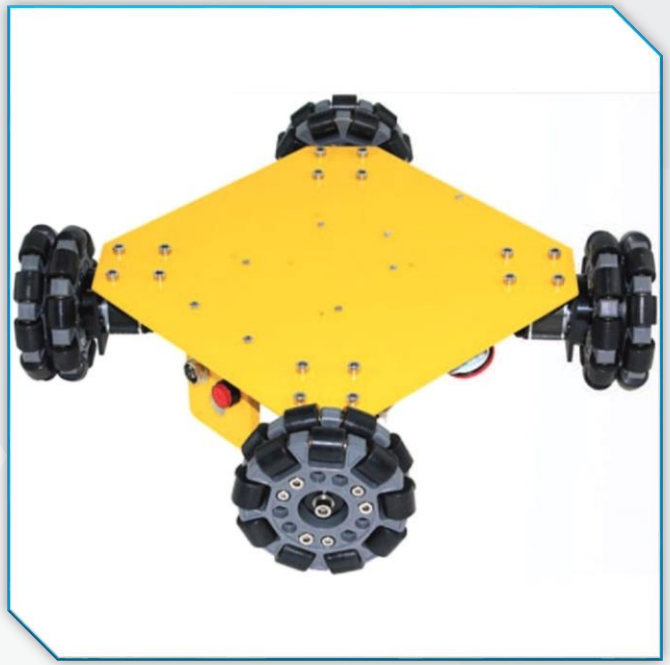
- 6-axis
- max. payload 7kg
- horizontal reach 717mm
- robot arm weight 25kg
- teach pendant
- remote control possible

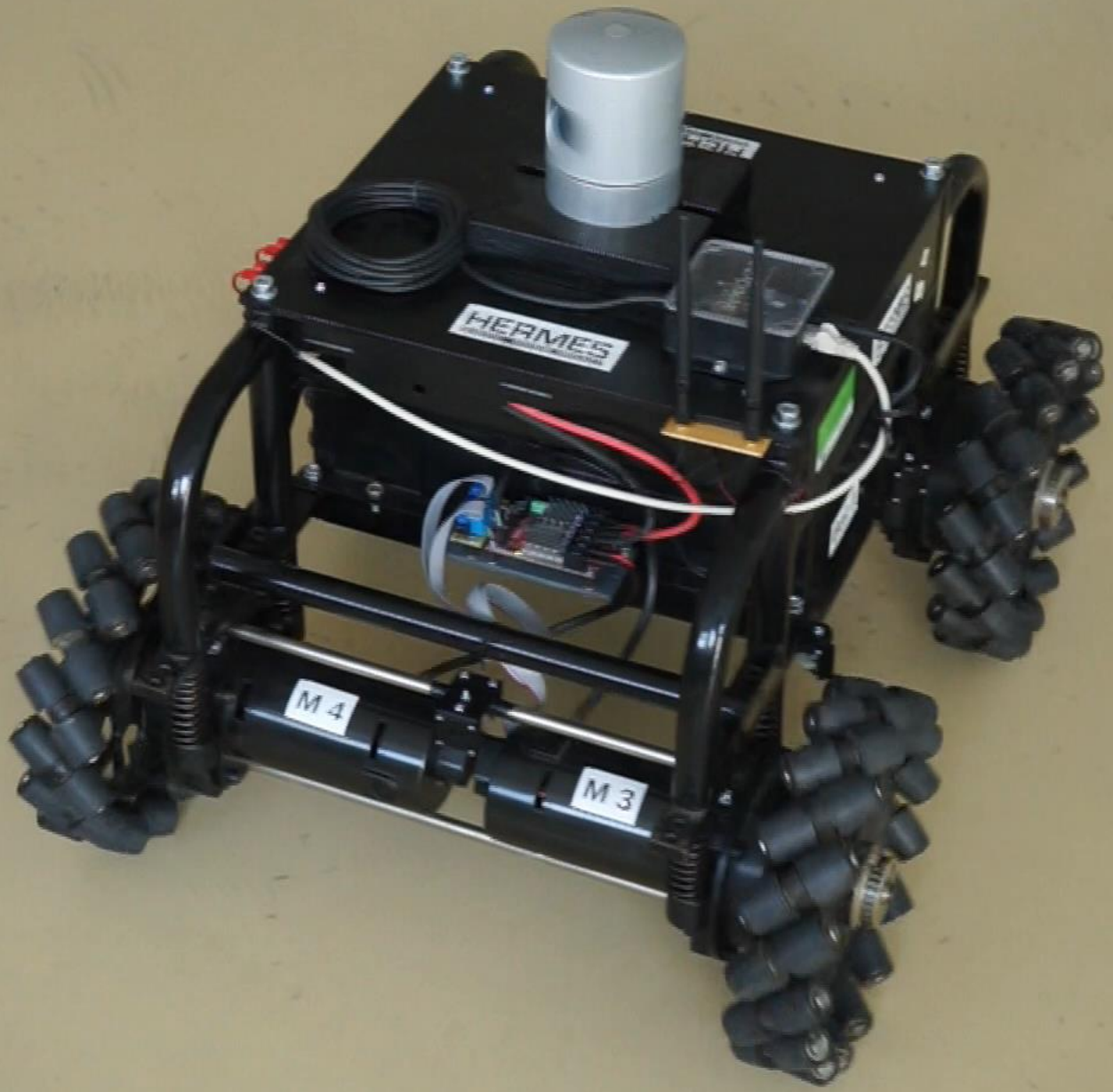
Omnidirectional Platforms

- Mecanum-wheel or omni-wheel
- 2 basic configurations – rectangular and circular

Hermes Robot

- 4 Mecanum-type wheels
- max. speed 5km/h
- payload up to 130kg
- Operation time up to 4 hrs
- remote wireless control
- Velodyne HDL-32 laser scanner
- on-board data-logger



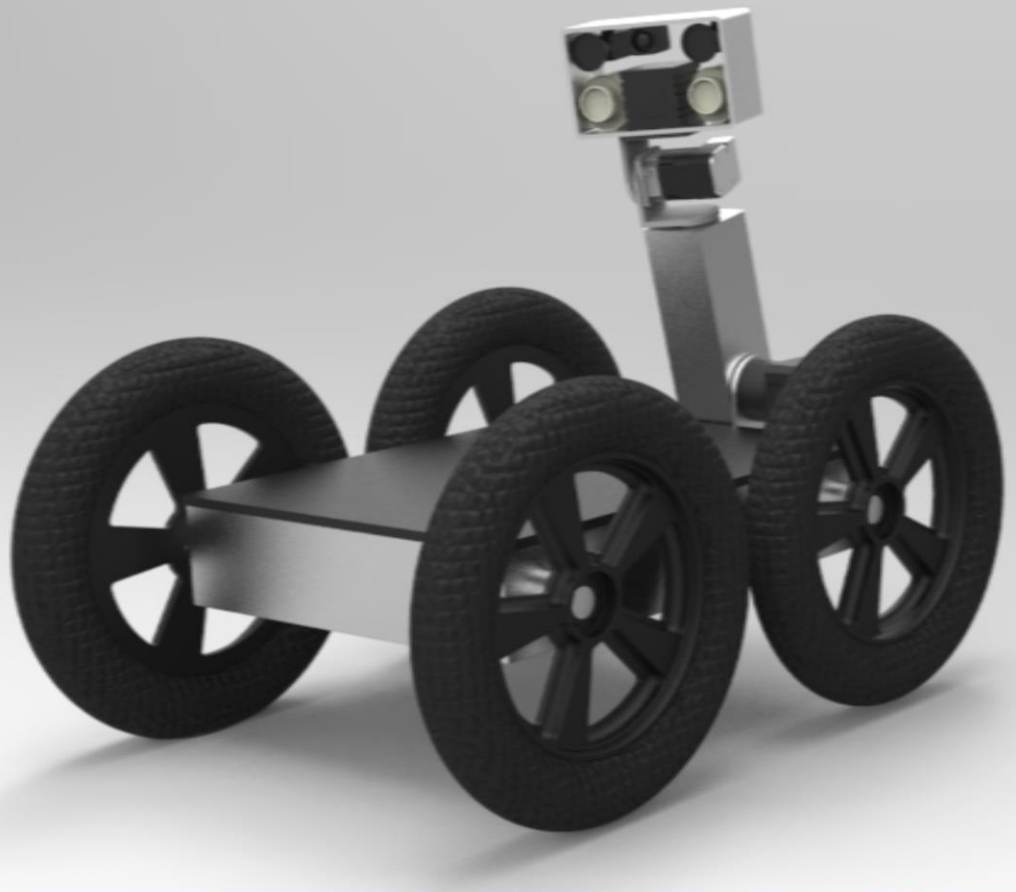

HERMES
M 4
M 3

Object Localization

Vicon VERO

- IR camera tracking system
- Frame-rate 250Hz
- 1.3 Mpix resolution
- 4 cameras
- 14 trackers
- one-wire connection
- system may be extended with other Vicon-system cameras

Guarding Robots for Industry 4.0



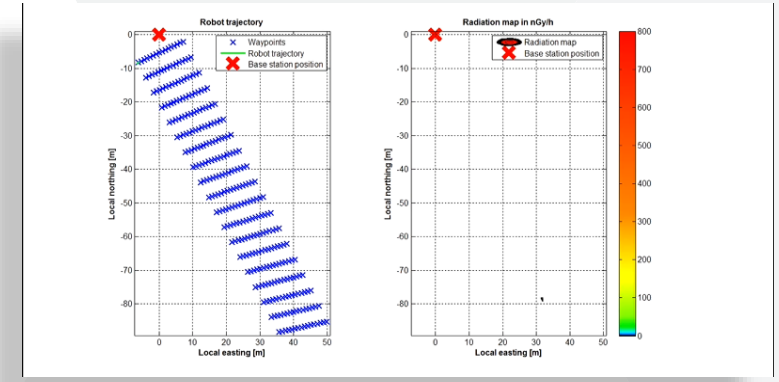
- AUTONOMOUS AREA GUARDING
- RANDOM-LIKE BEHAVIOUR
- SEARCH FOR VICTIMS/CRIMINALS
- MULTISPECTRAL MAPPING
- ENVIRONMENT MEASUREMENT
- TECHNOLOGICAL ACCIDENTS

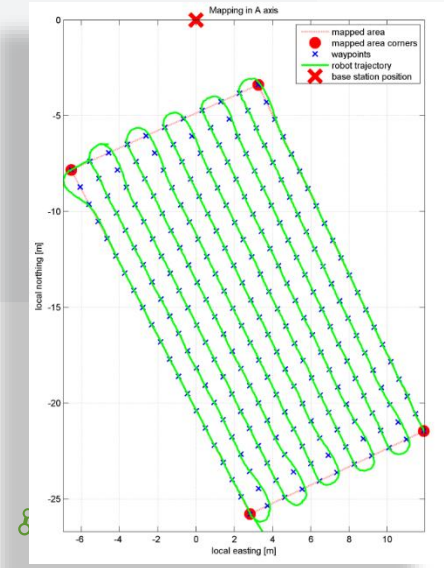
Radiation Field Measurement

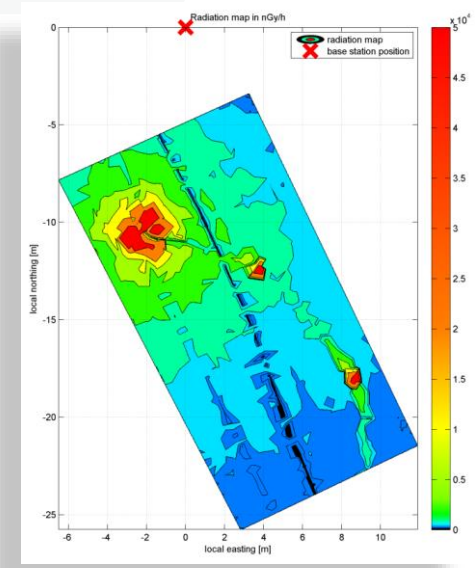
- cooperation with:
  - SURO,
  - NUVIA,
  - VVU Brno,
  - SUJEB
- CAK + TACR EPSILON project

Radiation Field Measurement

- precise self-localisation and navigation - RTK GNSS
- autonomous path-planning
- automatic datalogging based on GNSS time

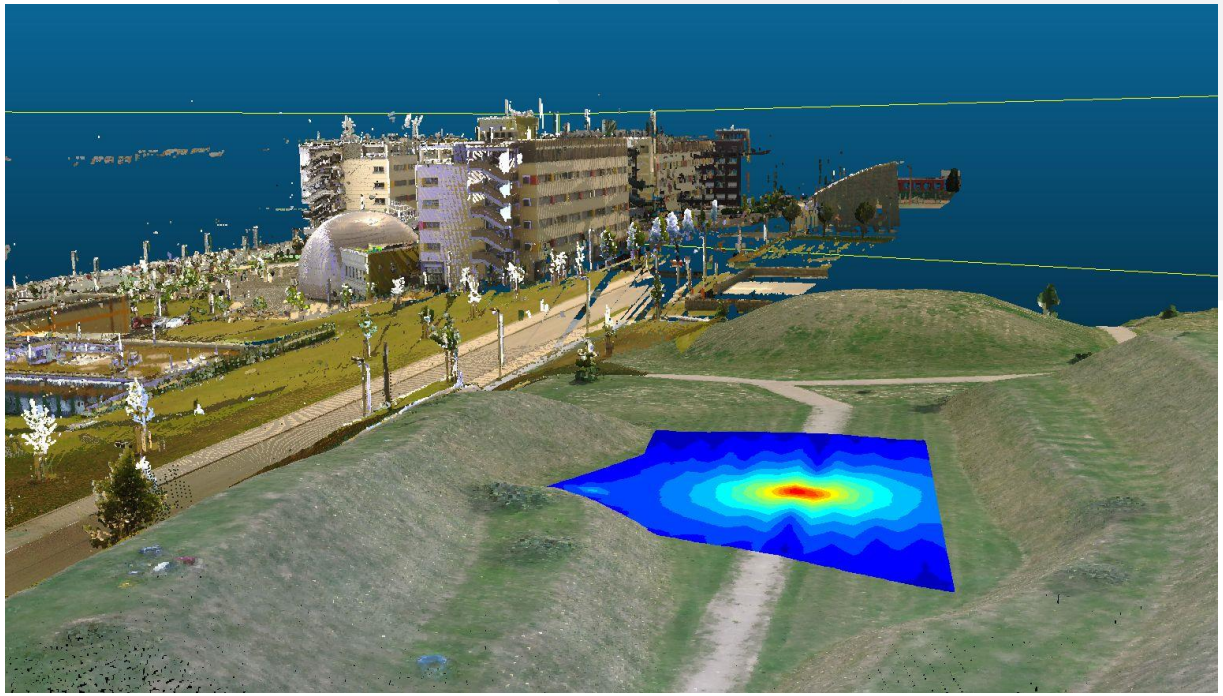


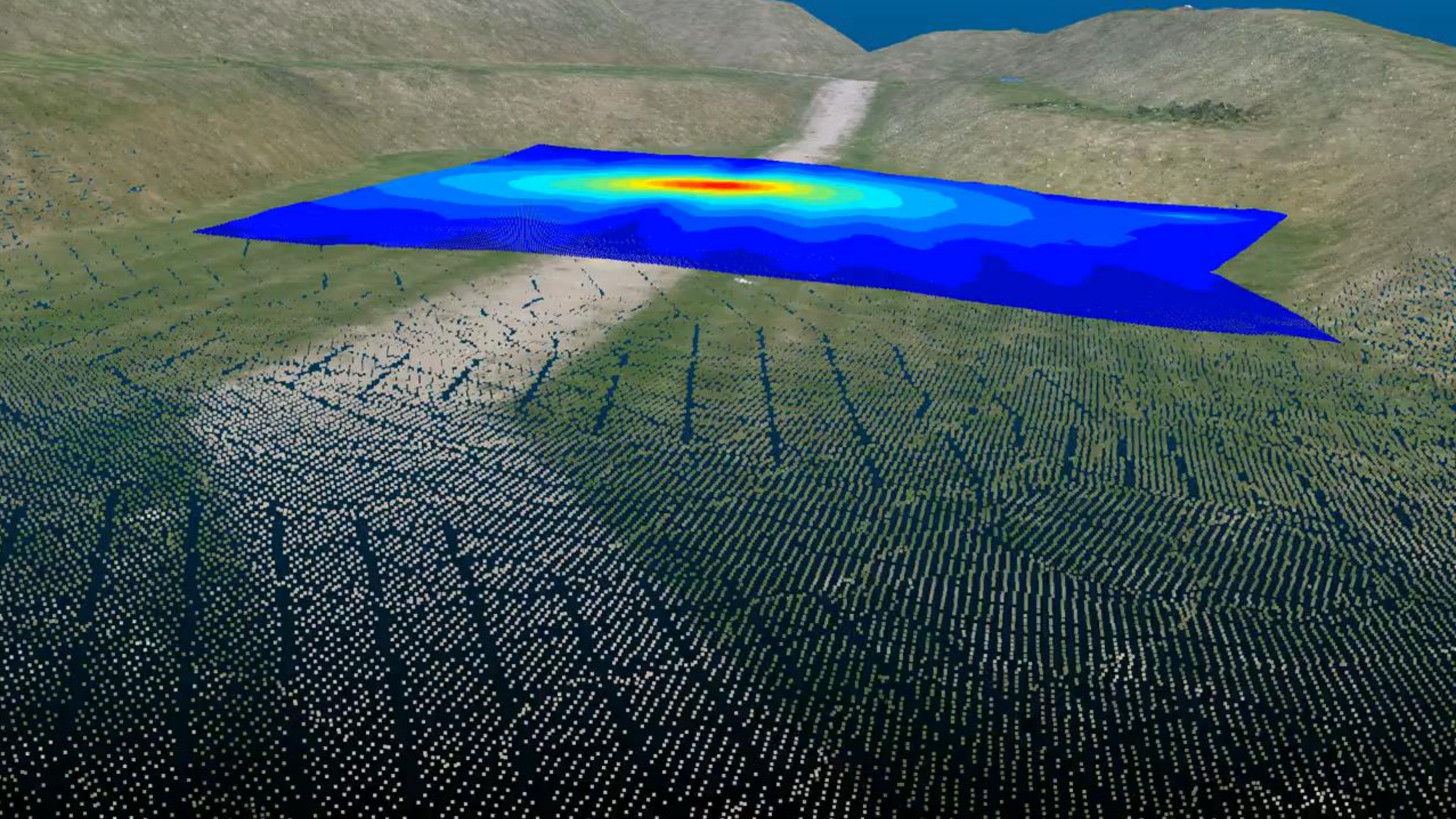




Radiation – current status

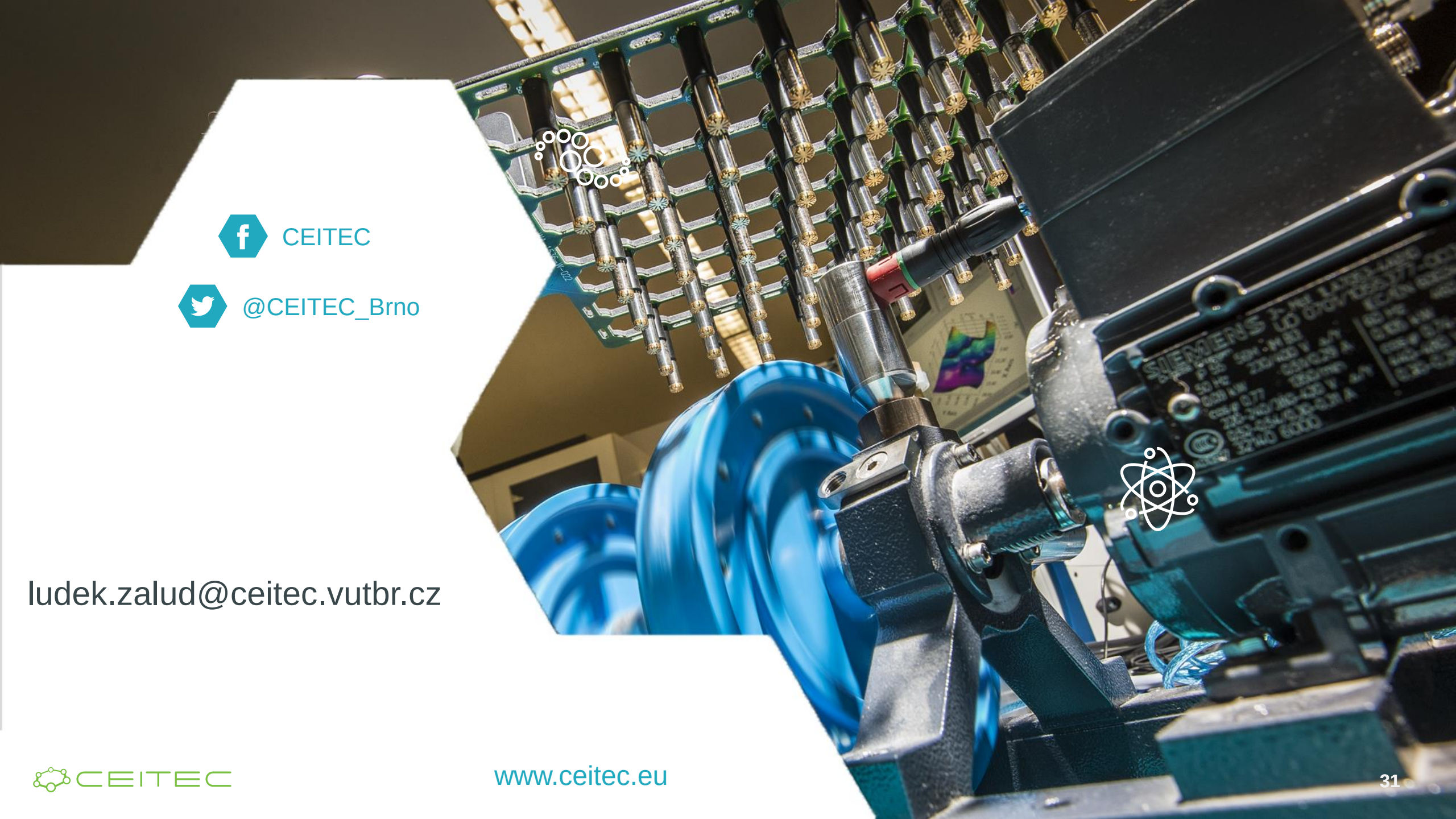
- autonomous mapping of predefined area
- geo-referenced 3D output
- can be added to point clouds from laser scans or ortophoto 3D model





-0.15
NORMAL
GEAR: 5
38.6V
--- dBi
NC
ORP-X3
MODE: HEAD
ARMIN

Experiment - results



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