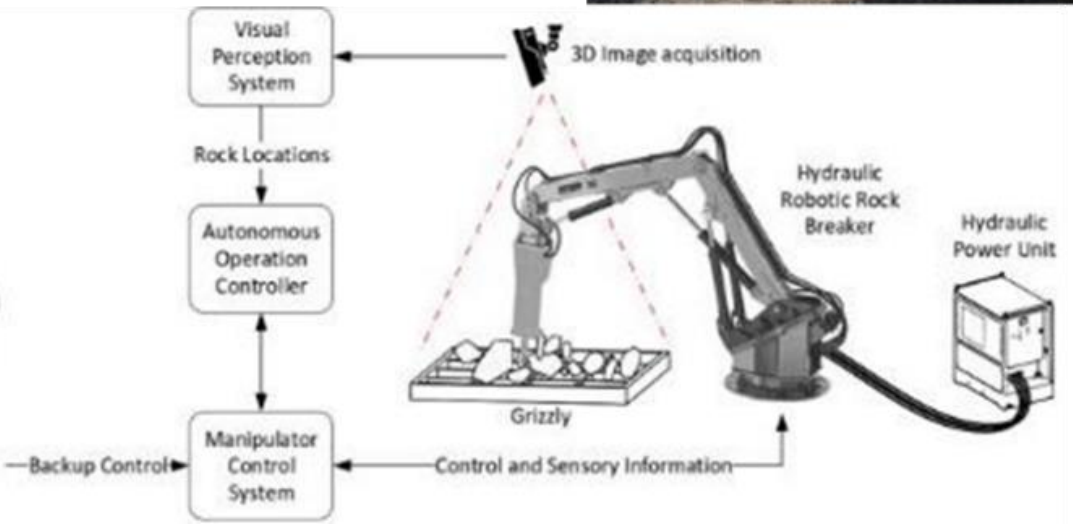


Introduction slides 28.10.2025

AI Powered Autonomous Control for Working Machinery (AI4Machinery)

Rauno Heikkilä

University of Oulu, Civil Engineering, Finland

Background

- Rapid advancement of AI and robotics impacting construction, forestry, and mining sectors
- AI integration in autonomous control systems enhances efficiency, safety, and sustainability
- Several research institutions and companies and contributing to AI in heavy machinery: PWRI, University of Tokyo, Brightwayvision, Hydack, ETH Zurich, Deepx,…
- AI4Machinery consortium background: Technion, Normet, Novatron, Infrakit, Destia, PictM, Nokia, VTT, University of Oulu

SWARM Oulu – Our Current Machines

Bobcat E85
8 tn

CAT D6K2
(2016)
14 tn

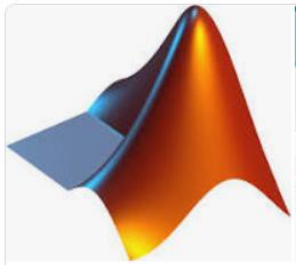
Bomag
BW177BVC-5
with Vario
Control System

Electric Autonomous Truck,
later several trucks

Drones for surveying,
monitoring, video capturing for
remote control,..

Software Platform Used

Matlab/ Simulink



ROS

SIMlabIO (CAN bus-Matlab/ Simulink interface)

CAN bus

ECU

Xsite MACHINE CONTROL

Trimble

Trajectories

ROS

Unity

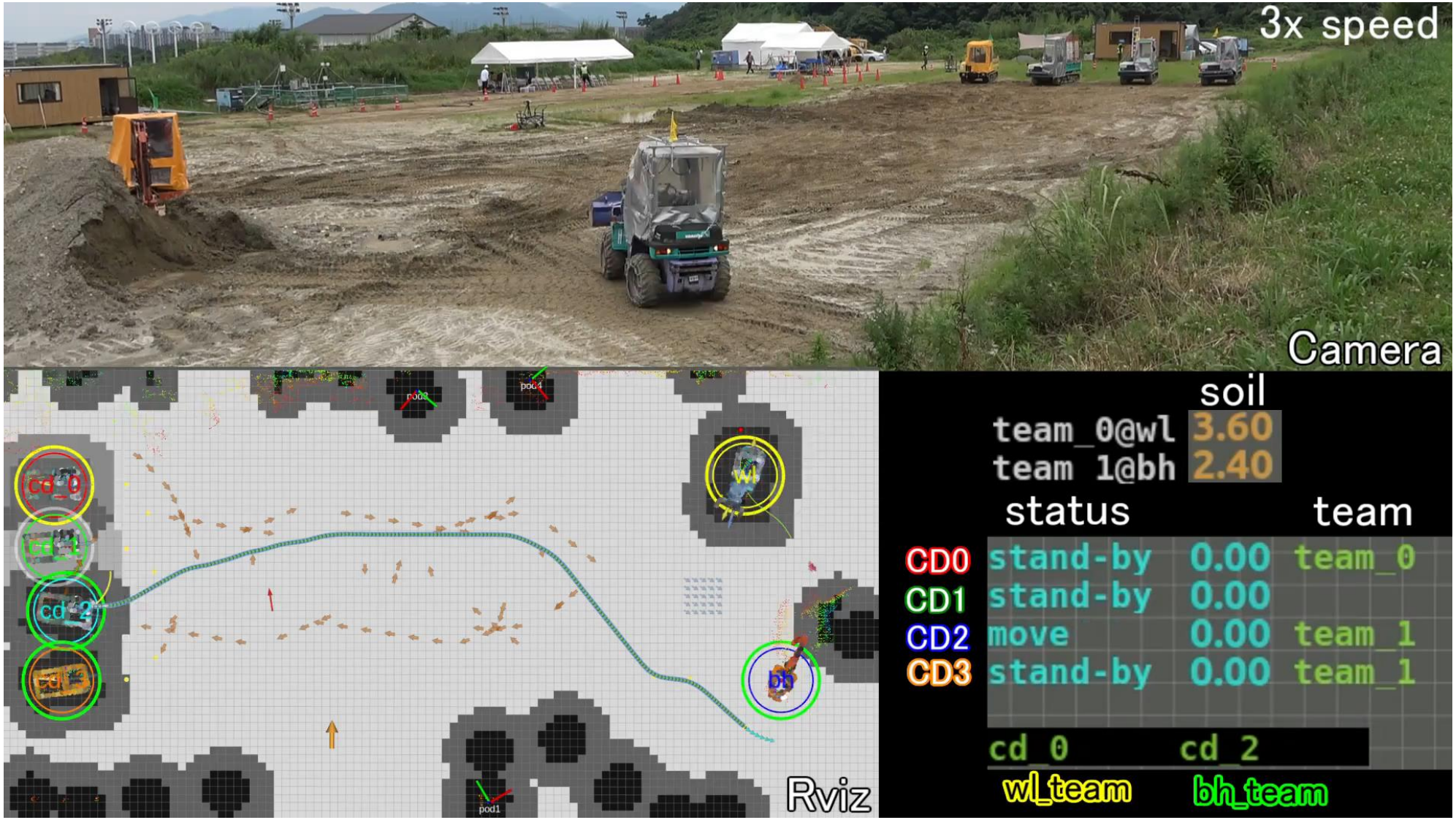
Algoryx AGX DYNAMICS

BIM – Building information models

AI is better Operator - Case ETH Zurich & Gravis Robotics, Prof. Marco Hutter, 2023

Example, Neural Network controlled Autonomous Excavation, 5/2024

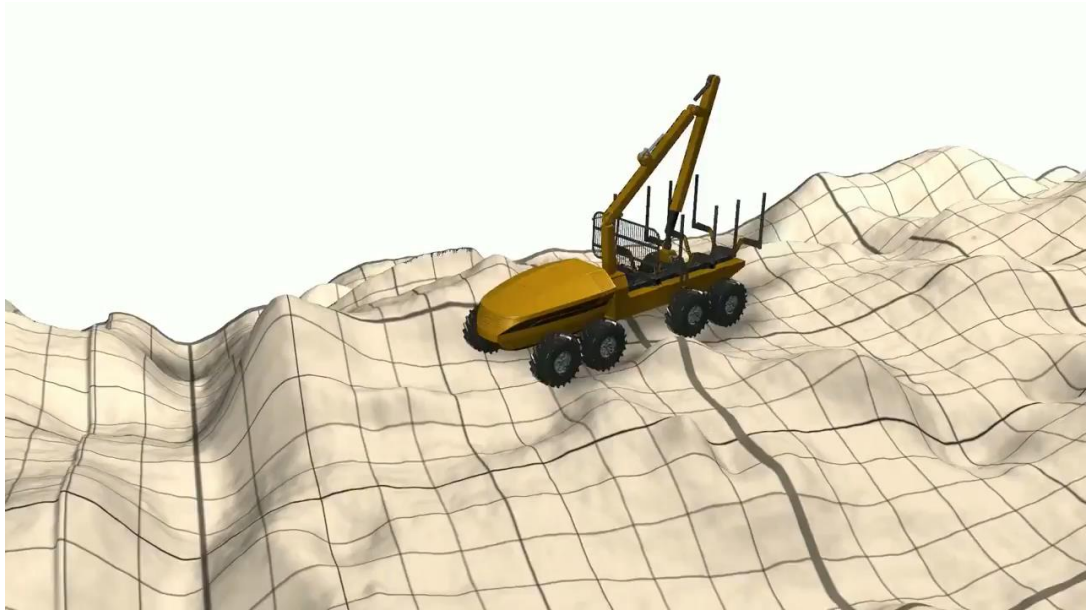
Neural network control demonstration at PWRI test field in Tsukuba, Japan, 2023



Aim

- Research and develop AI-powered autonomous control for work machines and swarms
- Revolutionize AI use in industrial working machinery for efficiency, safety, and sustainability
- AI4Machinery consortium aims:
  - Technion, Normet, Novatron, Infrakit, Destia, Nokia,
  - University of Oulu
  - VTT

Workpackages and Tasks



1 BACKGROUND

2 AIM
- 2.1 Research aims of the public research part
- 2.2 Research objectives of companies

3 WORKPACKAGES AND TASKS
- WP1: Coordination
  - WP1.1 Project planning
  - WP1.2 Project control
- WP2: AI for automation modules, networks and data intelligence
  - WP2.1 AI-assisted sensing, mapping and localization
  - WP2.2 Perception and data collection in harsh environment
  - WP2.3 Wireless information communication and industrial metaverse
  - WP2.4 AI for machine control modules and systems
  - WP2.5 Site and task planning and control, simulation and AI teaching
  - WP2.6 AI for model based infra construction process
- WP3: AI for Autonomous Machines
  - WP3.1 AI assisted teleoperation
  - WP3.2 AI powered autonomous operations
  - WP3.3 Work safety and cybersecurity
- WP4: AI for Autonomous Swarms
  - WP4.1 Open platform for swarm
  - WP4.2 AI powered autonomous machine swarm
  - WP4.3 AI powered drone swarm
  - WP4.4 International Standardization of Solutions
- WP5: Demonstrations and pilots
  - WP5.1 Infra Construction - AI powered Autonomous Infra Construction machines and Swarm
  - WP5.2 Forestry – AI powered Autonomous Forest machines and Swarm
  - WP5.3 Mining – AI powered Autonomous breaker and Swarm
- WP6: International cooperation and business network (growth engine)
- WP7: Exploitation and publication

4 RESOURCES
- 4.1 Participating organizations and key personnel
- 4.2 Schedule
- 4.3 Costs
- 4.4 Funding plan

5 BUSINESS POTENTIALS AND RISKS

Resources

- Research consortium: Technion (Maria Kivinen), Normet (Santeri Lampinen), Novatron (Antti Kolu), Infrakit (Visa Hokkanen), Destia (Mika Jaakkola), Nokia (Jarkko Pellikka), University of Oulu (Rauno Heikkilä), VTT (Tapio Heikkilä)
- International research cooperation and exchanges:
  - PWRI, Tsukuba, Japan
  - Tokyo University, Japan
  - ETH Zurich, Switzerland
  - University of Nebraska at Lincoln, Omaha site, USA
- Other international cooperation
  - European Robotics Forum
  - IAARC/ISARC

Resources

- Schedule plan: 1.10.2024-31.3.2027 (duration approximately 2.5 years)
- Cost estimate (draft):
  - Company research part 5 285 423 eur
  - Public research part 3 030 663 eur
  - Total 8 316 086 eur
- Funding plan (draft):
  - Consortium partners 3 238 129 eur
  - Business Finland 5 078 857 eur
  - Total 8 316 086 eur

Business Potentials and Risks

- Based on the industrial consortium partners:
  - Technion
  - Normet
  - Novatron
  - Infrakit
  - Destia
  - Nokia