

Troëdsson Forestry Teleoperation Lab



Tobias Semberg

XT28

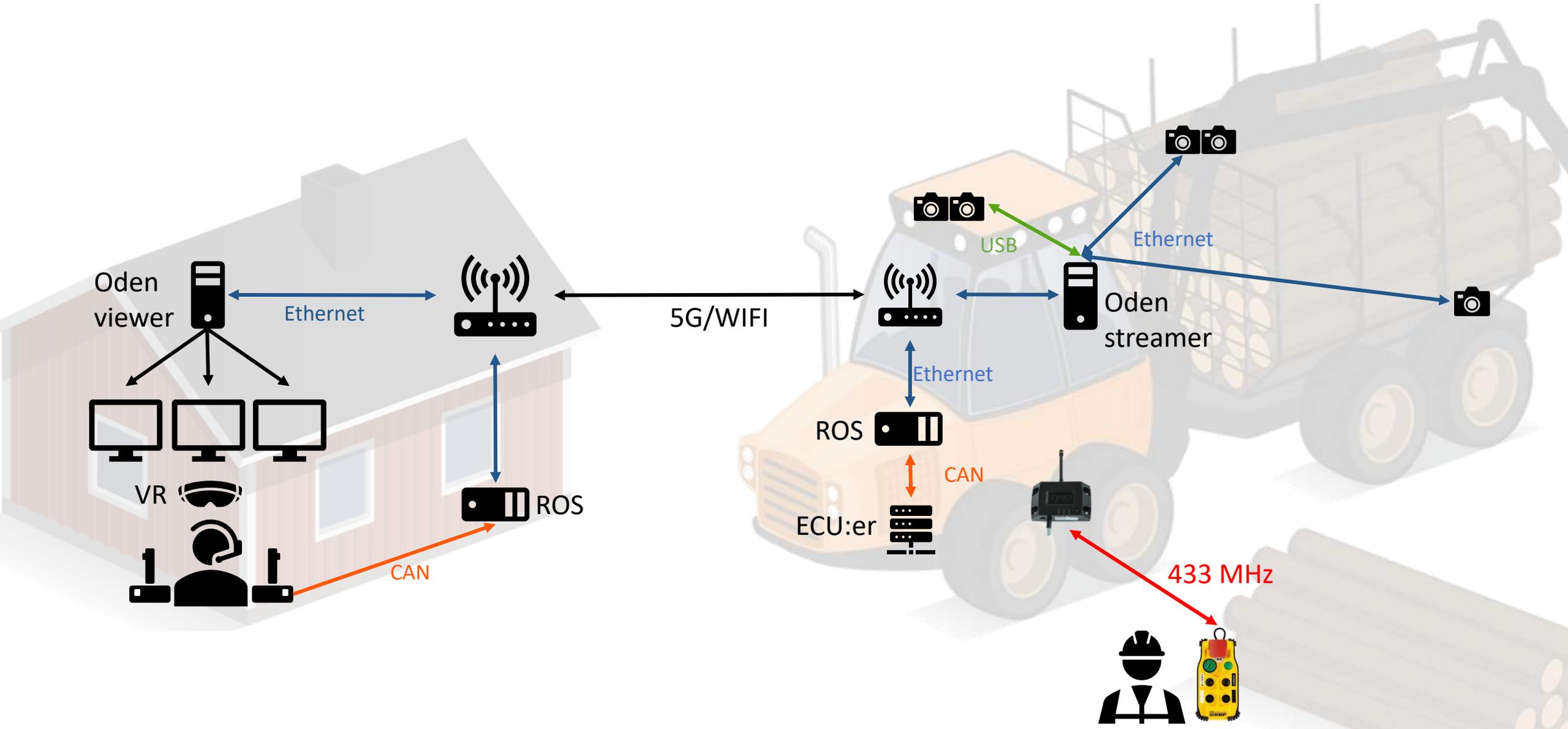


Komatsu 845



A	2620 mm
B	9380 mm
C	1900 mm
D	2900 mm
E	3880 mm
F	660 mm
Vikt	16950 kg

Troëdsson Forestry Teleoperation Lab



Kameror

- Upplösning: 1920x1200
- Frekvens: 53 fps
- Stereomonterade
- Fisheye-linser(190°)



Kontroller

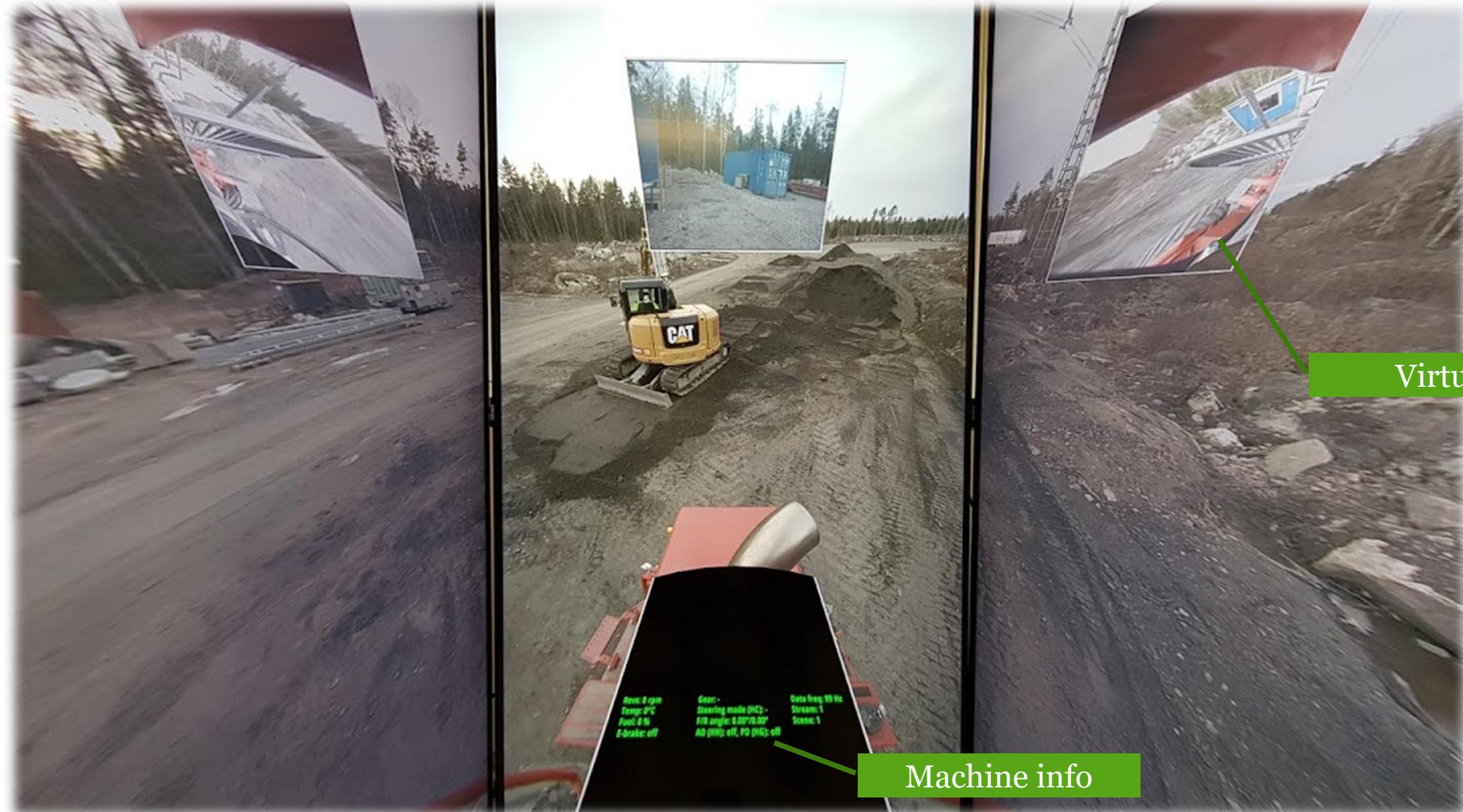


Maskinspakar



Spelkontroller

Användargränssnitt





Privat 5G

- Privat 5g-nät
- Lokal mobilmast

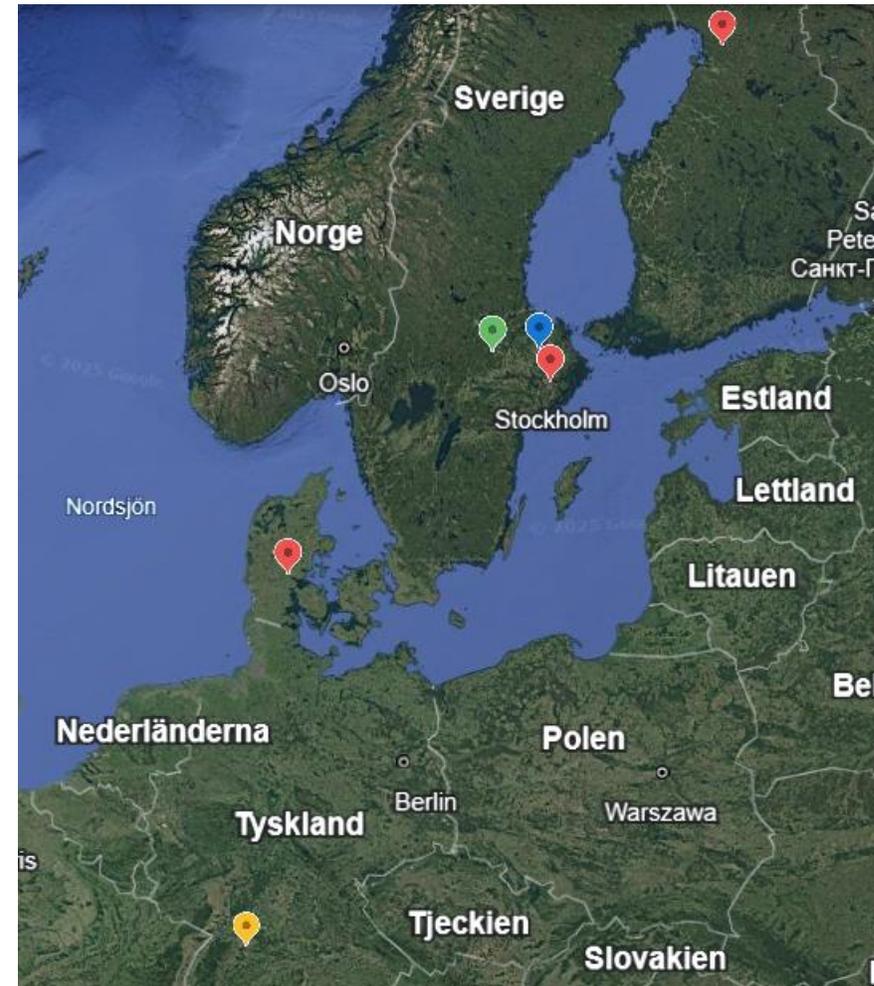


Privat 5G – CellOnWing

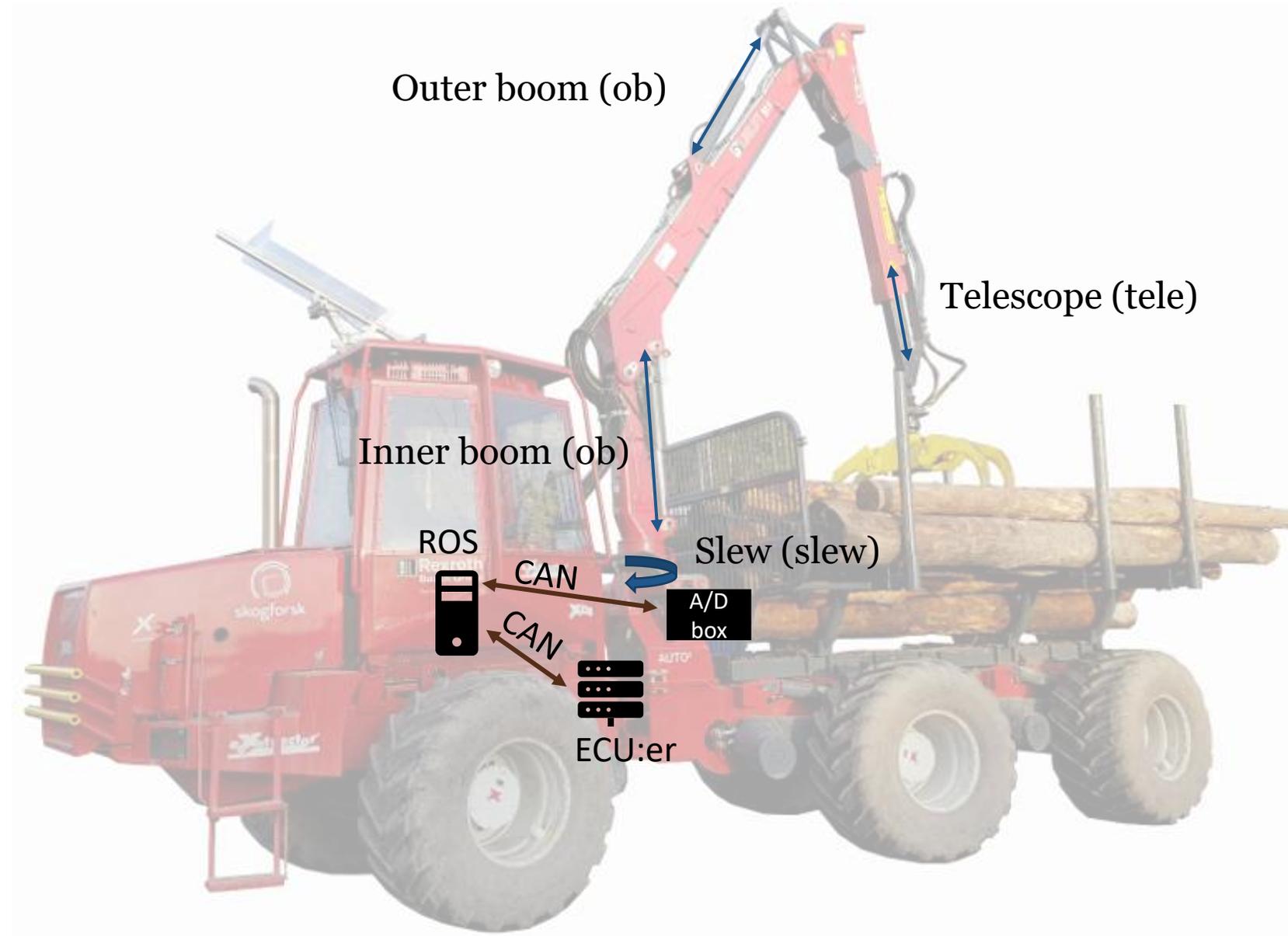


Fjärrstyrning från olika platser

- Troedsson Forestry Teleoperation Lab
- Public 5G
- Wifi
- 5G Drone



Automatic Crane – Crane sensors



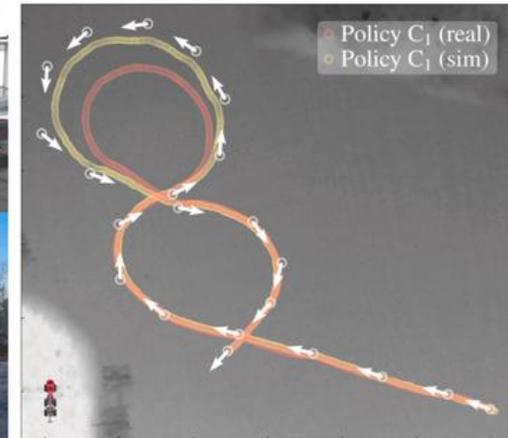
Automatic Crane – Camera



- ZED2 – Stereo Camera
- Object identification
- Relative positions

Samarbete med Umeå Universitet

Can a deep reinforcement learning controller for a rough terrain vehicle be trained in simulation and then transferred to a real machine?



Robotics and Autonomous Systems 179 (2024) 104731

Contents lists available at ScienceDirect

Robotics and Autonomous Systems

journal homepage: www.elsevier.com/locate/robot

Sim-to-real transfer of active suspension control using deep reinforcement learning

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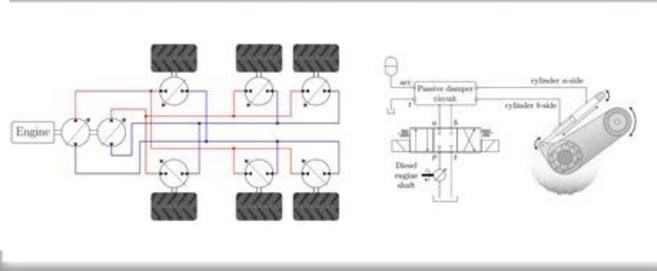
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ARTICLE INFO

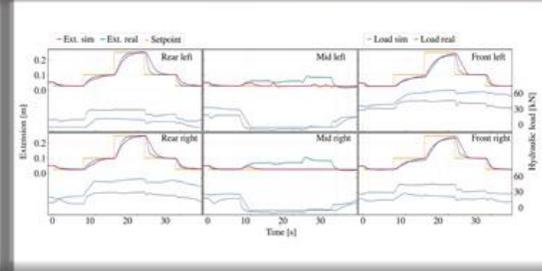
Keywords:
 Autonomous vehicles
 Rough terrain navigation
 Machine learning
 Sim-to-real
 Reinforcement learning
 Heavy vehicles

ABSTRACT

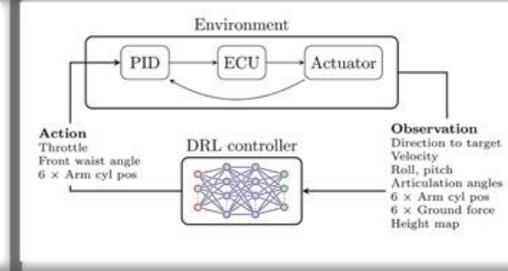
We explore sim-to-real transfer of deep reinforcement learning controllers for a heavy vehicle with active suspensions designed for traversing rough terrain. While related research primarily focuses on lightweight robots with electric motors and fast actuation, this study uses a forestry vehicle with a complex hydraulic driveline and slow actuation. We simulate the vehicle using multibody dynamics and apply system identification to find an appropriate set of simulation parameters. We then train policies in simulation using various techniques to mitigate the sim-to-real gap, including domain randomization, action delays, and a reward penalty to encourage smooth control. In reality, the policies trained with action delays and a penalty for erratic actions perform nearly at the same level as in simulation. In experiments on level ground, the motion trajectories closely overlap when turning to either side, as well as in a route tracking scenario. When faced with a ramp that requires active use of the suspensions, the simulated and real motions are in close alignment. This shows that the actuator model together with system identification yields a sufficiently accurate model of the actuators. We observe that policies trained without the additional action penalty exhibit fast switching or bang-bang control. These present smooth motions and high performance in simulation but transfer poorly to reality. We find that policies make marginal use of the local height map for perception, showing no indications of predictive planning. However, the strong transfer capabilities entail that further development concerning perception and performance can be largely confined to simulation.



Hydrostatic transmission & active suspension



System identification & domain randomization



Control system overview

Pågående projekt

- AutoPlant
- Røjrobot
- Exjobb
- Ny skotare



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