Viktor Lizenberg, Opel Automobile GmbH

12 MAY 22

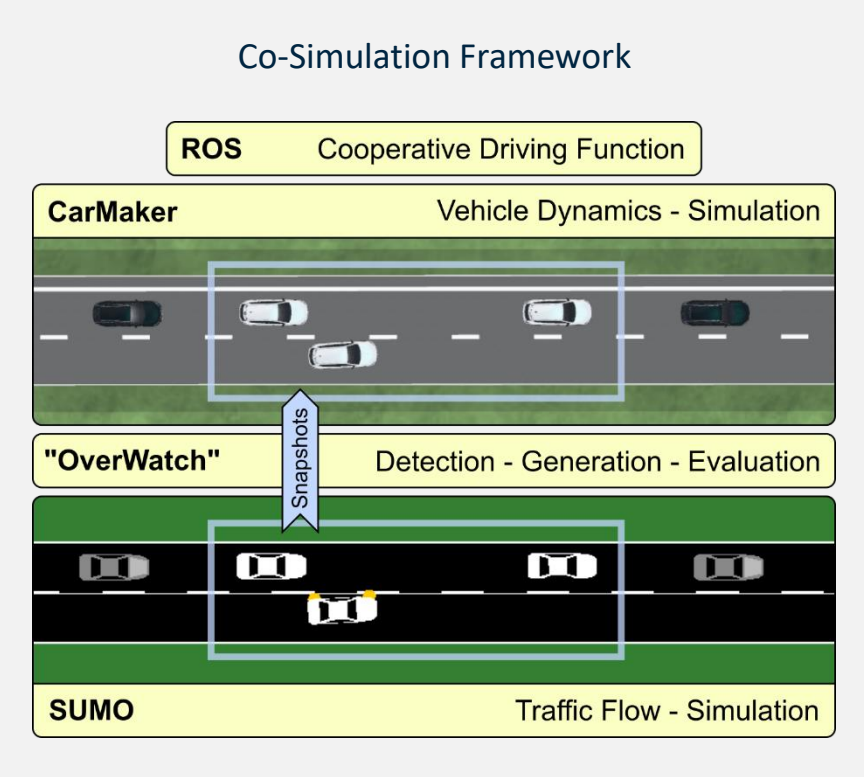
FINAL EVENT

Remote Adaptable Prototype-in-the-Loop

Remote Adaptable Prototype-in-the-Loop
Introduction

RA-PiL

- Remote:
  - V2X communication between simulation and real vehicle.
- Adaptable:
  - Detection, generation, evaluation of scenarios with artificial intelligence.
- Prototype-in-the-Loop:
  - Testing of prototypical system in hybrid (real/virtual) environment.



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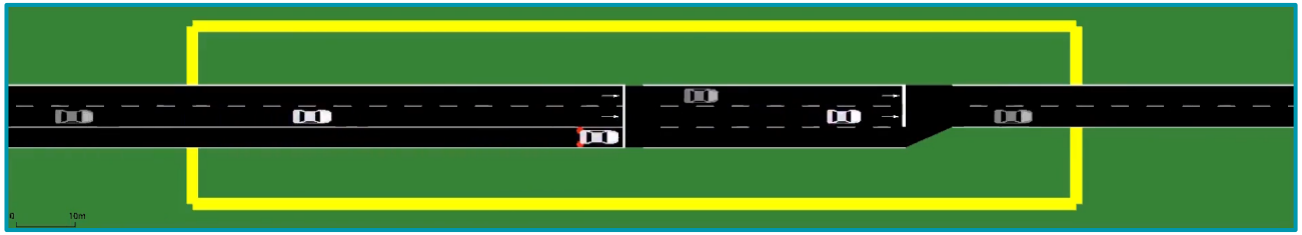
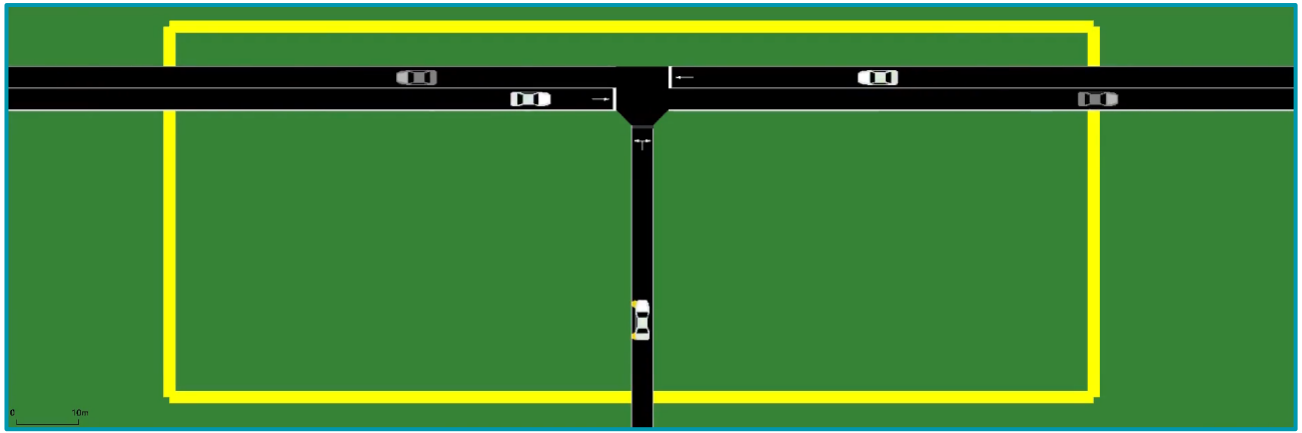
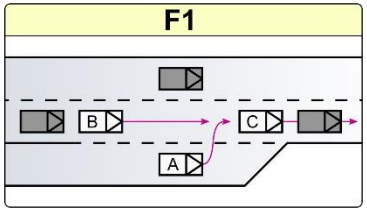
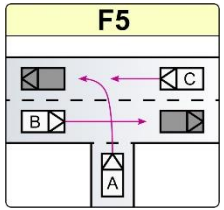
Intelligent Scene Detection







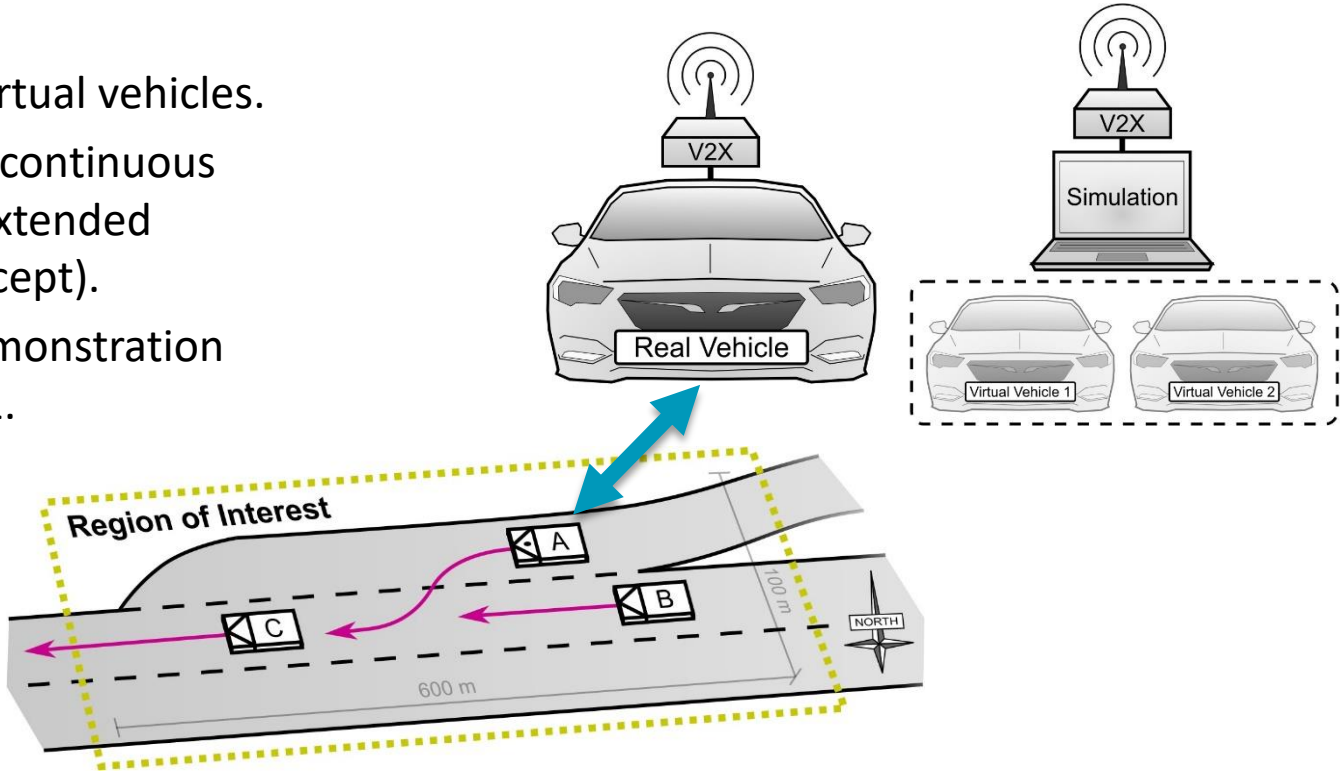
Cooperative Driving Functions



Remote Adaptable Prototype-in-the-Loop

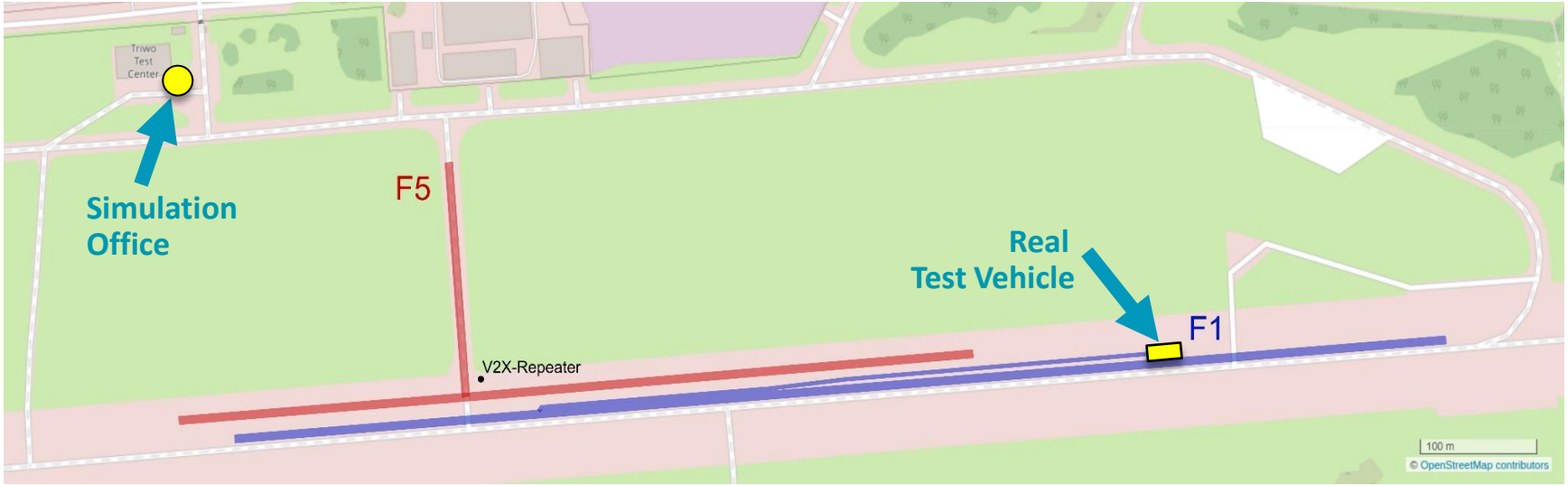
Hybrid Reality

- 1 real and 2 virtual vehicles.
- Integration of continuous cooperation extended (IMAGinE concept).
- Exemplary demonstration on function F1.



Remote Adaptable Prototype-in-the-Loop
Hardware Setup

- TRIWO Testcenter Pferdsfeld.



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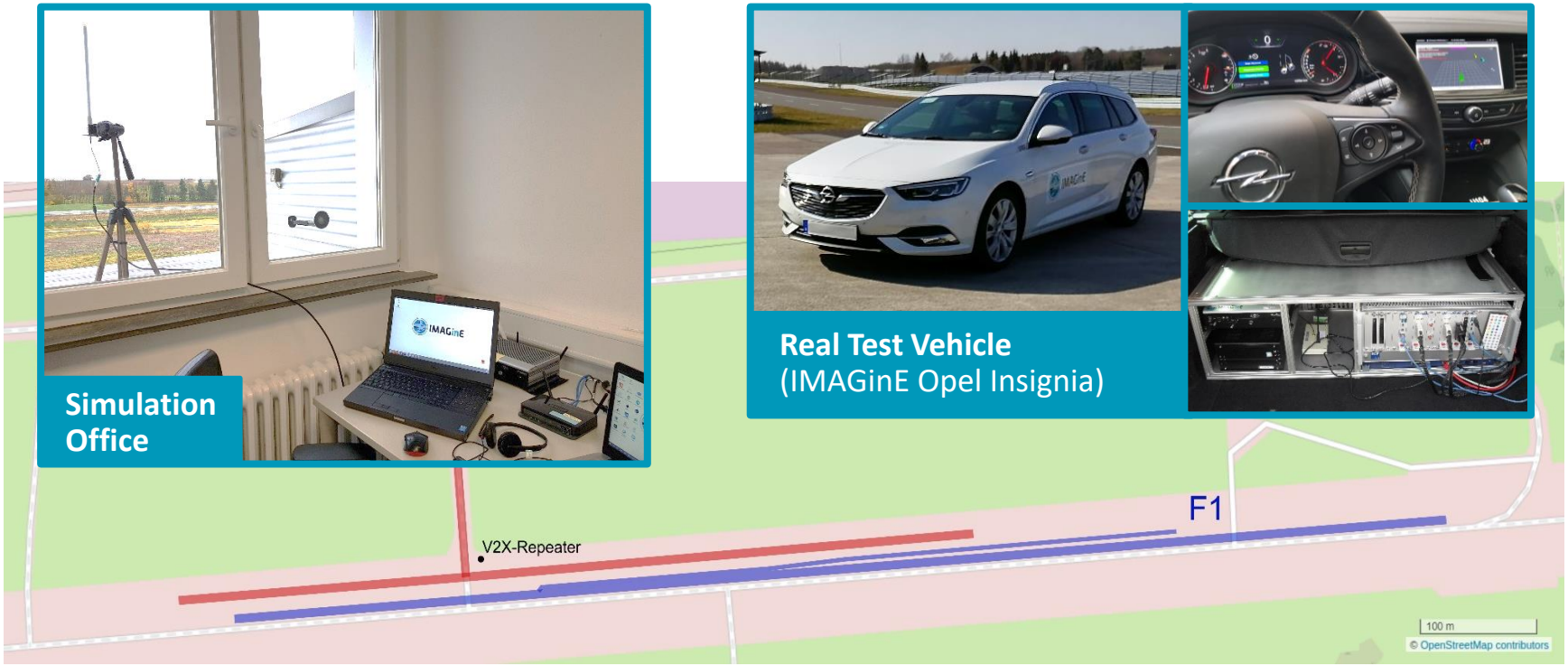
Hardware Setup



Remote Adaptable Prototype-in-the-Loop

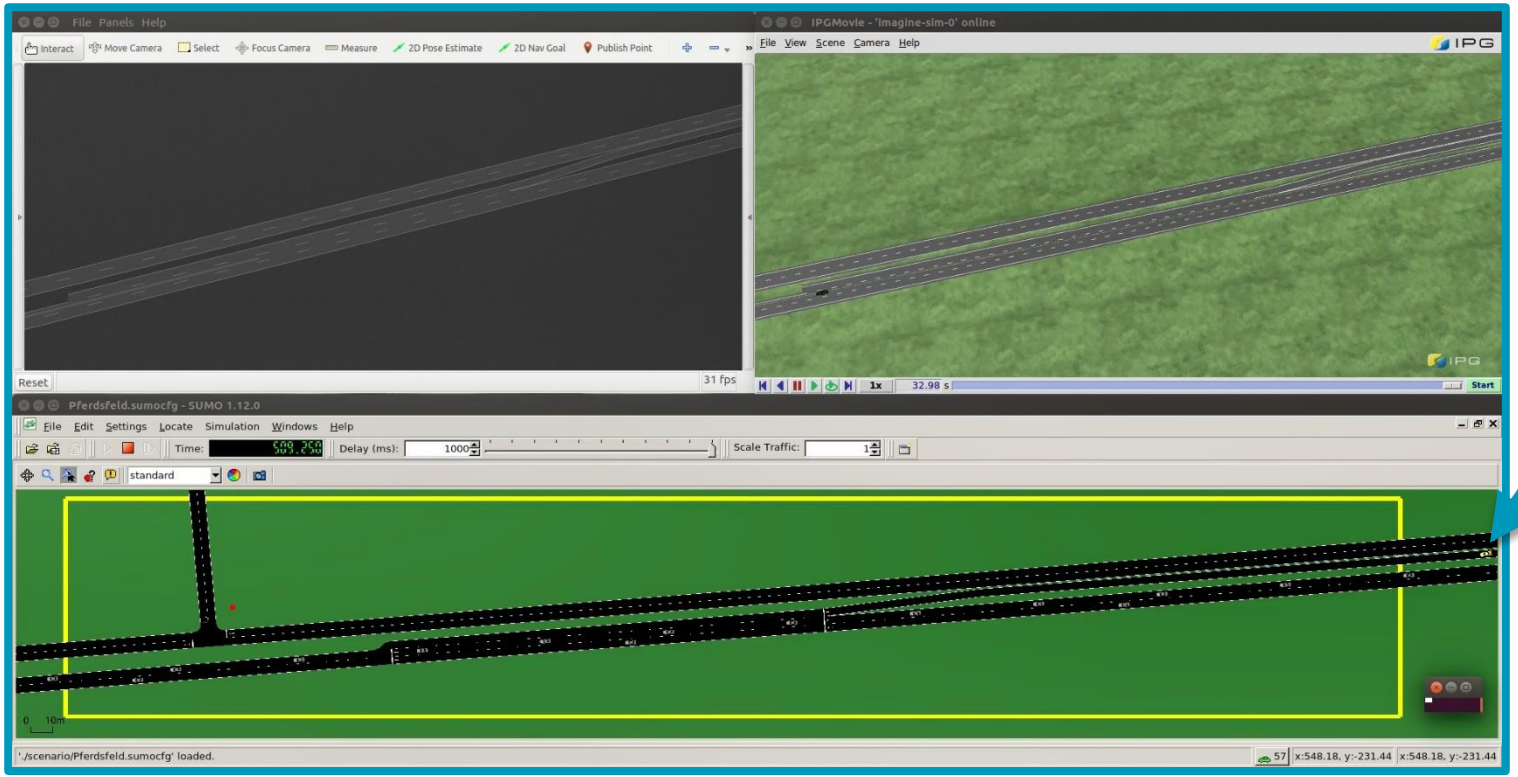
Simulation Example

ROS (RViz)

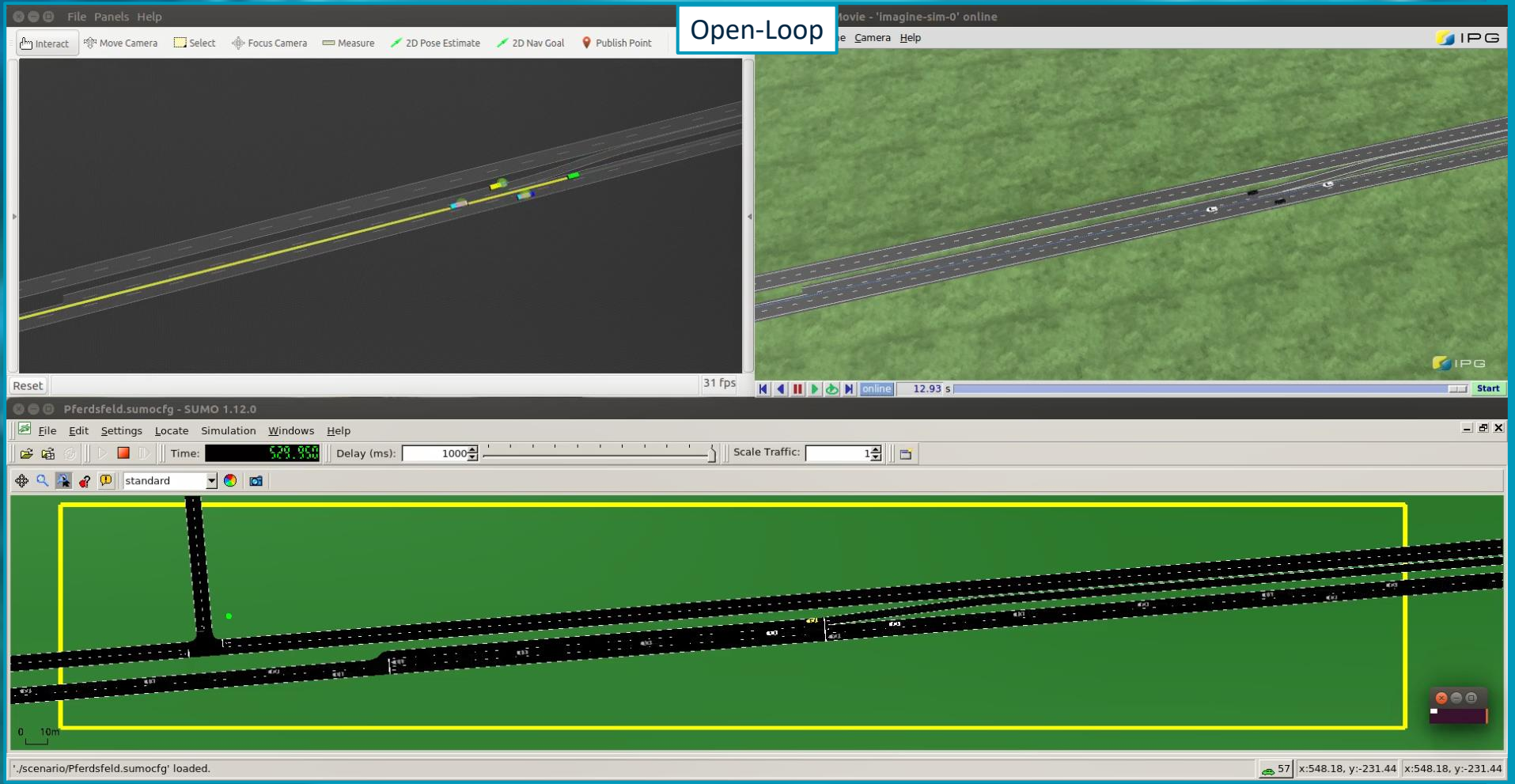
CarMaker

Real Test Vehicle CAM

SUMO



Open-Loop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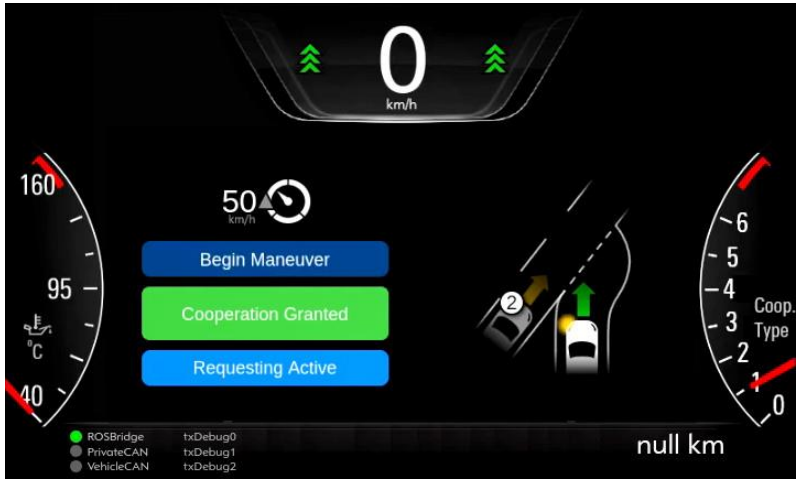
Interact
Move Camera
Select
Focus Camera
Measure
2D Pose Estimate
2D Nav Goal
Publish Point
Reset
31 fps
Movie - 'imagine-sim-0' online
Camera Help
IPG
online
12.93 s
Start
Pferdsfeld.sumocfg - SUMO 1.12.0
File Edit Settings Locate Simulation Windows Help
Time:
Delay (ms):
1000
Scale Traffic:
1
standard
0 10m
'./scenario/Pferdsfeld.sumocfg' loaded.
57
x:548.18, y:-231.44
x:548.18, y:-231.44

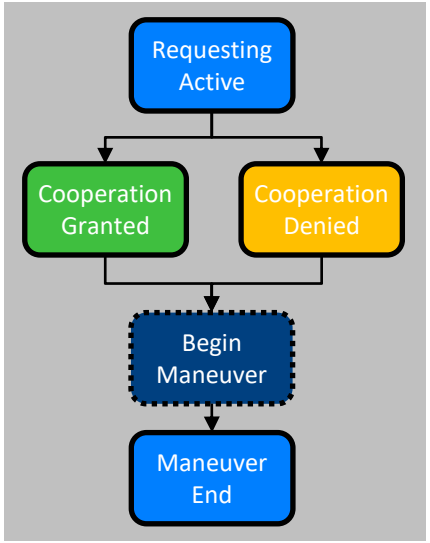
Remote Adaptable Prototype-in-the-Loop

Testing of Human-Machine Interface

- Real test vehicle is manually driven.
- Cooperation system triggers instructions for the driver.
- Instructions are displayed on the instrument panel cluster.



HMI-Support



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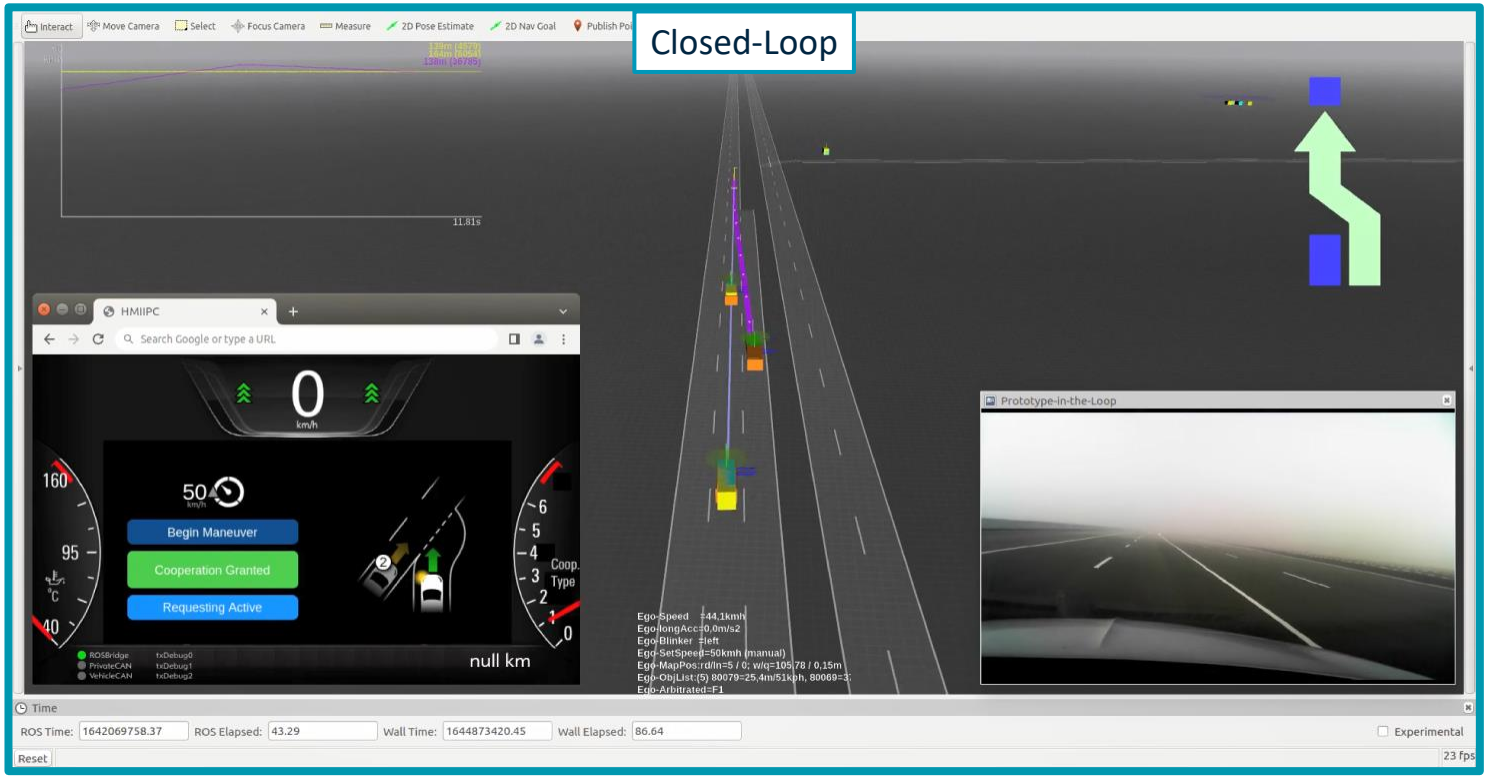
Result



THANK YOU

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[1] V. Lizenberg, S. Knapp, R. Mannale, V. Wendel & F. Köster. "Simulationsbasierte Bewertungs- und Vergleichsmethodik für Abstimmungsverfahren in kooperativen Fahrfunktionen". *AAET: Automatisiertes und vernetztes Fahren*; pp. 49-65. 2019; Brunswick, Germany.
[2] V. Lizenberg, B. Büchs, S. Knapp, R. Mannale & F. Köster. "Graphical Data Visualization for Vehicular Communication Systems in Real and Virtual Test Environments". *AmE: Automotive meets Electronics (11th GMM-Symposium)*; pp. 65-70. 2020; Dortmund, Germany.
[3] V. Lizenberg, D. Bischoff, Y. Haridy, U. Eberle, S. Knapp & F. Köster. "Simulation-Based Evaluation of Cooperative Maneuver Coordination and its Impact on Traffic Quality". *SAE International Journal of Advances and Current Practices in Mobility* from *WCX: World Congress Experience Digital Summit*; vol. 3, no. 6, pp. 3159-3169; Technical Paper 2021-01-0171. 2021; doi: 10.4271/2021-01-0171.
[4] V. Lizenberg, M.R. Alkurdi, U. Eberle & F. Köster. "Intelligent Co-Simulation Framework for Cooperative Driving Functions". *IEEE ICCP: 17th International Conference on Intelligent Computer Communication and Processing*; pp. 109-115. 2021; Cluj-Napoca, Romania; doi: 10.1109/ICCP53602.2021.9733618.

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