FORD OTOSAN

Auto-Trailer Parking Project & HIL Studies

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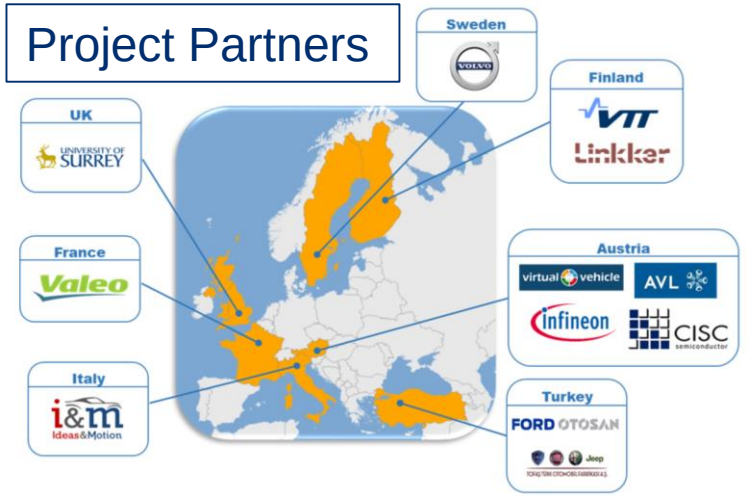
CONTENT

ABOUT TRUSTVEHICLE

Horizon2020
European Union Funding
for Research & Innovation

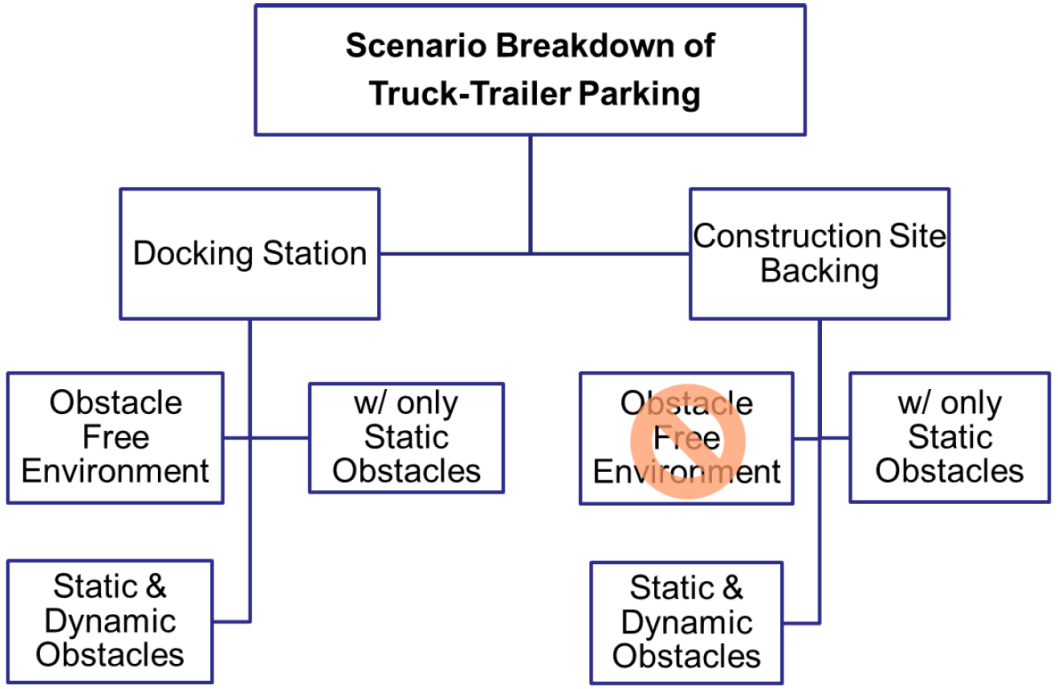
- **Improved Trustworthiness and Weather-Independence of Conditionally Automated Vehicles in Mixed Traffic Scenarios**
- TrustVehicle aims at **advancing L3AD functions** in normal operation and in critical situations (active safety) in **mixed traffic** scenarios and even under **harsh environmental** conditions. TrustVehicle follows a **user-centric approach** and will provide solutions that will significantly **increase reliability and trustworthiness of automated vehicles** and hence, contribute to end-user acceptance.

- Ford Otosan develops a L3AD reverse parking truck and trailer combination in TrustVehicle project



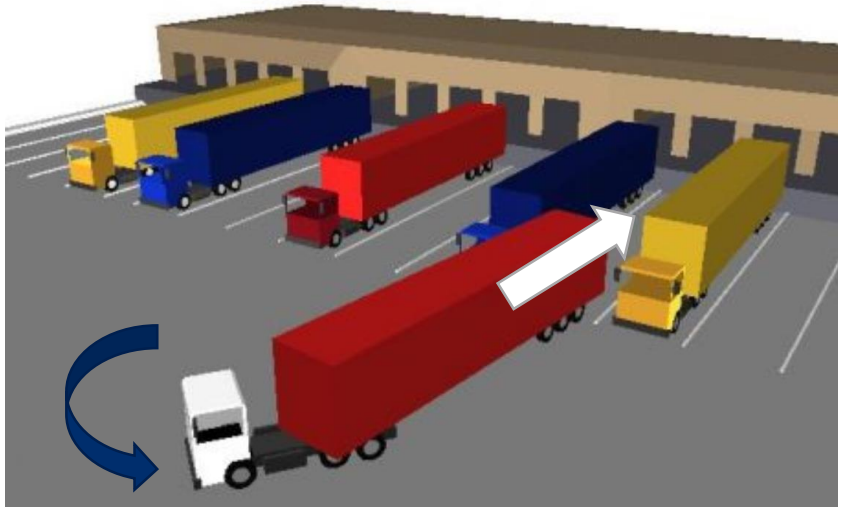
FORD OTOSAN USE CASE

- The driver needs several maneuvers to bring the trailer in the correct position, either to park correctly to the dedicated slot in the docking station, or to bring the truck in position on the construction site.



- While the main concern when considering the docking station scenario is the time spent to position the trailer, the problem with construction sites is also the surrounding traffic and other road users, such as pedestrians.

GOALS AND KPIS OF USE CASE



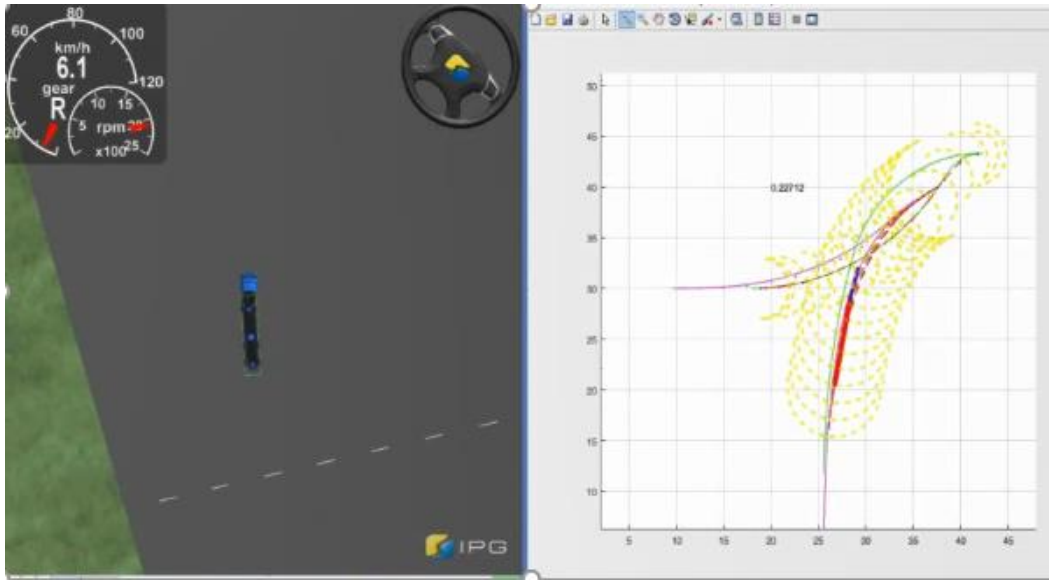
- The aim of this use case is to make backing scenarios with truck-trailer combinations more efficiently.
- The vehicle should be positioned precisely and the maneuver should become less time-consuming.

The system has to perform in various environmental conditions.

- In the docking station, different weather conditions have to be taken into account.
- In case of construction sites, the sensors additionally have to deal with dirt and dust covering the sensors so that the sensor availability is decreased.

AUTO – TRAILER PARKING PROJECT

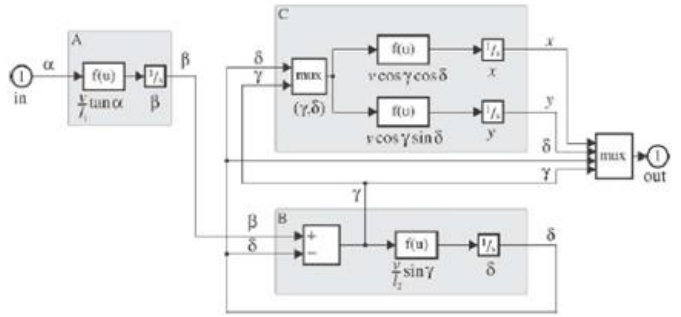
CAE Studies

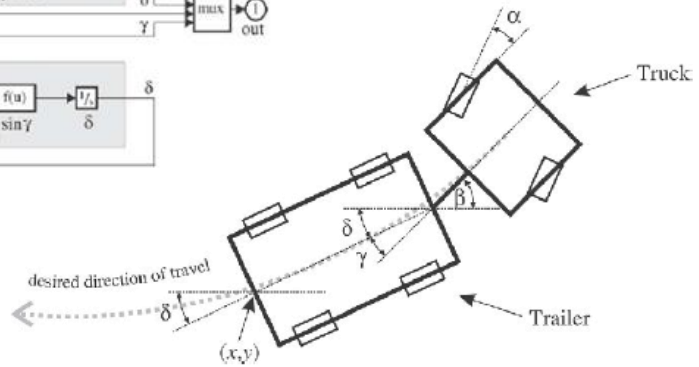


- Path Planning and Pure Pursuit Controller and Geometric Path Tracking Algorithm are developed using MATLAB/Simulink and implemented in TruckMaker Simulink.

- Performance evaluation and verifications of the path planning algorithm:

Local coordinates are represented in simuliation algorithm and tested.





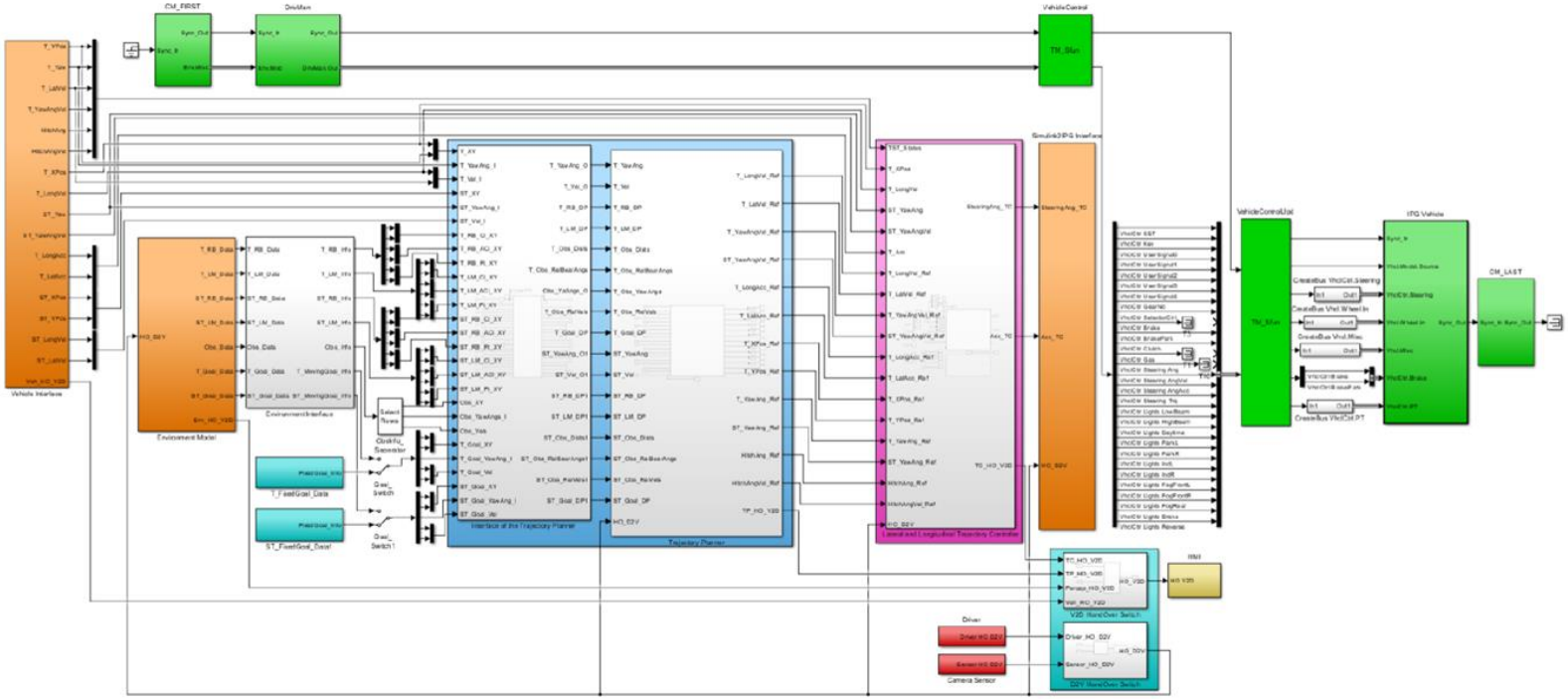
- Selection of controller:

Various controllers are evaluated in simulation and Pure Pursuit Controller is selected.

- Geometric Path Tracking Algorithm:

In order to decrease test periods and efforts, path tracking algorithm mainly tested in simulation environment with corrolated heavy commercial articulated vehicle.

OVERALL CO-SIMULATION BLOCK DIAGRAM FOR FO UC



Components

From IPG TruckMaker

- Environment model
- Sensor interface
- Simulink2IPG interface

From CAN/Ethernet

- Vehicle interface

From MATLAB

- Trajectory planner
- Lateral and longitudinal trajectory controller

- The blocks in green are MiL vehicle model components from IPG TruckMaker high-fidelity software and they are used to simulate the mule vehicle.
- The orange blocks are interface blocks between the IPG TruckMaker and Matlab/Simulink platforms.
- The Simulink components are in grey.

CO-SIMULATION BLOCK DIAGRAM COMPONENTS

Vehicle interface component

- The vehicle interface component is responsible for reading dynamics parameters from the IPG vehicle model.

Environment model component

- The environment component is dedicated to obtain signals data from IPG-modelled sensors for object detection.

Trajectory planner interface component

- An interface component for the trajectory planner was developed to provide the right signals based on the signals data given by the sensors.

Trajectory planner component

- The trajectory planner component generated the reference trajectories depending on the information given about the environment and the current state of the Truck & Semi Trailer.

Lateral and longitudinal trajectory controller component

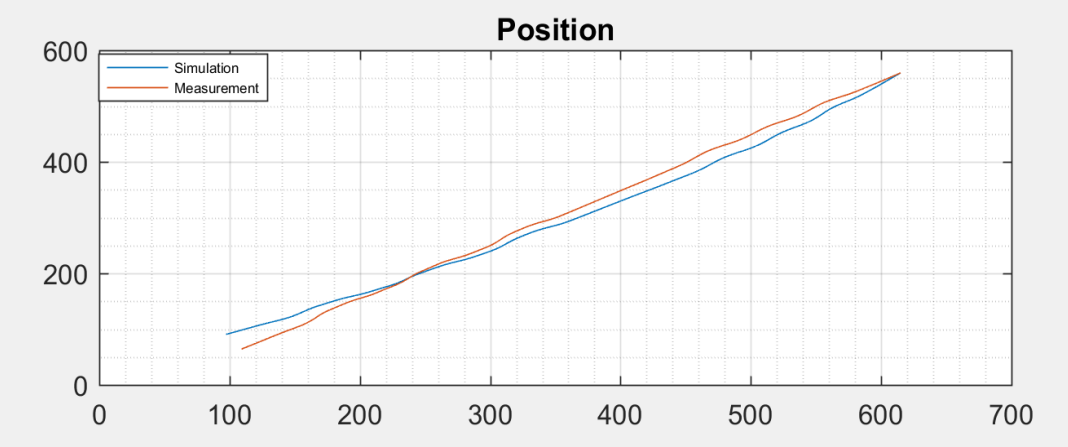
- The trajectory controller component receives the reference trajectory and current state of the Truck & Semi Trailer.

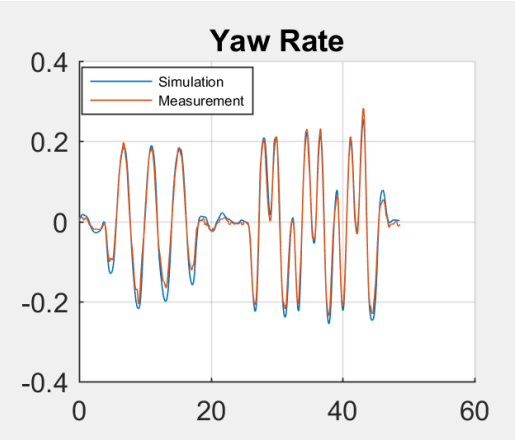
Simulink2IPG interface component

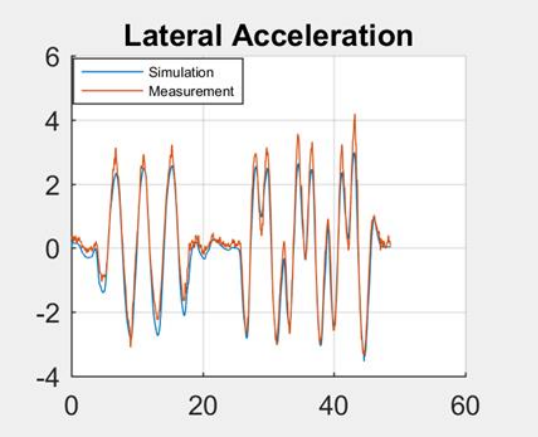
- All the output signals of the lateral and longitudinal trajectory controller block are connected to the input signals of the Simulink2IPG interface component.

LATERAL CORRELATION FOR TRUCK

Example Results – Lateral Correlation





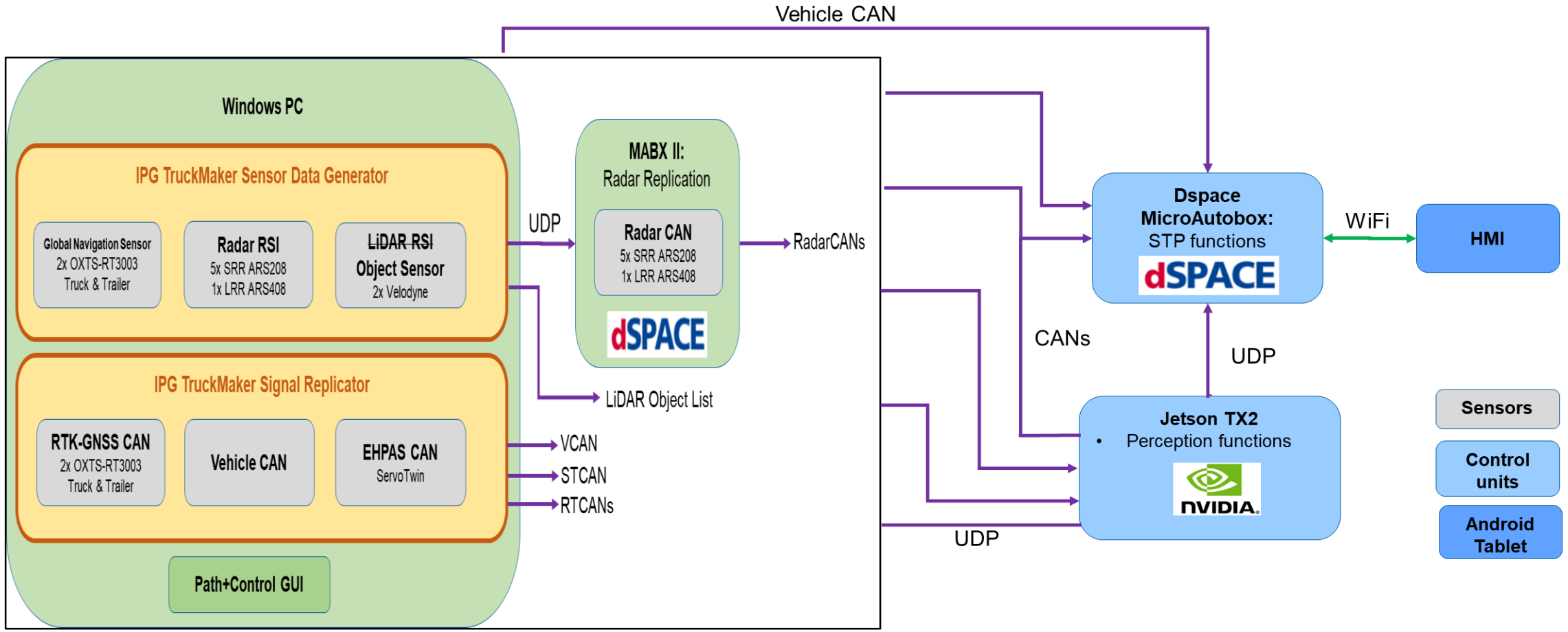


- The truck model is edited into Vehicle Data Set according to correlation between collected data from tests of lateral scenarios (half lock steering, quarter lock steering, sine steering etc.) in the test track of Ford Otosan in Eskisehir and data from same scenarios of TruckMaker test run.

Ford Otosan Inönü Test Track

AUTO – TRAILER PARKING PROJECT

HiL Setup Architecture

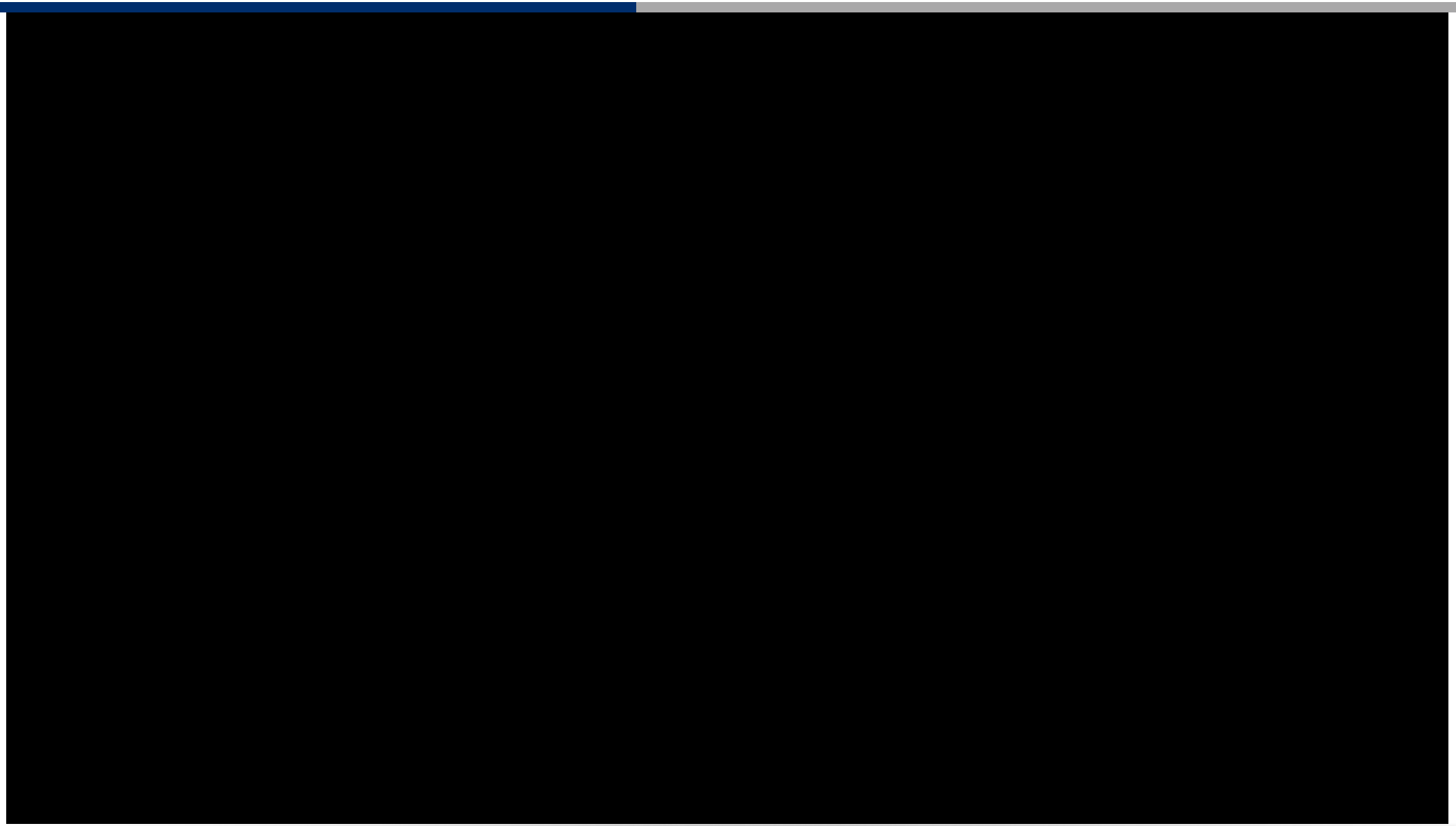


AUTO – TRAILER PARKING PROJECT

HiL Studies

- Environment and vehicle dynamics model of F-max truck has been built using IPG Truckmaker. Sensor models are built upon Truckmaker Physical sensor model add-on (PSM) which gives raw sensor outputs.
- Different test scenarios (Path Planning – Path following algorithms which run on dSpace environment) are tested repeatitively using real HW-SW architecture.
- Model-based software integration are completed faster in HiL iteratively.
- Many algorithm development phases and debugging are completed without real world test & validation.

FORD OTOSAN FINAL DEMO VIDEO



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CONTACT INFORMATION

Thank you for listening

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