Auto-Trailer Parking Project & HIL Studies

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• About TRUSTVEHICLE
• Ford Otosan Use Case
• Goals and KPIs of Use Case
• Auto – Trailer Parking Project CAE Studies
• Overall Co-simulation Block Diagram for Ford Otosan Use Case
• Co-simulation Block Diagram Components
• Lateral Correlation for Truck
• Auto – Trailer Parking Project HiL Studies
• Auto – Trailer Parking Project HiL Setup Architecture
• Ford Otosan Final Demo Video
• References
• Contact Information
ABOUT TRUSTVEHICLE

- 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
• 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.
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 simulation 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 correlated heavy commercial articulated vehicle.
• 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.
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.
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.
AUTO – TRAILER PARKING PROJECT

HiL Setup Architecture

Windows PC
- IPG TruckMaker Sensor Data Generator
  - Global Navigation Sensor
    - 2x OXTS-RT3003 Truck & Trailer
  - Radar RSI
    - 5x SRR ARS308
    - 1x LRR ARS408
  - LiDAR RSI
    - Object Sensor
      - 2x Velodyne
- IPG TruckMaker Signal Replicator
  - RTK-GNSS CAN
    - 2x OXTS-RT3003 Truck & Trailer
  - Vehicle CAN
  - EHPAS CAN
    - ServoTwin

Path+Control GUI

MABX II: Radar Replication
- Radar CAN
  - 5x SRR ARS308
  - 1x LRR ARS408

Vehicle CAN

Dspace MicroAutobox: STP functions
- WiFi
- HMI

Jetson TX2
- Perception functions

UDP
- LiDAR Object List
- VCAN
- STCAN
- RTCANs
- CANs

UDP
- RadarCANs
- UDP

Sensors
Control units
Android Tablet
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 repetitively 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.
REFERENCES


• Stettinger, G. et.al. (2018). D3.1 Requirements for the co-simulation framework, TrustVehicle Deliverable.


• Hillbrand, B. et.al. (2019). D3.4 Final co-simulation setup, TrustVehicle Deliverable.
Thank you for listening

- If you have any further questions do not hesitate to contact:

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