KI DELTA LEARNING
Scalable AI for Automated Driving

Test Vehicle build up and calibration concept

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WP 1.1

Sensors / Environment

Use-Case in Delta Learning

Deep Learning Algorithms like those which will be used in the KI-DL project requires a certain amount of data for training and validation of the algorithms. Therefore useful data needs to be gathered by a test vehicle with multiple State-of-the-Art sensors like cameras, LiDAR's, RADARs, and dGPS.

Technical Problem

Building such a prototype vehicle is a challenging task: The right sensor system needs to be chosen, all components need to be operated in a driving car – not just in an office room. These provide challenging requirements: Measurement system components need to be immune to vibrations, accelerations, and shock, special cooling and mounting solutions for the vehicle are required and also very high amounts of data need to be stored in a very short time. Access to different interesting in-Vehicle-BUS-signals needs to be granted and finally, the vehicle with a lot of extensions needs still to be safe for driving. For later processing of data, the sensors need to be calibrated to the Vehicle Coordinate System (VCS). This means, that the exact position (x, y, z) – the spatial offset - as well as the exact "viewing direction" – the rotational offset (Rx, Ry, Rz) – for every sensor need to be provided regarding the VCS. Therefore, a so-called "Calibration" is necessary, to find the spatial as well as a rotational offset for each sensor regarding the VCS with very high accuracy (<0.1° for "viewing direction").

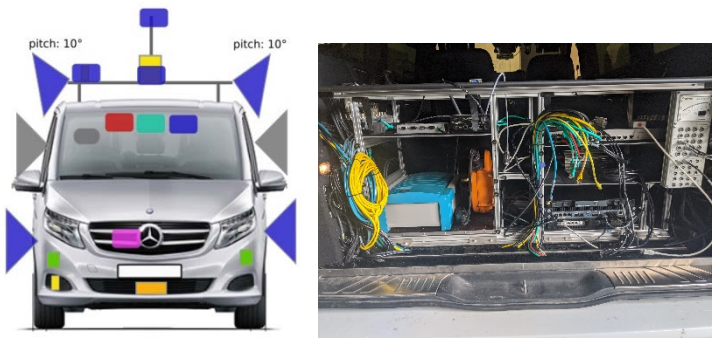

Figure 1: Sensor installation concept and Trunk mounting measurement system (e.g. data logger)

Figure 2: Calibration Concept and calibration recording (calibration target is recorded by the sensors)

Technical Solution

Preparing a vehicle prototype for test drive requires a lot of different steps:

1. Analysis of where and how to gather required vehicle-BUS signals
2. Definition of required Reference Sensors and Measurement Equipment
3. Construction and production of Mounting Solutions (for Trunk Rack and Sensors) – e.g. using 3D-Scanning and printing.
4. Demounting of vehicle components (e.g. seats) to get access to relevant wiring harnesses
5. Integration of all necessary Measurement System components
6. Measurement System commissioning (SW-installation and adaption)
7. Reintegration of vehicle components
8. Sensor Calibration

Calibration process

A calibration target is placed in a lot of different positions in front of the vehicle. By detecting certain feature points of the target of each sensor, a correspondence between the different sensor coordinate systems is given. These correspondences can be formulated as an optimization problem, to find the spatial and rotational offset between different sensors and the vehicle coordinate system as the optimal solution.

Evaluation

The test vehicle is now closed to be in a "ready-to-drive"-status. All HW-components of the measurement system are integrated according to the integration plan. The Software-adaptions of the recording tool C.FRAME was successful, so that the high data rate can be handled by the recording system. The system runs stable and reliable according to first tests.

Remaining tasks are providing the time-synchronization ("time-awareness") of all sensors regarding a common master-time as well as the sensor calibration. The calibration toolchain is also ready to use and was successfully tested in laboratory system before, the first analysis of vehicle-calibration recordings are under evaluation right now.

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Partners

External partners

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KI FAMILIE

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