Management

SAFIR Cluster 1

SAFIR Cluster 2

Dear Ladies and Gentlemen, Dear Colleagues,

we are very pleased to present you today our 13th SAFIR Newsletter and hope you enjoy reading it.

You can also find all previous newsletter issues for download on our website www.thi.de/go/safir in the "Newsletter" section. There you can also view the data protection information. If other colleagues or partners of yours would like to receive our newsletter automatically in the future, please contact Camila Heller by e-mail, at camila.heller@thi.de.

Our newsletter aims to provide you with regular updates on news, current topics and dates of interest relating to the SAFIR research partnership. We look forward to your feedback as well as constructive suggestions and requests for changes!

With best regards from the entire

SAFIR team

Management

- ***SAFIR Network Meeting: Security and Safety in Automotive Software Development and Electromobility, 10.11.2022***

The SAFIR research partnership is focusing this year's networking event on the topic of security and safety in automotive software development and electromobility.Be there and register here by 31.10.22.

- ***News from the SAFIR Network***

Since March 2022, the research partnership SAFIR and CARISSMA (Research and Test Centre for Vehicle Safety) is member of the Automotive Cluster of Bayern Innovativ. The last cluster meeting took place at Technische Hochschule Ingolstadt (THI). Together with the colleagues of the Cluster Automotive, SAFIR programme coordinator Camila Heller and CARISSMA speaker Prof. Lothar Wech organised an interesting programme on the topic of "Road safety of autonomous vehicles".

In addition to presentations by Prof. Dr.-Ing. Christian Birkner (VorSAFe - Plus project), Prof. Dr.-Ing. Hans-Joachim Hof (head of the SAFIR exploratory project HATS3) and the research assistant from the SAFIR exploratory project ANTON, Ömer Dönmez, presentations were also given by companies such as LiangDao GmbH and e:fs TechHub GmbH. Another highlight was the presentation by representatives of Istanbul Okan University with the OPINA Project (Open Innovation Autonomous Vehicle Development and Testing Platform), which provided for international exchange among the guests. The OPINA Project is a project funded by Turkey and the EU to support the development, integration, prototyping and testing of software for connected and autonomous vehicles.

News from the Impulse Project 8: Hybrid Models and AI Methods for Safe Mobility - Data Generation and Data Quality" (HyMne)

The impulse project "Hybrid Models and AI Methods for Safe Mobility - Data Generation and Data Quality" (HyMne) aims to add value to vehicle safety and automated driving by combining domain knowledge and machine learning. Insufficient data can be partially compensated by pre-processing steps based on expert knowledge. Similarly, machine learning methods in hybrid models are to be supplemented with expert knowledge to enable interpretability or to validate the results of the machine methods. The research project focuses on the generation of relevant data and the evaluation of their quality.

With this newsletter, we would like to give you an insight into the current research work in SAFIR Impulse Project 8, which is led by Professor Dr.-Ing. Michael Botsch.

Vehicle Reference State Estimation Using Inertial and On-Board Sensors

The research topic of subproject I in HyMne is the generation of correction data for inertial navigation systems (INS). This will allow the estimation of a highly accurate vehicle state that can be used as a reference for objective evaluation and validation of automated driving and vehicle safety systems.

Fig. 1: Shown is a test vehicle that is equipped with an ADMA G-Pro+, a Correvit S-Motion and a car pc. (Source: THI)

Typically, Satellite Navigation (SatNav) is used as a source of correction data. However, there are situations (e.g., in tunnels, parking garages, or street canyons) where SatNav is either not available or is so severely degraded that it cannot be used.

Since regular road vehicles are equipped with a variety of sensors that constantly monitor vehicle status, they are suitable candidates to temporarily replace SatNav as a source of correction data. The quality of signals in road vehicles is determined by the requirements of driving functions such as ESP, ABS, etc.. Thus, there are certain operational points where the quality of the vehicle signals is particularly good and again driving situations where they are unsuitable for high accuracy state estimation. Therefore, subproject I focuses on the development of methods that allow to learn the quality of the sensor information in the vehicle and, based on this, to realize a sensor fusion with modern inertial sensors to generate a reference vehicle state.

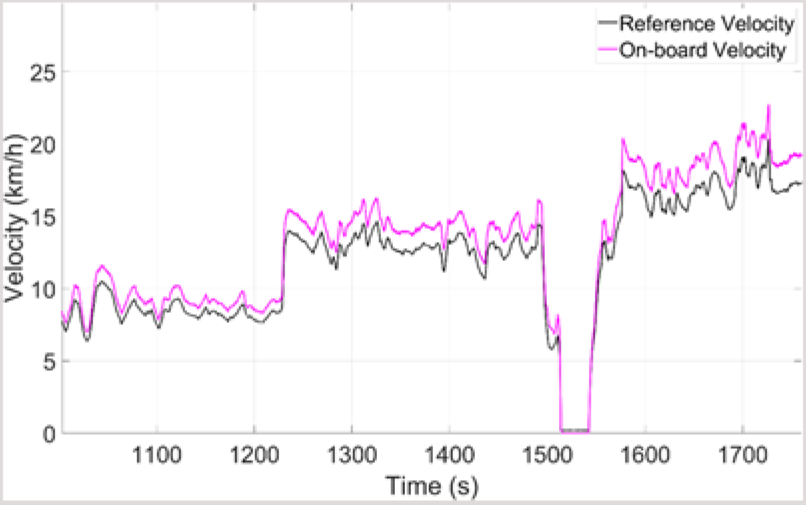

Fig. 2: Shown is the velocity as measured by the vehicle sensors (On-board velocity) and as measured by the ADMA G-Pro+.
(Source THI)

So far in the project, relevant signals such as wheel speeds, velocity, etc. have been recorded via the On-Board Diagnostics II (OBD-II) protocol in different driving situations at the outdoor open-air test site of CARISSMA and processed for use in machine learning methods.

The industry project partner in subproject I is the company GeneSys Elektronik GmbH, and the INS of the industry partner used is called ADMA.

Driver Modeling for Simulation-Driven Development and Validation

The HyMne subproject II focuses on the exploration of data-driven realistic driver behavior models for simulation-based development. Simulations are an important component in the development of autonomous vehicles, as they enable cost-effective testing. However, the quality of simulations depends on the models used in the simulation environment. In this subproject, AI-based methods are used to learn realistic driving behavior directly from the data.

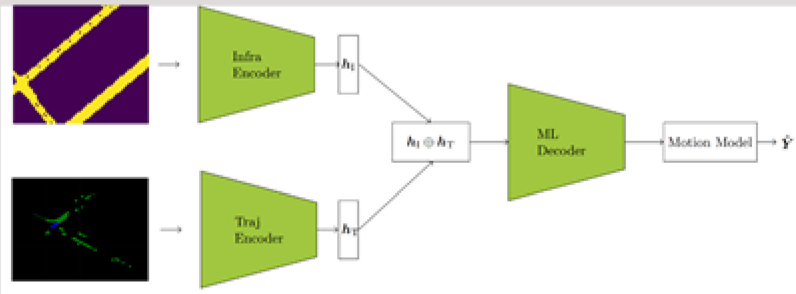

Fig. 3: Shown is a machine learning based driver behavior model. (Source: THI)

The proposed and partially implemented AI-based method is coupled with a vehicle motion model that allows it to dynamically generate plausible driving behaviors. The outputs of the AI model are the possible actions that a human driver would take: accelerate, brake, steer. At this stage, expert knowledge is incorporated to control the action space generated by the AI model. Dynamic motion models use the data from the action space to generate waypoints that represent the future vehicle trajectory. The hybrid AI and motion model architecture shown in Figure 3 is trained in an end-to-end manner. Incorporating vehicle dynamics models into the end-to-end learning process is a challenge that has been successfully addressed. Publicly available data sets such as Argoverse, Lyft and highD are used for training the hybrid model.

The industrial project partner in subproject I is the company ZF Mobility Solutions GmbH.

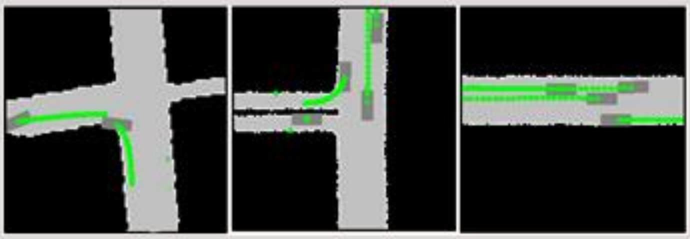

Fig. 4: Prediction of vehicle behaviors given history and infrastructure. (Source: THI)

Test Systematics for Automated Driving

Safeguarding automated driving functions poses major challenges for the industry, as the proven methods become too time-consuming and cost-intensive with increasing levels of automation. Realistic test scenarios that cover a wide range of relevant traffic situations are of crucial importance. In subproject III, research is being conducted on a method that enables the generation of test scenarios using machine learning methods and domain knowledge about the real behavior of road users. A first concept has already been implemented and is currently being validated

Fig. 5: Shown is the recreation of a real-life traffic scenario on the outdoor test facility. A pedestrian attempts to cross a street, and a vehicle performs an emergency braking to avoid a collision. (Source: THI)

One challenge is that the available data sets, which serve as the basis for generating new scenarios, contain only a small number of critical traffic situations that are of great importance for the validation of automated driving functions. To compensate for this, additional real-world scenarios are generated and recorded on the outdoor test site.

In order to generate the required real traffic scenarios, a lanelet-based representation of the road network is used. This allows an accurate replication of the road infrastructure on the THI test site. Crash dummies of cyclists and pedestrians are used to represent unprotected road users, increasing the relevance of the generated traffic scenarios. Two test vehicles are controlled by a predictive controller that generates control signals for an Autonomous Maneuvering System (AMS), which serves as an interface to the vehicle actuators (steering wheel, accelerator and brake pedal). The third vehicle is equipped with a driving robot from Stähle GmbH, an industry partner in SAFIR's Impulse Project 2.

The coordination of all road users is solved with a scenario planner implemented in the Robotic Operating System (ROS). The scenario planner receives information from the ADMAs about the status (position, orientation, speed, acceleration, etc.) of all road users. The scenario planner records all received data, which is later processed in MATLAB and finally converted into the same data format as the publicly available data sets like Lyft or Argoverse.

The industry project partner in subproject I is the company Audi AG.

Hinweis:
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Note:
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Kontakt: Camila Heller
E-Mail: camila.heller@thi.de

Contact: Camila Heller
Email: camila.heller@thi.de

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