Master thesis project
AI-based road friction information algorithm

Thesis title: AI-based road friction information algorithm (30 or 60 credits)

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Keywords: Vehicle dynamics, Road friction estimation (RFE), road weather information, machine learning (ML), data analysis, sudden road weather changes

Requested experience

- Engineering background with good skills in statistical signal processing, machine learning and data analysis
- Experience in vehicle dynamics and control function design is a merit

Workplace: Will be at SAFER Vehicle and Traffic Safety Centre at Chalmers, Lindholmen.

Background

Road friction estimation is important as a part of the vehicle state and road condition estimation functionality on board today. The tyre-road adhesion coefficient is the key and often a bottle-neck to be able to actively control the vehicle motion, in both normal and adverse driving conditions. Even an experienced driver today finds it difficult to understand the relation between weather/road surface conditions and the tyre-road adhesion. The general goal of this thesis is hence to “create” this most experienced driver, which can more accurately sense the road friction value, by fusing the sensor information from the in-car ADAS sensor and the real-time road weather information from external services. Statistical analysis and deep learning-based AI methods will be applied here, in order to explore and analyse the relation aforementioned and potential mutual benefits for in-car and external estimation. Further, multi-sensor fusion for in-car sensors will be utilized for accurate road condition modelling with respect to inclement weather conditions.

Thesis objectives

1. Review previous studies related to this work
2. Understand the existing Volvo cars road friction estimation algorithm.
3. Understand the existing V-Traffic Road Weather content information.
4. Understand the vehicle connectivity as 4G/5G, RDS-TMC, DAB-TPEG
5. Analyse historical measurement data from both in-car and external services, using RFE/ML algorithm(s) in a closed-loop simulation environment, e.g. CarMaker
6. Identify a mapping between road weather patterns and road friction estimations.
7. Develop a method/algorithm using ML technique(s) to fuse road weather information from external services and road friction estimation from in-car ADAS sensors online during driving in simulation environment.
8. Identify the safety benefit and risk measures, which can be used to indicate the performance of this fused functionality.
9. Stretched target: implement the method in a rapid-prototyping Volvo cars and conduct co-testing in an expedition together with a ground-truth RFE test car.
10. Estimate the limiting conditions with respect to input sensor and weather data to achieve standard safety limits for a vehicle being operated in AD/ADAS mode

Motivation

Road friction is dependent on the weather conditions and the goal is to optimally utilize road weather data towards road surface condition and friction estimation. The thesis study will focus to propose new algorithm/method that can effectively utilize external road weather information to enhance the driver to be more prepared by *warnings* before and under slippery road conditions.

Number of students	*Finances provided to the student(s)*
1 or 2	*Yes, from VCC and V-Traffic*