Driving situation characterization

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Background
Today, advanced driver assistance systems with different functions are in use, which rely on characterizing a driving situation mainly by the evaluation of images of the environment around a vehicle. This environment can be modelled by sensor-independent static (e.g. traffic signs) and dynamic (e.g. bicyclists) objects with attributes (e.g. position, size, object type). Furthermore, there are first systems to use image-based methods to observe the driver. Therefore, the driver state can be - for example - modelled by his attention, which can be derived from the frequency of eye blinks or from the head orientation. By adding additional model assumptions, the environment model and driver model can be extended to predict the driving situation and the intention of the driver (Fig. 1) for the next seconds. These assumptions base on physical facts and statistical-empirical analysis. The realization of this analysis requires a big amount of data about the vehicle environment and the driver from many and many different driving situations, which are normally recorded by few research vehicles.

Fig. 1: Driver intentions at an intersection: Turning right or going straight [Liebner et al., 2012]
Purpose
Main objective of this work is to develop a new method to characterize and recognize dynamic driving situations using supervised or semi-supervised machine learning techniques (e.g. active learning) based on images. The method should not be developed for data of a short time interval from few research cars, but for data acquired continuously by a whole fleet of cars. The driver should be modelled with mutual dependency on the vehicle environment. Therefore, especially geometric and semantic links in the data will be analysed. The improvement of the characterization and recognition of dynamic driving situations based on images should be shown and evaluated in comparison to the use only position data only (e.g. vehicle trajectory from GPS) for real or synthetic applications in the field of vehicle safety.

Results
It is expected that the detection rate and classification rate of objects in the vehicle environment will be increased by the proposed machine learning method. By comparing to manually marked or synthetic images used as ground truth, the completeness as well as the geometric quality of the detected objects will be evaluated. Furthermore, it is expected that the intention of the vehicle driver can be predicted better, if the driver attention as well as the movement of other road users are evaluated. The prediction for few seconds will be analysed by comparison with images of the subsequent seconds. As example application, critical and uncritical driving situations should be distinguished using the developed method.

References