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INDIVIDUAL ADAPTATION OF ADAS IN CAR-FOLLOWING STATE BASED ON NATURALISTIC DRIVING BEHAVIOR MODELING

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ABSTRACT - The research project aims to develop the design methodology for the advanced driver assistance system (ADAS) with individual adaptation to the driver characteristics and local hazardous potential of driving environment. Focusing on today's active safety devices, a number of driving assistance systems have been being developed for many years and some of them are equipped in vehicles on the market. The design of human-machine interface for driver assistance systems to obtain the satisfactory interaction in cooperative maneuver between safety system and human driver manual control has become a major issue of the driver assistance system study. For example, there are a number of Adaptive Cruise Control (ACC) as well as Forward Vehicle Collision Warning Systems (FVCWS) with different control algorithms, developed by automobile manufacturers in the markets now. Past research works by the authors give the understandings that it is important to utilize driving data in real-world traffic situation to make the Human-Machine-Interface (HMI) of ADAS more intelligent and acceptable for large-scale customers. Therefore, the concept of the study is to develop advanced driver assistance systems in each driving state, which can adapt their parameters for individual driver and driving environment by using statistical machine learning method and a large-scale driving database.

An experimental vehicle equipped with a continuous sensing drive recorder is used to collect the driving data in urban roads and highways. The structure of naturalistic driving behavior includes several modes of driving such as car-following, free-cruising, braking, stopping, etc. The naturalistic driving behavior in car-following state of each driver will be used for the analysis of headway control characteristics. To prevent the vehicle from forward collision in early stage by a safe headway assistance system, the key part of the paper is to propose a method to detect unusual driving behavior by employing an individual driver reference model of car-following state. From the analysis of real-world driving data, a standard 1 degree-of-freedom mass-spring-damper model seems to be valid to describe the car-following behaviour in real-world. The normalized deviation of the headway distance and the vehicle velocity are used as the indices to evaluate whether the driver is deviating from his/her normative driving behaviour. The real-world driving data analysis in the cases of the usual driving and the unusual driving shows that the proposed method is effective to be used for driver performance assessment in the individual adaptation algorithm.