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IMPLEMENTATION OF A SELF-LEARNING ROUTE MEMORY AS AN ELECTRONIC CO-DRIVER FOR REDUCED EMISSIONS

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ABSTRACT - An efficient and flexible transport system is crucial for our economy and way of life. But our current (intra-continental) transport system shows a substantial and ever-growing threat to the environment and to our health. Consequently, some of the main targets addressed in the European transport policy are the reduction of emissions and improvement of road safety. These targets are also for the automotive manufacturer of prime importance as, aside from emission legislation, high fuel efficiency, low emissions and high safety standards are important sales arguments. Several research projects around the world have shown that not only the fuel efficiency but also the comfort functions and some safety systems can be greatly improved with information about the road ahead, e.g. optimized gear shifting strategies, energy management in hybrid-electric vehicles, and curve light. This foresight information, however, is not yet available at a reasonable cost and accuracy from e.g. enhanced digital maps or intelligent infrastructure.

In this paper an alternative approach for the provision of the required preview information will be presented. The approach bases on the fact that many vehicles are mostly moved on a very limited part of the road network, which is true not only for commuter, public transport, and commercial vehicles, but also for private traffic. A database containing the required foresight information of a frequently driven route can be automatically generated and continually updated in the vehicle during each drive. For this, relevant road characteristics, e.g. slopes, curves, speed limits, and intersections, are identified during the drive and stored in a vehicle internal database. The stored information can be used for predictive driving strategies in subsequent trips along the route. The database is continually extended and updated during each drive by comparing newly identified events with events already existing in the database. Plausible and high quality situation descriptions are selected from the database and passed on to various assistance and control systems. The situation detection algorithms implemented in the route memory system are based on information from sensors used for e.g. standard engine and drivetrain control and vehicle stability. The only additional sensor system required is a GPS for the geographical positioning of the observed road characteristics. Each identified event is described in a storage efficient way with a set of attributes, e.g. geographical position, magnitude, length, number of observations, and date and time of the observation.

A prototype of the self-learning route memory has been developed and evaluated in a real-time driving simulator featuring 3D graphics and interactive driving. The vehicle dynamics and all sensor signals including GPS were simulated in the driving simulator. In various tests the algorithms for the situation detection and the selection of plausible road characteristics have been verified for e.g. different driving styles or in case of sensor malfunction.