Implementation of a Self-Learning Route Memory as an Electronic Co-Driver for Reduced Emissions

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Session

Driver Assistance

Abstract

Today 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.

In several research projects around the world it has been 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. This foresight information however, is not yet available at a reasonable cost and accuracy, e.g. from enhanced digital maps or intelligent infrastructure.

In this paper it will be shown how 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. Relevant road characteristics (e.g. slopes, curves, speed limits, intersections, etc) are identified during the drive, stored in the vehicle internal database, and used for predictive driving strategies in subsequent trips along the route (e.g. optimized gear shifting strategies, energy management in hybrid-electric vehicles, curve light, etc). Particularly vehicles frequently travelling the same route, i.e. commuters, public transport and commercial vehicles can benefit from this self-updating route memory. During each drive the database is continually extended and updated by comparing newly identified events with events already existing in the database to continually improve the quality of the event descriptions. Based on statistics, correctly identified events are selected and passed on to control and assistance systems as an electronic co-driver.

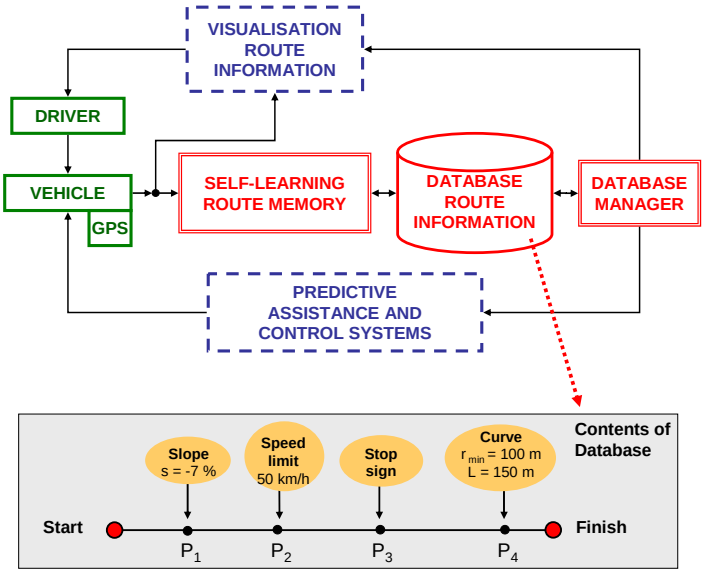

Figure 1: System setup with an example of the database contents

Investigations have shown that it is possible to realize such a system without costly sensors or communication systems such as car-to-car or car-to-infrastructure. The situation detection algorithms implemented in the route memory system are based on information from standard sensors used for engine and power train control and for the vehicle stability system. Additionally a positioning system (GPS, or in the future Galileo) is required to determine the geographical positions 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.

The development of the situation identification algorithms bases on measurement data from real test drives. It will be shown how the self-updating system is evaluated using a driving simulator with a 3D surround graphics system where the vehicle dynamics and all sensor signals

including GPS are simulated. Hence the algorithms for the selection of correctly detected road characteristics for e.g. different driving styles or in case of sensor malfunction can be verified. Within a further research project the self-updating route memory system will be implemented in a hybrid-electric vehicle featuring a small internal combustion engine powered with compressed natural gas (CNG).

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