GUEST EDITORIAL

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Perception and Planning for Autonomous Vehicles

The research area of autonomous driving in open and dynamic environments attracts much attention. Technologies related to application fields such as unmanned or highly automated road vehicles pose strong challenges to research both from a theoretical and a technological point of view. Fully automated driving is emerging as the approach to dramatically improve efficiency while at the same time leading towards the goal of zero fatalities. In the long term autonomous driving will cause nothing less but a major shift in the mobility of humanity.

This special issue has attracted 10 international submissions. After a thorough review process, we are proud to present four selected papers, two from academia and two from industry. These contributions discuss important aspects that mark trends in autonomous driving as well as complete system architectures of successful implementations. Foremost, maps have enabled autonomous driving over long distances and it comes hardly as a surprise that the majority of our papers at least employs map information. Obviously, questions of map accuracy and integrity need satisfactory answers before these may be introduced into safety-critical applications. Likewise, the reliability of other tasks for autonomous driving, such as perception, scene understanding or maneuver and trajectory planning needs significant enhancements, and many of those issues are addressed in this Magazine.

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The first paper by Kurdej, Moras, Cherfaoui, and Bonnifait, titled "Map-aided Evidential Grids for Driving Scene Understanding" proposes a method to fuse sensor and map data. While map information has long been known as an enabling technology for automated driving over long distances, little prior work had been concerned with methods to fuse such prior information with sensor data or to validate its up-to-dateness. The authors suggest evidential grids and Dempster-Shafer fusion to represent and handle partial information. They not only accumulate evidence on stationary and moving objects, but also introduce a discounting scheme to determine obsolescent map data.

The second paper by Joshi and James, titled "Generation of Accurate Lane-Level Maps from Coarse Prior Maps and Lidar" proposes a method to automatically generate maps that include the information needed for automated driving. To achieve the required details and accuracy for the topology and positioning of the individual lanes, an inference scheme with a probabilistic model is proposed to combine information from coarse OpenStreetMap data with the data of a 3D lidar. Experiments demonstrate that the method allows automated production of accurate maps for the lane geometry.

The third paper by Aeberhard, Rauch, Bahram, Tanzmeister, Thomas, Pilat, Homm, Huber, and Kaempchen, titled "Experience, Results and Lessons Learned From Automated Driving on Germany's Highways", provides insights from a fascinating automated driving project over thousands of kilometers on German highways. Lidar, video, and radar sensors as well as map data was used to generate safe driving maneuvers and trajectories. The contribution discusses open links and research challenges for the market introduction of highly automated driving.

The last paper by Ali, Garcia, and Martinet, titled "The flatbed platoon towing model for safe and dense platooning on highways" reports on the design of cooperative driving strategies in a platoon. The authors discuss stability and safety of the platoon in various situations, including platoon creation, velocity changes, and emergency stops. Furthermore, inter-vehicle spacing of as little as 1 m is implemented.

These papers spread the range from perception and mapping towards planning, control, and cooperative behavior for autonomous vehicles. We hope that this special issue of the ITS Magazine inspires our community to further research that eventually resolves some of the open key issues. The papers published here definitely support the idea that provable functional safety is among the major challenges for any module of autonomous vehicles. Above all, we hope you find this issue thought-provoking, educational, and exciting.

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Special Issue on ITSC2013

Creating realistic detailed models and control strategies for large-scale transportation systems remains a big challenge, due to the high unpredictability and heterogeneity of travelers and the lack of coordinated actions coupled with the limited infrastructure available. This special issue explores the recent developments in Intelligent Transport Systems to improve congestion and safety. At the pre selection level highly ranked papers were invited for submission, from the 16th International IEEE Conference on Intelligent Transportation Systems that took place in Hague, Netherlands 6–9 October, 2013. After a peer review process, a total of four papers (out of 11 submitted) are selected for final inclusion in this special issue ranging from macroscopic to microscopic traffic analysis, machine learning techniques for safety, vehicles to pedestrians and smart technologies.

The paper by Castignani, Derrmann, Frank, and Engel shows how acceleration sensors in the mobile phone can be used to track driver's behavior. In particular they can be used for estimating the risk on accidents for a driver. The paper shows the concept, as well as the algorithmic methodology to use these data and process them—using fuzzy logic—into risk levels.

The paper by Campanella, Halliday, Hoogendoorn and Daamen identifies a crowd management implementation for the safe and efficient movements of more than 100,000 passengers in the metro of Copacabana in Brazil during a big event. This article shows that an analysis identifying bottlenecks and the evolution of spillbacks is the basis of a crowd management plan can significantly improve the pedestrian conditions.

The paper by van Noort, Bakri, Fahrenkrog and Dobberstein deals with Advanced Driver Assistance Systems (ADAS). This paper described a Safety Impact Assessment Tool. The tool provides ex-ante assessment of safety oriented ADAS in terms of saved fatalities and injuries, based on in-depth accident data, results from technical and user related tests, and accident reconstruction models.

Finally, the paper by Gindele, Brechtel, and Dillmann shows how automated learning, including Baysian networks, can be applied to get a good prediction of the traffic movements. This is essential for seamless working of driver assistance and safety systems, which need to be aware of the expected movements of the other vehicles, as well as the desired movements of the driver.

The papers of this special issue are by no means an exhaustive collection of all emerging theories and quantitative methods in transportation science. However, we believe that this special issue can highlight recent developments and novel research directions in multi-disciplinary areas and advance the contributions of the transport research community with respect to intelligent transportation systems. It shows how technology is evolving and how we can make best use for safety, comfort and ease of travel.

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