GUEST EDITORIAL

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Special Issue on 2012 IEEE Intelligent Vehicles Symposium

The 2012 IEEE Intelligent Vehicles Symposium took place in June 2012 in Alcalá de Henares (Madrid), Spain. It was an honor and a privilege for us to host the IV conference for the first time in Spain. We agreed with Jeffrey Miller, the Editor-in-Chief of the *IEEE Intelligent Transportation Systems (ITS) Magazine*, to organize a Special Issue with selected papers from IV'12. A few months later, it is our pleasure to have it ready for publication in the summer issue of the Magazine. In a first step, we selected 9 papers, according to the scores and technical comments provided by IV'12 reviewers and members of the Best Paper Award committee. Positive response from authors of 8 of the selected publications was received and their manuscripts, as extended versions of their IV'12 articles, were duly submitted for this Special Issue. All of the invited papers went through the rigorous revision process of the *ITS Magazine*, and eventually, 4 of these could be accepted within the time frame constraints of this Special Issue. These 4 papers are authored by researchers from Germany, France and the USA.

The first paper in this issue by Martin Liebner, Felix Klanner, Michael Baumann, Christian Ruhhammer, and Christoph Stiller, with the title "Driver Intent Inference at Urban Intersections Using the Intelligent Driver Model," addresses the topic of predicting turn and stop maneuvers of potentially errant drivers, as a basic requirement for advanced driver assistance systems for urban intersections. Previous work has shown that an early estimate of the driver's intent can be inferred by evaluating the vehicle's speed during the intersection approach. In the presence of a preceding vehicle, however, the velocity profile might be dictated by car-following behavior rather than by the need to slow down before doing a left or right turn. To infer the driver's intent under such circumstances, a simple, real-time capable approach using an explicit model to represent both car-following and turning behavior is proposed. Models for typical turning behavior are extracted from real world data. Alternative parameterizations based on training data for an individual intersection as well as a general curvature based model are evaluated in combination with two different Bayes net classification algorithms. In addition, the driver model is shown to be capable of predicting the future trajectory of the vehicle.

The second paper by Maximilian Muffert, David Pfeiffer, and Uwe Franke, with the title "A Stereo-Vision Based Object Tracking Approach at Roundabouts," presents a stereo-vision based system for the recognition of dangerous situations at roundabouts. To this end, the authors investigate the necessary field of view and viewing direction using videos taken by a panoramic camera. Using the insights of these tests, a stereo-vision system is built up. This system is based on the well established disparity estimation scheme, semi-global matching and the recently introduced medium-level representation called Dynamic Stixel-World. This data is the input to compute a time-to-contact measure that makes explicit use of the roundabout's structural characteristics. This measure enables the authors to create a system for driver warning or possibly automated intervention. The empirical studies carried out by the authors reveal that the warning decision correctly mimics human driver decisions in most roundabout scenarios.

The third paper by Hao Li and Fawzi Nashashibi, with the title "Cooperative Multi-Vehicle Localization Using Split Covariance Intersection Filter," deals with vehicle localization (ground vehicles), as an important task for intelligent vehicle systems, and vehicle cooperation, given the benefits that it may bring for this

Digital Object Identifier 10.1109/MITS.2013.2250752
Date of publication: 23 April 2013

task. In the paper a new cooperative multi-vehicle localization method is proposed, using a split covariance intersection filter. In the proposed method, each vehicle maintains an estimate of a decomposed group state and this estimate is shared with neighboring vehicles; the estimate of the decomposed group state is updated with both the sensor data of the egovehicle and the estimates sent from other vehicles; the covariance intersection filter, which yields consistent estimates even facing an unknown degree of inter-estimate correlation, has been used for data fusion. A comparative study based on simulations demonstrates the effectiveness and the advantage of the proposed cooperative localization method.

The last paper by Sterling Anderson, James K. Walker, Sisir B. Karumanchi, and Karl Iagnemma, with the title "The Intelligent CoPilot: A Constraint-Based Approach to Shared-Adaptive Control of Ground Vehicles," presents a new approach to semiautonomous vehicle hazard avoidance and stability control, based on the design and selective enforcement of constraints. This differs from traditional approaches that rely on the planning and tracking of paths, and facilitates "minimally invasive" control for human-machine systems. Instead of forcing a human operator to follow an automation-determined path, the constraint-based approach identifies safe homotopies, and allows the operator to navigate freely within these, introducing control action only as necessary to ensure that the vehicle does not violate safety constraints. This method evaluates candidate homotopies based on "restrictiveness," rather than traditional measures of path goodness, and designs and enforces requisite constraints on the human's control commands to ensure that the vehicle never leaves the controllable subset of a desired homotopy. This paper demonstrates the approach in simulation and characterizes its effect on human teleoperation of unmanned ground vehicles via a 20-user, 600-trial study on an outdoor obstacle course. Aggregated across all drivers and experiments, the constraint-based control system required an average of 43% of the available control authority to reduce collision frequency by 78% relative to traditional teleoperation, to increase average speed by 26%, and to moderate operator steering commands by 34%.

These papers cover the cutting edge topics of driver intention inference, cooperative vehicle localization, and shared control, providing experimental results based on real world data. The papers shed light on these technical issues in quite a pioneer way. We want to thank the authors of invited papers for their high quality contributions. It is our hope that this Special Issue of the *ITS Magazine* will spark the interest of readers in these topics and motivate researchers all across the globe to intensify and extend their work in this field, as a solid basis for many more papers at future IEEE ITS conferences.

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