

Preface: Research Results on Artificial Intelligence (BME FIKP MI/FM)

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Application oriented research and development focused on Artificial Intelligence-based autonomous vehicle control and future mobility started at Budapest University of Technology and Economics 2 years ago with the cooperation of several faculties and departments. The research is aimed at two main directions and has achieved significant results within them.

A significant number of research tasks have been related to vehicle platforms and control systems. Combining the results of classical and modern control theory methods with the results of methods based on artificial intelligence has been the main research direction in situation-based and goal-based decisions. The control has been validated and verified by further testing in a scenario-in-the-loop principle. A vehicle control design process has been developed to reproduce the various driver characteristics in autonomous vehicle control. An end-to-end design architecture based on neural network approaching has been developed in order to provide the required performance level while guaranteeing closed-loop stability. A hybrid trajectory design method based on supervised teaching of a neural network has also been developed. In connection with vehicle communication and cybersecurity, a validation procedure has been developed and implemented within the functional safety methodological framework. The other main research direction is environmental perception and situation assessment. In order to solve this problem, the use of multiple redundant information sensors using different sensor fusion techniques has been proposed. The interpretation of traffic situations has been based on complex, intuitive and learning methods and algorithms. Simultaneous positioning and mapping methods and procedures have been developed based on the on-board camera image sequences.

In this special issue, we have collected papers that are devoted to the advancement of artificial intelligence in terms of future mobility. The paper "Fast Prototype Framework for Deep Reinforcement Learning-based Trajectory Planner" by Fehér et al. presents a method of how the self-training development is divided into training with simulation and validation through vehicle dynamics software, and real-world tests. A case study to the proposed method is also presented. The paper "Comparison of Game Theoretical Strategy and Reinforcement Learning in Traffic Light Control" by Guo and Harmati proposes two methods for traffic light control, i.e., game theoretical strategy, and reinforcement learning methods. The paper "Challenges and Possibilities of Overtaking Strategies for Autonomous Vehicles" by Hegedűs et al. presents several distinct probability-based methods for decision making and trajectory planning layers of overtaking maneuvering functionality for autonomous vehicles. The paper "Lane Change Prediction Using Gaussian Classification, Support Vector Classification and Neural Network Classifiers" by Rákos et al. presents several approaches to predict lane change on motorways. The paper "Towards Reliable Multisensory Perception and Its Automotive Applications" by Rövid et al. presents the difficulties in perceiving and understanding the environment through general fusion models and especially end-to-end driving models. The paper "An Overview of Current and Future Vehicular Communication Technologies" by Knapp et al. provides a technical overview of the most relevant current and future vehicular communication technologies. The paper "Introducing Safety and Security Co-engineering Related Research Orientations in the Field of Automotive Security" by Török and Pethő shows automotive safety and security related

development of co-engineering methodology and a validation framework from the viewpoint of autonomous transportation. The paper "Mixed-reality Automotive Testing with SENSORIS" by Varga et al. presents a new mixed-reality testing approach with an efficient combination of real and simulated components. The paper "The Role of Maps in Autonomous Driving Simulations" by Barsi et al. presents the development of a digital map since its spatial resolution has considerably increased, the road infrastructure and its neighbourhood required high accuracy. The paper "Operational Methods for Charging of Electric Vehicles" by Csonka et al. examines the effects of the charging process and energy management on the operation of both transportation and electric networks.

It is our hope that the readers will enjoy the breadth and depth of this collection of papers on future mobility.

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