

Multi-agent planning for driverless vehicles in smart cities

Summary

The candidate of this position will investigate a well-known NP-hard problem, i.e. the multi-agent planning, scheduling and coordination problem. The practical application is in the field of intelligent transportation systems, as future autonomous vehicles will communicate and coordinate with each other to increase the efficiency of the entire transportation system. The work involves writing algorithms and using artificial intelligence methods to find numerical solutions that apply to real-world systems. The research group has experimental self-driving shuttles and pilot studies on the road that will serve as an experimental platform.

Research field:	Production and materials engineering, robotics, transport and logistics
Supervisors:	Prof. Dr. Raivo Sell Prof. Dr. Mauro Bellone
Availability:	This position is available.
Offered by:	School of Engineering Department of Mechanical and Industrial Engineering
Application deadline:	Applications are accepted between January 02, 2023 00:00 and January 22, 2023 23:59 (Europe/Zurich)

Description

Recent studies on intelligent transportation systems suggest that the coordination of vehicles in traffic constitutes an important aspect of urban planning, generating significant savings. From a robotics perspective, it can be seen as a multi-agent coordination and planning problem. The candidate for this position will contribute to the body of knowledge with studies on the theory of multi-agent planning while having the opportunity to test ideas and concepts in simulation and in the real world using our vehicles. The study can address both centralised and decentralised algorithms. First, all vehicles are controlled via a specific master, and all communications have to pass through such a point. In the latter, all vehicles are “self-governing” but communicating and cooperating with each other to reach a common goal. The study goal is to carry out high-quality research in this domain involving both theoretical and practical aspects of multi-agent systems, with the potential to generate publications in high-ranked journals and conferences using both simulations and robotic vehicles. To this end, the candidate is expected to have a good knowledge of programming tools and acquire knowledge about our custom systems during the initial stage of the doctoral studies.

Responsibilities and (foreseen) tasks

- Multi-agent planning, decision making and scheduling techniques
- Self-driving vehicle behaviour in complex urban environments
- Co-operational behaviour based on V2V and V2X communication
- Autonomous driving algorithms and technologies (e.g. vehicle control, path planning, scheduling) and sensors (e.g. lidars, radars, cameras, and GNSS)
- High-level integration of autonomous driving techniques with open-source autonomous driving software (for simulation and testing)

Applicants should fulfil the following requirements:

- a master's degree in engineering sciences (preferably in computing, robotics, AI)
- a clear interest in the topic of the position
- excellent command of English
- strong and demonstrable writing and analytical skills
- capacity to work both as an independent researcher and as part of an international team
- capacity and willingness to provide assistance in organisational tasks relevant to the project



The following experience is beneficial:

- Experience with ROS and Autoware recommended
- Experience in designing software systems
- General overview and understanding of working principles of sensors and robotics

The candidate should submit a research plan for the topic, including the overall research and data collection strategy. The candidate can expand on the listed research questions and tasks and propose theoretical lenses to be used.

We offer:

- 4-year PhD position in one of the largest, most internationalised and leading social science research centres in Estonia with a large portfolio of ongoing pan-European projects
- The chance to do high-level research in multinational teams
- Opportunities for conference visits, research stays and networking with globally leading universities and research centres in the fields of smart cities, robotics, AI and engineering.

About the department

The position is supervised in a combination of two units in TalTech.

Department of Mechanical and Industrial Engineering (EMI) is an engineering and research unit of Tallinn University of Technology, School of Engineering that focuses on mechanical, industrial and robotics engineering in an interdisciplinary way. The research group **Autonomous Vehicles** is a future-oriented research group with the main strengths and focus topics:

- Self-driving vehicles, driving algorithms and cyber-physical system
- Sensor fusion, perception and big data
- Cybersecurity, automotive networking
- Simulations, verifications and validations of autonomous vehicles
- Human-machine interfaces and interactions
- Self-driving shuttle bus deployment and experimentation

FinEst Centre for Smart Cities (FinEst Centre) is an independent organisation under the Tallinn University of Technology. The aim of the FinEst Centre is to improve urban environments by testing new technologies and thereby grow into an internationally renowned research and development centre. FinEst Centre is an international organisation founded by Tallinn University of Technology, Aalto University, Forum Virium Helsinki and the Estonian Ministry of Economic Affairs and Communications. When FinEst Centre for Smart Cities started, researchers were divided into different streams by topic according to their area of interest. These streams have some level of autonomy and are led by renowned researchers in that field. One of the research streams is Smart Mobility. In order to operate future transport systems safely and efficiently, there is a need to design and implement a collaborative system where (automated) vehicles and infrastructure exchange information and coordinate their actions. This vision requires numerous and significant advances in multiple areas, including traffic flow, control systems, and communication networks.

Additional information



For further information, please contact Prof Raivo Sell raivo.sell@taltech.ee and Prof. Mauro Bellone mauro.bellone@taltech.ee or visit <https://autolab.taltech.ee/>



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