ITSC 2023 Special Session Proposal
Simulation Verification of Autonomous Driving Technologies

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Abstract
The development of safe and robust autonomous driving technologies is a significant challenge which complex nature of urban traffic represents a significant challenge for the development of safe and robust autonomous driving technologies, which would have to perform in a wide range of traffic conditions. Experts claim that 8 billion kilometres of accident-free driving is required before a self-driving algorithm can be considered safe enough to hit the road as a commercial product. Considering the enormous cost and time required by physical testing, simulation verification emerges as an effective alternative to assure the safety operation of these technologies. In this special session, we discuss methods and tools for the testing and validation of autonomous driving technologies to serve the emerging connected and autonomous vehicles technology market. The special session will demonstrate the trending research and is accessible from any background and seniority level. Presentations from renowned experts will demonstrate how these methods and tools can facilitate the simulation verification, and provide insights for future research avenues.

1 General Information
Type and duration: Special Session, half day, Hybrid
Title: Simulation Verification of Autonomous Driving Technologies

2 Organizers
Panagiotis Angeloudis: Reader in Transport Systems and Logistics, Centre for Transport Studies, Imperial College London.
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3 Contents

3.1 Motivation and relevance to the ITS community

Safety assessment is a critical step in the development and deployment of connected and autonomous vehicles. Owing to the complex nature of autonomous vehicles and their reduced reliance on human interventions, the importance of such tests is becoming ever more vital [1]. As a result, numerous approaches have been proposed to facilitate the testing and safety verification of autonomous vehicles, which can be generally classified into four groups: virtual simulation, X-in-the-loop simulation, closed-track testing, and on-road testing. Although each group has its own advantages and drawbacks, software simulation has stood out as a beneficial option due to its cost and scalability [2]. During the past few years, the importance of simulation-based verification is increasingly realised and extensive efforts have been devoted to develop these technology [3–6]. However, no consensus or standard procedures have been reached on this topic.

This special session focuses on sharing the frontier developments in simulation verification of autonomous driving technologies, including state-of-the-art algorithms, methods, metrics, datasets and simulation approaches. It will identify challenges and sheds lights on the future research.

3.2 Objectives

This special session aims to bring together autonomous driving experts from diverse background, such as manufacturers, regulation and certification, and academics producing research on new verification and validation (V&V) techniques for autonomous systems, etc., to

- identify challenges and opportunities regarding the aforementioned problems.
- present state-of-the-art research to address such challenges.
- find interaction opportunities between diverse research communities to unite forces and tackle the problems.

3.3 Topics of interest

The topics of interest of this special session include (but are not limited to) the following topics:

1. Methodological frameworks for simulation-based safety verification and validation.

2. Testing scenario generation for comprehensive trip safety evaluation.
3. Safe reinforcement learning, safe exploration, constrained reinforcement learning, safe learning + control theory.
4. Advanced simulation of edge case testing and evaluation.
5. Autonomous driving datasets, simulation, evaluations, and metrics.
6. Safety verification, certifying learning-based control under dynamical uncertainty, dependability analysis.

4 Intended Audience
Information of this special session will be advertised via Meta, LinkedIn, Twitter, and other social medias. This special session is expected to attract 60-80 in-person participants, and over 250 online participants. While it is difficult to estimate the actual number of participants, we aim to maximize the impact of the special session by providing a hybrid mode, recording the talks/discussions and streaming the event.

Highly interactive sessions will be designed and the content will be more suitable for mixed audience, and not target to participants with a specific background. To encourage interaction among participants, social breaks will be integrated into the schedule. GatherTown will also be used to foster interactions among virtual attendees.

5 Dissemination
We will compile a learning package that can be used as a reference guide to benefit people who are interested in this special session.

This package will contain:

- Recordings of the talks and discussions during the special session.
- List of relevant literature.
- A summary of highlighted open challenges and the potential solutions.

All these information will be available for download on the official website after the special session.

References


A. Biographies of the Organizers

Panagiotis Angeloudis is Reader and Head of the Transport Systems and Logistics Laboratory (TSL), based in the Centre for Transport Studies (CTS) at Imperial College London. Before establishing TSL, Panagiotis held a JSPS Research Fellowship at Kyoto University. He previously obtained a PhD in Transportation at Imperial College London and spent periods as a research analyst at DP World and the United Nations in Geneva. His research focuses on the study of networks, optimisation methods and multi-agent systems, as well as their applications in autonomous transport systems, urban infrastructure and logistics.

Yuxiang Feng is a Research Associate at the Transport Systems and Logistics Laboratory (TSL), Imperial College London. He received a BEng in Mechanical Engineering from Tongji University and an MSc in Mechatronics and PhD in Automotive Engineering from the University of Bath. His main research interests include environment perception, sensor fusion and artificial intelligence for robotics and autonomous vehicles.

Simon Hu received the Ph.D. degree from Imperial College London, U.K., in 2011. He is currently an Assistant Professor with the Zhejiang University-University of Illinois at Urbana-Champaign Institute, Zhejiang University, China. He is also an Honorary Research Fellow with Imperial College London. His research interests lie in intelligent transportation systems, connected and automated vehicles, smart mobility, and environmental impact from transportation systems. He is a member of the Chartered Institute of Highways and Transport Engineering (CIHT).

Mohammed Quddus received the B.Sc. degree in civil engineering from the Bangladesh University of Engineering and Technology in 1998, the master’s degree in transportation engineering from the National University of Singapore in 2001, and the Ph.D. degree from Imperial College London in 2006. He joined the School of Architecture, Building and Civil Engineering, Loughborough University, U.K., in 2006, as a Lecturer, and was promoted to a Professor of intelligent transport systems (ITS) in 2013. In 2021, he moved to Imperial College London as the Chair Professor in ITS. He has authored over 200 technical papers in international refereed journals and conference proceedings. His research interests include connected and autonomous vehicles, AI, and statistical modeling. He is an Associate Editor of Transportation Research—C: Emerging Technologies.

Yiannis Demiris (Senior Member, IEEE) received the B.Sc. degree (Hons.) in artificial intelligence and computer science and the Ph.D. degree in intelligent robotics from the Department of
Artificial Intelligence, The University of Edinburgh, Edinburgh, U.K., in 1994 and 1999, respectively. He is currently a Professor with the Department of Electrical and Electronic Engineering, Imperial College London, London, U.K., where he is the Royal Academy of Engineering Chair in Emerging Technologies, and the Head of the Personal Robotics Laboratory. His current research interests include human–robot interaction, machine learning, user modeling, and assistive robotics. He is a fellow of IET and BCS. He was a recipient of the Rector’s Award for Teaching Excellence in 2012 and the FoE Award for Excellence in Engineering Education in 2012.