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Editorial

Editorial for the Special Issue on Safety for Intelligent and Connected Vehicles

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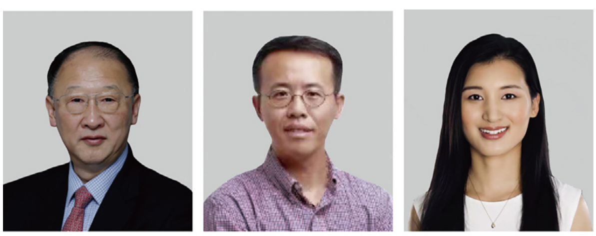

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Intelligent and connected vehicles (ICVs) are confronted with critically complex traffic scenarios and safety challenges that have attracted increasing attention from academia and industry. The intelligent safety of ICVs involves several technologies and requires the common efforts of researchers and engineers, including the safety of the intended functionality (SOTIF), the safety of artificial intelligence, the intricacies of cybersecurity, and ethical dilemmas. Ensuring the intelligent safety of ICVs presents substantial challenges in both research and commercialization, particularly SOTIF, which refers to the absence of unreasonable risk owing to hazards resulting from functional insufficiencies of the intended functionality or reasonably foreseeable misuse by person. Because of the limited scene coverage ability of training samples and the practical application conditions without boundary restrictions, it is very difficult to find the functional insufficiency of the intended functionality and overcome it under dynamic unknown scenarios, which is also the source of SOTIF.

This Special Issue of *Engineering* contains the latest research findings and engineering experiences of researchers and engineers from academia, industry, and policymakers in developing and applying novel technologies to solve the challenges regarding the intelligent safety of ICVs. This special issue contains ten papers. From a systems engineering standpoint, Wang et al. comprehensively explored the SOTIF landscape by reviewing academic research, practical activities, challenges, and perspectives across the development, verification, validation, and operation phases. By delving into this comprehensive exploration, it is evident that ensuring safety beyond functional capabilities is intricate, and the collaborative efforts of academic researchers, industry engineers, and regulators are crucial for establishing robust safety standards and effectively integrating ICVs to address these challenges.

Ensuring the trustworthiness in decision-making remains a substantial challenge in the realization of autonomous driving. Yuan et al. proposed an online evolutionary decision-making and planning framework for autonomous driving based on a hybrid data- and model-driven method and several principles of safety and rationality for the self-evolution of autonomous driving. Based on this framework, a motion envelope was established and embedded in a rational exploration and exploitation scheme that filters out unreasonable experiences by masking unsafe decision actions to collect high-quality training data for the deep reinforcement learning agent. Wang et al. combined two reachability analysis techniques, and proposed an integrated probabilistic collision detection framework for highway driving. He et al. introduced a novel robust reinforcement learning approach with safety guarantees to attain trustworthy decision-making for autonomous vehicles, besides they also devised a safety mask to ensure the collision safety of the autonomous driving agent during both the training and testing processes via an interpretable knowledge model known as responsibility-sensitive safety.

Huang et al. presented a general optimal trajectory planning framework for autonomous vehicles, which can effectively avoid obstacles and guide the vehicle to complete the driving task safely and efficiently. They proved that compared with the driver's manipulation, real-time planning and safety requirements can still be guaranteed. Wu et al. propose an anthropomorphic obstacle-avoidance trajectory planning strategy for adaptive driving scenarios, and the proposed strategy is verified based on real driving scenarios. The results show that the strategy can adjust the weight distribution of the trajectory optimization function in real-time according to the "emergency degree" of obstacle avoidance and the state of the vehicle. Zheng et al. proposed a safe motion planning and control (SMPAC) framework for automated vehicles to address the uncertainties of model mismatch. The results of a hardware-in-the-loop experiment validated the safety,

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effectiveness and real-time performance of the SMPAC scheme. Consequently, the SMPAC scheme can reduce the possible hazardous/unknown areas in the automated driving scenario categories for SOTIF.

Wan et al. proposed a formal verification method that combines equivalence verification with model checking, and reasonable and reassuring digital traffic rules can be obtained by utilizing the proposed traffic rule digitization flow and verification method. Wei et al. introduced a resilient distributed model predictive platooning control framework and proposed a resilient platoon control strategy that took advantage of the predesigned optimal control and distributed model predictive control optimization to ensure robust constraint satisfaction and optimized the platoon control performance. Human occupants are passengers and do not have direct vehicle control in fully automated cars (i.e., driverless cars). An interesting question is whether users are responsible for the accidents. Normative ethical and legal analyses usually argue that they should not bear responsibility for harm beyond their control. Zhai et al. considered human judgments of responsibility for fully automated vehicle accidents through three studies with seven experiments. They found that this was not due to the perception that these occupants possess greater control over driving, but because they are more likely to foresee the potential consequences of using driverless cars involving counterfactual thinking.

We hope that the articles in this Special Issue will benefit interested researchers and engineers and promote the research and commercialization of ICVs. We thank all the authors for presenting their latest research findings and engineering experiences in developing and applying novel technologies to solve challenges related to the intelligent safety of ICVs. We would also like to thank the reviewers and the editors. Finally, we are grateful to the editor of *Engineering* who provided invaluable assistance in ensuring the prompt handling and publication of this Special Issue.