Title

Automated Driving Systems (ADS) Safety Testing and Beyond

Abstract

In this presentation, one starts with discussing the undergoing safety testing transitions from Advanced Driver Assistant Systems (ADAS) to Automated Driving Systems (ADS). The concrete scenario-based testing approaches are revisited along with the standard testing demonstrations. Various vehicle performance metrics published in the literature over the past half-century are analyzed focusing on their constructive differences and performance diversities. However, most of the discussed safety testing and evaluation methods extended from ADAS to ADS are lack of theoretical guarantees of unbiasedless, generalization, and accuracy.

Generally, the design of a theoretically sound and practically efficient safety testing framework for ADS has always been a challenging task in the field. Among some of the recent proposals, the second part of this presentation presents a class of scenario-based safety testing algorithms with formal guarantees referred to as the safe set quantification algorithms. The algorithm provably characterizes (i) where (in terms of a set of states commonly known as the operational design domain) the subject ADS is potentially safe, and (ii) how safe the subject is within the specified set.

Finally, the presentation is concluded with a recent study on the so-called *adversarial* testing algorithms that are expected to accelerate the safety testing process. Different from the explicit algorithm proposals commonly observed in the existing literature, the study is featured with investigating fundamental properties of whether scenario-based safety testing algorithms perform differently and how can the optimal aggressiveness be justified (i.e. the comparability and optimality), especially within the black-box testing regime. An *impossibility theorem* is proposed to show that all scenario-based testing algorithms perform equally well if certain conditions are met. This provides theoretical foundations to some recently reported empirical deficiencies of adversarial testing and training in practice.

Biography

Bowen Weng is a technical specialist at Transportation Research Center (TRC) Inc. on assignment to National Highway Traffic Safety Administration (NHTSA), where he leads the research and technical development of projects related to safety testing and performance evaluation of Automated Driving Systems (ADS). Mr. Weng is also a Ph.D. candidate at The Ohio State University, Columbus, USA. Mr. Weng has published in various venues across robotics, transportation, control, and machine learning, including IEEE Transactions on Intelligent Transportation Systems, IEEE Transactions on Intelligent Vehicles, IEEE Robotics and Automation Letters, ICRA, IROS, ITSC, IV, ACC, ICML, to name a few. His research interests center around the safety of cyber-physical systems including its leading perspective (i.e., safe robotic system and algorithm design) and the lagging prospect (i.e., safety testing and evaluation). This fundamentally draws various techniques from the control theory, probability theory, optimization, and machine learning. The current primary applications of interests include the intelligent transportation system, multi-agent system, and the dynamic locomotion of legged robots.