Robotics and Autonomous Systems Thesis Defense

A Scenario-Based Test Selection and Scoring Methodology for Inclusion Into a Safety Case Framework for Automated Vehicles

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Abstract

The need for robust verification and validation of automated vehicles (AVs) to ensure driving safety grows more urgent as increasing numbers of AVs are allowed to operate on public roads. To address this need, AV developers can present a safety case to regulators and the public that provides an evidence-based justification of their assertion that an AV is safe to operate on public roads. This work aims to describe the development of a scenario-based testing methodology that contributes to this safety case. A high-level definition of this test selection and scoring methodology (TSSM) is first presented, along with an outline of its scope and key ideas. This is followed by a literature review that details the current state of the art in AV testing, including the driving performance metrics and equations that provide a basis for the TSSM. A chart-based method for quantifying an AV's operational design domain (ODD) and behavioral competency portfolio is then described that provides the foundation for a scenario generation and filtration process. After outlining a method for the AV to progress through increasingly robust test methods based on its current technology readiness level (TRL), the generation and filtration of two sets of scenarios by the TSSM is outlined: a standardized set that can be used to compare the performance of vehicles with identical ODD and behavioral competency portfolios, and a set containing high-relevance scenarios that is partially randomized to ensure test integrity. A related framework for incorporating testing on public roads is subsequently specified. An equation for an overall AV driving performance score is then defined that quantifies the aggregate performance of the AV across all generated scenarios. The TSSM continues according to an iterative process, which includes a method for exploring edge and corner scenarios, until a stopping condition is achieved. Two proofs of concept are provided: a demonstration of the ability of the TSSM to pare scenarios from a preexisting database, and an example ODD and behavioral competency portfolio specification form. Finally, this work concludes by evaluating the TSSM and its proofs of concept and outlining possible future work on the methodology.

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