Software Testing of Autonomous Systems

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Concepts in Testing of Autonomous Systems

Testing of autonomous systems is extremely important as many of them are both safety-critical and mission-critical, yet it is still an open challenge on how to test such systems effectively and efficiently. To gain a better understanding of autonomous systems practice and facilitate testing of different autonomous systems, we conduct an exploratory study [1] by synthesizing existing academic literature with a focus group discussion and interviews with industry practitioners. As a result, we present a conceptualization of autonomous systems, classifications of challenges and current practices as well as of available techniques and approaches for testing of autonomous systems.

Critical Scenario Identification for Realistic Testing of Autonomous Driving Systems

The number of real-world operational scenarios for autonomous systems is extremely large, and choosing effective test scenarios is essential, as well as combining simulated testing and real-world testing. We focus on a common area within autonomous systems – autonomous vehicles and establish an industrial workbench to generate efficient and effective scenarios for testing such systems [2]. The workbench consists three existing engineering tools and a workflow, and helps smoothly integrate simulated testing, with real vehicle parameters and software. We also demonstrate the effectiveness of the workbench by using two real autonomous driving systems from industry by collaborating with Volvo Cars.

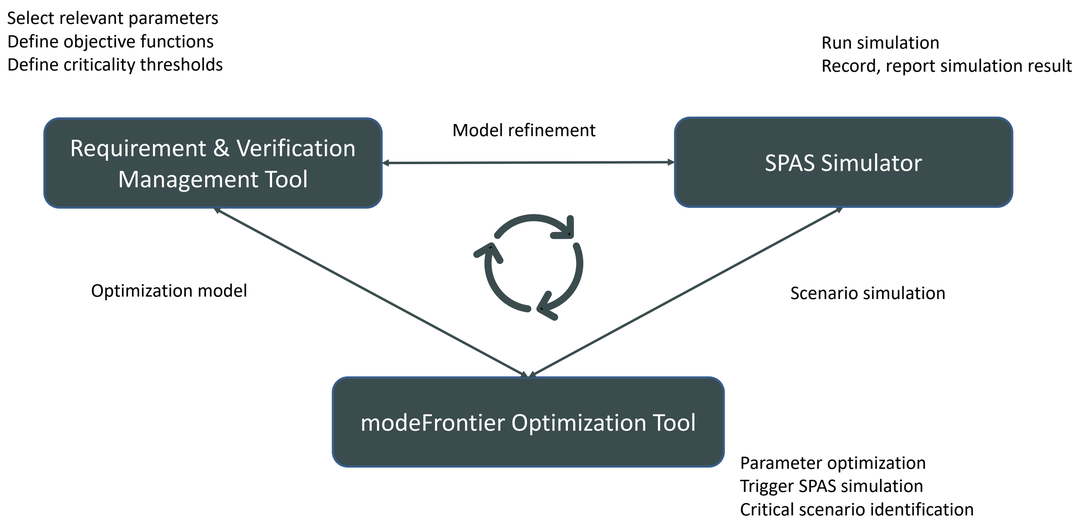

Figure-1. Tools and workflow involved in the workbench for critical scenario identification for autonomous driving systems

A Vehicle-Pedestrian Time-To-Collision Model for Testing of Autonomous Driving Systems

While autonomous driving systems are expected to reduce road accidents and improve traffic safety, understanding of the intensive and complex traffic situations is prerequisite to enable testing of such systems in a realistic traffic setup. We propose a model that predicts the worst-case distribution of TTC (Time-to-Collision) for vehicle-pedestrian interactions at unsignalized crossings, based on the traffic density. We validate the model using real traffic data collected in Sweden. We also demonstrate its use for testing of autonomous driving systems by connecting the model to critical test scenario identification for an autonomous emergency braking function from the industry.

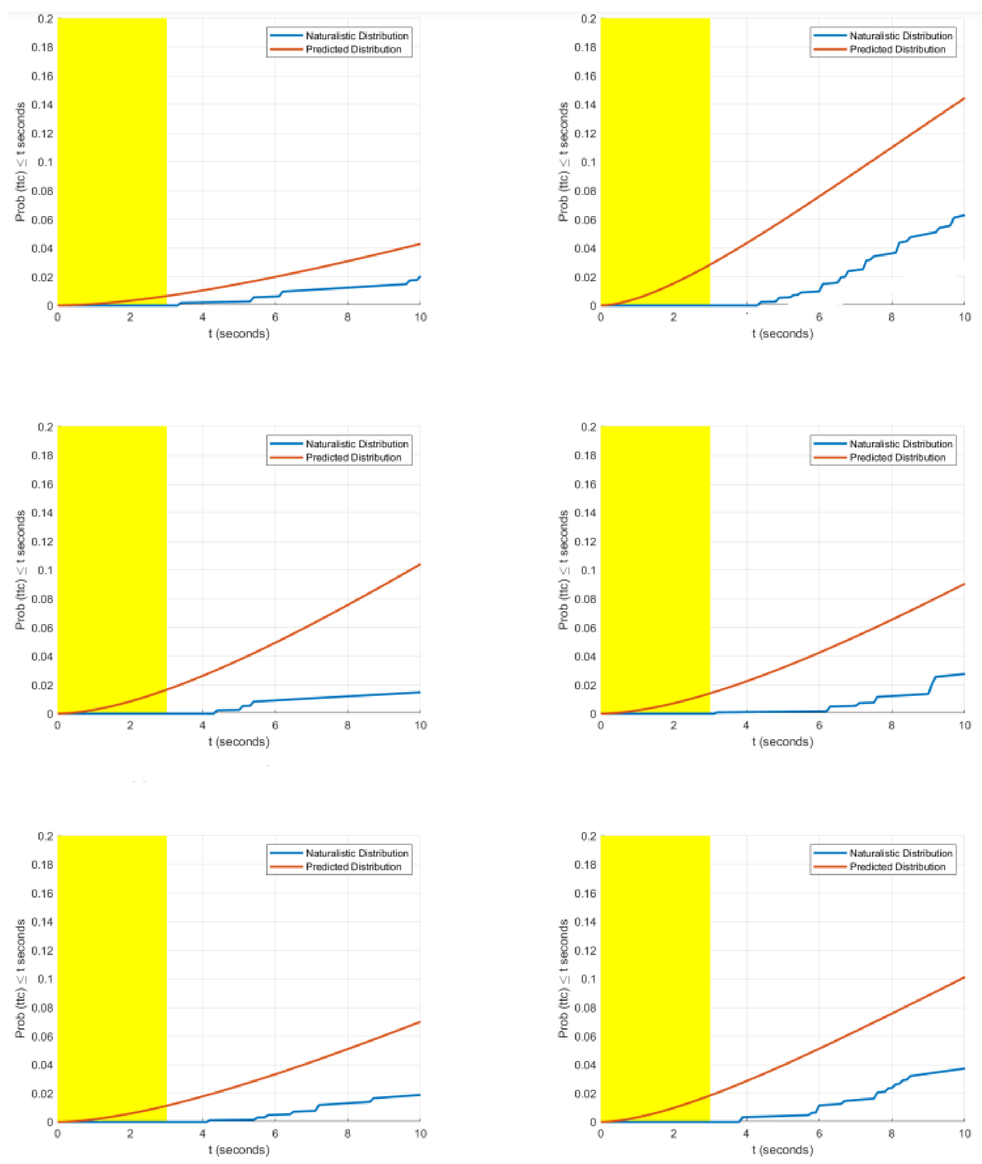

Figure-2. Model validation with naturalistic traffic data collected by Viscando in Linköping, Sweden

References

1. Song, Qunying, Emelie Engström, and Per Runeson. "Concepts in Testing of Autonomous Systems: Academic Literature and Industry Practice." In *WAIN'21 1st Workshop on AI Engineering*. IEEE Computer Society, 2021.
2. Song, Qunying, Kaige Tan, Per Runeson, and Stefan Persson. "An Industrial Workbench for Test Scenario Identification for Autonomous Driving Software." In *2021 IEEE International Conference on Artificial Intelligence Testing (AITest)*, pp. 81-82. IEEE, 2021.

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