Master thesis proposal

ZENUITY

Winter 2020 - Spring 2021

Safety assurance of self-driving vehicle through formal scenario-based simulation

Background

Self-driving vehicles can bring benefits to society, such as making the transportation system safer and bringing back valuable time to the driver when driving is no longer a pleasant task. Over the last couple of years, industry and academia have spent enormous effort to build self-driving vehicles which can serve their intended purposes. One of the key challenges in enabling such technology is to ensure that self-driving vehicles are safe and do not cause accidents due to malfunction. However, such systems are very complex, with different algorithms implemented ranging from artificial intelligence (AI) and machine learning (ML) to model-based approaches. Therefore, the verification is not a trivial task.

The best practices that are adopted in the development and verification of different modules in self-driving system include testing, simulations and use of formal methods. However, these verification techniques are commonly utilized independently, or their combinations of usage are relatively limited. For example, verification of the perception module heavily relies on extensive testing and re-simulation of data while trajectory planning module requires closed loop simulation of the environment and other road users. On the other hand, mode management module makes use of formal verification techniques.

Project description

The focus of this master thesis project is on development and verification of trajectory planning module, which as aforementioned, relies on closed-loop simulation of environment and interactions with other road users. To accomplish this, a probabilistic model of environment, stochastic model of perception module and extensive scenario database are required.

We aim to combine best practices of verification techniques in one framework that can be used for verification of trajectory planner. Tasks can be summarized as following,

- Understand the technical requirements and formulate them formally.
- Apply probabilistic modelling techniques to model the environments and scenarios.
- Integrate selected parts of software stack in an AV simulator, e.g. Carla.
- Use and evaluate property-based testing techniques known as falsification to identify safe and unsafe behaviours in simulation and develop a robustness metric towards certain scenarios.

A tool/framework (SCENIC+VeriAI) is recently developed in US Berkeley to support the aforementioned objectives. The students are expected to use these tools and technology behind them in their work to address the verification challenge.

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Purpose and goals

The purpose of this project is to partially and systematically address the verification problem of trajectory planning module in a self-driving vehicle. We aim to reach this goal, by formally modelling the requirements, probabilistic modelling of the environment and run search algorithms which can find edge cases in a closed-loop simulation environment.

Requirements and qualifications

This thesis is suitable for two students with background in system control, computer science or similar. Good mathematical and programming skills, knowledge of simulation, formal verification and/or requirement engineering are meritorious.

Further information

This is a thesis project driven by Zenseact (formally Zenuity). For questions regarding the project, please contact:

Industrial supervisors:

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To apply

Send your CV, cover letter, grades transcripts, recommendation letters (if any) or any other document/diploma that may support your application.

https://career.zenseact.com/jobs/966945-master-thesis-scenario-based-simulation

Final application date: **11/15/2020**
Expected start date: **01/15/2021**, with some flexibility.

IMPORTANT: Do not apply using the personal email addresses given above.