

Semesterarbeit/Masterarbeit

LLM/VLM-Assisted Adversarial Scenario Generation and Editing for Autonomous Driving Simulation

Constructing safety-critical scenarios manually is highly labor-intensive and lacks scalability. To automate this process, this project proposes an intelligent scenario generation and editing framework leveraging Large Language Models (LLMs) and Vision-Language Models (VLMs).

Unlike purely text-based instructions, we aim to develop a framework that ingests structured environment representations, including HD maps and surrounding dynamic object information. The core objective is to programmatically transform normal driving scenarios into challenging adversarial situations.

Work packages:

In this project, you will build a unified pipeline that automatically interprets normal driving layouts and crafts complex, adversarial edge cases. The work packages are organized as follows:

- **Literature Review:** Investigating state-of-the-art LLM and VLM-based critical/adversarial scenario generation techniques.
- **Adversarial Editing Engine & Action Generator:** Developing the core reasoning engine that changes other vehicle trajectories and outputs safety-critical maneuvers.
- **Adversarial Scenario Dataset:** generating structured datasets of adversarial scenarios in formats like CommonRoad or OpenSCENARIO, establishing a standardized database of corner cases for automated benchmarking.
- **Verification through CARLA/esmini Execution:** Executing and validating the generated adversarial scenarios in dual simulation environments.

Requirements:

- Very good programming skills in Python and PyTorch.
- Familiarity with foundation models (LLMs/VLMs) and tools (CARLA, esmini, CommonRoad, OpenScenario) is a plus.
- High personal motivation and independent working style.
- Very good language proficiency in English.

Recommended literature:

- [CAT: Closed-loop Adversarial Training for Safe End-to-End Driving](#)
- [Foundation Models in Autonomous Driving: A Survey on Scenario Generation and Scenario Analysis](#)
- [CommonRoad](#), [Esmini](#)

Possibility for publication in case of excellent work.

The thesis should clearly document the individual work steps. The candidate undertakes to complete the term paper independently and to indicate all scientific aids used. The submitted work remains the property of the chair as an examination document.

Prof. Dr.-Ing. M. Lienkamp

Betreuer: Hojun Lim, M. Sc.

Ausgabe: _____

Abgabe: _____