Deep Traffic Scenario Mining, Detection, Classification and Generation on the Autonomous Driving Test Stretch using the CARLA Simulator

Keywords: Deep Learning – Autonomous Driving – Simulation – Scenario Mining/Classification/Generation - CARLA Simulator - ScenarioRunner - OpenSCENARIO

Background

As part of the research project Providentia++ funded by the federal ministry of transport and digital infrastructure under the initiative "Digital Test Beds for Autonomous Driving", a group of eminent industry partners and research institutes have come together to conduct research in the field of intelligent transportation systems, and to come up with solutions and recommendations for improving traffic safety, efficiency and comfort. Within the framework of this project, an existing infrastructure for real-time localization of traffic participants on the Highway A9 will be extended from the highway into an adjacent urban environment. The infrastructure will include multiple sensor stations equipped with a mix of complementary sensors, edge computing devices and state of the art communication networks in order to be able to create and distribute digital twins of the traffic in real-time, which in turn can widen the perception range for autonomous cars far beyond the capabilities of onboard sensors and vastly improve their situational awareness. A project video is available on: https://youtu.be/4oCnQlGFuc4.

Description

Key challenges in autonomous driving are a robust detection of all traffic participants and a reliable prediction of vehicle trajectories. This requires also a large dataset with relevant traffic scenarios (e.g. overtaking or lane change scenarios). Many interesting research topics are available within this project.

Your Tasks

- Scenario **mining, detection,** and **classification** on the Providentia++ Test Stretch
- Virtual **scenario generation** based on real-life sensor data using the **CARLA vehicle simulator**, **ScenarioRunner** and **OpenSCENARIO**
- Representing the Providentia++ Test Stretch in the CARLA vehicle simulator (**3D Modelling**)
- Support in creating a new Providentia++ dataset by including relevant and interesting scenarios
- **Evaluating** a driving agent on different scenarios

Requirements

- Studies in **Computer Science** (e.g. Games Engineering, Informatics, Data Science etc.)
- Good knowledge in **Python** (and C++)
- Experience with **Deep Learning** libraries (Tensorflow, PyTorch)
- Experience with a **3D Modelling** Software (e.g. Blender, Maya, RoadRunner)
- Basics in **Game Engine** design (e.g. Unreal Engine, Unity)
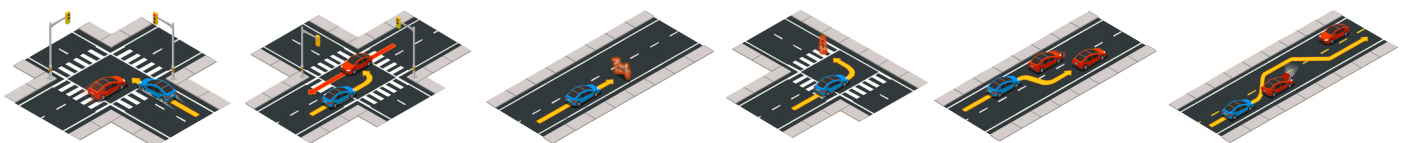- **Linux** command line skills

Figure: Traffic Scenarios (vehicle running red light, left turn, animal crossing, pedestrian crossing, lane change, overtaking). Reference: https://leaderboard.carla.org/scenarios/

If you have **your own ideas** within this research area you are welcome to suggest your own topic.

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