

Master Thesis: Real-time and multi-modal 3D Object Detection on the Highway A9

Keywords: Perception – Deep Learning – Autonomous Driving – 3D Object Detection – Multi-Sensor Data Fusion

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 A9 Highway 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 PROVIDENTIA project video is available on: <https://youtu.be/4oCnQIGFuc4>.

Description

A key challenge lies in the reliable and accurate detection of road users (e.g. vehicles, buses, trucks) based on various data generated from the different sensors (cameras, LiDARs and radars). Due to the complex multi-sensor system subject to real-life conditions and application-oriented challenges, many interesting research topics are available within this project. These include, but are not limited to:

- Research various **deep learning architectures** for 3D Object Detection
- Research **fusion algorithms** to fuse infrastructure and vehicles sensor data
- Research on multi-modal **3D object detection algorithms**
- **Your ideas:** If you have any other ideas for research in this area you are welcome to suggest your own topic.

Your Tasks

- Familiarization with fusion and detection algorithms via literature research
- Development of a solution approach for the specific problem
- Evaluation of the concept using real-life data
- Support in creating a new Providentia++ dataset that includes scenes from the highway and the city
- Visualization of 3D Object Detection results

Requirements

- A strong interest in object detection, sensor fusion and Deep Learning
- High motivation and ability to work independently
- Experience with Deep Learning Libraries (Tensorflow, Keras, PyTorch)
- Basic understanding of the Robot Operating System (ROS)
- Good knowledge in programming languages: Python, C++

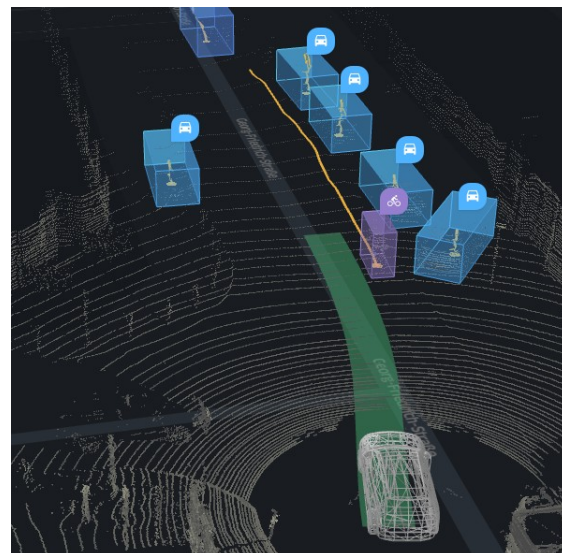


Figure: Visualization of 3D Object Detection and fusion results (by Uber). Ref.: <https://bit.ly/2L6oDZl>