

Real-Time and Multi-Modal 3D Object Detection on the Autonomous Driving Test Stretch Using Camera and LiDAR Sensors

Keywords: Perception – Deep Learning – Autonomous Driving – 3D Object Detection and Tracking – 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 has come up 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 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. Project video: <https://youtu.be/4oCnQlGFuc4>.

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 **deep learning architectures** for 3D Object Detection
- Research **fusion algorithms** to fuse infrastructure 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 **perception** algorithms
- Research the problem and pick suitable frameworks
- 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

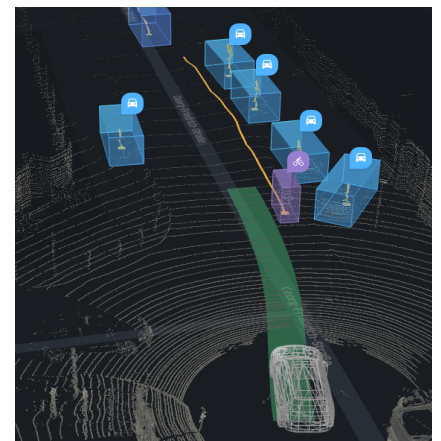


Figure: Visualization of 3D Object Detection and fusion results (by Uber). Ref: <https://bit.ly/2L6oDZI>

Requirements

- You are currently studying Computer Science, Electrical Engineering or Mechanical Engineering (or similar)
- A strong interest in **object detection**, sensor fusion and deep learning
- High motivation and ability to work independently
- Experience with **deep learning libraries** (Tensorflow or PyTorch)
- Basic understanding of the **Robot Operating System (ROS)**, PCL, Open3D or similar frameworks for handling LiDAR data
- Good knowledge in programming languages: **Python**, C++
- Experience with **Linux** and the command line
- Experience with LiDAR point cloud processing (nice to have)
- Very good communication skills in English or German

You will be working in a very dedicated and highly motivated team of experts from the field of software engineering, machine learning and robotic engineering.