

Bachelor/Master Thesis: Real-Time Object Detection in Poor-Visibility-Scenes Using Multi-Sensor-System

Background

Within the PROVIDENTIA++ project, a section of the highway A9 between Munich and Nuremberg was converted to a testing site for autonomous driving. As part of this, a large sensor network system has been set up along the highway to allow monitoring and steering of traffic, as well as to improve the coordination between autonomous and traditional cars. The primary task of the intelligent transportation system is to create a digital traffic twin that accurately represents the physical road situation in real-time. Based on this digital twin, the smart infrastructure can provide a far-reaching and comprehensive view to the drivers and autonomous cars in order to improve their situational awareness within the current traffic environment. More information about the PROVIDENTIA++ project is available on <https://innovation-mobility.com/projekt-providentia/>.

Description

Creating Digital Twins of traffic participants, stands and falls with a reliable and accurate object detection. That is the why, design and implementation of high efficient object detection algorithms are a central task in the PROVIDENTIA++ project. The tough requirements in poor visibility scenes (e.g. night, fog, rain, snow, etc.) can be handled camera only as well as with *early-sensor* fusion where sensor raw data will be combined. For this challenge, usual camera systems, event-based cameras, Radars and LiDARs are available. Due to the complexity and application-oriented challenges, many interesting Thesis topics are available within this area. These include, but are not limited to:

- **Research on camera based object detection:** How can we detect objects in challenging scenes (e.g. night, fog, rain, snow, etc.) based only with a camera system? What are the limits? Can we improve the reliability by combining a deep learning approach with a classical, non-learning-based computer vision approach?
- **Research on event-based camera object detection:** How can we detect objects with this type of sensor? What are the possibilities, what are the limits?
- **Research on object detection with raw data fusion:** How can we increase the performance of camera based object detection with the support of other sensors (e.g. event-based cameras, Radars, LiDARs) with early sensor fusion?
- **Research on automatic camera and algorithm adjustment:** How can we dynamically adjust our system (e.g. camera settings and algorithm parameters) during runtime to improve object detection in challenging scenes such as night, fog, rain and snow?
- **Your ideas:** Your ideas on this topic are expressly welcome. If a key question is not listed here, you are welcome to suggest it.

Your Tasks

- Familiarization with object detection algorithms via literature research
- Development of a solution approach (e.g. as a prototype) for the specific problem
- Evaluation of the concept using real-world data

Requirements

- A strong interest in computer vision, deep learning and object detection
- High motivation and ability to work independently
- Good knowledge in at least one programming language: C++, Python
- Experience with deep learning libraries is not required, but recommended.