Lehrstuhl für Fahrzeugtechnik
Fakultät für Maschinenwesen
Technische Universität München

TLM

Master's Thesis

Uncertainty Estimation in Deep Learning Object Detectors

Autonomous driving is a fast-moving research discipline. At the moment, most of the research community's attention is centered on public streets. However autonomous racing provides a few benefits for research: High-speed driving uncovers a different set of problems than the usual public road scenes. At the same time, the closed track allows for testing new algorithms without safety concerns for the public. The Chair of Automotive Technology competes in the Indy Autonomous Challenge where autonomous Dallara vehicles race against each other at speeds exceeding 250 km/h.

A vital part for success in autonomous racing (and public road driving) is the system's capability to detect objects and track their movements reliably. Current DL object detectors only provide an estimation of the most likely object location and has no measure of how certain it is regarding the position. However, knowing the uncertainty of the object's position would be of great benefit to the subsequent tracking and planning task. Classical tracking algorithms already have the notion of uncertainty (e.g. think of the Kalman filter). The uncertainty could then be propagated to the path planning. As a result, maneuvers could be planned with the adequate level of "aggressiveness", resulting in an overall more agile interaction with other vehicles.

Your work will consist of following work packages:

- Familiarizing yourself with 3D object detectors and exploring the various possibilities to estimate localization uncertainty
- Developing a concept for the evaluation of the uncertainty estimation
- Implementing a real-time capable uncertainty estimation into an object detector
- Testing the object detector and its uncertainty estimate as an input for a tracking algorithm.
- Evaluating the uncertainty aware object detector using classical perception as well as tracking metrics.

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Chair of Automotive Technology | Prof. Dr. Markus Lienkamp

Good knowledge of Python and ideally experience with pytorch, a strong interest in perception and tracking, a drive to learn and an involved working attitude will make you the ideal candidate.

Please include a CV and your current transcript of records into your application.

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