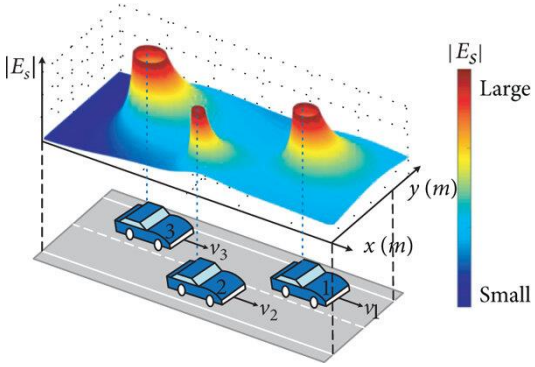
Lehrstuhl für Fahrzeugtechnik
Fakultät für Maschinenwesen
Technische Universität München

Master's Thesis

# Deep Learning for Autonomous Driving: Calibration of Localization Uncertainty in 3D Object Detectors




Help autonomous cars plan safer, more reliable trajectories by making their object detectors honest about what they **don't** know!

Even top-tier detectors won't be perfect. Downstream modules—tracking, prediction, and trajectory planning—work best when they can *trust* the detector's confidence and localization uncertainty. Today's networks can output per-object uncertainties, but these are often **miscalibrated** and don't match empirical error. Calibrated uncertainties are the missing link to robust decision-making.

**Your mission**

Compare existing uncertainty calibration techniques and develop a method that works exceptionally well for our 3D object detector—ideally robust enough to run on our research vehicle EDGAR.

**What you'll do**

1. **Survey the field:** Review uncertainty calibration for (3D) object detection.
2. **Measure the gap:** Quantify miscalibration in state-of-the-art 3D detectors.
3. **Build baselines:** Implement promising confidence/uncertainty calibration methods.
4. **Calibrate & evaluate:** Apply and rigorously evaluate calibration on 3D detectors.
5. **Develop** a calibration strategy that combines what you have learned from literature and analysis

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**Chair of Automotive Technology | Prof. Dr. Markus Lienkamp**

**What you'll learn**

- Practical uncertainty estimation & calibration (e.g., reliability diagrams, ECE/NLL).
- 3D detection evaluation
- Hands-on deep learning engineering in Python (PyTorch or similar), experiment design, and reproducible research.

**You are a great fit if you**

- Have a strong interest in autonomous driving and object detection.
- Bring an engaged, independent working style.
- Have solid **Python** skills (experience with deep learning frameworks is a plus).

Should you be interested in this thesis project or any other project in the context of perception for autonomous driving, please send a CV and a transcript of records to cornelius.schroeder@tum.de.

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