

Master Thesis

Industrial Master Thesis in collaboration with MAN Truck & Bus SE in Munich.



ATLAS-L4: FÖRDERPROJEKT
FÜR AUTONOME TRUCKS.

ATLAS-L4 – Autonomous transport solution for highway applications [4].

Robust Model Predictive Control for autonomous Trucks with Steering Actuator Uncertainty

Challenge

The control of articulated vehicles is particularly challenging due to uncertainties in the steering system and its interaction with vehicle dynamics. This thesis aims to address these challenges by developing a robust adaptive approach for lateral vehicle control under steering uncertainties. Two complementary thesis topics are offered:

1. **Learning actuator characteristics via Sparse Gaussian Process Regression (GPR):** This objective focuses on approximating the steering actuator behavior to reduce model mismatch and improve control performance [1].
2. **Robust Set-Membership estimation (SME) for steering offset identification:** This objective targets the estimation and compensation of unknown steering offsets, ensuring robust lateral control despite systematic steering errors [2].

Your Task

- + Review literature on robust Model Predictive Control (RMPC) approaches with performance learning [3]
- + Design and implement an RMPC controller for lateral control using acados [5], and integrate it into an existing Simulink environment
- + Implement a robust parameter estimation method (Gaussian Process Regression (GPR) or Set-Membership estimation (SME))
- + Simulate and validate the implemented controller in MATLAB/Simulink
- + Deploy and test the controller on our autonomous trucks

Getting Started

Before starting the thesis, we offer a paid 2–3 month internship position at MAN Truck & Bus in Munich to get familiar with the tools, models, and project context.

Institute of Measurement and Control Systems (MRT)
Prof. Dr.-Ing. Christoph Stiller

Advisor:

M.Sc. Christian Gajek

Programming language(s):

MATLAB/Simulink, C, cmake

System, Framework(s):

acados [5], CasADi

Language(s):

English, German

Your Profile:

- Fundamental knowledge in control theory, familiarity with Model Predictive Control (MPC)
- Knowledge in vehicle dynamics and modeling is a plus
- Knowledge in sparse GPR or SME is a plus
- Practical experience from student projects (e.g. Formula Student)
- Excellent academic performance
- Independent and solution oriented working style

What we offer:

- A paid industrial student thesis at MAN Truck & Bus SE in Munich
- Test your controller on our autonomous truck prototypes.

Apply:

Send me an E-mail with your CV, your transcript of grades and a *short* motivation why this topic sparks your interest and you are a perfect fit for this thesis.

There will be a **preliminary test** to assess your qualification for this position.

For more information please contact

Christian Gajek

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[1] Kabzan (2019) "Learning-based model predictive control for autonomous racing"

[2] Bujarbaruah (2018) "Adaptive MPC for autonomous lane keeping"

[3] Hewing (2020) "Learning-Based Model Predictive Control: Toward Safe Learning in Control"

[4] ATLAS-L4 project website

[5] Verschueren (2021) "acados – a modular open-source framework for fast optimal embedded control"