Autonomous driving & obstacle avoidance

Project Summary

Modeling the dynamics of vehicles with a trustful digital twin analog for achieving full automation and control through safe-aware environments.

Project Types

- BA thesis – 3 months
- MA thesis – 6 months

Project Objectives

- Studying the fundamentals of model predictive control MPC
- **Parameter identification of the dynamical model** from actual measurements of an **F1tenth car** and control for **lane keeping**
- **Obstacle Avoidance** with methods that enhance **real-time** and implementation to an **F1tenth car**

Required Qualifications

- Basic courses in automatic control
- Programming skills (e.g., Matlab)

Contact

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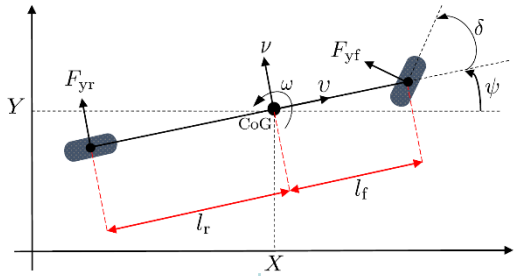
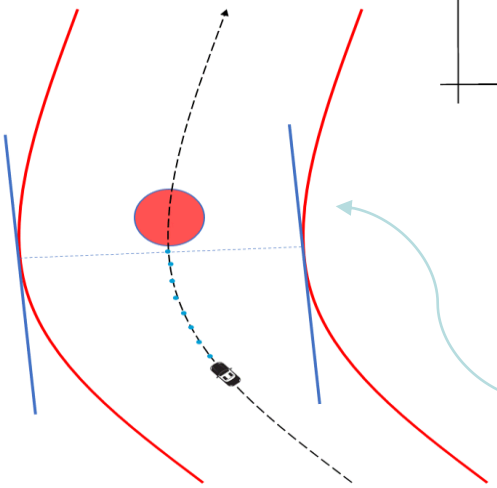
Detailed Description

Dynamic bicycle model

$$\dot{x}(t) = f(x(t), u(t))$$





Model Predictive Control

$$\min_{u_{i|k}} \sum_{i=0}^{N-1} \ell(x_{i|k}, u_{i|k}) + \ell_f(x_{N|k})$$

$$\text{subject to } x_{i|k} \in \mathbb{X},\ i = 1, \ldots, N-1$$

$$u_{i|k} \in \mathbb{U},\ i = 1, \ldots, N-1$$

$$x_{i+1|k} = f(x_{i|k}, u_{i|k})$$

$$x_{0|k} = x(k)$$

$$x_{N|k} \in \mathbb{X}_f$$

References

- M. Nezami, D. S. Karachalios, G. Schildbach, H. S. Abbas. On the Design of Nonlinear MPC and LPVMPC for Obstacle Avoidance in Autonomous Driving. IEEE Conference on Control, Decision and Information Technologies, 2023.