Lateral Control Homework

Vehicle Dynamics, Planning and Control of Robotic Cars

Gastone Pietro Papini Rosati & Mattia Piccinini

EIT Digital
University of Trento

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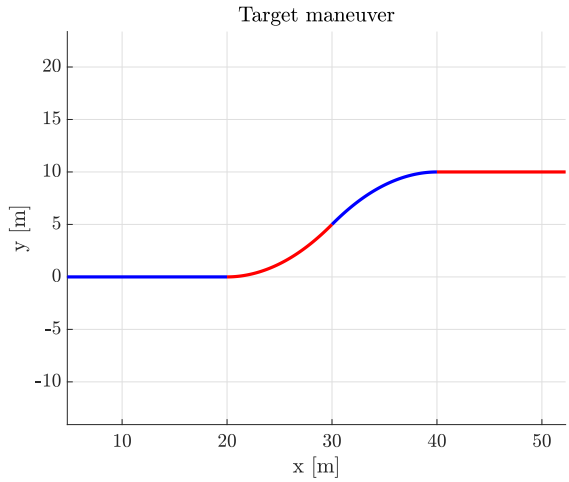
Assignment

This homework gives you the possibility to optimize the implementation of several lateral control algorithms for self-driving vehicles. All the following exercises can be carried out using the MATLAB & SIMULINK files that were provided.
You are supposed to attach the solution of the following homework in the final report that you are going to deliver before the oral exam.

Problem Description

The main objective consists of driving the vehicle model along the following target path, simulating an evasive maneuver for obstacle avoidance, at constant speed.



Exercise 1 - lateral control

You are required to perform the following tasks:

- Copy the code of your vehicle model SIMULINK block (from assignment 3) inside the vehicle model block of the file framework_sim.slx.

- You find the clothoid-based lateral controller already implemented. Try to optimize its implementation, by changing the look-ahead distance and using the understeering gradient K_{us} which you computed in the assignment 4.
- Implement the pure pursuit controller and optimize the look ahead distance. Point out if and how it should be changed when the speed is increased.
- Use the SIMULINK blocks to evaluate the performance of the Stanley kinematic and dynamic controllers.
- Compare the performance of the lateral controllers. In this regard, consider the path tracking error (e.g. max error, mean error, etc), but also the resulting steering angle profile. Take into account how each controller behaves when increasing vehicle speed (perform several tests, at different speed values - each test can be carried out at a constant speed -). Try to point out which are the most important paramenters for each algorithm and their effect on path tracking.
- On the basis of your results, underline the pros and the cons of each algorithm.

The following tasks are instead optional (i.e. not mandatory), and you will get extra points if you complete them:

- Implement the preview point lateral controller and compare it with the other controllers.
- Re-write the Stanley kinematic and dynamic controllers with your own code.