

ROB 535 Control Project Team2 Documentation

Qilin He

qilinhe@umich.edu

Task Distribution

In this project, I focused on exploring method for part 1 and also methods for part 2. In conclusion, the method of using fmincon failed, and our team succeeded on using the PID controller for part 1. For part 2, I explored the PID method and found it was not sufficient to implement, which we used the MPC method in the end.

Part 1

In part 1, the optimization problem was solved using the fmincon function. The function used the gradient descent algorithm to find the optimal solution for a given cost function and constraint function. However, the dimensionality of the problem is quite high, which is in the costfcn. This made the fmincon difficult/hard to find an optimal solution. The high dimensionality may overwhelm Matlab to solve. Therefore, we decided to move on to the different method for part 1.

Part 2

I have slightly contributed to the implementation of PID for part 2, in which we found that the PID method was time efficient for completing the track but the car had chances of crashing into obstacles. I mainly focused on writing the several functions for the MPC method for part 2, including clearance, nearest_point, kinematic_dynamics, and bound_cons. Clearance function is used for calculating the clearance between vehicle and surround obstacle. nearest_point function finds the nearest point on the obstacle's surface to the vehicle. Kinematic dynamic function calculates the kinematic dynamic of the vehicle and used for simulating the next state of the vehicle given current state and control input. These functions will be further implemented into Ziqi's task of writing MPC algorithm.

Teammates Task

- Yuzhou Chen: Explored PID for part 2, set up dynamic systems for part 2 MPC method
- Ziqi Han: Responsible for overall control structure for part 2 with MPC method
- Yifan Wang: Explored Reinforcement Learning for part 1, implemented PID for part 1
- Siyuan Yin: Explored fmincon for part 1, implemented PID for part 1