

# ROB 535 Control Project Team2 Documentation

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## 1. Task Definition

The control Project has 2 tasks, which require us to use a bicycle model to track a given trajectory and avoid some random obstacles.

- **Task 1** We are required to design a controller for the bicycle model to get from the beginning to the end of a given track.
- **Task 2** We are required to design a controller which could help the bicycle avoid random-generated obstacles on the basis of task1.

## 2. My Contribution

I mainly focused on PID control to part 2 and contribute to set up the dynamic and partial system: computing the Jacobian matrix, form A and B matrices.

For PID control, I firstly set up the desired path to avoid obstacle by calculating the distance from the center of obstacle to the lane boundary to determine whether the vehicle goes to left or right lane. Then, follow the chosen lane to generate  $u_{ref}$  and  $\psi_{ref}$ . Finally, I set up parameter for the PID controller: proportional gain for generate  $F_x$  and  $\delta$ , integral gain for  $\delta$ . I highly expected the performance of PID method. The task can quickly and smoothly finished the task without any overshoot. Noticed that the final score is the average performance of 5 times. Therefore, I wrote a loop to run PID method 15 times, but the vehicle crashed 3 times at the very beginning. This forced us finally abandoning PID and turned to MPC method.

## 3. Teammates Task

- Ziqi Han: Responsible for overall control structure for part 2 with MPC method
- Siyuan Yin: Explored `fmincon` for part 1, implemented PID for part 1
- Qilin He: Explored `fmincon` for Task 1; Implemented MPC for Task 2.
- Yifan Wang: Explored Reinforcement Learning for part 1, implemented PID for part 1