Control and Trajectory Tracking for Autonomous Vehicles

Overview

The goal of the Project is to design a PID controller for trajectory tracking (The trajectory is an array of locations) inside CARLA simulator.

Project Steps:

1- Design PID controller
2- Integrate with CARLA Simulator
3- Parameter Tuning
4- Strategy explanation for testing the controller and performing the test
5- Create Plots
6- Theory behind controller recovery

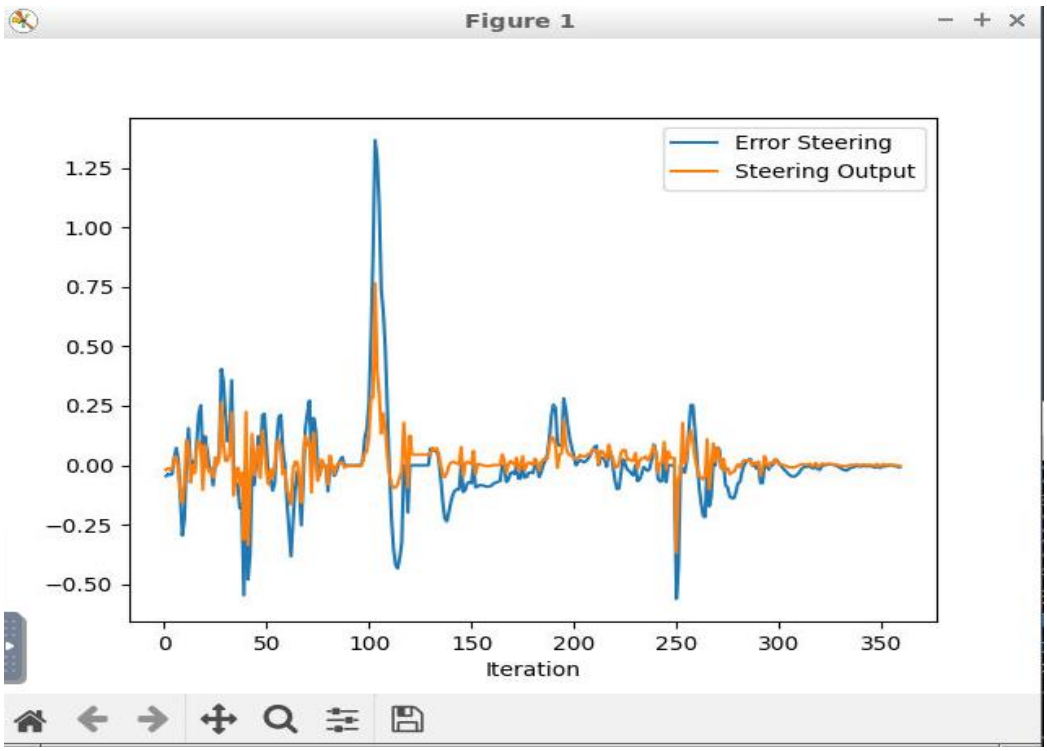
Step 1

Fig: Output of Step 1

Answer the following questions:

Question1- Add the plots to your report and explain them (describe what you see)

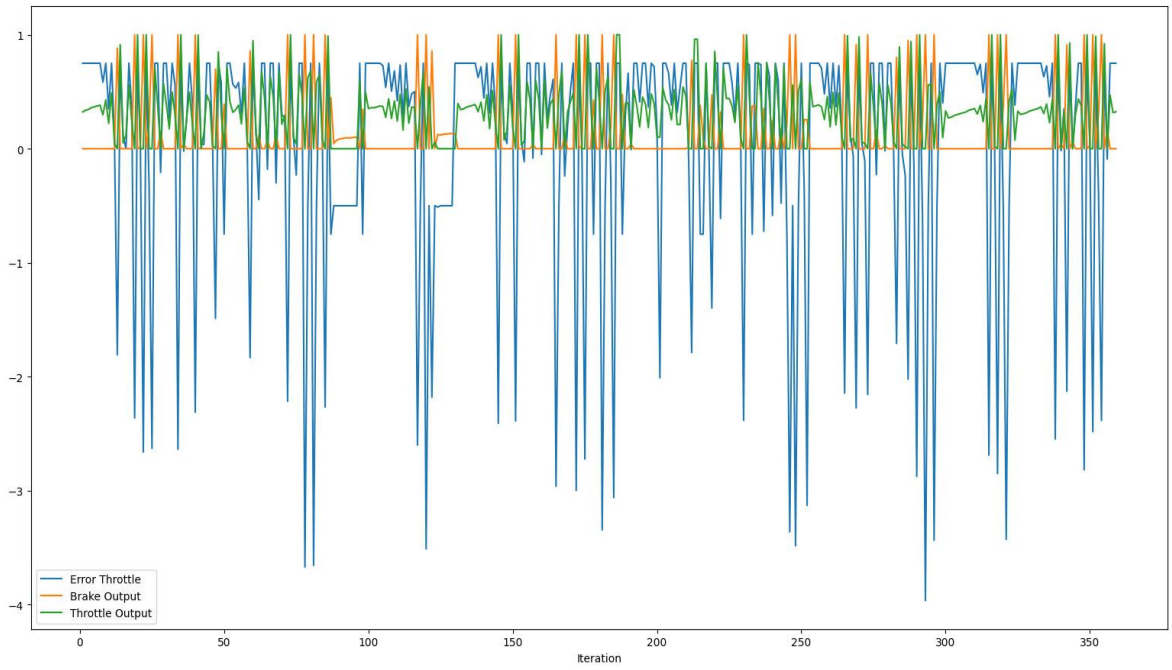
Steering plot:



Explanation:

There are two curves, the blue curve represents Error Steering and the orange curve represents Steering output. The error Steering is the difference between the current steering and the desired steering. The error is less at most of the places. The errors are more at the start and at the turnings of the vehicle. There is not much problem when the car is travelling in a straight line. The whole problem occurs at the turnings. This can be seen at iteration 100 as well.

Throttle Plot



Explanation

In the throttle graph, there are 3 curves. The blue is Error throttle, Orange is for brake output and green is throttle output. The Error throttle means the difference between the current and the desired speed. Brake output and throttle output are both positive while error throttle takes both positive and negative values.

Question2- What is the effect of the PID according to the plots, how each part of the PID affects the control command?

Answer: The steering output is proportional to the steering error. The throttle output is proportional to Error throttle. Both Throttle output and brake output are positive.

Question3 - How would you design a way to automatically tune the PID parameters?

Answer- In this experiment, the PID parameters have been tuned manually. Although, we

can find the optimal values for the controller using Optimization techniques.

Question4- PID controller is a model free controller, i.e. it does not use a model of the car. Could you explain the pros and cons of this type of controller?

Answer-

Pros:

1- Modelling the car is a complex process and not straight forward. When, we skip this part, it makes the development process easier.

Cons:

1- It is very difficult to tune the parameters for the car.

(Optional) What would you do to improve the PID controller?

Answer- I would like to implement optimization based techniques to implement PID controller.