UDACITY

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PID Controller

REVIEW

CODE REVIEW

HISTORY

Meets Specifications

Dear Excellent Student,

You put a lot of effort into this project and I think it was worth it because you implemented a very useful piece of code. Congratulations! Keep up the good work for the next project!

Extra Material

You could refer to these resources for more insight on the subject matter.

- Automating tuning of PID Controllers;
- On Automation of the PID Tuning Procedure;
- Tuning a PID Controller;
- Automatic Controller Tuning using Relay-based Model Identification.

Also, take a look at these topics for more reading.

- PID controller;
- PID Explained for Process Engineers: Part 2 - Tuning Coefficients.

Compilation

Code must compile without errors with `cmake` and `make`.

Given that we've made CMakeLists.txt as general as possible, it's recommend that you do not change it unless you can guarantee that your changes will still compile on any platform.

Awesome, your project compiles with `cmake && make` . For more information on this build tool, refer to the following:

- https://cmake.org/runningcmake/
- https://rix0r.nl/blog/2015/08/13/cmake-guide/
- https://cmake.org/cmake/help/latest/guide/tutorial/index.html
- http://preshing.com/20170511/how-to-build-a-cmake-based-project/

Implementation

It's encouraged to be creative, particularly around hyperparameter tuning/optimization. However, the base algorithm should follow what's presented in the lessons.

Very good implementation, your code follows the general guidelines of the PID algorithm.

Suggestion

You can also use another instance of the PID controller to handle the throttle.

Reflection

Student describes the effect of the P, I, D component of the PID algorithm in their implementation. Is it what you expected?

Visual aids are encouraged, i.e. record of a small video of the car in the simulator and describe what each component is set to.

You clearly passed this requirement. you explained the effect of each of the P, I , D components on the behavior of the car. One way to improve your write up will be to actually discuss and contrast the actual behavior of the car with the expected behavior of the car under various conditions including a P controller, a D controller and other types of controllers.

You should also refer to the following links that have some more information on the role of each component.

- https://www.youtube.com/watch?v=4Y7zG48uHRo&t=31s
- https://www.wikiwand.com/en/PID_controller#/Derivative_term
- http://oa.upm.es/30015/1/INVE_MEM_2013_165545.pdf

Student discusses how they chose the final hyperparameters (P, I, D coefficients). This could be have been done through manual tuning, twiddle, SGD, or something else, or a combination!

Awesome! You have found out the most optimized parameters by manual tuning.

Suggestion

In order to fine tune parameters using twiddle algorithm, you should run it first for n-steps and then save the optimized values. Tune parameters at each frame is not reasonalbe because the system is changing all the time, and average the total CTE for a certain time would be better.

Here are some online resources for better understanding the twiddle algorithm:

- https://github.com/justinlee007/CarND-PID-Control-Project
- http://georgegillard.com/programmingguides/introduction_to_pid_controllers_ed2-pdf?format=raw
- https://medium.com/intro-to-artificial-intelligence/pid-controller-udacitys-self-driving-car-nanodegree-c4fd15bdc981
- https://github.com/RomanoViolet/Udacity-PID-Controller
- https://www.youtube.com/watch?v=2uQ2BSzDvXs
- https://robotics.stackexchange.com/questions/167/what-are-good-strategies-for-tuning-pid-loops

Simulation

No tire may leave the drivable portion of the track surface. The car may not pop up onto ledges or roll over any surfaces that would otherwise be considered unsafe (if humans were in the vehicle).

Nice work! The car drives around the track successfully without any tires leaving the drivable portion of the track surface.

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