PID Controller

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Abstract

The purpose of the project is to tune the hyper-parameters of a Proportional-Integral-Derivative Controller (PID) using a method of choice such as twiddle, SGD or a combination and simulate the results using the Udacity race track simulation.

1 P, I, D Behaviour

The individual components effect on the behaviour of the ego vehicle in the simulation are as expected and describe behaviour seen similar to literature. In the simulation, the center line of the lane acts as the target around which the oscillations induced by the PID controller are seen most clearly. The *P, Proportional* parameter as expected contributes to a large overshooting of the vehicles position around the center of the lane when the wheels begin to turn too far. If the P value is large compared to the latter parameters, the oscillations are seen more intensely as no counter-steering is in place. The parameter that controls the extent of the oscillations is the *D, Derivative* parameter. In the final tuning, the D parameter coefficient is quiet large and is expected to be this way as the vehicle drives much faster through the track and tends to react slightly late to some incoming turns. The D parameters helps suppress the intense oscillations created by the P parameter. Generally the *I, Integral* parameter is seen to approach a very small value is approximately 0 for the implementation used in the simulator. This is perhaps to do there no bias in place for the integral to reduce the error of, but may become more significant if a larger drift was introduced.

2 Model Documentation

A C++ implementation of `Twiddle` was used to determine sufficient coefficients of the hyper-parameters P, I, and D. The values used in the simulation are $[0.30,\ 1.80e{-4},\ 4.55]$ respectively. The following figure display the progress of the Twiddle algorithm.

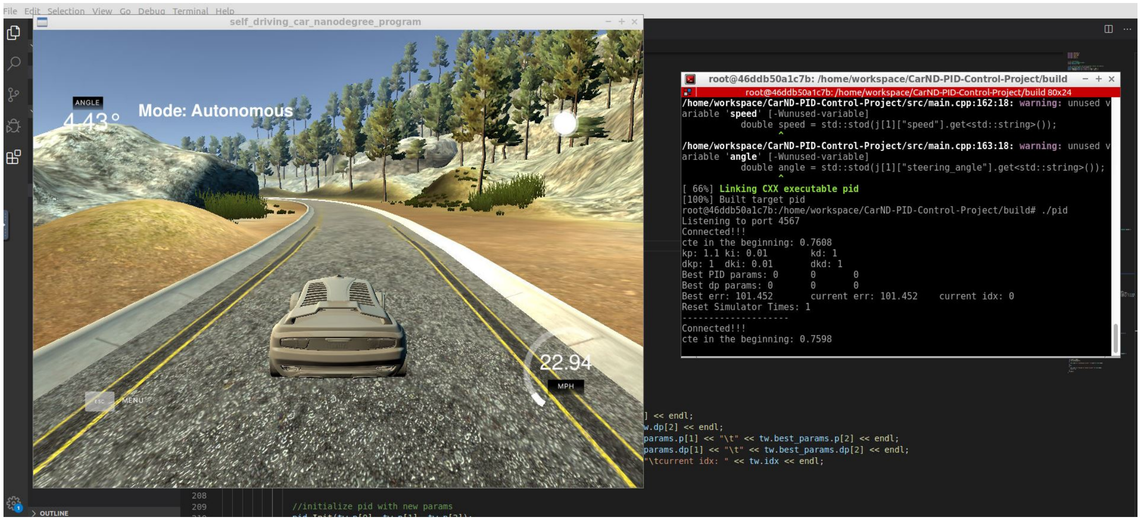

Figure 1: Initial Error with no Iterations

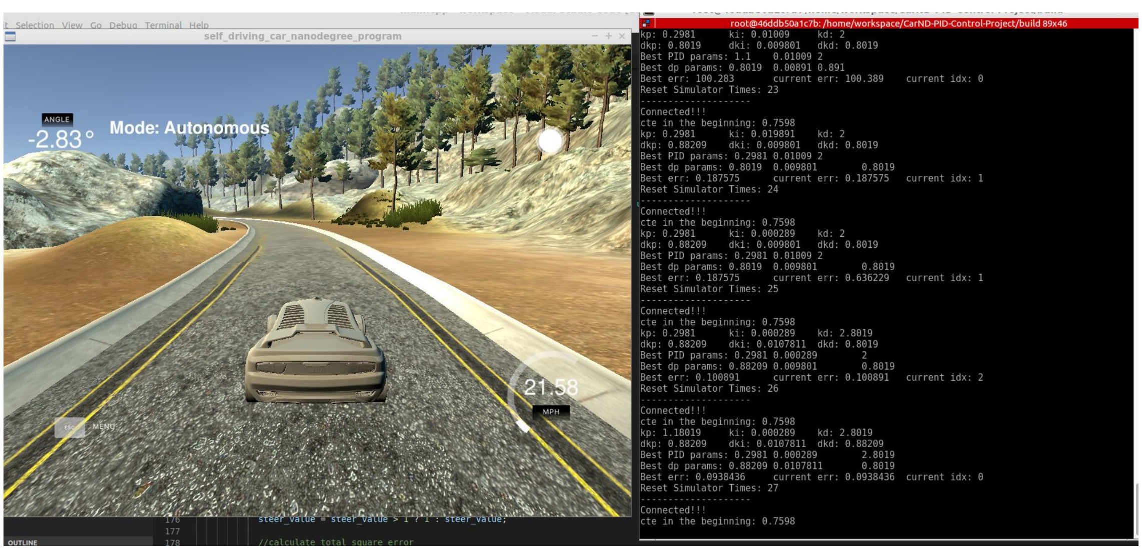

Figure 2: Progressive convergence of the Twiddle algorithm.