CS519 Wall Following Lab Report

1) The Steering angle error for:
    a) The following right condition is calculated by subtracting D_{t+1} from the reference distance (i.e., e = R - D_{t+1})
    b) The following left is calculated by subtracting the reference distance from D_{t+1} (i.e. e = D_{t+1} - R), because the controller behavior should be the opposite of followRight. (Note: the **constants b, a** used for calculating D_{t+1} also accordingly, 180 and 180-θ, respectively).
    c) The following center error is basically the difference between the followLeft error, and the followRight error.

2) The choice of look-ahead distance L was 1.5m. Intuitively, this distance performs a 1 sec lookahead into the future, since the maximum velocity is capped at 1.5 m/s. Any value greater than 1.5m underestimated the steering, causing the vehicle to collide at tight turns (e.g., U-turns), and any value less than 1.5m overestimated the steering angle, causing the vehicle to go in circles. Values between 1-2m usually did the trick for me, and 1.5m was a nice sweet spot.

3) I set Kp to be 0.5, and Kd to be 0.01. I initially started playing with only Kp values. Once I found a good value for Kp (which was Kp = 1.0), I slowly increased Kd in multiples of 5 to get the right values.
    a) Setting Kp to very low (e.g., < 0.5), resulted in a sluggish response, meaning the car, for the most times, was moving very fast, but it was suffering to make turns, and frequently ended up colliding with the walls.
    b) Setting Kp to a very high (e.g, > 1.0), resulted in a quick response, but also made the car move very slowly, because it was constantly steering back-and-forth.
    c) Introducing Kd aided a lot in making sharp turns (e.g., U-turns), which was initially not possible with using Kp alone.
    d) Setting Kd to a high value (i.e., > 0.01), gave a noisy response. Since the controller was running at 40 Hz, the D-controller was very sensitive even for a slight change in error. Therefore, I had to reduce the value of Kd, at least an order of magnitude less than the Kp value.