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| --- | --- | --- |
| **Kp value** | **Kd value** | **Results** |
| *Weights are -4 -3 -2 -1 1 2 3 4, BASE\_SPEED is 30.* | | |
| -2.50 | 2.50 | The change in left and right wheel speed was not fast enough for speeds above 30ish |
| 5 | 2 | Steadily overshooting, overdamped |
| 2 | 2 | Better straight line performance/correction, not turning fast enough |
| 2 | 5 | Better at turning than previous, but still not sharp enough |
| 2 | 6 | Turning got worse ☹ |
| 5 | 0 | Followed first curved, destabilized too much on the second curve and failed |
| 8 | 4 | Overshot the first curve |
| *Weights are -4.5 -2.5 -1.5 -1 1 1.5 2.5 4.5, BASE\_SPEED is 60.* | | |
| 10 | 1 | Made the first turn, oscillated too much on straight lines, missed the second turn |
| 12 | 3 | Missed the second turn again, oscillated was slightly fixed |
| 10 | 3 | Completed the track! Oscillated way too much though |
| 8 | 3 | Missed the very last turn, oscillation is more controlled |
| 7 | 5 | Made the track relatively well, time to up the speed! |
| *Same weights, BASE\_SPEED increased to 100.* | | |
| 7 | 5 | Fails to make it past the second turn (maybe due to too much oscillation, speed difference made it worse) |
| 7 | 7 | Made it thru all turns except the very last one |
| 8 | 6 | Overshot consistently but corrected on turns, and missed the 3rd one |
| ***Switched to 1.5V batteries*** *for this, BASE\_SPEED back down to 60* | | |
| 8 | 7 | Too fast, ran off track |
| 5 | 2 | Oscillating too much |
| 6 | 4 | Bounces around too much |
| *Around here Professor Briggs noticed our run and asked for our scale. At his recommendation, we switched to a weight array with a steeper difference in the first initial values and lower differences towards the end.* | | |
| *Weights are -4 -3.5 -2.5 -1 1 2.5 3.5 4* | | |
| 6 | 4 | Doesn’t correct oscillations, need lower Kp or higher Kp |
| 4 | 4 | Made 2 runs successfully |
| *Weights are -5 -4.5 -4 -2 2 4 4.5 5* | | |
| 4 | 4 | Ran successfully, uncontrolled oscillations tho |
| 4 | 5 | More controlled |
| 4 | 6 | A lot more controlled |
| *Weights are -5 -4.5 -4 -2.5 2.5 4 4.5 5* | | |
| 4 | 6 | Made a run |
| 4 | 7 | Best run we’ve had so far, robot was right in the middle almost 100% of the time. Time to up the speed! |
| *BASE\_SPEED increased to 80* | | |
| 4 | 7 | Overshot quite a lot |
| 4 | 6 | Overshot still, way too all over the place, dynamic |
| 5 | 8 | All over the place still, it’s embarrassing |
| 6 | 8 | Better but still oscillating a lot |
| *Multiplied scale by 1.333 since the speed increase was 133% (BASE\_SPEED = 80)*  *Weights are now -6.666 -6 -5.333 -3.333, 3.333 5.333 6 6.666*  *Multiplied Kp (4) and Kd (7) values by the same constant* | | |
| 5.33 | 8 | Oscillating too much at the end |
| 5.33 | 9 | Better but still oscillating too much around turns |
| 5.333 | 9.3333 | Almost perfect, but can still get better |
| *Multiplied original scale by 1.666 since the speed increase is now 166%*  *Weights are now -8.333 -7.5 -6.666 -4.166 4.166 6.666 7.5 8.333*  *Multiplied Kp (4) and Kd (7) values by the same constant* | | |
| 6.666 | 22 | Really good run, oscillates too much in a straight line tho, so we’re upping the speed cuz we get the hang of it |
| 6.666 | 23 | Terrible run, ran off the track |
| 6.666 | 21 | Better, still kinda jerky, maybe lower the Kp value |
| 6 | 23 | Solid run, a lot better, could increase Kd tho |
| 6 | 24 | Good, even better, oscillated a little in the beginning, can do better tho |
| 6 | 25 | Maybe too much Kd, back down to 24 |
| *Multiplied original scale by 2 since the speed increase is now 200% (BASE\_SPEED = 120)*  *Weights are now -10 -9 -8 -5 5 8 9 10*  *Multiplied Kp (4) and Kd (7) values by the same constant* | | |
| 8 | 29 | Almost good run, need more Kd |
| 8 | 32 | Oscillating way too much |
| 8 | 35 | Made a run, not correcting oscillations enough tho |
| 8 | 40 | Missed a turn, too much Kd |
|  |  |  |
| ***Observation:*** *It seems that whatever factor we increase the speed by,* ***we must increase the weights by that same factor****, along with the Kp value. The Kd value is increased by that factor plus something else which we’re still trying to figure out. We are using the green row on the previous page as our baseline since that has been a near perfect run. All factors are multiplied by those values.* | | |

**Update 11/25/2019:** Backed down to BASE\_SPEED = 100 and Kp (6) and Kp (24). Near perfect run. What we need to do is get rid of the 100ms delay after the car does the doughnut. Since the sensors are not lined up with the axle, once it flips it will be off the tape anyway, therefore we don’t need the offset push for 100ms. If there is time, recommend tripling speed to 180 and testing until perfect.