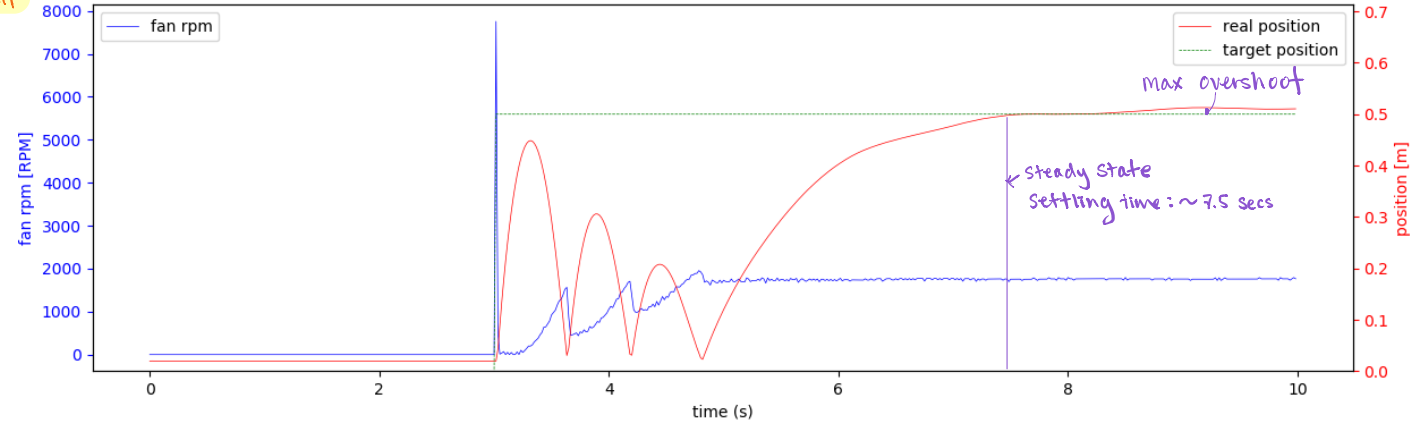
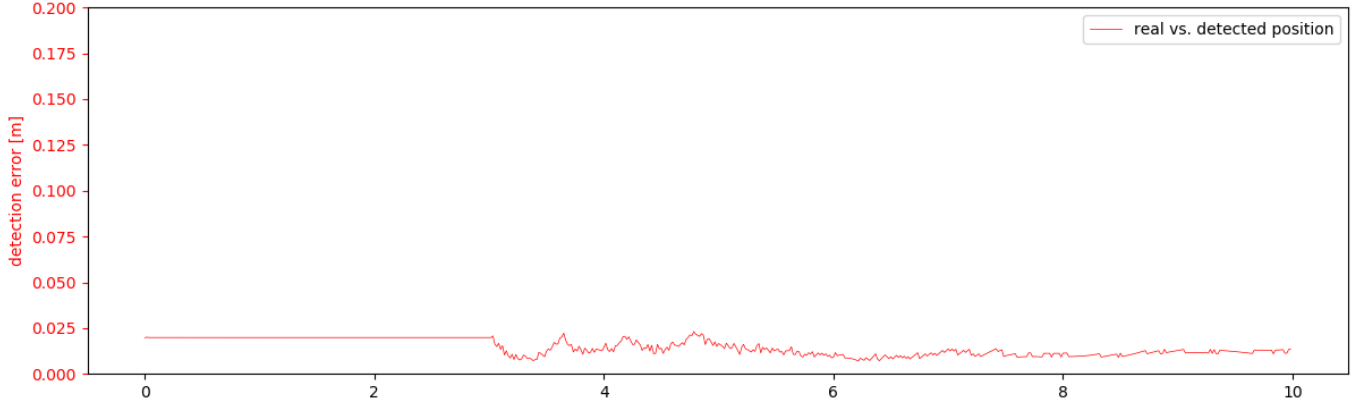
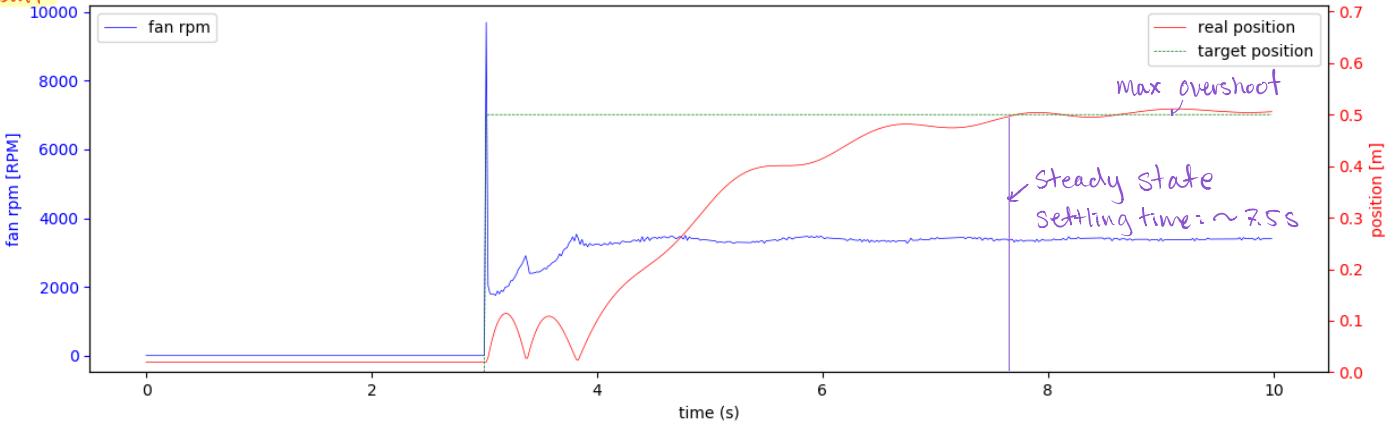
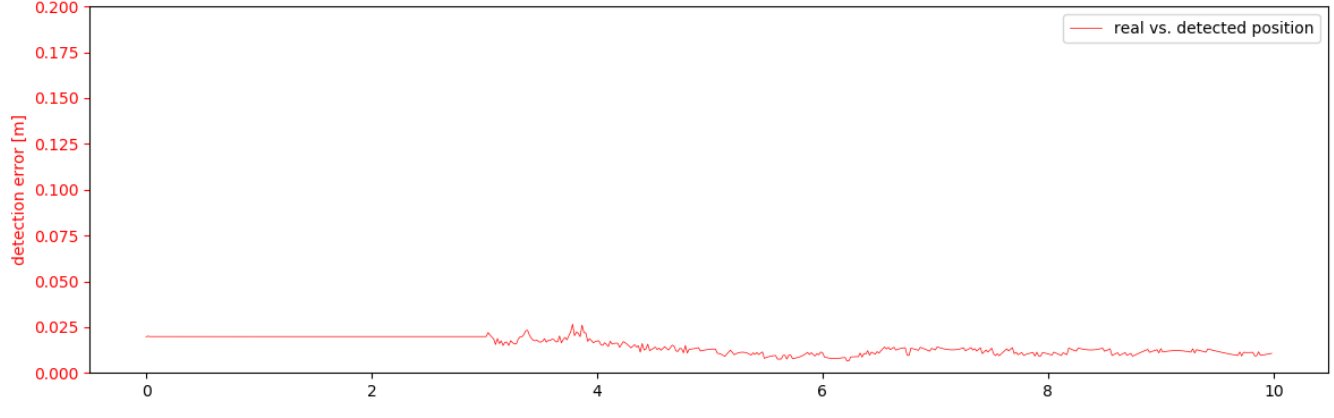
2.7g Ball


fan rpm
real position
target position
max overshoot
steady state
Settling time : ~7.5 secs
fan rpm [RPM]
position [m]
time (s)
8000
7000
6000
5000
4000
3000
2000
1000
0
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
0
2
4
6
8
10


real vs. detected position
detection error [m]
0.200
0.175
0.150
0.125
0.100
0.075
0.050
0.025
0.000
0
2
4
6
8
10

② 0.01 kg Ball


fan rpm
real position
target position
Max overshoot
Steady state
Settling time: ~7.5s
fan rpm [RPM]
position [m]
time (s)
10000
8000
6000
4000
2000
0
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
0
2
4
6
8
10


real vs. detected position
detection error [m]
0.200
0.175
0.150
0.125
0.100
0.075
0.050
0.025
0.000
0
2
4
6
8
10

1.2 Effects and limitations of controllers.

While it is easy to implement the PID controller, it lacks in resilience and robustness. If the system parameters (i.e. ) are not precisely estimated/achieved, the PID gains may not be resistant under disturbances and/or different conditions. While I was able to find a set of parameters that works best in all cases, it is not necessarily optimal for one given case. This can be seen when we changed the mass of the ball; we were able to achieve the desired target position with the previous parameters but had a longer settling time. Hence, we would need frequent manual tuning. Furthermore, the Integral term itself added to the settling time as it slowly accumulates and is slow to respond. the system was weak and sensitive to any disturbances/noise and so, the derivative term easily caused instability and oscillations. The nature of the system's produced high-frequency oscillations due to the concurrent act of gravity and the fan. Lastly, the system needed to reach that target state within 10 seconds. Consequently, somewhat high average error and overshoot was needed at the beginning to overcome the last three limitations listed above.