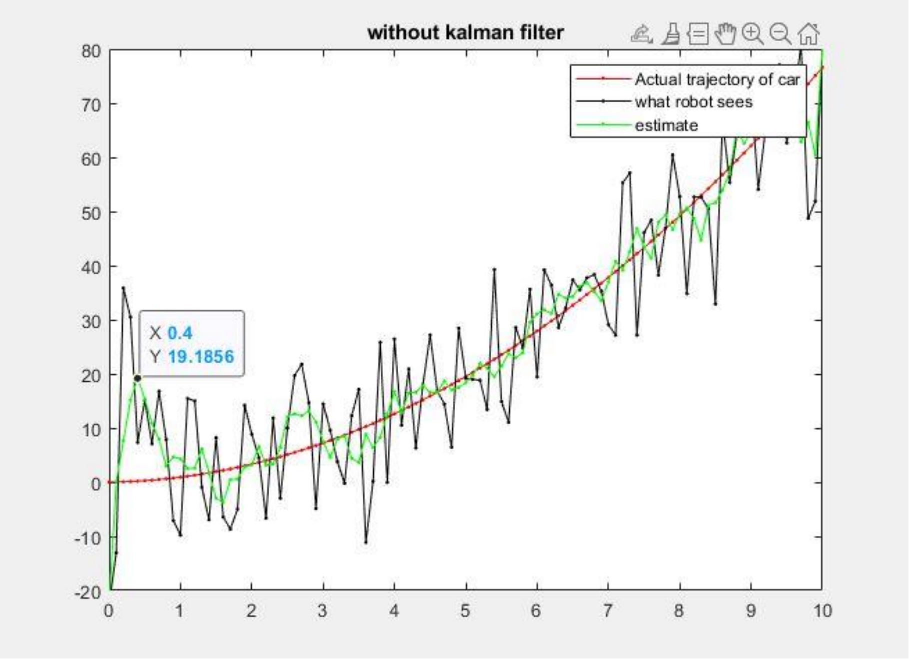
Task 6.3

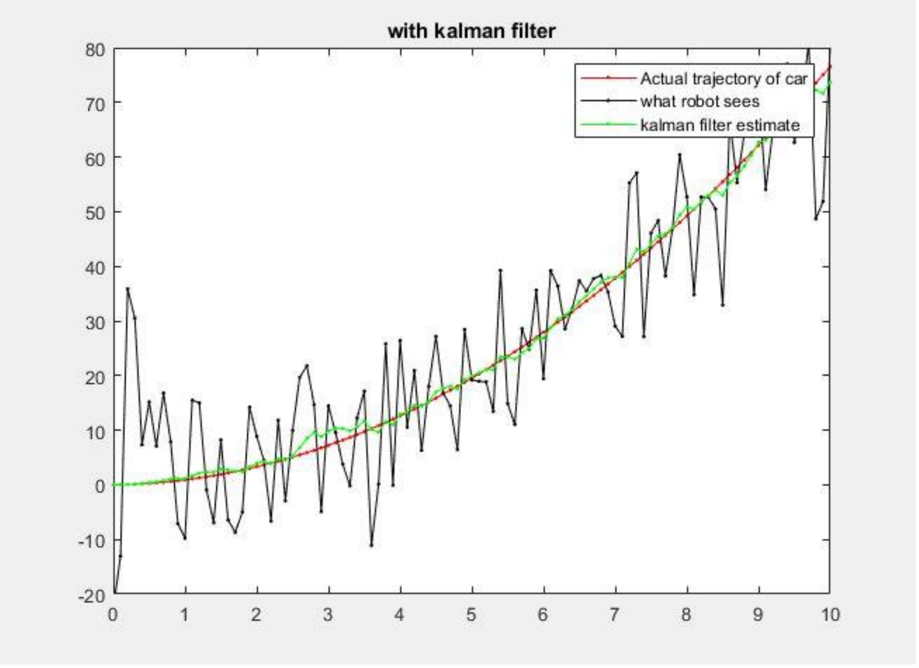
Running the code on given noise levels 0.05 for car acceleration and 0.1 on robot internal and reviewing the graph, following are the observations to be drawn:

1) The estimate by Kalman filter follows the line of actual car trajectory as close as possible because of the best estimate and update. The same is not true for Smoothing filter that shows a case without employing Kalman filter. Its trajectory is beyond the actual car trajectory with many deviations along the line, while Kalman showcases a much steady trajectory along the actual car trajectory.

   Car noise acceleration = 0.05

   Robot noise = 0.1

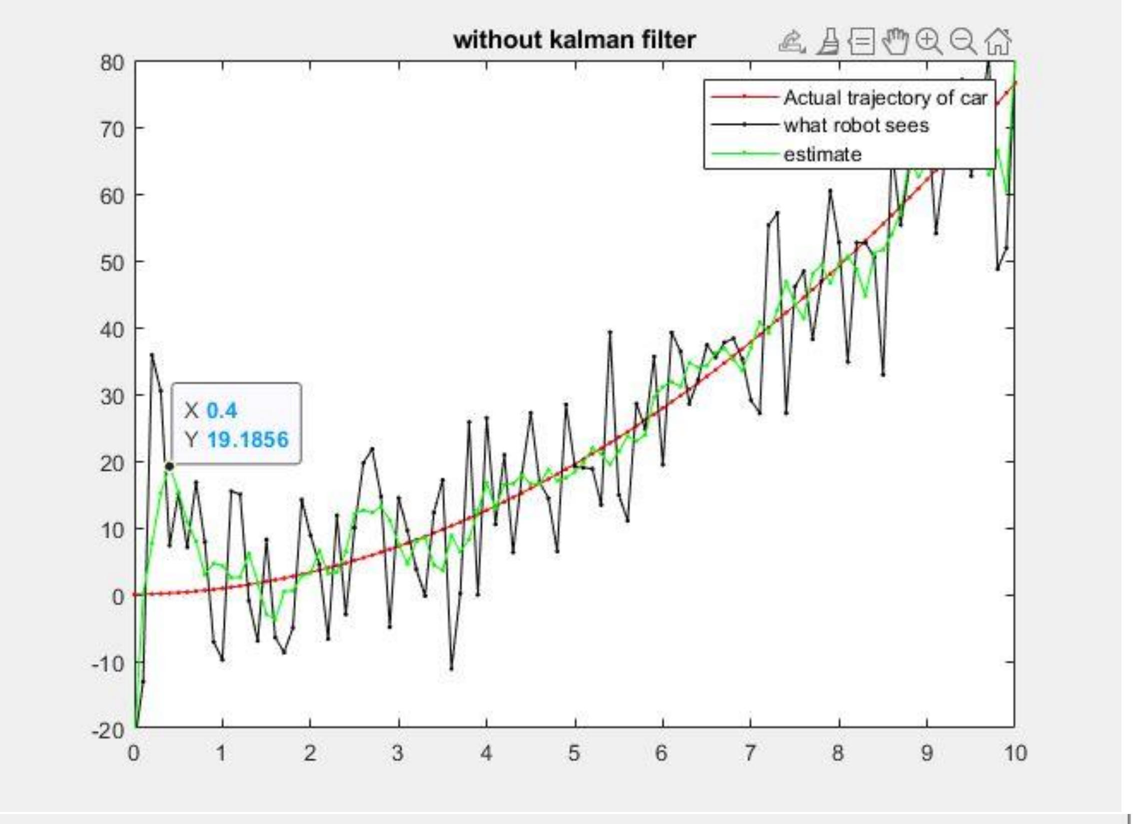


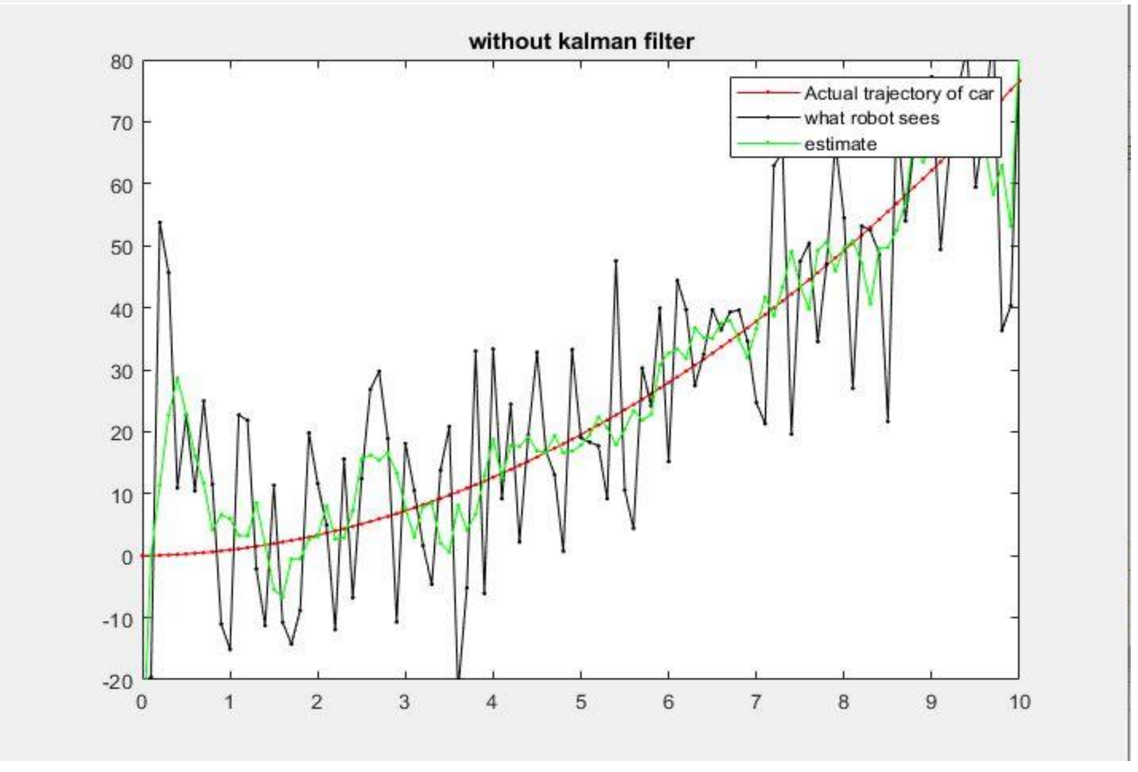


2) Kalman Filter adjusts the Kalman gain according to the actual measurement accuracy. That is, with increasing or decreasing noise levels the Kalman variance estimate does not change as aggressively as the smoothing filter result. The smoothing filter shows a deviation linear to the noise level, while Kalman Filter with the best estimate and adjusting gain is not linear to the noise as smoothing filter. That is, increasing noise levels increases the first peak of estimate for the case without Kalman Filter. For the case with Kalman Filter, such a behavior is not found due to Kalman's adjusting gain.

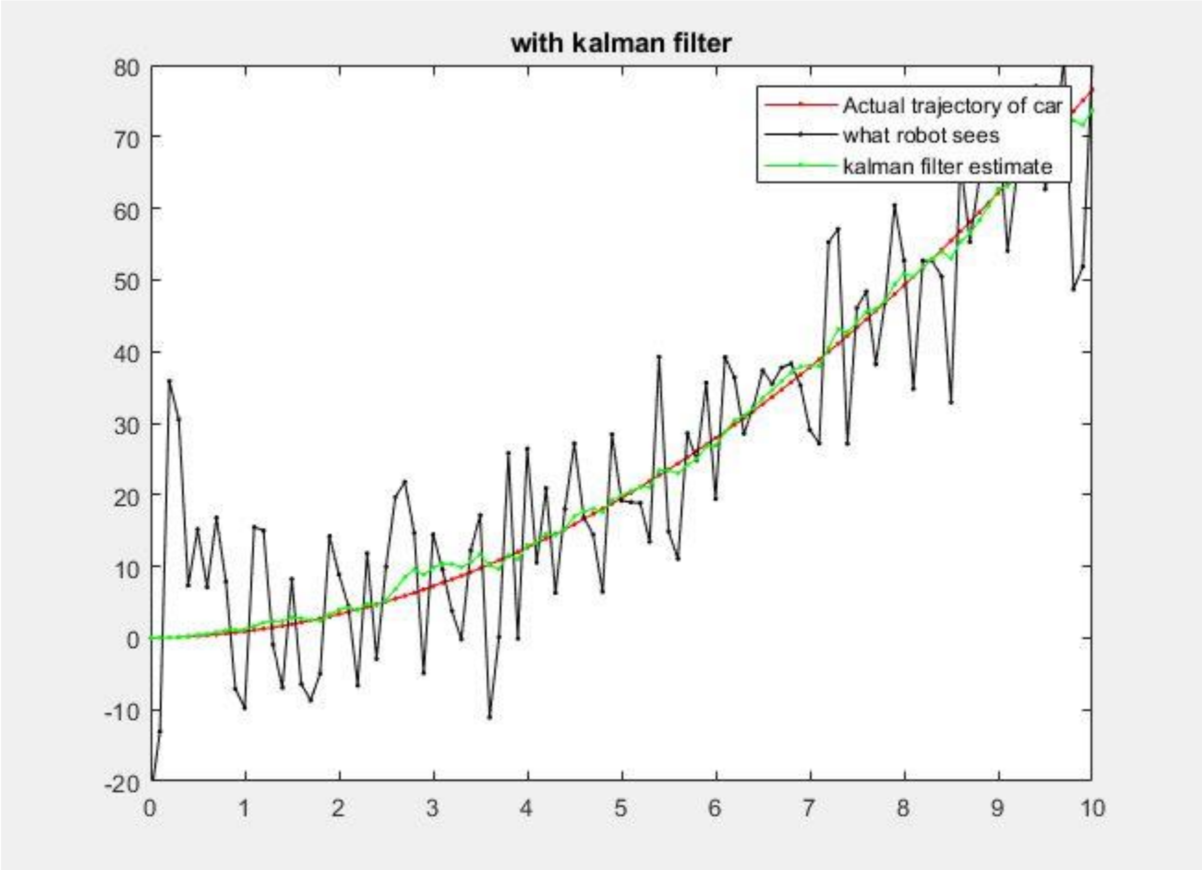
Car noise acc = 0.05 then 0.1 Robot noise = 0.1 then 0.15

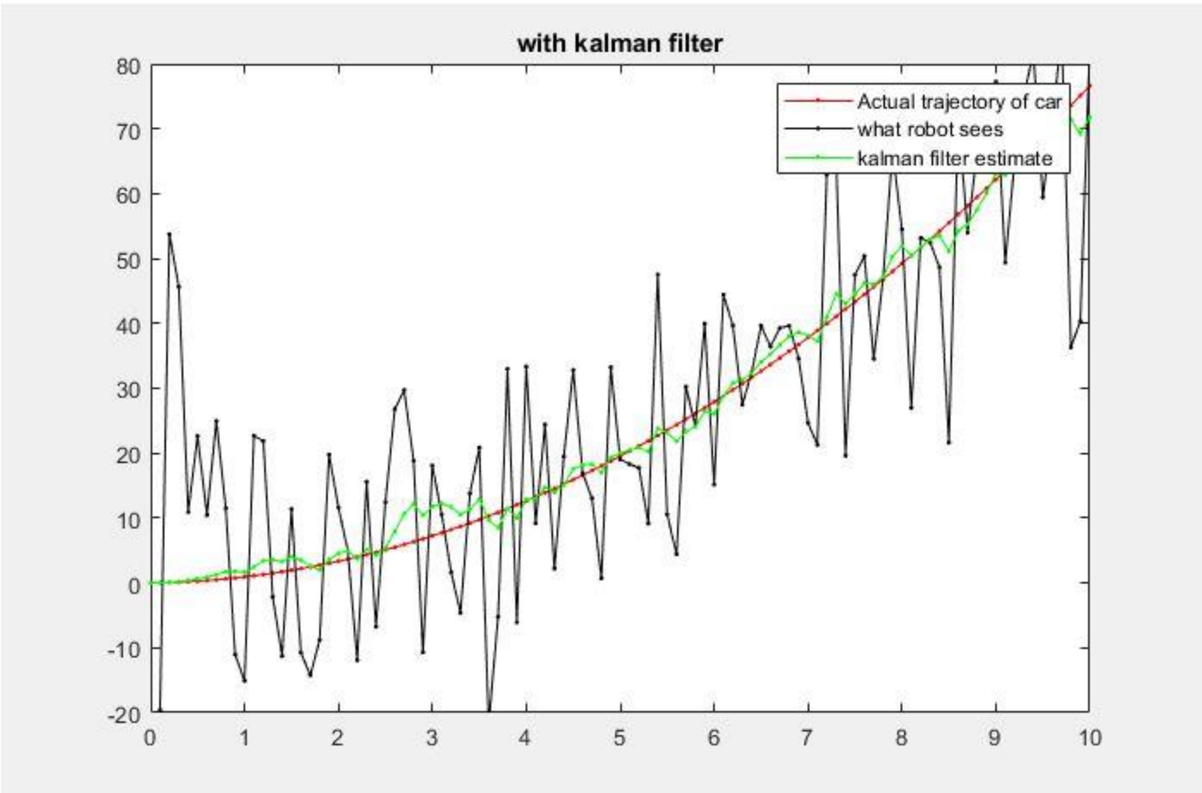
- **Without Kalman Filter ()**





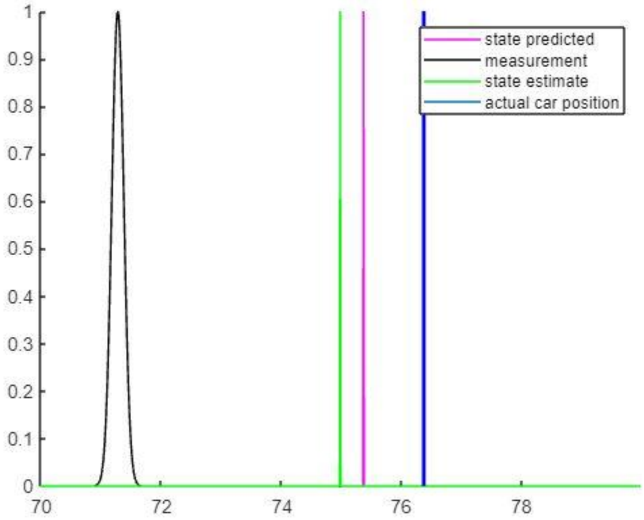
- **With Kalman Filter**



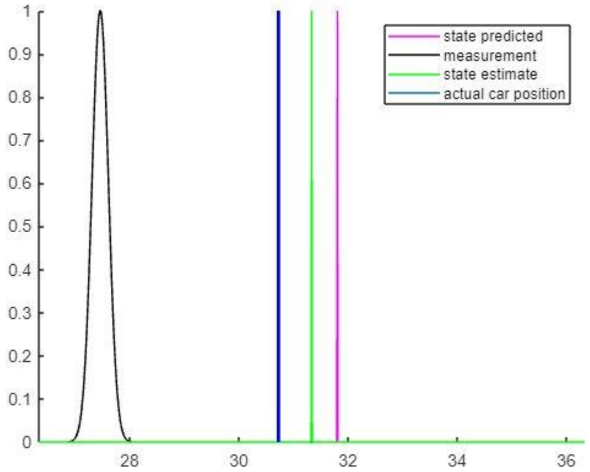


3) With changing values, it is observed that the estimated values by Kalman filter are closer than the measured values from actual values. That is, irrespective of the measured values being farther due to increasing noise levels as illustrated below. This could be observed via the combined results graph and changing car acceleration noise and robot noise:

- **Car noise acceleration 0.05** **Robot noise 0.1**



- **Car noise acceleration 0.1** **Robot noise 0.15**



- **Car noise acceleration 0.15** **Robot noise 0.2**