Solution to analysis in Home Assignment 2

Arshad Nowsath(nowsath)

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Contents

1 Analysis

In this report I will present my independent analysis of the questions related to home assignment 1. I have discussed the solution with Varun G Hegde Oskar Begic Johansson but I swear that the analysis written here are my own.

2 Scenario 1 - A first Kalman filter and its properties

2.1 Task (a)

The state sequence and measurement sequence are generated from the above model. The plot is shown below:

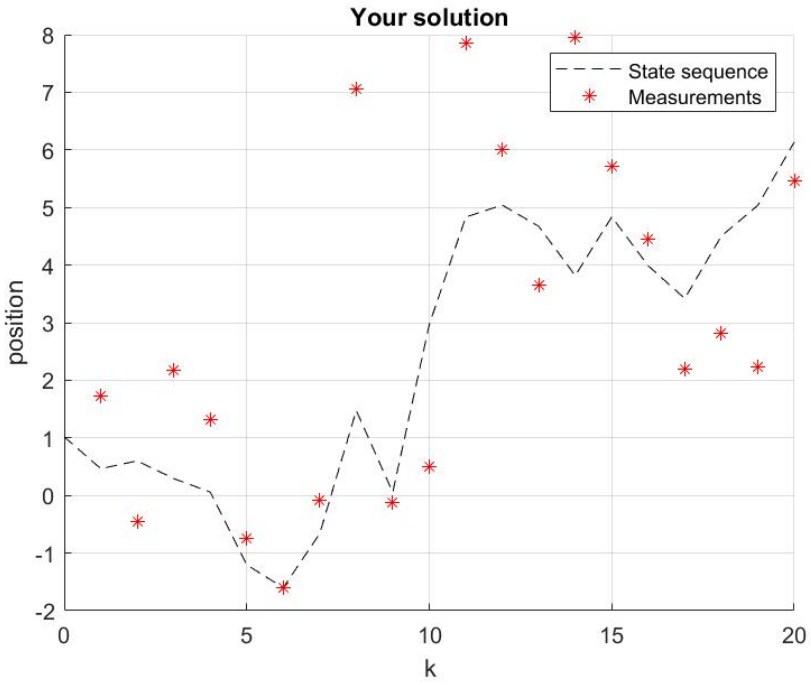

Figure 1: plot of State seq and Measurement seq for N=20

In my point of view, the measurement model scatter around the state sequence but not accurately match with model.

2.2 Task (b)

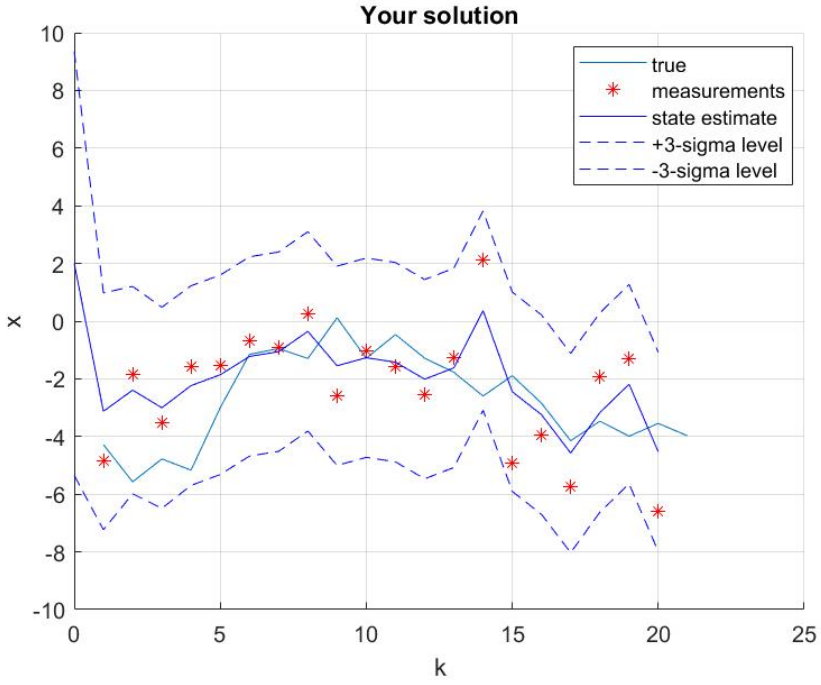

Figure 2: Plot of sequence of estimates with state and Measurement

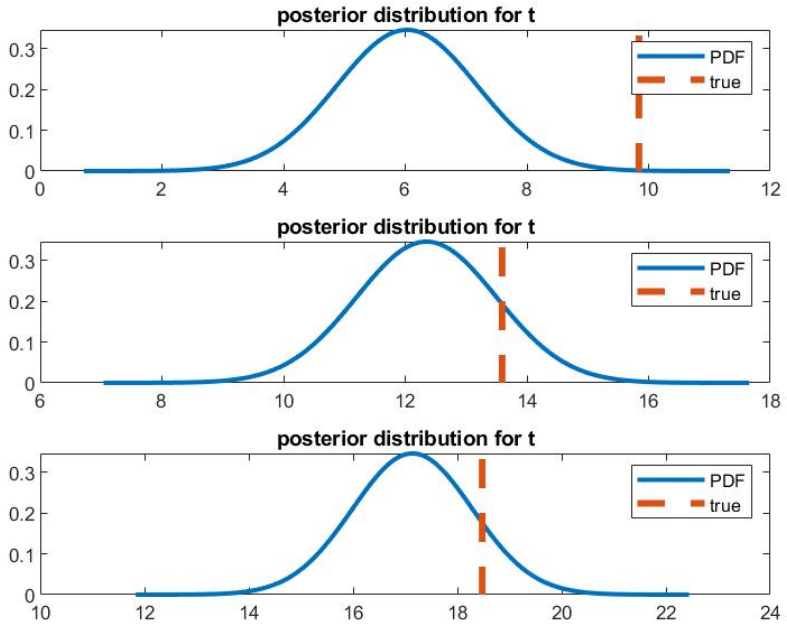

Figure 3: plot of posterior density with true state

yeah, the estimates that the filter output reasonable because it almost lie between the state and measurement. The observation that i made was the 3sigma levels are resemble state estimate with +-3 and as-usual measurement values are scatter around true value.

2.3 Task (c)

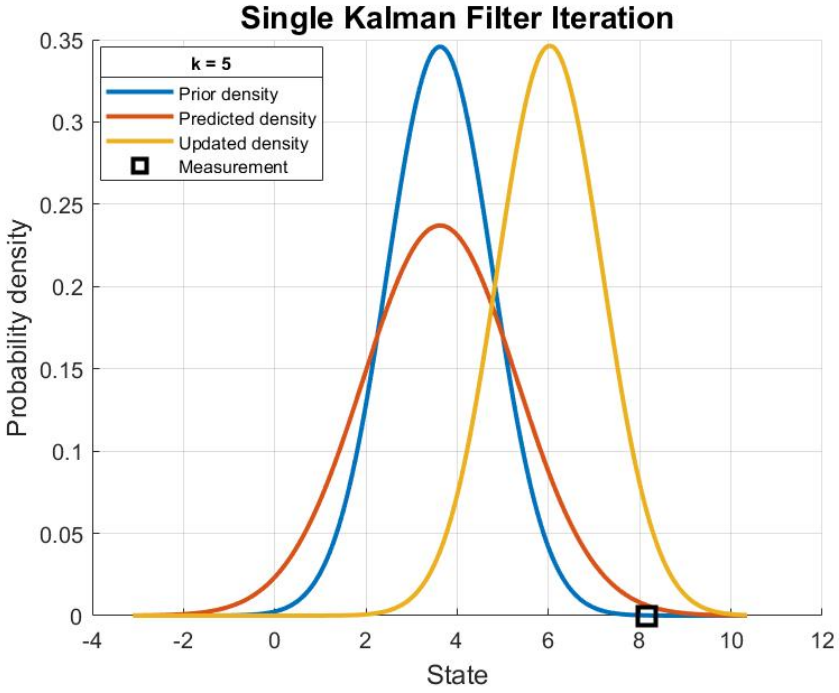

Figure 4: plot of Kalman filter iteration

The predict phase uses the state estimate from the previous timestep to produce an estimate of the state at the current timestep. This predicted state estimate is also known as the a priori state estimate because, although it is an estimate of the state at the current timestep, it does not include observation information from the current timestep. In the update phase, the current a priori prediction is combined with current observation information to refine the state estimate. This improved estimate is termed the a posteriori state estimate.
source:Kalman filter

2.4 Task (d)

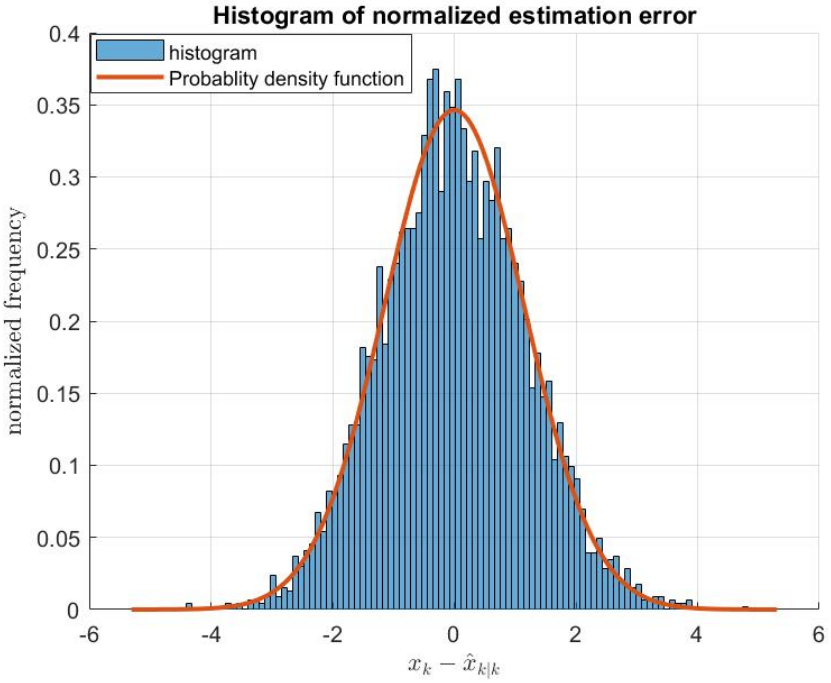

Figure 5: plot of Histogram of normalized estimation error

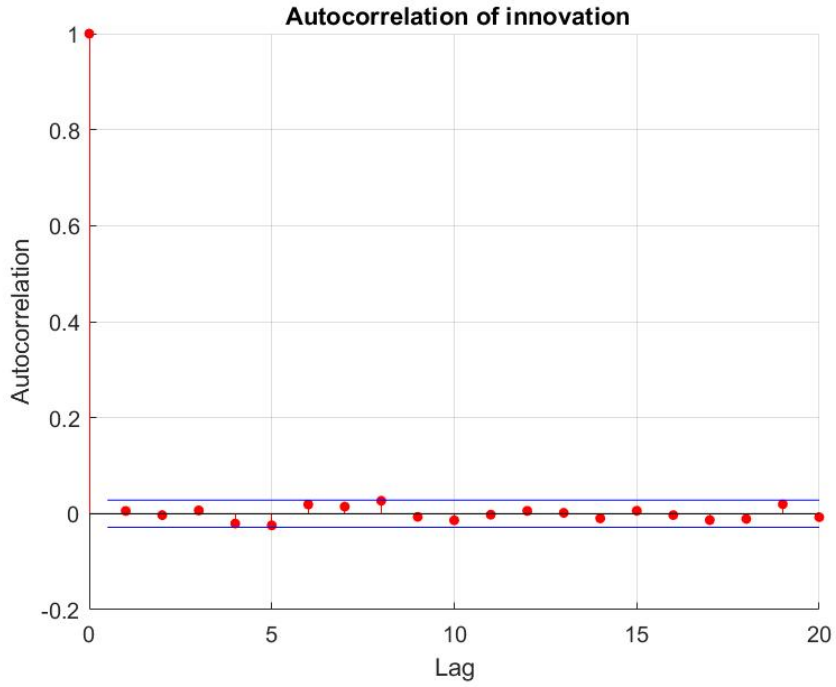

Figure 6: plot of Auto correlation of innovation

The histogram results in a perfect match with probability density function. There's no hard and fast rule here. If we know the density of our population, then a PDF is better. On the other hand, often we deal with samples and a histogram might convey some information that an estimated density covers up.

2.5 Task (f)

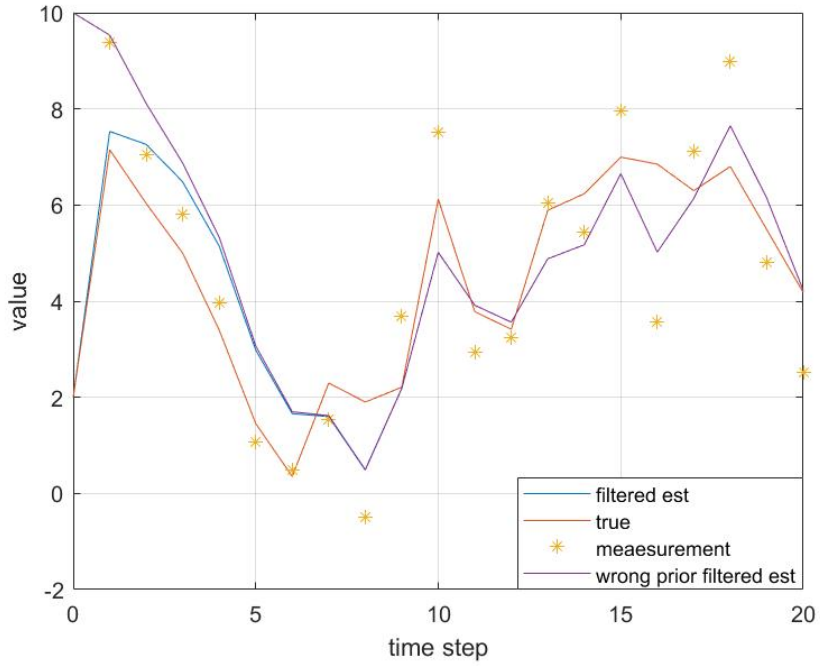

Figure 7: plot of new sequence of estimates

yeah first I run the filter with mean 0 and later for wrong assumption mean is 10 and of course filter didn't work well. After some time it tries to cope up with the true and measurement value and try to correct itself.

3 Scenario 2 Kalman filter and its tuning

3.1 Task (a)

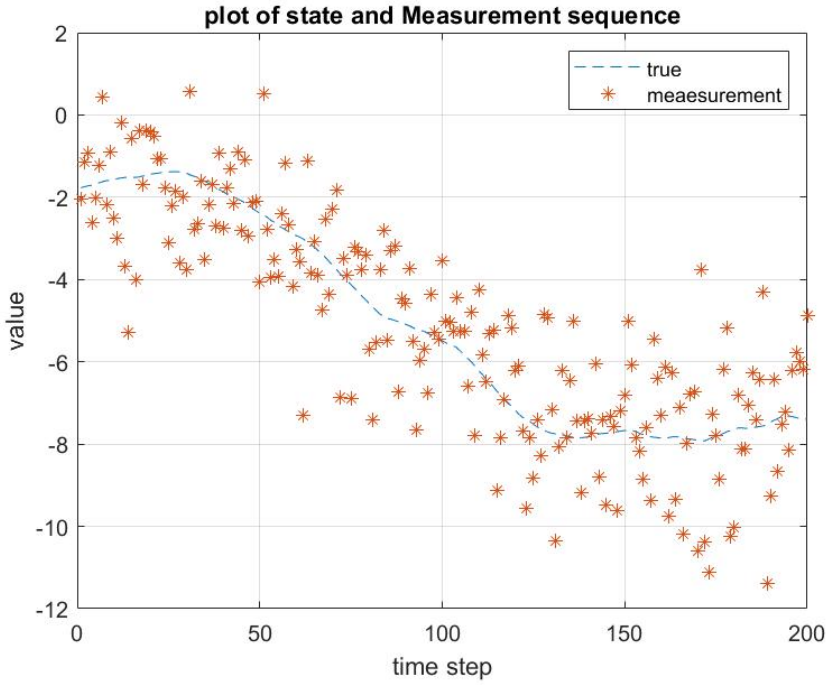

Figure 8: plot of State seq and Measurement seq for N=200

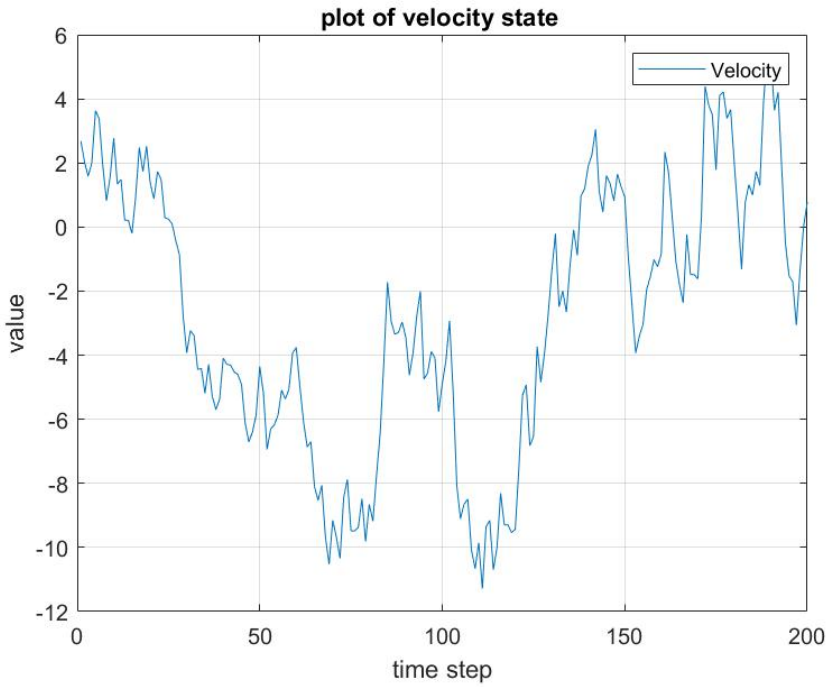

Figure 9: plot of velocity state

The result look reasonable and asusual measurement model scatter around the true value and makes some error.

3.2 Task (b)

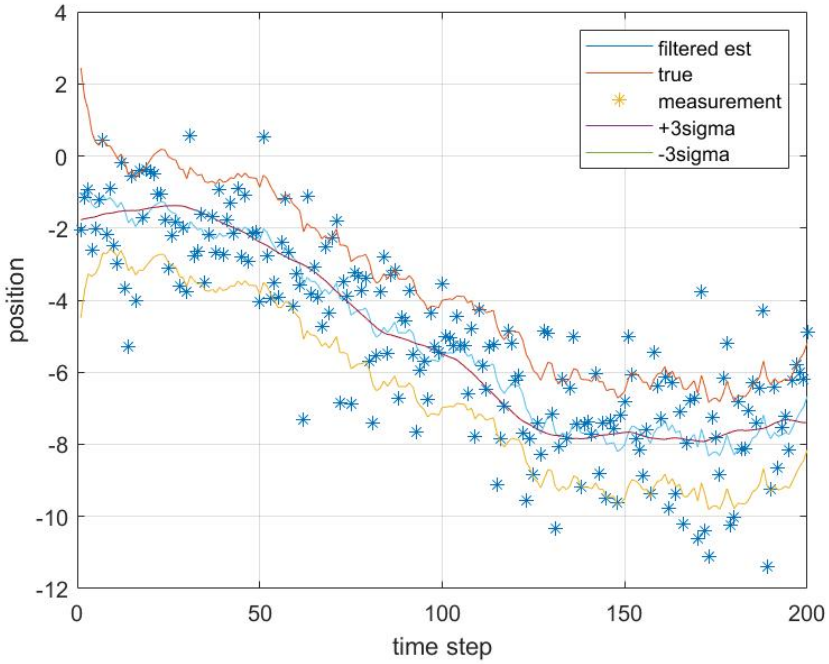

Figure 10: plot of position of estimate sequence with state and measurement

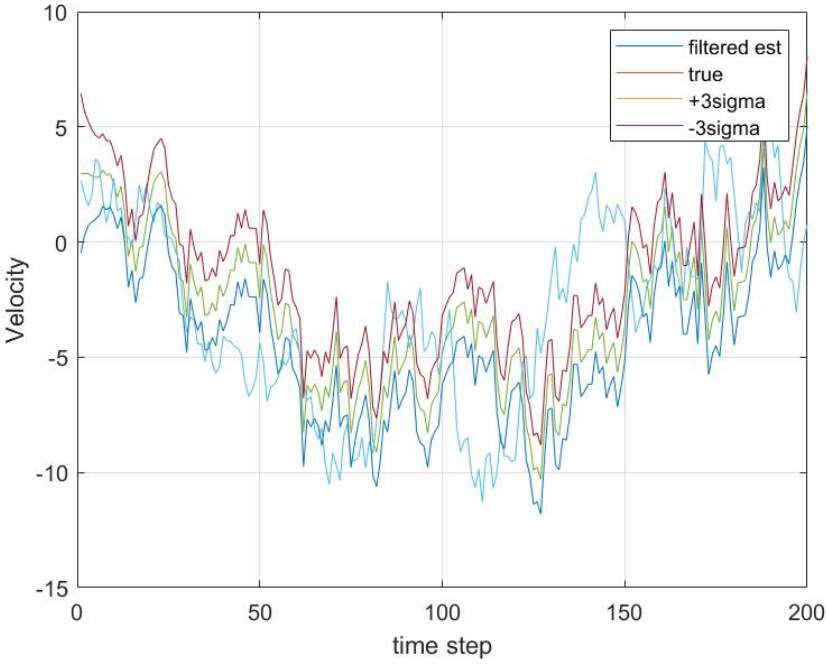

Figure 11: plot of velocity of estimate sequence with state and measurement

The filter behaves well and gives precise value with state estimate but measurement value scatter make some error . The observation that i made was the 3sigma levels are resemble state estimate with +-3 and as-usual measurement values are scatter around true value.

3.3 Task (c)

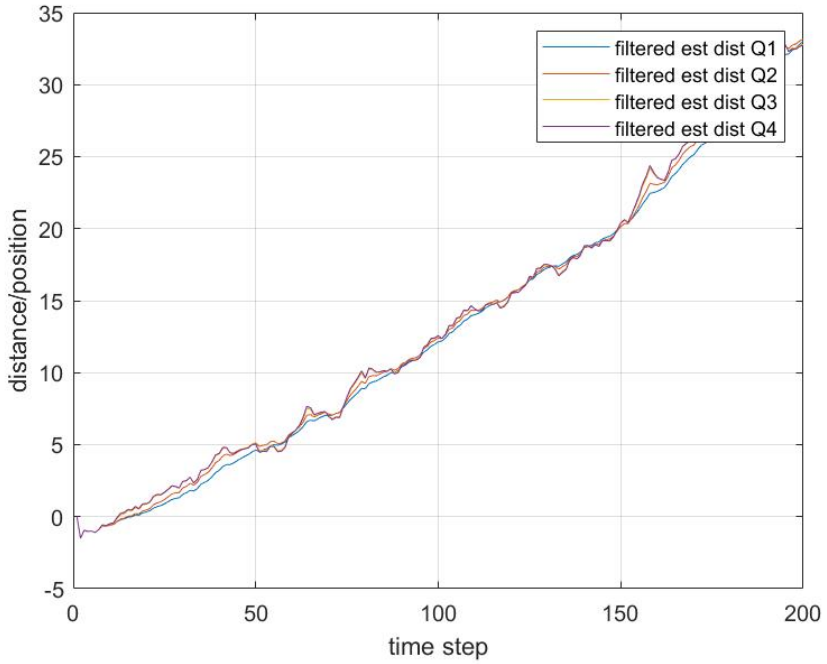

Figure 12: plot of position of state sequence for different motion noise

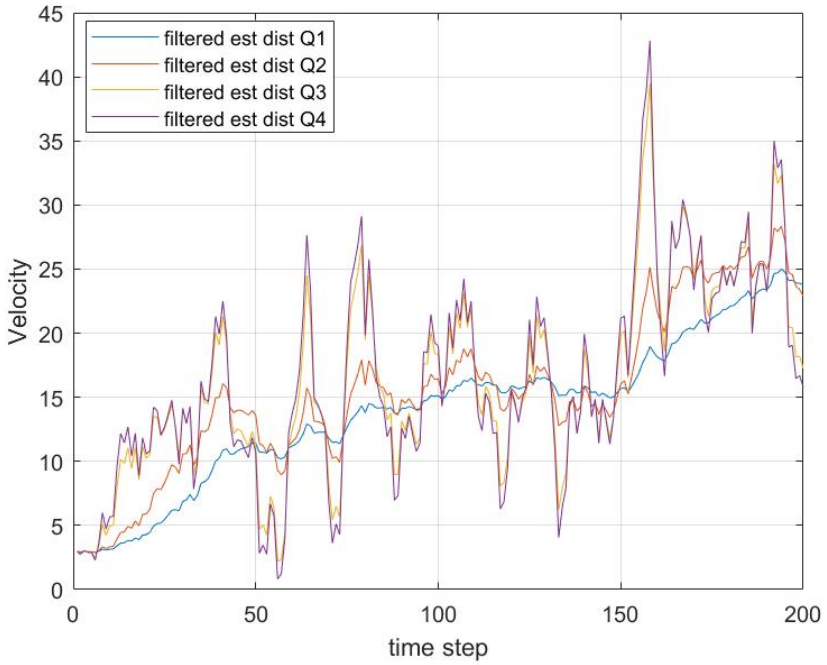

Figure 13: plot of velocity of state sequence for different motion noise

The plot for various motion noise variance by tuning the kalman filter. The choice of motion noise variance Q and measurement noise R can affect the performance of the kalman filter. when tuning it doesn't make much change in position but in velocity for more motion noise variance it oscillates and doesn't make accurate with state values.