KALMAN FILTER
Working

1)

For estimating the attitude angle of the satellite, we will be using Kalman Filter.

The assumption are as follows,

$E[u]=0; E[u^2]=0.1$

$E[w]=0; E[w^2]=0.001$

$E[v]=0; E[v^2]=0.1$, where u,v,w are assumed to be **Gaussian noise.**

And **the discrete state space model** is as follows,

```
Phi=[1 T;
     0 1];

Gamma=[(T^2)/2;
        T];
Gamma1=[0.00;
        0.01];
H=[1 0];
```

The Gaussian noise are added and the kalman filter is developed. The results are as follows,

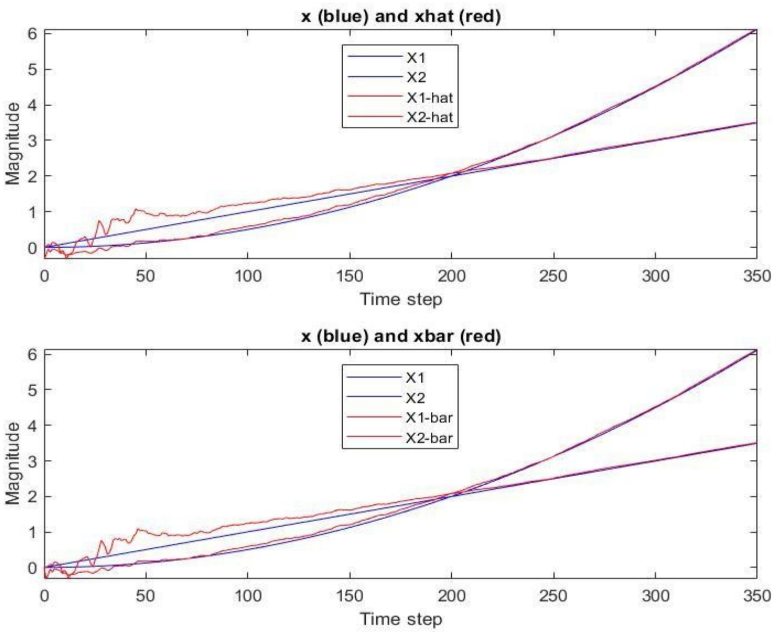


Fig1. Response of Kalman Filter for Step input, with Gaussian noise on V and W

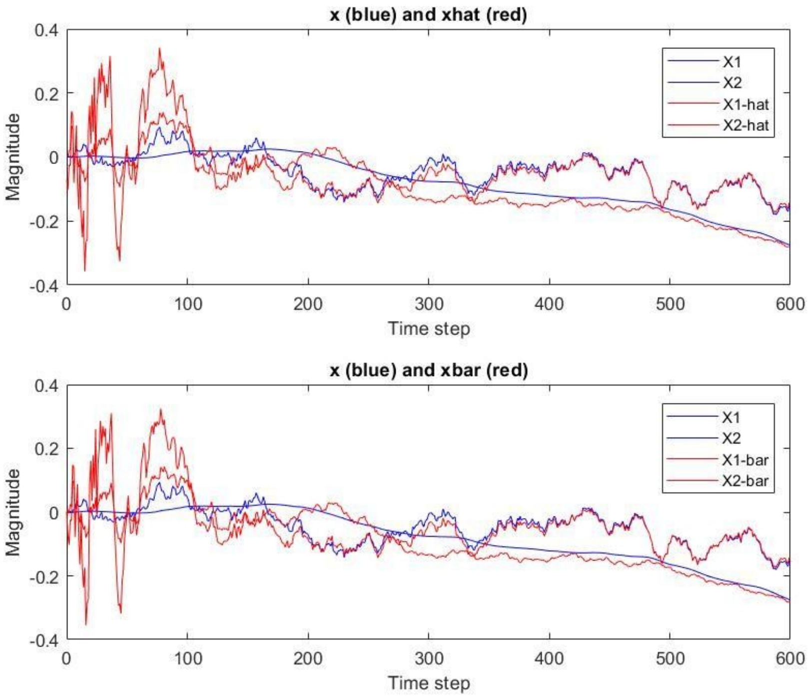
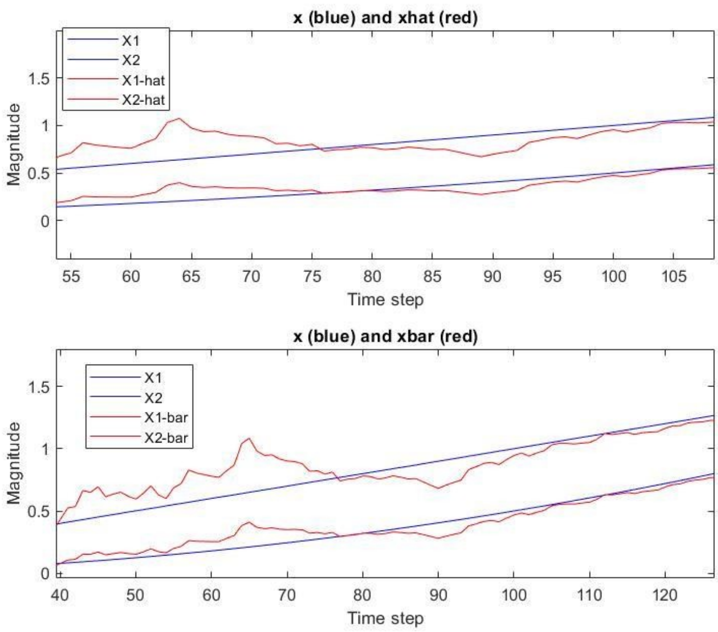


Fig1. Response of Kalman Filter with Gaussian noise on V, W and U

From the above graph, it can be seen that, **both the state and current estimator are tracking the states significantly**. Both the state are **tracked properly after approximately after 200s**. But both state are **significantly tracked after approximately 80s**.



If we **look closer at the graph**, it can be inferred that **the current estimator is better** in tracking the state **than the prediction estimator**.

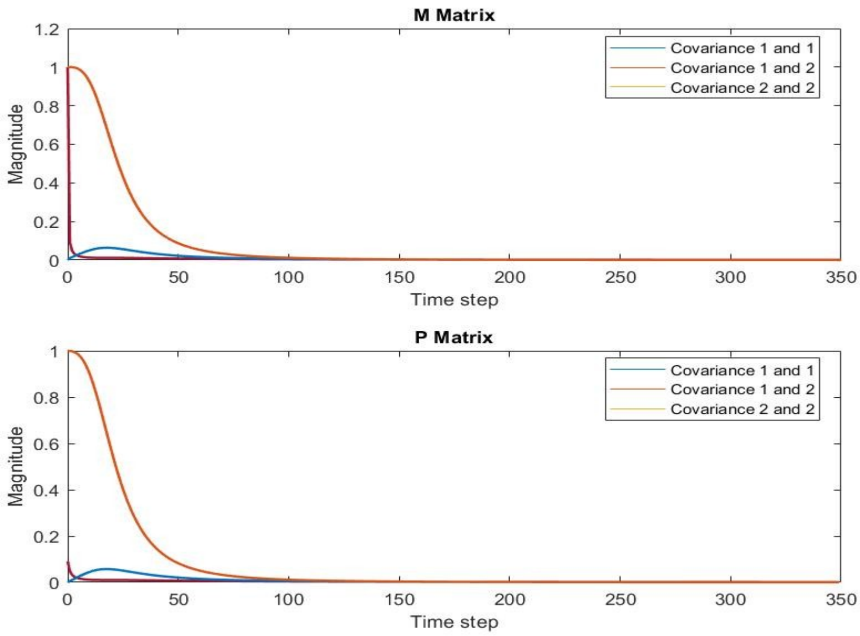


Fig3 For step input

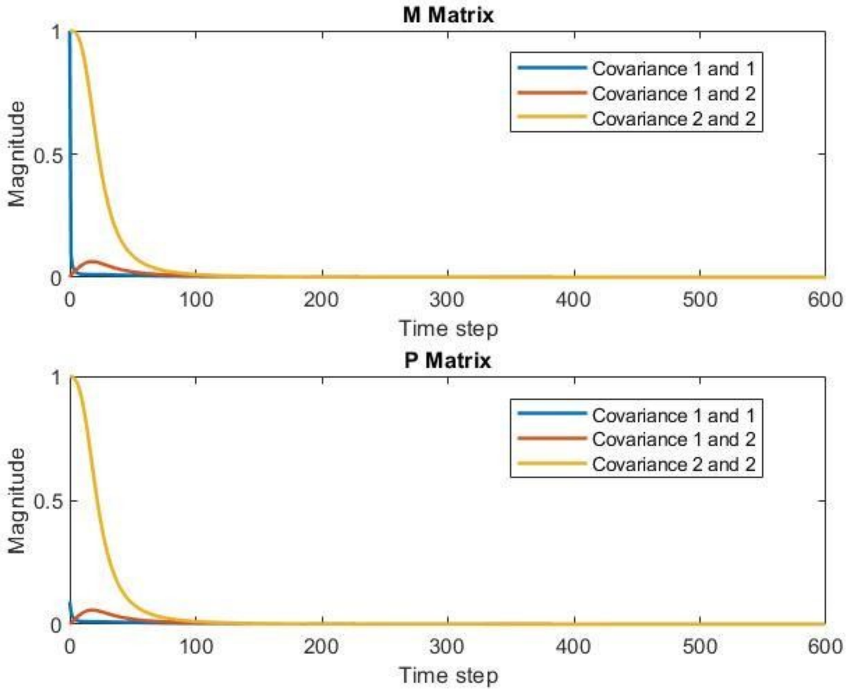


Fig3 For Gaussian input

The above graphs shows the covariance of the state variables and how they reduces when the kalman filter starts to track those state variable (attitude angle and rate of change of attitude angle) Just like earlier, the covariance are much reduced after 80sec. Thus, we can say, both the filter are good on tracking after approximately 80-100 seconds.