CSE 5524 – Homework #7
10/14/2013
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1). Using the data (kfdata.txt) provided on the WWW site, run the discrete Kalman filter to estimate the mean of the 1-D data (as in the class notes), and report the final estimated state mean (the estimated value of the constant value) and variance of the model (x, P). Plot the temporal traces of input data and the filtered output, along with a +/- 1 standard deviation "errorbar" (derived from P) on the filtered output. Use the following values for your algorithm, and then compare with different noise values for Q and R.

- Checked for larger and smaller values of both Q and R
- Table 1 shows a comparison between these values
- For Q=0.001/100 and R=0.05, the state error is very low
- For Q=0.001*100 and R=0.05, the error was pretty high
- For large value of R (100 times), final error value was the largest of all. Also from figure 3, we can see that the filter output has a slow response
- For small value of R (/100), final error value was small. Also from figure 4, we can see the filter output has a very quick response. The error in this case was the least among all the cases
- From the table, it can be seen that state error was very low compared to all the other cases when either Q or R was divided by 100 (for smaller values of Q or R)

Q	R	Filtered Output	Variance
0.001	0.05	-0.492736	0.006589
0.001	0.05*100	-0.506747	0.077860
0.001	**0.05/100**	**-0.421100**	**0.000366**
0.001*100	0.05	-0.421100	0.036603
0.001/100	0.05	-0.524279	0.000791

Table 1: Comparison of different Q and R values

<u>Output</u>

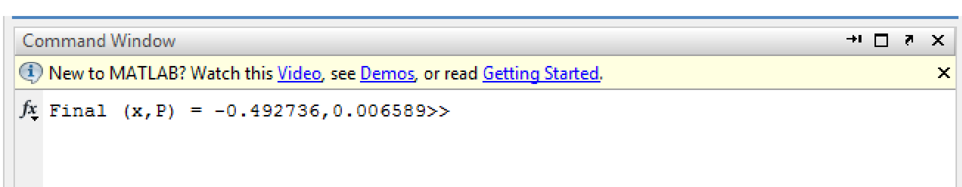

Figure 1: Final (x,P) for given Q=0.001, R=0.05

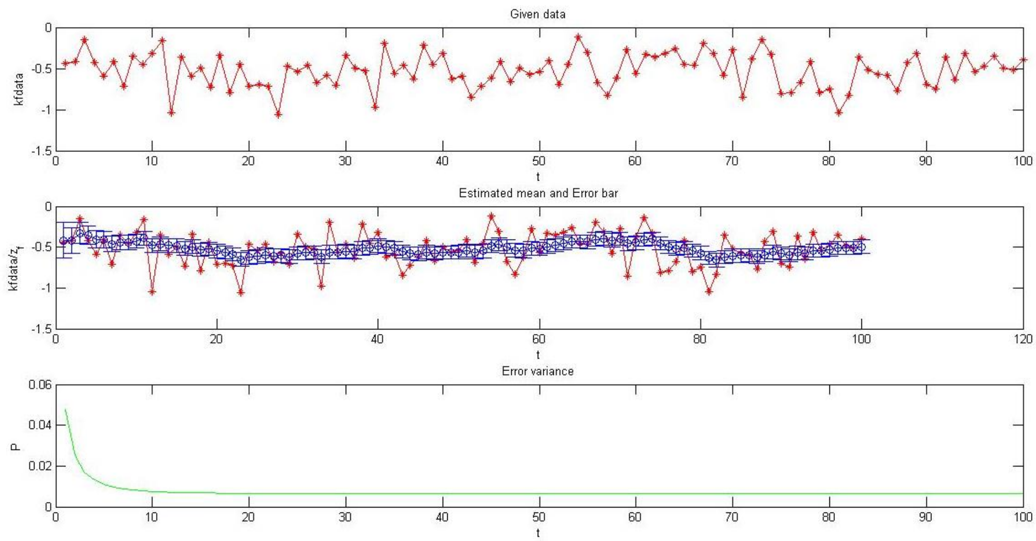

Figure 2: Temporal Plots Q=0.001, R =0.05

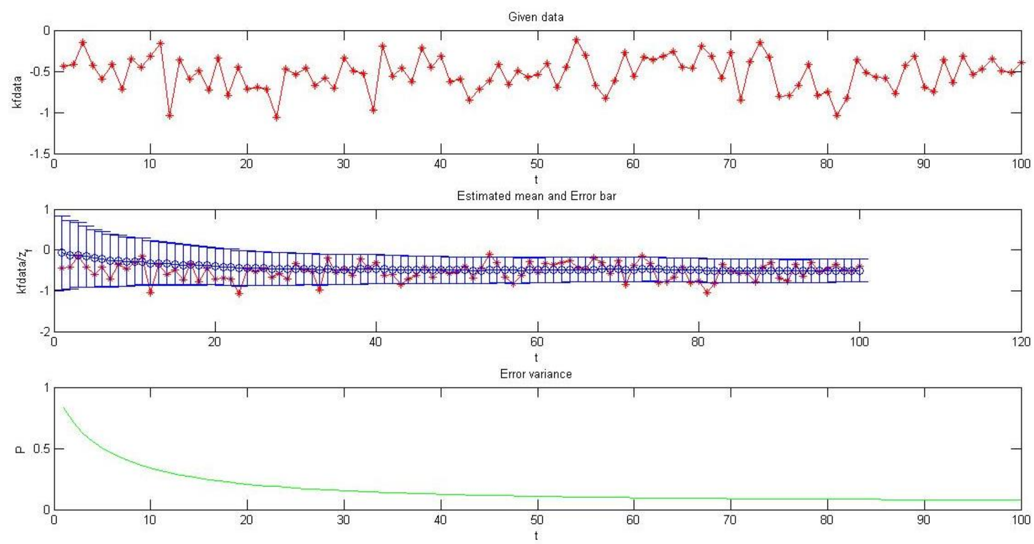

Figure 3: Temporal Plots Q=0.001, R =0.05*100

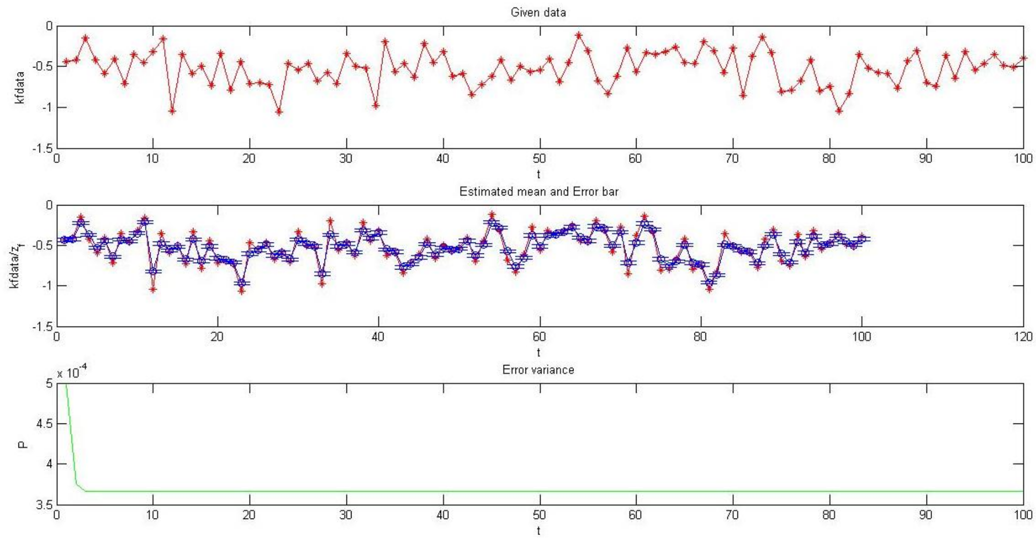

Figure 4: Temporal Plots Q=0.001, R =0.05/100

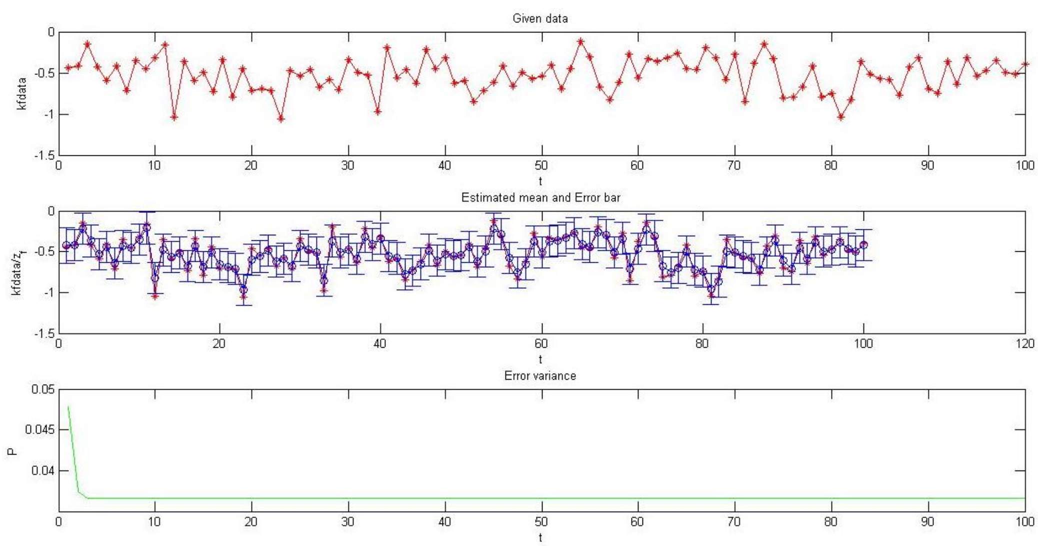

Figure 5: Temporal Plots Q=0.001*100, R =0.05

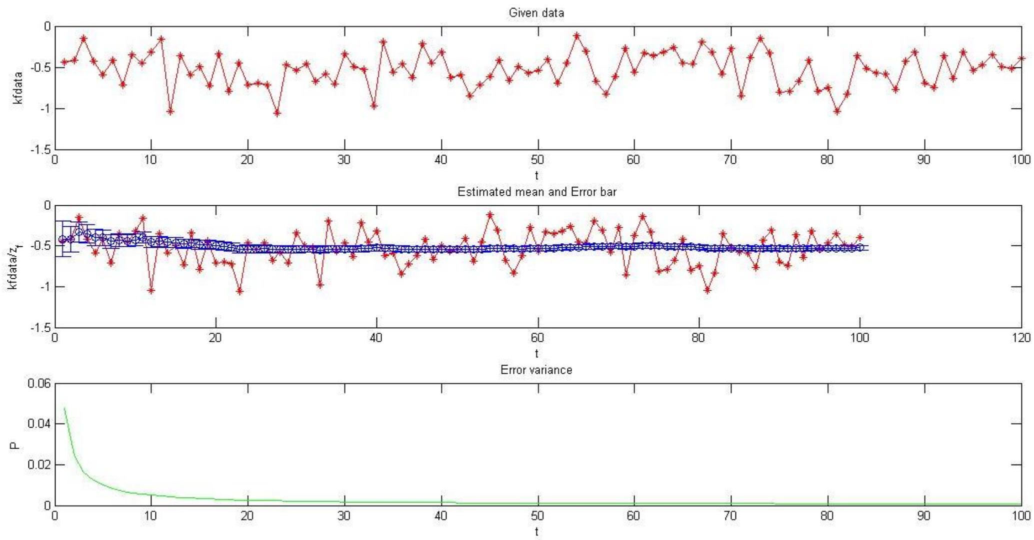

Figure 6: Temporal Plots Q=0.001/100, R =0.05

CODE

1). HW7.m

```
% Manjari Akella
% CSE5524 - HW7
% 10/14/2013

%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
% Question 1
clear all;
close all;
clc;
load 'kfdata.txt'
%% state equation
% state update
G = [1];
% Process noise variance
% Q = .001;
% Q = .001*100;
Q = .001/100;

%% observation equation
% transformation
H = [1];
% observation noise variance
R = .05;
% R = .05*100;
% R = .05/100;

%% initial guesses
x = 0; % initial state guess
P = [1]; % initial state error variance guess
```

```
% Estimate at t=1 without seeing observed value
x_(1,1) = G*x;
P_(1,1) = G*P*G' + Q;

for i=1:size(kfdata,1)
    K(i,1) = (P_(i,1)*H')*((H*P_(i,1)*H'+R)^-1);
    x(i,1) = x_(i,1) + (K(i,1)*(kfdata(i,1)-H*x_(i,1)));
    P(i,1) = (1-K(i,1))*P_(i,1);
    z_filtered(i,1) = H*x(i,1);
    % If i=100, no need to estimate next observation
    if(i~=size(kfdata,1))
        x_(i+1,1) = G*x(i,1);
        P_(i+1,1) = G*P(i,1)*G'+Q;
    end
end
figure;
subplot(311),plot(kfdata,'r');
title('Given data');
xlabel('t');
ylabel('kfdata');
hold on;
plot(1:size(kfdata,1),kfdata,'r*');
hold off;
subplot(312),plot(kfdata,'r');
title('Estimated mean and Error bar');
xlabel('t');
ylabel('kfdata/z_f');
hold on;
plot(1:size(kfdata,1),kfdata,'r*');
plot(1:size(z_filtered,1),z_filtered,'bo');
errorbar(z_filtered,sqrt(P),'b');
hold off;
subplot(313),plot(P,'g');
title('Error variance');
xlabel('t');
ylabel('P');

fprintf('Final (x,P) = %f,%f',z_filtered(100,1),P(100,1));
```