Suyog Daga
EMI-Assignment 2
UFID-57735749
Ph:352(284)-5342

1.1)

- For selecting the hyper parameters, we need to train data on training.mat. Also as per the hint given , I selected 5 values from the range 3 to 30 for filter order and took lambda as a set of following values**:**

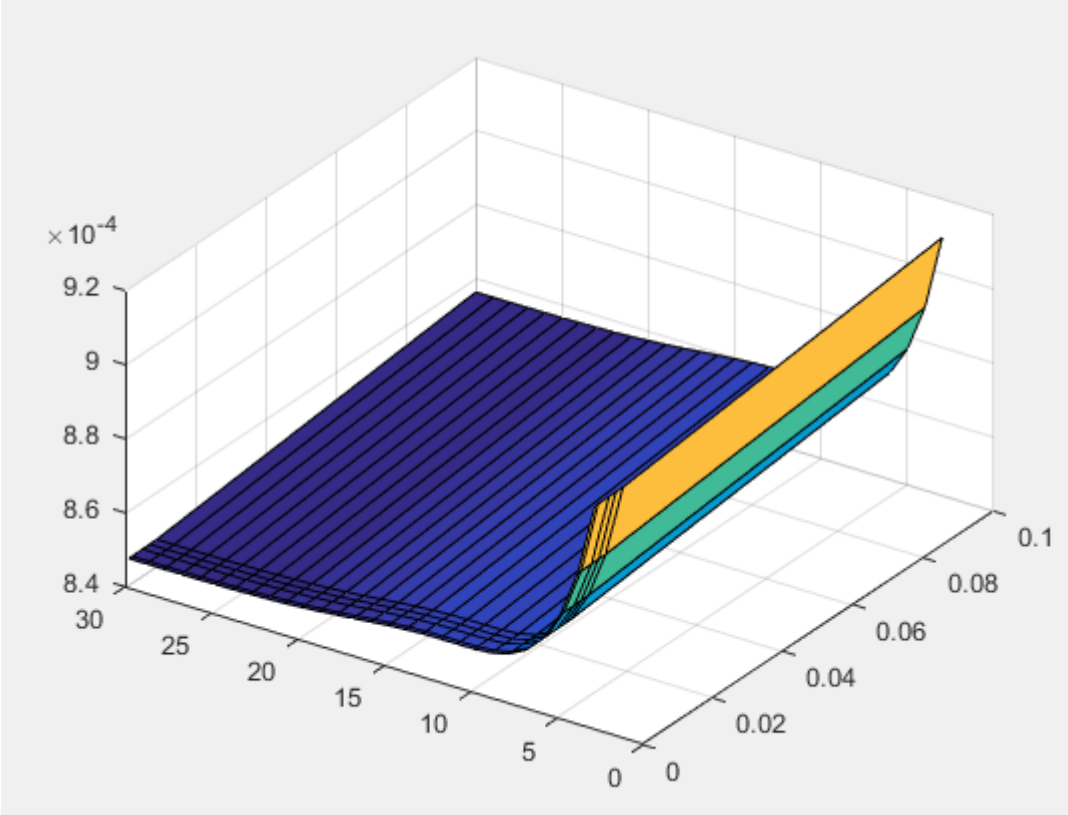
```
14 -    lambda = [0.01,0.05,0.1,0.5,1];
```

- Calculation of W* for m=3: 30 using training or validation data.
- W* was calculated as product of autocorrelation matrix and correlation matrix.
- Desired signal is train/validate (Y).
- Calculation of Y(hat) :

$$\hat{y}(n) = \sum_{k=0}^{M-1} w(k)x(n-k)$$

- Calculation of mean square error , using Y , Y(hat).

- With this idea , I approximately understood that value of m lies in range of 20:30 . Then plotting error (J) with respect to all values in range of 3:30 and all possible value of Lambda, we get following plot on validate set:

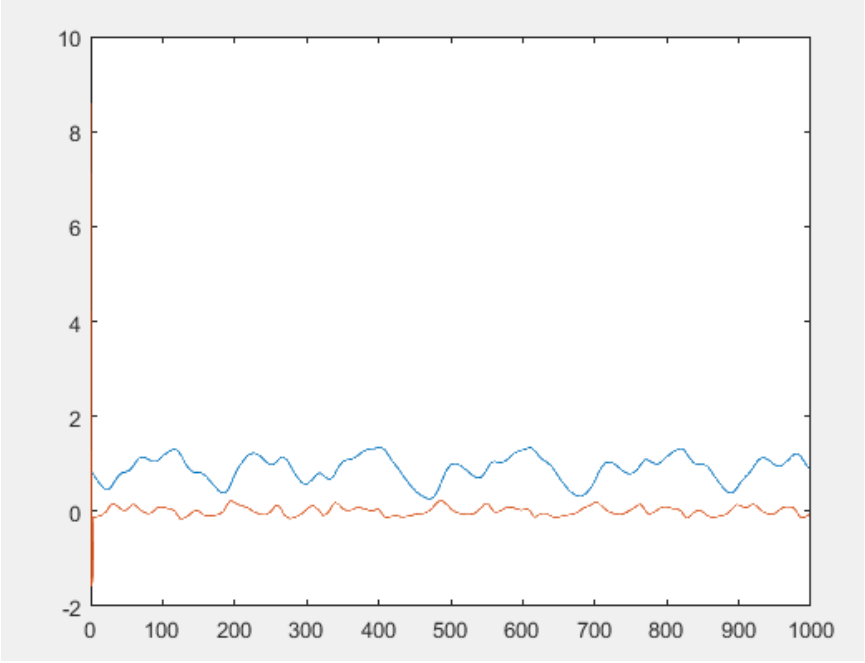


This shows that m=30 and lambda = 0.001 gives us a best mean square error. Also the same , was confirmed with training data, which also gave minimum value for error for m= 30 and lambda= 0.001

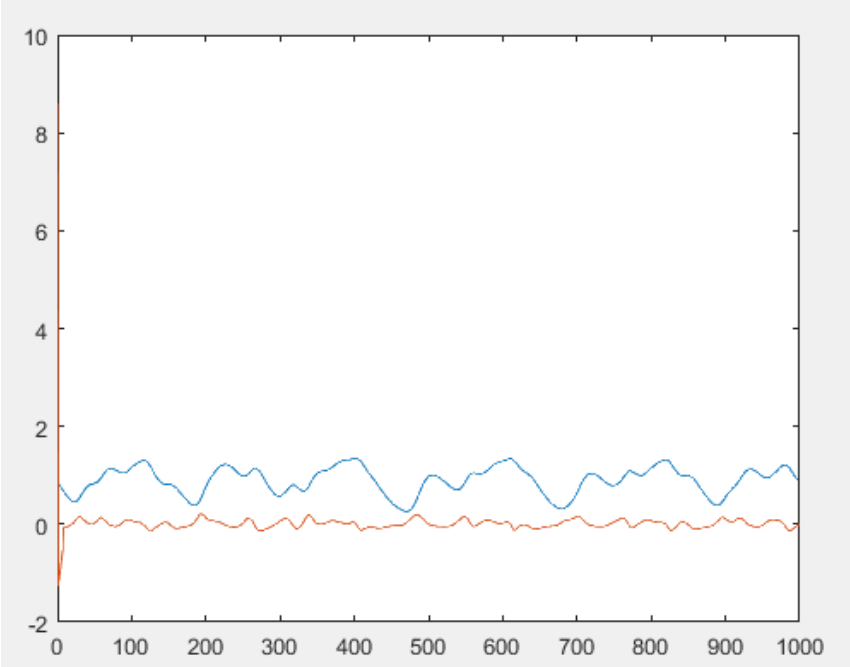
1.2) Plot of Test vs error over time.

- Blue line is the signal and orange line is error **(error is scaled 10 times that means error for plotting is 10 times the original error).**
- Following steps were used to deduce this:
- Calculation of W* for m=4,8 and 30 using training /validation data.
- Then respective X matrix's were calculated from test.mat
- Desired signal is test (Y).
- Calculation of Y(hat) = which is X * W obtained from 1 and 2 respectively for filter order 4,8 and 30.
- Calculation of mean square error , using Y , Y(hat).

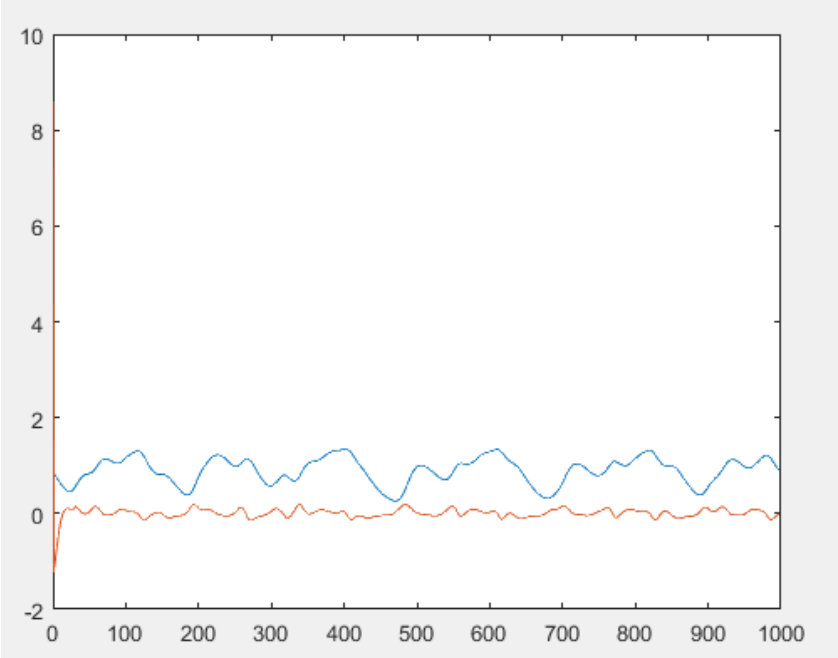
- For m=4, and lambda = 0.001



For m=8 , and lambda = 0.001



For m= 30 and lambda = 0.001



This plots approximately looks the same, as the value of error is extremely small . Difference between error at m=4, 8 and m= 30 is very small. We are trying to fit a sinusoidal type wave, in an linear regression, that is the reason I think error is not constant across time.
Though regular sinusoidal wave can be well approximated by linear regression, the test signal is not regular.

1.3) Quantifying results on testnoisy.mat:

- Following were the steps followed :
  1) Calculation of W* for m=4,8 and 30 using training or validation data. We will use the values of W obtained from them for prediction.
  2) Then respective X matrix's were calculated from testnoisy.mat
  3) Desired signal is test (Y).
  4) Calculation of Y(hat) = which is X * W obtained from 1 and 2 respectively for filter order 4,8 and 30.
  5) Calculation of mean square error , using Y , Y(hat).
- After following the above procedure we get following values, min square error values for error for m= 4, 8 and 30 and lambda = 0.001,

As we see, value for Err3 or when m= 30 and lambda = 0.001 is minimum, we can say that filter order 30 works better for noisy data.

References :

1) Discussion with friends – Kunal Bajaj, Ruturaj Zadbuke, Devyash Sanghai ,Ning Wei, Mayank Kulkarni, Atharva.
2) Hw2 help documents.

Note :

1) No code file has been attached as per request. Code for the questions have been programmed by myself completely.