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EXPERIMENT 5. OPTIMUM FILTERING: FIR WIENER FILTER IMPLEMENTATION FOR NOISE REMOVAL

PART 1

LABORATORY REPORT

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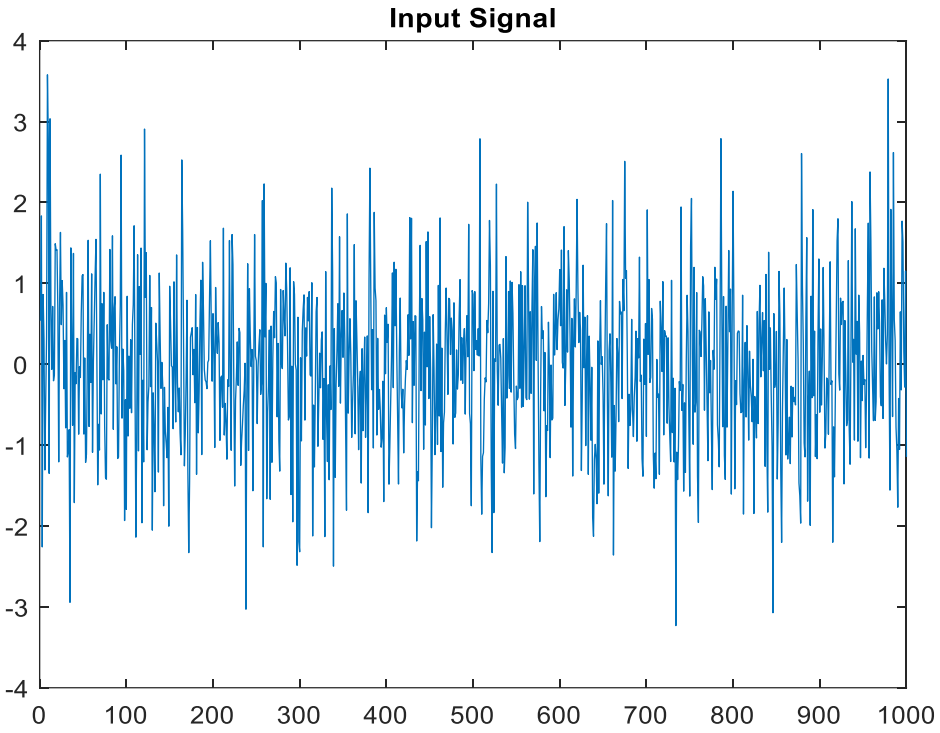
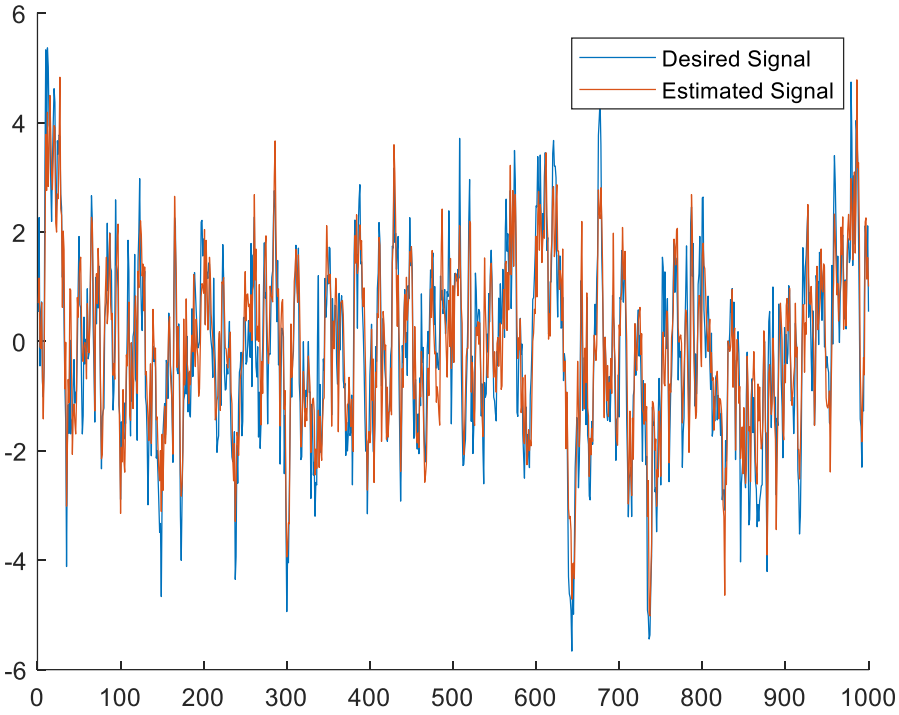
Write ‘rng default;’ in the beginning of your code so that the random number generation settings will be the same for all of us. Attach your final MATLAB code below.

Task

1) Choose N=1000, P = 10, a = 0.8 and noise standard deviation 1.
Plot input, output and desired signals on the same figure and attach it below.
Write the MSE and LSE values you obtained.





MSE: 0.578050594036740
LSE: 0.622527842094210

2) Compute LSE with Parks Mcclellan Filter (use firpm command):

Desired Response of the filter:

Normalized Frequency (0-1 corresponds to 0-fs/2)	*Desired Amplitude*
0	1
0.4	1
0.8	0
1	0

Filter Order: 30
Compare the results of 1) and 2).

With the Parks Mcclellan Filter, we obtained the LSE= 6.162226488245635. This result is significantly higher than the Wiener filter's LSE value as expected because the Wiener obtains coefficients by using the input statistics. Considering the first 10 elements in our case. Since the rest of the input signal has the same probabilistic characteristics, the wiener coefficients filters the noise in the best way. Weiner obtains coefficients specifically depending on the input signal.

3) **Choose P_{step} = 2. Write the MSE and LSE values you obtained. What happens as you increase P_{step}?**

MSE: 1.397677264994337
LSE: 0.749945152397084

As we increase the Pstep, the error increases. Because prediction accuracy falls as we try to predict further indexes and coefficients depending on them, therefore MSE increases.

In a more mathematical way, used Rx values are the same however now shifted rdx values are used while constructing the filter during Rx*h=rdx. rdx values decreases in index and the filter coefficients decreases as well. Therefore, the filter diverges from the 'best' possible characteristics.