Signal and System
MATLAB Homework #2

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1 Problem 1

(a) **Plot $x[n]$.**

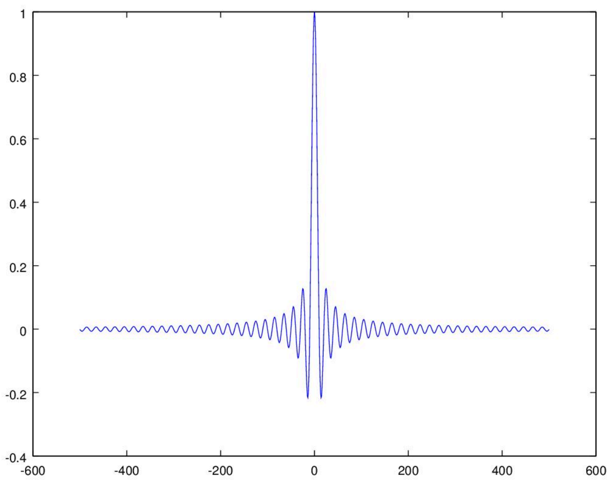


Figure 1: Plot of $x[n]$.

(b) **Plot the magnitude response of the DFT of x during $[-N_1, N_1]$. The zero frequency should be centered in your plot. Observe the Gibbs phenomenon here.**

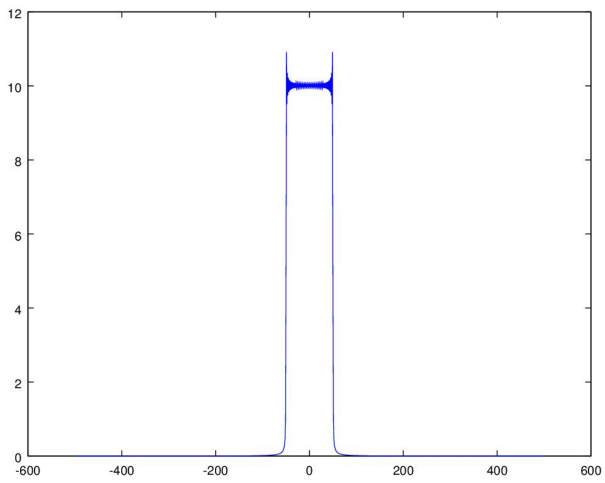
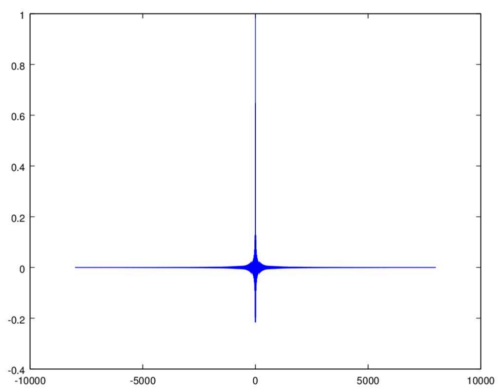
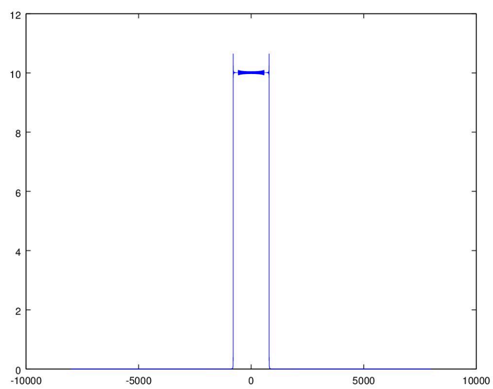


Figure 2: Plot of the magnitude response.

(c) **We define the overlapping factor K so that $n \in \{-KN_1, -KN_1+1, \cdots, 0, \cdots, KN_1-1, KN_1\}$. Please repeat part (a) and (b) with $K = 16$ and fixed T_s, then compare the Gibbs phenomenon in (b).**



(a) Plot of $x[n]$.



(b) Plot of the magnitude response.

The distortion width is smaller, but the maximum height (i.e the maximum error) remain the same.

2 Problem 2

(a) **Plot $x[n]$ when $n \in \mathcal{N}$.**

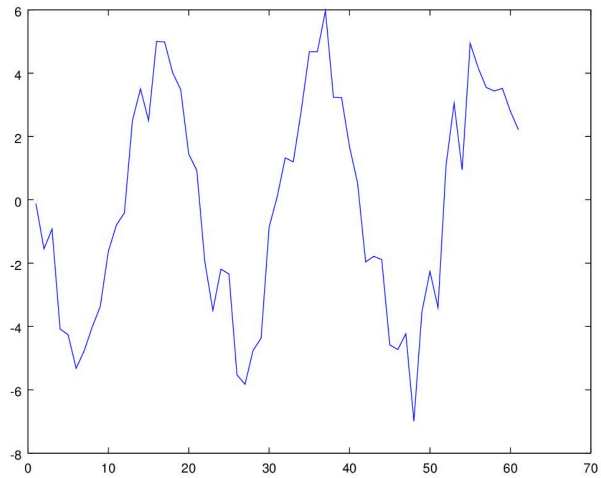


Figure 4: Plot of $x[n]$.

(b) **Now let $b = 0.2$ and $N = 3$. Assuming that at $n = 0$ and we initialize the EWMA filter with $x[-1] = \cdots = x[-N] = 0$, plot the output of the filter for $n \in \mathcal{N}$.**

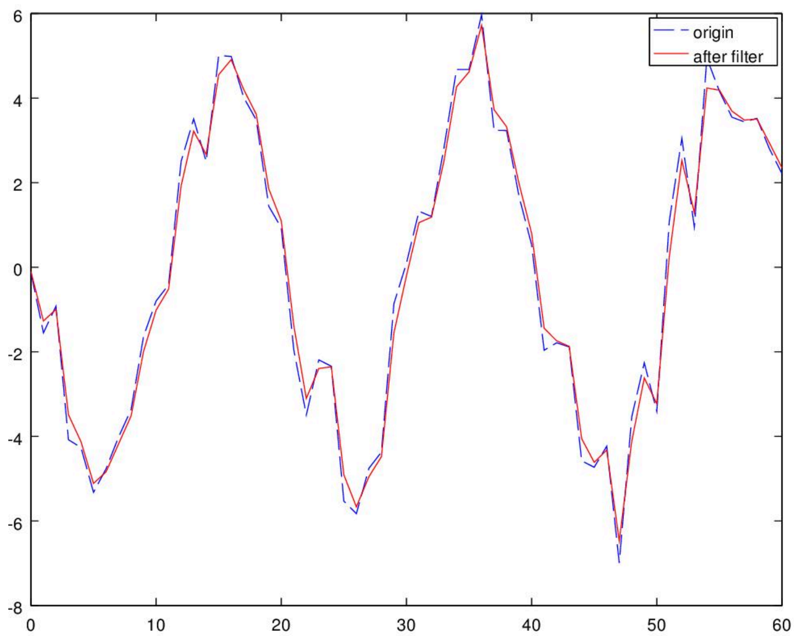


Figure 5: Plot of the output after filter.

(c) **Repeat part (b) with $b = 0.2$ and $N = 10$.**

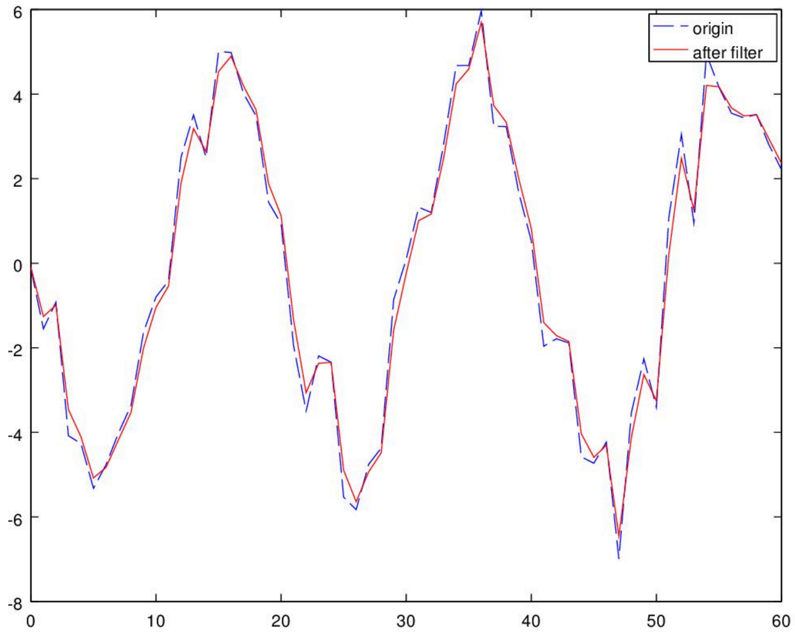


Figure 6: Plot of the output after filter.

(d) **Comment on the relationship between the filter outputs in parts (b) and (c) with the original signal $s[n]$.**

After the filter, the signal looks slightly smoother, but is still similar to the origin input, since the decay rate b is small (so it decay fast!).

Also because the decay rate b is too small, $N = 3$ and $N = 10$ gives almost the same result.

(e) **Please repeat parts (b), and (d) with $b = 0.5$ and $N = 3$.**

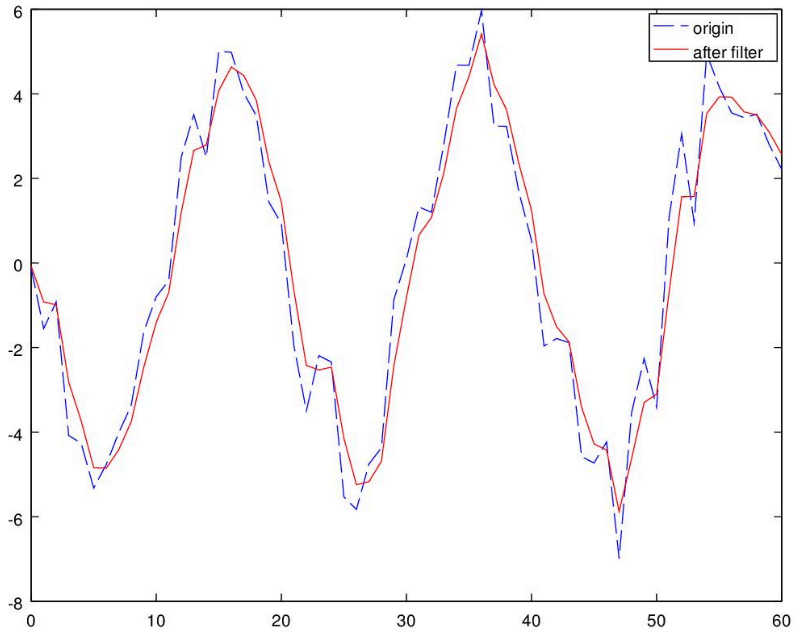


Figure 7: Plot of the output after filter.

The output is much smoother and closer to the signal without the noise compare to the input.

(f) **What is the effect of increasing b? What about increasing N?**

Increasing b tends to make the output smoother.
Increasing N at small N could also let the output become smoother, provided that b is not too small.