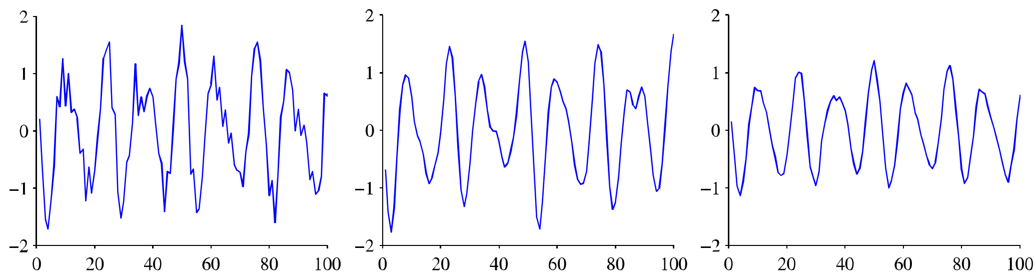
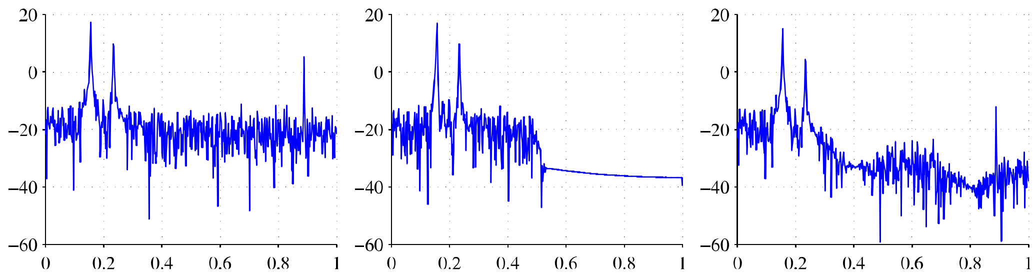


(a) Original signal (b) FIR lowpass filtered (c) Moving average filtered

Figure 15.9: Signals in time domain



(a) Originalsignal (b) FIR lowpass filtered (c) Moving average filtered

Figure 15.10: Signals in frequency domain

15.11 Filtering example

Here is an example of using different filters on signal Figure 15.9a. We can see that the signal is contaminated with noise, but we don't know if it is white noise or if it has a specific frequency.

We start the analysis by plotting the periodogram of the signal (Figure 15.10a). It reveals that there is high frequency noise at around 0.9 [3] and the interesting frequencies are well 0.4. This means we can use a lowpass filter with stopband at 0.4 to remove the noise.

[3] The unit is relative to $0.5 \cdot$ sampling rate, 0.9 becomes $0.9 \cdot 0.5 \cdot$ sample rate in actual units

Figures 15.9 and Figure 15.10 show the effect of using 100th order FIR hamming filter to the time domain signal and the PSD. Also the effect of 5 point moving average filter is shown for reference. The FIR filter is clearly the right choise for this signal, it preserves the time domain features nicely [4] and completely eliminates the high frequency noise. The moving average fails to remove the high frequency noise, but "cuts" the peaks from decreasing the amplitude.

[4] Beware of small phase shift for time critical applications

15.12 Modifying sample rate

The sampling rate of a digital signal can be changed computationally. There are two basic operations:

Decimation is used to lower to sample rate. The operation uses an antialising filter to make sure there aren t too high frequency components. signal.decimate in