Lab 3
Pre-processing of ECG Signals: Notes

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1. Order Selection of a FIR filter and Usage of fir1()

fir1 FIR filter design using the window method.

B = fir1(N,Wn) designs an N'th order lowpass FIR digital filter and returns the filter coefficients in length N+1 vector B.

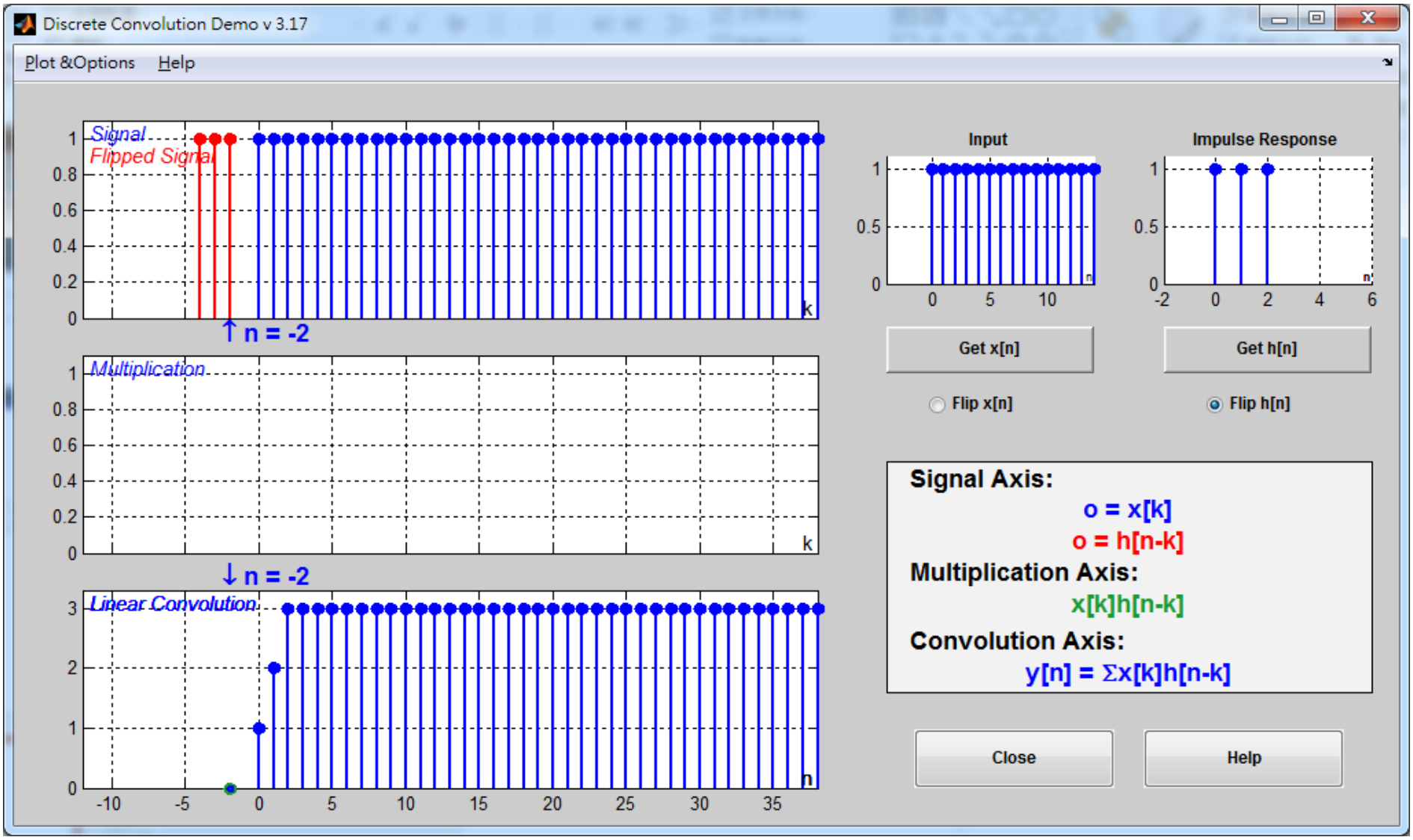
(impulse response)

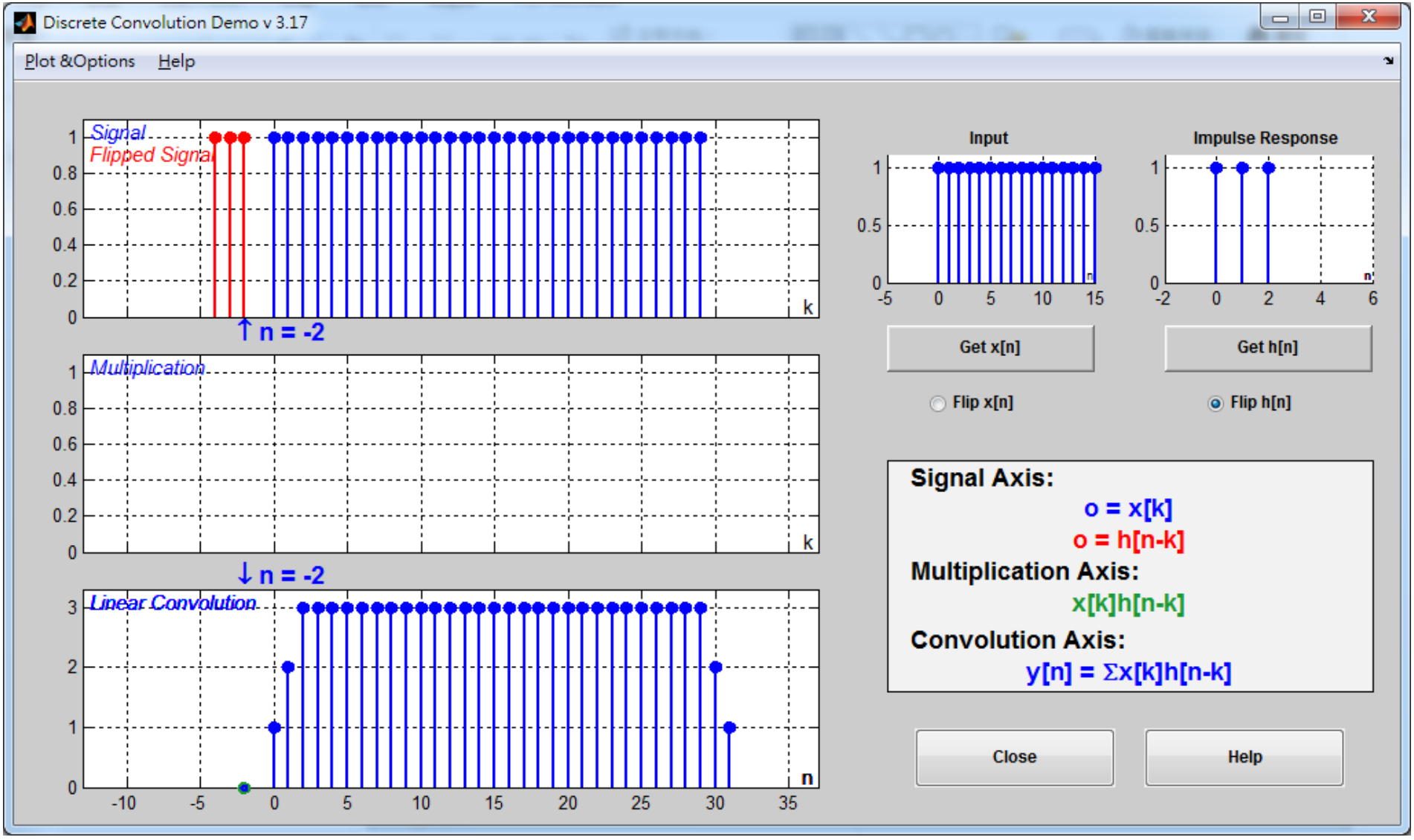
The cut-off frequency Wn must be between 0 < Wn < 1.0, with 1.0 corresponding to half the sample rate.

B = fir1(N,Wn,'high') designs an N'th order highpass filter.
You can also use B = fir1(N,Wn,'low') to design a lowpass filter.

Check frequency response via MATLAB freqz()
MATLAB filter()?

More about LTI FIR Systems, Convolution Sum, Transient Response and Steady State Response


Discrete Convolution Demo v 3.17
Plot &Options
Help
Signal
Flipped Signal
k
↑ n = -2
Multiplication
k
↓ n = -2
Linear Convolution
n
Input
Impulse Response
Get x[n]
Get h[n]
Flip x[n]
Flip h[n]
Signal Axis:
o = x[k]
o = h[n-k]
Multiplication Axis:
x[k]h[n-k]
Convolution Axis:
y[n] = Σx[k]h[n-k]
Close
Help


Discrete Convolution Demo v 3.17
Plot &Options
Help
Signal
Flipped Signal
n = -2
Multiplication
n = -2
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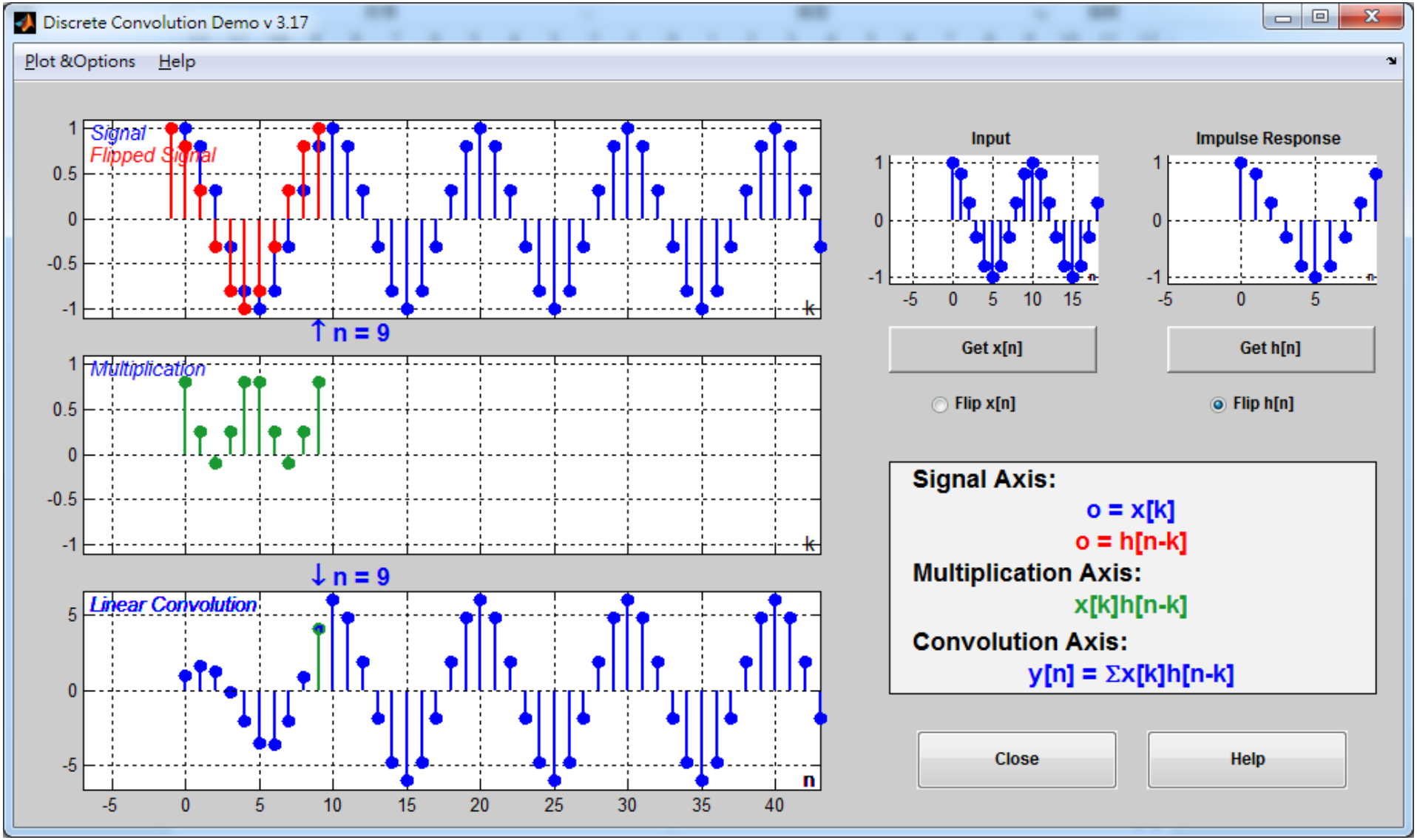
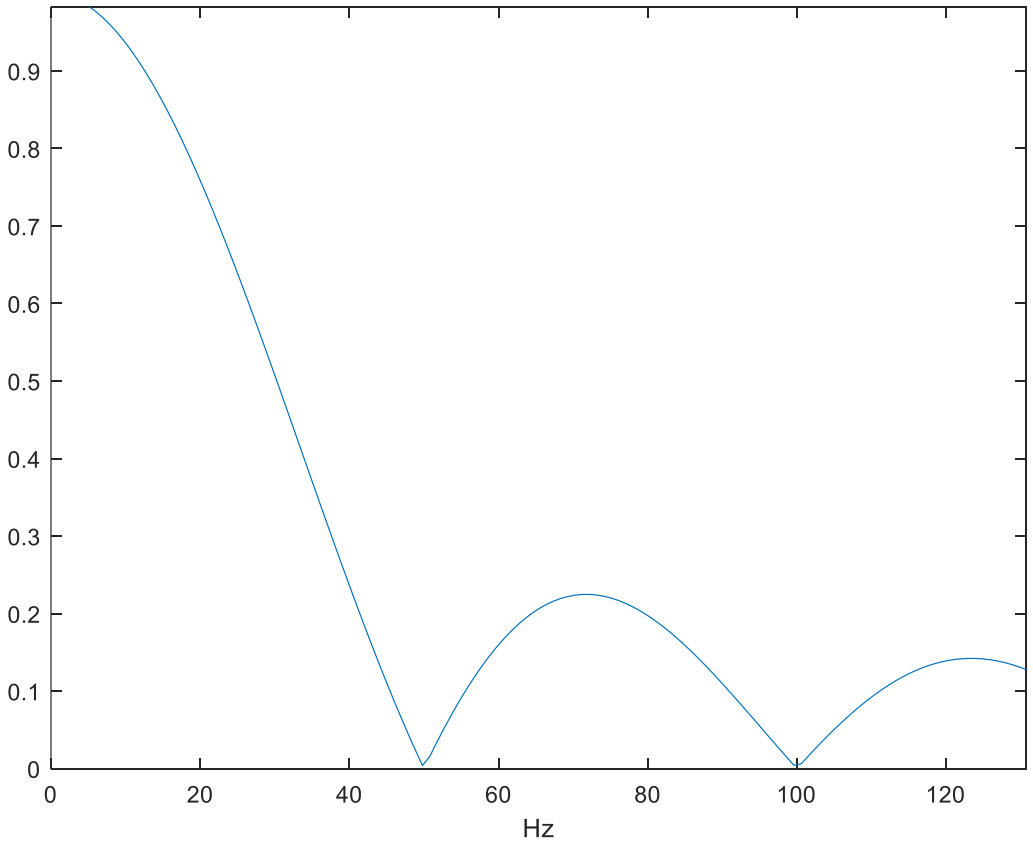
y[n] = Σx[k]h[n-k]
Close
Help

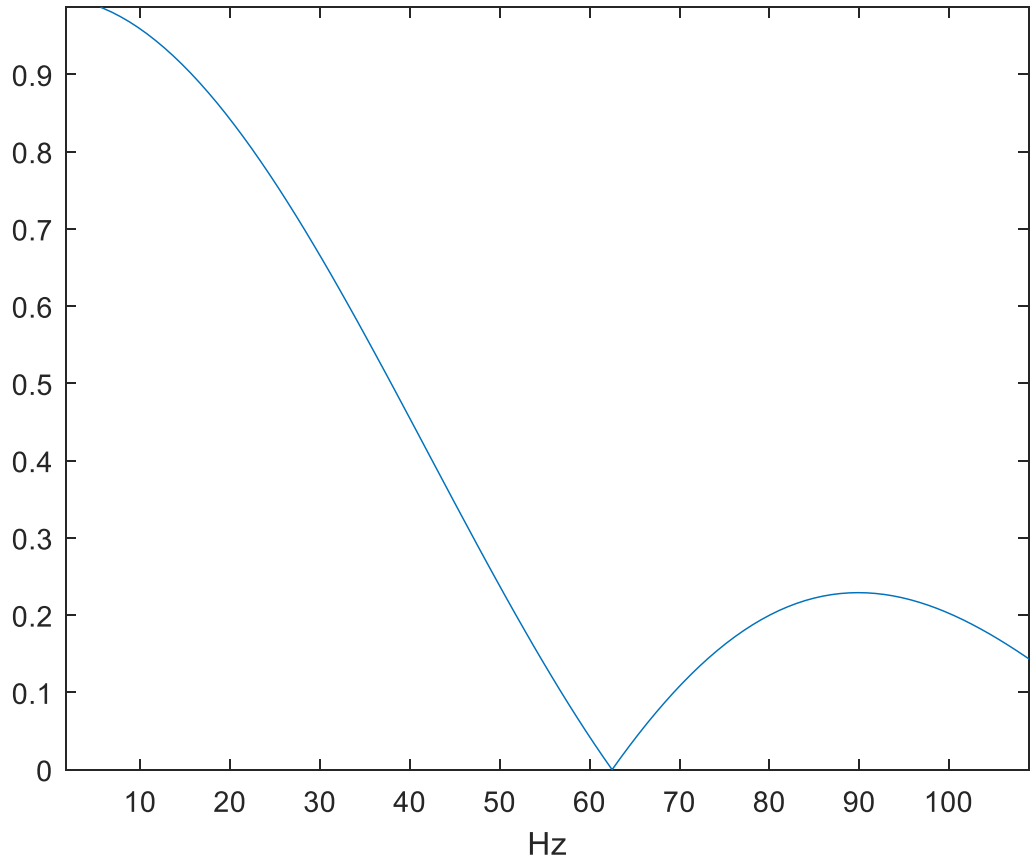

Discrete Convolution Demo v 3.17
Plot &Options
Help
Signal
Flipped Signal
k
↑ n = 9
Multiplication
k
↓ n = 9
Linear Convolution
n
Input
Impulse Response
Get x[n]
Get h[n]
Flip x[n]
Flip h[n]
Signal Axis:
o = x[k]
o = h[n-k]
Multiplication Axis:
x[k]h[n-k]
Convolution Axis:
y[n] = Σx[k]h[n-k]
Close
Help

2. Moving Average Filtering and Difference Filtering

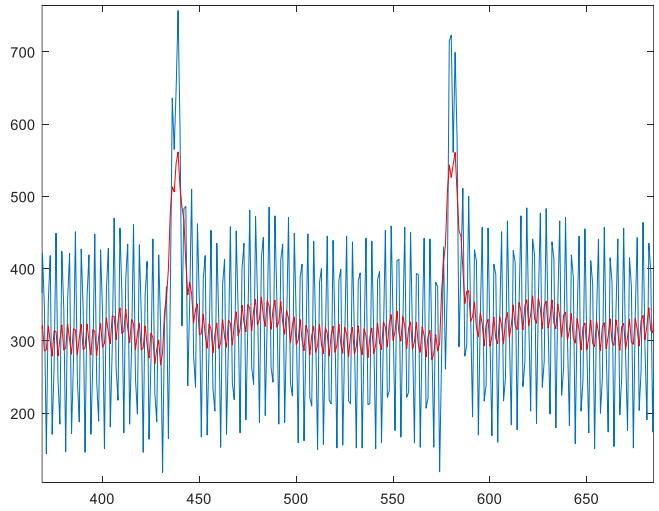
```
>> Fs = 500; % in Hz
>> ma = ones(1,10)/10;
>> figure
>> plot((0:511)*Fs/512, abs(fft(ma,512)));
>> xlabel('Hz')
```



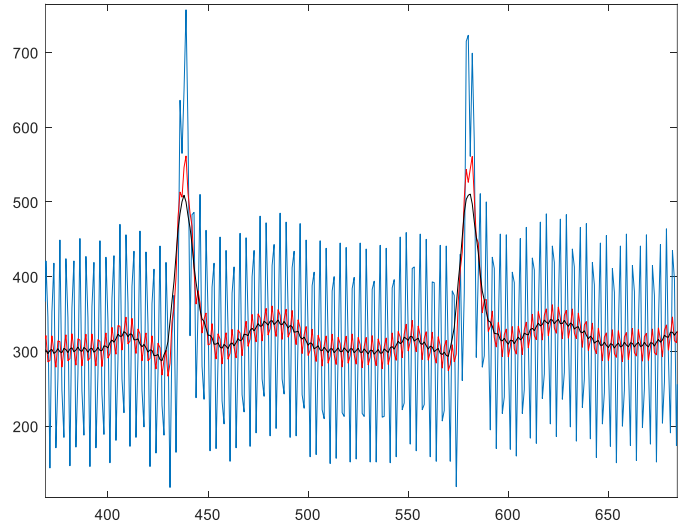
```
>> Fs = 500; % in Hz
>> ma = ones(1,8)/8;
>> figure
>> plot((0:511)*Fs/512, abs(fft(ma,512)));
>> xlabel('Hz')
```



ECG_notchfiltered = conv(raw_ECG,ma,'same');

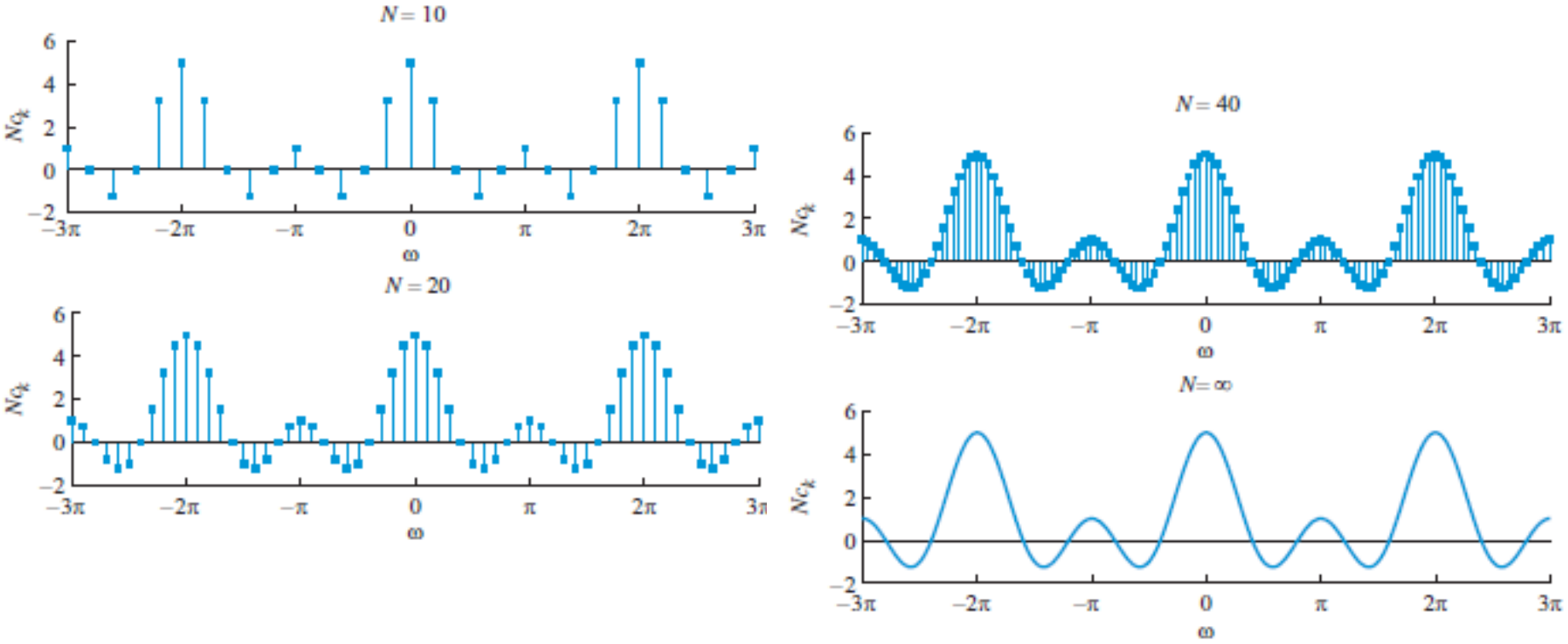


ECG_notchfiltered = conv(ECG_notchfiltered ,ma,'same'); % casecaded system



Fourier Transforms for DT Aperiodic Signals: View in Terms of DTFS

Example 4.8



$\omega_k = (2\pi/N)k$

Figure 4.22 How the DTFS converges to the DTFT as the period N of a fixed-width ($2L + 1 = 5$ samples) rectangular pulse tends to infinity.