Experiment 17
Filtering Known Signal Using FIR LPF

Aim

To apply FIR LPF to filter the known signal.

Theory

We will select the known signal so that we have the idea of the frequency contents of the signal.

Experiment

We will consider a known signal containing the following frequencies: 1000 Hz, 4000 Hz and 6000 Hz. Let us use a filter as an LPF with cut-off frequency of 2 kHz same as in experiment 14. The reader has to write a MATLAB program to generate 1024 samples of the known signal as stated above and design the filter with specifications as follows.

We have used following specifications for the FIR filter.

1. Sampling frequency: 16 kHz.
2. Cut-off frequency: 2 kHz.
3. Duration of the response: 0.00125 s.

Teaser *The reader has to write a program in MATLAB to convolve the sequence containing 1024 samples and the samples of filter impulse response and plot the output. Note that we will get 11 FIR filter coefficients and these will be convolved with the signal. The reader is encouraged to verify the filter design.*

Figure 1 shows a plot of original speech signal and Figure 2 shows the plot of spectrum of the signal with three peaks corresponding to three different frequencies. Figure 3 shows filtered signal containing only pure sine wave with 1000 Hz. Figure 4 shows the spectrum of filtered signal containing only one peak corresponding to a single frequency of 1000 Hz. We can see only 1000 Hz signal in Figure 3 and high frequencies 4000 Hz and 6000 Hz are filtered out. The MATLAB program is as follows.

```
%filtering known signal using FIR-LPF
clear all;
fs=16000;
for n=1:256,
```

```
y(n)=10*cos(2*pi*n*1000/fs)+10*cos(2*pi*n*4000/
fs)+10*cos(2*pi*n*6000/fs);
end
plot(y);title('plot of signal with 1000,4000 and 6000
Hz');xlabel('sample number'); ylabel('amplitude');
y1=fft(y);
figure;
plot(abs(y1));title('plot of spectrum of signal with 1000,4000
and 6000 Hz');xlabel('sample number'); ylabel('amplitude');
t=0.00125;
Q=fs/2*t;
disp(Q);
for i=1:10,
    x(i)=(sin(0.125*pi*i))/(i*pi);
end
a(11)=0.125;
for i=1:10,
    a(i)=x(Q-(i-1));
end
for i=2:11,
a(i+Q)=x(i-1);
end
w1=window(@blackman,21);
for i=1:21,
    z(i)=a(i)*w1(i);
end
c=conv(y,z);
figure;
plot(c);
%axis([1 1024 80 130]);
title('plot of filtered signal');xlabel('sample number');
ylabel('Amplitude');
 c1=fft(c);
 figure;
```

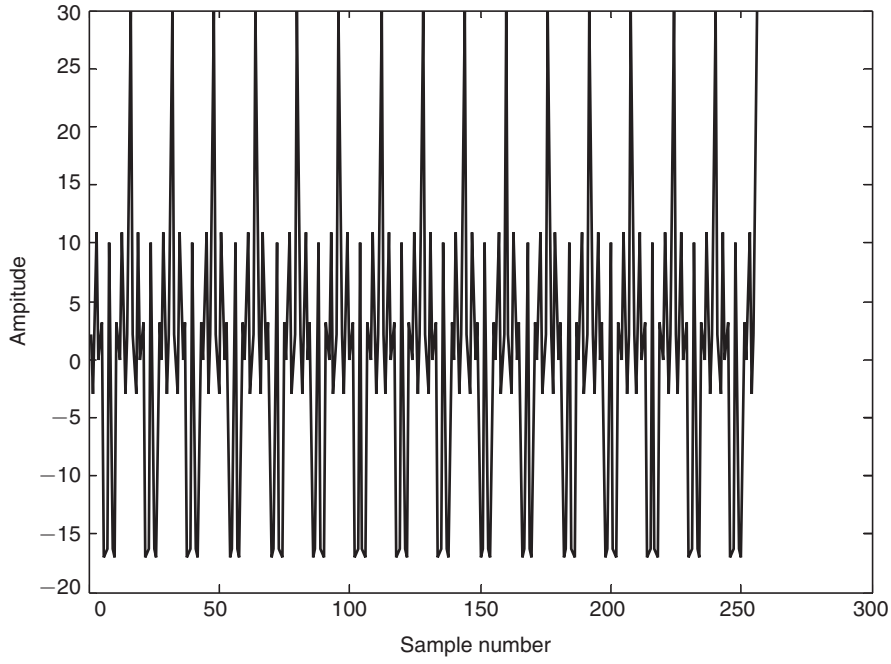

Figure 1 Plot of signal containing 1000, 4000 and 6000 Hz frequencies.

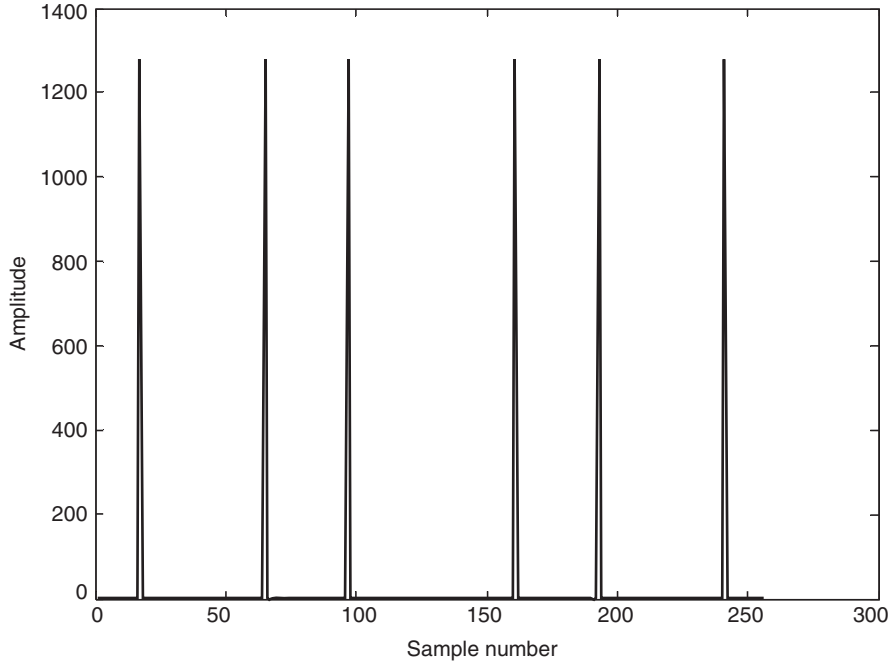

Figure 2 Plot of spectrum of signal containing 1000, 4000 and 6000 Hz frequencies.