Experiment No: 11 Date: 14/10/2024

FIR FILTERS

Aim

To perform Linear Convolution of two sequences using DSP Processor.

Theory

FIR (Finite Impulse Response) filters are a class of digital filters that have a finite number of coefficients, meaning they respond to input values for a finite number of sample periods before the response ends. They are widely used in signal processing due to their inherent stability and the fact that they can be designed to have a linear phase response. FIR filters can be categorized based on several factors, including their frequency response, structure, and design method. Here are some common types of FIR filters:

1. Low-Pass FIR Filter

- Purpose: Allows frequencies below a certain cutoff frequency to pass through while attenuating higher frequencies.
- Application: Used for smoothing signals, removing high-frequency noise, or in audio processing.

2. High-Pass FIR Filter

- Purpose: Allows frequencies above a certain cutoff frequency to pass through while attenuating lower frequencies.
- Application: Used to remove DC offset, low-frequency drift, or for differentiating signals.

3. Band-Pass FIR Filter

- Purpose: Allows frequencies within a certain band to pass through while attenuating frequencies outside of the band.
- Application: Used in communication systems, audio equalization, and spectral analysis.

4. Band-Stop FIR Filter

- Purpose: Attenuates frequencies within a certain band while allowing frequencies outside of the band to pass through.
- Application: Used for removing interference or noise at specific frequency ranges, such as power-line noise (50/60 Hz).

Program

```
%Low Pass Filter using Rectangular Window

clc;
clf;
close all;
clear all;
Wc=0.5*pi;
N=input('Enter the value of N');
alpha=(N-1)/2;
eps=0.001
n=0:1:N-1
hd=sin(Wc*(n-alpha+eps))/(pi*(n-alpha+eps));
Wr=boxcar(N);
hn=hd*Wr';
W=0:0.01:pi;
subplot(2,1,1);
plot(W/pi,10*log10(abs(n)));
title('Low Pass Filter using Rectangular Window');
xlabel('Normalized Frequency');
ylabel('Magnitude in dB');
stem(Wr);
title('Rectangular Window Sequence');
xlabel('No of Samples');
ylabel('Amplitude');

%High Pass Filter using Rectangular Window

N=input('Enter the value of N');
Wc=0.5*pi;
alpha=(N-1)/2;
eps=0.001
n=0:1:N-1
hd=(sin(pi*(n-alpha+eps))-sin(Wc*(n-alpha+eps)))/(pi*(n-alpha+eps));
Wr=boxcar(N);
hn=hd*Wr';
W=0:0.01:pi;
h=freqz(hn,1,W);
subplot(2,1,1);
plot(W/pi,10*log10(abs(n)));
title('High Pass Filter using Rectangular Window');
xlabel('Normalized Frequency');
ylabel('Magnitude in dB');
subplot(2,1,2);
stem(Wr);
title('Rectangular Window Sequence');
xlabel('No of Samples');
ylabel('Amplitude');
```

```
%Band Pass Filter using Rectangular Window

N=input('Enter the value of N');
Wc1=0.25*pi;
Wc2=0.75*pi;
alpha=(N-1)/2;
eps=0.001
n=0:1:N-1
hd=(sin(Wc1*(n-alpha+eps))-sin(Wc2*(n-alpha+eps)))/(pi*(n-alpha+eps));
Wr=boxcar(N);
hn=hd*Wr';
W=0:0.01:pi;
h=freqz(hn,1,W);
subplot(2,1,1);
plot(W/pi,10*log10(abs(n)));
title('Band Pass Filter using Rectangular Window');
xlabel('Normalized Frequency');
ylabel('Magnitude in dB');
subplot(2,1,2);
stem(Wr);
title('Rectangular Window Sequence');
xlabel('No of Samples');
ylabel('Amplitude');

%Band Stop Filter using Rectangular Window

N=input('Enter the value of N');
Wc1=0.25*pi;
Wc2=0.75*pi;
alpha=(N-1)/2;
eps=0.001
n=0:1:N-1
hd=(sin(Wc1*(n-alpha+eps))-sin(Wc2*(n-alpha+eps))+sin(pi*(n-alpha+eps)))/(pi*(n-
alpha+eps));
Wr=boxcar(N);
hn=hd*Wr';
W=0:0.01:pi;
h=freqz(hn,1,W);
subplot(2,1,1);
plot(W/pi,10*log10(abs(n)));
title('Band Stop Filter using Rectangular Window');
xlabel('Normalized Frequency');
ylabel('Magnitude in dB');
subplot(2,1,2);
stem(Wr);
title('Rectangular Window Sequence');
xlabel('No of Samples');
ylabel('Amplitude');
```

Result

Implemented Low Pass, High Pass, Band Pass, and Band Stop Filters using Window Method.

OBSERVATION

Result

Verified the Properties of DFT.