T. Y. B. Tech (Electrical) Sem VI

Digital Signal Processing

Lab Experiment : Decimation of discrete data sequence

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Decimation of discrete data sequence

Aim : To implement decimation process for given discrete data sequence.

Software used: MATLAB

Theory :

Q1. Define decimation. What is its significance?

Decimation can be regarded as the discrete – time counterpart of sampling. Decimation is for reducing the sampling rate. Where as in sampling we start with a continuous – time signal x(t) and convert it into a sequence of samples x[n], in decimation we start with a discrete – time signal x[n] and convert it into another discrete – time signal y[n], which consists of sub – samples of x[n]. Thus, the formal definition of N-fold decimation or down sampling is defined as:

$$y[n] = x[nN]$$

Decimation finds its application in (i) sub-band coding of speech or image (ii) voice privacy using analog phone lines, (iii)signal compression by sub-sampling, and (iv) A/D and D/A converters. Also, it is used in the areassuch as communication systems, data acquisition and storage systems, speech and audio processingsystems, antenna systems and radar systems.

Q2. What is multirate signal processing?

A multirate digital signal processing means the system uses multiple sampling rates within the system. Multirate digital signal processing is required in digital systems where more than one sampling rate is needed. Whenever a signal at one rate has to be used by a system that expects a different rate, the rate has to be increased or decreased, and some processing is required to do so. While designing multirate systems, the effects of aliasing for decimation and pseudo-images for interpolation should be avoided.The advantages of multirate signal processing are that it reduces computational requirement,storage for filter coefficients, finite arithmetic effects, and filter order required in multirate application and sensitivity to filter coefficient length.

Program :

```
% To Downsample a signal by Sampling Rate Reduction Factor
%Author - Satyam,Sandesh,Aaditya,Narendra


xn=input('Enter the input sequence:');
N=length(xn);
n=0:1:N-1;
subplot(2,1,1)
stem(n,xn,'k');
xlim([0 12]);
ylim([-9 9]);
xlabel('n')
ylabel('x(n)')
title('Input Signal')
D=input('Enter the rate for which the signal is to be downsampled:');
xDn=xn(1:D:N);
n1=1:1:N/D;
subplot(2,1,2)
stem(n1-1,xDn,'k')
xlim([0 12]);
ylim([-9 9]);
xlabel('n')
ylabel('xDn')
title('Downsampled Signal')
```

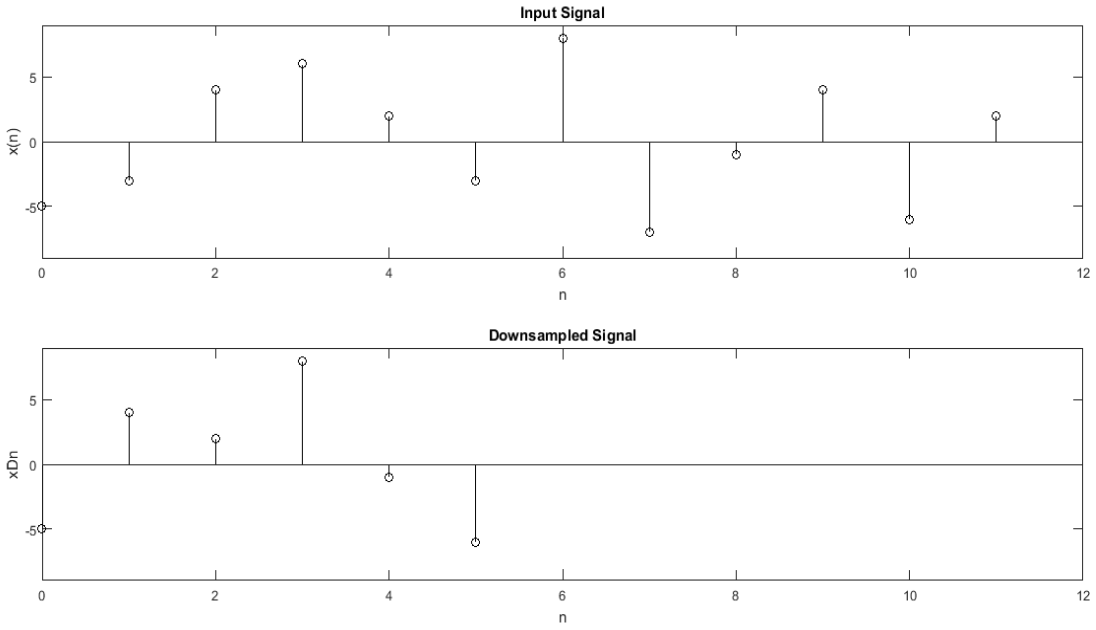
Output :

Enter the input sequence:

[-5,-3,4,6, 2,-3,8,-7,-1,4,-6,2]

Enter the rate for which the signal is to be downsampled:

2



Downsampled Signal

Conclusion : The decimationof the given system is done in this given experiment in two ways. The experiment as performed in MATLAB is done by executing the various codes of MATLAB. Firstly, it is found out by doing manual calculations. Then, it is done by executing codes in MATLAB. Decimated signal is found by downsampling the signal through the provided rate of decimation. The input sequence and output decimated signal is plotted using the subplot command. The plots obtained through both the methods are same and have been verified.

Manual Calculations:

(on the next page)

Satyam.

Calculations:-

$x[n] = [-5, -3, 4, 6, 2, -3, 8, -7, -1, 4, -6, 2]$

We know that, for decimation

$y[n] = x[2n]$

$y[0] = x[2 \times 0] = x[0] = -5$

$y[1] = x[2 \times 1] = x[2] = 4$

$y[2] = x[2 \times 2] = x[4] = 2$

$y[3] = x[2 \times 3] = x[6] = 8$

$y[4] = x[2 \times 4] = x[8] = -1$

$y[5] = x[2 \times 5] = x[10] = -6$

Decimated sequence is

$\therefore y[n] = [-5, 4, 2, 8, -1, -6]$