EE2703 : Applied Programming Lab
Assignment 10
Linear and Circular Convolution

Chagari Koushal Kumar Reddy
EE20B023

May 5, 2022

Contents

1 Aim

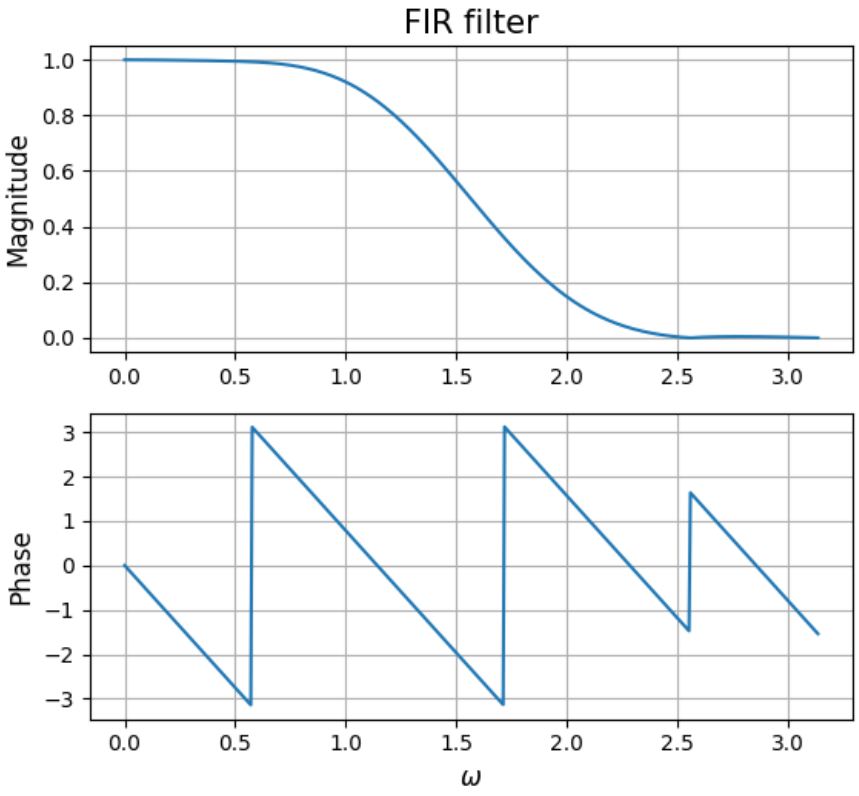
The aim of this assignment is to:

- Perform Linear and Circular convolutions of FIR filters
- Perfom Linear convolution using circular convolution
- Perform auto-correlations on shifted versions of Zadoff-Chu sequence

2 Assignment

2.1 Magnitude and Phase response of FIR filter

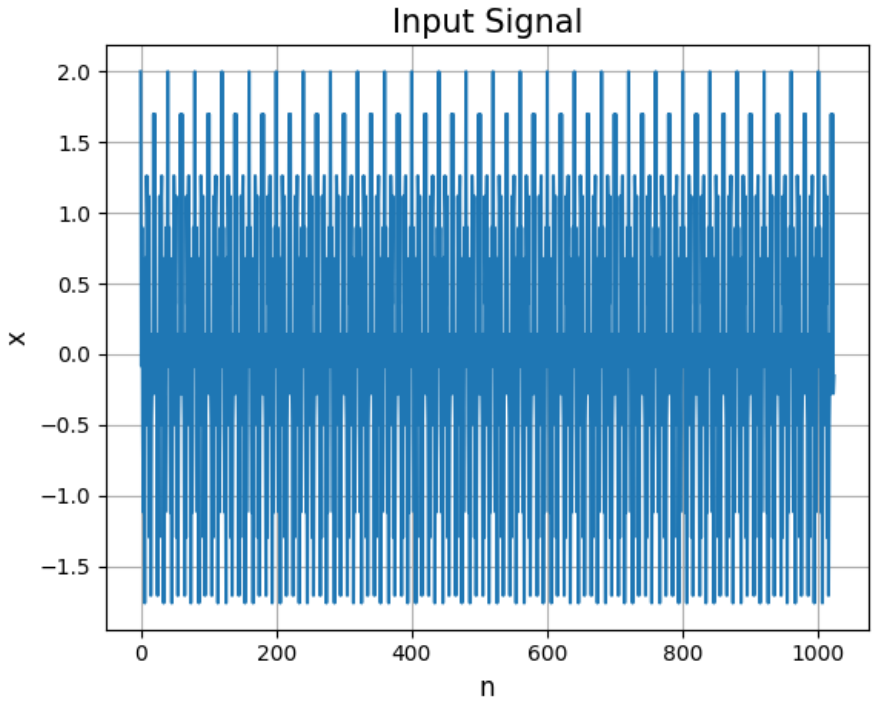
The FIR filter coefficients are present in the 'h.csv' file. The data was extracted from the file and by using the `scipy.signal.freqz` method, I was able to plot the magnitude and phase response of the FIR filter.

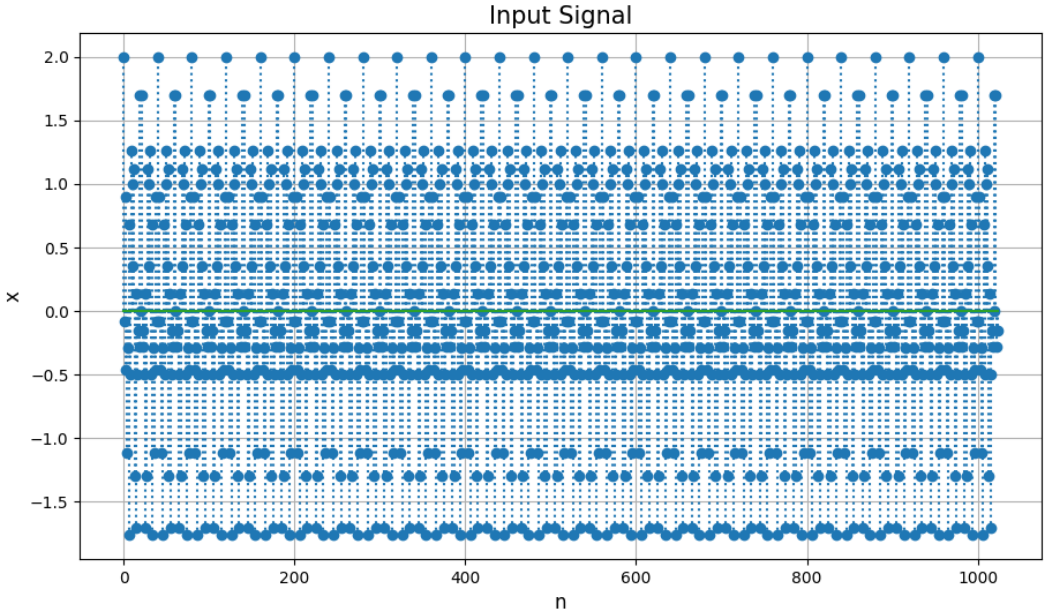


Magnitude response indicates that this is a low pass FIR filter

2.2 Linear Convolution

The given signal is $x[n] = \cos(0.2\pi n) + \cos(0.85\pi n)$. The plot of the signal is shown below:



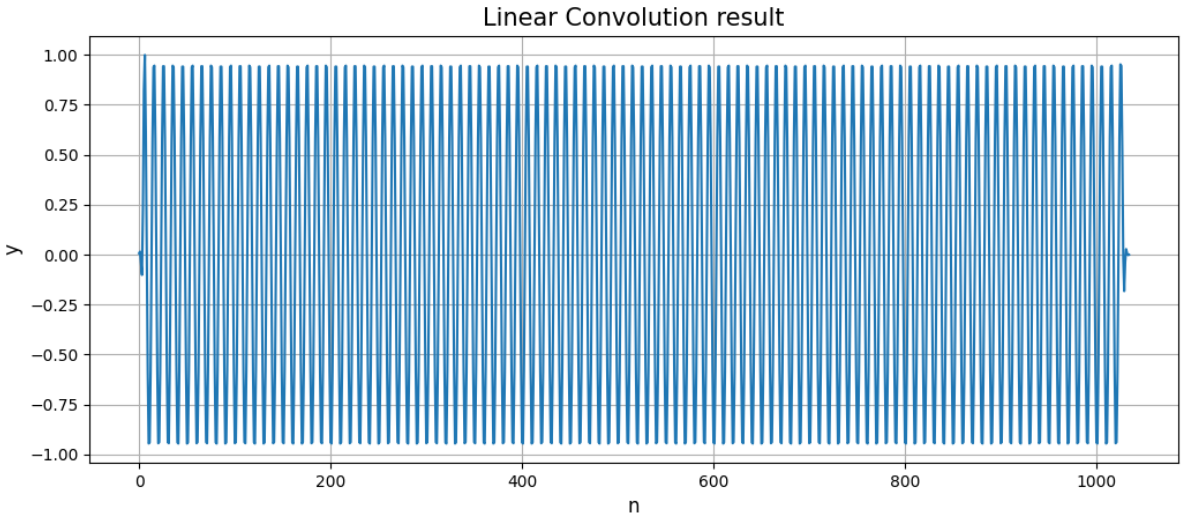


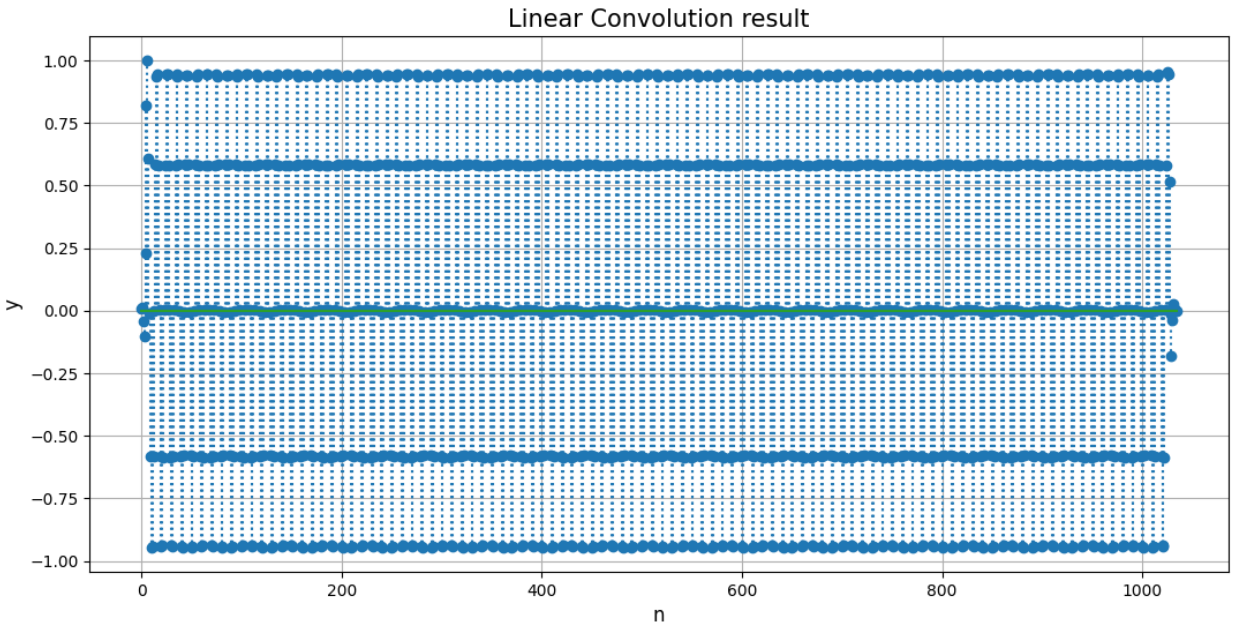
This signal is now convolved with the FIR filter using `np.convolve` which was plotted in the

previous section.

$$y[n] = \sum_{k=0}^{N} x[n-k]h[k]$$

The output signal $y[n]$ is shown below:





We can observe that the high frequency component 0.85π is almost attenuated and the low frequency component 0.2π is still present

2.3 Circular Convolution

2.4 Circular Convolution as Linear Convolution with Aliasing

2.5 Circular Correlation of Zadoff-Chu Sequence

We now examine the Zadoff-Chu sequence. It has the following properties:

- It is a complex sequence
- It is a constant amplitude sequence
- The correlation of a Zadoff-Chu sequence with a cylically shifted version of itself is 0
- Correlation of Zadoff-Chu sequence with the delayed version of itself will give a peak at that delay

We will examine the last property of the above list.