University of Tehran
College of Engineering
School of Electrical and Computer Engineering

Real-time Digital Signal Processing Laboratory

Dr.Shah-Mansouri

Lab 4

Soroush Mesforush Mashhad

SN:810198472

Azar 01

Contents

Abstract

In this lab we shall create a sine wave signal using an IIR filter, first we shall begin with computing the Z-Transform of a discrete sine signal, then we shall go on to design an appropriate filter and apply it in our C program then we shall plot the output as required.

1 Z-Tranform of sine wave

Here we shall calculate the Z-transform of $y[n] = \sin(n\omega T)$ as follows.

$$\sin(n\omega T) = \frac{e^{j\omega nT} - e^{j\omega nT}}{2j} \xrightarrow{\mathcal{Z}} \frac{1}{2j}\left(\frac{1}{1 - z^{-1}e^{j\omega nT}} - \frac{1}{1 - z^{-1}e^{-j\omega nT}}\right)$$

$$\longrightarrow \frac{z^{-1}\left(e^{j\omega nT} - e^{-j\omega nT}\right)}{2j\left(z^{-2} - z^{-1}e^{j\omega nT} - z^{-1}e^{-j\omega nT} + 1\right)} = \frac{\sin(n\omega T)z^{-1}}{1 - 2\cos(n\omega T) + z^{-2}}$$

$$\mathcal{Z}\left[\sin(n\omega t)\right] = \frac{\sin(n\omega T)z^{-1}}{1 - 2\cos(n\omega T) + z^{-2}}$$

2 Sine wave generation

Here we generate a sine wave with our C program and plot it in the time and frequency domain accordingly, the results are as follows.

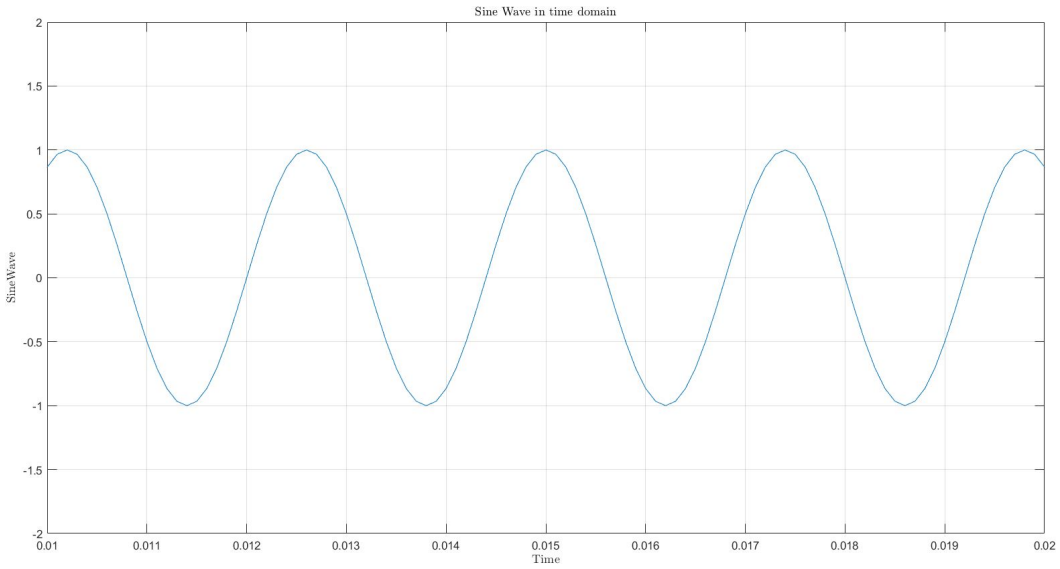

Figure 1: Sine wave in time domain

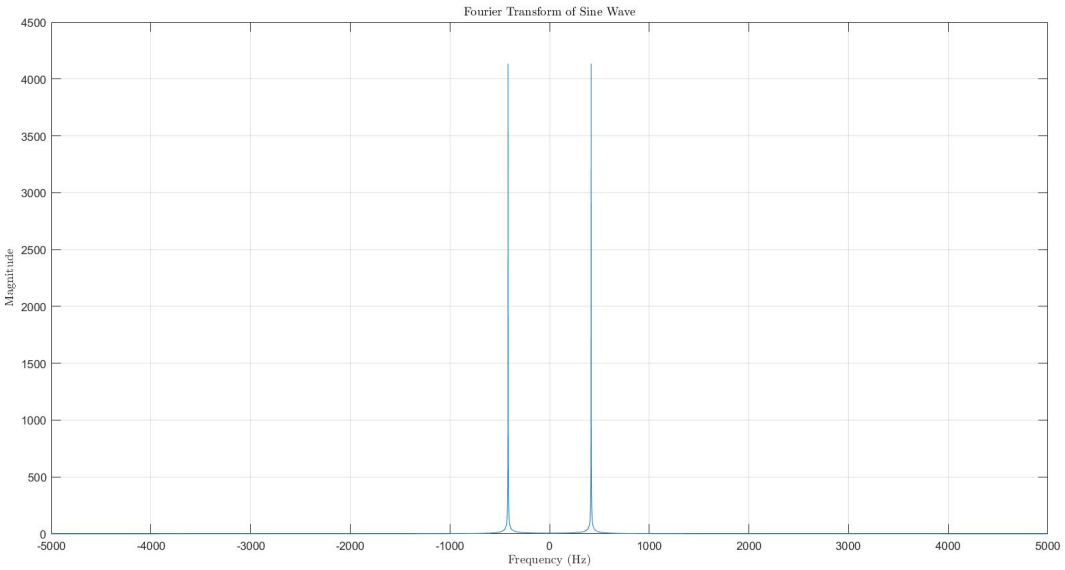

Figure 2: Sine wave in frequency domain

References

[1] Vahid Shah-Mansouri, *Real-time Digital Signal Processing Laboratory lab notes, Fall 01*

[2] Mohammad Ali Akhaee, *Digital Signal Processing lecture notes, Spring 01*