GATE Assignment 4

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Download all python codes from

https://github.com/Adarsh541/EE3900/blob/main/Gate4/codes/Gate4.py

Download latex-tikz codes from

https://github.com/Adarsh541/EE3900/blob/main/Gate4/Gate4.tex

1 Problem(GATE 2001 EC Q.2.19)

The Nyquist sampling interval, for the signal

$$x(t) = Sinc(700t) + Sinc(500t) \tag{1.0.1}$$

is.

1) $\frac{1}{350}$sec
2) $\frac{\pi}{350}$sec
3) $\frac{1}{700}$sec
4) $\frac{\pi}{175}$sec

2 Solution

Lemma 2.1. *Fourier transform of Sinc function*

$$Sinc(at) \overset{\mathcal{F}}{\rightleftharpoons} \frac{1}{|a|} rect\left(\frac{f}{a}\right) \tag{2.0.1}$$

Since Fourier Transform is linear, and using (2.0.1)

$$X(f) = \frac{1}{700} rect\left(\frac{f}{700}\right) + \frac{1}{500} rect\left(\frac{f}{500}\right) \tag{2.0.2}$$

$$X(f) = 0 \text{ for } f > 350Hz \tag{2.0.3}$$

$$\text{Nyquist rate} = 2 \times \text{max frequency} \tag{2.0.4}$$

$$= 2 \times 350Hz \tag{2.0.5}$$

$$\text{Nyquist sampling interval} = \frac{1}{\text{Nyquist rate}} \tag{2.0.6}$$

$$= \frac{1}{700} sec \tag{2.0.7}$$

Sampling rate(Hz)	Observations
$fs = 1k$	The signal is perfectly reconstructed. It is made up of frequencies $-350 < f < 350$.
$fs = 2k$	The signal is perfectly reconstructed. It is made up of frequencies $-350 < f < 350$.
$fs = 500$	$150 < f < 350$ are missing
$fs = 600$	$250 < f < 350$ are missing

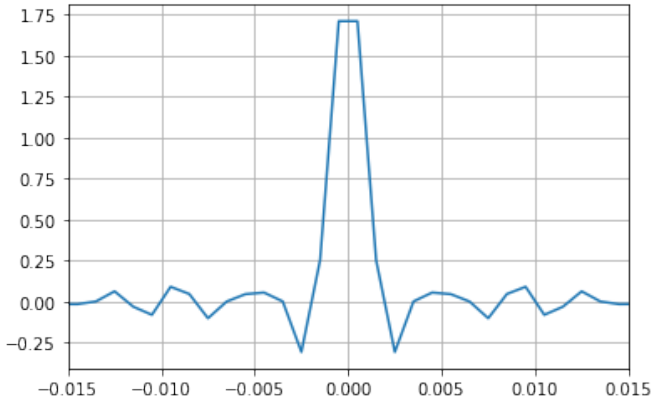

Fig. 4: Plot of $x(t)$ sampled at 1kHz.

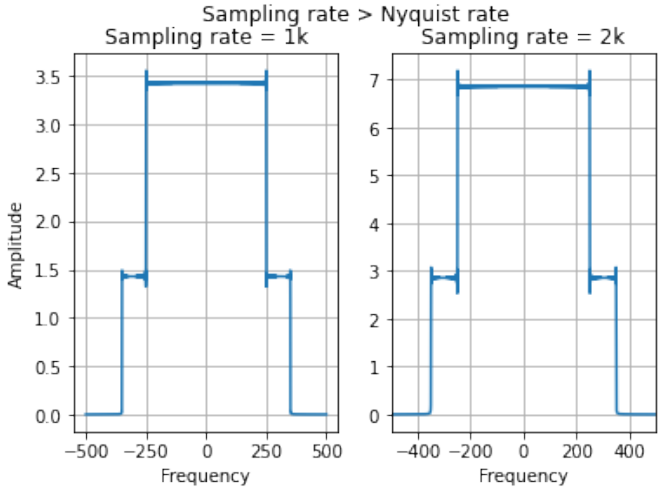

Fig. 4: DFT of $x(t)$ sampled at 1k and 2k

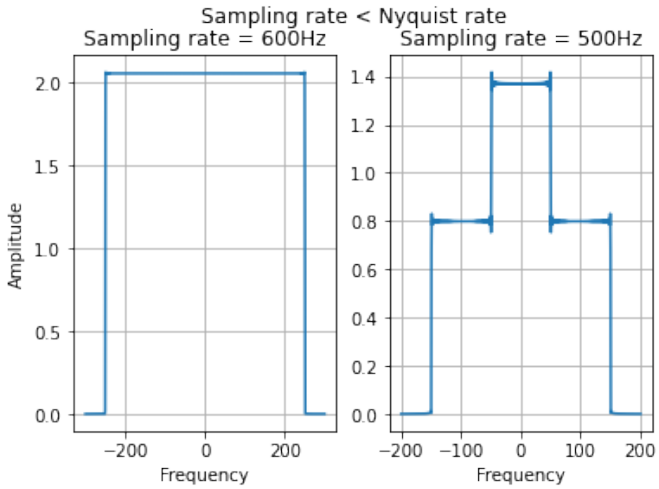

Fig. 4: DFT of $x(t)$ sampled at 600 and 500Hz.