Principles Of Communication
Programming Assignment 1 Report

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CS13B021

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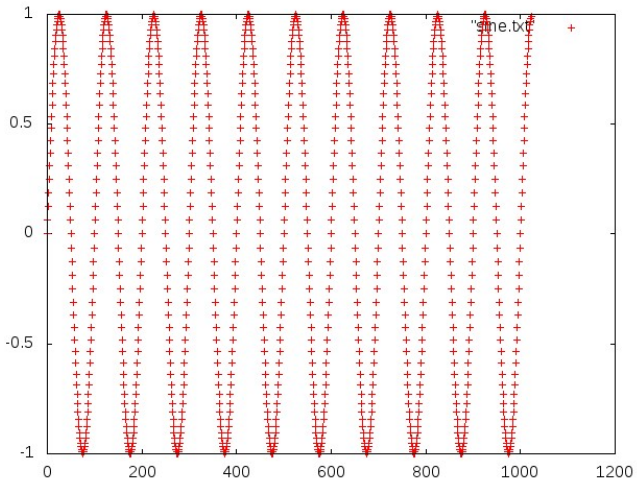

Figure 1: Sine wave of $f = 1$ $f_s = 100$ $A = 1$

Question 1A

- Sinusoidal waves of frequency 1 and $\frac{1}{2}$ are drawn with a sampling Rate R equals 100, Amplitude 1 and FFTSize 1024 are in Figure 1 and Figure 2.
- Now caluclate the zero Crossing count from the dataFile and caluclate the error in frequency by comparing with original value which when varied with the sampling Rate R gives a plot Figure 3.
- From the Graph it is clear that a sampling rate R which is less than twice of the frequency of sinusoid wave or Band width increases the error rapidly.
- We can see that the decrease in error is linear in the sampling range $f < f_s < 2f$.

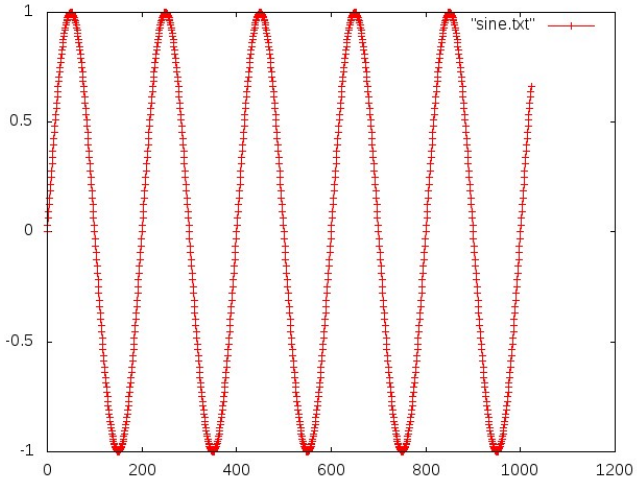

Figure 2: Sine wave of $f = \frac{1}{2}$ $f_s = 100$ $A = 1$

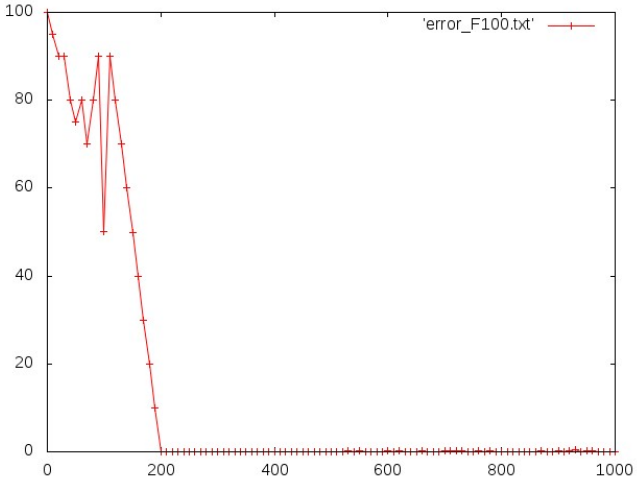

Figure 3: Error vs Sampling Rate

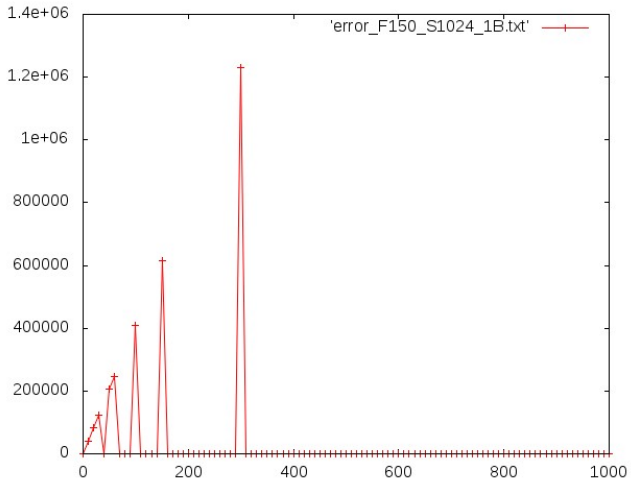

Figure 4: Error vs Sampling Rate

Question 1B

- Now we generate the Fourier transform of the Sinusoids generated above and caluclate the frequency from the position of peaks in the Fourier Transform and plot the error vs sampling rate in Figure 4.
- This graph is similar to the above error plot for $f_s > 2B$ i.e the error is nearly zero.

Question 2A

- The Superposition of two signals is nothing but adding their values at each and every sample. The two signal data files are added using a c function and its Fourier transform is made which is in Figure 5.
- From the Figure we can observe that the Fourier Transform of Sum of two sinusoid waves is equal to sum of Fourier Transforms of two sinusoids.

Question 2B

- The Convolution of two signals is calculated by shifting one signal and multiplying them at each and every sample. The Bandwidth of a convolved signal is the sum of the bandwidths of the given two signals.
- The Fourier Transform of the convolution of two sinusoids is given in Figure 6.

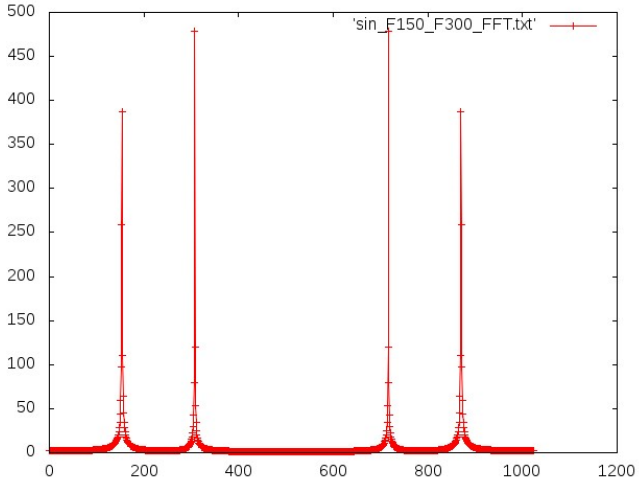

Figure 5: Fourier Transform of superposition of two sinusoids of frequency 150 and 300.

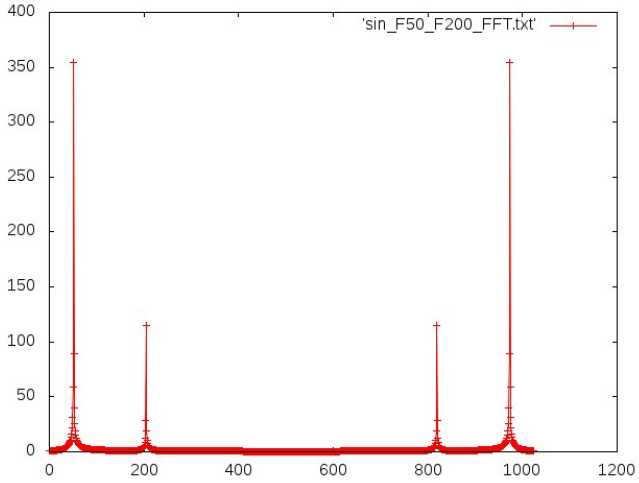

Figure 6: Fourier Transform of convolution of two sinusoids of frequency 50 and 200.

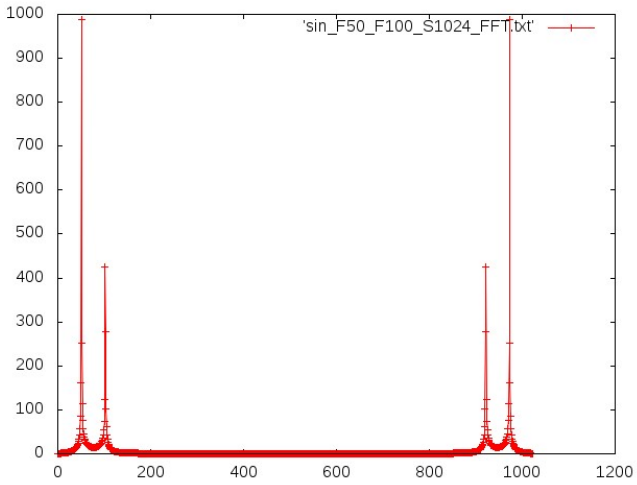

Figure 7: Fourier Transform of convolution of two sinusoids of frequency 50 and 100 with FFTSize 1024.

Question 2C

- The Convolution of two sinusoids should ideally give zero but its not beacause we are actually multiplying the signal with finite pulse train whose Fourier Transform is not perfectly consist of two pulses but of two sinc's which is not zero at other places apart from the peak. So this non zero quantity when multiplied with the other peak gives a high value which is seen as peek.
- This is like sinc's still but when we increase the FFTSize the Graphs tend to reality that is the peaks become sharper which can be seen from the Figures 7 & 8.

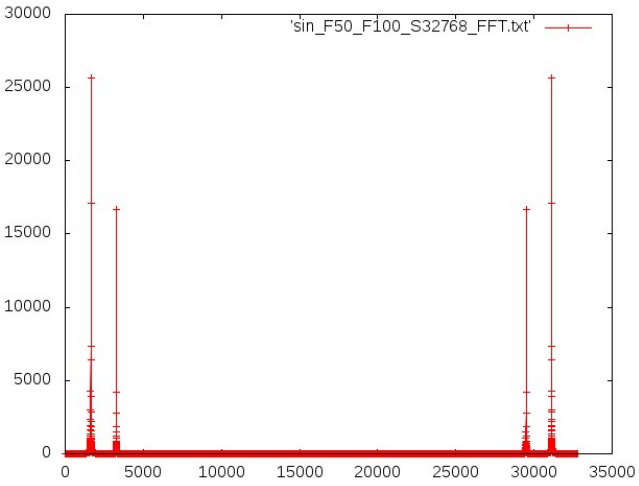

Figure 8: Fourier Transform of convolution of two sinusoids of frequency 50 and 100 with FFTSize 32768.