Assignment 9

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1 Overview

The objective in this assignment is to find the spectra of non-periodic signals. To get the desired magnitude plots of the signals, we convolve the signal with a *Hamming Window*. This ensures that the peak of the plots are spread apart and also suppress the jump at the edge of the window.

The *Hamming Function* is given as

$$w[n] = \begin{cases} 0.54 + 0.46\ cos(\frac{2\pi n}{N-1}),\ |n| \leq \frac{N-1}{2} \\ 0,\ otherwise \end{cases}$$

Using this window, we get decent plots for the non-periodic signals. Also, more the number of points, more the impact of the window in the plots.

2 Plots

The plots for the example function $\sin(\sqrt{2}t)$ with and without hamming window are as follows
The plots for the function $cos^3(\omega_o t)$ with and without hamming window are as follows
The simple cosine function has two plots, one with noise and one without. In two different scenarios the estimate of coefficients were found to be

$$\begin{aligned} wo &= 1.350 & wo(estimated) &= 1.453 \\ do &= 1.571 & do(estimated) &= 1.571 \\ wo &= 1.350 & wo(estimated) &= 1.458 \\ do &= 1.571 & do(estimated) &= 1.571 \end{aligned}$$

The plots for the two functions are as follows
The chirp unction is defined as

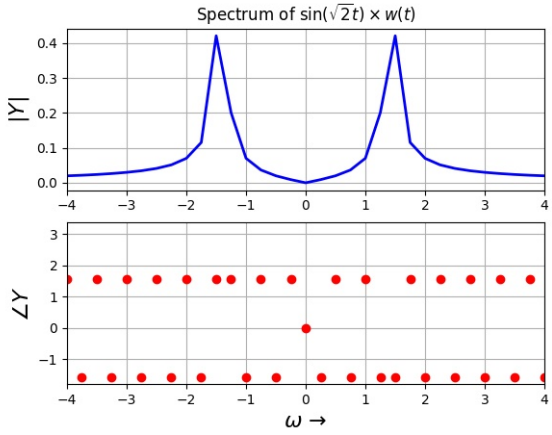

Figure 1: Example function without hamming window

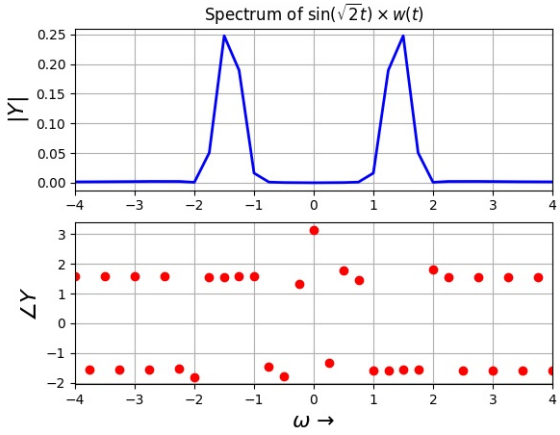

Figure 2: Example function with hamming window

$$f(t) = cos(16(1.5 + \frac{t}{2\pi})t)$$

The chirp spectrum plot is as follows
The final two plots are the surface plots for the chirp function, with and without the hamming window

3 Conclusion

The code for the assignment can be referred to in the other file.

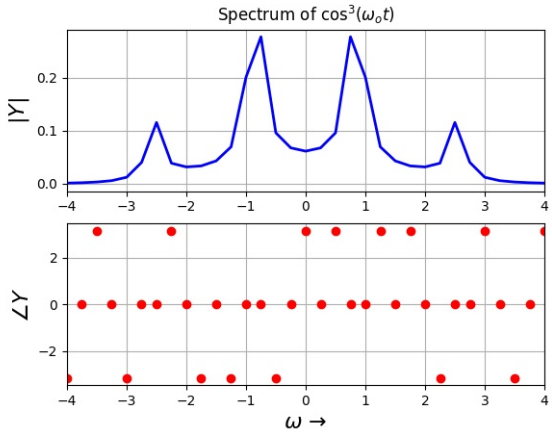

Figure 3: $cos^3(\omega_o t)$ without hamming window

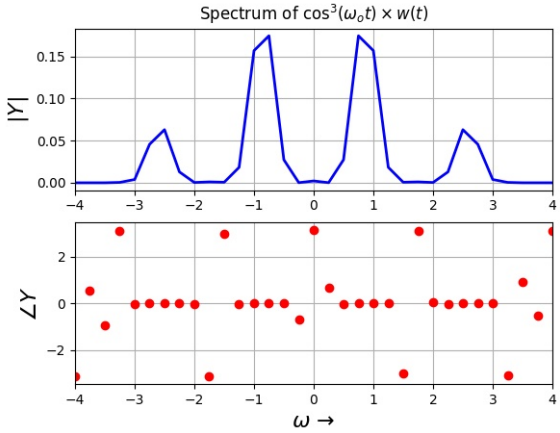

Figure 4: $cos^3(\omega_o t)$ function with hamming window

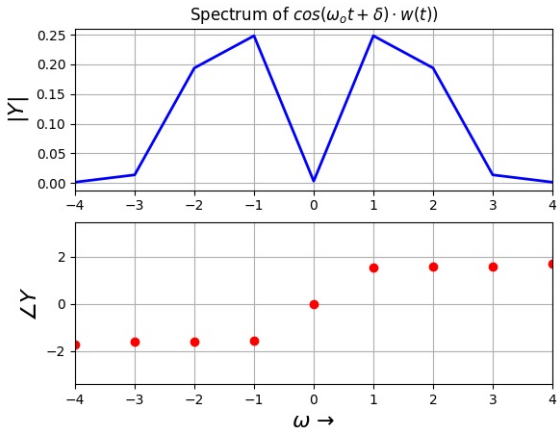

Figure 5: Cosine function without error

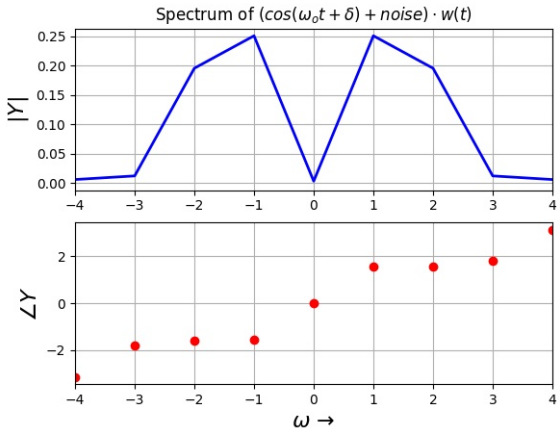

Figure 6: Cosine function with error

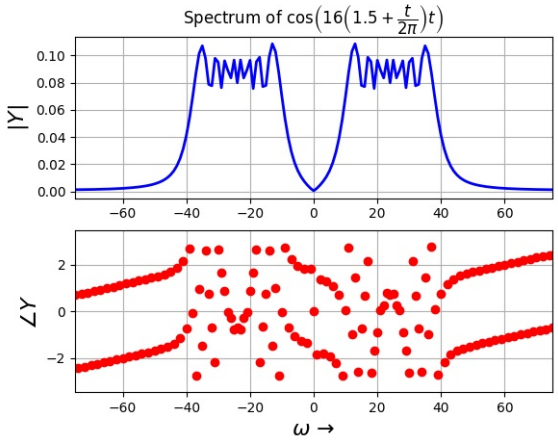

Figure 7: Chirp function spectrum

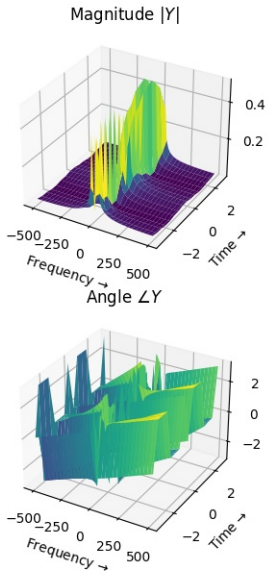

Figure 8: Surface plot of chirp function without hamming window

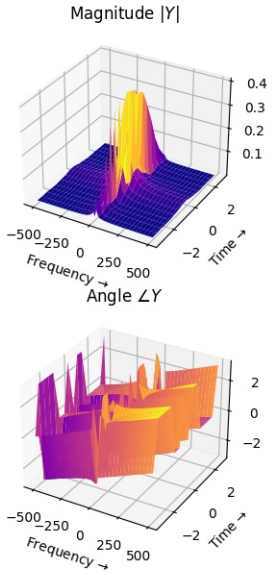

Figure 9: Surface plot of chirp function with hamming window