Homework #2

Written: Not Due
Programming: Due Nov. 14, 2019

Optional Problems: #2.73, 2.75, 3.4 (no need to determine $a = 0.3$), 3.14, 3.22

2.72
Consider the signal

$$x(t) = 2W\text{sinc}(2Wt)\cos(2\pi f_0 t), \quad f_0 > W.$$

a) Obtain the spectrum of $x_p(t) = x(t) + j\widehat{x}(t)$.
b) Obtain the spectrum of the complex envelope $\widetilde{x}(t)$, where the complex envelope is defined in (2.294).
c) Find the complex envelope $\widetilde{x}(t)$.

3.10
An AM modulator has output

$$x_c(t) = 30\cos(2\pi 200t) + 4\cos(2\pi 180t) + 4\cos(2\pi 220t).$$

Determine the modulation index and the efficiency.

Matlab Problems:

Please put your code and/or documentation into a directory using the format:

student ID number_first name_last name

as the directory name. Zip up the whole directory and send it to your instructor.

M1) **DSB Modulation and Demodulation**
Based on the original signal $m(t) = 2\cos 2\pi t + \cos 6\pi t$, we generate a DSB AM signal $x_c(t)$, which is expressed as

$$x_c(t) = [A_c + m(t)]\cos 200\pi t.$$

At the receiver, assume $x_c(t)$ is received without distortion and is multiplied by $2\cos(200\pi t + \theta)$ to get

$$d(t) = 2\cos(200\pi t + \theta) \cdot x_c(t).$$

(a) Plot $m(t)$ and $x_c(t)$ for $A_c = 0, 3$, and 6.

(b) Plot the spectrum of $m(t)$ and $x_c(t)$ for $A_c = 0, 3$, and 6.

(c) Assume $d(t)$ passes through a lowpass filter, which is defined as

$$h = \text{gaussian2D}(\text{'gaussian'},\ [\ 1 \quad 13\ ],\ 3)$$

using Matlab and the gaussian2D function which will be supplied with the assignment. Plot the demodulated signal and spectrum for $\theta = 0$ and $\theta = \frac{\pi}{4}$.

M2) **SSB Modulation**
Implement the phase-shift modulation in Figure 1. Plot the magnitude of the upper and lower sideband signals vs. analog frequency, i.e. $|X_{U,SB}(F)|$ and $|X_{L,SB}(F)|$, with F denoting analog frequency. Assume a sampling frequency of $F_s = 1000$ Hz and $N = 1000$ (the number of FFT points).

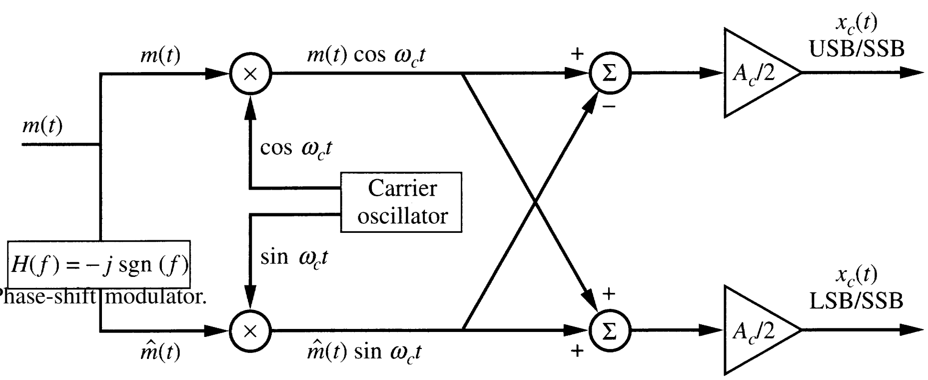

Fig. 1. Phase-shift modulator.