Communications Systems-I

Chapter 3: Amplitude Modulations

Simulations

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Note: Submit the codes in google classroom along with necessary documents if explanation and observation are needed, or for any interesting remarks.

1) **(Single-tone Modulation):** Design an AM experiment for sinusoidal modulation based on the following parameters:

   Carrier amplitude, $A_c = 1$

   Carrier frequency, $f_c = 0.4$ Hz

   Modulation frequency, $f_m = 0.05$ Hz

   Write a Matlab code to display and analyze 10 full cycles of the modulated wave, corresponding to a total duration of 200 seconds. Provide the modulated waveform in time domain, frequency spectrum of the modulated and message signal for modulations indices (a) $\mu = 0.5$ (undermodulation), (b) $\mu = 1$ (100% modulation) and (c) $\mu = 2$ (overmodulation).

   Hint: To display the analog wave in digital form a sampling rate of $f_s = 10$ Hz can be used. Similarly for displaying the frequncy spectrum a resolution of $f_r = 0.005$ Hz can be assumed.

2) **(Modulation of a bandlimited signal):** Generate the following signal

$$m_2(t) = 2\,\text{sinc}(2t/T_a) + \text{sinc}(2t/T_a + 1) + \text{sinc}(2t/T_a - 1)$$

   Generate a DSB-SC signal with $m_2(t)$ as the message signal modulated to a carrier frequency of 300 Hz. Plot the time domain signal for the duration $-0.04 \leq t \leq 0.04$ seconds, the frequency spectra of the message and modulated signals.

3) **(AM demodulation):** Consider the following message signal which is not strictly band-limited,

$$m_3(t) = \Delta\left(\frac{t + 0.01}{0.01}\right) - \Delta\left(\frac{t - 0.01}{0.01}\right)$$

   Assume a carrier of frequency 300 Hz. Design and implement a cohenrent demodulator with a finite impulse response (FIR) low pass filter. Plot the time domain transmitted and demodulated signal for a duration $-0.04 \leq t \leq 0.04$ seconds. Also plot the necessary frequency domain plots and enumerate the observations.