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Junior
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ECE252 – Fundamentals of Communication Systems

Sheet #2

Amplitude Modulation using Octave

DSB-SC transmitter

1. Using a DSB-SC Transmitter (Tx), a sinusoidal baseband signal of frequency $f_m = 100Hz$ is transmitted using a carrier of frequency $f_c = 10kHz$
   a) Plot the baseband signal and the modulated signal versus time.
   b) Plot the spectrum of the baseband signal and the modulated signal. Compare the peaks values with what is expected from your analysis.
   c) Repeat the problem using a carrier of frequency $f_c = 0.5kHz$ and baseband frequency of 10 Hz. (Hint: choose the correct time step and total simulation time)

DSC-SC Receiver

2. A DSB-SC modulated signal ($f_c = 10\ kHz$, $f_m = 100\ Hz$) was demodulated using a coherent detector (product modulator followed by an **ideal** LPF).
   a) Plot the spectrum of the signal (after the product modulator). Compare the peaks values with what is expected from your analysis.
   b) Choose the cut-off of the filter and plot the signal (after the LPF) versus time. In the same figures, plot the corresponding figures of the original baseband signal.

AM transceiver (Transmitter and receiver)

3. Consider the message signal $m(t) = \begin{cases} J_0(t)\,, 0 < t < 10 \\ 0\ \ , \ otherwise \end{cases}$. (Hint signal is non-periodic)
   a) Plot $m(t)$ and its corresponding spectrum.
   b) Verify Parseval's law, by calculating the signal total energy in time domain and frequency domain.
   c) Determine the BW (BW criteria: BW contains 99% of signal energy).
   d) Choose appropriate carrier frequency of AM modulated signal and appropriate k_a.
   e) Plot the time domain signal $s(t)$ and check no phase reversal happened and the signal envelope is the message itself.
   f) Plot the corresponding spectrum.
   g) Using an ideal envelope detector, compare the output signal with the message $m(t)$.

SSB transceiver

4. Consider the message signal $m(t) = J_0(t)\cos(2\pi 10t)\,, 0 < t < 10$ and a carrier of frequency 200 Hz are used to have a SSB signal (USB is transmitted)
   a) Plot the spectrum of $m(t)$
   b) Determine the BW of $m(t)$ (BW criteria: BW contains 99% of signal energy).
   c) Find the appropriate filter to transmit only the USB.
   d) Plot the spectrum of the modulated signal.

   Using a coherent detector to receive the SSB signal

   e) Plot the spectrum of the signal (after the product modulator).
   f) Choose the cut-off of the filter and plot the signal (after the LPF) versus time. In the same figures, plot the corresponding figure of the original message (Hint normalize curves to make an easy comparison