Principles of Communication Systems Lab (303 P)

Lab-4 (SSB-SC modulation and demodulation)

(Due Date: 14-9-2021, Time: 1 pm)

Instructions:

1. NO PLAGIARISM. Your solution must be written in your words.
2. Please strictly follow the LaTex template for making lab reports. The template has been uploaded on LMS.
3. Please mention legends, axis labels, titles etc in your plot/subplot for better understanding and clarity.
4. For best quality, please add .eps format of simulation plot in the report. You can directly export .eps plot from MATLAB.
5. The report to be submitted must include MATLAB code and all observations pertaining to each plot below the same.
6. Kindly number your answers correctly.
7. Please feel free to ask any questions in class or via LMS..

Questions:

1. Consider a SSB-SC modulated signal $\phi_{\text{SSB}}(t) = A_c m(t)\cos(2\pi f_c t) \pm j A_c m_h(t)\sin(2\pi f_c t)$ with message signal $m(t) = A_m \cos(2\pi f_m t)$. Assume $A_m = A_c = 2$, $f_m = 100$ Hz and $f_c = 2$ KHz.

   (a) Plot the message signal $m(t) = A_m \cos(2\pi f_m t)$ for complete 4 cycles.

   (b) Plot the carrier signal $c(t) = A_c \cos(2\pi f_c t)$ for a duration equal to the duration of the message signal $m(t)$.

   (c) Plot the SSB-SC signal $\phi_{\text{SSB}}(t)$ for both USB and LSB transmissions.

   (d) Plot the frequency spectrum of the signals in part (a) (b) and (c).

   (e) Demodulate the above SSB-SC signal using the synchronous detector discussed in the class. Plot the demodulated signal and its spectrum. Assume that the receiver can generate a carrier signal i) $c(t) = A_c \cos(2\pi f_c t)$; and ii) $c(t) = A_c \cos(2\pi f_c t + \phi)$ with $\phi = 90^o$.

   Note: Do not use inbuilt function 'modulate' and 'demodulate'! Take a large no. of samples to get a smooth curve. Plot all the sub-parts in the same plot using subplot.

2. Consider a multi-tone signal $m(t) = A_1 \cos(2\pi f_1 t) + A_2 \cos(2\pi f_2 t)$ and a carrier signal $A_c \cos(2\pi f_c t)$ with $A_c = A_1 = A_2 = 1$, $f_1 = 100$ Hz, $f_2 = 200$ Hz and $f_c = 2$ KHz.

   (a) Plot the signal $A_1 \cos(2\pi f_1 t)$ for complete two cycles.

   (b) Plot the signal $A_2 \cos(2\pi f_2 t)$ and the carrier signal $A_c \cos(2\pi f_c t)$ over the duration of signal $A_1 \cos(2\pi f_1 t)$.

   (c) Plot the SSB-SC signal $\phi_{\text{SSB}}(t) = A_c m(t) \cos(2\pi f_c t) \pm j A_c m_h(t) \sin(2\pi f_c t)$ for both USB and LSB transmissions.

   (d) Plot the frequency spectrum of the message signal $m(t)$, the carrier signal $c(t) = A_c \cos(2\pi f_c t)$ and the signal $\phi_{\text{SSB}}(t)$ for both USB and LSB transmissions.

   (e) Demodulate the above SSB-SC signal using the synchronous detector discussed in the class. Plot the demodulated signal and its spectrum. Assume that the receiver can generate a carrier signal i) $c(t) = A_c \cos(2\pi f_c t)$; and ii) $c(t) = A_c \cos(2\pi f_c t + \phi)$ with $\phi = 90^o$.

Note: Do not use the inbuilt function 'modulate' and 'demodulate'. Take a large no. of samples to get a smooth curve. Plot all the sub-parts in the same plot using subplot.