Principles of Communication Systems Lab (303 P)

Lab-6 (Angle Modulation and Demodulation)
(Due Date: 12-10-2021, 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 an information signal $m(t) = A_m \cos(2\pi f_m t)$ with $A_m = 1$ V and $f_m = 50$ Hz, and a carrier signal $c(t) = A_c \cos(2\pi f_c t)$ with $A_c = 2$ V and $f_c = 250$ Hz.

   (a) Plot $m(t)$ for 5 complete cycles, and plot $c(t)$ over the duration of $m(t)$.

   (b) Consider frequency sensitivity $k_f = 12.5$ Hz/Volt and plot the frequency modulated signal $\phi_{\text{FM}}(t) = A_c \cos(2\pi f_c t + 2\pi k_f \int_{-\infty}^{t} m(\alpha) d\alpha)$ and its spectrum. Also calculate the bandwidth of the modulated signal.

   (c) Consider frequency sensitivity $k_f = 100$ Hz/Volt and plot the frequency modulated signal $\phi_{\text{FM}}(t) = A_c \cos(2\pi f_c t + 2\pi k_f \int_{-\infty}^{t} m(\alpha) d\alpha)$ and its spectrum. Also calculate the bandwidth of the modulated signal.

   (d) Vary k_f from 12.5 Hz/V to 100 Hz/V and analyze its effect on power and bandwidth of the FM signal.

   (e) Demodulate the frequency modulated signal and plot the demodulated signal (take $k_f = 100$ Hz/Volt).

Note: Use inbuilt function 'fmmod' and 'fmdemod' for modulation and demodulation. Take a large no. of samples to get a smooth curve. Plot all the sub-parts in the same plot using subplot.

2. Consider an information signal $m(t) = A_m \cos(2\pi f_m t)$ with $A_m = 1$ V and $f_m = 50$ Hz, and a carrier signal $c(t) = A_c \cos(2\pi f_c t)$ with $A_c = 2$ V and $f_c = 250$ Hz.

   (a) Plot $m(t)$ for 5 complete cycles, and plot $c(t)$ over the duration of $m(t)$.

   (b) Consider phase sensitivity $k_p = 0.25$ rad/Volt and plot the phase modulated signal $\phi_{\text{PM}}(t) = A_c \cos(2\pi f_c t + k_p m(t))$ and its spectrum. Also calculate the bandwidth of the modulated signal.

   (c) Consider phase sensitivity $k_p = 2$ rad/Volt and plot the phase modulated signal $\phi_{\text{PM}}(t) = A_c \cos(2\pi f_c t + k_p m(t))$ and its spectrum. Also calculate the bandwidth of the modulated signal.

   (d) Vary k_p from 0.25 rad/V to 2 rad/V and analyze its effect on power and bandwidth of the PM signal.

   (e) Demodulate the phase modulated signal and plot the demodulated signal (take $k_p = 2$ rad/Volt).

   Note: Use inbuilt function 'pmmod' and 'pmdemod' for modulation and demodulation. Take a large no. of samples to get a smooth curve. Plot all the sub-parts in the same plot using subplot.

3. Plot the frequency modulated signal and phase modulated signal in the same plot using subplots. Compare the two plots and write your observation.