Communication Systems Lab
Lab Manual 11
FM Demodulation techniques

In the previous lab, we formed various frequency modulated signals from a given message signal. In this lab, we will demodulate the FM signal to recover the original message signal back. The suggested reading from the text is topic 5.4 (Demodulation of FM Signals.)

Two approaches for demodulation of FM signals will be implemented in this lab:

- Derivative Method
- Phase-locked Loop (PLL) Method

In the derivative method, we will convert a frequency demodulation (FM) demodulation problem into an easier amplitude demodulation problem by the use of a differentiator. In the PLL method, we will use the fact that in locked state the output of the loop filter of the PLL would be proportional to the message signal.

Laboratory Tasks

Task 1: Take $m(t) = 0.5\cos(20\pi t)$, and using a carrier frequency of 5000Hz, form a suitable frequency modulated signal $\phi_{FM}(t)$.

Task 2: Since we are dealing with samples in MATLAB and not continuous values, we will approximate the derivative by the following relation:

$$\frac{x[t+\Delta t]-x[t]}{\Delta t},$$

where Δt is the sampling time. Differentiate the sampled FM signal using the above relation and plot it. Also superimpose the frequency modulated signal on the plot.

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Task 3: The signal obtained in Task 2 will be an amplitude modulated signal. Perform envelope detection on this signal using the techniques developed in the amplitude demodulation lab tasks, to recover the message signal. Plot the recovered signal and verify that it is the desired signal. (**Note:** You should select suitable frequency of the carrier to ensure that envelope detection can be performed)

Task 4: Pass the FM signal developed in Task 1 to the PLL developed in Lab 8. Modify the center frequency parameter of the PLL if required. Verify that the PLL is able to lock onto the input signal.(**Hint:** If the frequency variation of the FM signal is greater than the lock range of the PLL ,0 you can modify k_f)

Task 5: Plot the signal at the output of the loop filter of the PLL. This signal will be proportional to the message signal.

Task 6: Determine the scaling factor required to extract $m(t)$ from the signal in the previous step.Scale the signal with that factor and plot $m(t)$.

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