LAB SESSION 4

FREQUENCY MODULATION

OBJECTIVE

To perform the frequency modulation using MATLAB and visualize the characteristics of signals by changing parameters

REQUIREMENTS

- Intel based computer
- MATLAB

THEORY

Frequency modulation (FM) is the encoding of information in a carrier wave by varying the instantaneous frequency of the wave. The technology is used in telecommunications, radio broadcasting, signal processing, and computing. In analogue frequency modulation, such as radio broadcasting, of an audio signal representing voice or music, the instantaneous frequency deviation, i.e. the difference between the frequency of the carrier and its centre frequency, has a functional relation to the modulating signal amplitude.

Frequency modulation is widely used for FM radio broadcasting. It is also used in telemetry, radar, seismic prospecting, and monitoring newborns for seizures via EEG, two-way radio systems, sound synthesis, magnetic tape-recording systems and some video-transmission systems. In radio transmission, an advantage of frequency modulation is that it has a larger signal-to-noise ratio and therefore rejects radio frequency interference better than an equal power amplitude modulation (AM) signal. For this reason, most music is broadcast over FM radio.

The message signal, such as an audio signal that is used for modulating the carrier, is $m(t)$, and has a frequency f_m, much lower than f_c:

$$m(t) = A_m sin\,(2\pi f_m t)$$

The carrier wave (sine wave) of frequency f_c and amplitude A is expressed by

$$c(t) = A_c sin\,(2\pi f_c t)$$

The expression of modulated signal y(t), can be written as,

$$y(t) = A_c \cos\,(2\pi f_c t + \frac{f_\Delta}{f_m} sin\,(2\pi f_m t))$$

where A_m is the amplitude of the modulating sinusoid is represented in the peak $f_\Delta = k_f * A_m$ deviation and k_f is the sensitivity of frequency modulator.

PROCEDURE

Generating message and carrier signals

Matlab Code :

```
clc

close all

t = 0:0.001:1; %upto 1000 samples

vm = input('Enter Amplitude (Message) = ');

vc = input('Enter Amplitude (Carrier) = ');

fM = input('Enter Message frequency = ');

fc = input('Enter Carrier frequency = ');

m = input('Enter Modulation Index = ');

msg = vm*sin(2*pi*fM*t);

subplot(3,1,1); %plotting message signal

plot(t,msg);

xlabel('Time');

ylabel('Amplitude');

title('Message ');

carrier = vc*cos(2*pi*fc*t);

subplot(3,1,2); %plotting carrier signal

plot(t,carrier);

xlabel('Time');

ylabel('Amplitude');

title('Carrier Signal');

y = vc*sin(2*pi*fc*t+m.*cos(2*pi*fM*t));

subplot(3,1,3);%plotting FM (Frequency Modulated) signal

plot(t,y);

xlabel('Time');

ylabel('Amplitude');

title('FM Signal');
```

LAB WORK

Task 1

Generate the message signal with 8 Hz frequency and amplitude 5, and modulate it to the carrier with 100 Hz frequency and amplitude 8. Enter the modulation index 10. Plot the message signal, carrier and modulated signal in single figure and place the plot in Figure 4.1. The plot should contain student ID and Name as title of the figure.

Figure 4.1

COMMENTS & DISCUSSION

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