ANALOG COMMUNICATION LAB REPORT (EC - 225)

ELECTRONICS AND COMMUNIACTION ENGINEARING

Submitted By

Himanta Biswa Deka

Scholar Id: 1914018

ECE(A)

Exp: 4

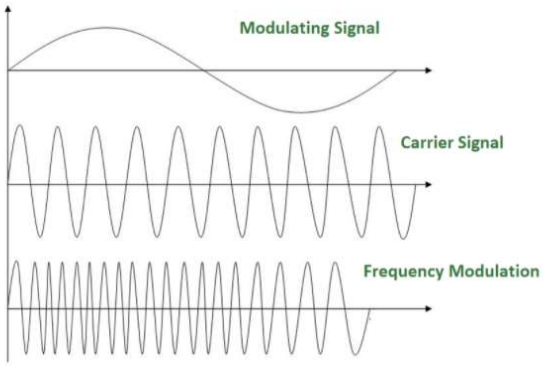
Titile : *Frequency modulation and demodulation.*

Aim: To generate the frequency modulated signal (FM Wave)by using given carrier signals and message signals in MATLAB and also perform its demodulation.

Software Used : **MATLAB** software.

Brief Theory :

Frequency Modulation (FM) is the encoding of information in a carrier wave by changing the instantaneous frequency of the wave. In analog 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 center frequency, has a functional relation to the modulating signal amplitude.



Frequency Modulation equation:
There are two types of FM waves, they are Narrow Band FM(NBFM) and Wide Band FM(WBFM).
The equation of NBFM is

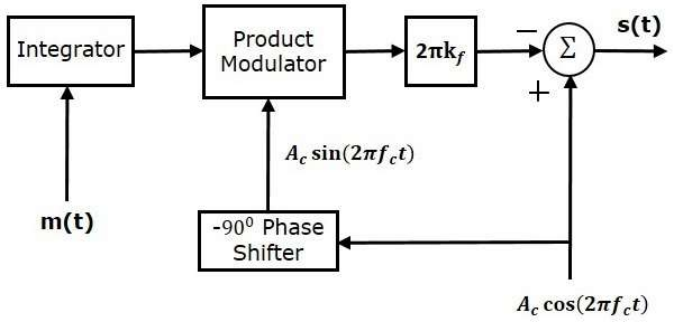
$$s(t)=A_c \cos(2\pi f_c t+2\pi k_f \int m(t)dt)$$

$$s(t) = A_c\cos(2\pi f_c t)\cos(2\pi k_f \int m(t)dt) - A_c\sin(2\pi f_c t)\sin(2\pi k_f \int m(t)dt)$$

For NBFM,

$$|\ 2\pi k_f \int m(t)dt\ | << 1$$

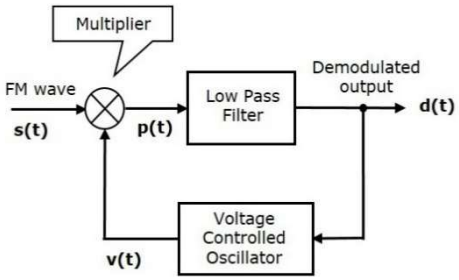
Block Diagram of FM Modulation:



When there is modulation, usually we need to successfully demodulate it and at the same time recover the original signal. The following two methods demodulate FM wave.

- Frequency discrimination method
- Phase discrimination method

Block Diagram of FM Demodulator:



CODE AND EXECUTION:

The code attached herewith is for the frequency modulation and demodulation.

#Code:: Frequency Modulation

```
clc;
clear all;
close all;

fm = 10;          %modulating signal frequency
fc = 100;         %carrier signal frequency
B = 5;           %modulation index
t = linspace(0,0.2,1000);

em = cos(2*pi*fm*t);  %modulating/message signal
ec = cos(2*pi*fc*t);  %carrier signal
y = cos((2*pi*fc*t) + (B.*sin(2*pi*fm*t)));  %modulated signal

figure;
subplot(3,1,1);
plot(t,em);      %plotting modulating/information signal
xlabel('Time(sec)');
ylabel('Amplitude(V)');
title('Modulating Signal');
legend('e_m(t)');
grid on;

subplot(3,1,2);
plot(t,ec);      %plotting carrier signal
xlabel('Time(sec)');
ylabel('Amplitude(V)');
title('Carrier Signal');
legend('e_c(t)');
grid on;

subplot(3,1,3);
plot(t,y);      %plotting modulated signal
xlabel('Time(sec)');
ylabel('Amplitude(V)');
title('FM Modulated Signal');
legend('e(t)');
grid on;
```

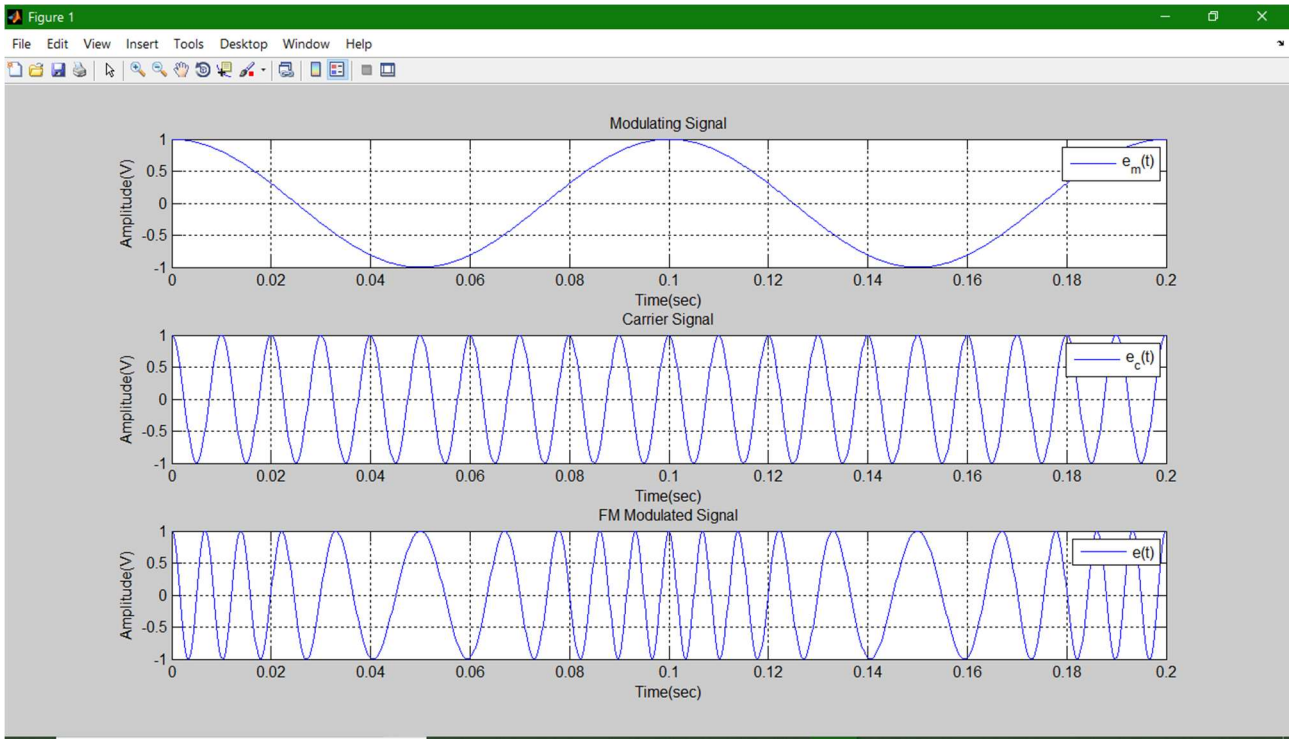


Fig1: Frequency Modulation

#Code:: Frequency Demodulation

```
clc;
clear all;
close all;

fs = 1000;
fm = 10;                %modulating signal frequency
fc = 100;               %carrier signal frequency
B = 5;                 %modulation index
t = 0:0.001:1;

m = cos(2*pi*fm*t);     %modulating/message signal
c = cos(2*pi*fc*t);     %carrier signal
fm_mod = cos((2*pi*fc*t) + (B.*sin(2*pi*fm*t)));         %modulated signal
x = diff(fm_mod);
y = abs(x);
[b,a] = butter(10,0.56);
h = filter(b,a,y);

% filter
f_high = 2*fm;
f_low = 0.5*fm;
[num,den] = butter(2,[f_low f_high]*2/fs); % Lowpass filter
% s1 = fmdemod(fm,fc,fm,0,0,num,den); % Demodulate
fm_demod = filter(num,den,y);

figure;
```

```
subplot(3,1,1);
plot(t,fm_mod);                %plotting modulated signal
xlabel('Time(sec)');
ylabel('Amplitude(V)');
title('Modulated Signal');
legend('modf_m(t)');
grid on;

subplot(3,1,2);
plot(fm_demod);                %plotting demodulated signal
xlabel('Time(sec)');
ylabel('Amplitude(V)');
title('Demodulating Signal');
legend('demodf_m(t)');
grid on;
```

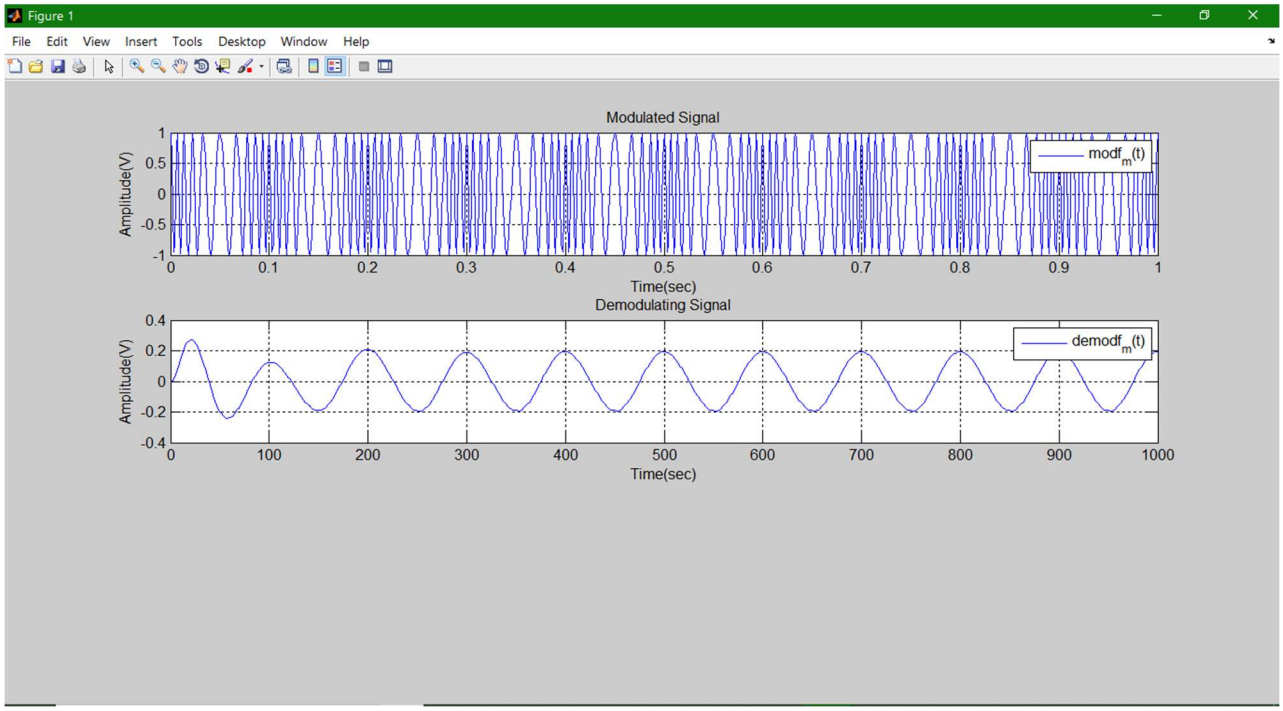


Fig2: Frequency Demodulation

CONCLUSION:

The MATLAB code for FM modulation and demodulation both worked properly and the output curve for both were recorded and studied how they are varying with time. This is how a particular frequency modulated signal is created and then it is sent through the channel and then the demodulation is done in the receiving

station for extracting the original signal. Several advanced methods are also there, which involves better mechanisms.