

LABORATORY RECORD COMMUNICATION ENGINEERING LAB (EC 2094) AUTUMN 2020

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SCHOOL OF ELECTRONICS ENGINEERING, KIIT Deemed to be University

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Experiment Number	01
Date of Experiment	03/08/2020
Date of Submission	17/08/2020
Name of the student	Debagnik Kar
Roll Number	1804373
Section	ETC-06

Aim of The Experiment :-

Generation and detection of Amplitude Modulation and Demodulation, DSBSC and SSB-SC modulation.

Equipment / Software Required:-

- Matlab R2018a

Theory:

Amplitude modulation: AM is a modulating technique which is generally used to transmit Radio signals over a carrier signal, where the amplitude of the modulated changes in response of the signal.

Mathematically,

If the carrier signal is,

$$c(t) = A_c \cdot \cos(2\pi \cdot f_c \cdot t)$$

And the message signal is,

$$m(t) = A_m \cdot \cos(2\pi \cdot f_m \cdot t)$$

Then the equation of the modulated signal is,

$$s(t) = [A_c + \cos(2\pi \cdot f_m \cdot t)] \cdot \cos(2\pi \cdot f_c \cdot t)$$

If we solve this equation further, we get,

$$s(t) = A_c \left[1 + \frac{A_m}{A_c} \cdot \cos(2\pi \cdot f_m \cdot t) \right] \cdot \cos(2\pi \cdot f_c \cdot t)$$

$$s(t) = A_c [1 + \mu \cdot \cos(2\pi \cdot f_m \cdot t)] \cdot \cos(2\pi \cdot f_c \cdot t), \quad \text{Where, } \mu = \frac{A_m}{A_c}$$

Modulating Index(μ), also known as modulation depth, of a modulation scheme describes by how much the modulated variable of the carrier signal varies around its unmodulated level. It is defined differently in each modulation scheme.

DSBSC: The transmission of a signal, which contains a carrier along with two sidebands can be termed as Double Sideband Full Carrier system or simply DSBSC.

Mathematically,

If the carrier Signal is,

$$c(t) = Ac. \cos(2. \pi. fc. t)$$

And the message signal is,

$$m(t) = Am. \cos (2. \pi. fm. t)$$

Then the modulating signal will be,

$$s(t) = m(t).c(t)$$

or, $s(t) = Am. Ac. \cos(2. \pi. fm. t) . \cos(2. \pi. fc. t)$

SSBSC: The process of suppressing one of the sidebands along with the carrier and transmitting a single sideband is called as Single Sideband Suppressed Carrier system or simply SSBSC.

Mathematically,

If the carrier Signal is,

$$c(t) = Ac. \cos(2. \pi. fc. t)$$

And the message signal is,

$$m(t) = Am. \cos (2. \pi. fm. t)$$

Then the modulating signal will be,

$$s(t) = \frac{Am. Ac}{2} . \cos[2. \pi. (fc + fm).t] \text{ for the upper Sideband}$$

$$s(t) = \frac{Am. Ac}{2} . \cos[2. \pi. (fc - fm).t] \text{ For the lower Sideband}$$

Code:-

<<<File: GenerateAM.m Comment: This code will amplitude modulate and then demodulate a sine wave.>>>

```
%generating user defined AM Signals  
%Written By Debagnik Kar 1804373
```

```
clc;  
clear all;  
close all;
```

```
t = linspace(0,1,1000) %Time of 1 secs divided by 1000 times  
%Carrier wave  
fc = input('Enter fc = ');  
ac = input('Enter ac = ');  
xc= cos(2*pi*fc*t)
```

```
%Message signal  
fm = input('Enter fm = ');  
am = input('enter am = ');
```

```
xm = cos(2*pi*fm*t);
```

```
%AMplitude modulation
```

```
y = [ac + am*xm].*xc;
```

```
%plot AM  
subplot(4,1,1)  
plot(t,xc);  
xlabel("Time -->")  
ylabel("Amplitude -->")  
title("Carrier Wave")  
subplot(4,1,2)  
plot(t,xm)  
xlabel("Time -->")  
ylabel("Amplitude -->")  
title("Message Wave")  
subplot(4,1,3)  
plot(t,y)  
xlabel("Time -->")  
ylabel("Amplitude -->")  
title("Modulated Wave")
```

```
%if else statement
```

```
mu = am/ac;
```

```
if mu==1
```

```

        disp('Critical modulation');
elseif mu>1
    disp('Over modulated signal');
elseif mu<1
    disp('under modulated signal');
end

```

```

%Demodutating The wave
dm = y.^2;
[b,a] = butter(10,0.1);
xd = filter(b,a,dm);

```

```

subplot(4,1,4)
plot(t,xd);
xlabel("Time -->")
ylabel("amplitude")
title("Demodulated Wave")

```

<<<File:DSBSC.m Comment: This code will generate a DSBSC Modulated signal>>>

```

%DSBSC Generation
%Written by Debagnik Kar 1804373
clc;
clear all;
close all;
t = linspace(0,4,1000);

```

```

fc = input('Enter the carrier frequency: ');
ac = input('Enter the carrier amplitude: ');
fm = input('Enter the message frequency: ');
am = input('Enter the message amplitude: ');

```

```

y = am*cos(2*pi*fm*t) %message signal
z = ac*cos(2*pi*fc*t) %carrier signal

```

```

w = ((am*ac)/2).*(cos(2*pi*(fc+fm)*t)+cos(2*pi*(fc-fm)*t))
%DSBSC Modulation
subplot(3,1,1)
plot(t,z)
xlabel("time -->")
ylabel("magnitude -->")
title("Carrier Signal")
subplot(3,1,2)
plot(t,y)
xlabel("time -->")
ylabel("magnitude -->")
title("Message Signal")
subplot(3,1,3)
plot(t,w)
xlabel("time -->")
ylabel("magnitude -->")

```

```
title("DSBSC Signal")
```

```
<<<File: SSBSC.m Comment: Generates an upper sideband, a lower side band SSBSC>>>
```

```
% Generation of SSB-SC Signal
```

```
% Written by Debagnik Kar
```

```
clear all
```

```
close all
```

```
clc
```

```
fc = input('Enter the frequency of Carrier: ')
```

```
ac = input('Enter the amplitude of Carrier: ')
```

```
fm = input('Enter the frequency of Message: ')
```

```
am = input('Enter the amplitude of Message: ')
```

```
t = linspace(0,1,1000)
```

```
m = am*cos(2*pi*fm*t) %Message signal
```

```
c = ac*cos(2*pi*fc*t) %carrier Signal
```

```
Susb = ((am*ac)/2).*cos(2*pi*(fc+fm)*t) %upper Sideband
```

```
Slsb = ((am*ac)/2).*cos(2*pi*(fc-fm)*t) %lower Sideband
```

```
subplot(4,1,1)
```

```
plot(t,c,'r')
```

```
xlabel("Time -->")
```

```
ylabel("Amplitude-->")
```

```
title("Carrier Wave")
```

```
subplot(4,1,2)
```

```
plot(t,m,'g')
```

```
xlabel("Time -->")
```

```
ylabel("Amplitude-->")
```

```
title("Message Wave")
```

```
subplot(4,1,3)
```

```
plot(t,Susb,'b')
```

```
xlabel("Time -->")
```

```
ylabel("Amplitude-->")
```

```
title("Upper Sideband SSB-SC Signal")
```

```
subplot(4,1,4)
```

```
plot(t,Slsb,'k')
```

```
xlabel("Time -->")
```

```
ylabel("Amplitude-->")
```

```
title("Lower Sideband SSB-SC Signal")
```

Output/Graph:-

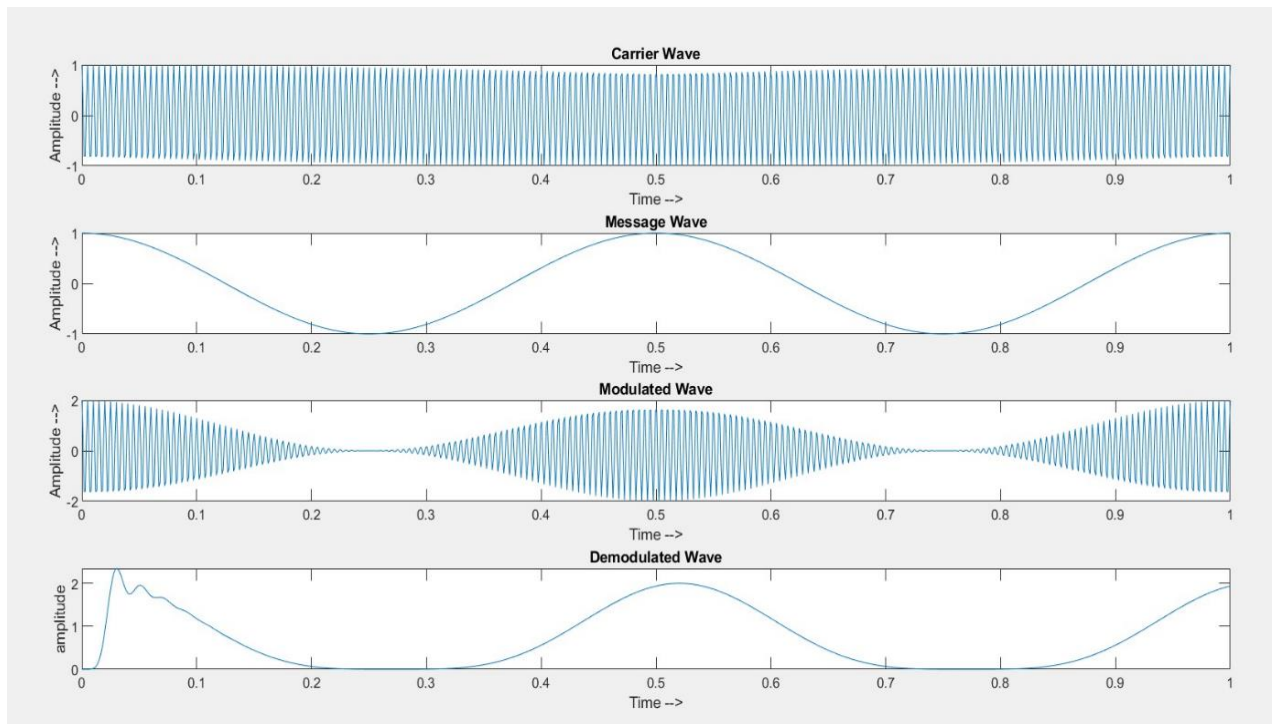


Fig 1 : Amplitude modulating and Demodulating a Sine wave of 2Hz

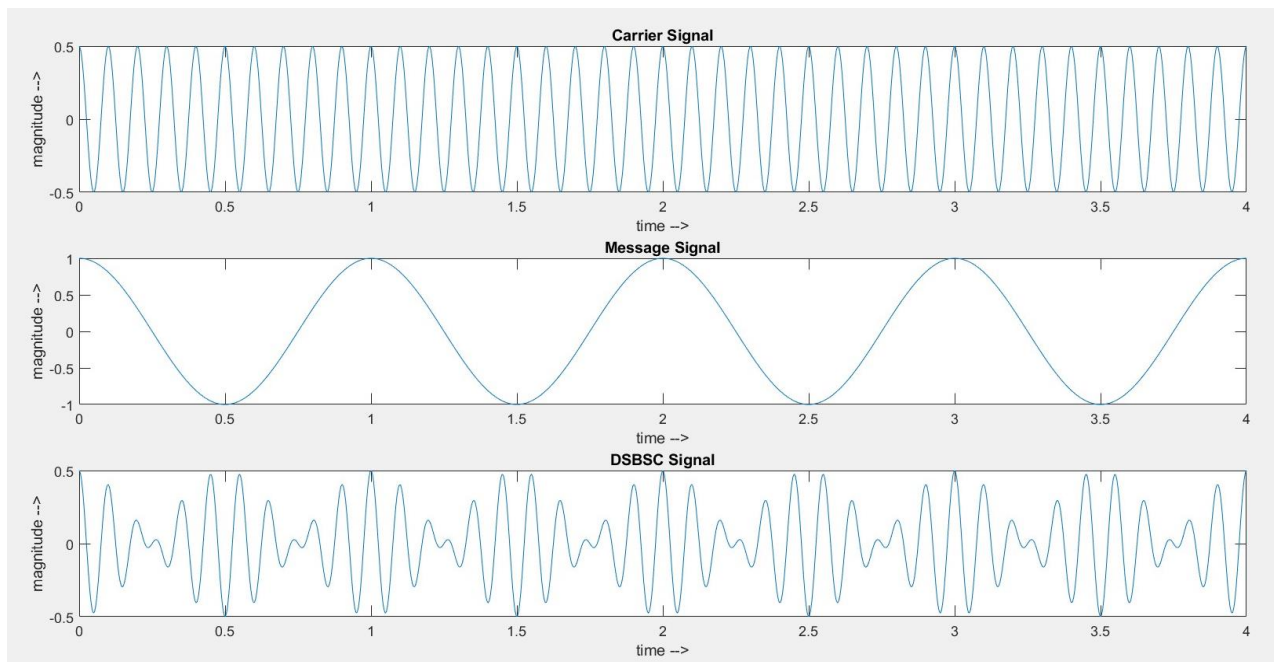


Fig 2: Generation of DSBSC Signal

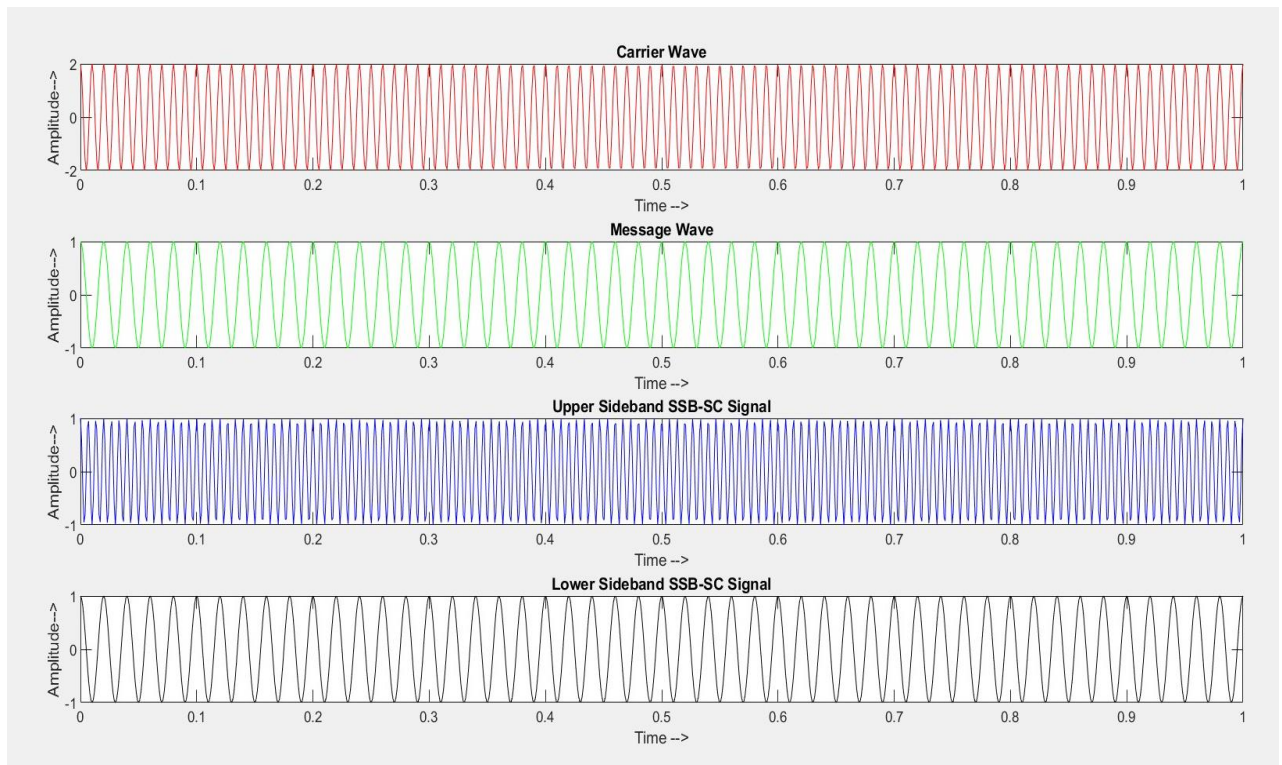


Fig 3: Generation of SSBSC Signal

Discussion or Inference of the experiment

This experiment taught me about different kind of amplitude modulation and demodulation techniques that is practiced in analog radio communication technology. It also helped me visualize the difference between the different techniques of transmission

Conclusion:-

The simulation of experiment is done successfully using MATLAB Software.