Faculty of Engineering & Technology

Electrical & Computer Engineering Department

ENEE3309

Communication Systems

Course Project

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Abstract:

The aim of this project is to get to know how to use matlab program to plot and modulate a signal in many ways, also knowing how to demodulate a signal using envelop detector. Finally, to learn more closely about the materials we took.

Contents

Procedure:

Consider the AM signal:

$$(t) = Ac\ [1 + \mu \cos(2\pi fmt)]\cos(2\pi fc\ t)$$

- ### Part 1:

Use Matlab (m-file commands) to plot (t) assuming $\mu = 0.25$, $Ac = 1$, fm = 1Hz, fc = 25Hz over two cycles of the message m(t) = cos(2πfmt).

<u>Matlab Code:</u>

```
close all
clear all
mu=0.25;
Ac=1;
fm=1;
fc=25;
t=0:0.001:2;
m=cos(2*pi*fm*t);
s=(Ac.*(1+(mu.*m)).*cos(2.*pi.*fc.*t));
plot(t,s);
title('Modulated Signal (s(t))');
xlabel('Time (s)');
ylabel('s(t)');
grid on
```

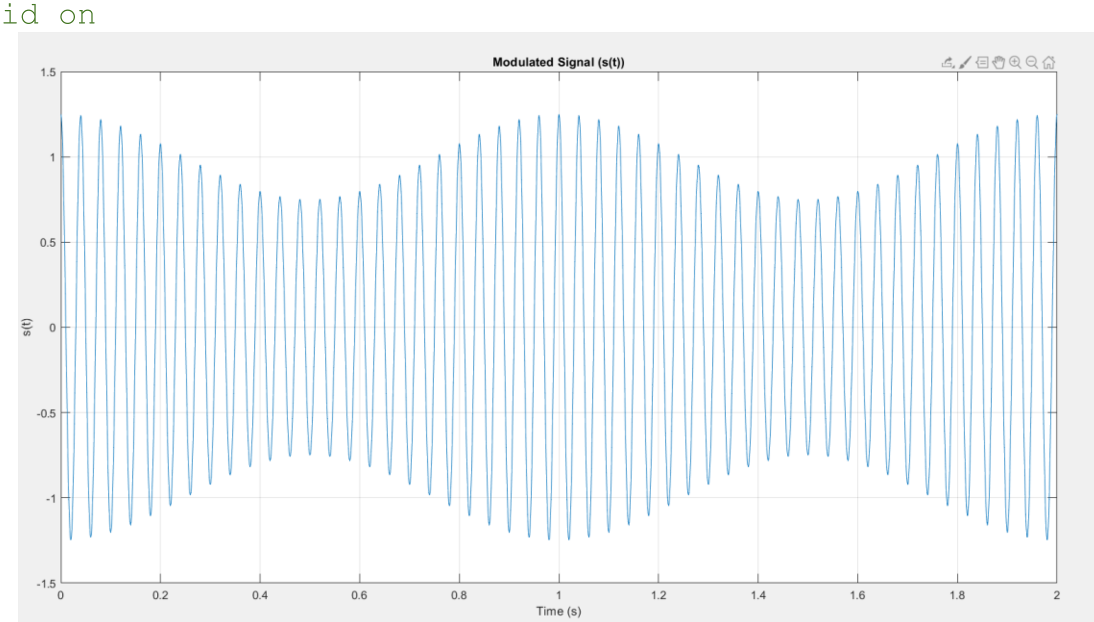

Fig.1

Discussion:

As we see the program plotted the modulated signal s(t) on two cycles (Tm=1s ➔ 2Tm=2s), As shown in fig.1.

- ## Part 2:

If (t) is passed through an ideal envelope detector, plot the demodulated signal over two cycles of the message m(t).

Matlab Code:

```
close all
clear all
mu=0.25; %modulation index
Ac=1;
fm=1;
fc=25;
t=0:0.001:2;
m1=cos(2*pi*fm*t); %modulating signal m1(t)
s=(Ac.*(1+(mu.*m1)).*cos(2.*pi.*fc.*t)); %modulated signal
s(t)
m2=abs(Ac.*(1+(mu.*m1))); %demodulated signal using ideal
envelope m2(t)
subplot(2,2,1);
plot(t,m1);
title('Modulating Signal m1(t)');
xlabel('Time (sec)');
ylabel('m1(t)');
grid on
subplot(2,2,2);
plot(t,s);
title('Modulated Signal (s(t))');
xlabel('Time (s)');
ylabel('s(t)');
grid on
subplot(2,2,3);
plot(t,m2);
title('Demodualted signal m2(t)');
xlabel('Time (s)');
ylabel('m2(t)');
grid on
```

Output:

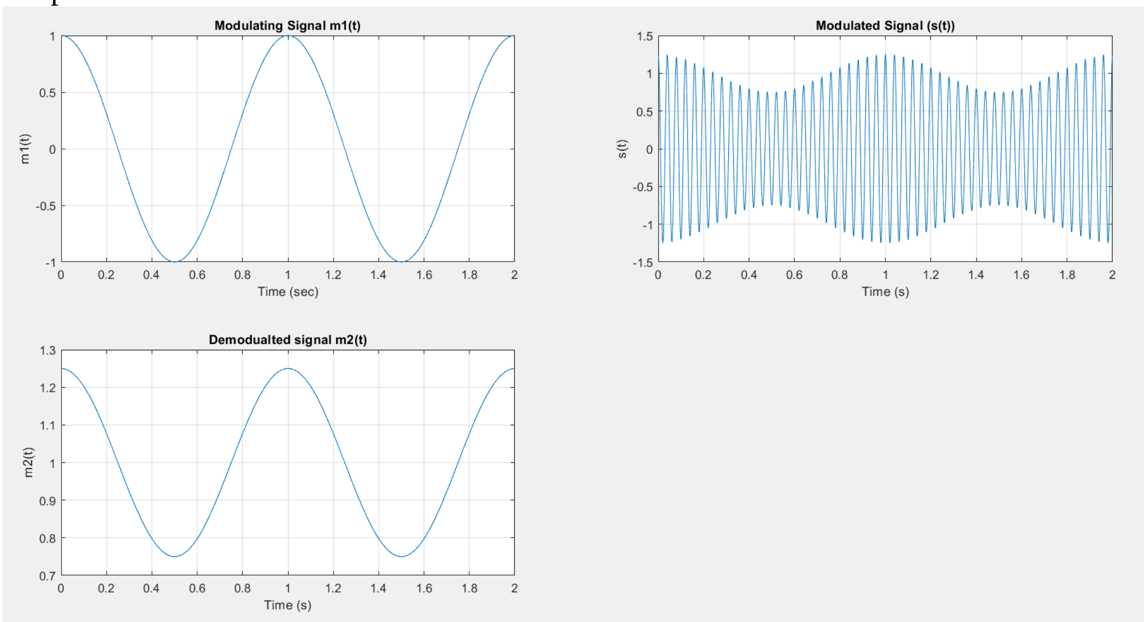

Fig.2

Discussion:

I made the program here plot both modulated and demodulated signal. The demodulated signal is came from applying ideal envelope on the modulated signal and the final result is approximately the original signal m(t), as shown in fig.2.

- ## Part 3:

Matlab Code:

```
close all
clear ALL
mu=0.25;  %modulation index
Ac=1;
fm=1;
fc=25;
t=0:0.001:2;
m1=cos(2*pi*fm*t); %modulating signal m1(t)
s=(Ac.*(1+(mu.*m1)).*cos(2.*pi.*fc.*t)); %modulated signal s(t)
m2=abs(Ac.*(1+(mu.*m1))); %demodulated signal using ideal
envelope m2(t)
tau=0.04:0.0005:1;
num_tau=length(tau);
Ts=0.004/100;             %Sampling time
num_pts=length(t);
plot(t,s)
hold all
plot(t,m2)
for i=0:num_tau
    output_signal(1,1)=1+mu;
    for n=1:num_pts-1
        if output_signal(1,n)<=s(1,n)
            output_signal(1,n+1)= s(1,n);

        else
            output_signal(1,n+1)=output_signal(1,n).*exp(-
Ts/tau(1,i));

        end


    end
    D=fm.*(sum((output_signal-m2).^2));
end
plot(t,output_signal);
plot(tau,D);
[~,TauOptimum]=min(D);
```

Note:

The program is logical in my view but I couldn't detect the error and get the requested in the question.

Discussion:

a-First, the program should plot the mean square verses tau so it will be similar to the sinusoidal graph.

b-The best value or the obtimum value of time that the mean square error is the least at it.

We get it from min(D)=OptimumValue

c-Plotting y is the basic of the question which will show the spaces that error is clear and it will take approximately small triangular.

Conclusion:

In the final of this project, we have gotten knowledge of how to use matlab in many ways and particularly in calculating and plotting signal modulation and demodulation systems. Also we have learned the concept of AM modulation and demodulation by ideal envelope detector in better way.