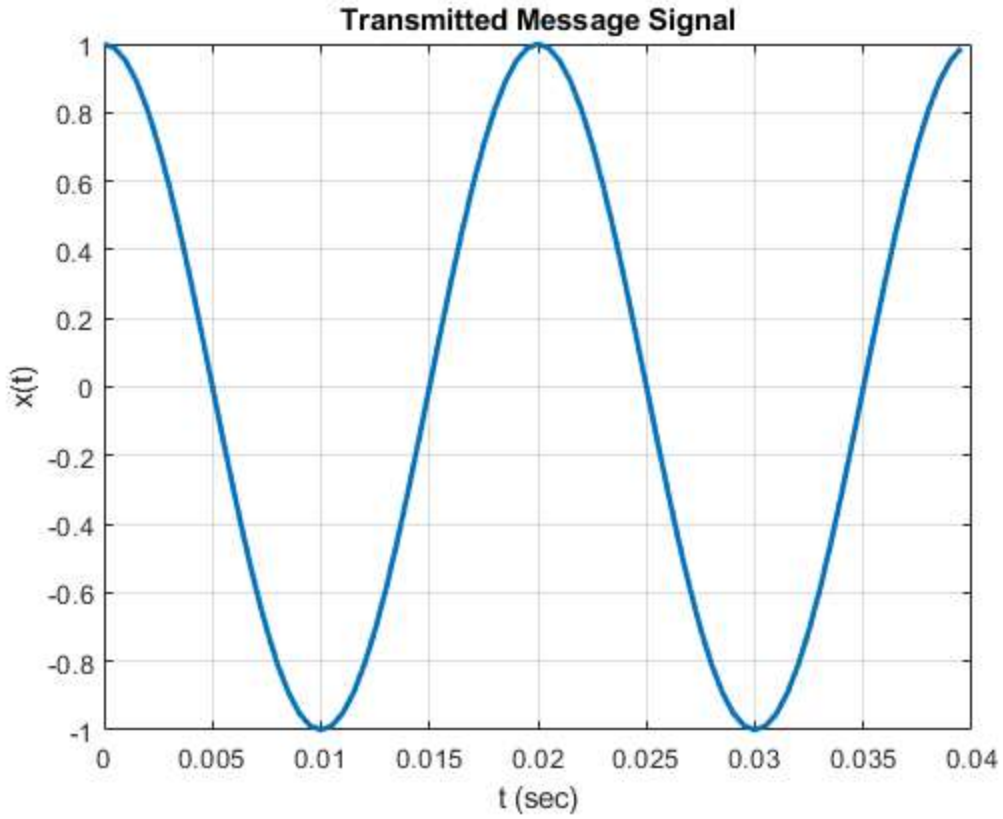
Contents

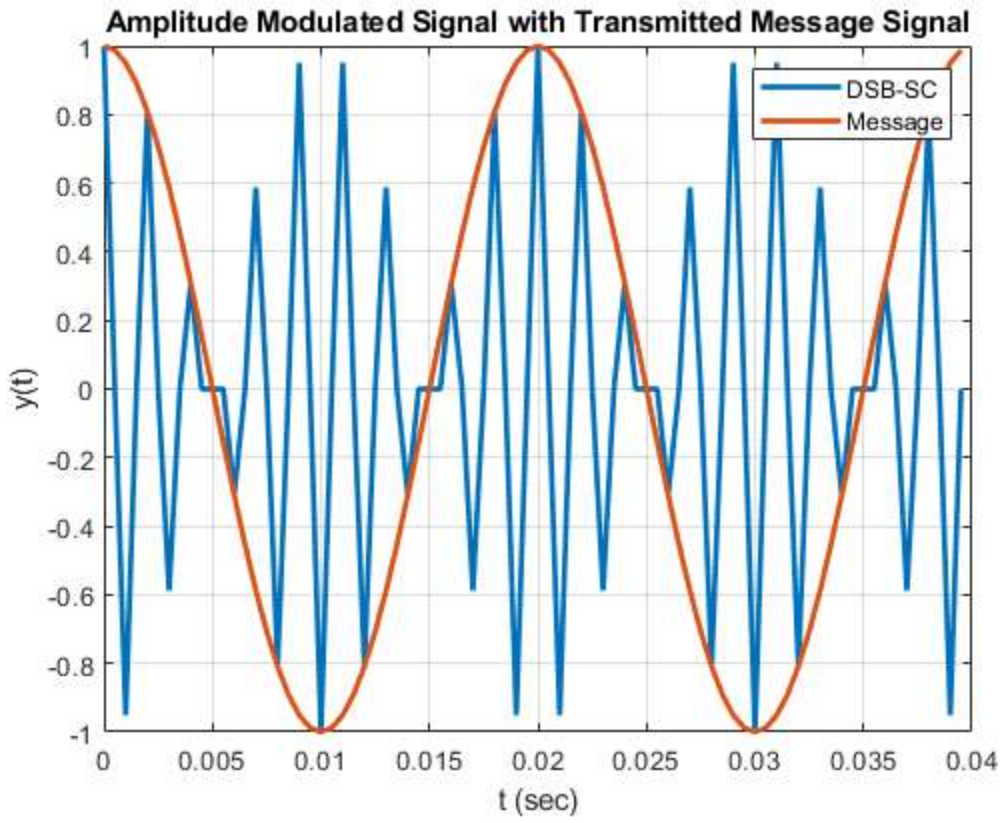
ELEG 44143 - Project 02 - 2022

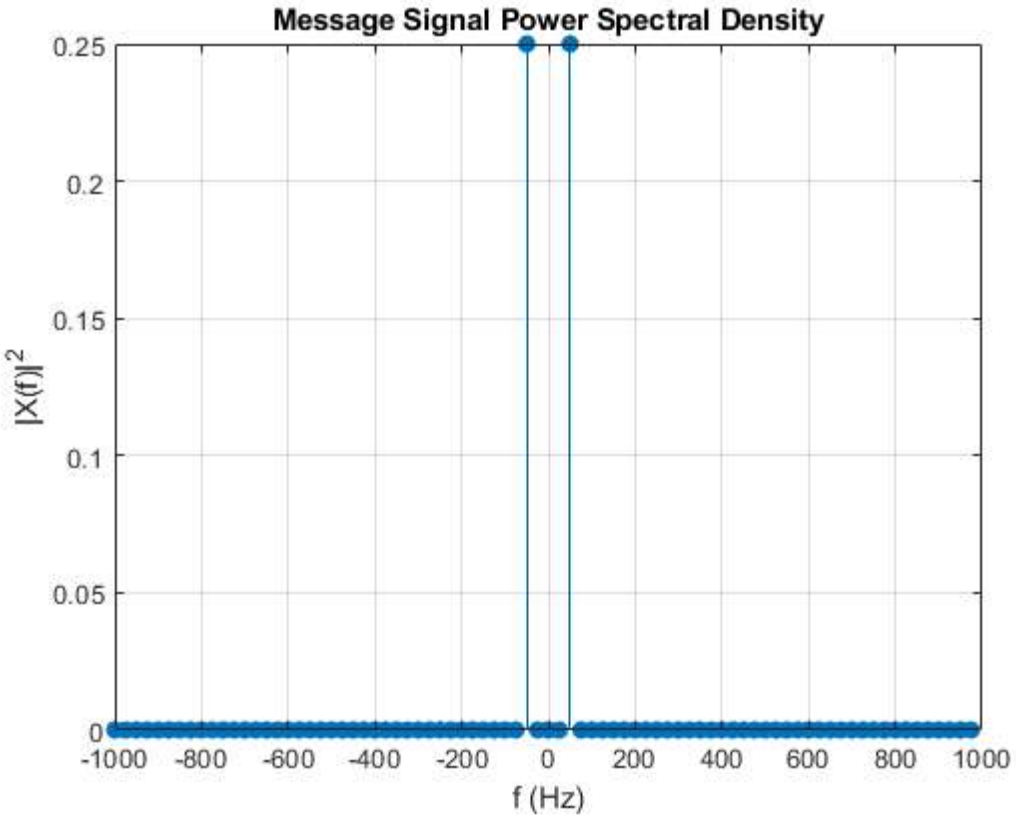
Generate a message signal with amplitude modulation

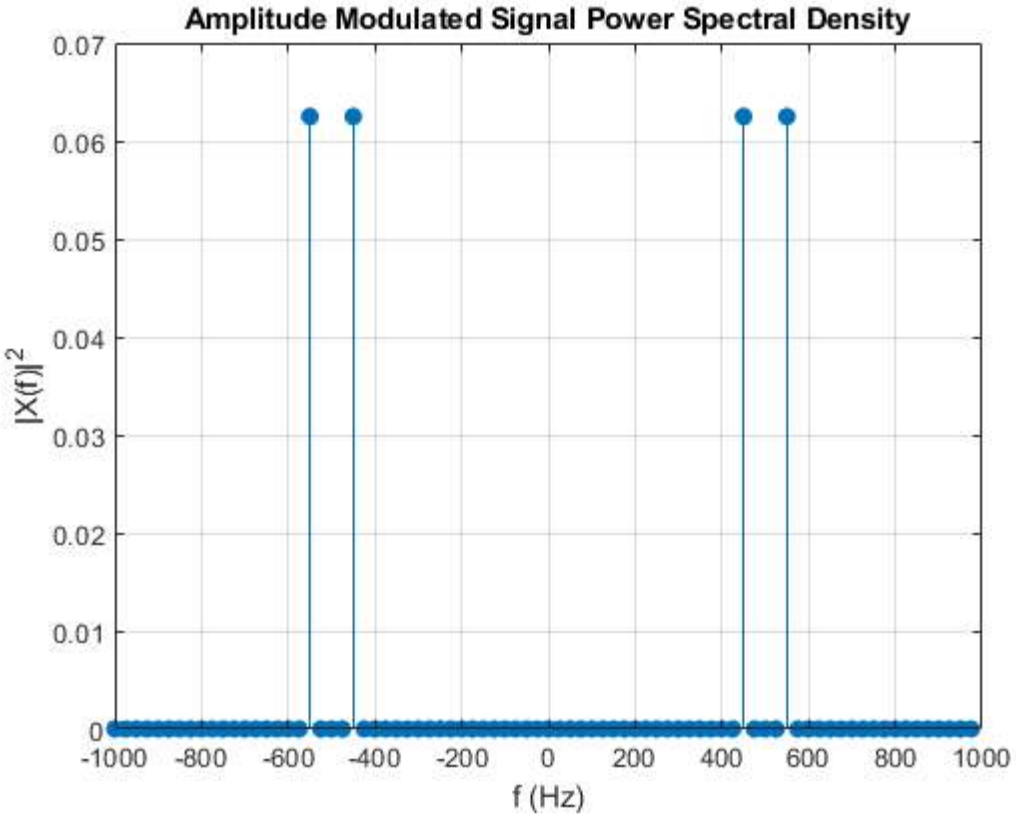
```
clear; close all; clc;
% Signal default parameters
fs = 2000; % Sampling frequency
fc = 500; % Carrier frequency
Nper = 2; % Number of periods in message
fm = 50; % Message frequency
Tp = 1/fm; % Period of message signal
T = Nper*Tp; % Signal duration
t = (0 : 1/fs : T-1/fs); % Sampling times
A = 0.0; % Message DC Shift ( 0 for DSB-SC or 1 for AM)
Am = 1.0; % Message amplitude
mu = 1.0; % Modulation index [0 to 1]
w = 0.5;
% Generate the message signal
wavetype = menu('Message Wave Form','Sinusoidal','Triangular');
if wavetype == 1
 message = cospi(2*fm*t); % Sinusoidal Message Signal
elseif wavetype == 2
 message = sawtooth(2*pi*fm*t,w); % Triangular Message Signal
end
modtype = menu('Modulation Protocol','DSB-SC','AM');
if modtype == 1
 A = 0.0;
 mu = 1;
elseif modtype == 2
 A = 1.0;
 mu = 1.0;
 titleBar = 'Enter a value for mu';
 userPrompt = 'mu =';
 Mu = inputdlg(userPrompt,titleBar,1,{num2str(mu)});
 mu = str2double(cell2mat(Mu));
end
x = Am*(A + mu * message); % Transmitted Message Signal
% Amplitude Modulation
y = ammod(x, fc, fs); % Amplitude Modulation
figure()
plot(t,x,'Linewidth',2);grid
xlabel('t (sec)');ylabel('x(t)')
title('Transmitted Message Signal')
figure()
plot(t,y,t,x,'Linewidth',2);grid
xlabel('t (sec)');ylabel('y(t)')
title('Amplitude Modulated Signal with Transmitted Message Signal')
legend('DSB-SC','Message')
% Spectrum of X (message) and Y (amplitude modulated signal)
X = fft(x);
lenX = length(X);
X = abs((X/lenX).^2); % Power Spectral Density (PSD)
```

```
X = fftshift(X);
Y = fft(y);
Y = abs((Y/length(Y)).^2); % PSD
Y = fftshift(Y);
f = (-lenX/2:lenX/2-1)*fs/lenX;
figure()
stem(f,X,'fill');grid;
xlabel('f (Hz)'); ylabel('|X(f)|^2')
title('Message Signal Power Spectral Density')
figure()
stem(f,Y,'fill');grid;
xlabel('f (Hz)'); ylabel('|X(f)|^2')
if modtype == 2
 title(['Amplitude Modulated Signal PSD, \mu = ',num2str(mu)])
else
 title('Amplitude Modulated Signal Power Spectral Density')
end
```


Transmitted Message Signal
x(t)
t (sec)
1
0.8
0.6
0.4
0.2
0
-0.2
-0.4
-0.6
-0.8
-1
0
0.005
0.01
0.015
0.02
0.025
0.03
0.035
0.04


Amplitude Modulated Signal with Transmitted Message Signal
DSB-SC
Message
y(t)
t (sec)
1
0.8
0.6
0.4
0.2
0
-0.2
-0.4
-0.6
-0.8
-1
0
0.005
0.01
0.015
0.02
0.025
0.03
0.035
0.04





Power Calculations

Power of the message, modulated signals (Ps), power efficiency for AM This code corresponds to whatever choice was selected via buttons and outputs the result to console.

```
PM = mean((mu.*x).^2) % mu is 1 by default, vald on all cases
PS = PM/2
eta = PM/(1+PM) * 100 % AM Power Efficiency
```

```
PM =

    0.5000


PS =

    0.2500


eta =

   33.3333
```

Results

When the message wave form is Sinusoidal:

```
And the modulation protocol is DSB-SC:
 PM = 0.5
 PS = 0.25
 eta = 33.3333%

And the modulation protocol is AM and mu = 0.5
 PM = 0.2813
 PS = 0.1406
 eta = 21.9512%
```

When the message wave form is Triangular:

```
And the modulation protocol is DSB-SC:
 PM = 0.3350
 PS = 0.1675
 eta = 25.0936%

And the modulation protocol is AM and mu = 0.5
 PM = 0.2709
 PS = 0.1355
 eta = 21.3179%
```

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