Frequency Devision Multiplexing – FDM

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# Variables :

% Samples

fs =1000;

endpoint=(1-(1/fs));

t=[0:1/fs:endpoint];

%frequency scale

l=length(t);

kd=[-l/2:1:(l/2)-1];

%Signal Parameters

fc1=100;

fm1=20;

fc2=300;

fm2=50;

Vc1=12;

Vc2=10;

Vm1=5;

Vm2=3;

% Signals in time domain

vm1=Vm1\*cos(2\*pi\*fm1\*t);

vm2=Vm2\*cos(2\*pi\*fm2\*t);

f1=figure;

plot(t,vm1+10);hold on % blue

plot(t,vm2); % orange

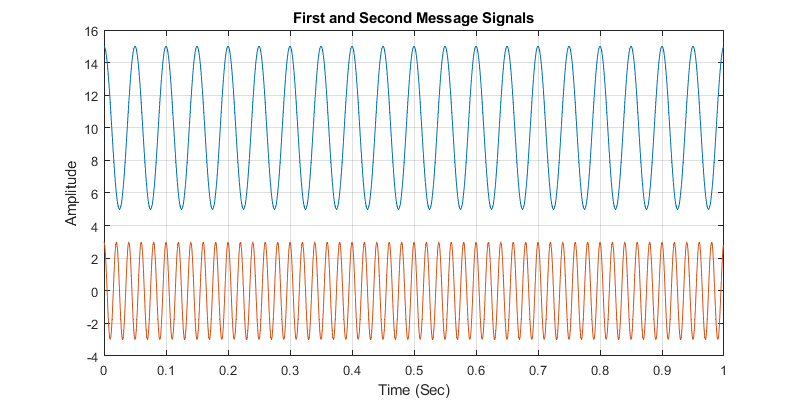
title("First and Second Message Signals");

xlabel('Time (Sec)');

ylabel('Amplitude');

set(f1,'Position',[0 0 800 400]);

grid on;



% Carrier siganls

vc1=Vc1\*cos(2\*pi\*fc1\*t);

vc2=Vc2\*cos(2\*pi\*fc2\*t);

# Modulated Signals :

vam1=vm1.\*vc1; % Components : fc1-fm1, fc1+fm1

f2=figure;

plot(t,vam1);

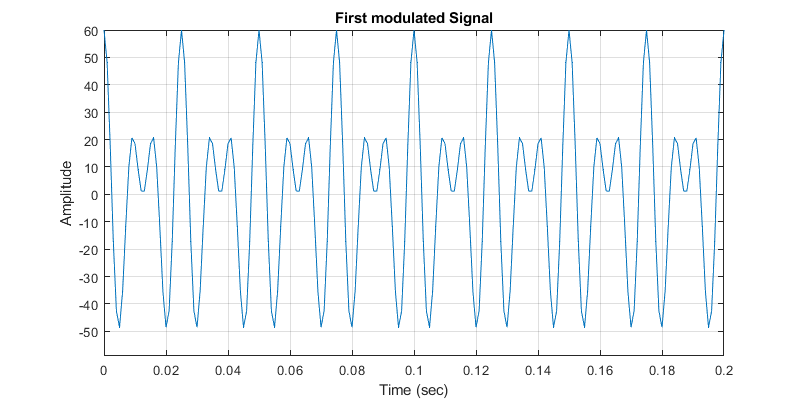
title("First modulated Signal");

xlabel('Time (sec)');

ylabel('Amplitude');

set(f2,'Position',[0 0 800 400]);

grid on;



vam2=vm2.\*vc2; % Components : fc2-fm2, fc2+fm2

plot(t,vam2);

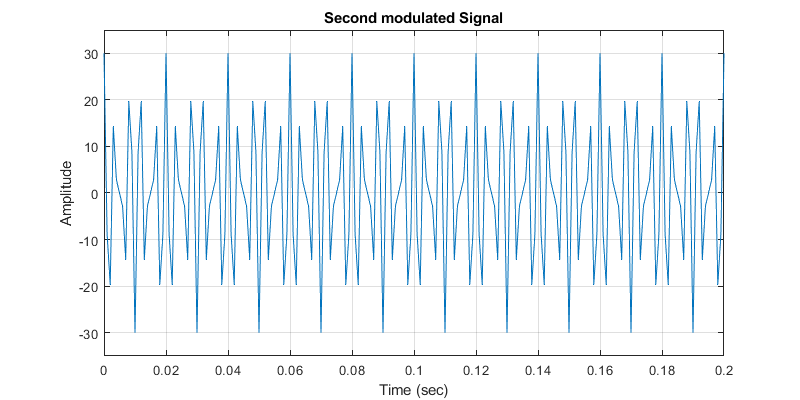
title("Second modulated Signal");

xlabel('Time (sec)');

ylabel('Amplitude');

set(f2,'Position',[0 0 800 400]);

grid on;



# FDM signal :

f3=figure;

vfdm= vam1+vam2;

plot(t,vfdm);

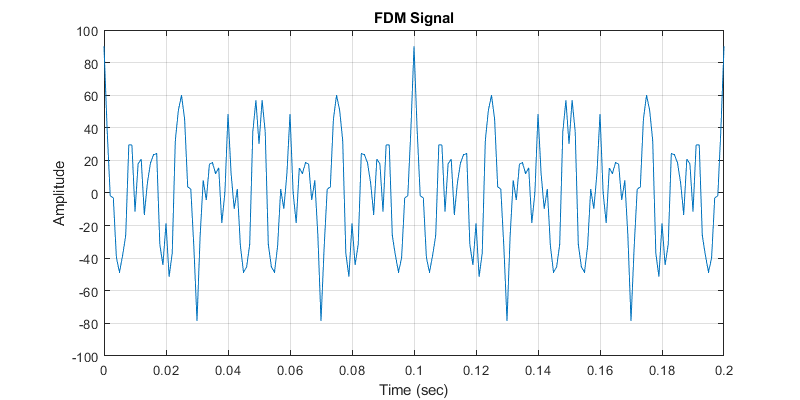
title("FDM Signal");

xlabel('Time (sec)');

ylabel('Amplitude');

set(f3,'Position',[0 0 800 400]);

grid on;



# Receiving End

%frequency spectrum of fdm

vfdmf=abs(fftshift(fft(vfdm))); %Components : fc1-fm1, fc2-fm2, fc1+fm1, fc2+fm2

f4=figure;

% subplot(2,1,1);

plot(kd,vfdmf);

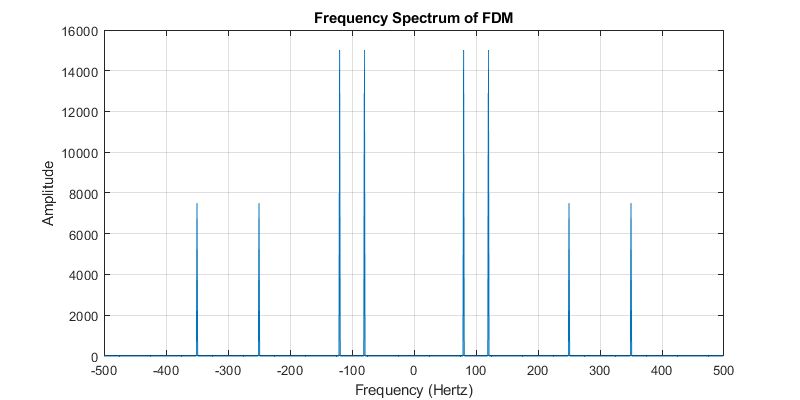
title("Frequency Spectrum of FDM");

xlabel('Frequency (Hertz)');

ylabel('Amplitude');

set(f4,'Position',[0 0 800 400]);

grid on;



# Band Pass Filters :

% Filter for First Signal

tuner1=10;

a=round(l/2);

b=round(fc1-fm1-tuner1);

bpf1=[zeros(1,a+b),ones(1,2\*fm1+2\*tuner1),zeros(1,l-(a+b+2\*fm1+2\*tuner1))];

f5=figure;

plot(kd,bpf1);hold on

plot(kd,vfdmf/10000);

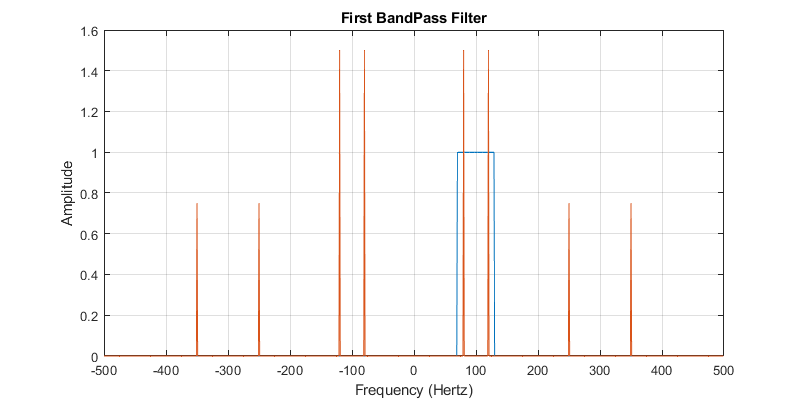
title("First BandPass Filter");

xlabel('Frequency (Hertz)');

ylabel('Amplitude');

set(f5,'Position',[0 0 800 400]);

grid on;



%First BandPass Filter Output

vamf1= vfdmf.\*bpf1;

% Filter for Second Signal

tuner2=10;

bpf2=[zeros(1,a+(fc2-fm2)-tuner2),ones(1,2\*fm2+2\*tuner2),zeros(1,l-(a+(fc2-fm2)+2\*fm2+tuner2))];

f6=figure;

plot(kd,bpf2);hold on

plot(kd,vfdmf/10000);

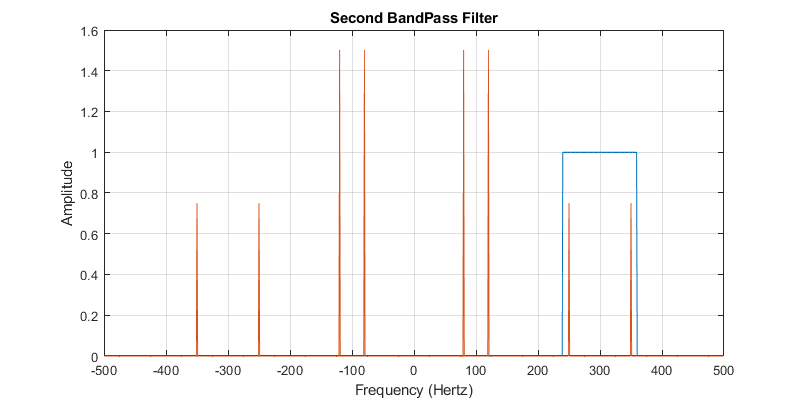
title("Second BandPass Filter");

xlabel('Frequency (Hertz)');

ylabel('Amplitude');

set(f6,'Position',[0 0 800 400]);

grid on;



%Second BandPass Filter Output

vamf2= vfdmf.\*bpf2;

# Synchronous Detection :

# For First Signal :

vamm1=ifftshift(ifft(vamf1));

multiplier1=cos(2\*pi\*fc1\*t);

vam\_m1= vamm1.\*multiplier1; %Components : fc1-fm1, -fm1, fc1+fm1, fm1

vam\_mf1= abs(fft(vam\_m1));

f7=figure;

plot(kd,vam\_mf1);

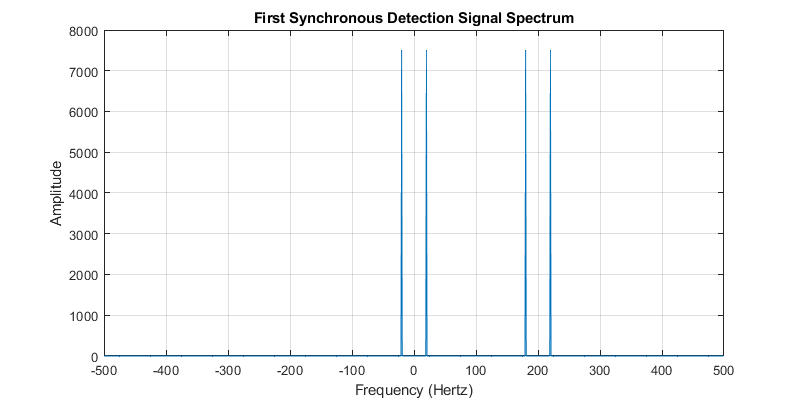
title("First Synchronous Detection Signal Spectrum");

xlabel('Frequency (Hertz)');

ylabel('Amplitude');

set(f7,'Position',[0 0 800 400]);

grid on;



%lpf filter

tuner3=2\*fm1-10;

lpf1=[zeros(1,a-tuner3),ones(1,2\*tuner3),zeros(1,l-(a+tuner3))];

vmmf1=lpf1.\*vam\_mf1;

f7=figure;

plot(kd,lpf1);hold on

plot(kd,vam\_mf1/10000);

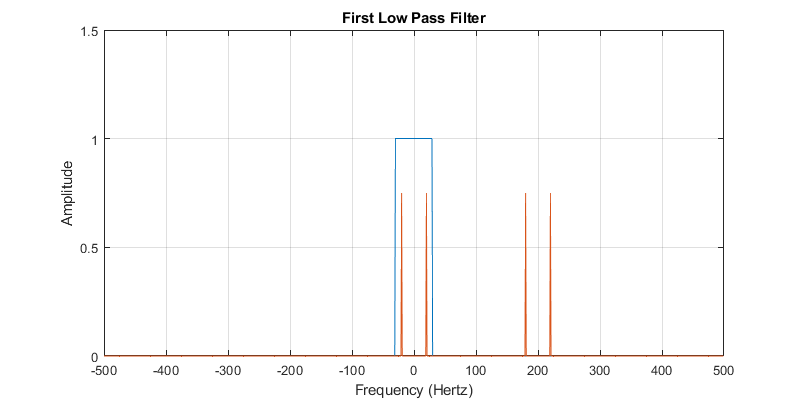
title("First Low Pass Filter");

xlabel('Frequency (Hertz)');

ylabel('Amplitude');

set(f7,'Position',[0 0 800 400]);

grid on;



vmm1=ifft(ifftshift(vmmf1));

f7=figure;

plot(t,vmm1);hold on %modulated signal - blue

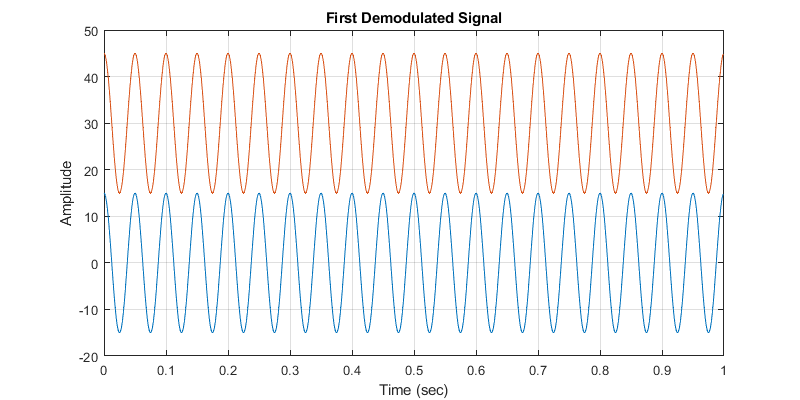
plot(t,3\*vm1+30); %original signal - orange

title("First Demodulated Signal");

xlabel('Time (sec)');

ylabel('Amplitude');

set(f7,'Position',[0 0 800 400]);



# For Second Signal :

vamm2=ifft(vamf2);

multiplier2=cos(2\*pi\*fc2\*t);

vam\_m2= vamm2.\*multiplier2; %Components : fc2-fm2, -fm2, fc2+fm2, fm2

vam\_mf2= abs(fft(vam\_m2));

f1=figure;

plot(kd,vam\_mf2);

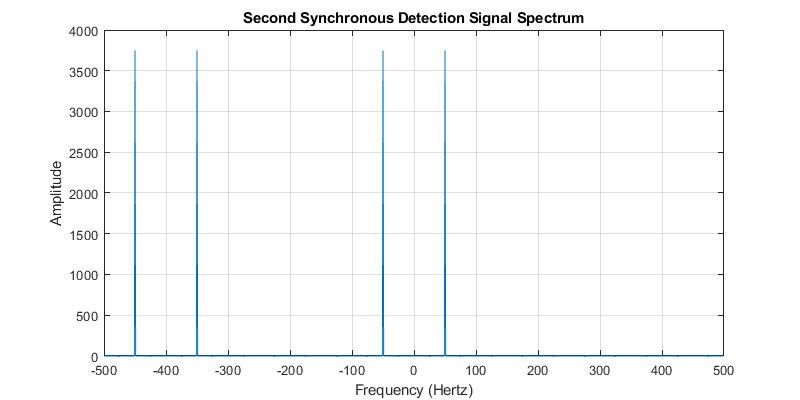
title("Second Synchronous Detection Signal Spectrum");

xlabel('Frequency (Hertz)');

ylabel('Amplitude');

set(f1,'Position',[0 0 800 400]);

grid on;



%lpf filter

tuner4=2\*fm2-40;

lpf2=[zeros(1,a-tuner4),ones(1,2\*tuner4),zeros(1,l-(a+tuner4))];

vmmf2=lpf2.\*vam\_mf2;

f5=figure;

plot(kd,lpf2);hold on

plot(kd,vam\_mf2/4000);

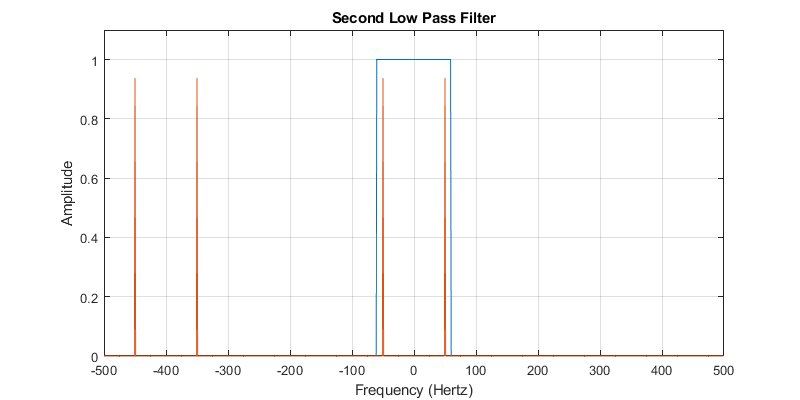
title("Second Low Pass Filter");

xlabel('Frequency (Hertz)');

ylabel('Amplitude');

set(f5,'Position',[0 0 800 400]);

grid on;



vmm2=ifft(ifftshift(vmmf2));

f6=figure;

plot(t,vmm2);hold on %modulated signal - blue

plot(t,2.5\*vm2+17); %original signal - orange

% plot(t,3\*vm1);

title("Second Demodulated Signal");

xlabel('Time (sec)');

ylabel('Amplitude');

set(f6,'Position',[0 0 800 400]);

grid on;

