ECE 311 Lab 7

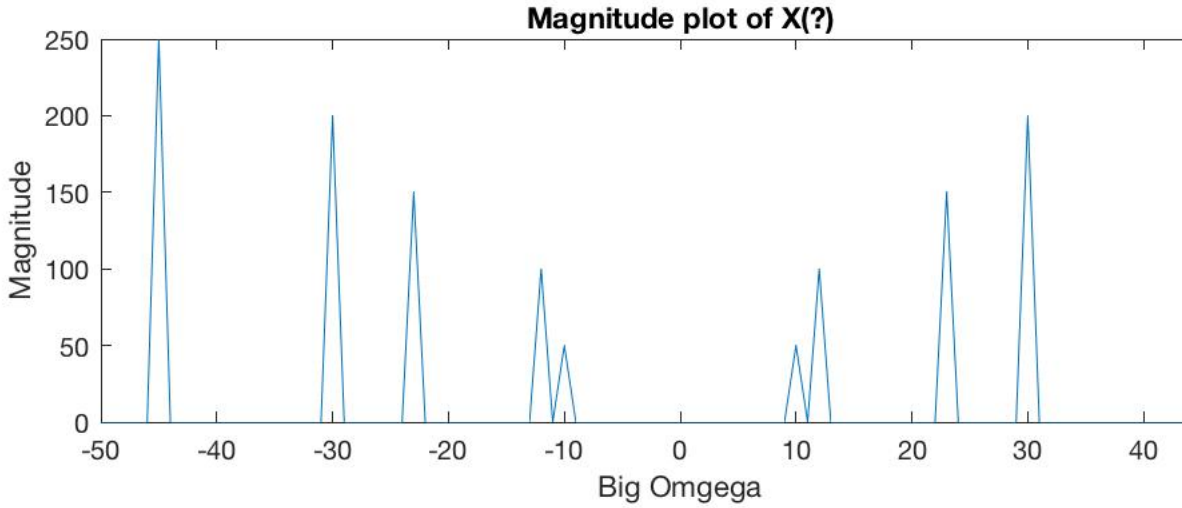
Jacob Hutter

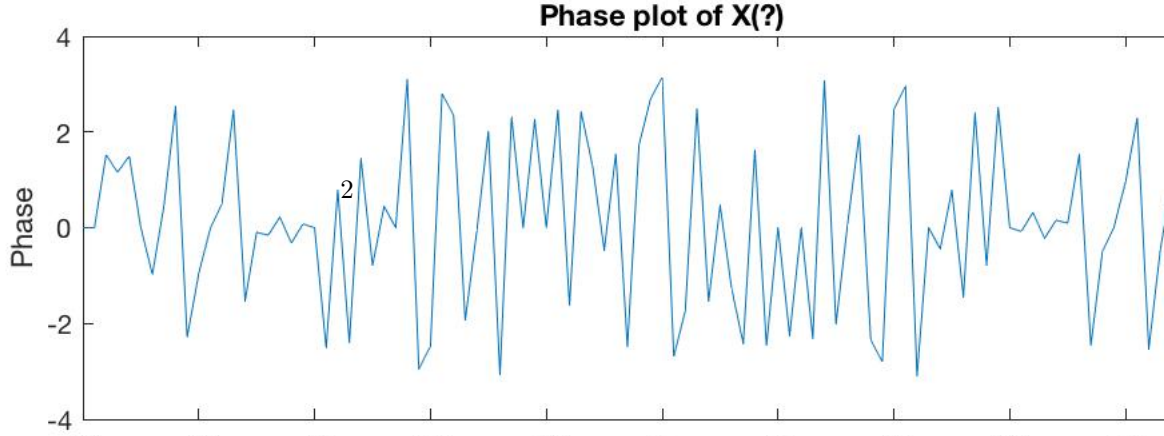
May 7, 2017

Sakanaya

```m
clear all;
clc;

load signal.mat;

N = length(x);

w = fftshift((0:N-1)/N*2*pi);
w(1:N/2) = w(1:N/2) - 2*pi; % get freq in radians

% using w = Big w * T with T = 1/100, big omega = w * 100 / 2pi
w = w.*100/(2*pi);

x_w = fftshift(fft(x));

figure;
subplot(211);
plot(w,abs(x_w));
title('Magnitude plot of X(?)');
xlabel('Big Omgega');
ylabel('Magnitude');

subplot(212);
plot(w,angle(x_w));
title('Phase plot of X(?)');
xlabel('Big Omgega');
ylabel('Phase');
```

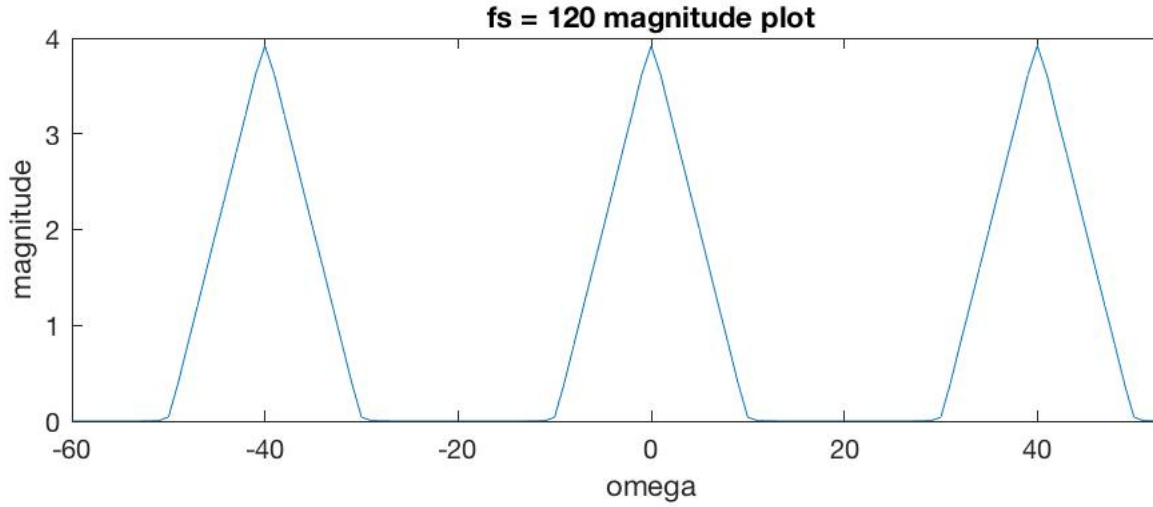
Sakanaya.m

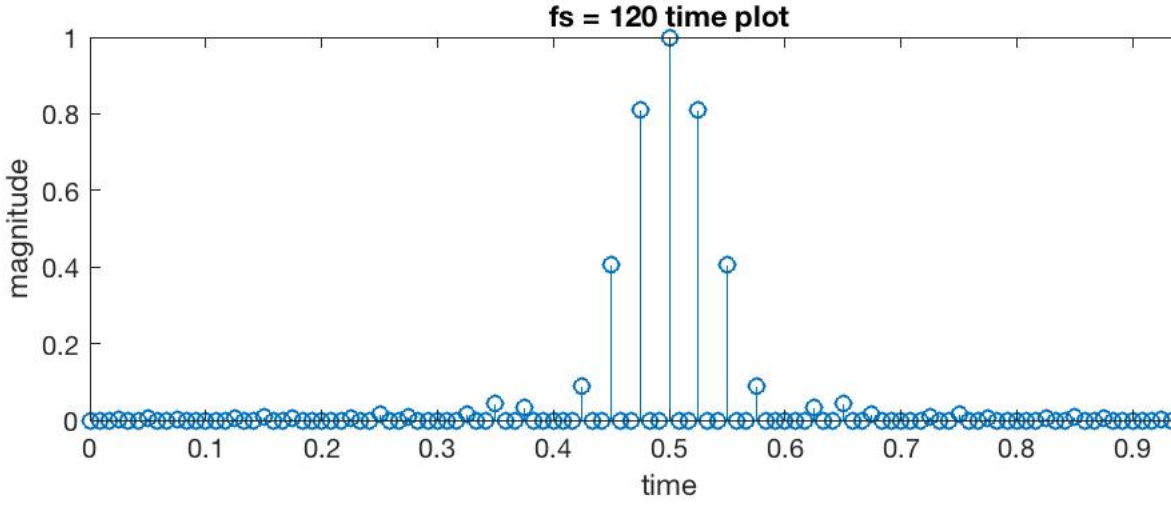


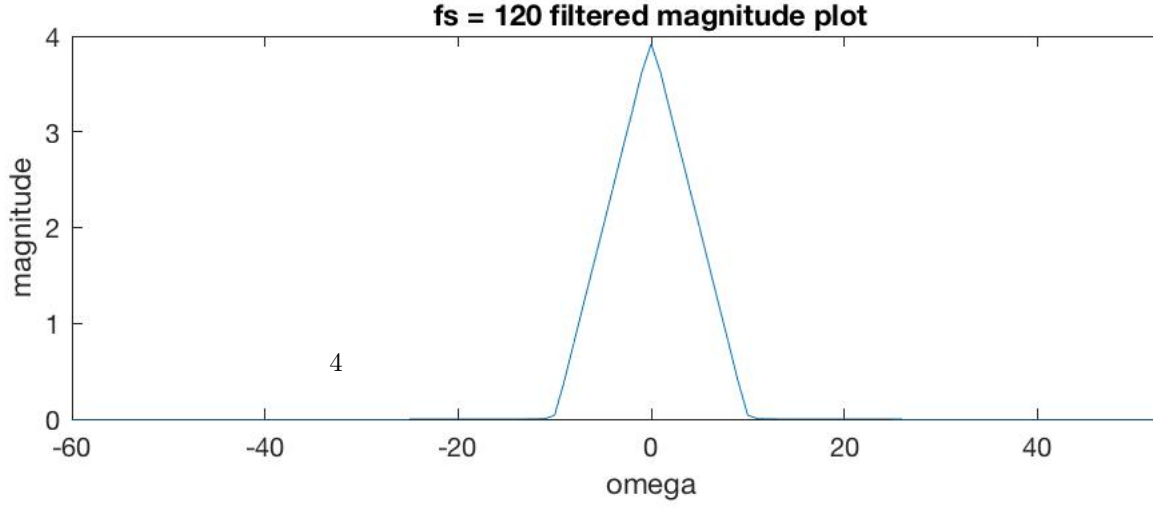


Chipotle

```
clear all;
clc;

load samplerate.mat;
fs = 40;
N = 40;

w = fftshift((0:N-1)/N*2*pi);
w(1:N/2) = w(1:N/2) - 2*pi; % get freq in radians
x_w = fftshift(fft(x));
t = linspace(0,N-1,N) * 1/fs;
w = 40 * w/(2*pi);
figure;
subplot(211);
plot(w,abs(x_w));
title('fs = 40 magnitude plot');
xlabel('omega');
ylabel('magnitude');
subplot(212);
stem(t,x);
title('fs = 40 time plot');
xlabel('time');
ylabel('magnitude');


x_up = upsample(x,3);
x_up_w = fftshift(fft(x_up));
N = length(x_up);
t = linspace(0,N-1,N) .* 1/N;
w = fftshift((0:N-1)/N*2*pi);
w(1:N/2) = w(1:N/2) - 2*pi;
w = 120 * w/(2*pi);
figure;
subplot(211);

plot(w,abs(x_up_w));
title('fs = 120 magnitude plot');
xlabel('omega');
ylabel('magnitude');
subplot(212);
stem(t,x_up);
title('fs = 120 time plot');
xlabel('time');
ylabel('magnitude');

for i = 1:length(x_up)
    if(abs(w(i)) > 25)
        x_up_w(i) = 0;
    end
end
figure;
subplot(211);
plot(w,abs(x_up_w));
title('fs = 120 filtered magnitude plot');
xlabel('omega');
ylabel('magnitude');
subplot(212);
x_up = ifft(ifftshift(x_up_w));
plot(t,abs(x_up));
title('fs = 120 filtered time plot');
xlabel('time');
ylabel('magnitude');

x_down = downsample(x_up,2);
N = N/2;
t = linspace(0,N-1,N)/N;
w = fftshift((0:N-1)/N*2*pi);
w(1:N/2) = w(1:N/2) - 2*pi;
w = N * w/(2*pi);
```


fs = 120 magnitude plot
magnitude
omega
4
3
2
1
0
-60
-40
-20
0
20
40

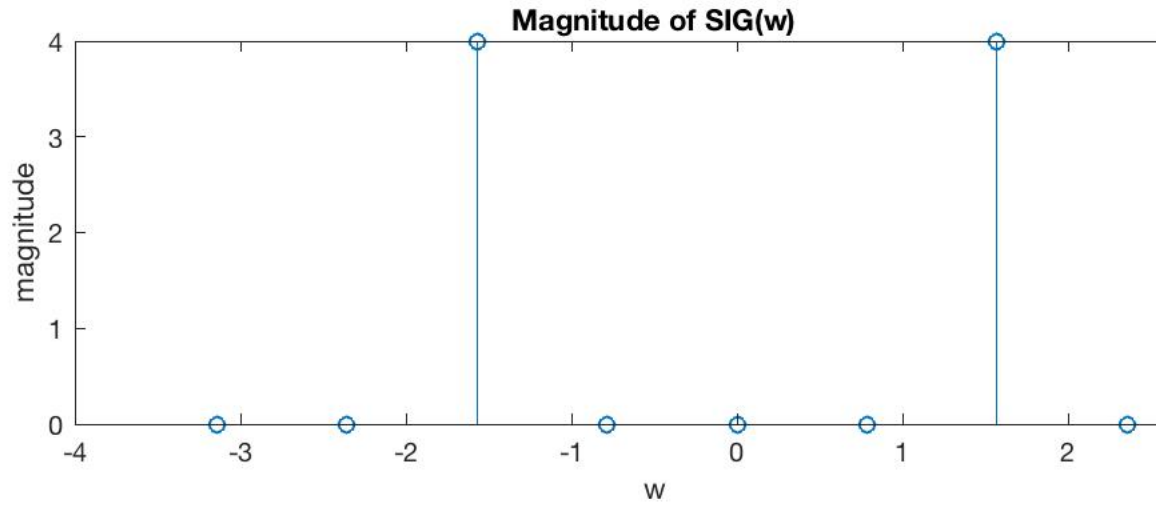

fs = 120 time plot
magnitude
time
1
0.8
0.6
0.4
0.2
0
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9

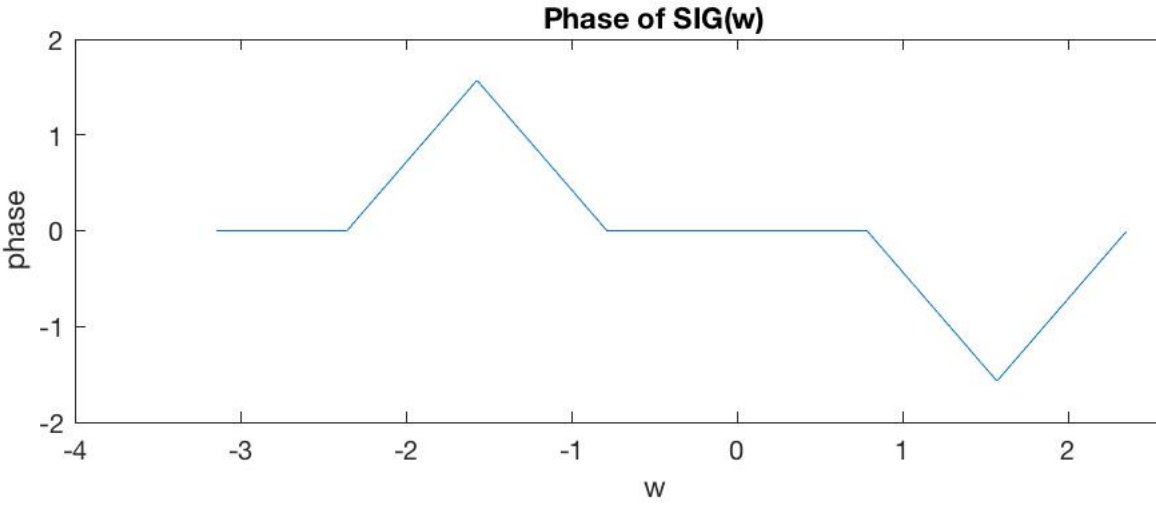

fs = 120 filtered magnitude plot
magnitude
omega
4
3
2
1
0
-60
-40
-20
0
20
40

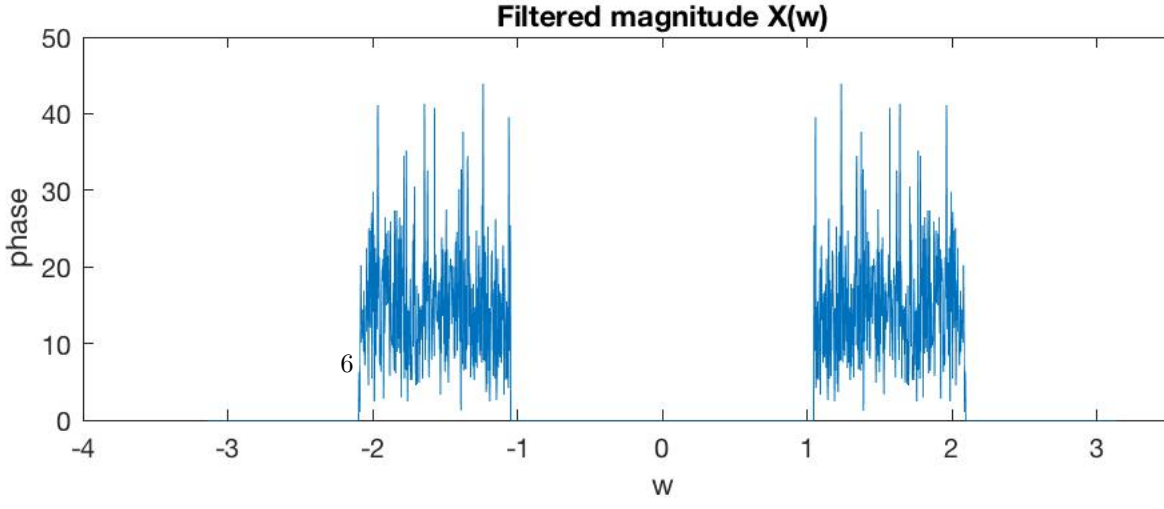

fs = 120 filtered time plot
0.4

Legends

```
clear all;
clc;

load q1_signal.mat;
N = length(x);

w = fftshift((0:N-1)/N*2*pi);
w(1:N/2) = w(1:N/2) - 2*pi; % get freq in radians
w = w';
figure;
subplot(211);
x_w = fftshift(fft(x));
plot(w,abs(x_w));
title('Magnitude of X(w)');
xlabel('w');
ylabel('magnitude');
subplot(212);
plot(w,angle(x_w));
title('Phase of X(w)');
xlabel('w');
ylabel('phase');
%%%%%%%%%%%%%%% end part 1 %%%%%%%%%%%%%

sig_w = fftshift(fft(sig));
N2 = length(sig);
w2 = fftshift((0:N2-1)/N2*2*pi);
w2(1:N2/2) = w2(1:N2/2) - 2*pi; % get freq in radians
figure;
subplot(211);
stem(w2,abs(sig_w));
title('Magnitude of SIG(w)');
xlabel('w');
ylabel('magnitude');
subplot(212);
plot(w2,angle(sig_w));
title('Phase of SIG(w)');
xlabel('w');
ylabel('phase');

%%%%%%% end part 2 %%%%%%%%%%%%%%%


% filter x
for i=1:length(x_w)
    if(w(i) < -2*pi/3 || w(i) > 2*pi/3)
        x_w(i) = 0;
    end
    if(abs(w(i)) < pi/3)
        x_w(i) = 0;
    end

end

figure;
subplot(211);
plot(w,abs(x_w));
title('Filtered magnitude X(w)');
xlabel('w');
ylabel('phase');
subplot(212);
plot(w,angle(x_w));
title('Filtered phase X(w)');
xlabel('w');
ylabel('phase');


x_new = ifft(ifftshift(x_w));
figure;
plot(x_new);
```


Magnitude of SIG(w)
magnitude
w


Phase of SIG(w)
phase
w

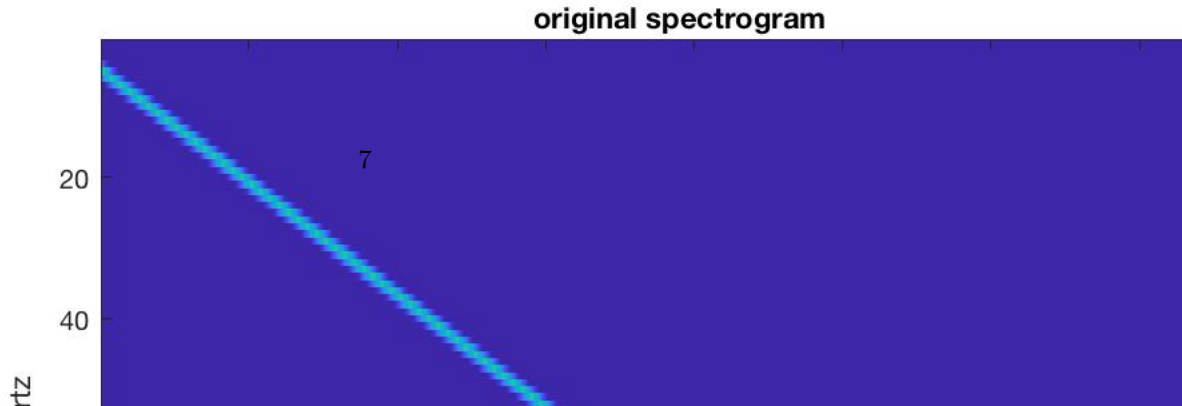

Filtered magnitude X(w)
phase
w

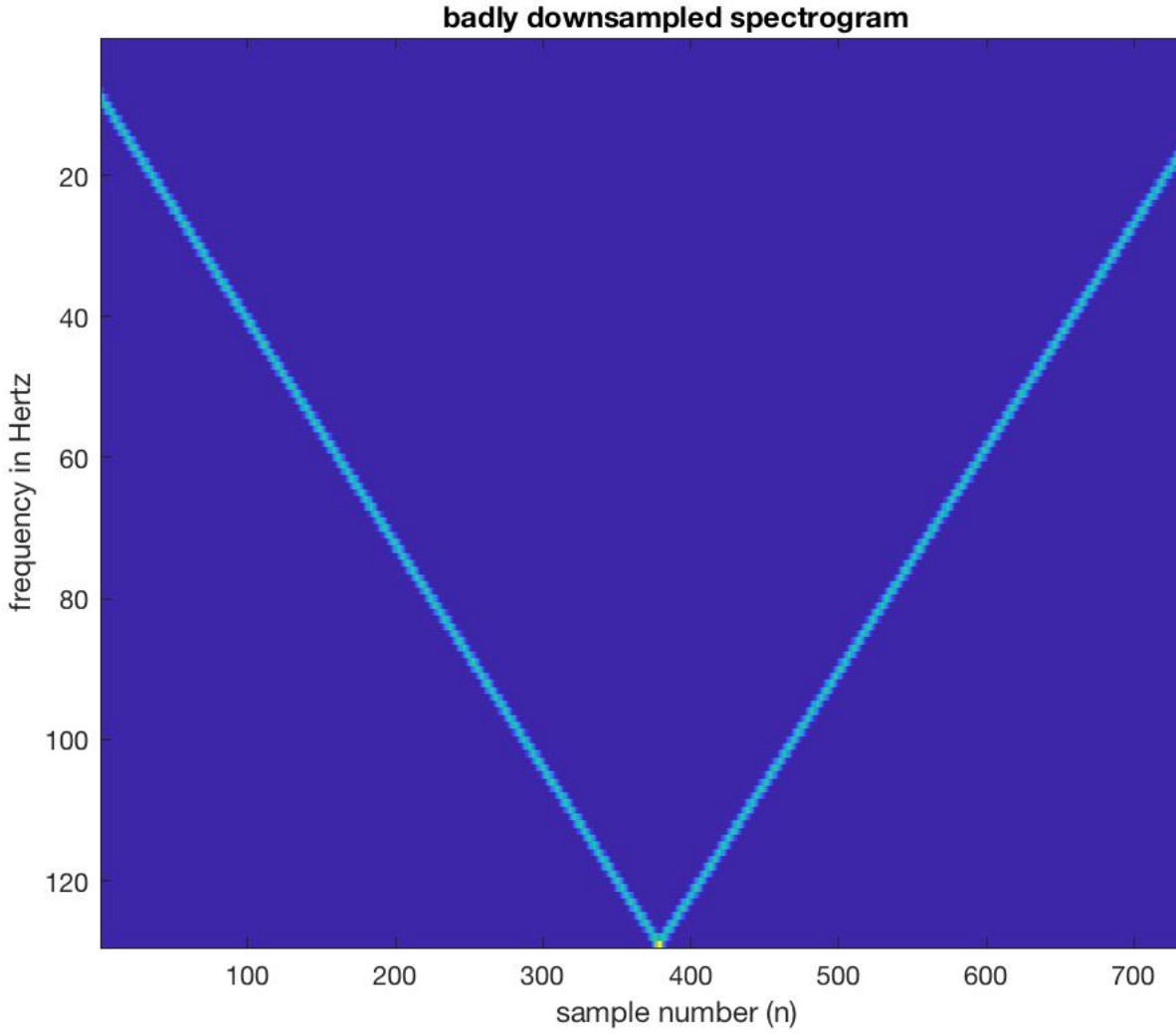

Filtered phase X(w)

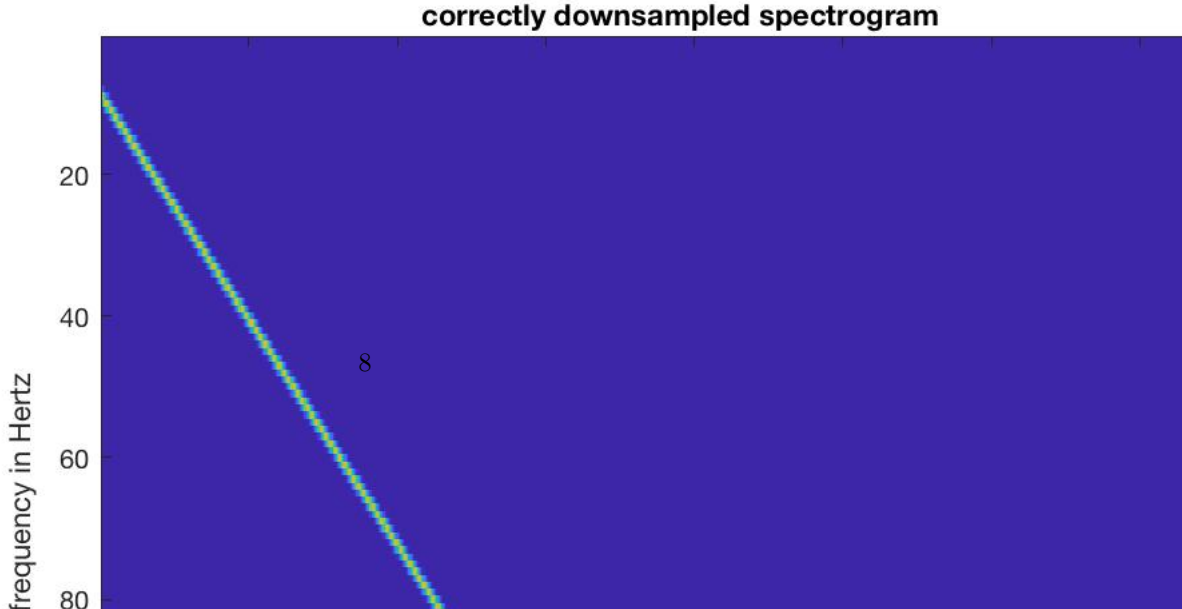
Blackdog

```
clear all;
clc;

load q2_signal.mat;

soundsc(x,fs);

s1 = spectrogram(x,hamming(256),128);
figure;
imagesc(abs(s1));
title('original spectrogram');
xlabel('sample number (n)');
ylabel('frequency in Hertz')

% end part 1
xodd = x(1:2:length(x));
soundsc(xodd,fs);
s2 = spectrogram(xodd,hamming(256),128);
figure;
imagesc(abs(s2));
title('badly downsampled spectrogram');
xlabel('sample number (n)');
ylabel('frequency in Hertz')
% end part 2

N = length(x);

x_w = fftshift(fft(x));

w = fftshift((0:N-1)/N*2*pi);
w(1:N/2) = w(1:N/2) - 2*pi; % get freq in radians
for i = 1:length(x) %lpf x_w
    if(abs(w(i)) < pi/2)
        x_w(i) = x_w(i);
    else
        x_w(i) = 0;
    end

end
xright = ifft(ifftshift(x_w));
xright = downsample(xright,2);
soundsc(xright,fs);
s3 = spectrogram(xright,hamming(256),128);
figure;
imagesc(abs(s3));
title('correctly downsampled spectrogram');
xlabel('sample number (n)');
ylabel('frequency in Hertz')
```

Blackdog.m




badly downsampled spectrogram
frequency in Hertz
20
40
60
80
100
120
100
200
300
400
500
600
700
sample number (n)


correctly downsampled spectrogram
frequency in Hertz
20
40
60
80