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```
%Introduction: The purpose of this lab was to create a filter using
 Matlabs
%firpm function. The filter was able to filter the high end
 frequencies in
%the sound file, and only allowed the low frequencies.

%Materials: PC, Matlab, Headphones
```

Q1

1)

```
clear all;
samp_freq = 22050;
pB = 3000;% passband
sB = 5000;% stopband
sr = 0.001;% stopband ripple
pr = 0.01; % Passband ripple
fp = pB/samp_freq;%normalized pB
fs = sB/samp_freq;%normalized sB
%Use of Equation 1
Lp =( -20* log10(sqrt(sr*pr))-13)/(14.6*abs(fs-fp))+1; %length
%Lp=28.94

F = [pB, sB];
A = [1,0];
Dev = [pr, sr];
%Use of MATLAB function

L = firpmord(F,A,Dev,samp_freq );
%The two methods did not yield the same answer; Lp(Equation
%1)=28.94,L(Matlab)=27
```

2)

```
%FIR filter using equation 1
```

```
figure
[q,Fi,Ai,W]=firpmord(F,A,Dev,samp_freq);
h1=firpm(ceil(Lp),Fi,Ai,W); %filter coeffcient
freqz(h1,1);

figure
lpbwq1=imread('lowpassbandequation1.png');
imshow(lpbwq1);
%Low pass band for Equation 1. Does meet requirement since lower than
%60dB(-20log(0.001)=60).

figure
hpbwq1=imread('highpassbandequation1.png');
imshow(hpbwq1);
%High pass band for Equation 1. Does meet requirement since lower than
%0.0864dB(-20log(0.01)=0.0864).
% The FIR filter design does meet the specifications because the
 ripples
% are lower than needed.
```

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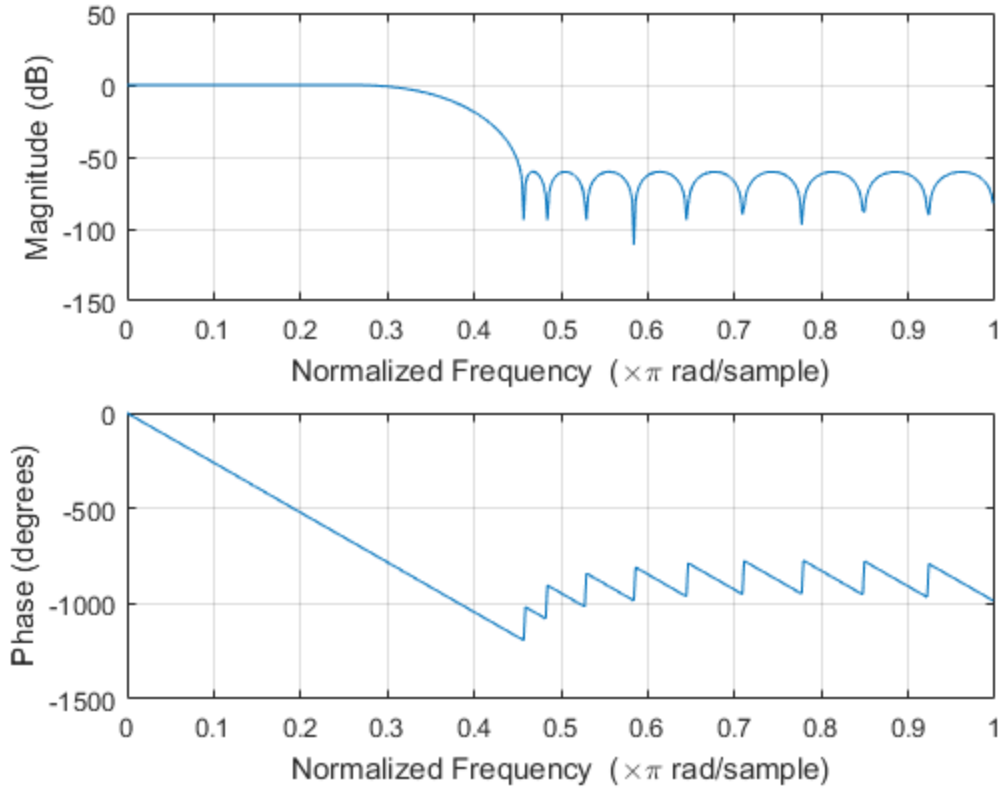
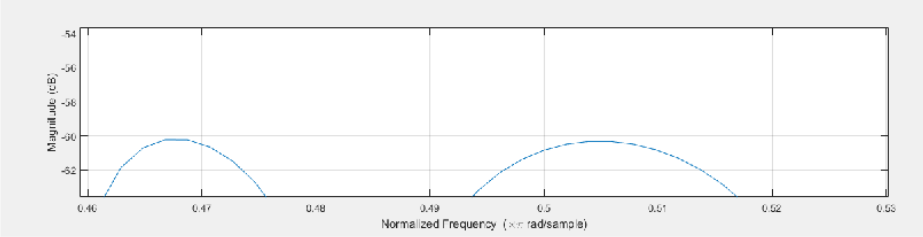
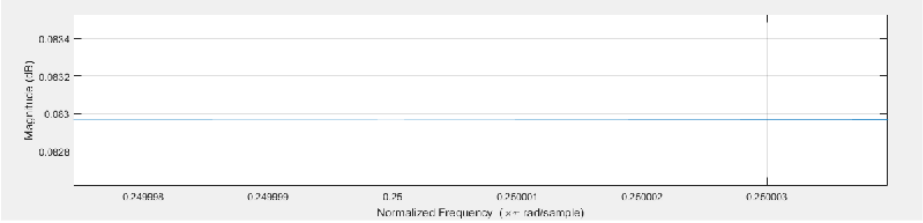




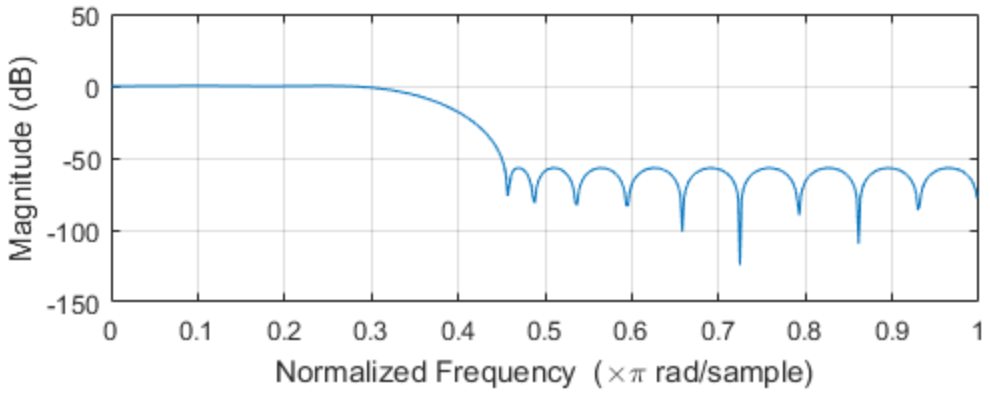


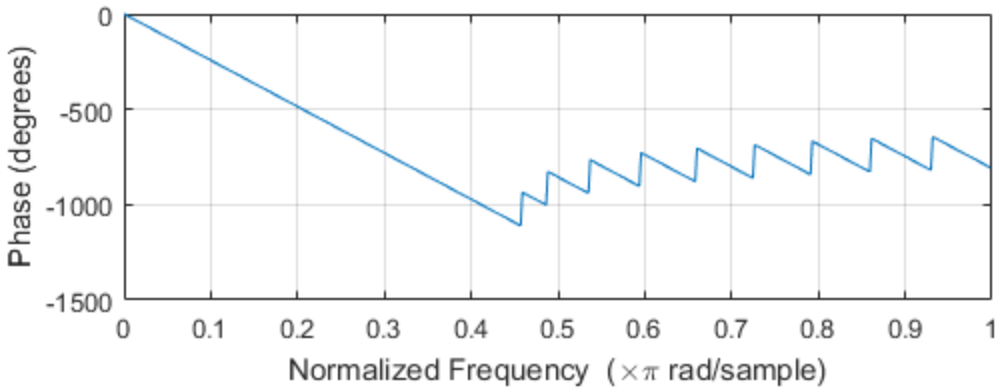
3)

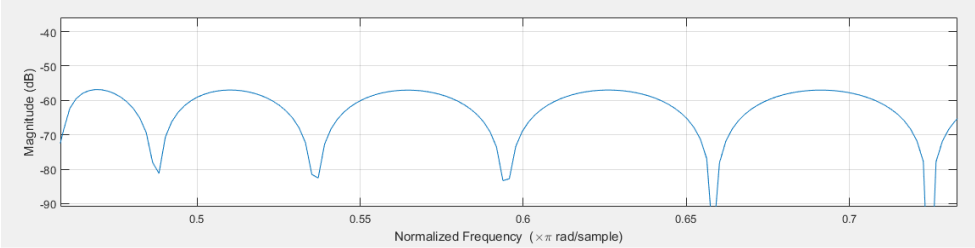
```
%FIR filter using matlab equation
figure
[N,Fi,Ai,W]=firpmord(F,A,Dev,samp_freq);
h2=firpm(N,Fi,Ai,W); %filter coeffcient
freqz(h2,1); %plot

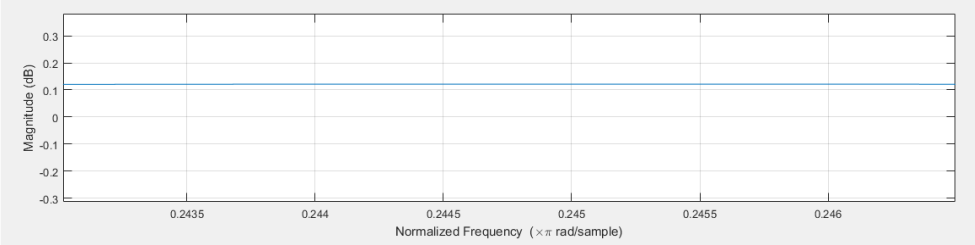
figure
lpbwm=imread('lowpassbandmatlab.png');
imshow(lpbwm);
%Low pass band for Matlab function. Doesnt meet requirement since
 higher than
%60dB(-20log(0.001)=60).

figure
hpbwm=imread('highpassbandmatlab.png');
imshow(hpbwm);
%High pass band for Matlab function. Doesnt meet requirement since
 higher than
%0.0864dB(-20log(0.01)=0.0864).
%This filter does not meet the specifications because the ripples are
%higher than intended.
```









4

```
%Equation 1 does meet the requirement(assume use ceiling of Lm)
 since ripples less than intended. Matlab funciton does not meet
```

```
requirements since ripples greater than intended. To improve,
increase the length.
```

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```
figure;
[N,Fi,Ai,W]=firpmord(F,A,Dev,samp_freq);
h2=firpm(N+2,Fi,Ai,W); %filter coeffcient
freqz(h2,1);
%Length of Matlab function increased by 2.
figure;
lpbwq1=imread('lowpassbandequation1.png');
imshow(lpbwq1);
%Low pass band for New signal. Does meet requirement since lower than
%60dB(-20log(0.001)=60).
figure
hpbwq1=imread('highpassbandequation1.png');
imshow(hpbwq1);
%High pass band for New Signal. Does meet requirement since lower than
%0.0864dB(-20log(0.01)=0.0864).
```

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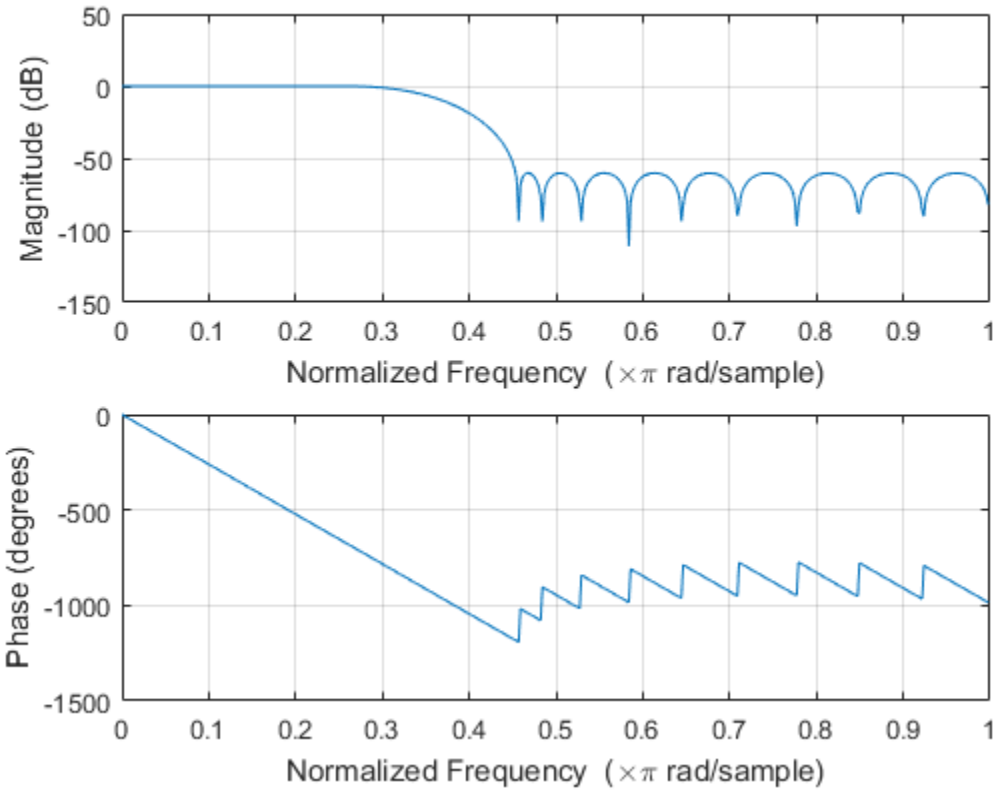
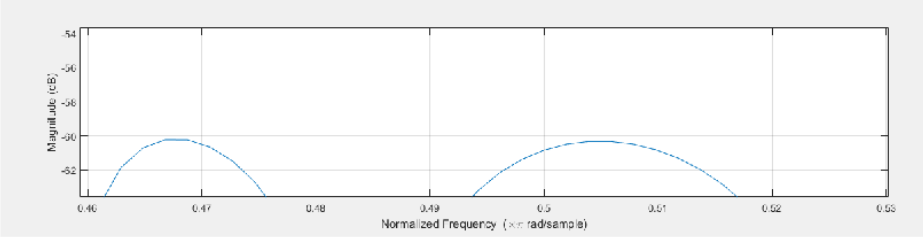
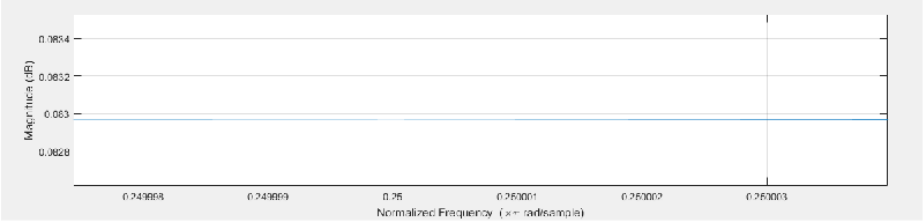






6

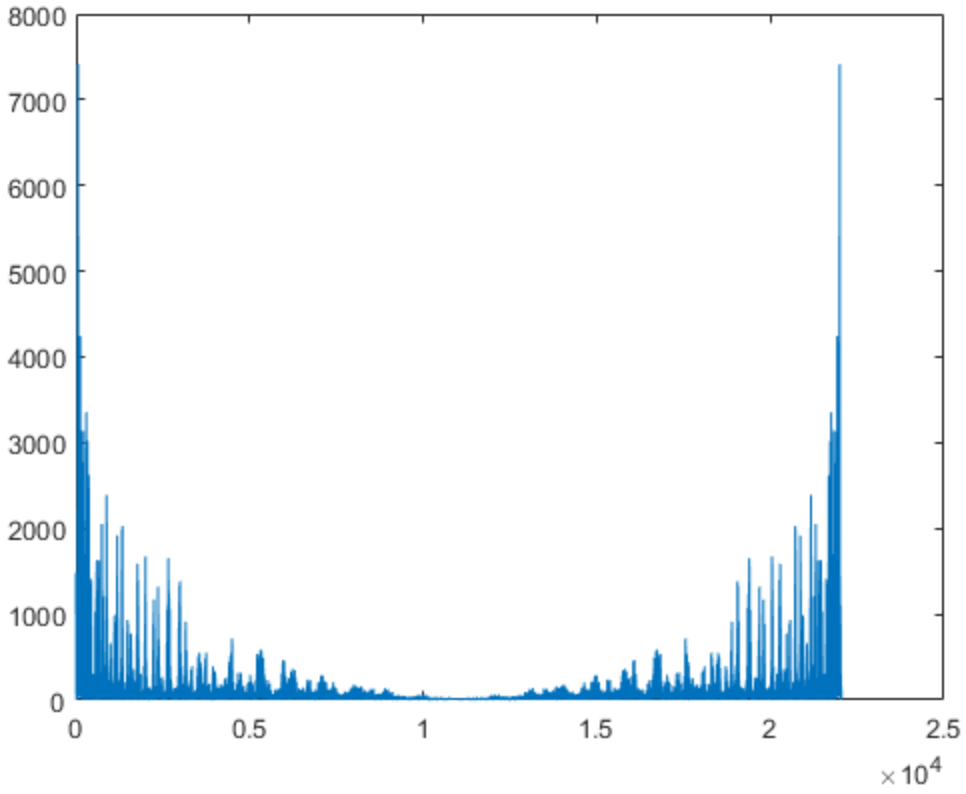
```
figure;
[y,FS] = audioread('music.wav');
sound(y,FS);
Y = fft(y);
m = abs(Y);
n = length(Y);
f = (0:1/n:1-1/n)*FS;
plot(f,m);

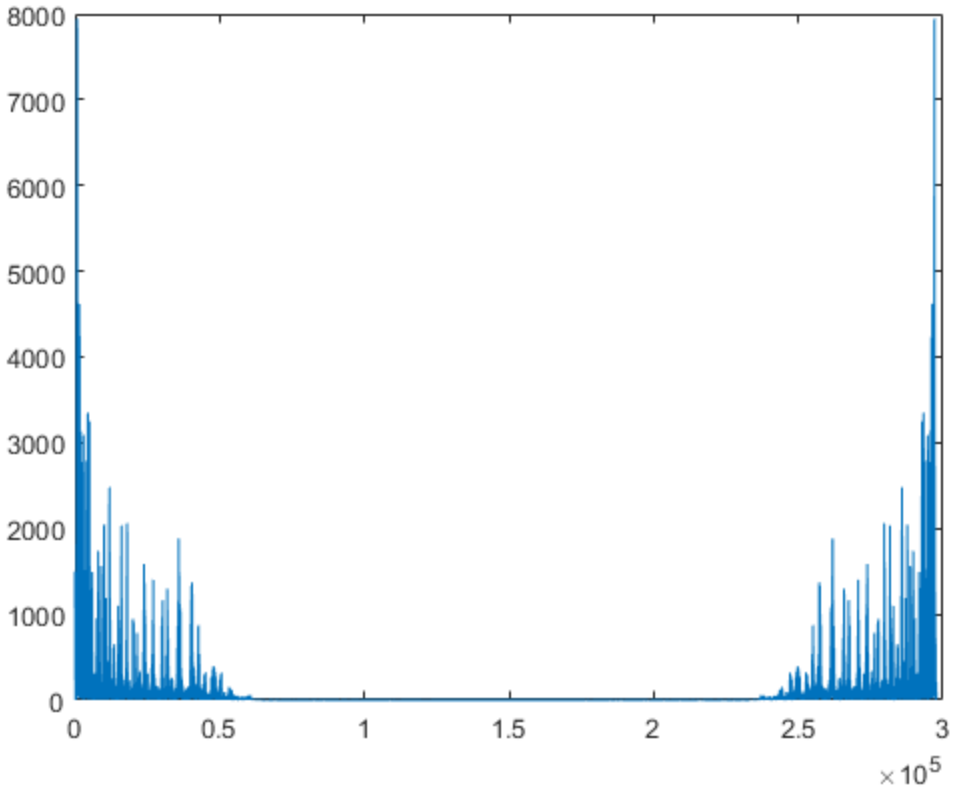
%6aconvolition
figure;
yhcon = conv(y,h2);
sound(yhcon,FS);
plot(abs(fft(yhcon)));
% Got rid of the high frequncies, and kept the low frequencies intact.

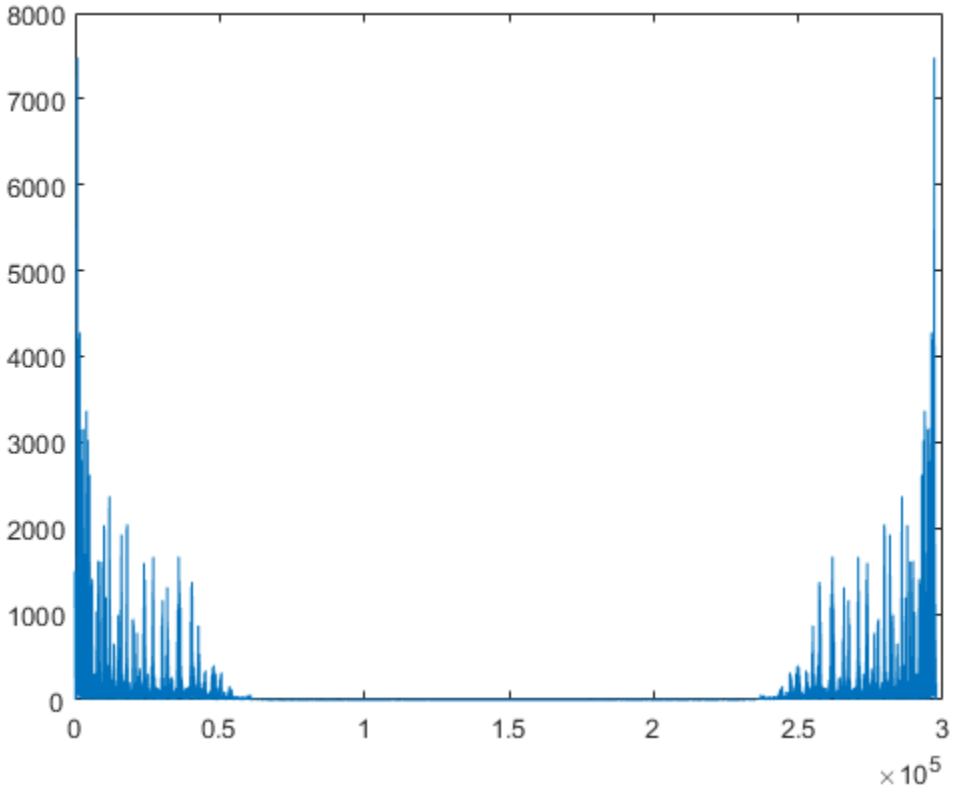
%bfft
figure;
H2=fft(h2,297702);
YH2Mul= Y.*H2';
sound(ifft(YH2Mul),FS);
plot(abs(YH2Mul));
%Got rid of the high frequncies, and kept the low frequencies intact.

%cfilter
figure;
m1=filter(h2,1,y);
sound(m1,FS);
```

```
plot(abs(fft(m1)));
%Got rid of the high frequncies, and kept the low frequencies intact.
```




8000
7000
6000
5000
4000
3000
2000
1000
0
0
0.5
1
1.5
2
2.5
3
×10^5


8000
7000
6000
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4000
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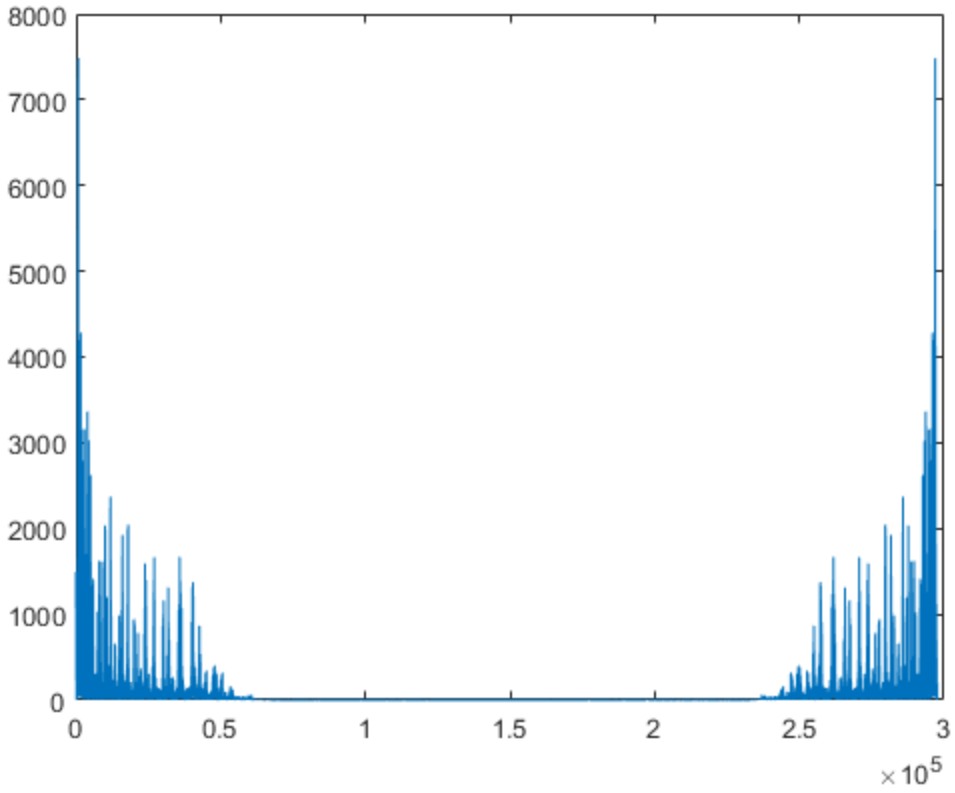
2000
1000
0
0
0.5
1
1.5
2
2.5
3
×10^5



Conclusion

```
%The lab went as expected. The lab taught us how to make filters and
 apply
%them in matlab.
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