Frequency Content of Signals
Circuits & Signals
EECE2150

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0 Introduction

The purpose of this laboratory experimentation was to demonstrate signal analysis through fast Fourier transforms, as well as connecting this concept to real-world signals. In the case of this lab, the real-world signals used were that of voice recordings, which demonstrate Fourier response to different sounds.

1 Discussion and Analysis

1.1 Q1

The highest peak in the spoken audio signal occurs at 100[Hz]. There are subsequent peaks at 200[Hz], 350[Hz], and 500[Hz]. Most of the signal is between 0 and 600[Hz]. There is a smaller peak at 4300[Hz]. (Shown in Figure 1)

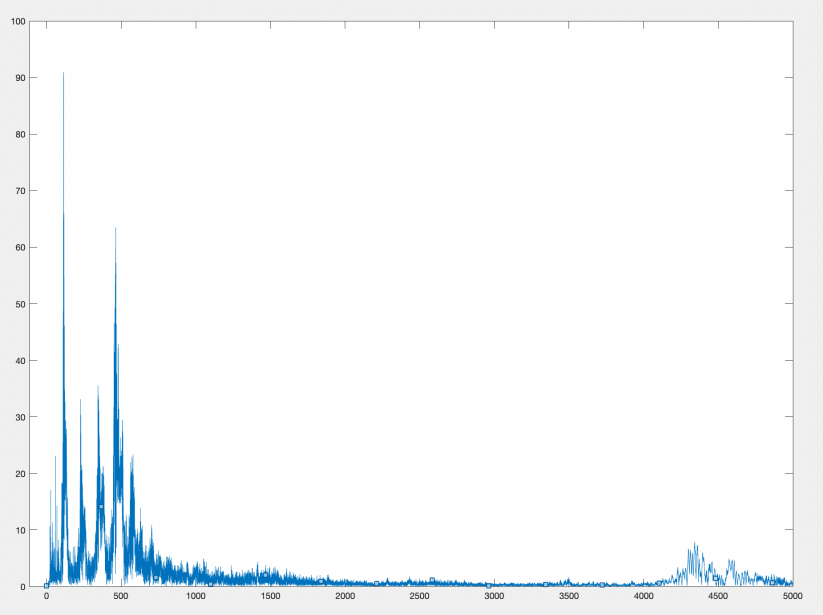

Figure 1: The Generated Fourier Analysis

1.2 Q2

The frequency almost never goes past 500[Hz]. What changes is the amplitude of these frequencies in different subintervals. (Shown in Figures 2-4)

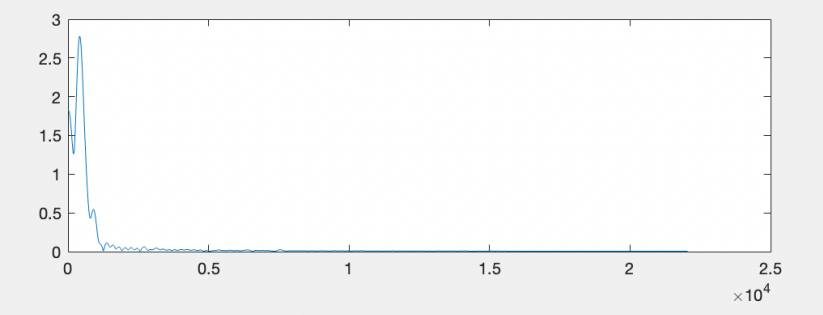

Figure 2: Subinterval One

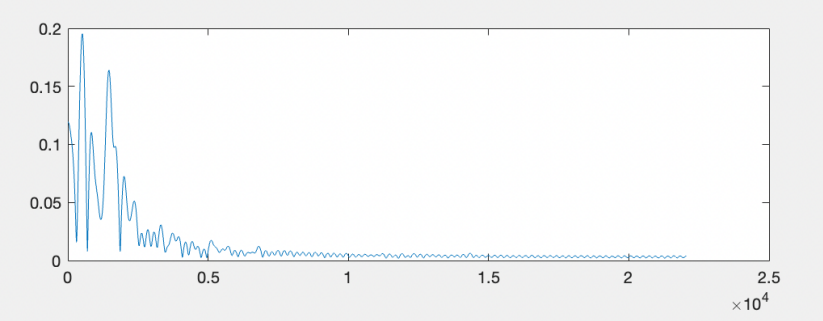

Figure 3: Subinterval Two

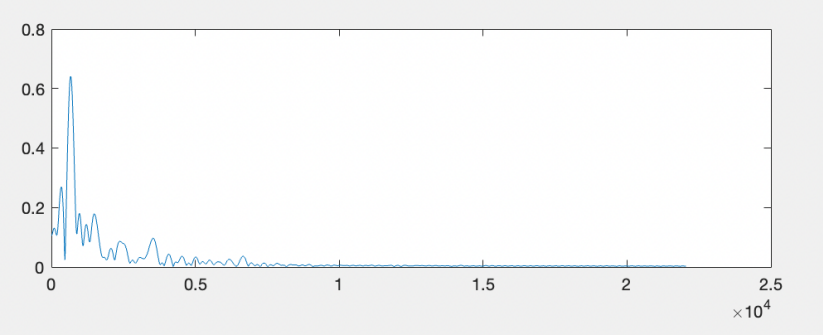

Figure 4: Subinterval Three

1.3 Q3

Using a vowel sound, spikes were produced, as well as other harmonically-related spikes. The tallest spike is at 115[Hz]. There are other spikes at 230, 345, 460, 575, 690, 805, and 920[Hz]. The height of the spikes decrease as the frequency increases, except at 575[Hz]. (Shown in Figure 5)

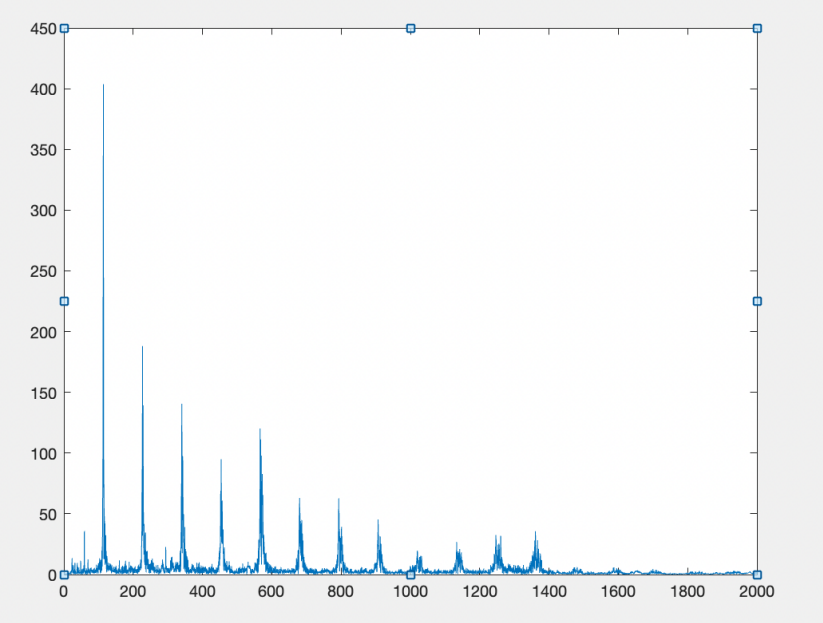

Figure 5: Fourier Transform Using Vowels

1.4 Q4

Making a sound like 'SH' produces more frequencies than a constant vowel sound. It has a control spike at 300[Hz], and it has a relatively high amplitude at most frequencies in the range of 0-600[Hz]. (Shown in Figure 6)

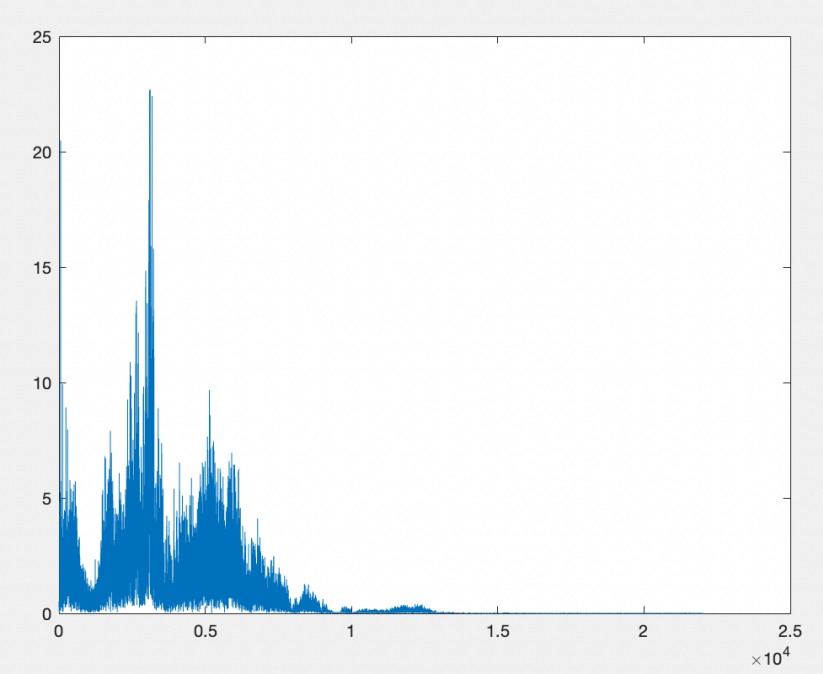

Figure 6: Fourier Transform Using 'Shh' Sound

1.5 Q5

There are slight differences between the two peoples' spectra.

1.6 Q6

For both signals, the range with the dominant frequency content is 0-60[Hz]. (Shown in Figures 7-8)

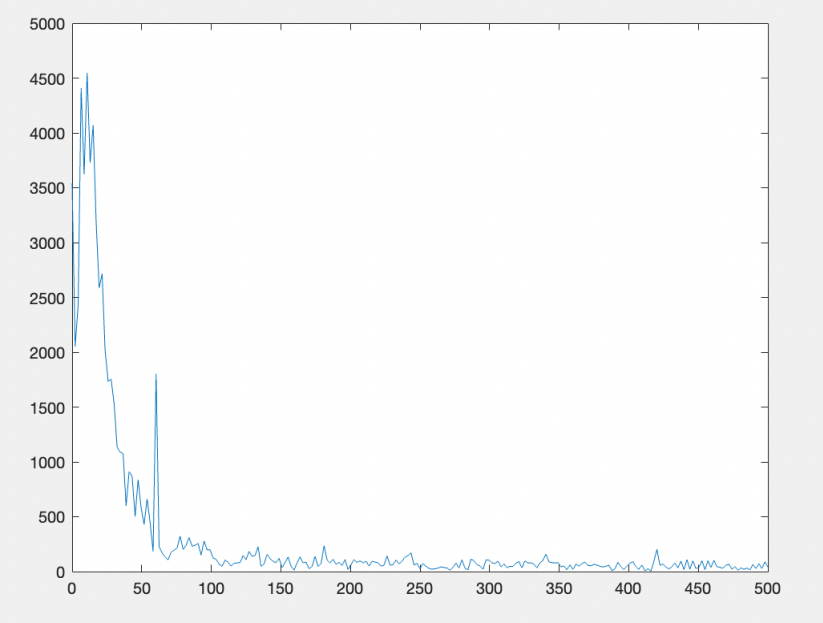

Figure 7: ECG1 Waveform

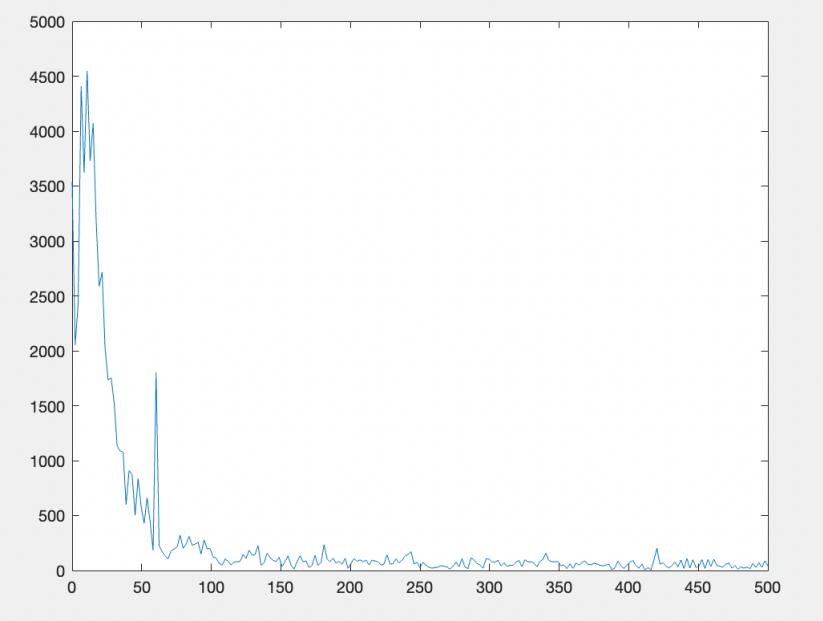

Figure 8: ECG2 Waveform

1.7 Q7

The frequency of the major noise content in ECG1 is 60[Hz]

1.8 Q8

The highest peak is at 1.25[Hz]. At a rate of $1.25[\text{Hz}] \cdot 60 = 75[\text{bpm}]$

1.9 Q9

There is no noticeable additional noise in either signal.

1.10 Q10

I would want to amplify the frequencies from 0-50[Hz], and reject anything above 100[Hz]

1.11 Q11

At least 200[Hz] sampling rate, as this allows up to 200[Hz] of the signal

2 Conclusion

Overall, this laboratory experiment allowed for a thorough analysis of real-world signals through the use of Fourier transforms. By applying this somewhat abstract topic to real life scenarios, the concept of the Fourier transform becomes much easier to grasp.