Contents

Table of figures

1. ***The transmitter***

This part contains the following tasks

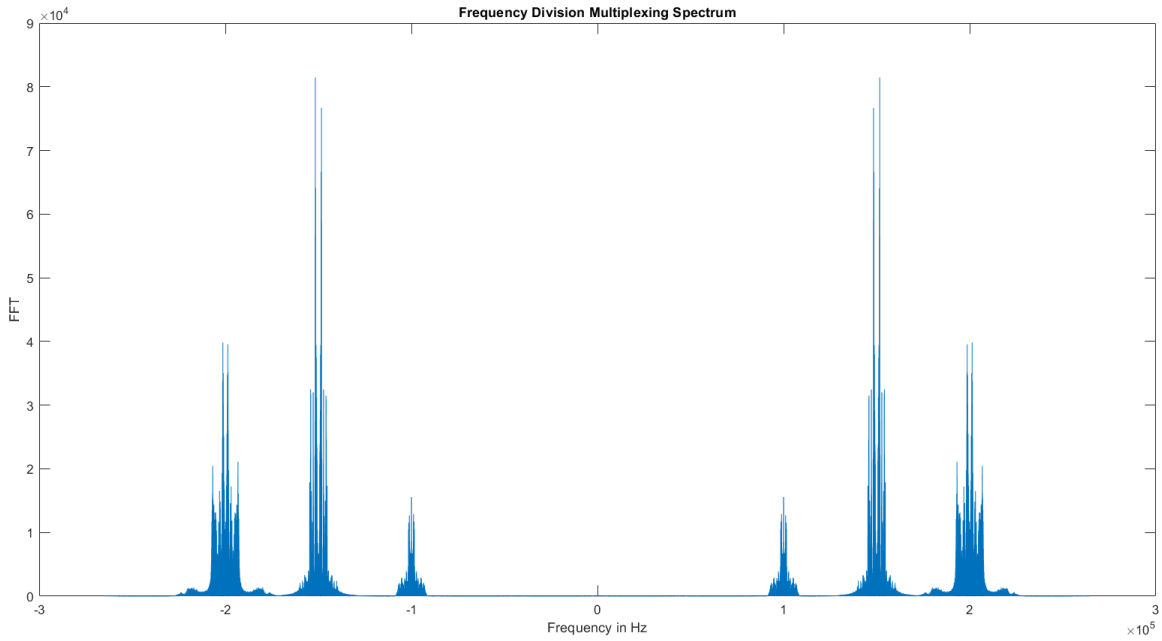
1. Reading monophonic audio signals into MATLAB.
2. Upsampling the audio signals.
3. Modulating the audio signals (each on a separate carrier).
4. Addition of the modulated signals.

Discussion

First we read 3 audio signals & added their 2 stereo columns to transform them into monophonic signals as we implement monophonic receiver, then we modified their sizes to fit the longest one using padding, after that we up-sampled the signals to fit the highest sampling rate of their highest carrier (fs>=2*200 KHz), then we generated 3 carriers, multiplied by 3 signals & adding the 3 results together to construct FDM signal.

The figures

Figure 1: The spectrum of the output of the transmitter



2. ***The RF stage***

This part addresses the RF filter and the mixer following it.

Discussion

As we intend to move signals to intermediate frequency IF, we may suffer the problem of IF image so we use bandpass filter to select the intended received signal & reject the others then multiply the filtered signal by a carrier with frequency = f_c + f_{IF} to move the signal to IF.

The figures

Assume we want to demodulate the first signal (at ω_o).

Figure 2: the output of the RF filter (before the mixer)

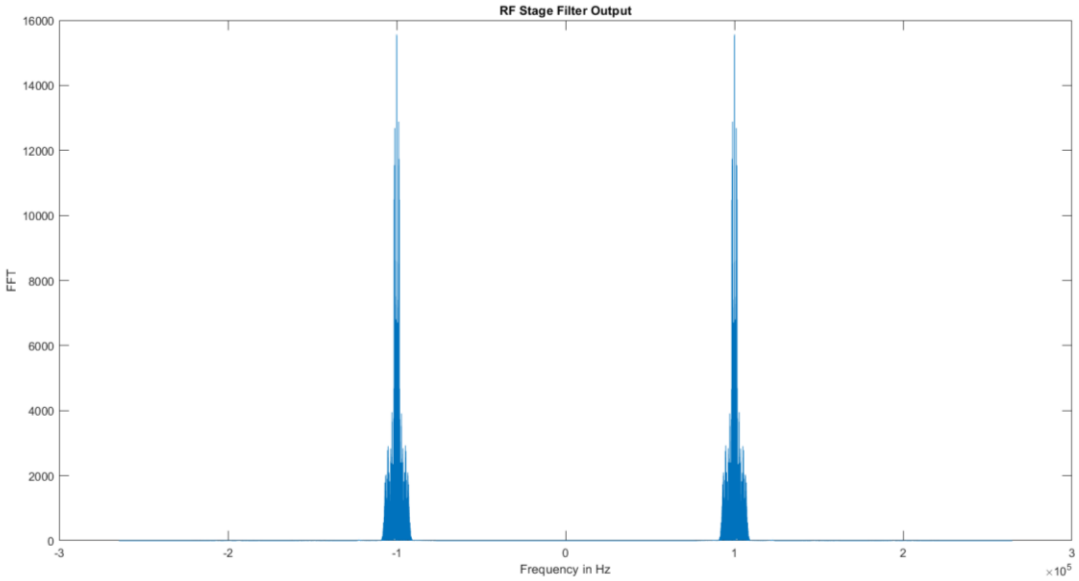
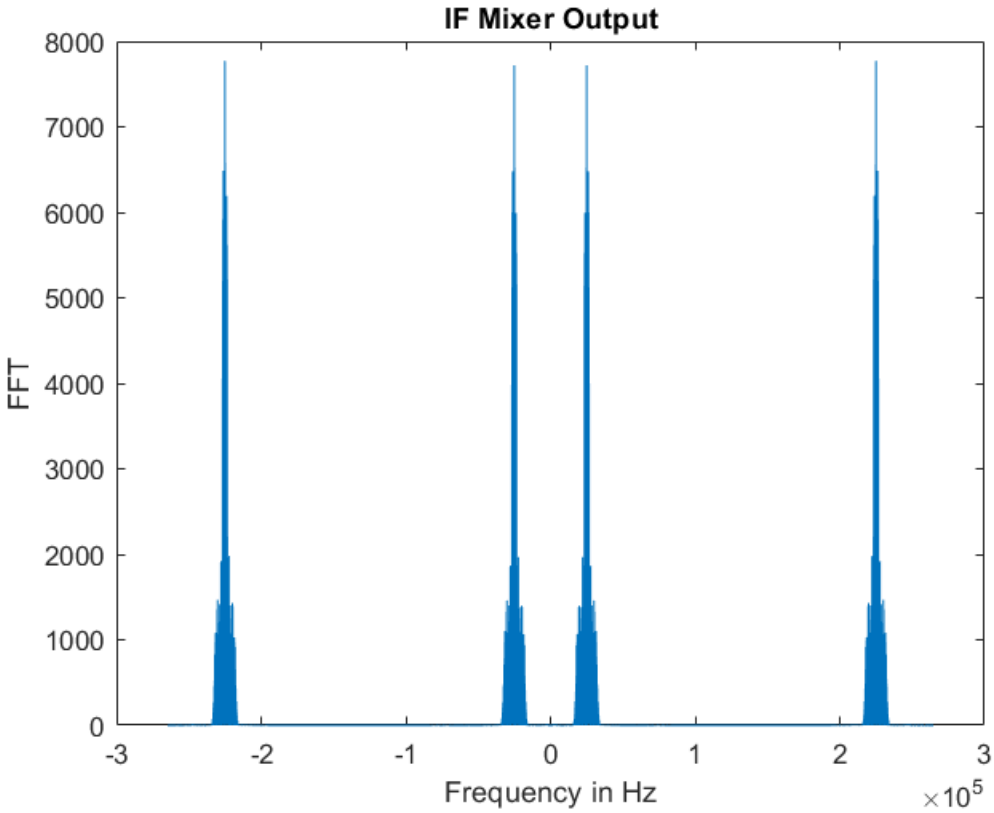


Figure 3: The output of the mixer



3. The IF stage

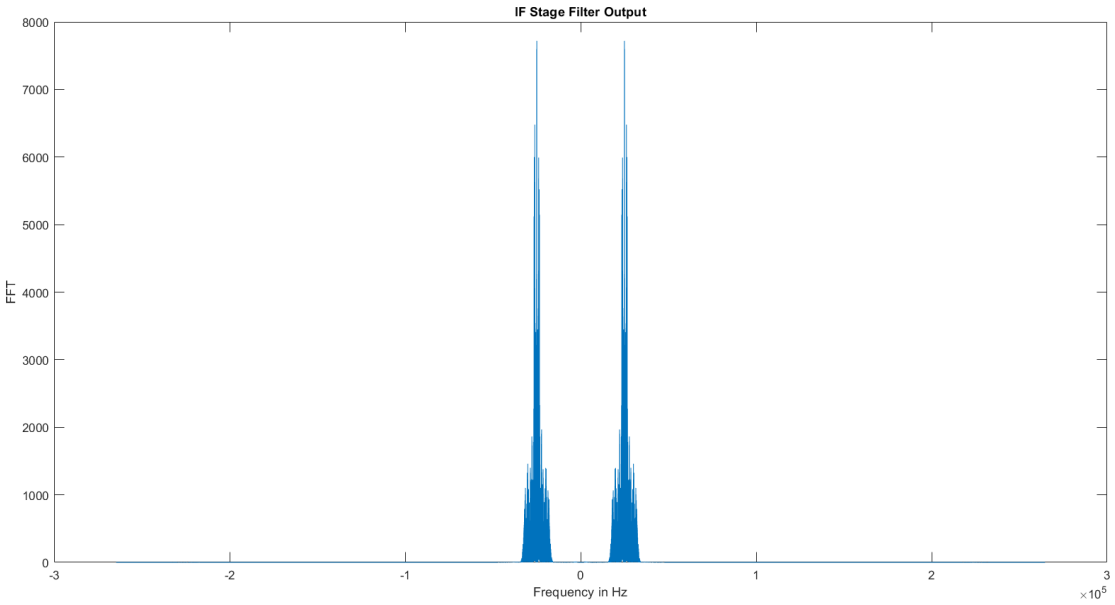
This part addresses the IF filter.

Discussion

After IF mixer stage signal is carried to IF as intended but it also has carried to higher frequency band, so we need a bandpass filter to select the IF signal & reject its higher frequency version, and the importance of carrying the received signal on IF before baseband to get rid of leakage & flicker noise & to improve the filters' selectivity.

The figures

Figure 4: Output of the IF filter



4. The baseband demodulator

This part addresses the coherent detector used to demodulate the signal from the IF stage.

Discussion

The previous modulated signal needs to be demodulated to return the signal to the baseband, we will multiply it by a carrier with frequency = f_{IF} to perform coherent demodulation then use a lowpass filter to select the baseband signal & reject higher frequencies then multiplied by a gain = 4.5 (due to carriers the signal's amplitude was reduced 4 times), now if we use the sound command we can successfully listen to the original audio message.

The figures

Figure 5: Output of the mixer (before the LPF)

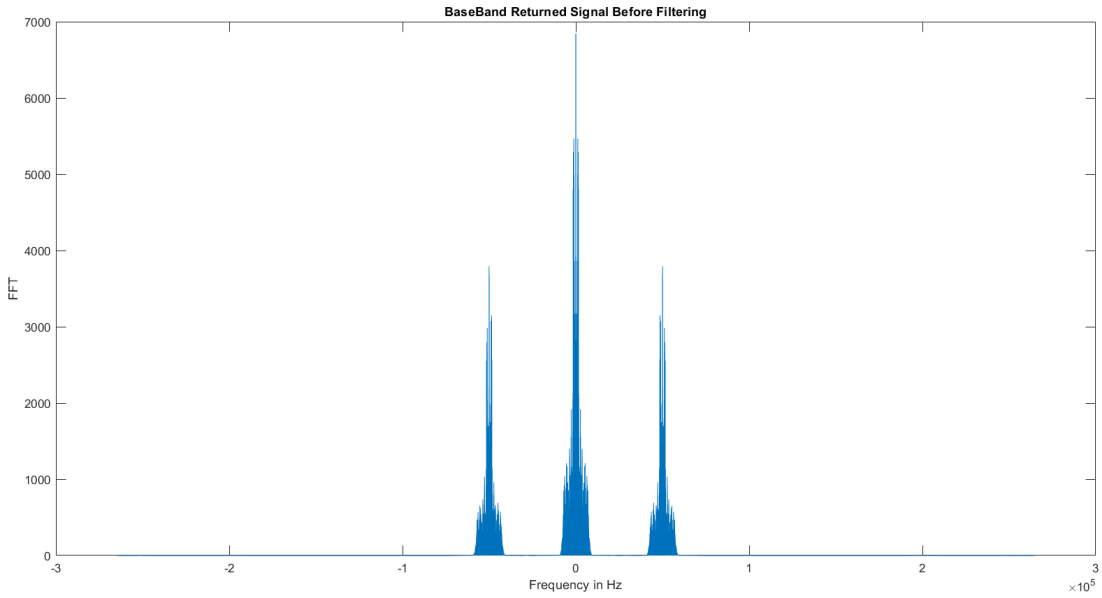
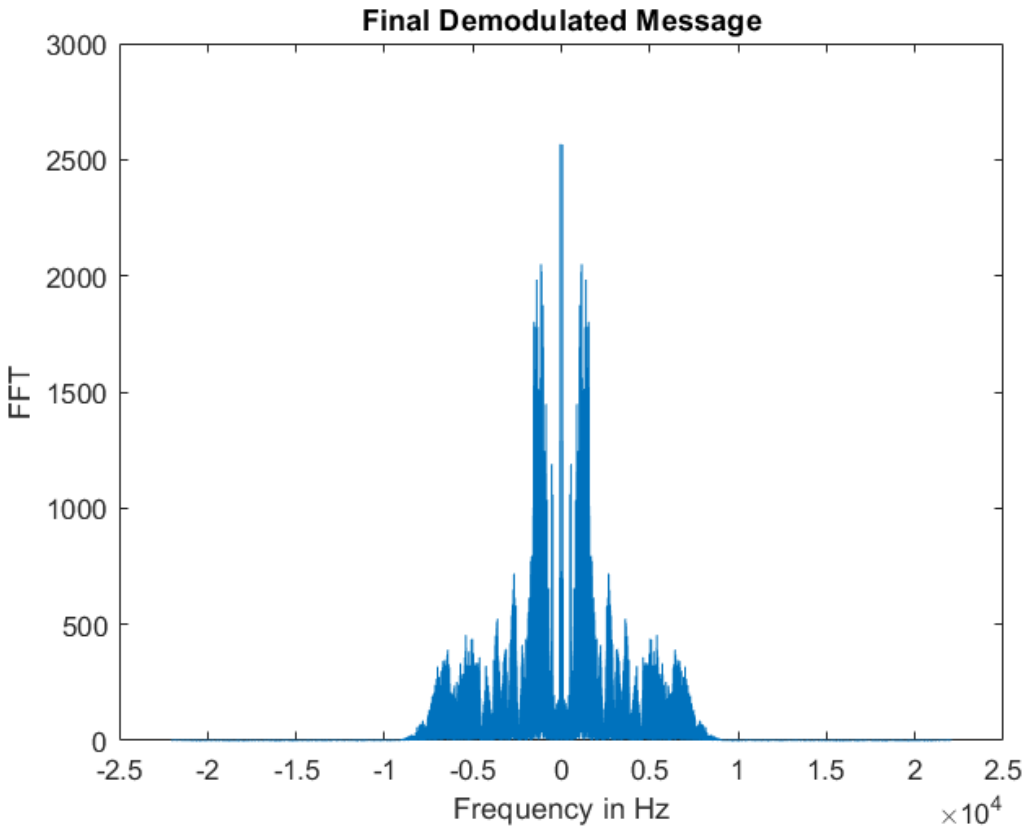


Figure 6: Output of the LPF



5. ***Performance evaluation without the RF stage***

The figures

Figure 7: output of the RF mixer (no RF filter)

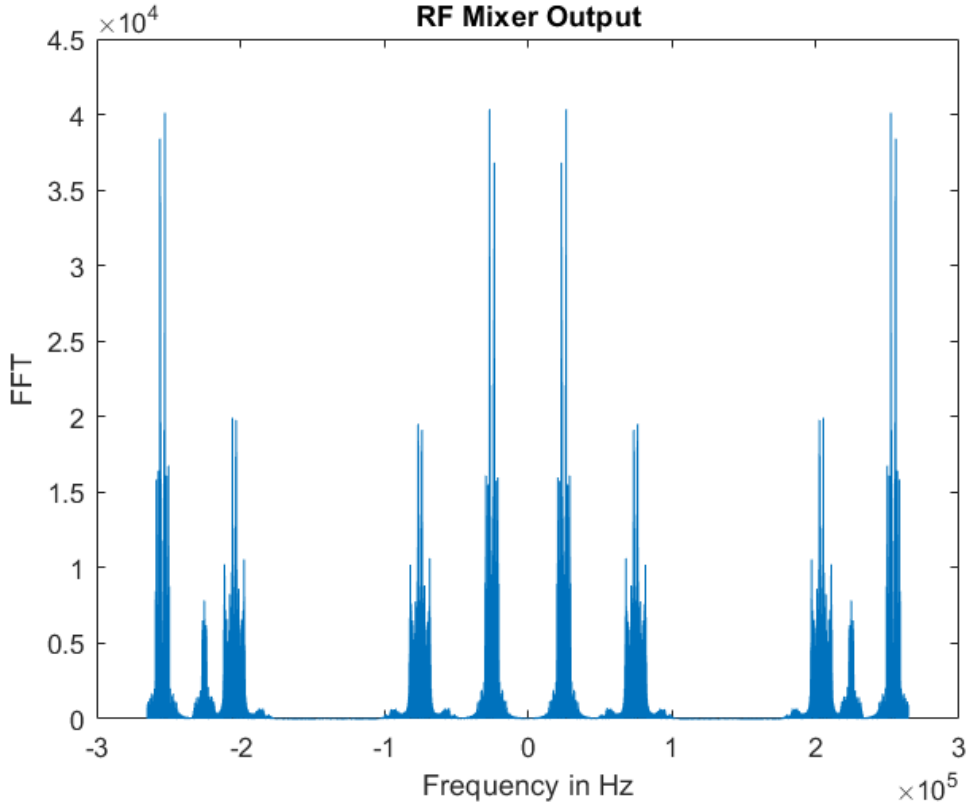


Figure 8: Output of the IF filter (no RF filter)

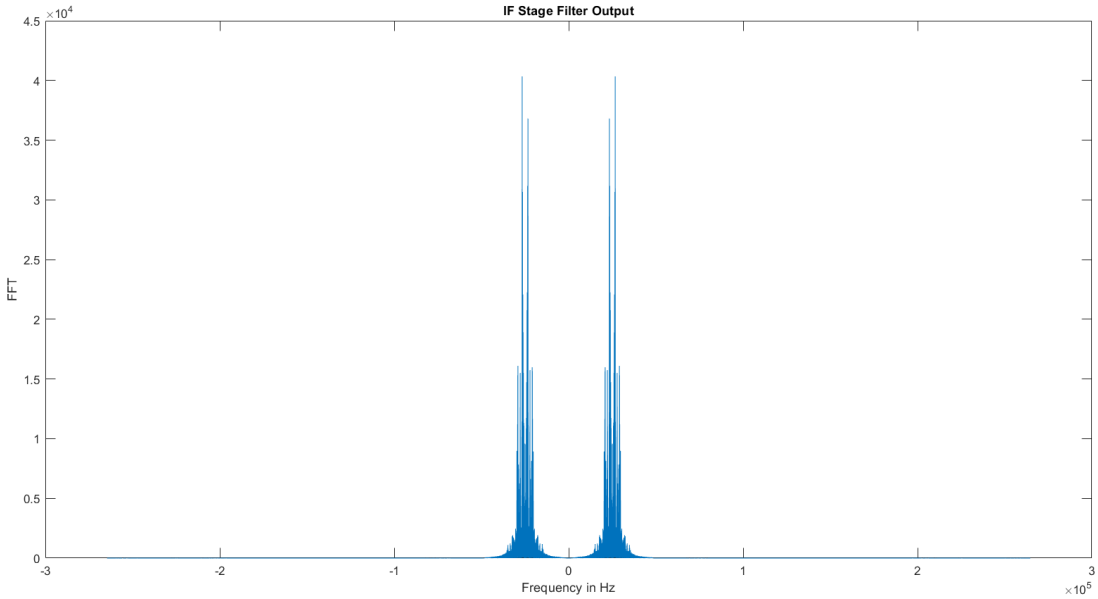


Figure 9: Output of the IF mixer before the LPF (no RF filter)

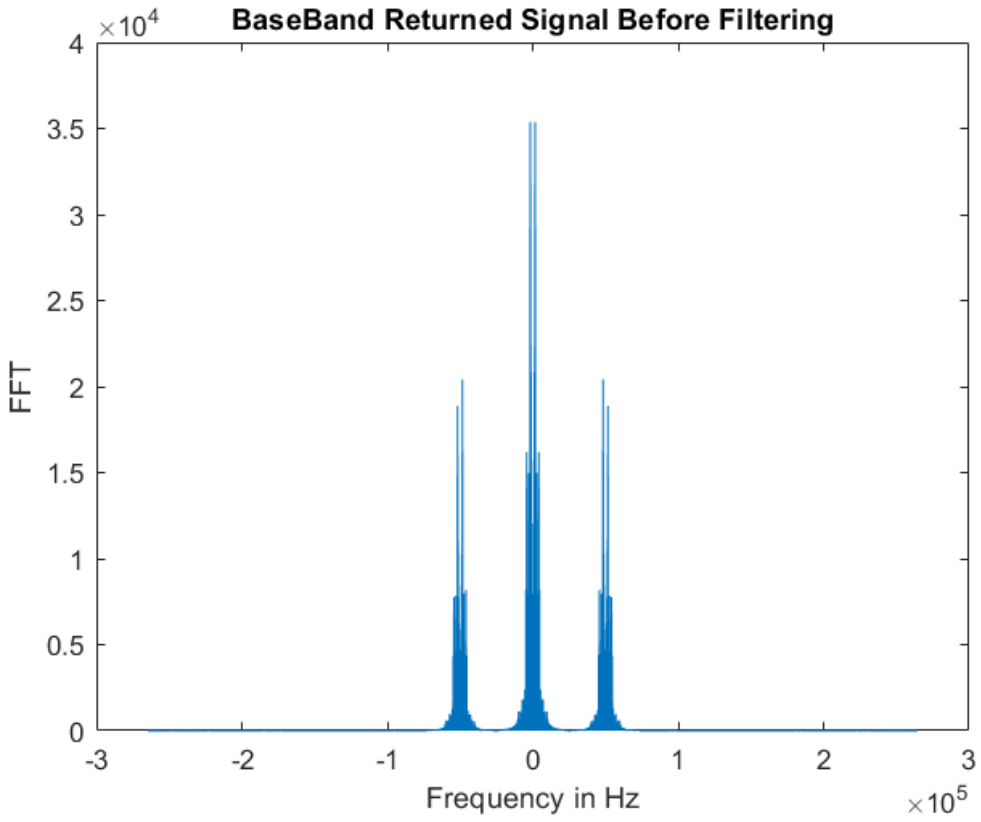
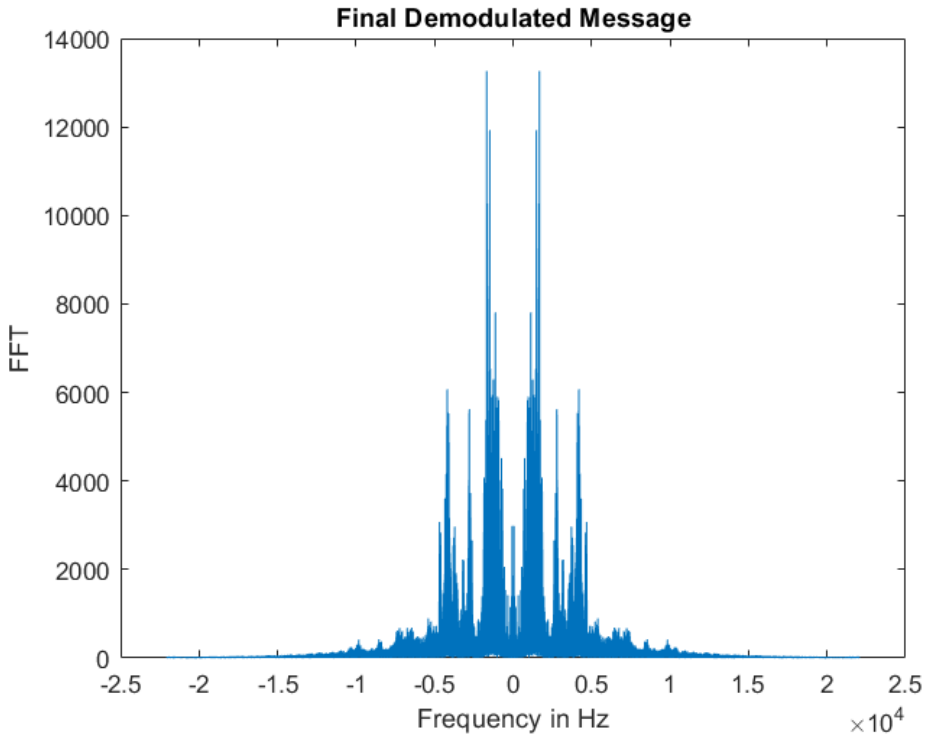


Figure 10: Output of the LPF (no RF filter)



6. ***Comment on the output sound***

In the existence of RF stage we chose the signal with f_c = 100 KHz (Sky News Message) we heard at the receiver this message clearly without any difference between it and the original one, but after removing the RF stage an interference occurred between the required signal and the signal with $f_c = 100 + 2*f_{IF}$ KHz (150 KHz) it was in our program Quran message which causes IF image to interfere with the required signal and we heard both signals at the receiver's output.

What happens (in terms of spectrum and the sound quality) if the receiver oscillator has frequency offset by 0.1 KHz and 1 KHz

1. Offset = 0.1 KHz: the sound was a little bit distorted; it is different than the original sound but still recognizable & understood.

2. Offset = 1 KHz: the sound was totally distorted; it is different than the original and neither recognizable nor understood.

This is due to that the signal has not been carried to the f_{IF} exactly but it is shifted so the coherent demodulator with f = 25 KHz has not done its job correctly.