Filter Design Project

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Introduction

In this project, I designed a Butterworth Lowpass Filter to remove unwanted noise from an audio file from the movie *Airplane!* (1980) using the MATLAB software.

Design

First I read the data of the audio file with a sampling frequency. Then, I used the graph of the Discrete Fourier Transform (DFT) visually to determine what values to use for the end of the passband (ωp) and the beginning of the stopband (ωs).

My initial values for ωp and ωs were not accurate, but I adjusted them to get values that produced a sufficient output. I repeated this process for δp and δs. I then used the values δp and δs to get the values for k_p and k_s. I then used my previous calculations to get Ω_p and Ω_s.

Using k_p, k_s, Ω_p, and Ω_s, I calculated my filter order (N). And adding this value into my data, I calculated my cutoff frequency (Ω_c).

To start applying the filter, I plugged my cutoff frequency and the filter order into $H_a(S)$.

Results

To see the final results, I compare the DFT vs Frequency graph before filtering to itself after filtering, as well as listening to the audio before and after filtering.

Figure 1 - DFT vs Frequency (Before Filtering)

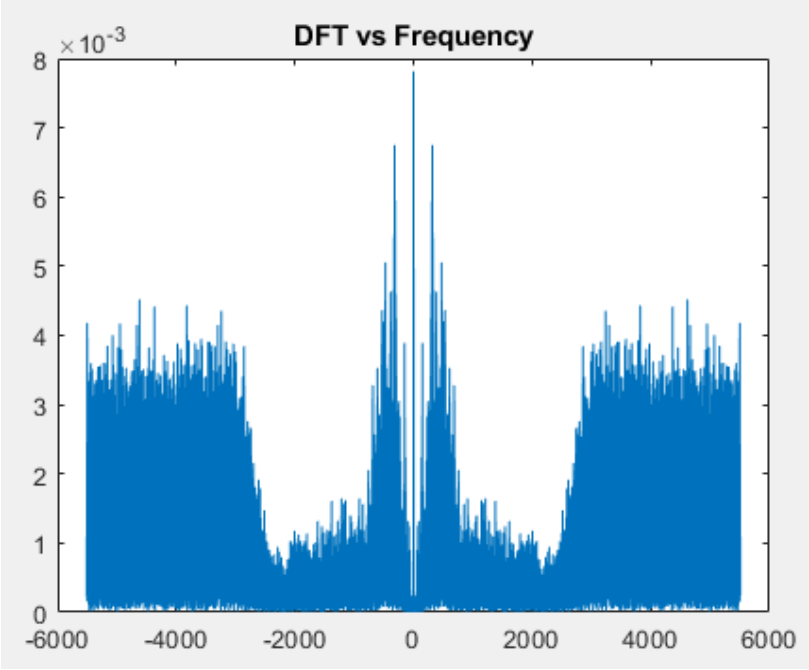

Figure 2 - DFT vs Frequency (After Filtering)

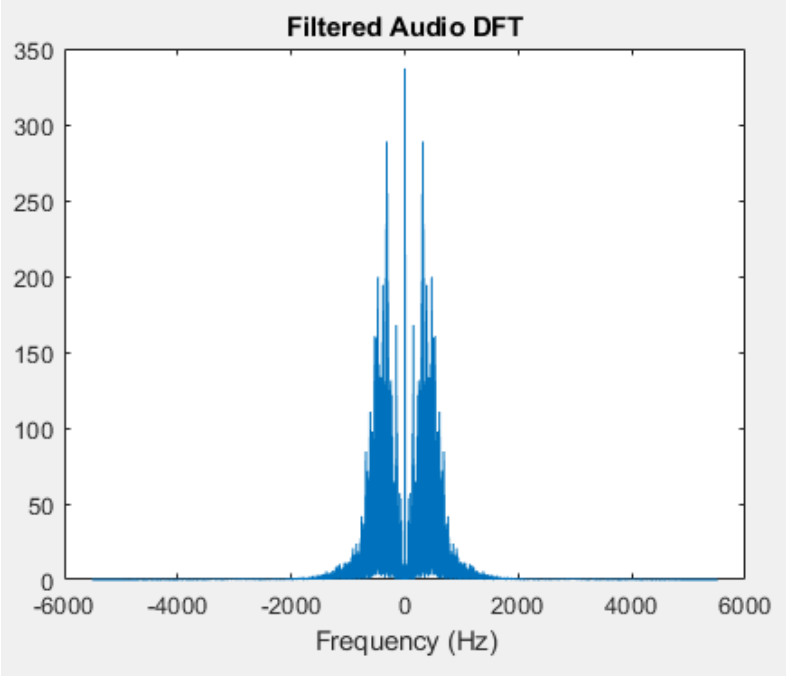

Figure 3 - Normalized DFT (Before Filtering)

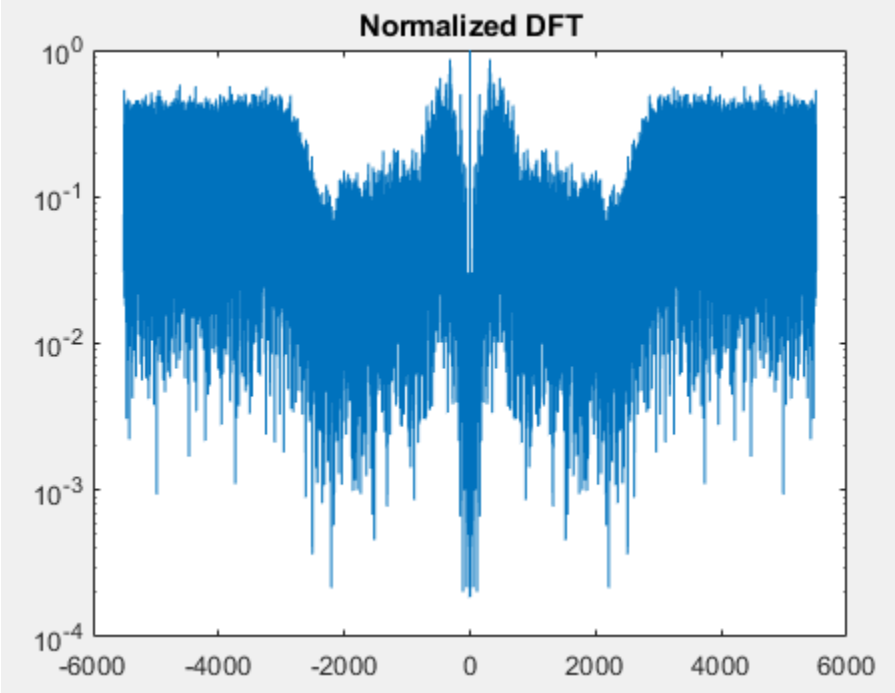

Figure 4 - Logarithmic Gain of Frequency Response