Elektronica Spring Bootcamp
Week-2 Assignment

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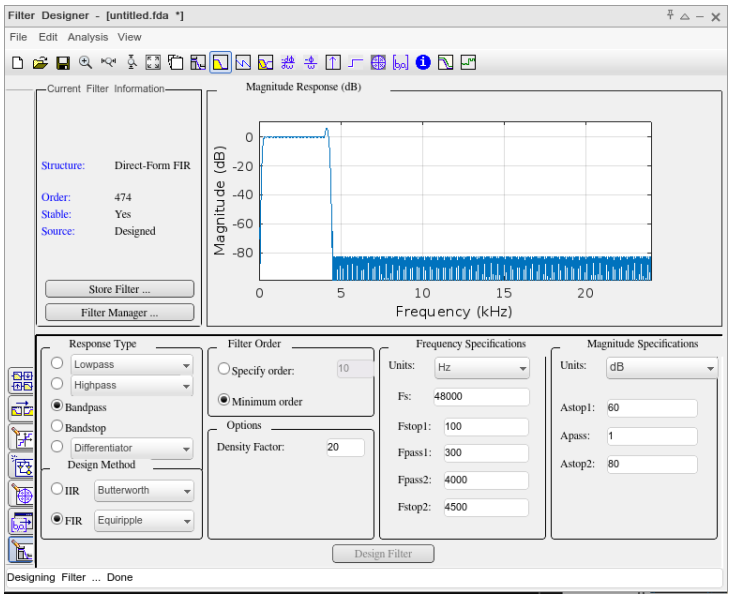
Filter Design

The goal of this assignment was to design a filter and apply it on a signal to see the response.

I chose to make a Band-pass filter between $300\,Hz - 4000\,Hz$. This is approximately the range of usable human voice frequencies for communication.

This filter can be applied on speech signals to remove most of the noise from higher frequencies, after which further processing can be done to remove the noise within $300\,Hz - 4000\,Hz$.



The filter was designed using the *filterDesigner* tool from the DSP toolbox of *MatLab*.

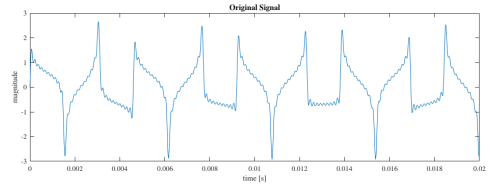
The generated coefficients were exported to a MatLab file *myFilter.m*.

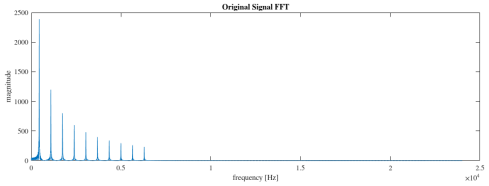
The stopping frequencies for the filter were chosen basically randomly, just to make the filter design possible.

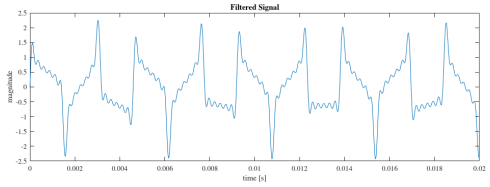
Testing

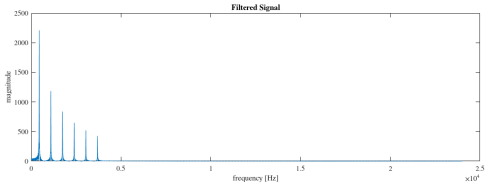
In order to test the filter, we generate a signal containing pure *sin* waves. We can see which frequencies get cut off after applying the filter by taking the *Fourier Transform* of the initial signal and the filtered signal.

The signal below consists of 10 sin waves starting at $440\,Hz$, with each successive frequency being $650\,Hz$ greater than the previous, i.e 440, 1090, 1740, 2390, 3040, 3690, 4340, 4990, 5640 and $6290\,Hz$.
The amplitude of the sin waves decreases as their frequency increases.







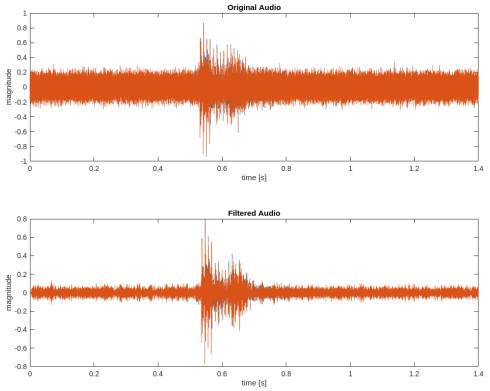


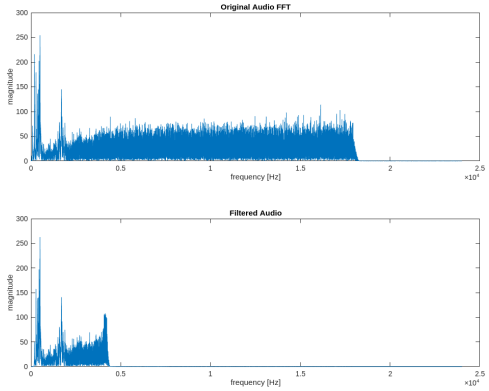
We can see that the FFT plot of the original signal contains 10 spikes, each corresponding to one of the sin components.

On the other hand, the filtered signal only contains 6 spikes, indicating that the 4 frequencies above $4000\,Hz$ have been attenuated.

Practical Demonstration

I recorded an mp3 of me saying *hello* and added some white noise in the range of about $3\,kHz - 20\,kHz$. By applying the filter, we can see that all the noise above $4\,kHz$ was cut-off, and only some noise within $0 - 4\,kHz$ remains in the filtered signal.





The above example clearly shows the importance of filters and the Fourier transform in signal processing.