

CMPE362

Homework 3

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I used MATLAB's built-in functions to design and implement the filters. These functions are part of MATLAB's Signal Processing Toolbox, which simplifies creating different types of filters. It has much more customization options than `filter`. Here's a brief explanation of each filter and the parameters I used:

1. Low-Pass Filter (Drum Kick)

Isolates the low frequencies of a drum kick.

Function: `designfilt('lowpassfir', ...)`

Parameters:

`'PassbandFrequency'`, 480: This means the filter will allow frequencies below 480 Hz to pass through with little amplitude.

`'StopbandFrequency'`, 520: This means frequencies above 520 Hz will be significantly reduced.

`'SampleRate'`, `fs`: This tells the filter the sampling rate of the audio signal.

Why I Chose These Parameters: Drum kicks have low frequencies. By setting the passband at 480 Hz and the stopband at 520 Hz, I ensure the filter captures the main frequencies of the drum kick while reducing higher frequencies. Also, this specific set of numbers prevent some weird pitch.

2. Band-Pass Filter (Piano)

Isolates the mid-range frequencies of a piano.

Function: `designfilt('bandpassfir', ...)`

Parameters:

`'StopbandFrequency1'`, 480: Frequencies below 480 Hz are reduced.

`'PassbandFrequency1'`, 520: Frequencies starting from 520 Hz are allowed through.

`'PassbandFrequency2'`, 4000: Frequencies up to 4000 Hz are allowed through.

`'StopbandFrequency2'`, 4050: Frequencies above 4050 Hz are reduced.

`'SampleRate'`, `fs`: This tells the filter the sampling rate of the audio signal.

Why I Chose These Parameters: Pianos cover a wide range of frequencies, mostly in the mid-range. By setting the passband from 520 Hz to 4000 Hz, I can capture the piano's main frequencies and filter out unwanted low and high frequencies.

3. High-Pass Filter (Cymbal)

Isolates the high frequencies of cymbals.

Function: `designfilt('highpassfir', ...)`

Parameters:

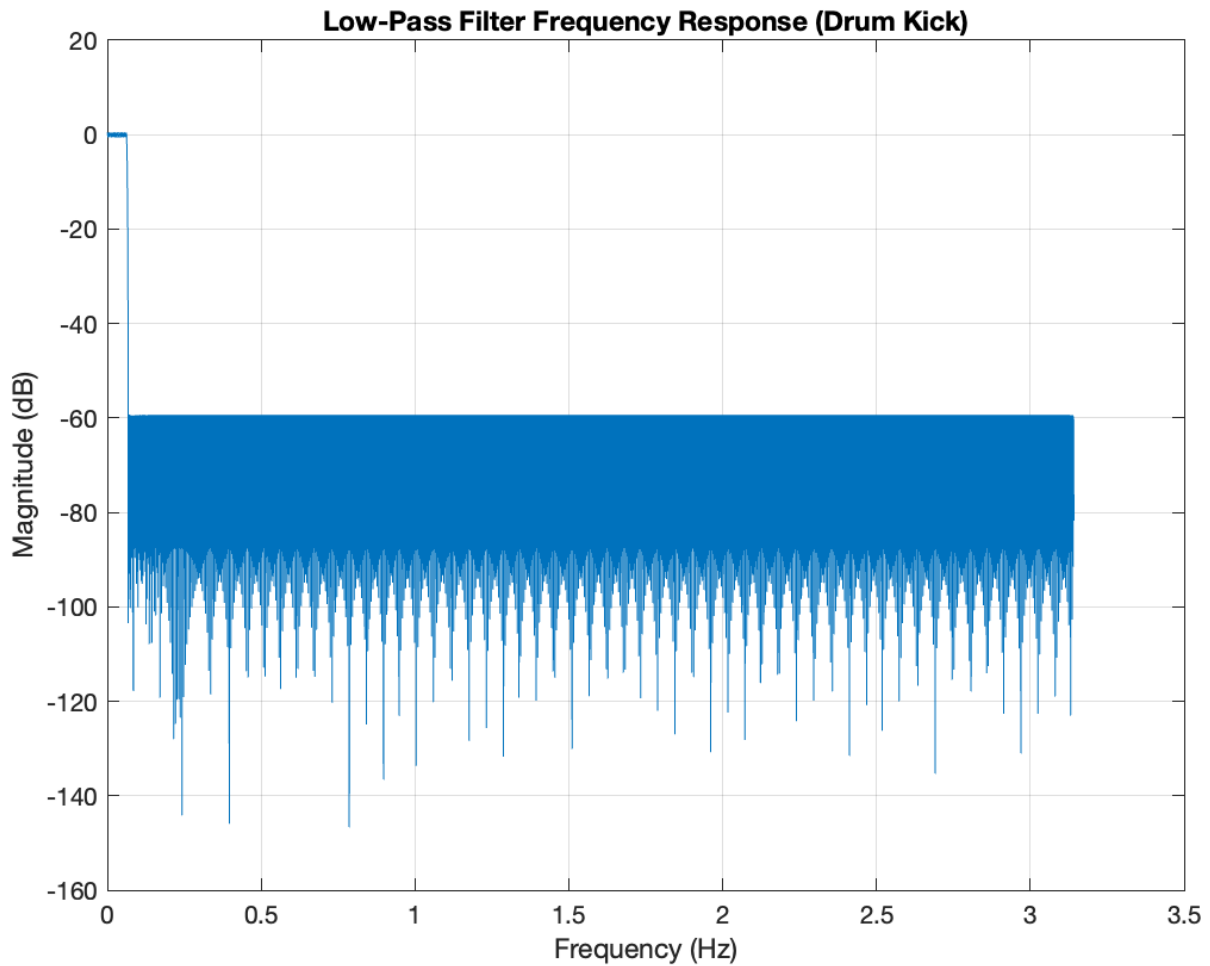
`'StopbandFrequency'`, 3950: Frequencies below 3950 Hz are reduced.

`'PassbandFrequency'`, 4000: Frequencies above 4000 Hz are allowed through.

`'SampleRate'`, `fs`: This tells the filter the sampling rate of the audio signal.

Why I Chose These Parameters: Cymbals have high frequencies. By setting the passband at 4000 Hz, I can capture these high frequencies while filtering out lower frequencies.

Plots of magnitude of the frequency response of each filter



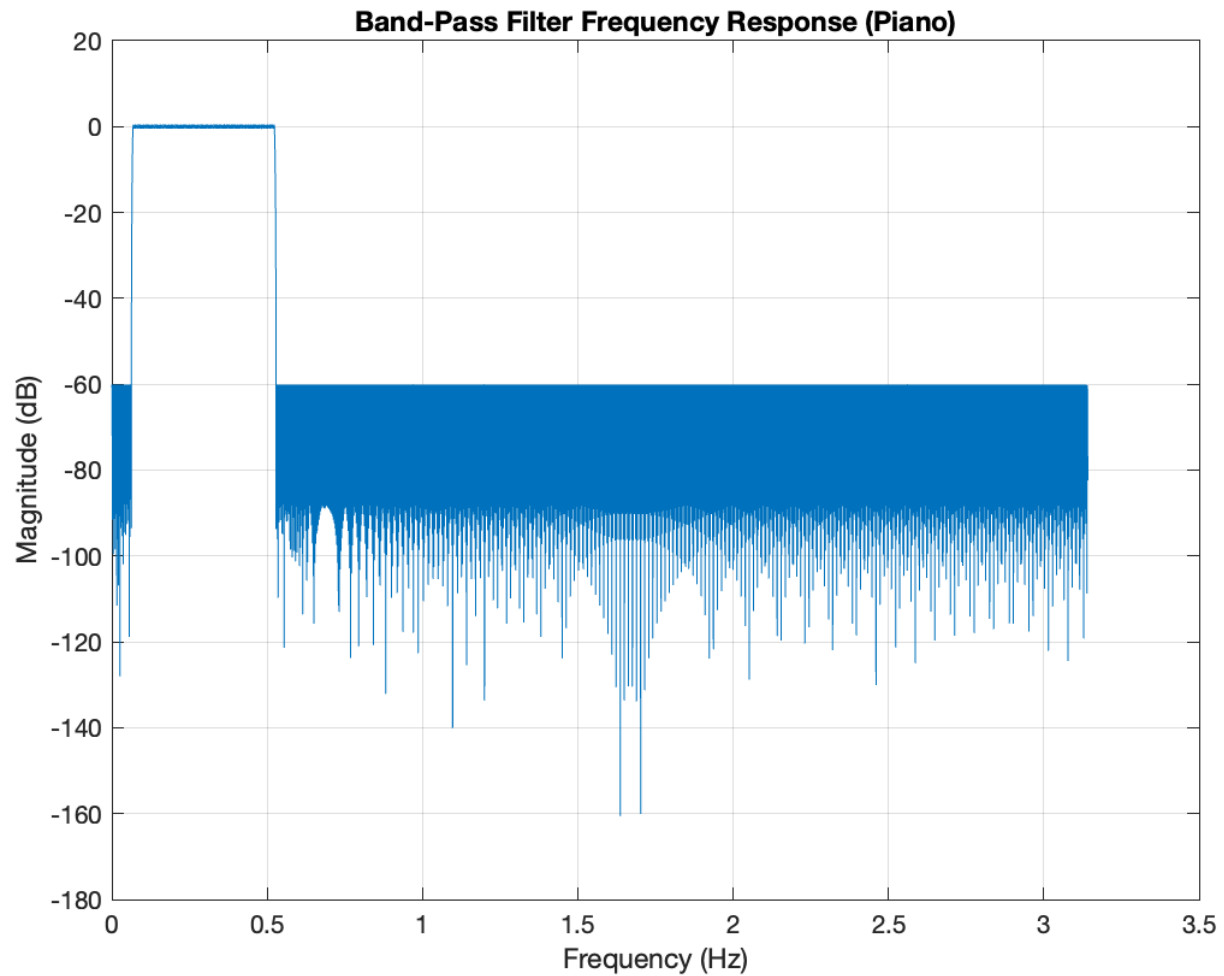
Low-Pass Filter (Drum Kick)

Frequencies below 480 Hz are passed through with minimal attenuation (close to 0 dB). Frequencies above 520 Hz are significantly attenuated (large negative dB values).

Why It Works:

Drum kicks primarily occupy lower frequencies.

By allowing frequencies below 480 Hz to pass and attenuating higher frequencies, the filter effectively isolates the drum kick sounds.



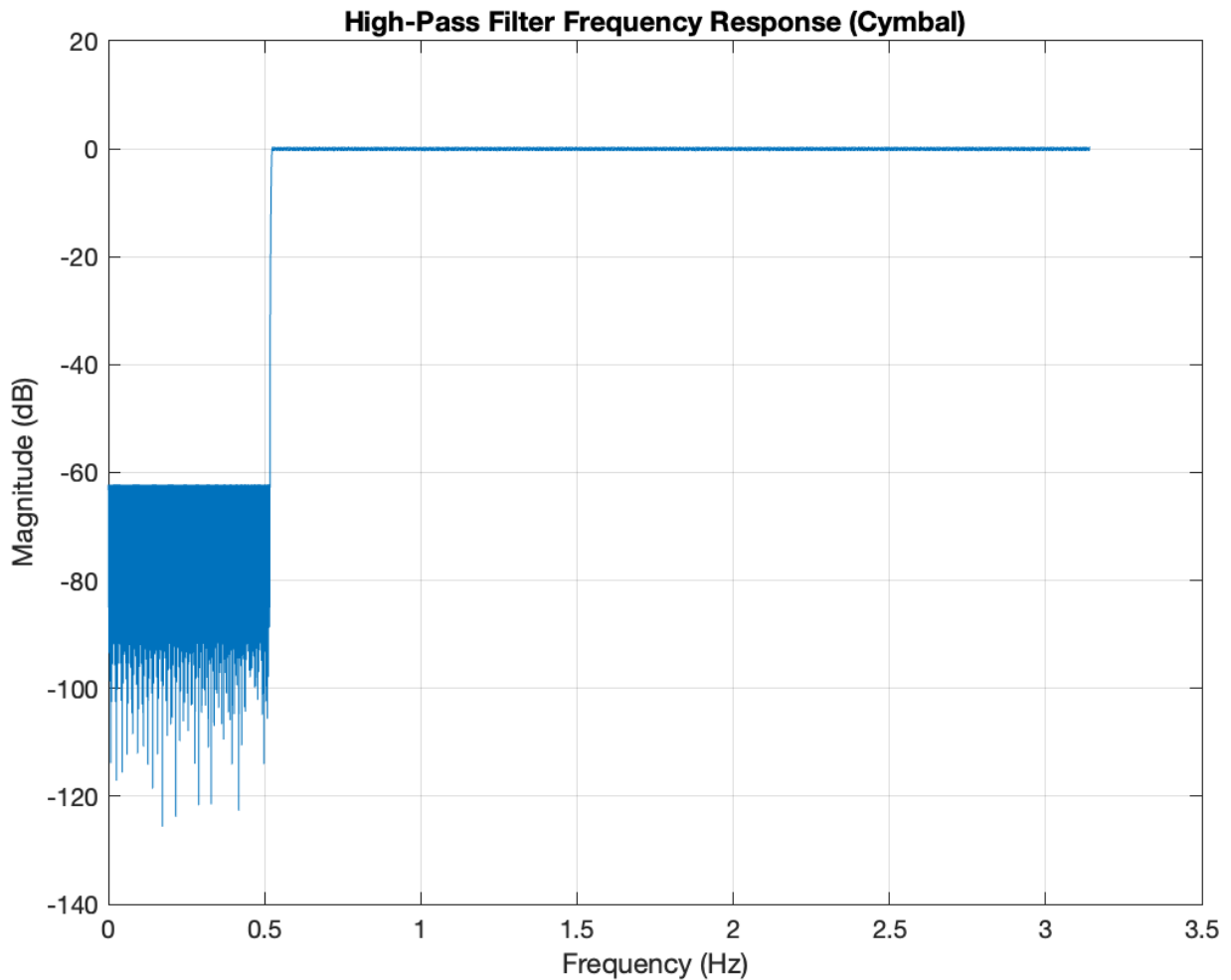
Band-Pass Filter (Piano)

Frequencies between 520 Hz and 4000 Hz are passed through with minimal attenuation. Frequencies below 480 Hz and above 4050 Hz are significantly attenuated.

Why It Works:

Pianos cover a broad range of mid frequencies.

By passing frequencies between 520 Hz and 4000 Hz, the filter isolates the piano sounds while filtering out low and high-frequency noise.



High-Pass Filter (Cymbal)

Frequencies above 4000 Hz are passed through with minimal attenuation.
Frequencies below 3950 Hz are significantly attenuated.

Why It Works:

Cymbals produce high-frequency sounds.

By allowing frequencies above 4000 Hz to pass and attenuating lower frequencies, the filter effectively isolates the cymbal sounds.

Note: The frequency axis has a different scale.

