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 fir1. 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** A graph of a frequency

Description automatically generated

**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.

A graph of a frequency

Description automatically generated with medium confidence

**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.

A graph with a blue line

Description automatically generated

**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.

A group of blue sound waves

Description automatically generated