

Mini-Project 03: Tone Removal

Background

Write a simple MATLAB program that removes unwanted tones from a wav file. The file **SunshineSquare.wav** has had some unwanted tones added to it. Your job is to remove the tones so you can hear the message better.

Approach

There are two steps needed to remove the tones. First determine the frequencies of the interfering tones, and second, filter out those frequencies.

Find the frequencies

The following MATLAB code will read the wav file and plot a spectrogram of it.

```
[xx, fs] = audioread('SunshineSquare');
xx = xx';
figure;
spectrogram(xx, [], fs) or spectrogram(xx, 1024, 512, 11025, fs, 'yaxis');
```

Note, f_s is the sampling rate of the wav file and is important. Estimate the frequencies of the tones from the spectrogram. Convert the frequencies in Hz to digital frequencies in $\hat{\omega}$.

Filter the Frequencies

A weighted three-point averager is enough to remove one frequency at a time. Given the impulse response:

$$h[n] = \{1, A, 1\}$$

find the frequency response $H(e^{j\hat{\omega}})$ in terms of A . Find the values of A needed to remove each of the unwanted frequencies. Once you have the correct values, this code can be used to remove one frequency at a time:

```
hh = [1, AA, 1];
yy = filter(hh, 1, xx);
```

You will have to fill in your values for AA . You can check the frequency response of your filter by using `freqz`:

```
ww = -pi:pi/100:pi;
HH = freqz(hh, 1, ww);
plot(ww, abs(HH));
```

After removing unwanted tones, you can listen the result using `audioplayer`:

```
player = audioplayer(yy, fs);
play(player);
```

Hint: You will have to use multiple filters. Once you have it working, combine those filters into one filter.

대충
foo1 → data tip? 그래프에서 점 확인

sampling freq → 1초에 몇 번씩 알 수 있을
→ 몇 초인지 파악함

주파수 하나 하나 → cascade
impulse response의 freq response 하나
확인

Instructions:

What is due:

1. A report describing what you did. Your report should include:
 - a. An introduction telling what you are doing. (One or two sentences should be enough.)
 - b. Frequency response $H(e^{j\hat{\omega}})$ in terms of A .
 - c. A table listing the frequency in Hz, the digital frequency, and A for each tone.
 - d. Include a spectrogram of the cleaned up tones.
 - e. A brief conclusion. (A sentence or two should be plenty.)
2. Your MATLAB code.
 - a. Filter out all unwanted tones and play the result using `audioplayer`.