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## Mini-Project 03: Tone Removal

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### 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] = wavread('SunshineSquare');  
xx = xx';  
figure(1)  
specgram(xx, [], fs)
```

Note,  $fs$  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));
```

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

## Due Date:

For this mini project you are to work on your own, however you are free to discuss ideas with others.

What is due:

1. wav file of your cleaned up file.
2. One page memo describing what you did. Your memo should include:
  - a. An introduction telling what you are doing. (One or two sentences should be enough.)
  - b. A brief summary of what you did. Have a table listing the frequency in Hz, the digital frequency, and **A** for each tone. Include a spectrogram of the cleaned up signal in your memo. Highlight any **extras** you've added. No more than half a page or so.
  - c. Your judgment of the effectiveness of this project in reinforcing the class. Justify your opinion. No more than a sentence or two.
  - d. A brief conclusion. (A sentence or two should be plenty.)
  - e. Use a memo format.
3. Your MATLAB code.