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```
clear; clc;
```

Section A

```
[x, fs] = audioread('SunshineSquare.wav');

window = hamming(256); % window function
noverlap = 128; % overlap between windows
nfft = 512; % FFT size

[S, F, T] = spectrogram(x, window, noverlap, nfft, fs);

%plot before remove the noises
figure;
imagesc(T, F, 20*log10(abs(S)));
axis xy;
colorbar;
colormap(jet);
xlabel('Time (s)');
ylabel('Frequency (Hz)');
title('Spectrogram of Original Signal');

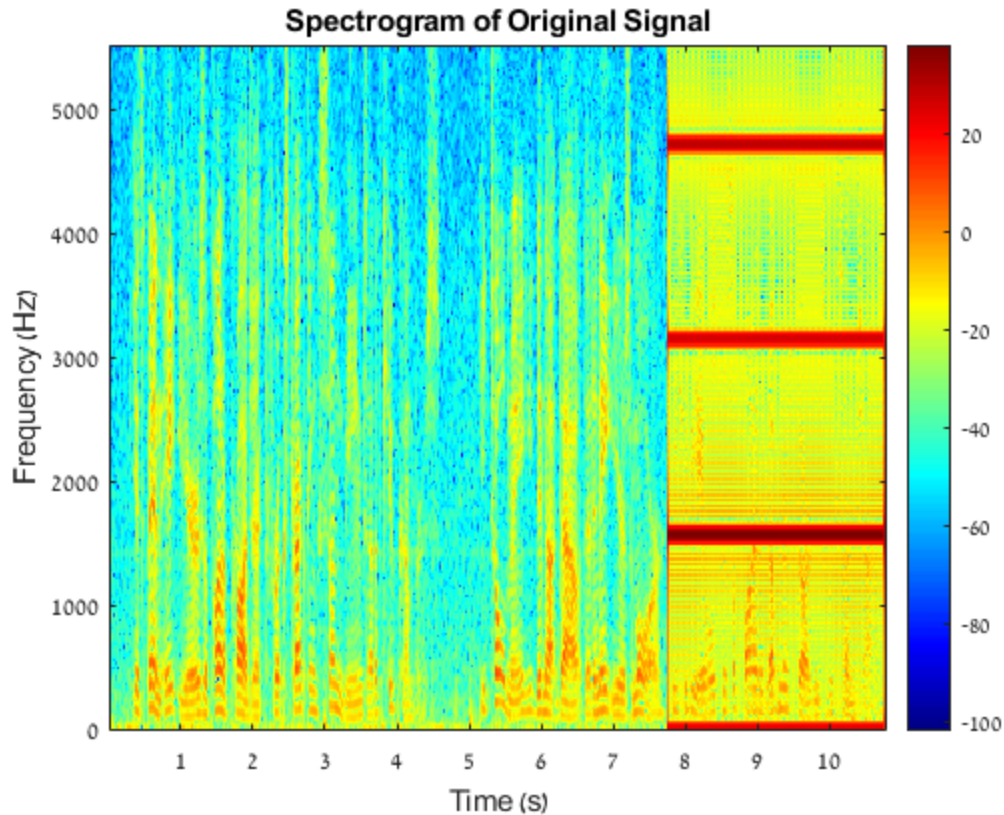
%finding the noises by looking at the spectrogram graph
freqs=[30 , 1575 , 3150 , 4725];

% convert frequencies to discrete-time frequencies (w)
dw = 2*pi/nfft;
to_w = freqs * dw; %multiply each freq to convert to discrete time

disp('Sinusoidal frequencies (Hz):');
disp(freqs);
disp('Sinusoidal frequencies (w):');
disp(to_w);

Sinusoidal frequencies (Hz):
      30      1575      3150      4725

Sinusoidal frequencies (w):
    0.3682    19.3282    38.6563    57.9845
```



Section B

```
%we found the formula by mathematical calc on notebook
As = -2*cos(2*pi*freqs/fs);
for j = 1:length(freqs)
    fprintf("Frequency %d Hz: A = %f\n", freqs(j), As(j));
end
```

```
Frequency 30 Hz: A = -1.999708
Frequency 1575 Hz: A = -1.246980
Frequency 3150 Hz: A = 0.445042
Frequency 4725 Hz: A = 1.801938
```

Section D

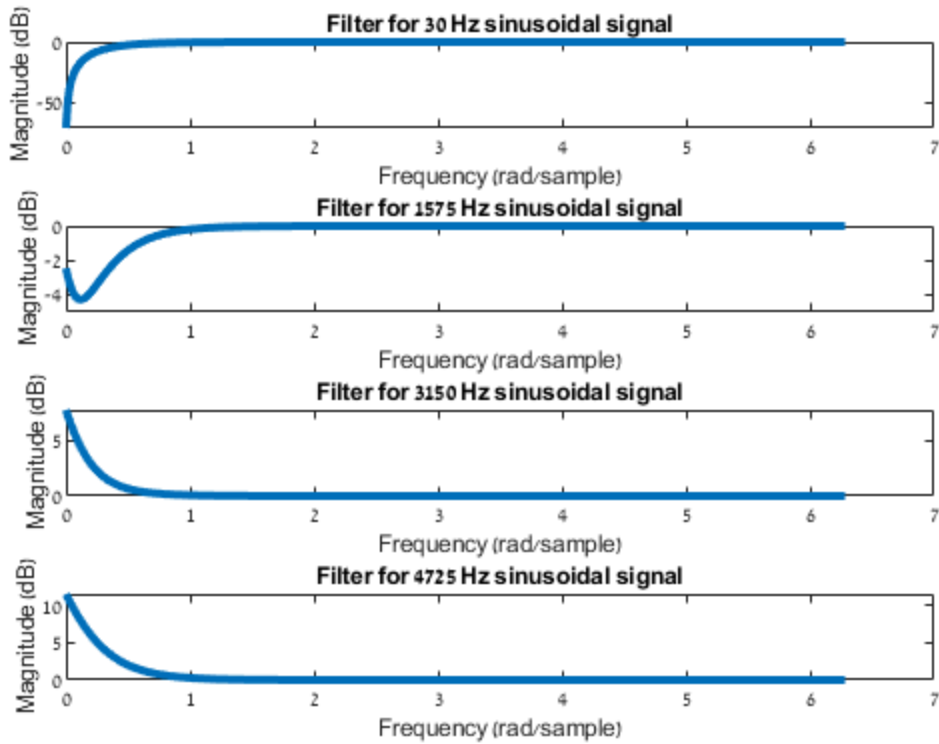
```
total_mag=1;
w = linspace(0, 2*pi, 1000);
figure;
for i = 1:length(As)
    H = @(w) 1 + As(i)*exp(-1*j*w) + exp(-2*j*w);

    mag = 20*log10(abs(H(w)));
    total_mag=total_mag.*mag;
    subplot(4,1,i);
    plot(w, mag, 'LineWidth', 3);
```

```

xlabel('Frequency (rad/sample)');
ylabel('Magnitude (dB)');
title(sprintf('Filter for %d Hz sinusoidal signal', freqs(i)));
end

```

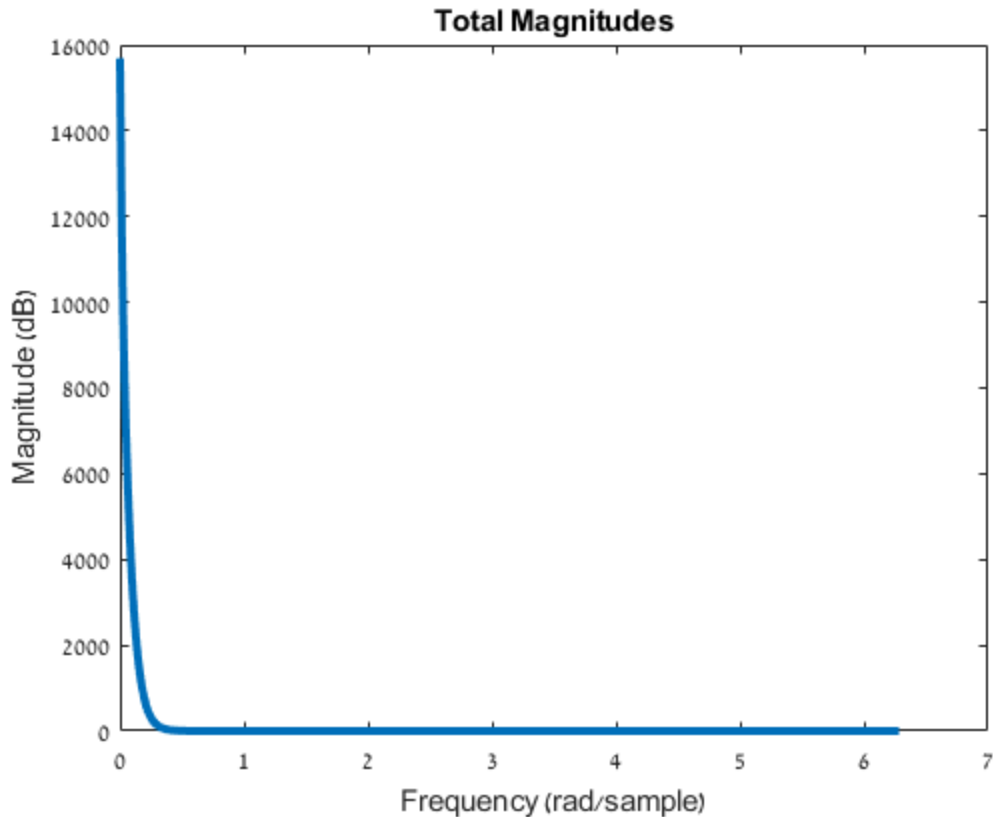


Section E

```

figure;
plot(w, total_mag , 'LineWidth', 3);
xlabel('Frequency (rad/sample)');
ylabel('Magnitude (dB)');
title(sprintf('Total Magnitudes'));

```



Section F

```
y=x;  
for i=1:length(As)  
    h1=[1 As(i) 1];  
    y = conv(y,h1);  
end
```

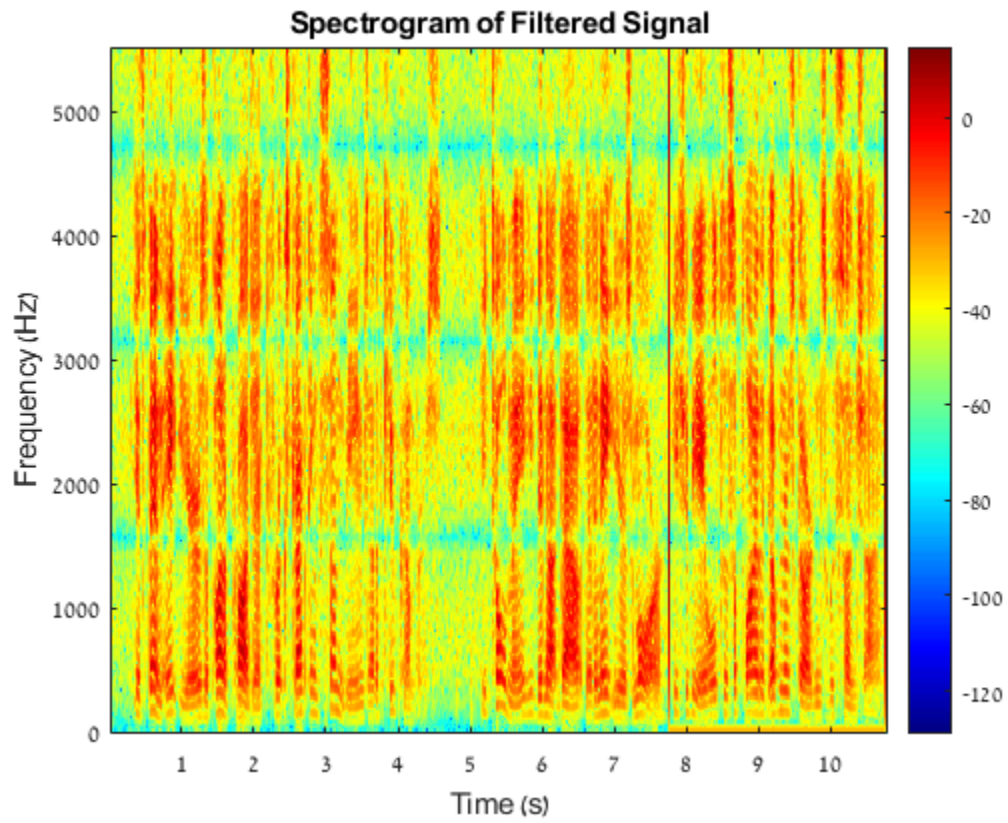
```
%before filtering  
%sound(x, fs);  
%sound off  
%after filtering  
sound(y, fs);
```

Section G - plots the spectrograms

Spectrogram of filtered signal

```
[S_filt, F_filt, T_filt] = spectrogram(y, window, noverlap, nfft, fs);  
figure;  
imagesc(T_filt, F_filt, 20*log10(abs(S_filt)));  
axis xy;  
colorbar;  
colormap(jet);  
title('Spectrogram of Filtered Signal');
```

```
xlabel('Time (s)');  
ylabel('Frequency (Hz)');
```



Published with MATLAB® R2021b