
The Matlab Club; City Graduate School

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Introduction to sounds and spectra.

The human voice consists of sounds created by vibrations of the vocal folds for talking, reading, singing, laughing, crying, screaming, etc. The human voice is specifically a part of human sound production in which the vocal folds (vocal cords) are the primary sound source.

This tutorial explores the sounds of three snippets of music and displays them in different ways.

Read three sound tracks, aproximately 25 seconds each

```
[y1,fs1] = wavread('Queen_of_the_Night.wav');  
[y2,fs2] = wavread('LOUIS_ARMSTRONG.wav');  
[y3,fs3] = wavread('Afrojack.wav');
```

```
Error using wavread (line 68)  
Invalid Wave File. Reason: Cannot open file.
```

```
Error in SoundsAndSpectra (line 14)  
[y1,fs1] = wavread('Queen_of_the_Night.wav');
```

To play a signal as a wave, you use the command 'sound'

```
sound(y1(1:57000),fs1)
```

Display the three sound waves together

```
figure
```

```
subplot(311)
plot(y1,'k')
title('Queen of the Night, Mozart','fontsize',16)
grid on; axis tight
subplot(312)
plot(y2,'r')
title('It's a wonderful world, Louis Armstrong','fontsize',16)
grid on; axis tight
subplot(313)
plot(y3,'b')
title('The Spark, Afrojack','fontsize',16)
grid on; axis tight
```

Zoom into the signals, notice the different characteristics of each signal

```
figure

sampTime = (4.01)*1e5:(4.09)*1e5;
subplot(311)
plot(y1(sampTime),'k')
grid on; axis tight
title('Queen of the Night, Mozart','fontsize',16)
subplot(312)
plot(y2(sampTime),'r')
grid on; axis tight
title('It's a wonderful world, Louis Armstrong','fontsize',16)
subplot(313)
plot(y3(sampTime),'b')
grid on; axis tight
title('The Spark, Afrojack','fontsize',16)
```

Zoom into the signals, notice the different characteristics of each signal

```
figure

sampTime = (4.01)*1e5:(4.03)*1e5;
subplot(311)
plot(y1(sampTime),'k')
grid on; axis tight
title('Queen of the Night, Mozart','fontsize',16)
subplot(312)
plot(y2(sampTime),'r')
grid on; axis tight
title('It's a wonderful world, Louis Armstrong','fontsize',16)
subplot(313)
plot(y3(sampTime),'b')
grid on; axis tight
title('The Spark, Afrojack','fontsize',16)
```

Obtain the Fourier transforms of each signal

As the signals have different number of elements, generate a variable that will be used as the axis for the plots

```
y1_f = abs(fftshift(fft(y1)));
y2_f = abs(fftshift(fft(y2)));
y3_f = abs(fftshift(fft(y3)));

axis_F1=1:numel(y1);
axis_F2=1:numel(y2);
axis_F3=1:numel(y3);

figure
subplot(311)
plot((y1_f),'k')
grid on; axis tight
title('Queen of the Night, Mozart','fontsize',16)
subplot(312)
plot((y2_f),'r')
title('It's a wonderful world, Louis Armstrong','fontsize',16)
grid on; axis tight
subplot(313)
plot((y3_f),'b')
grid on; axis tight
title('The Spark, Afrojack','fontsize',16)

figure
subplot(311)
plot(log(1+y1_f),'k')
grid on; axis tight
title('Queen of the Night, Mozart','fontsize',16)
subplot(312)
plot(log(1+y2_f),'r')
grid on; axis tight
title('It's a wonderful world, Louis Armstrong','fontsize',16)
subplot(313)
plot(log(1+y3_f),'b')
grid on; axis tight
title('The Spark, Afrojack','fontsize',16)
```

Obtain the Fourier transform of a short period in time

```
spec1=[];
spec2=[];
spec3=[];
stepSamp = round(fs1/10);
for k=1:stepSamp:540000-fs1
    q1=abs((fft(y1(k:k+stepSamp-1))));
    q2=abs((fft(y2(k:k+stepSamp-1))));
    q3=abs((fft(y3(k:k+stepSamp-1))));
```

```
spec1=[spec1;q1(1:floor(stepSamp/2))'];  
spec2=[spec2;q2(1:floor(stepSamp/2))'];  
spec3=[spec3;q3(1:floor(stepSamp/2))'];  
end
```

Display the spectra of the signals (time v. frequency)

```
figure  
subplot(311)  
imagesc(log(1+spec1'))  
axis xy  
set(gca,'xtick',0:20:240,'xticklabel',(0:20:240)/10);  
title('Queen of the Night, Mozart','fontsize',16)  
  
subplot(312)  
imagesc(log(1+spec2'))  
axis xy  
set(gca,'xtick',0:20:240,'xticklabel',(0:20:240)/10);  
title('It's a wonderful world, Louis Armstrong','fontsize',16)  
  
subplot(313)  
imagesc(log(1+spec3'))  
axis xy  
title('The Spark, Afrojack','fontsize',16)  
set(gca,'xtick',0:20:240,'xticklabel',(0:20:240)/10);  
xlabel('Seconds','fontsize',16)
```

You can record your voice for 5 seconds with these commands

```
recObj = audiorecorder; disp('Start speaking.') recordblocking(recObj, 5); disp('End of Recording.');
```

Then you can play it like this:

```
play(recObj)
```

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