Dhirubhai Ambani Institute of Information and Communication Technology

ADSP

LAB – 9 : Noise based Analysis

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EXERCISES

Question) What is spectrogram? Why it is used?

Answer

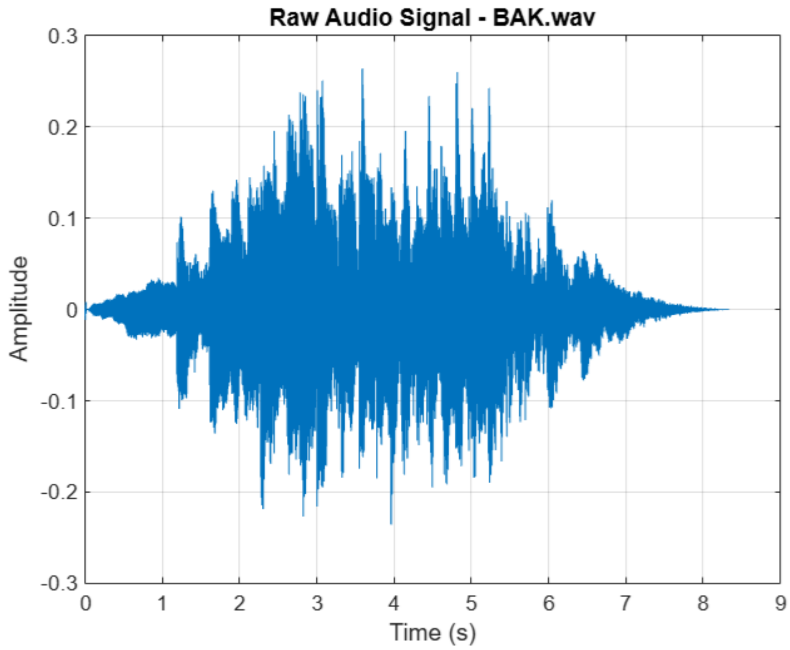
- ⇨ A **spectrogram** is a visual representation of how the frequency content of a signal changes over time.
- ⇨ It's basically a time-vs-frequency plot where:
    - X-axis = Time
    - Y-axis = Frequency
    - Color (or intensity) = Amplitude (strength) of that frequency at that time
- ⇨ Spectrograms are super useful because they give a **joint-frequency analysis** of signals – something that pure Fourier Transform (FT) can't do.

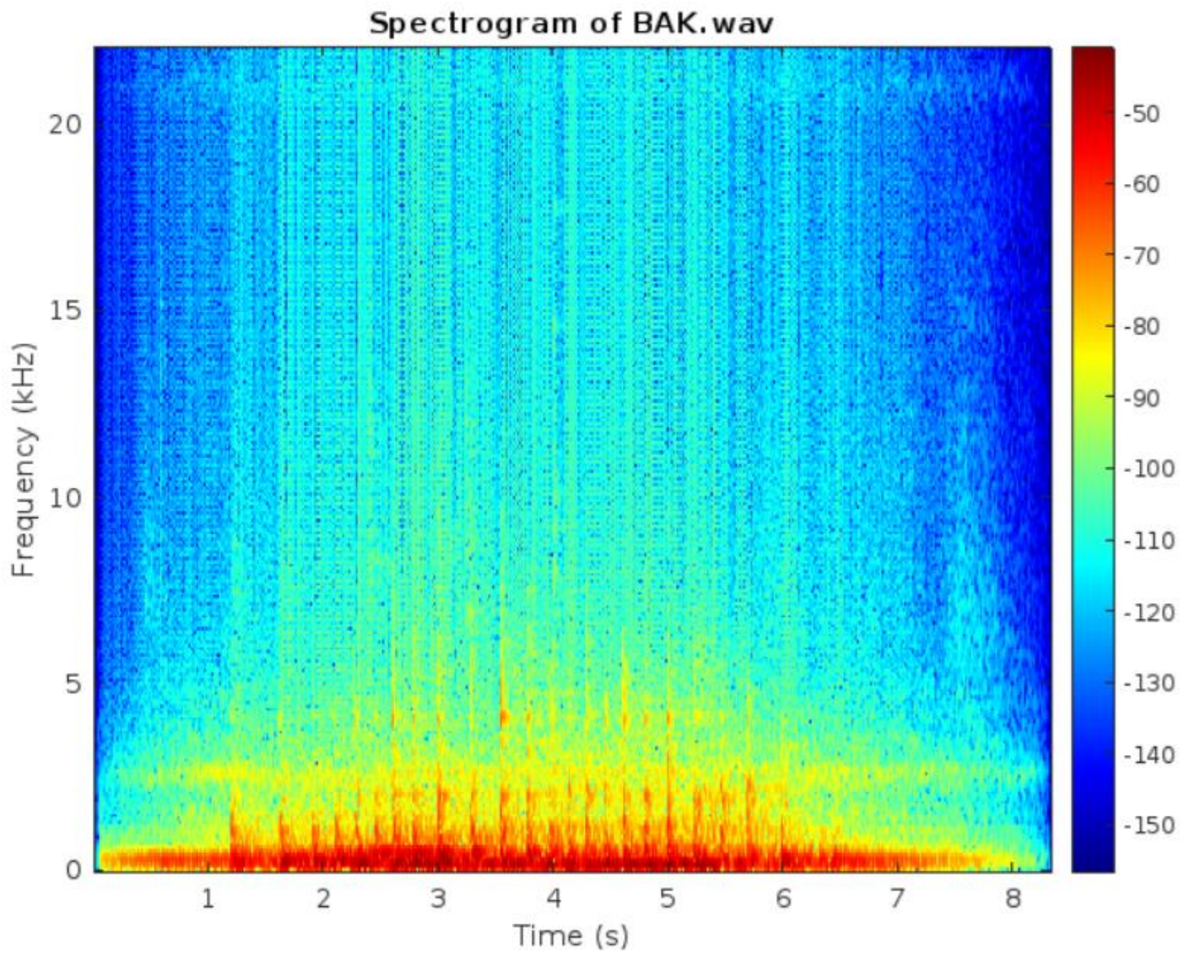
Fourier Transform	**Spectrogram**
Only frequency information	Time + Frequency information
Can't tell when things happen	Can see when a frequency occurs
Good for stationary signals	Better for non-stationary signals

Q1) Take 1 audio signal. Plot the spectrogram of audio signal.

CODE:

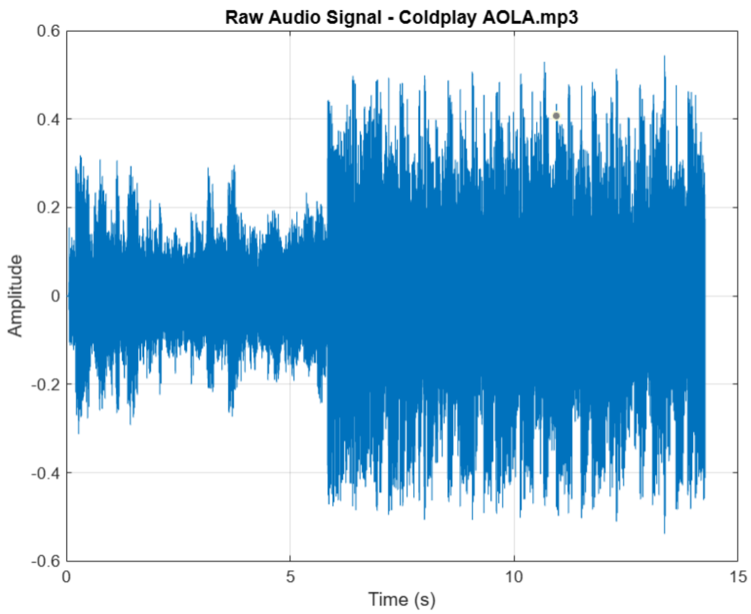
```
% 202411012
% Audio signal's spectrogram

clc; clear; close all;


% Loading the audio file

[audio, Fs] = audioread('BAK.wav');  % Fs = Sampling frequency
audio = mean(audio, 2);

% Time vector (optional, for signal plotting)
t = (0:length(audio)-1)/Fs;

% Plotting the raw waveform
figure;
plot(t, audio);
xlabel('Time (s)');
ylabel('Amplitude');
title('Raw Audio Signal - BAK.wav');
grid on;

% Spectrogram Parameters
win_length = 256;                 % Window length
overlap = round(0.75 * win_length); % Overlap between windows
nfft = 512;                       % FFT size

% Plotting the Spectrogram
figure;
spectrogram(audio, hamming(win_length), overlap, nfft, Fs, 'yaxis');
title('Spectrogram of BAK.wav');
colormap jet;
colorbar;
```

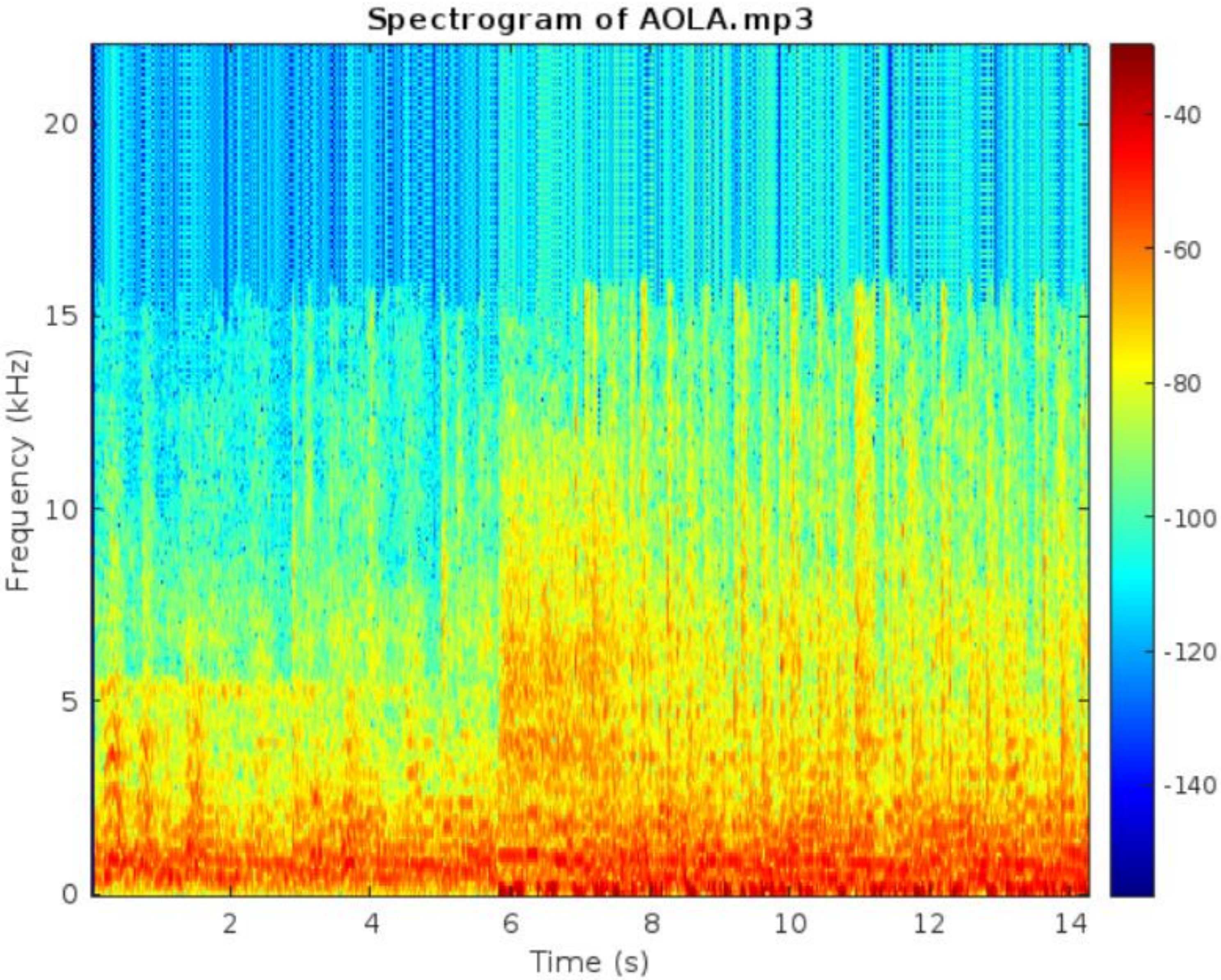

Raw Audio Signal - BAK.wav
Amplitude
Time (s)
0.3
0.2
0.1
0
-0.1
-0.2
-0.3
0
1
2
3
4
5
6
7
8
9


Spectrogram of BAK.wav
Frequency (kHz)
Time (s)
20
15
10
5
0
1
2
3
4
5
6
7
8
-50
-60
-70
-80
-90
-100
-110
-120
-130
-140
-150

Q2) Take 1 music signal. Plot the spectrogram of music signal.

```
% 202411012
% Music signal's spectrogram

clc; clear; close all;


% Loading the audio file

[audio, Fs] = audioread('Coldplay_AOLA_Trimmed.mp3');  % Fs = Sampling frequency
audio = mean(audio, 2);

% Time vector (optional, for signal plotting)
t = (0:length(audio)-1)/Fs;

% Plotting the raw waveform
figure;
plot(t, audio);
xlabel('Time (s)');
ylabel('Amplitude');
title('Raw Audio Signal - Coldplay AOLA.mp3');
grid on;

% Spectrogram Parameters
win_length = 256;                  % Window length
overlap = round(0.75 * win_length); % Overlap between windows
nfft = 512;                        % FFT size

% Plotting the Spectrogram
figure;
spectrogram(audio, hamming(win_length), overlap, nfft, Fs, 'yaxis');
title('Spectrogram of AOLA.mp3');
colormap jet;
colorbar;
```




Spectrogram of AOLA.mp3
Frequency (kHz)
Time (s)
0
5
10
15
20
2
4
6
8
10
12
14
-40
-60
-80
-100
-120
-140

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