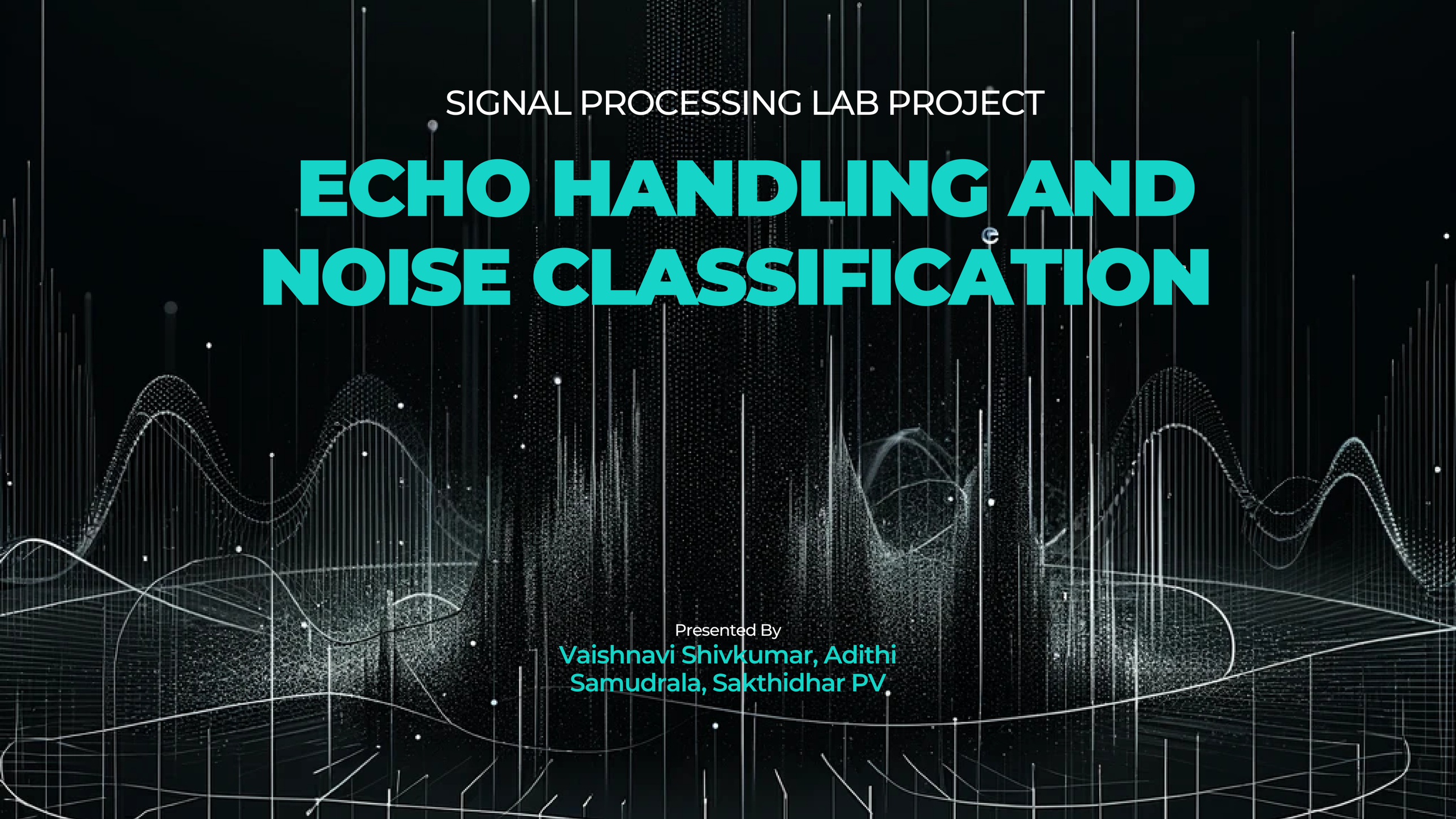


SIGNAL PROCESSING LAB PROJECT

ECHO HANDLING AND NOISE CLASSIFICATION

Presented By
Vaishnavi Shivkumar, Adithi Samudrala, Sakthidhar PV

PART 1 : ECHO GENERATION

Our task in this part is to simulate a natural echo in an audio, given to us in a particular format.

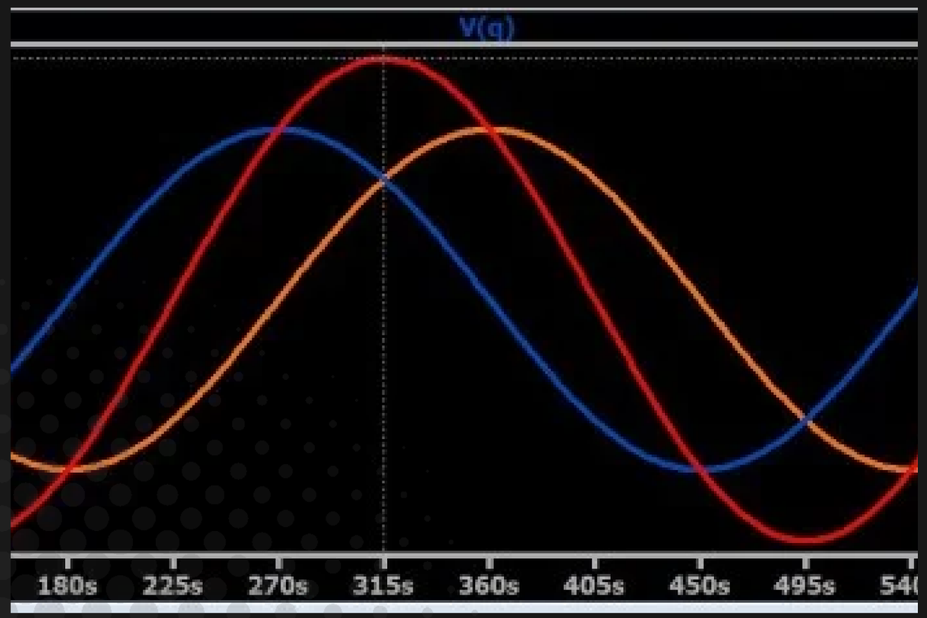
CONCEPTUAL UNDERSTANDING

- In signal processing terms, an "echo" refers to a delayed and attenuated version of a sound or signal that is heard after the original sound. It is a time-delayed replication of the original signal, where the delayed version is often quieter than the original due to the signal being reflected off surfaces or travelling a longer path.

- Echoes are commonly encountered in various acoustic environments, such as rooms, hallways, and outdoor spaces.

TIME LAG

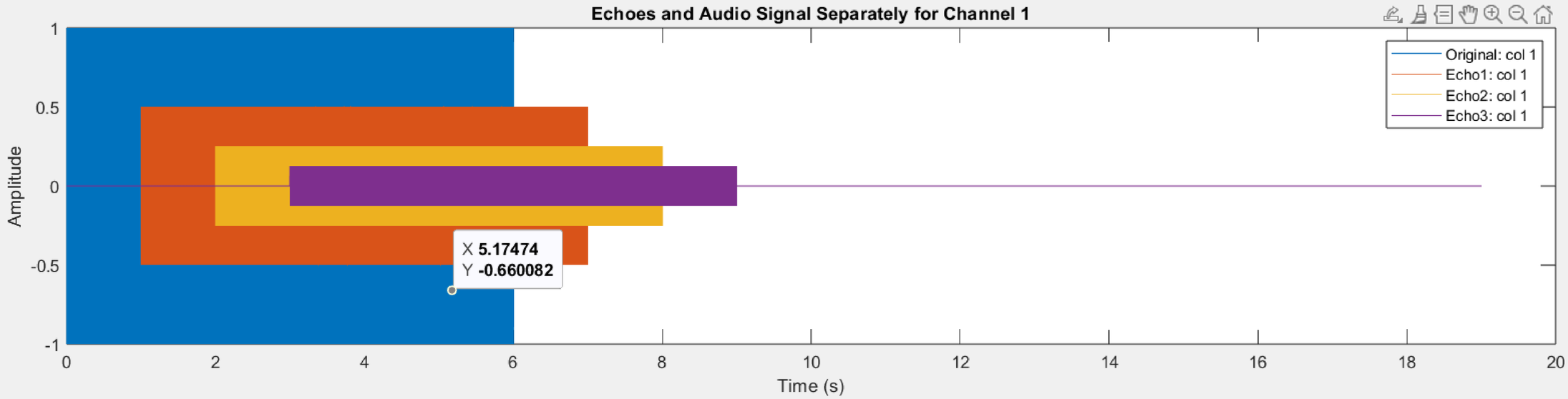
We generate a time lag

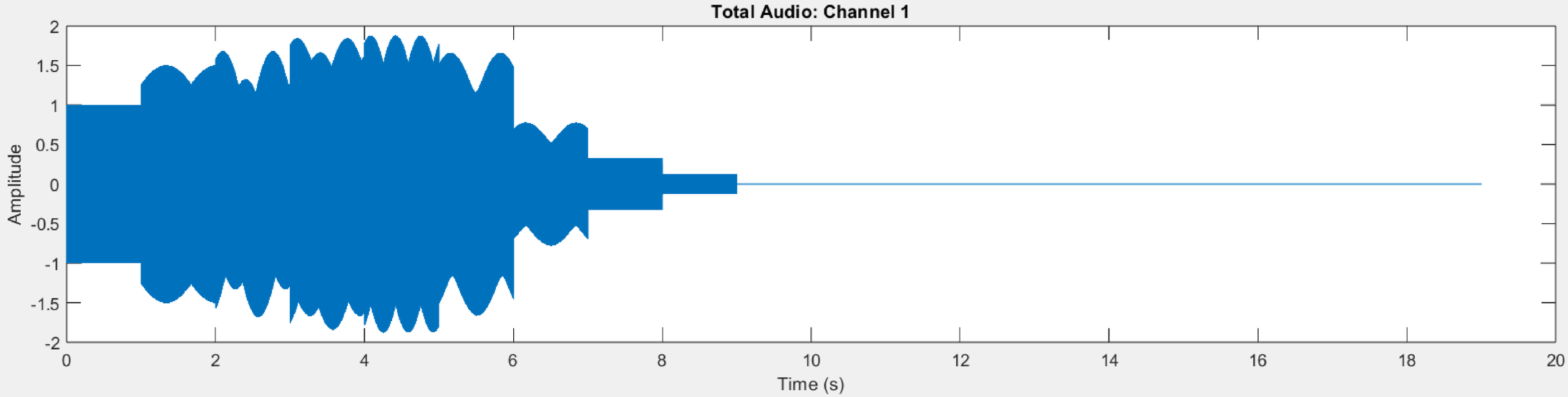


AMPLITUDE MODULATION

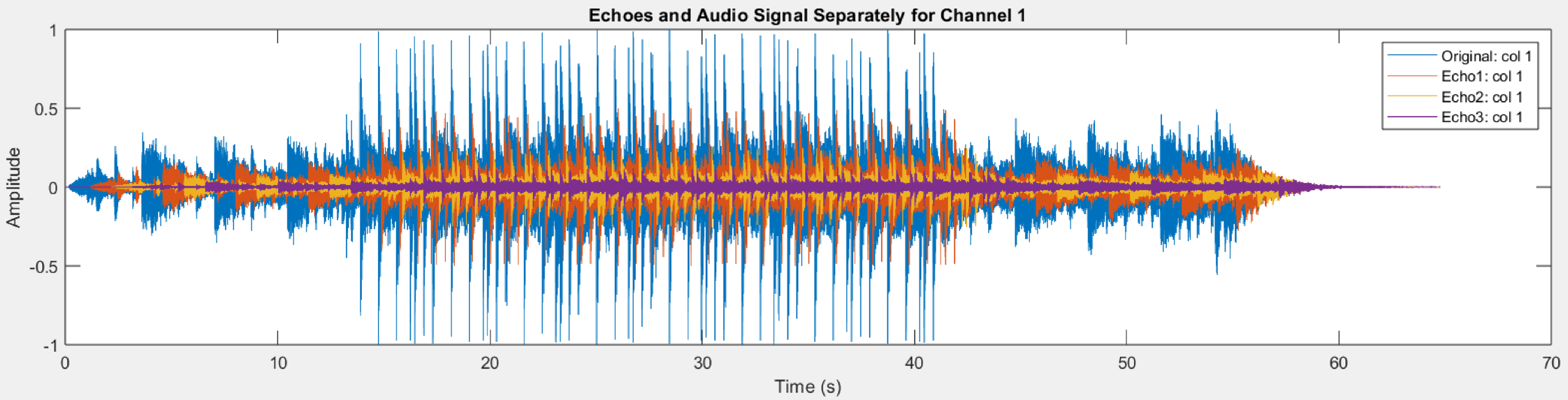
We are multiplying the delayed signal with a scaled factor to represent attenuation in echo

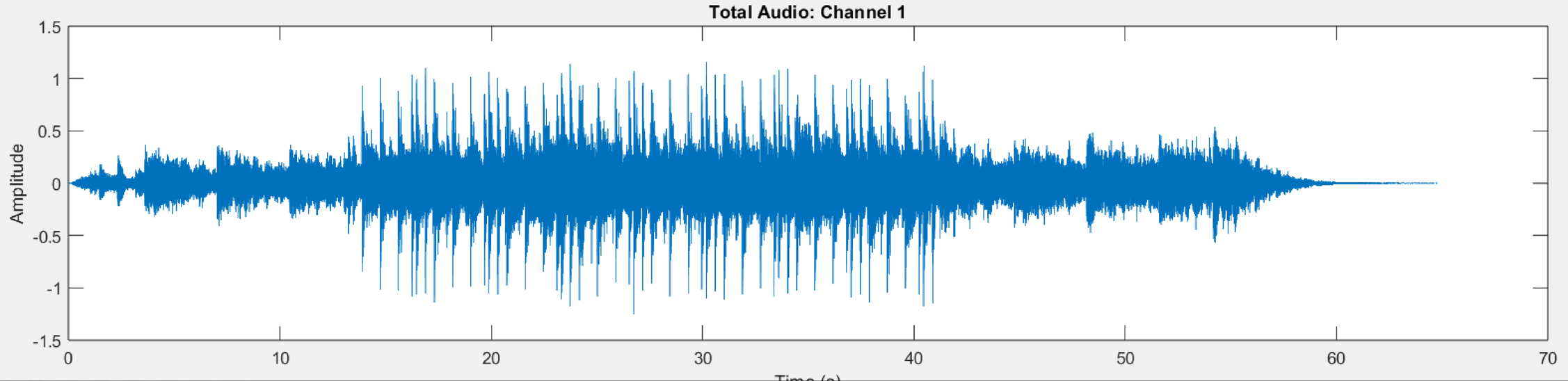
RESULTS: EASY



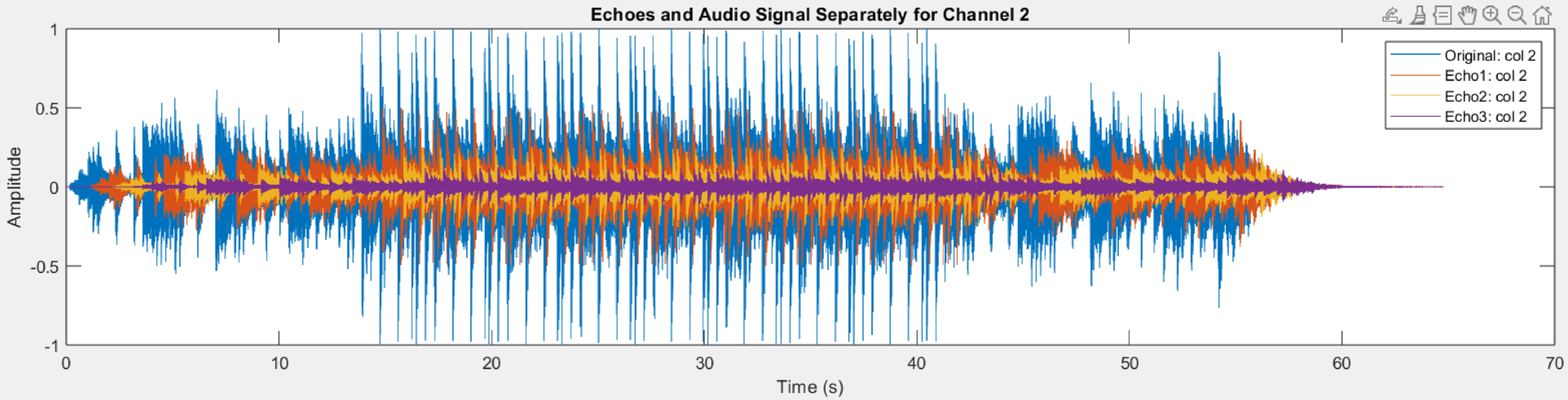


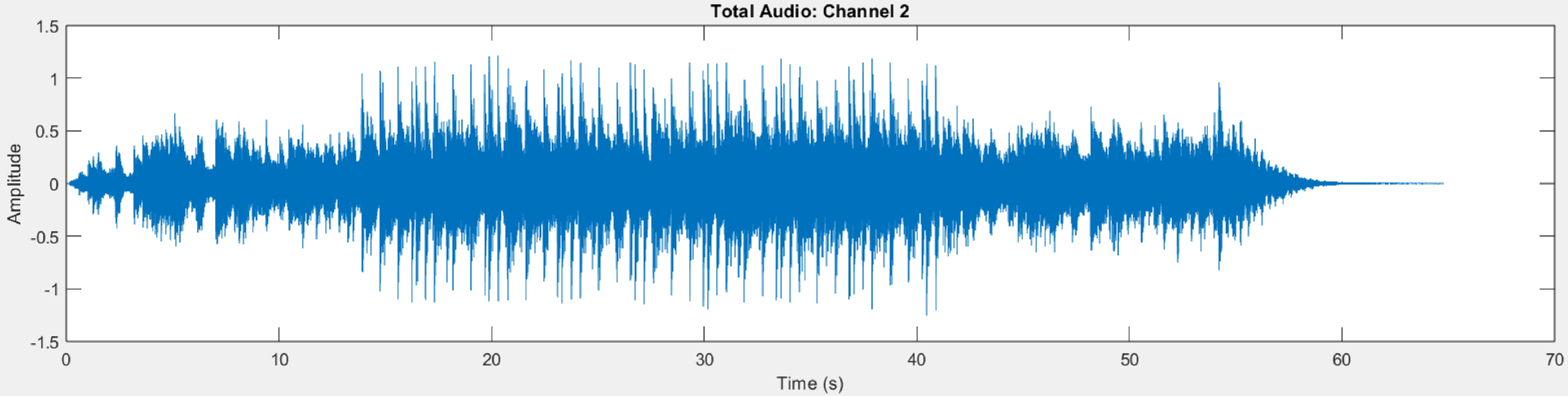
RESULTS: HARD

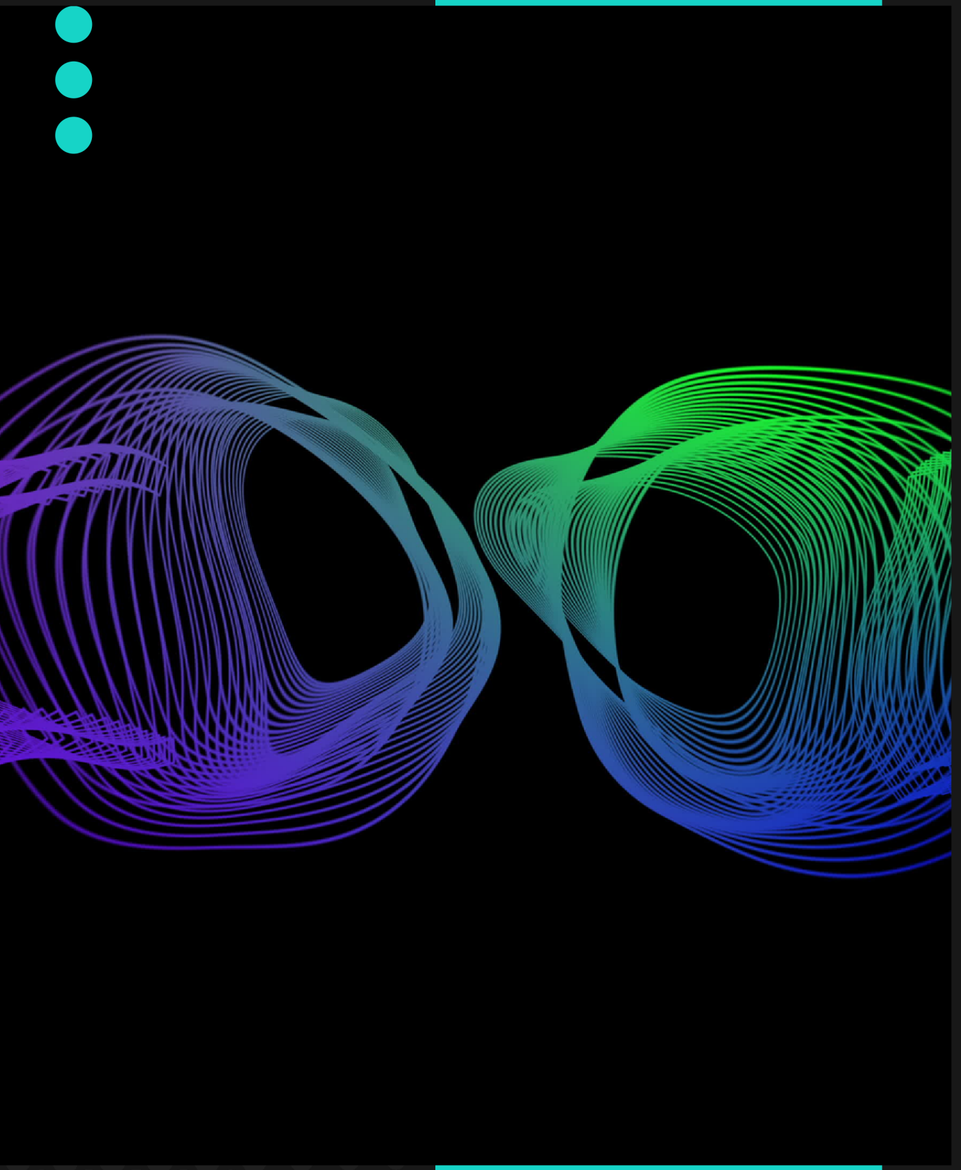




RESULTS: HARD



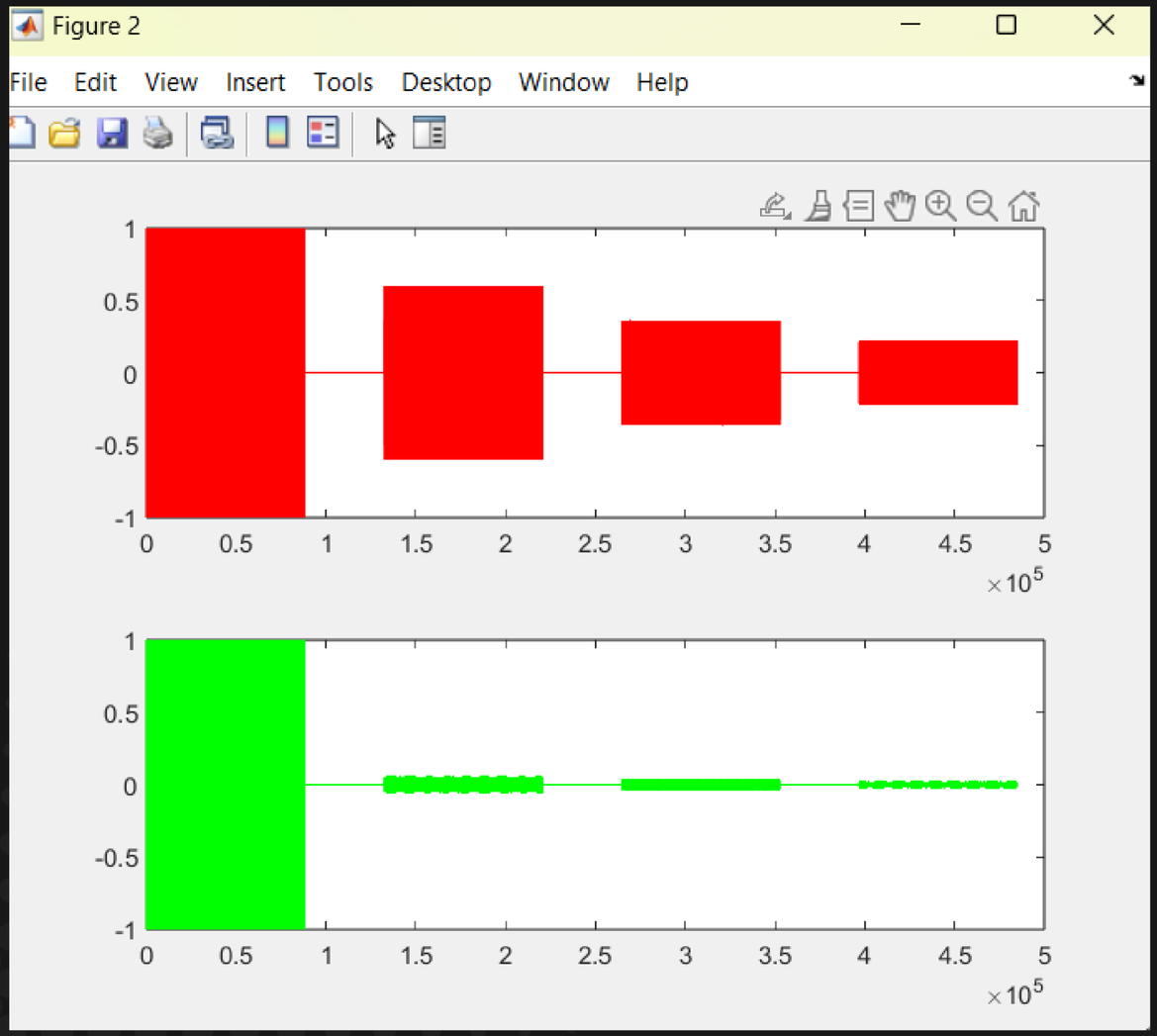




PART 2 : ECHO CANCELLATION

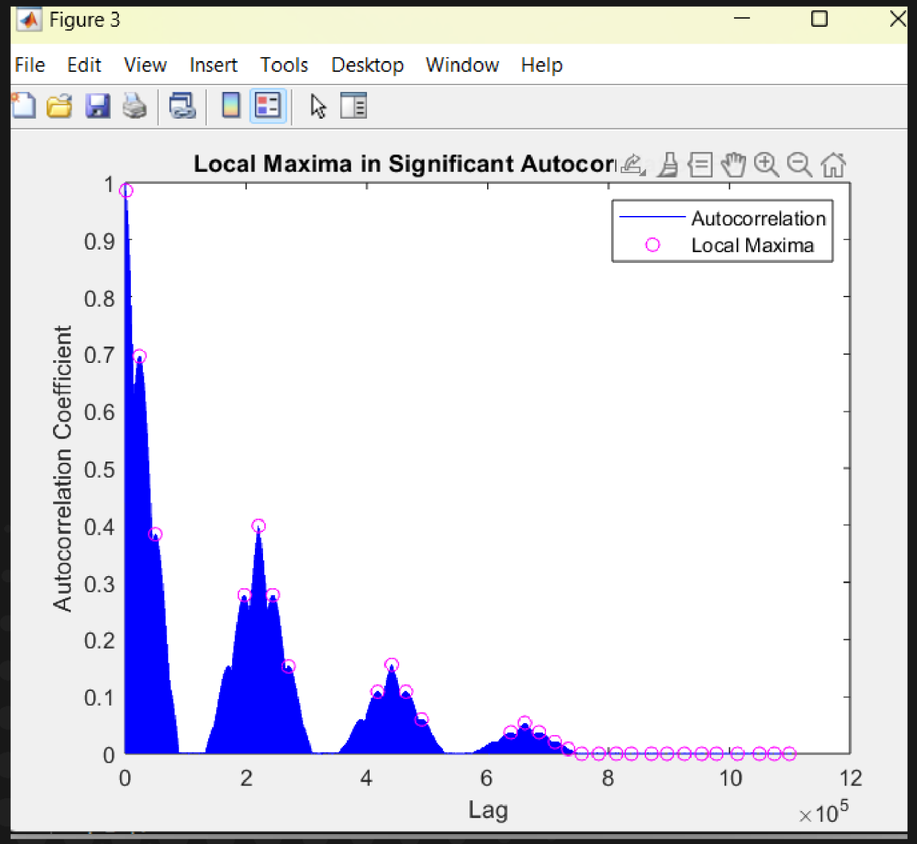
Our task in this part is to simulate a natural echo in an audio, given to us in a particular format.

METHOD 1: EASY: PEAK CALCULATION



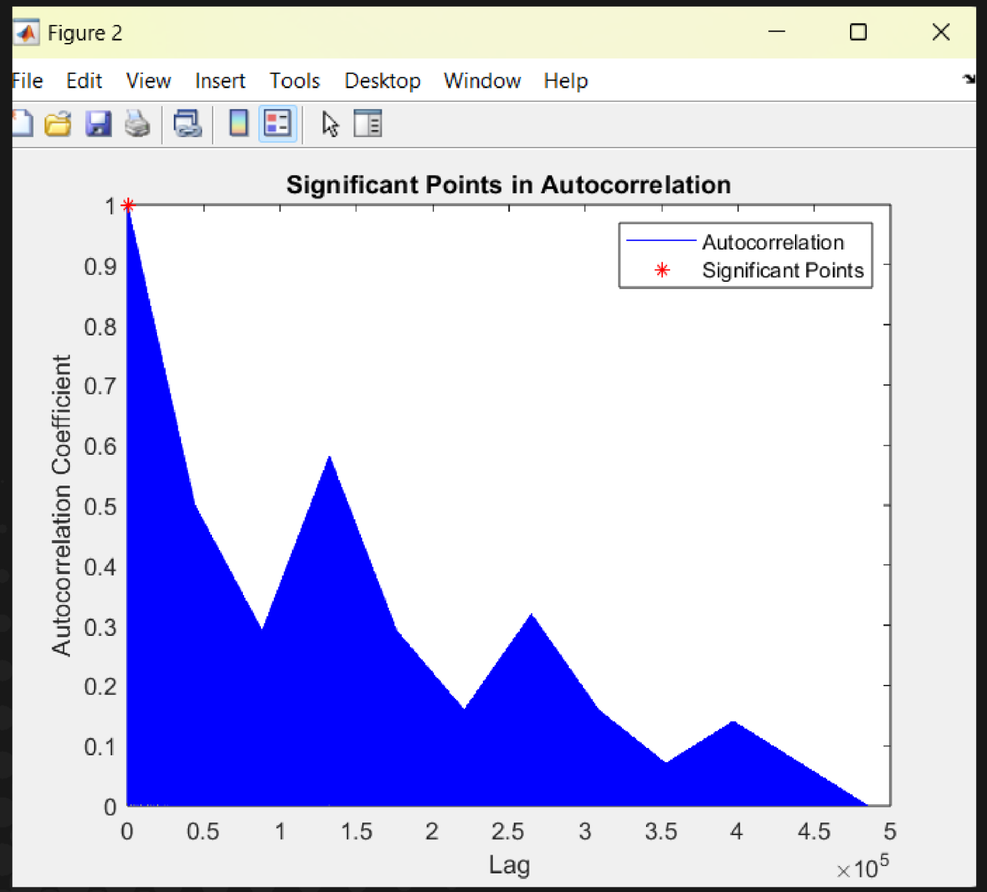
METHOD 1: HARD:

AUTOCORRELATION FOR PEAK AT ITERATIVE PIVOT

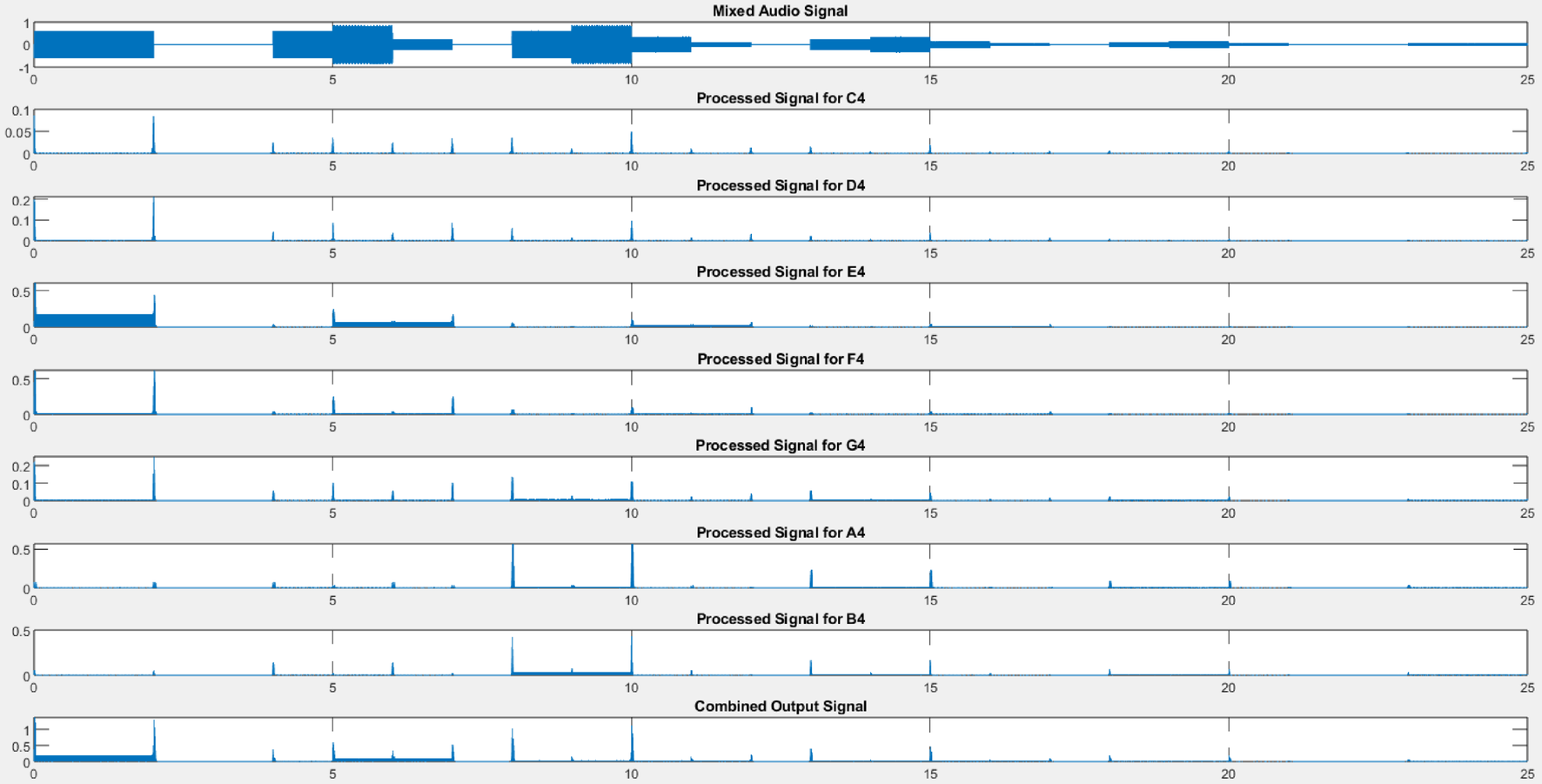


METHOD 2: HARD:

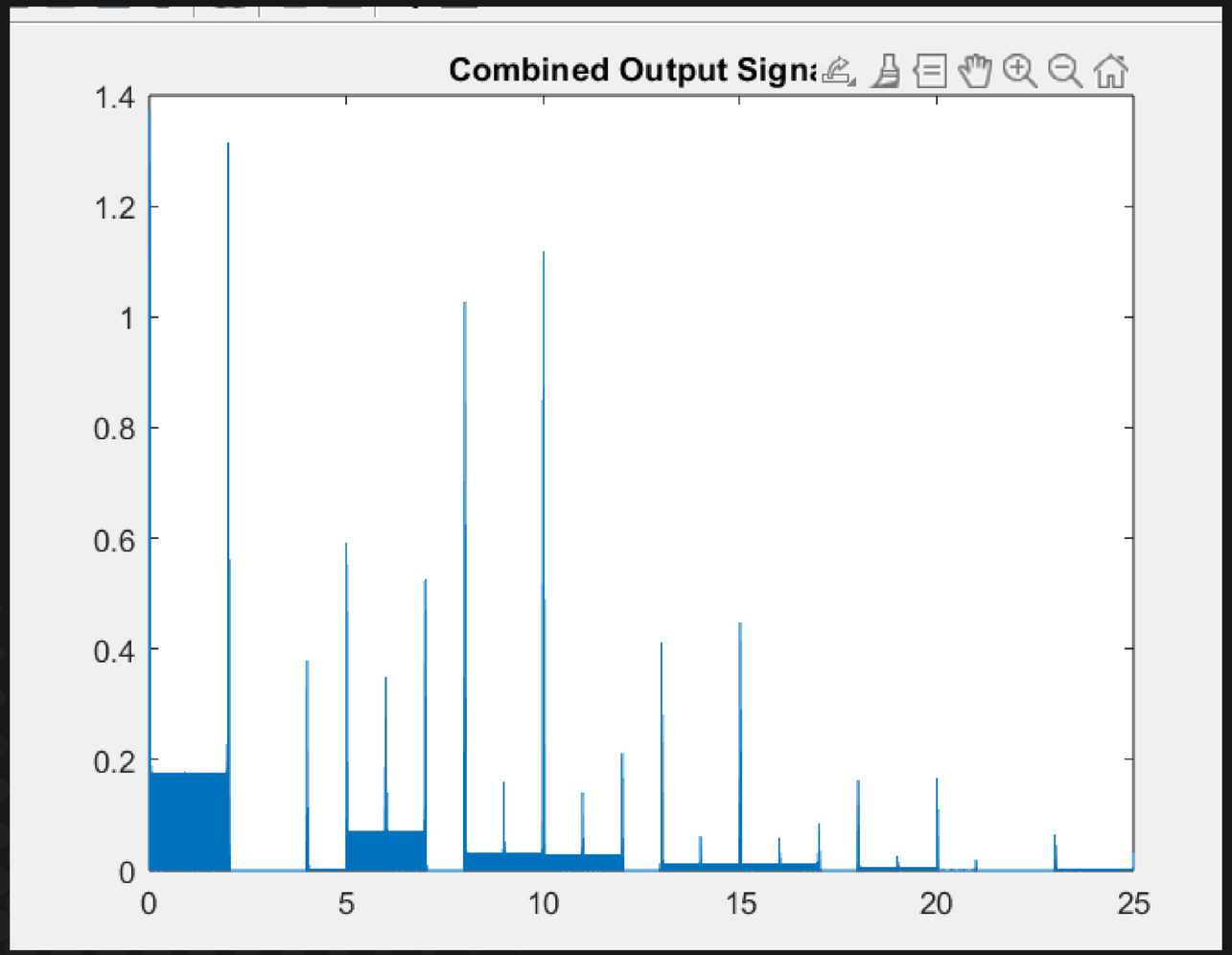
AUTOCORRELATION FOR PEAK AT LAST INDEX

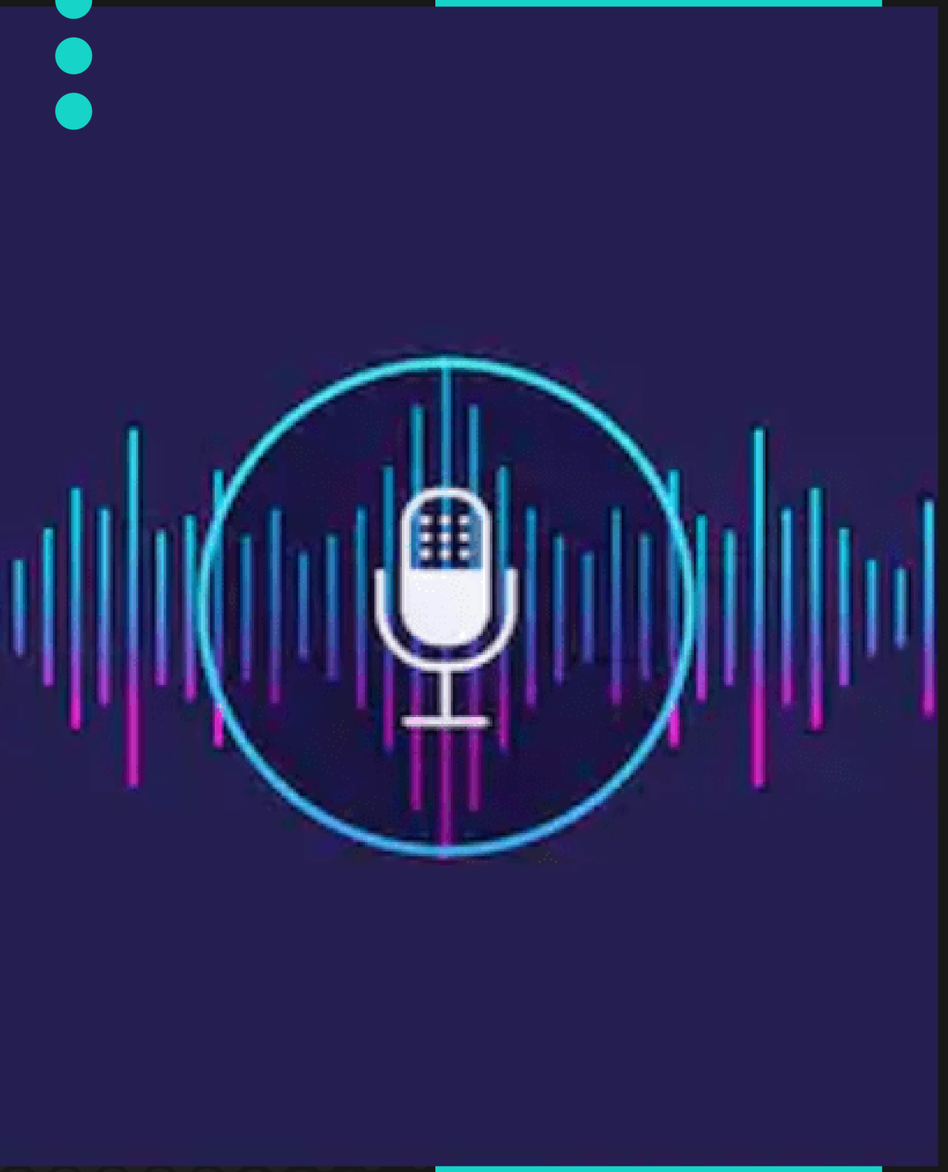


RESULTS: METHOD 3 : HARD-FREQUENCY SPLITTING



RESULTS: METHOD 3 : HARD-FREQUENCY SPLITTING





PART 3: NOISE CLASSIFICATION

Our task in this part is to identify the background noise in a given audio file. The background noise can be a fan, water pump, traffic and pressure cooker.

CONCEPTUAL UNDERSTANDING

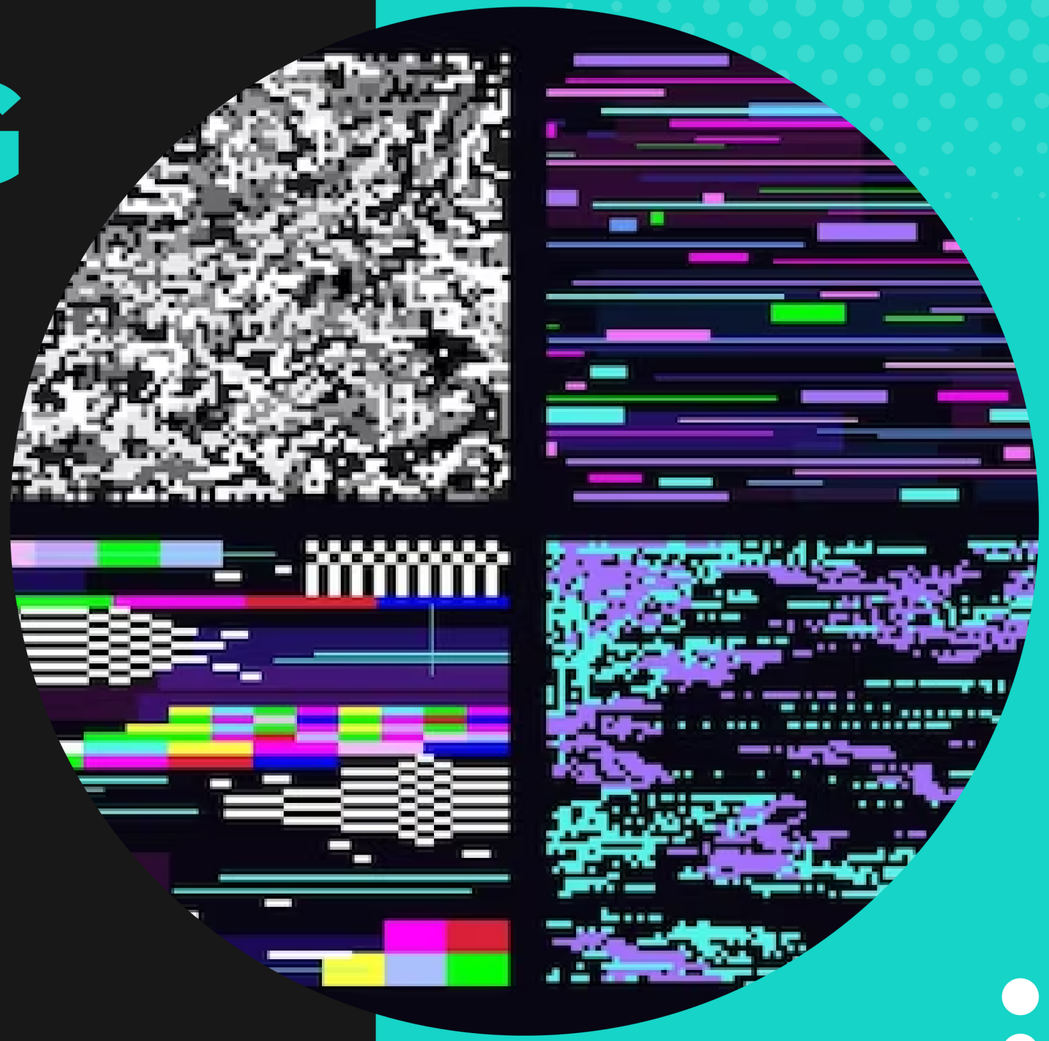
- Our goal in this part is to work on only the high frequency component of this signal (noise has high frequency)

- We are initially given 4 files with music and noise. We isolate the noises of each file by finding the common music We do this by comparing their frequency components.. Then we take these isolated audio files and use them as “signatures” to identify whether or not our input signal contains that particular noise.

CONCEPTUAL UNDERSTANDING

- We then correlate our input file with all the four signatures

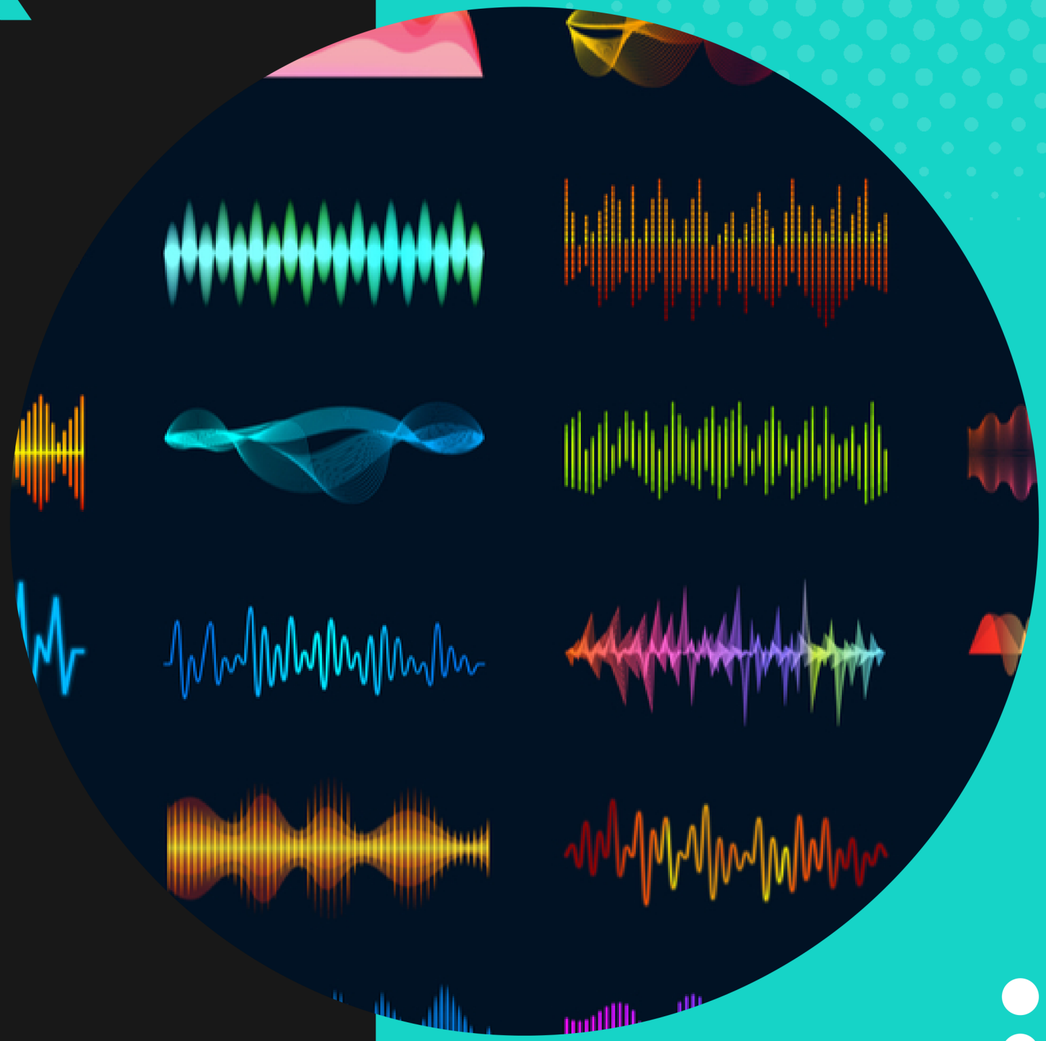
- We find the maximum correlation with each of the signatures. The maximum of these maximums is the noise in our background



AREAS OR ERROR

- The correlation is not perfect so we might get a different noise. For example, the cooker noise has very prominent amplitudes. So if our signal has a lot of variation, its likely to give cooker as an output

- Here we take maximum correlation as a measure to compare. But this parameter of measurement may have error



RESULTS: FAN

Editor - C:\Users\shivk\Documents\MATLAB\sp_project\q3\codes\q3_blackbox.m

q3_blackbox.m

```
1  input = 'music_ceiling-fan.wav';
2  input_audio = loadmusicfile(input);
3  solve(input_audio);
4
```

Command Window

```
The noise is of a fan
>>
```

RESULTS: PRESSURE COOKER

Editor - C:\Users\shivk\Documents\MATLAB\sp_project\q3\codes\q3_blackbox.m

q3_blackbox.m

solve.m

```
1  clc, clearvars, close all
2  input = 'music_pressure-cooker.wav';
3  input_audio = loadmusicfile(input);
4  solve(input_audio);
5
```

Command Window

```
The noise is of a cooker
>>
```

RESULTS: WATER PUMP

Editor - C:\Users\shivk\Documents\MATLAB\sp_project\q3\codes\q3_blackbox.m

q3_blackbox.m

solve.m

```
1  clc, clearvars, close all
2  input = 'music_water-pump.wav';
3  input_audio = loadmusicfile(input);
4  solve(input_audio);
5
```

Command Window

```
The noise is of a pump
>>
```

RESULTS: TRAFFIC

Editor - C:\Users\shivk\Documents\MATLAB\sp_project\q3\q3_blackbox.m

+13

q3_blackbox.m

```
1   clc, clearvars, close all
2   input = 'music_city-traffic.wav';
3   input_audio = loadmusicfile(input);
4   solve(input_audio);
5
```

Command Window

```
The noise is of traffic
>>
```

Q&A SESSION

Any questions?

THANK YOU

Further Info:

Vaishnavi Shivkumar - 2022102070
Adithi Samudrala - 2022102065
Sakthidhar PV - 2022112005