Time Frequency Analysis Of Accelerogram

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Content

Overview

1. In **signal processing of Accelerogram** , time-frequency analysis consists of studying the signal in time and frequency domains simultaneously.

2. These high-level representations such as time-frequency maps convey a wealth of useful information, but they involve a large number of parameters that make statistical investigations of many signals difficult at present.

3. we will describe a method that performs a drastic reduction in the complexity of time-frequency representations through modeling of the maps by elementary functions, Artificial Intelligence, and Machine learning.

4. The methods is validated on artificial signals and subsequently applied to signals recorded at original stations.

5. We will try to validate the advanced technological improvement in this field to show the potential and promise of technology in this area.

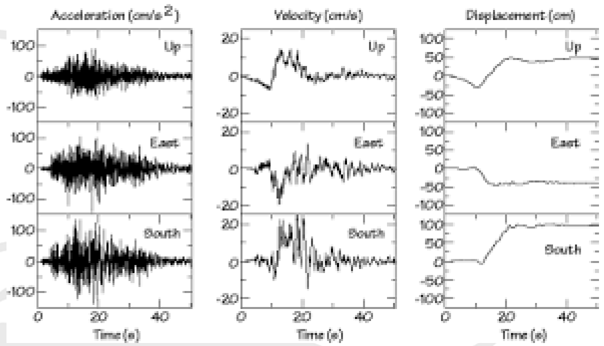
Objective Of The Work

A. Understanding Time Frequency Analysis Of Accelerogram.
B. Visualization Of Time Frequency Diagram Of Different Earthquake Recorded Via Accelerograph
C. Understanding The Error In Representation Of Signal In Time Or Frequency Domain.
D. Applying Different Legacy Methods into Time Frequency Analysis Of Accelerogram.
E. Finding The Different Limitation Caused By These Approach’s.
F. Implementation Of New Stack Of Technology To Solve The Limitations Caused By These Approach’s.
G. Generating Artificial Data To Validate This Methods.
H. Applying The Findings Into The Ground.

About Accelerogram And Accelerograph

1. An **accelerograph** can be referred to as a strong-motion instrument or seismograph, or simply an earthquake accelerometer
2. Accelerographs record the acceleration of the ground with respect to time. This recording is often called an accelerograms, strong-motion record or acceleration time-history. From this record strong-motion intensity measures (IMs, also called parameters) can be computed.
3. A response spectrum is computed to show how the earthquake would affect structures of different natural frequencies or periods. These observations are useful to assess the seismic hazard of an area.

Accelerograph



Records From Accelerograph(Accelerogram)

Accelerograph And Seismograph

ACCELEROGRAPH

1. Used for strong ground motion recording
2. Used in Engineering structures, Dams ,Buildings
3. Less sensitive
4. Typical Range 1-6000 Hz

Typical Accelerograph installed in Groningen field(Netherlands)

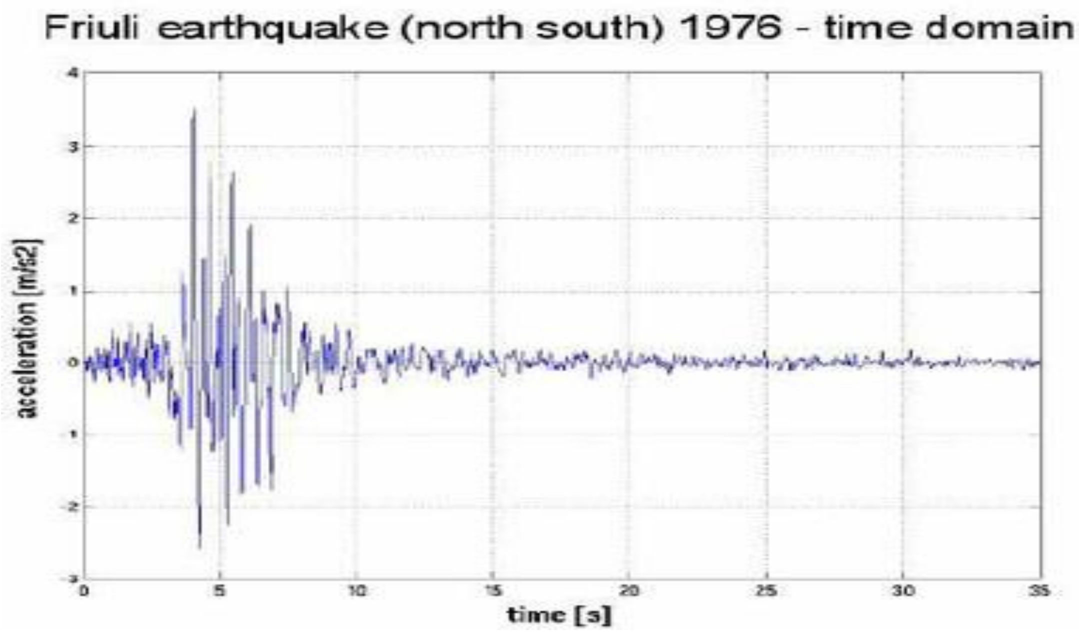
SEISMOGRAPH

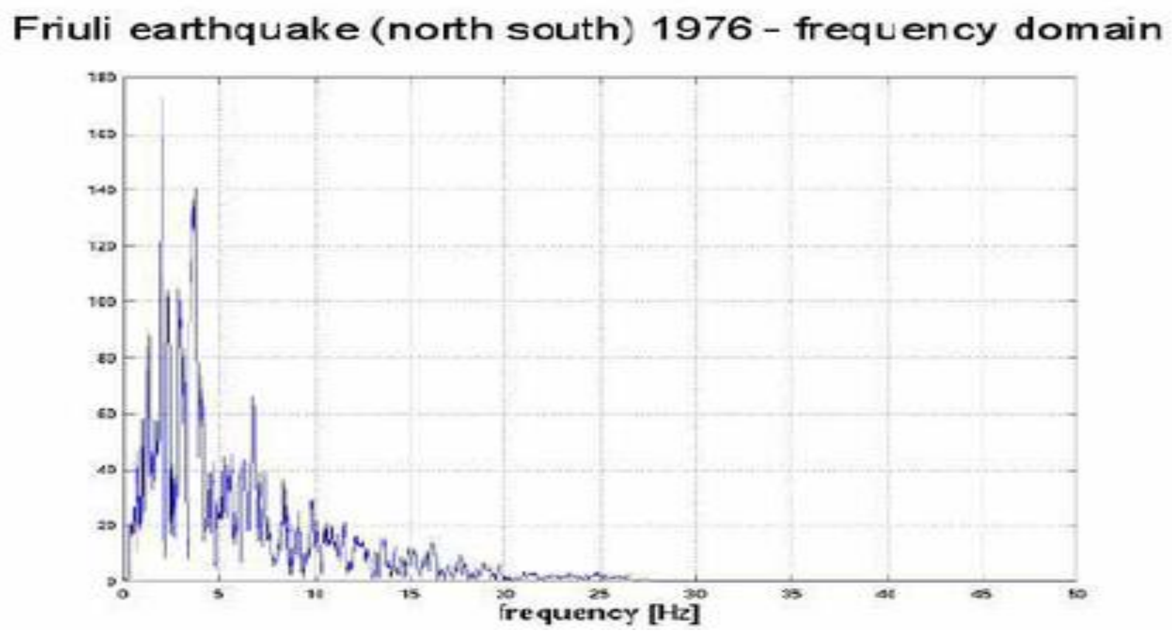
1. Used for ground motion recording
2. Used in Earthquake detection of small magnitude
3. More Sensitive
4. Typical Range 0.001-500 Hz

Typical Seismograph installation in Australia

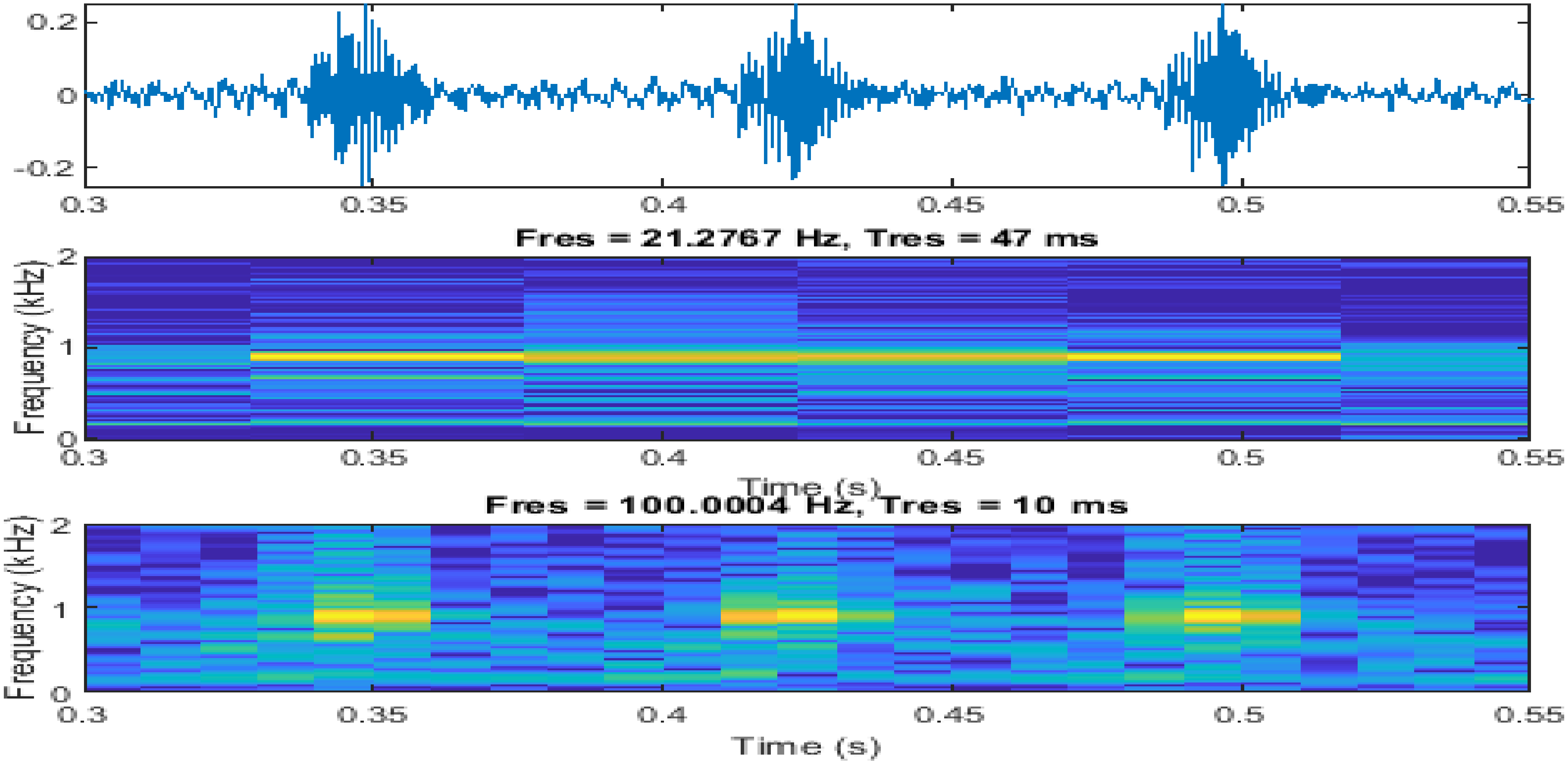
About Time Frequency Analysis

- Time-frequency analysis consists of studying a signal in time and frequency domains simultaneously. Rather than viewing a 1-dimensional signal time-frequency analysis studies a two-dimensional signal obtained from the signal.
- The practical motivation for time-frequency analysis is that classical Fourier analysis assumes that signals are infinite in time or periodic, but accelerograph instruments do not produce infinite duration signals, but instead begin with an attack, then gradually decay.
- Response Spectrum Which hangs with Earthquake Engineers most of the time and is a great source of Information about ground motion parameters but not the only solution upon which you can depend.





Time Frequency Analysis(Example)



APPLICATION OF TIME FREQUENCY ANALYSIS

- Discovering Pattern of frequency changes.
- Classifying Signals according to spectral Amplitude.
- Elimination of Noise from corrupt signal.
- Localization of Signal to further analysis.
- Detection of Soil Liquefaction.
- Detection Of Oil and Gas .
- Prediction Of EARTHQUAKE

DATA GENERATION METHODS

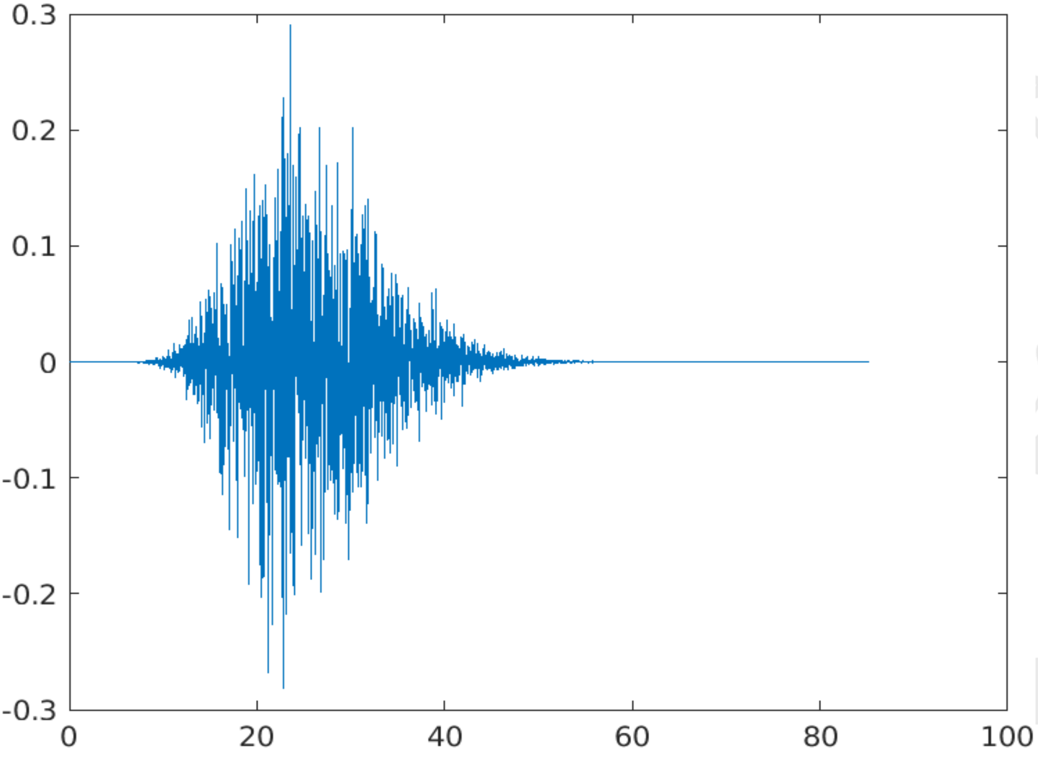
Data Generation

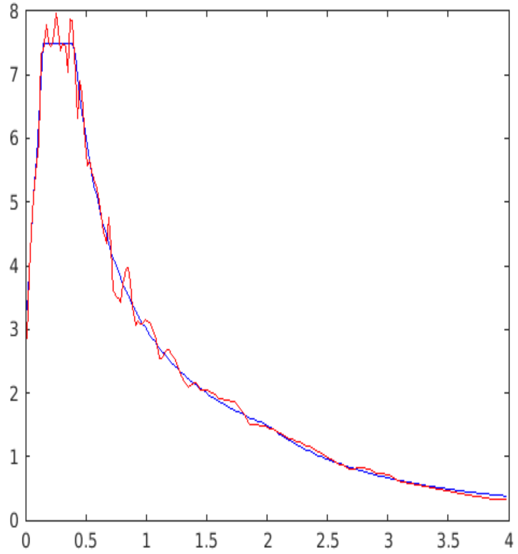
- Statistical Method (Kanai-Tajimi Method)
- Data Based Method(Code Based[IS code] Approach)

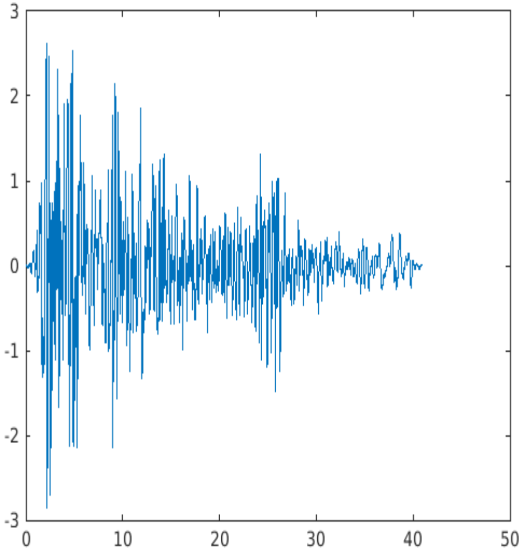
GENERATED EARTHQUAKE

KANAI-TAJIMI MODEL

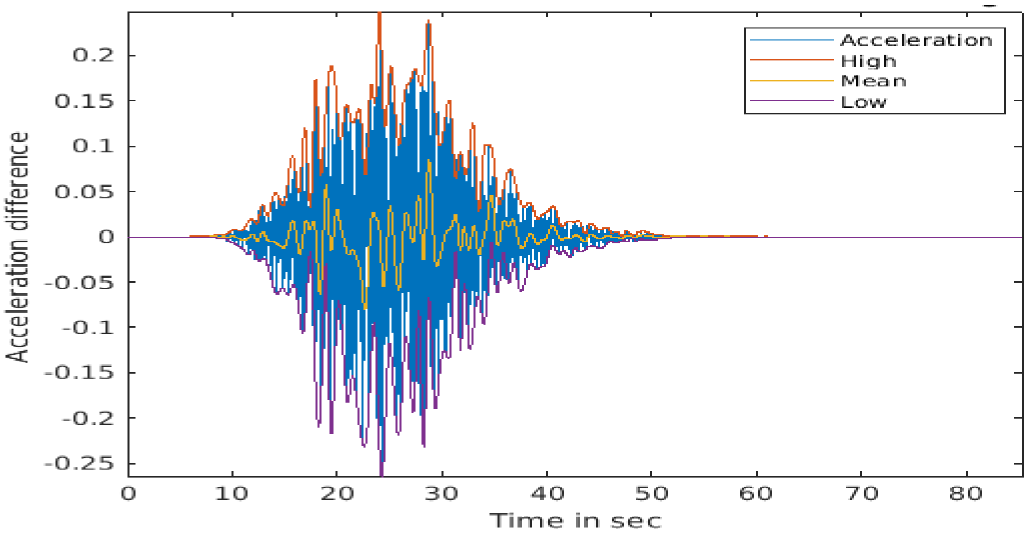
CODE BASED MODEL(IS CODE)

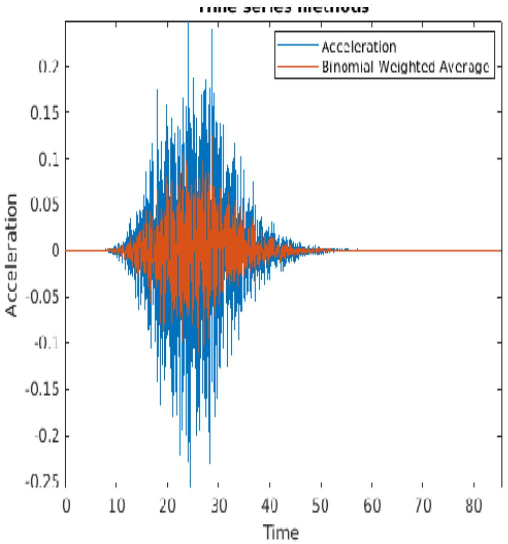


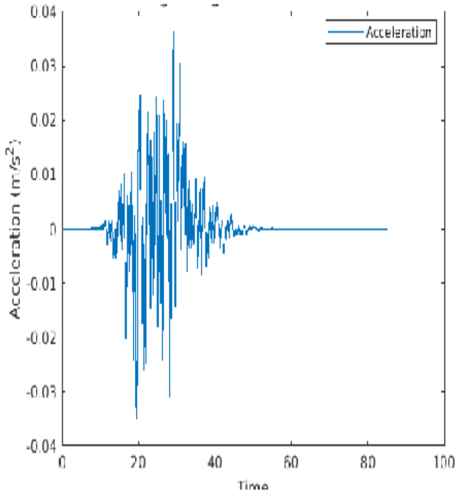


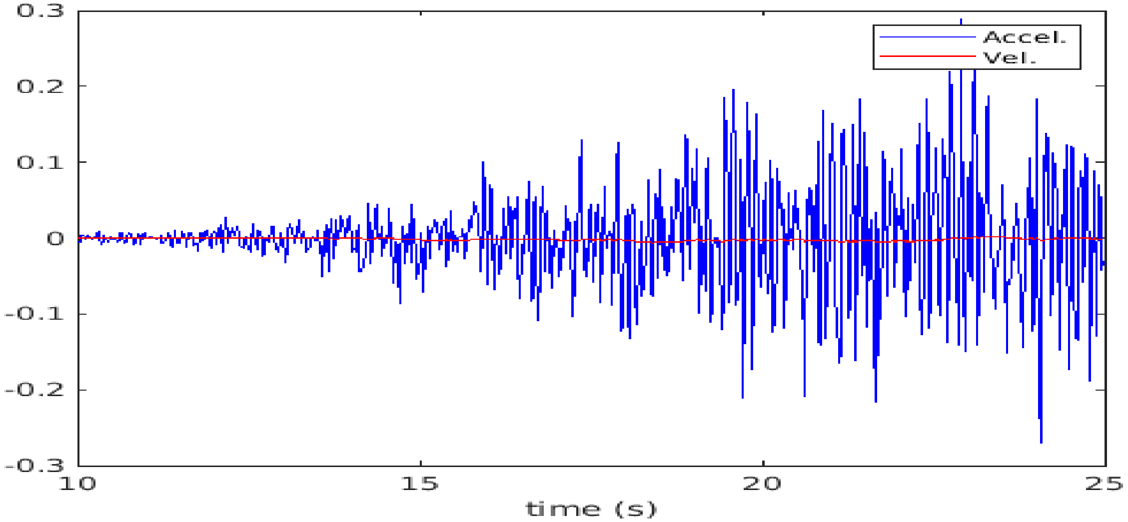


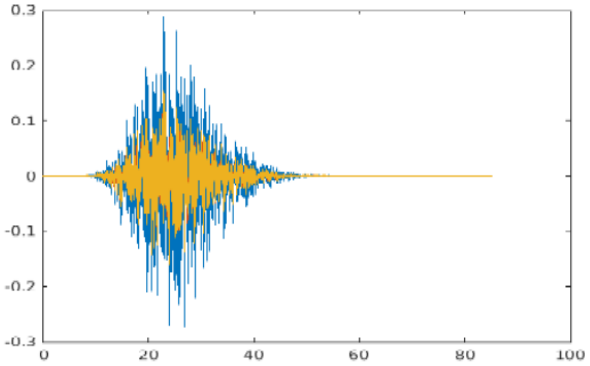
ANALYSIS OF SIGNAL



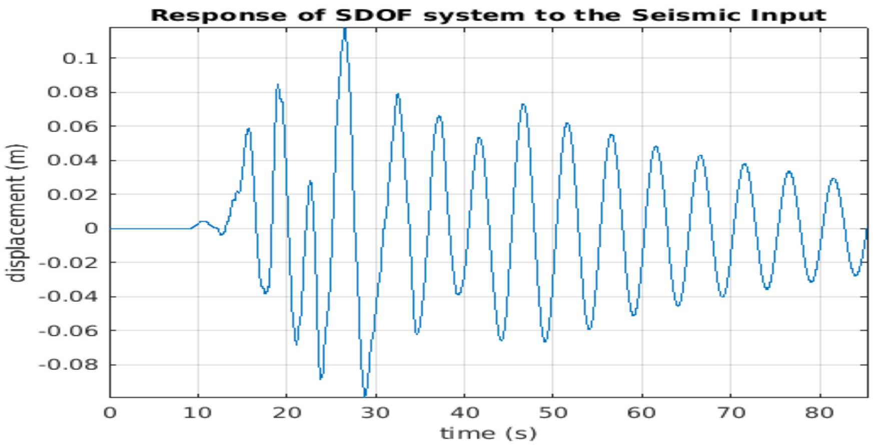


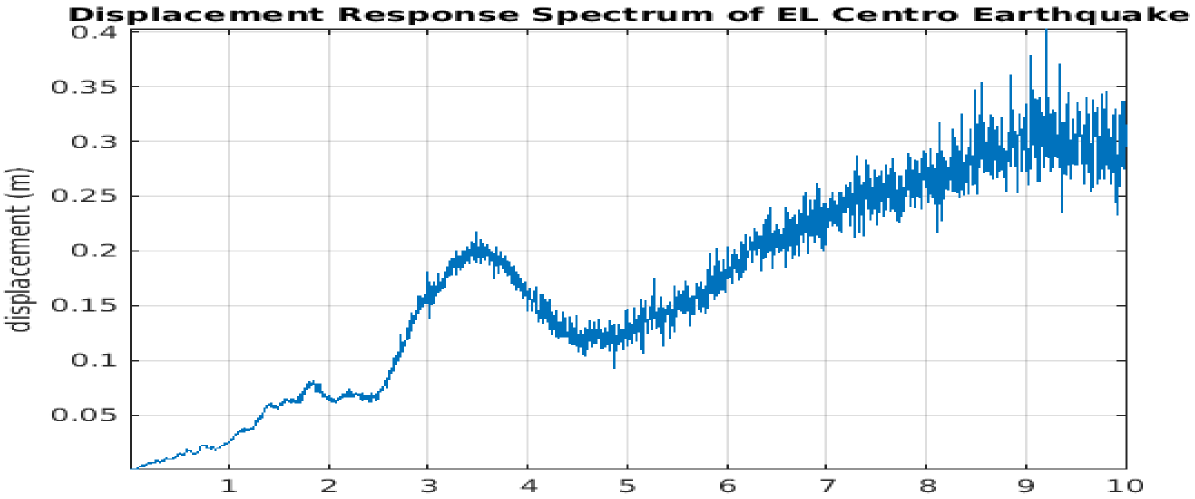


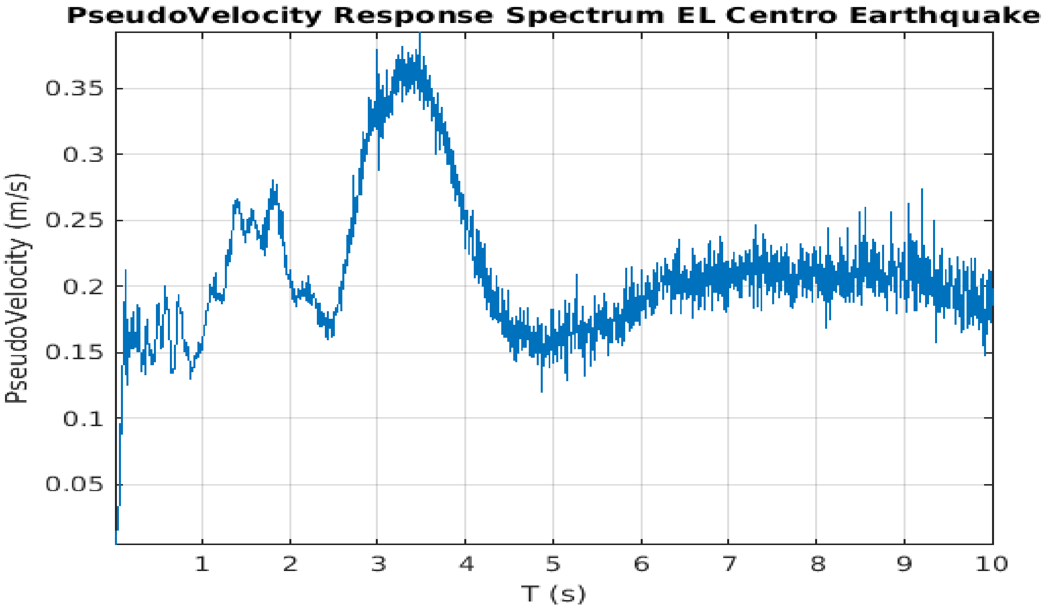


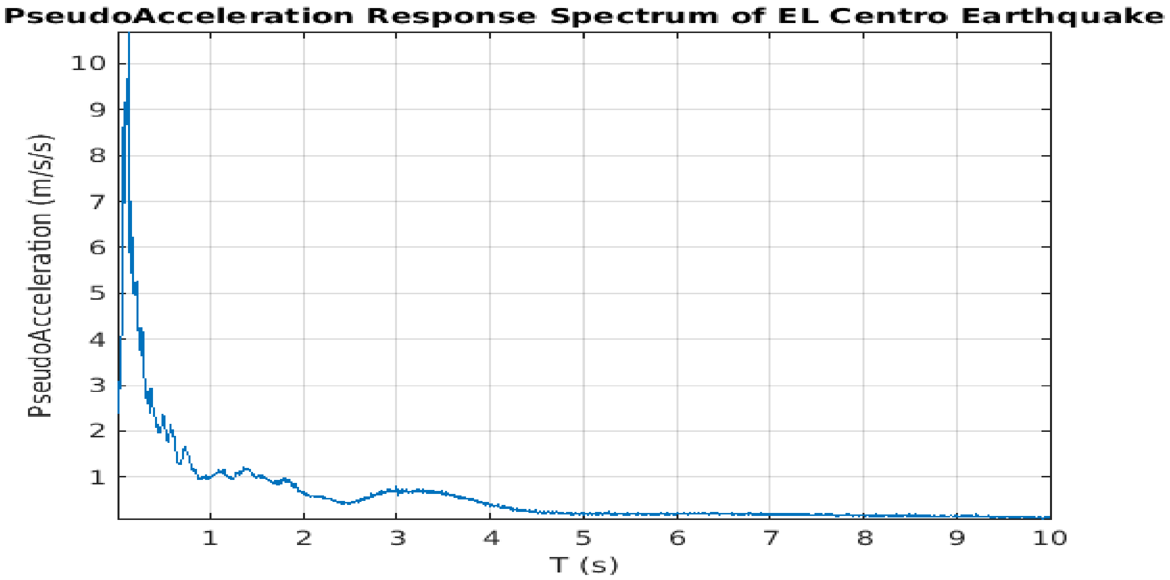


RESPONSE SPECTRUM





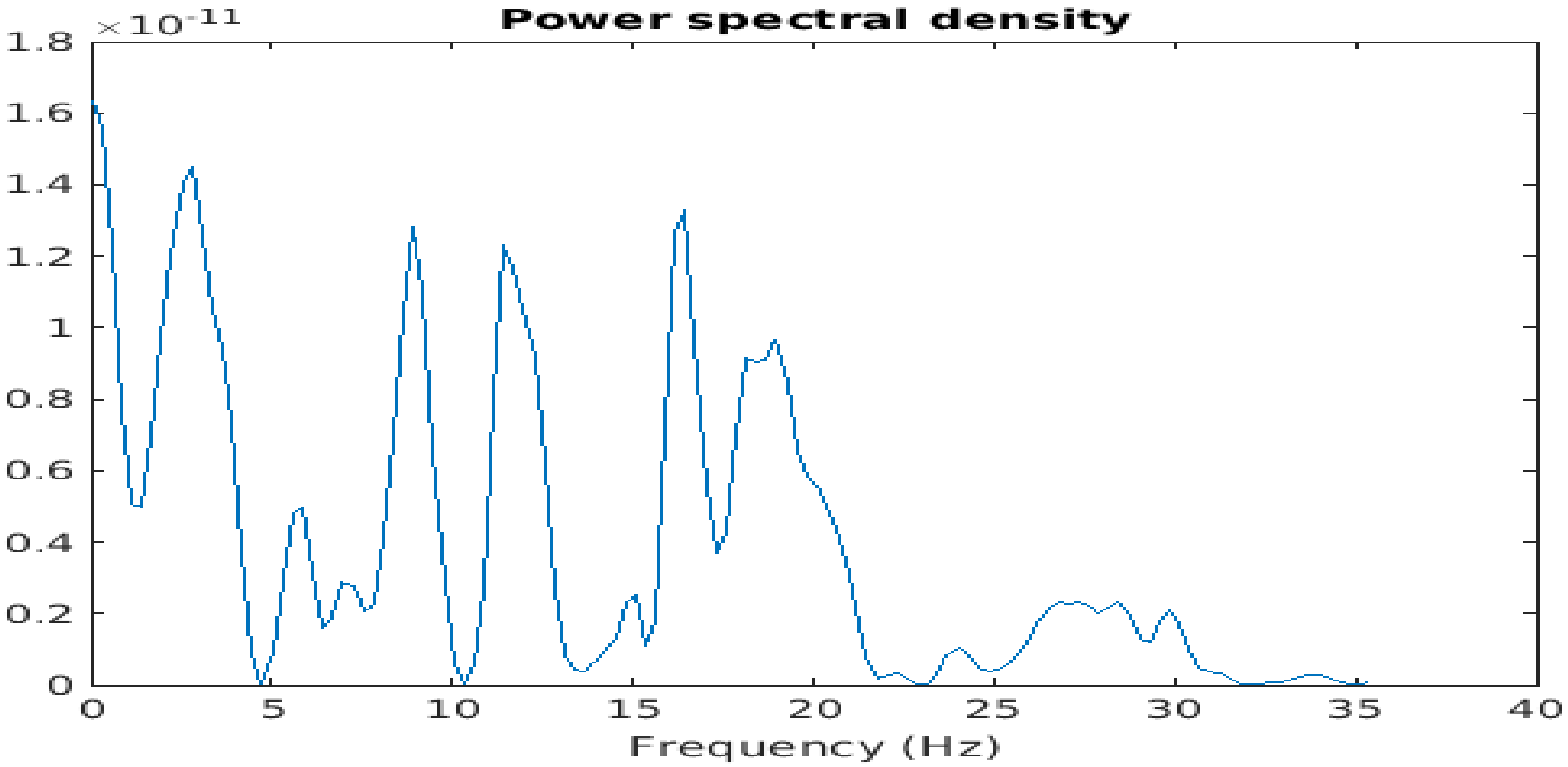




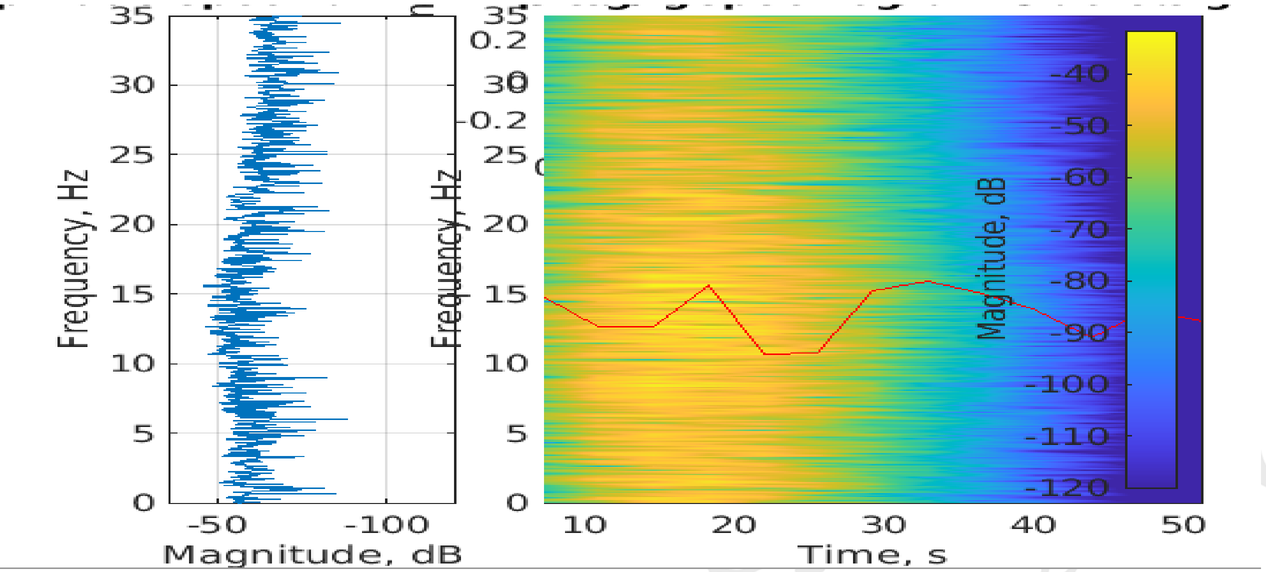
METHODS OF TIME FREQUENCY ANALYSIS USED

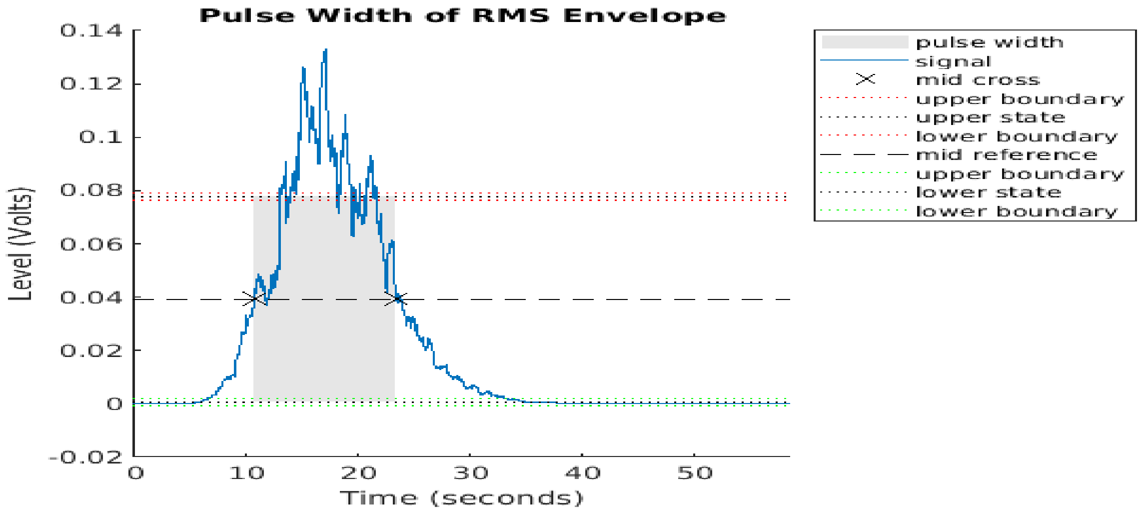
- FOURIER TRANSFORM
- STFT
- WAVELET
- WIGNER VILLE
- REASSIGNMENT AND SYNCHROSQUEEZING
- CONSTANT-Q GABOR TRANSFORM
- EMPIRICAL MODE DECOMPOSITION AND HILBERT-HUANG TRANSFORM

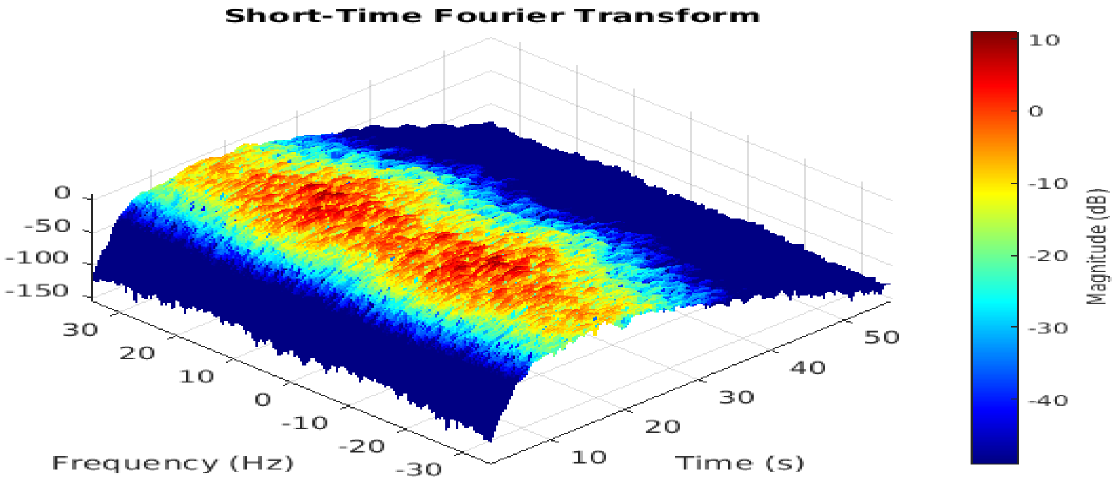
RESULT OF FOURIER TRANSFORM

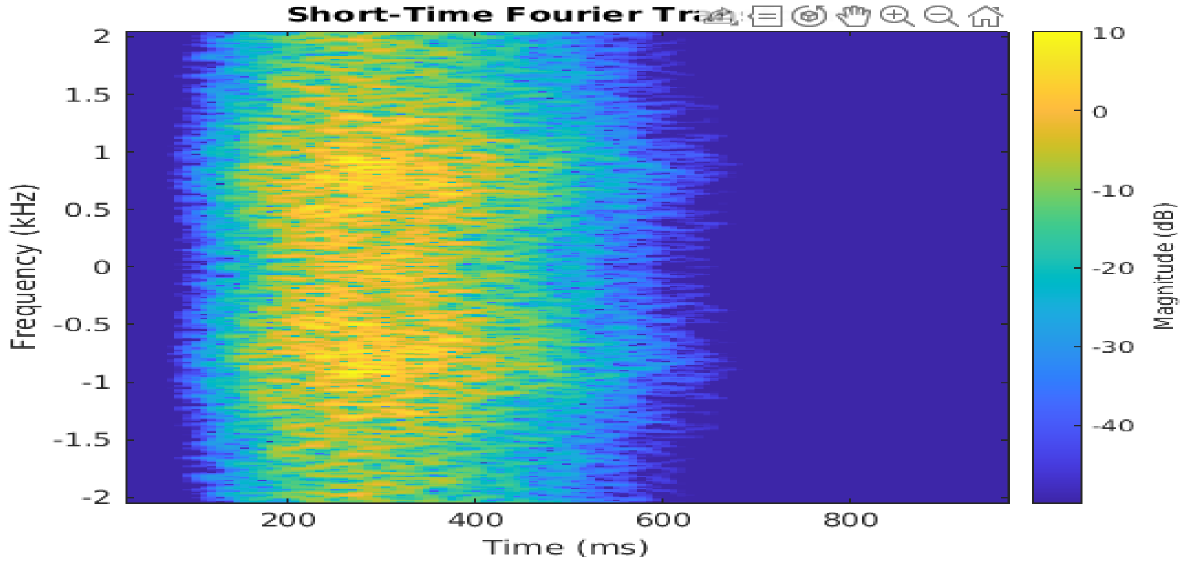


RESULT OF STFT TRANSFORM

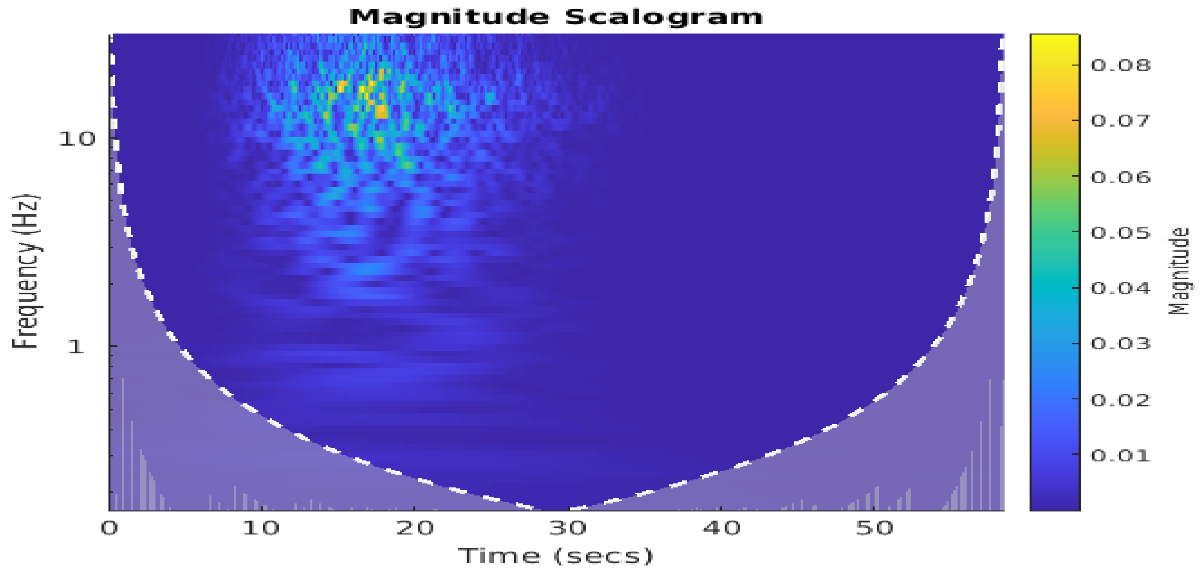


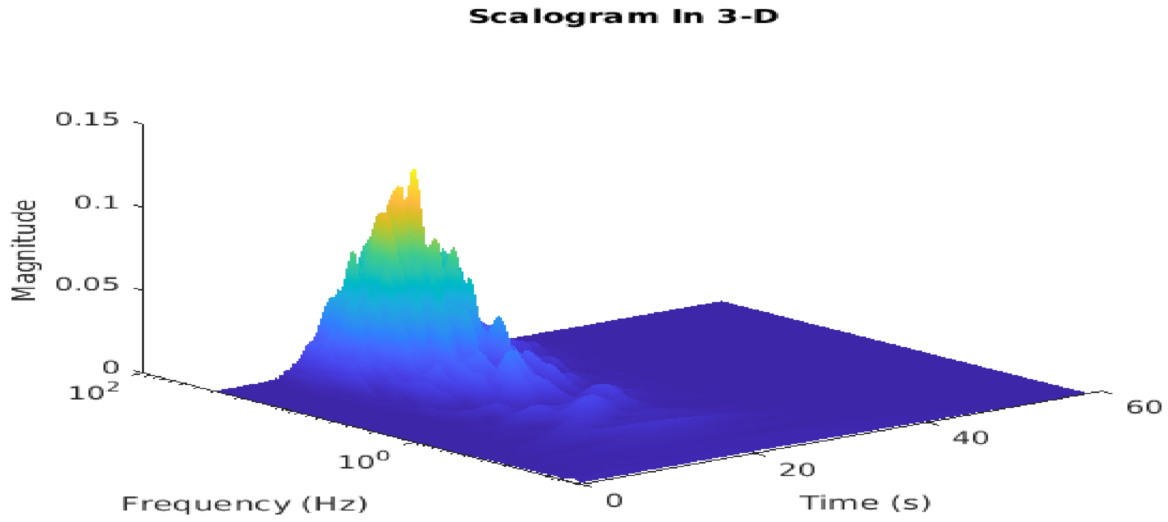


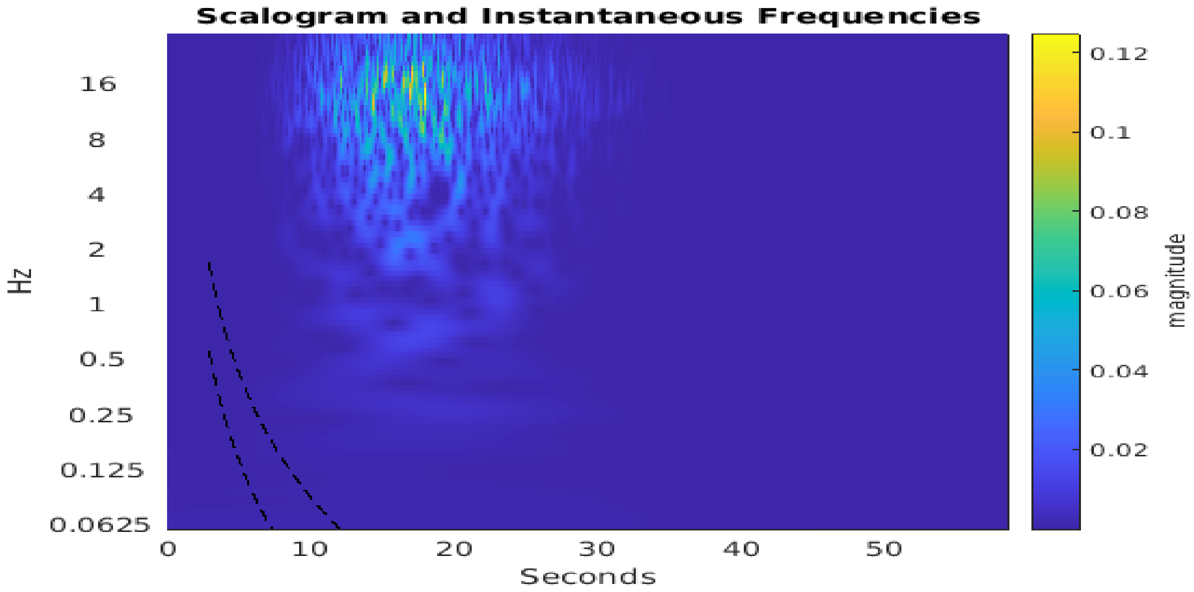


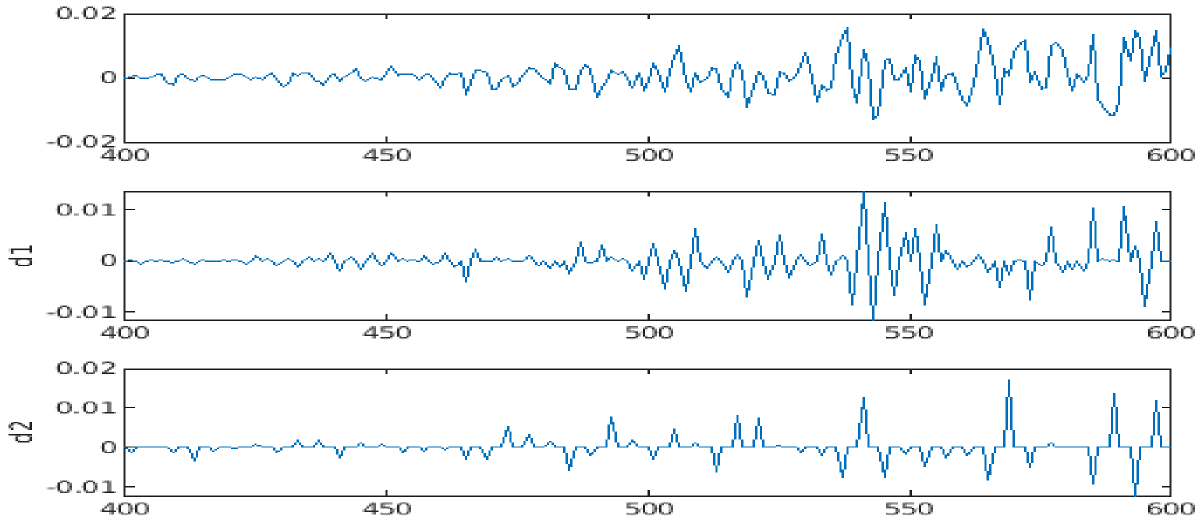


RESULT OF WAVELET TRANSFORM



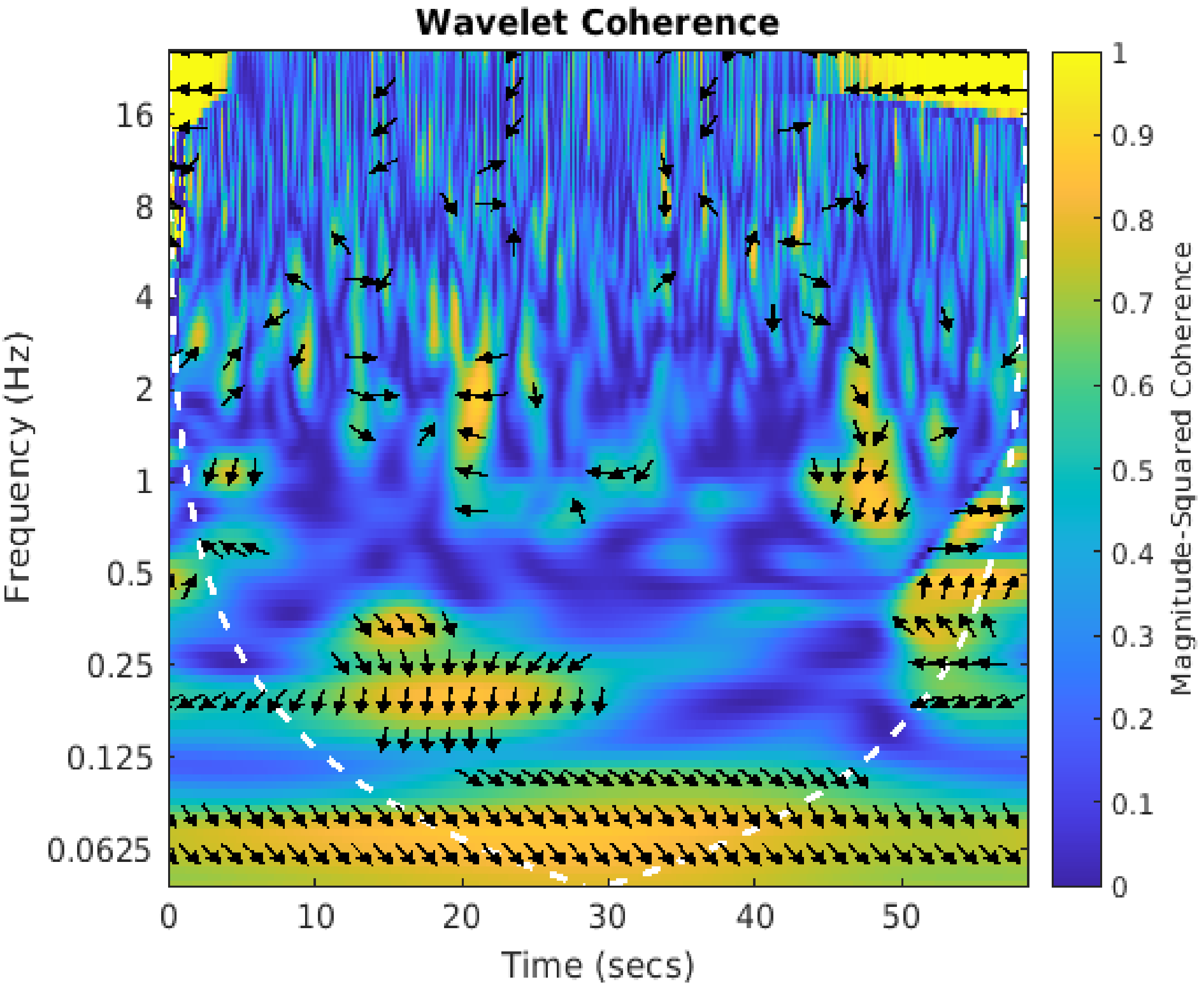




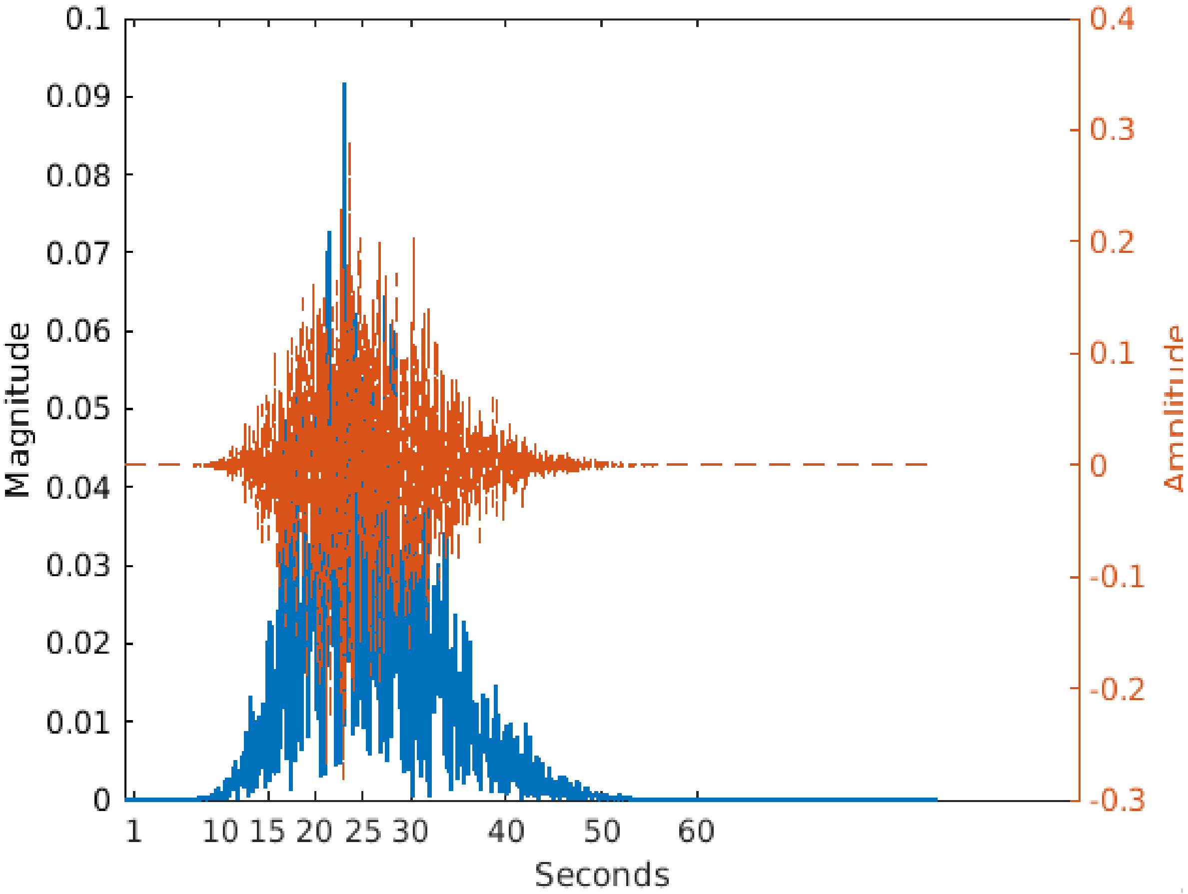


RESULT OF WAVELET TRANSFORM

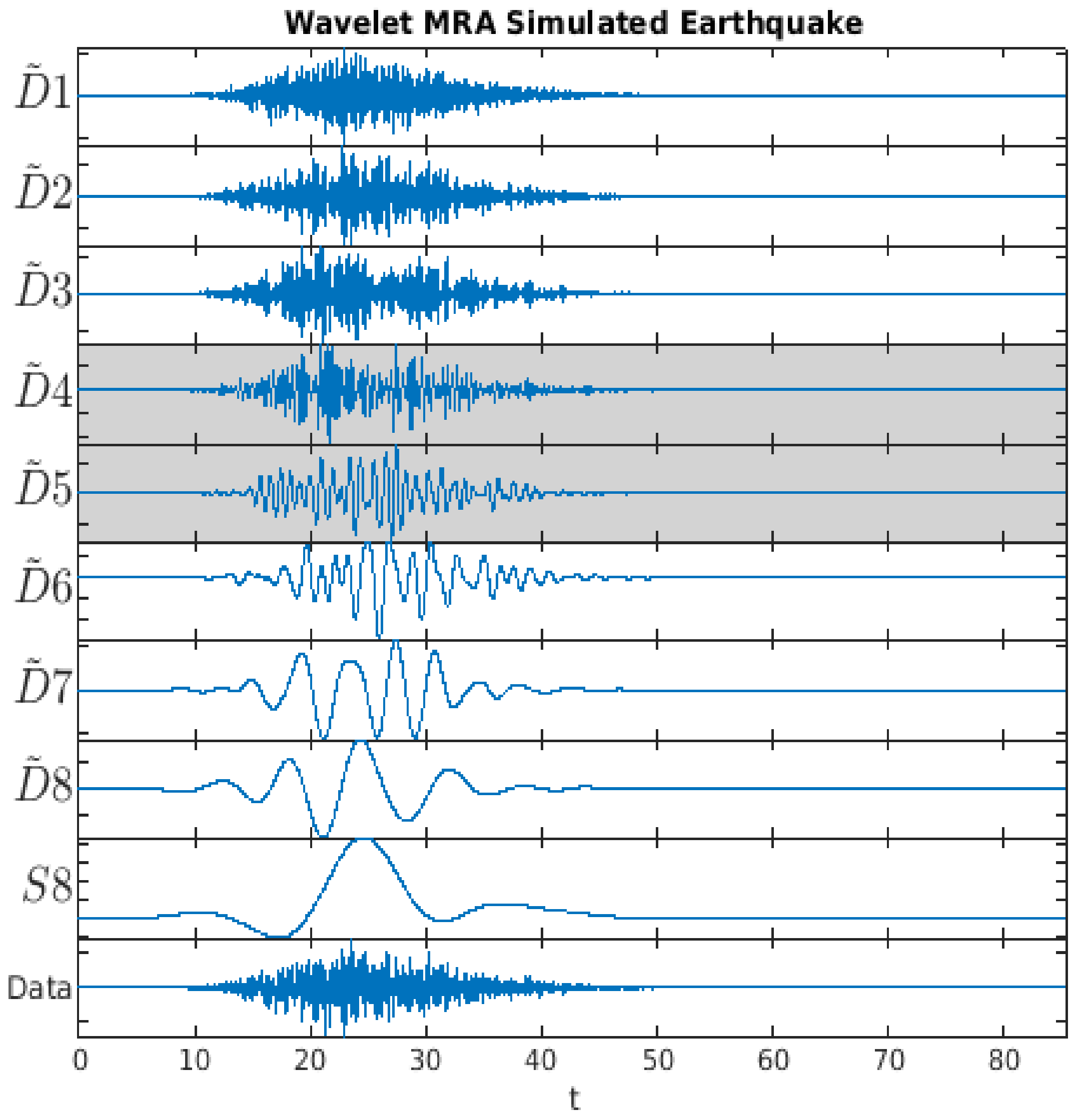
Wavelet Coherence(10 and 25 Hz)

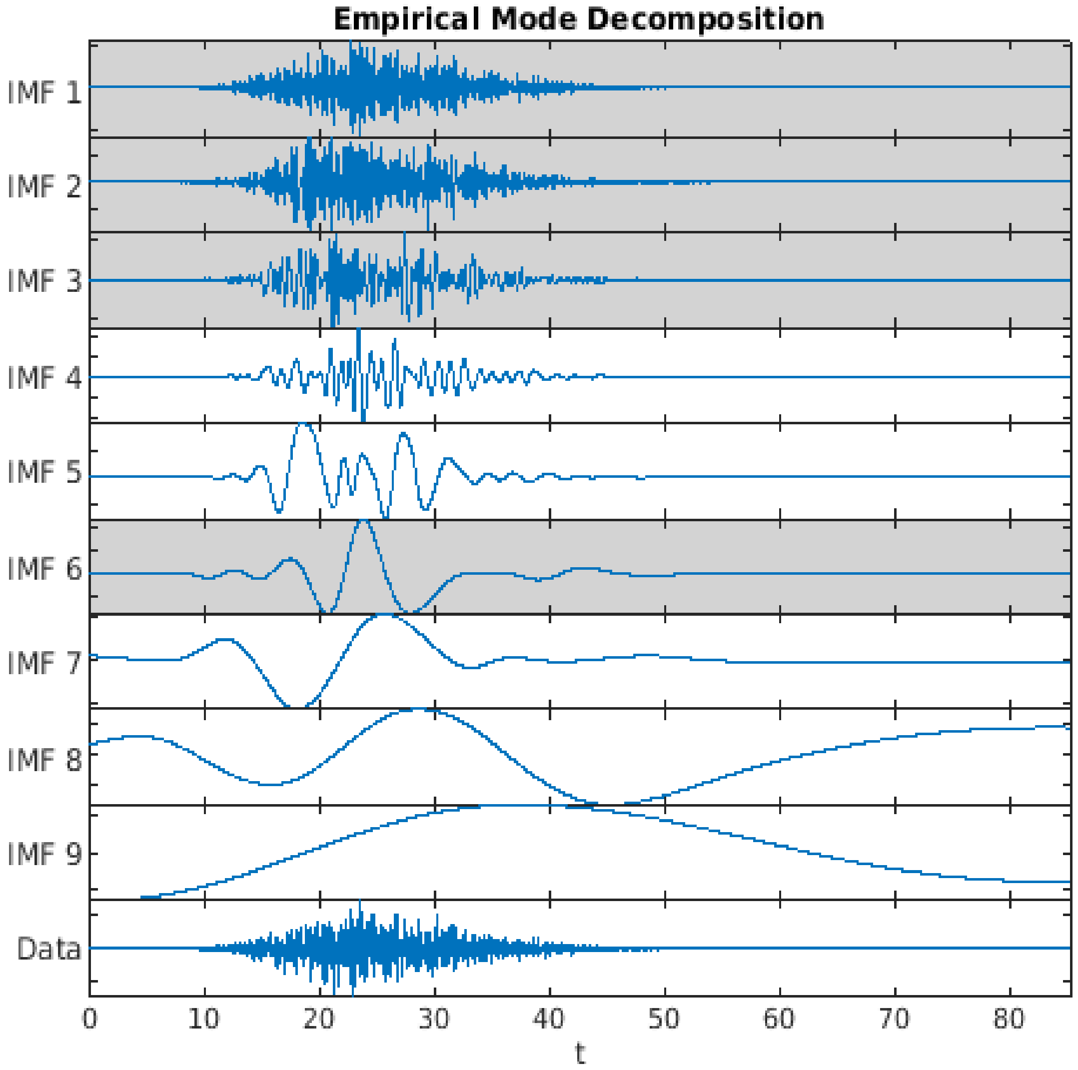


VISUALIZATION OF EQ SIGNAL

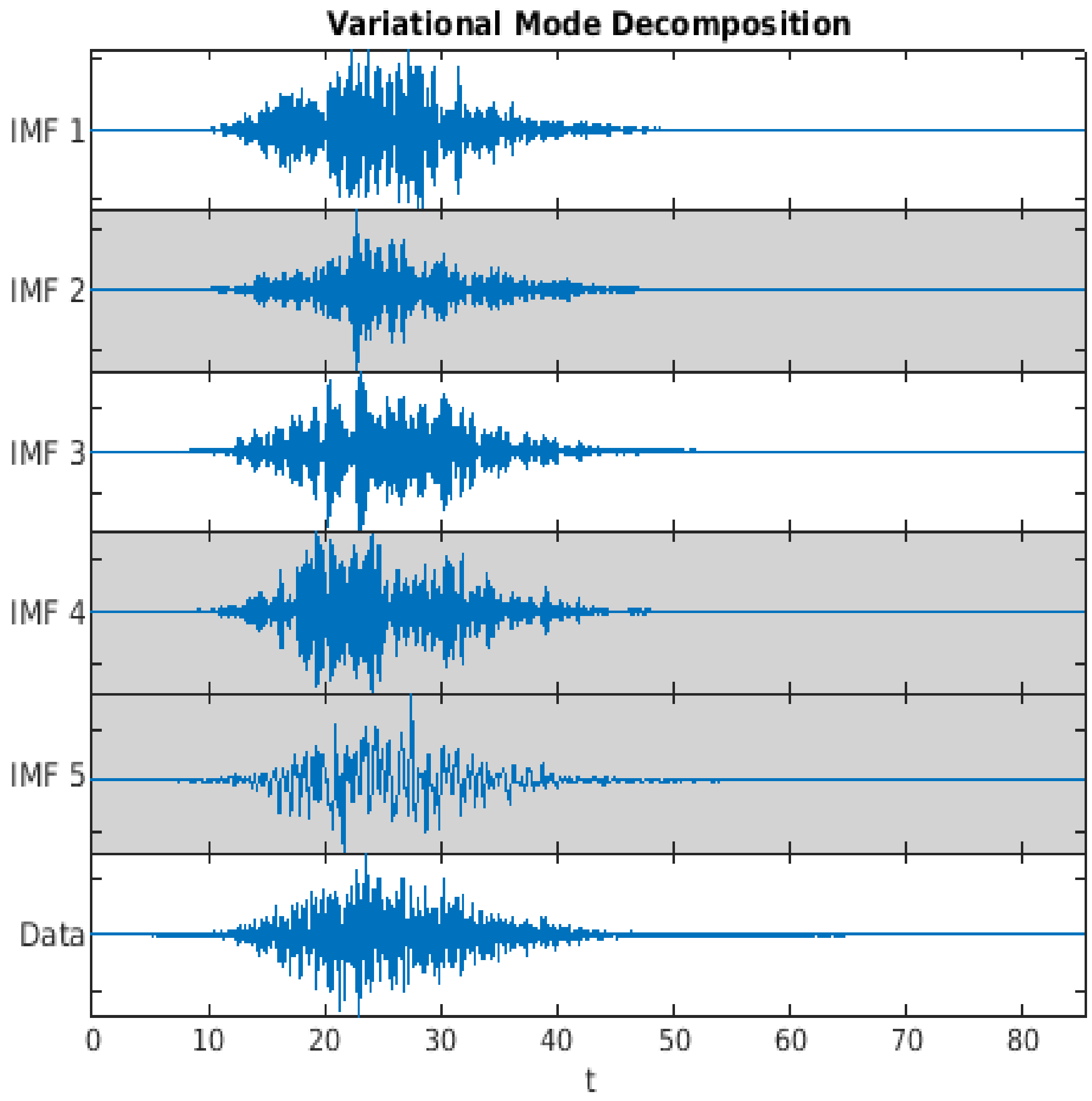


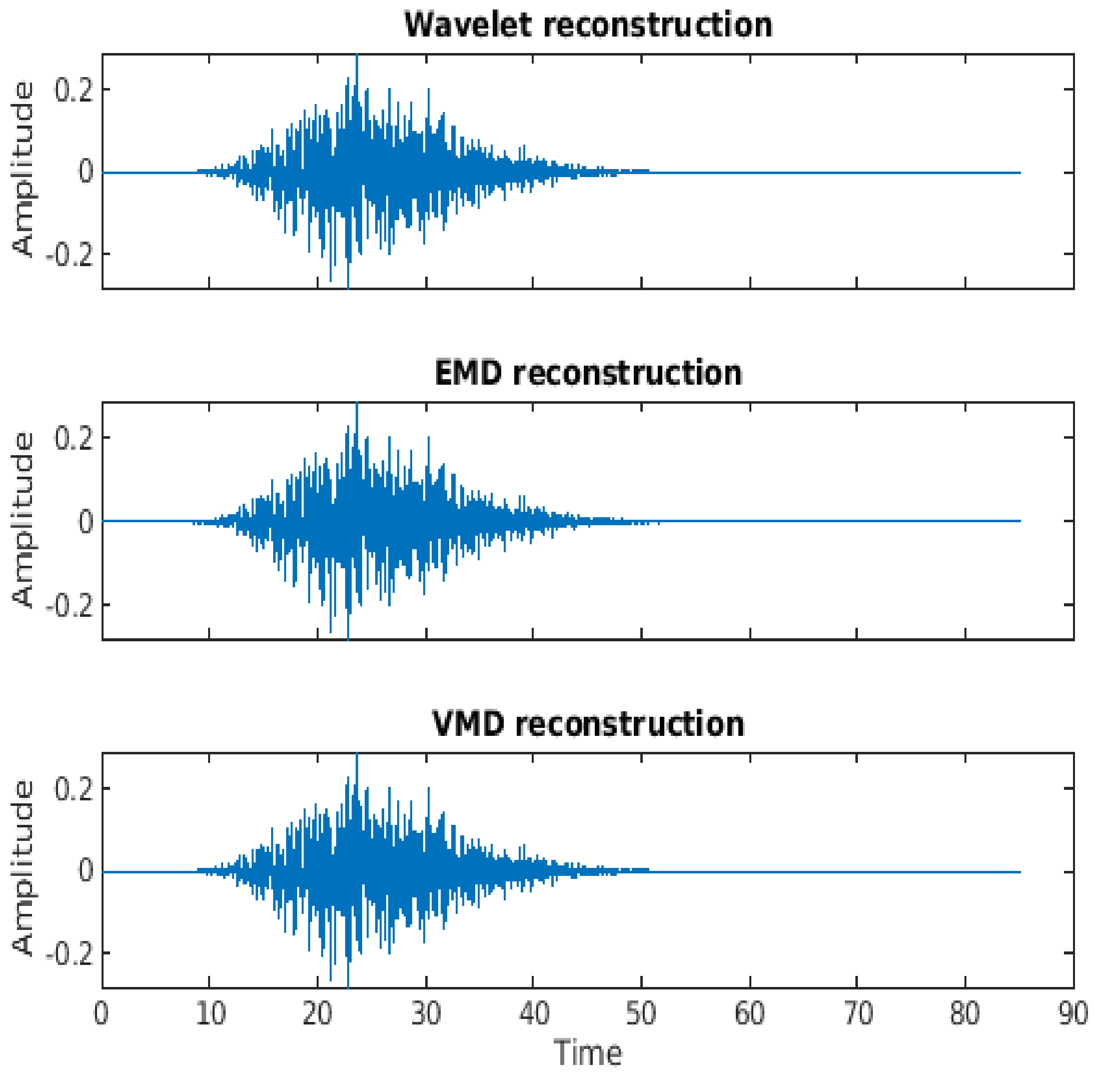
RESULT OF MRA



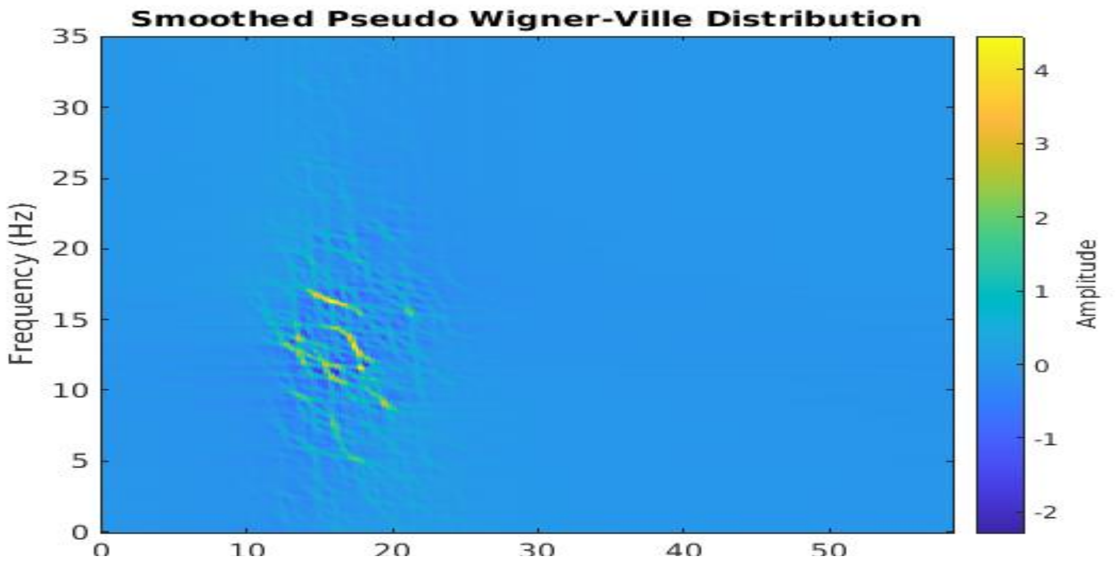


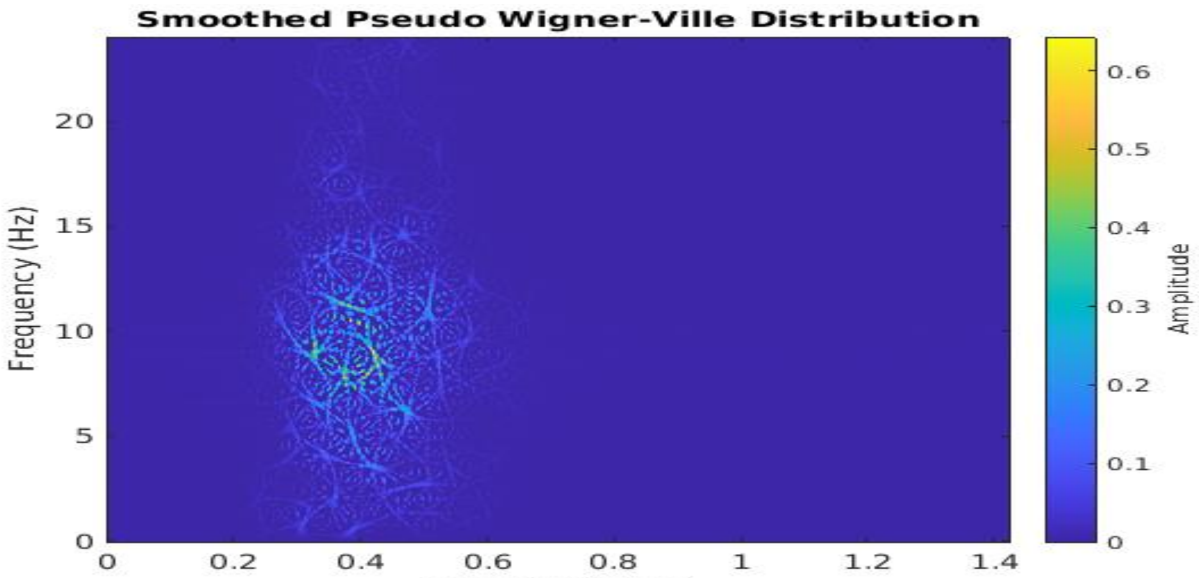
RESULT OF MRA

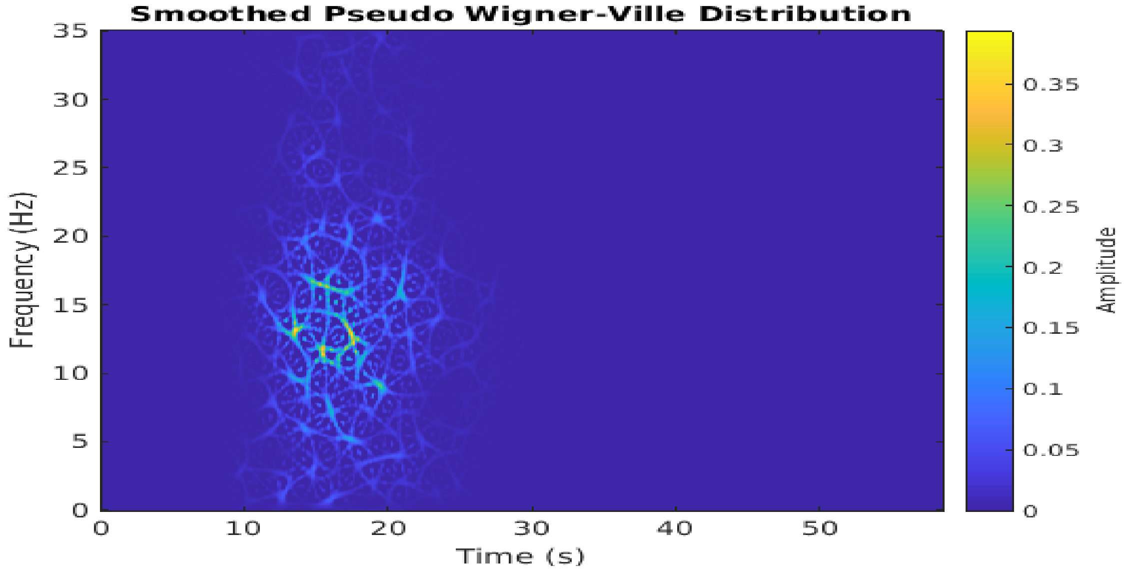


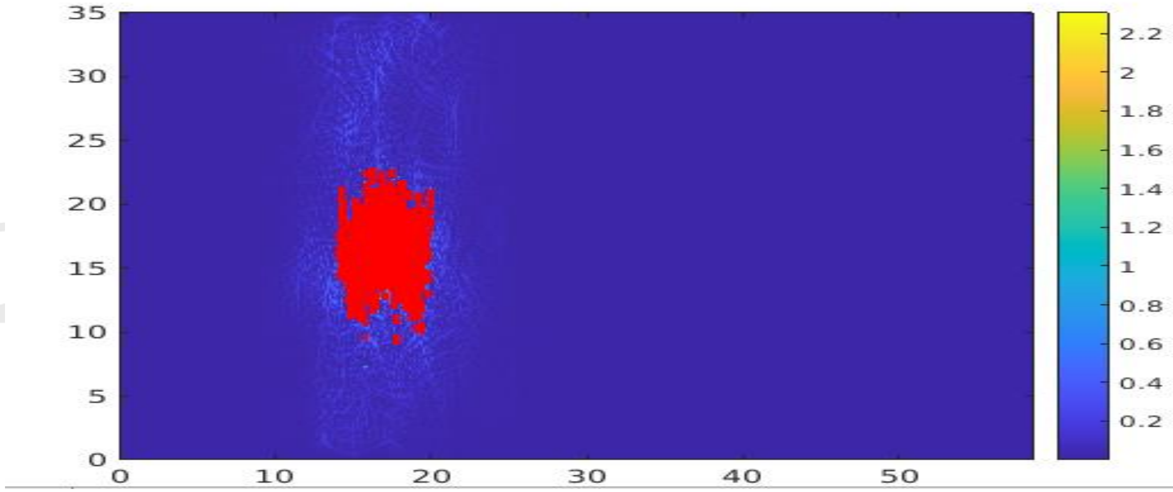


RESULT OF WVD TRANSFORM

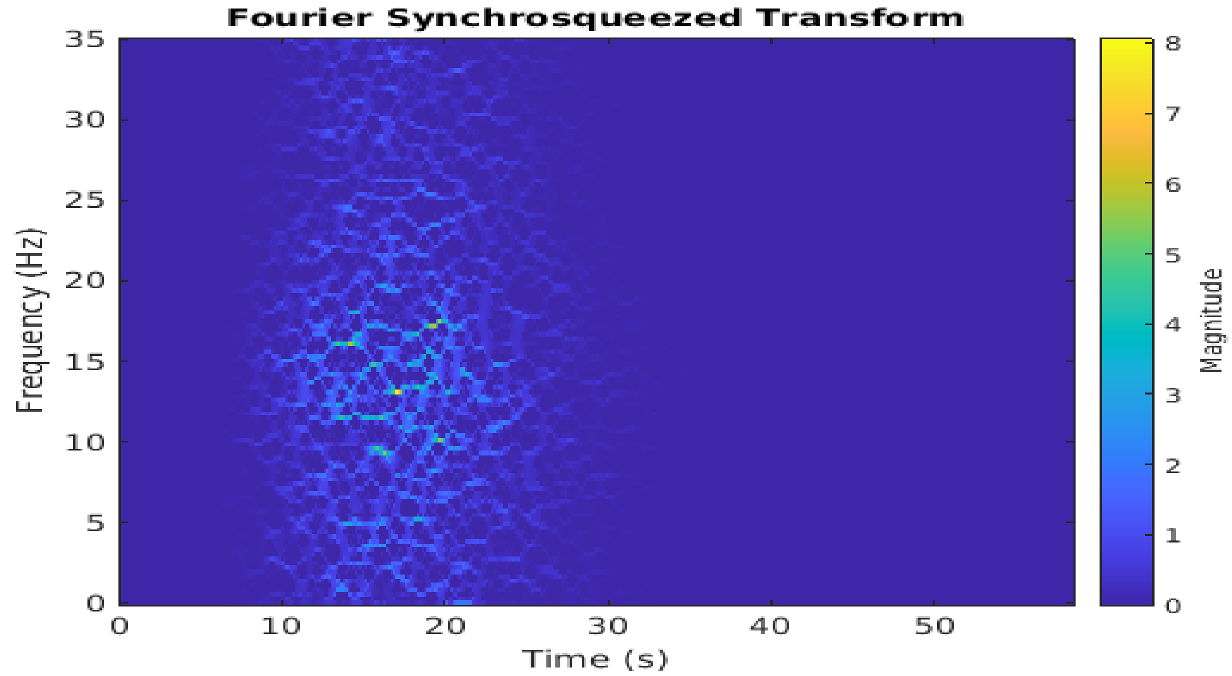


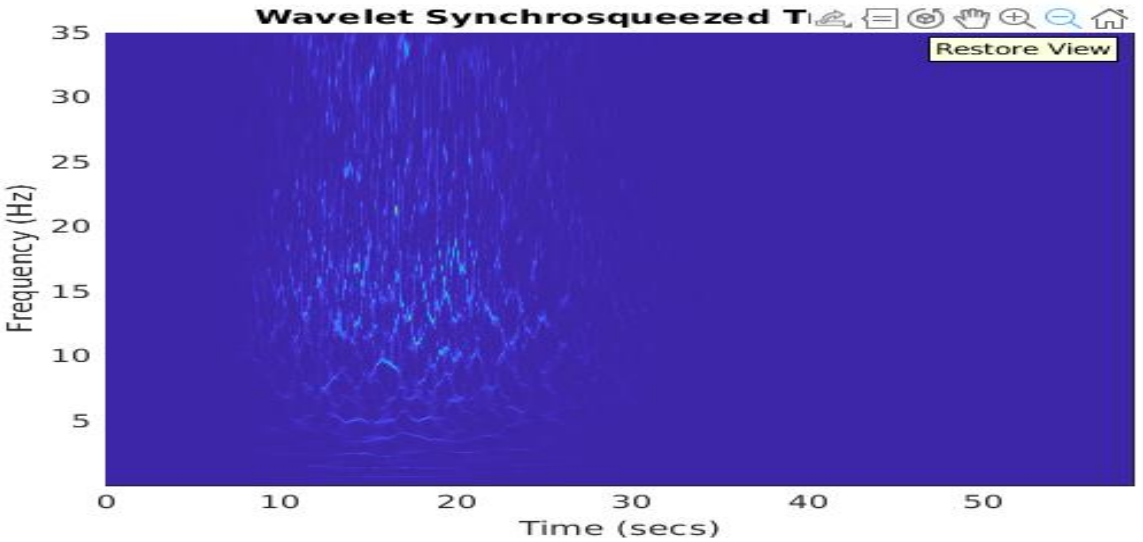


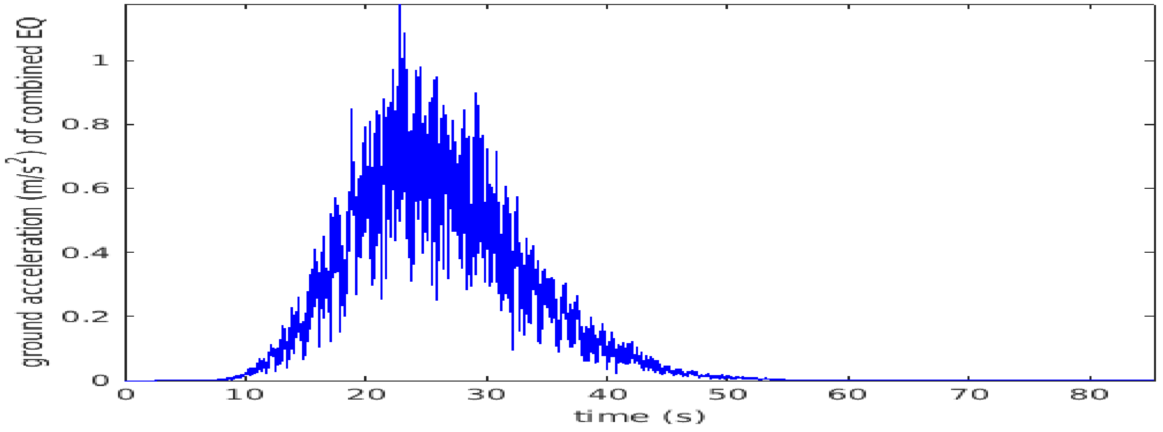


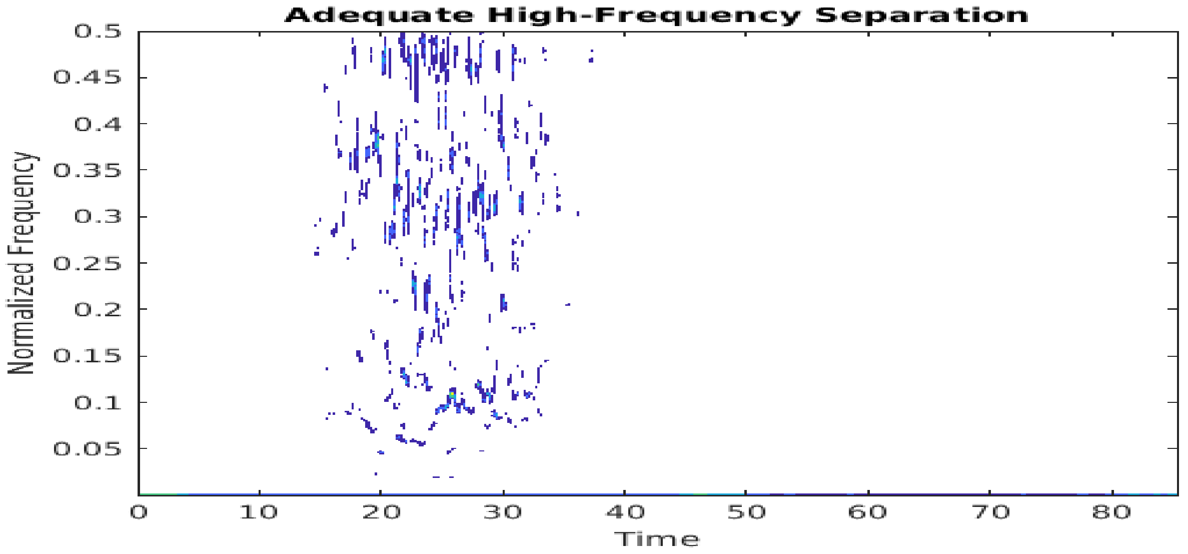


RESULT OF SYNCHROSQUEEZING TRANSFORM

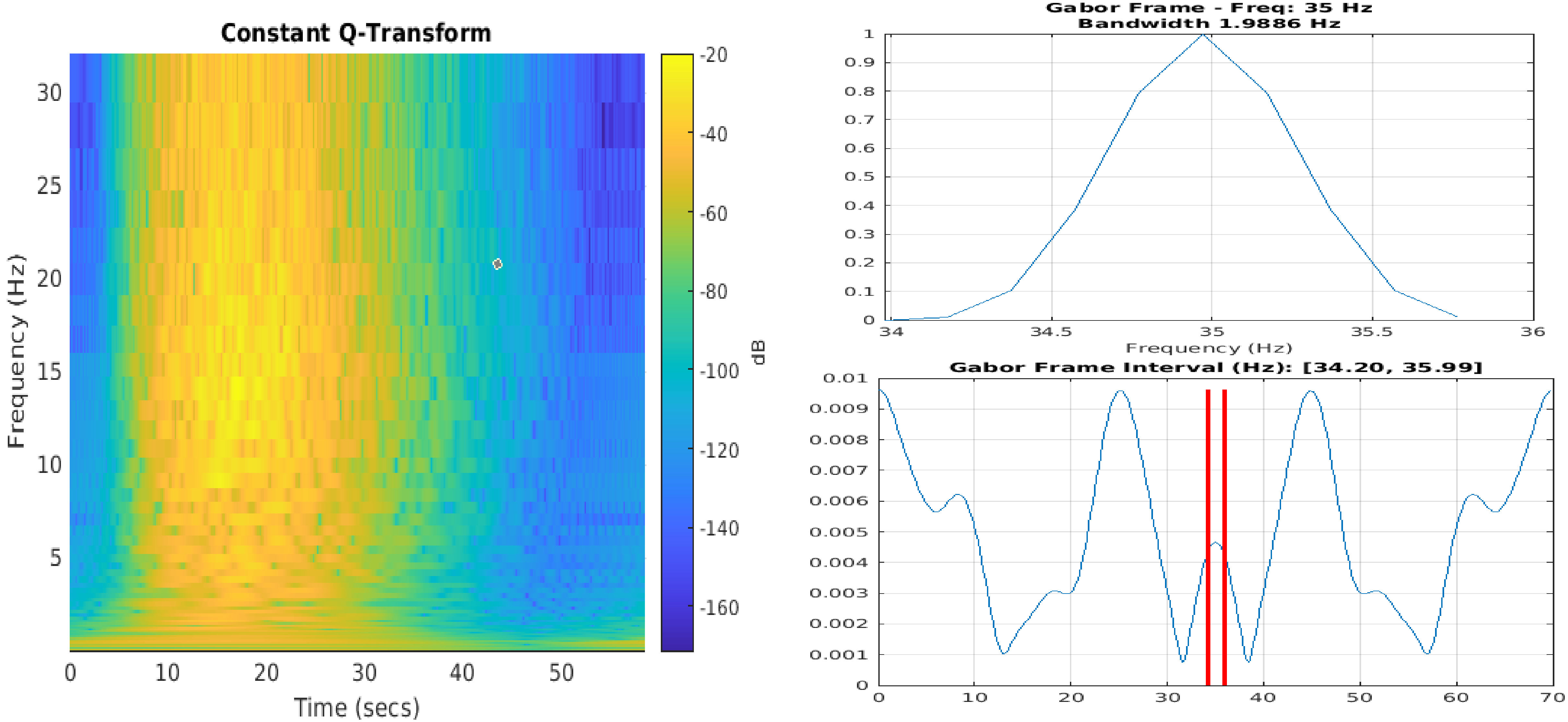




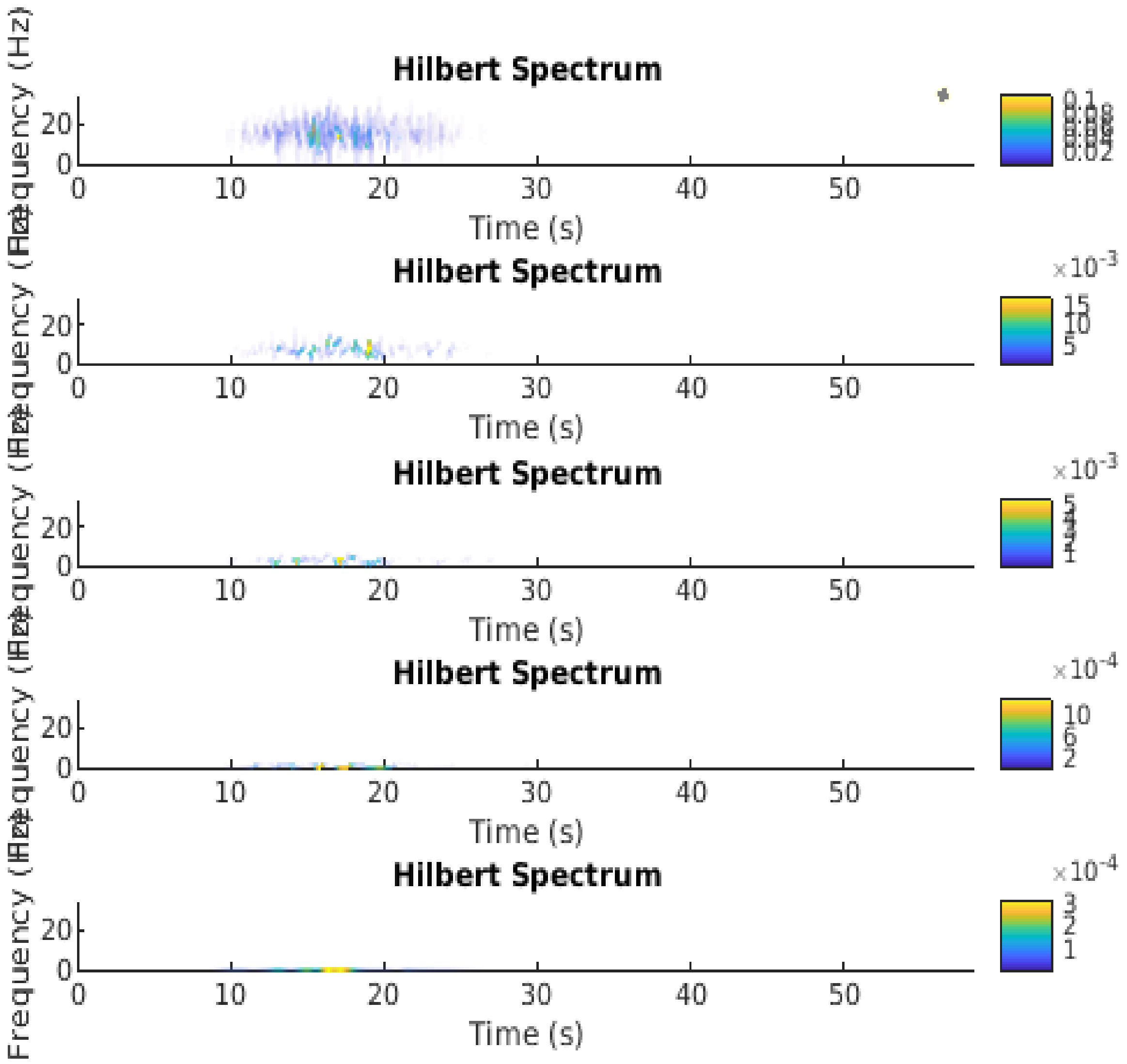


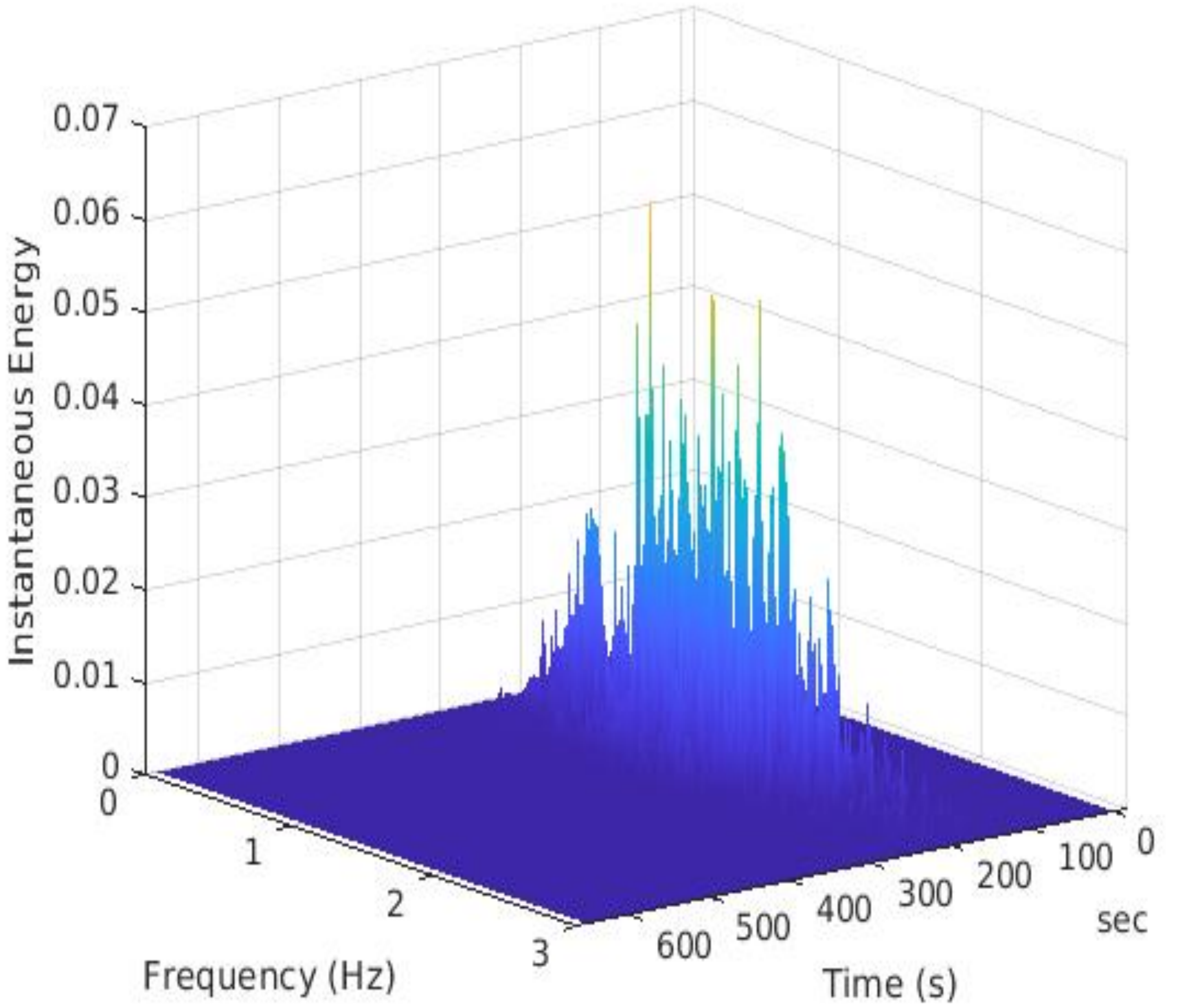


RESULT OF CONSTANT-Q GABOR TRANSFORM

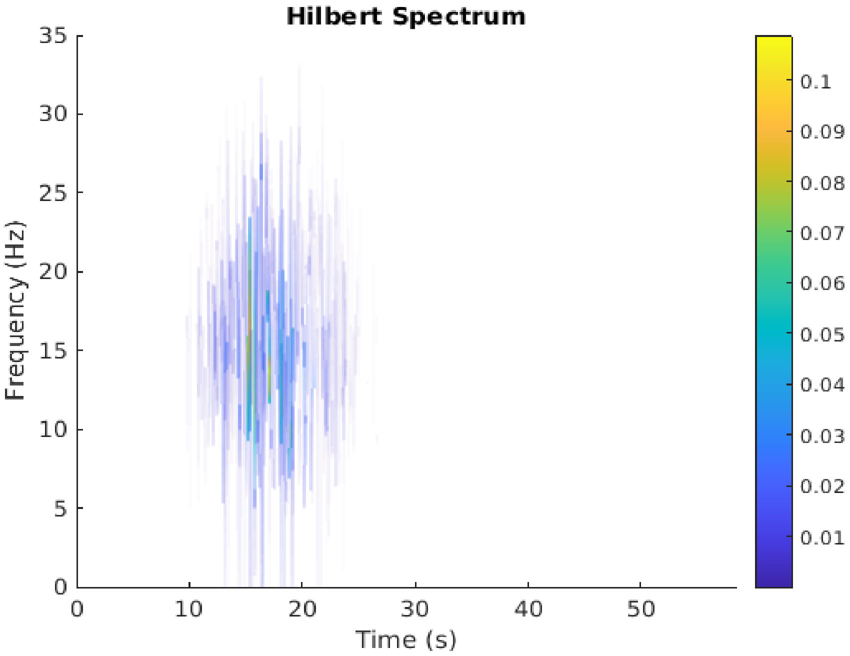


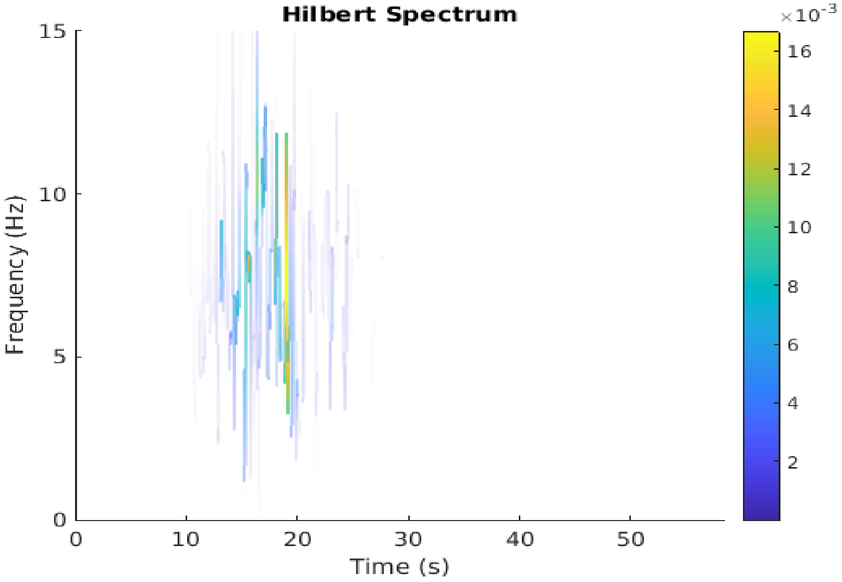
RESULT OF EMPIRICAL MODE DECOMPOSITION AND HILBERT-HUANG TRANSFORM

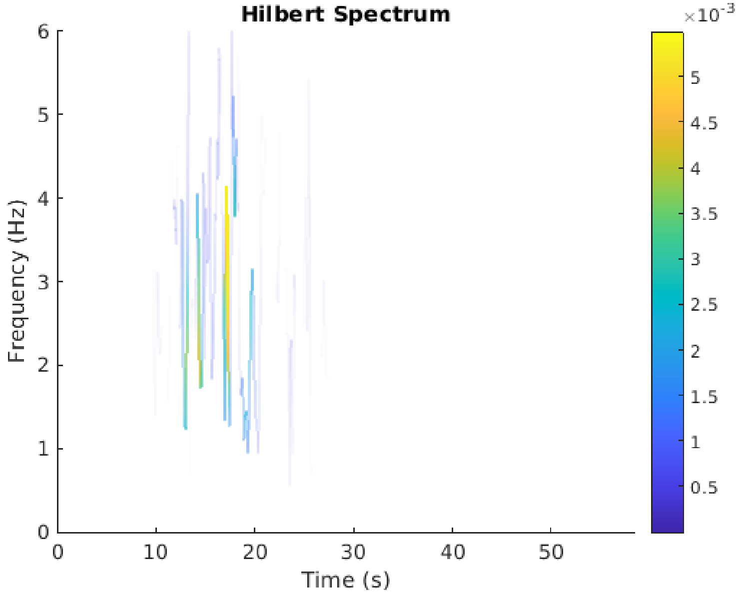


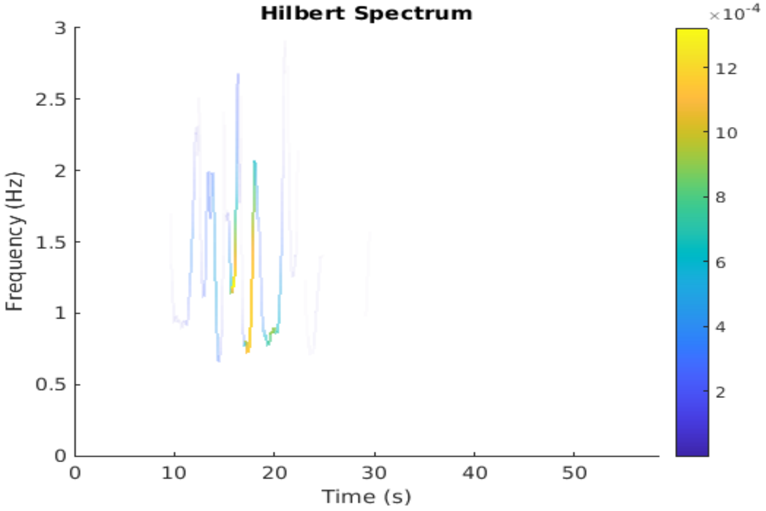


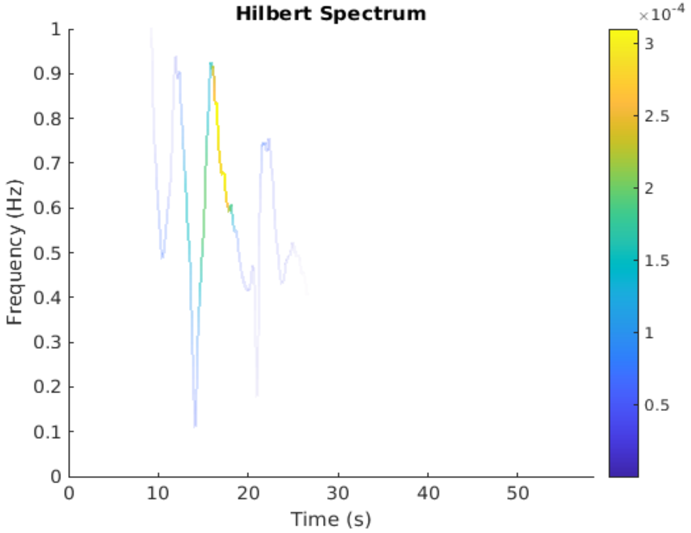
RESULT OF EMPIRICAL MODE DECOMPOSITION AND HILBERT-HUANG TRANSFORM[1-5]



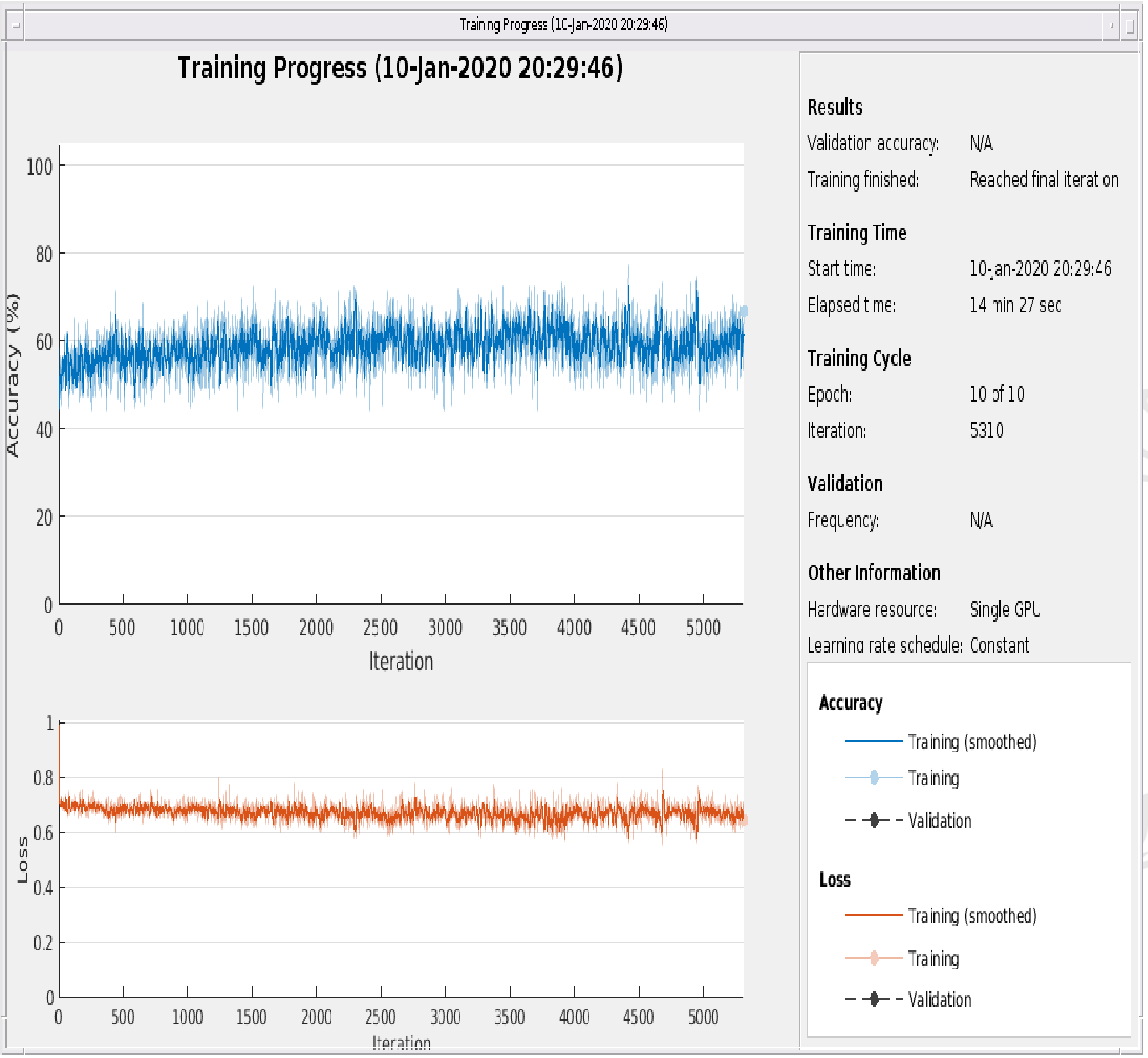


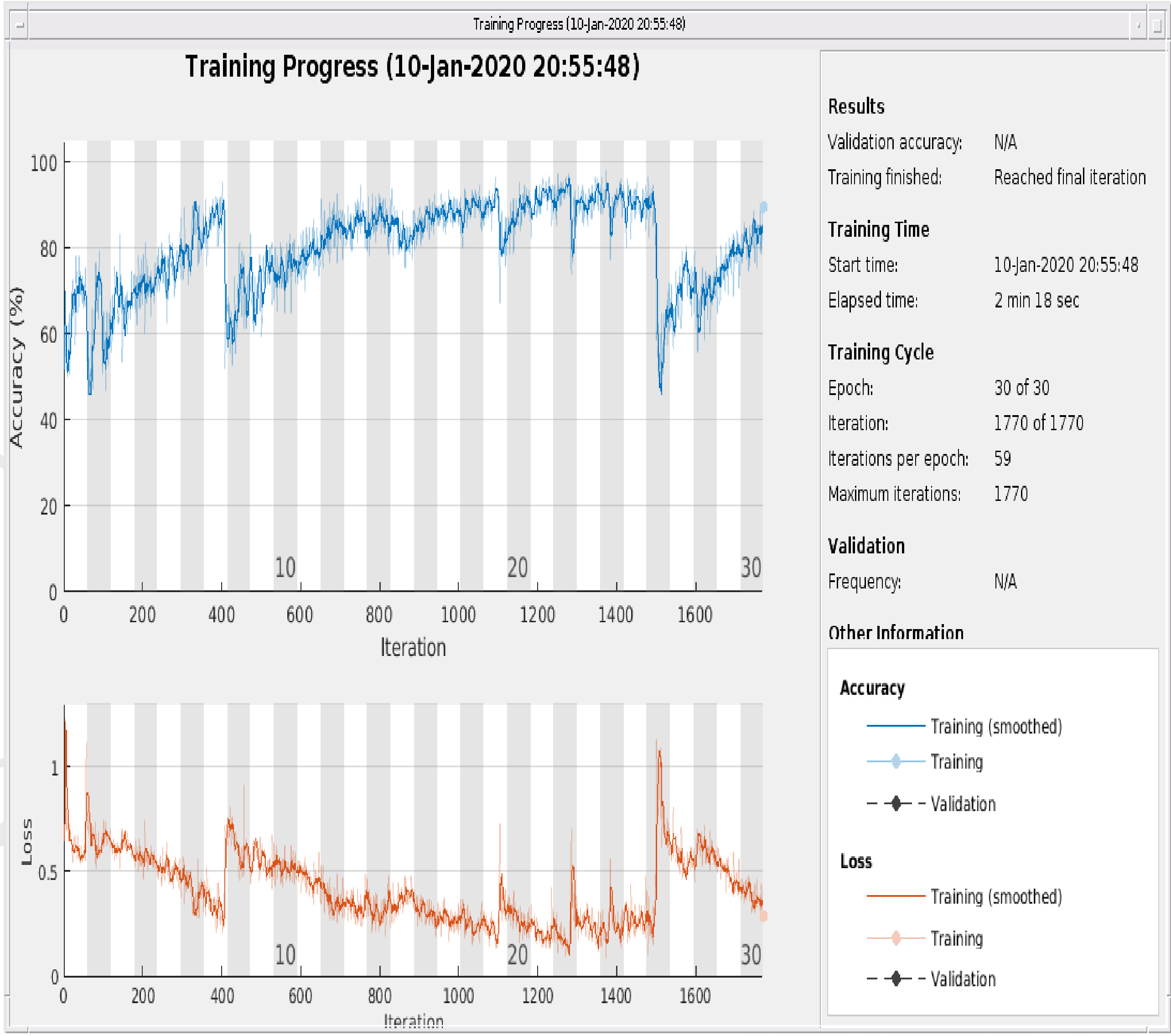






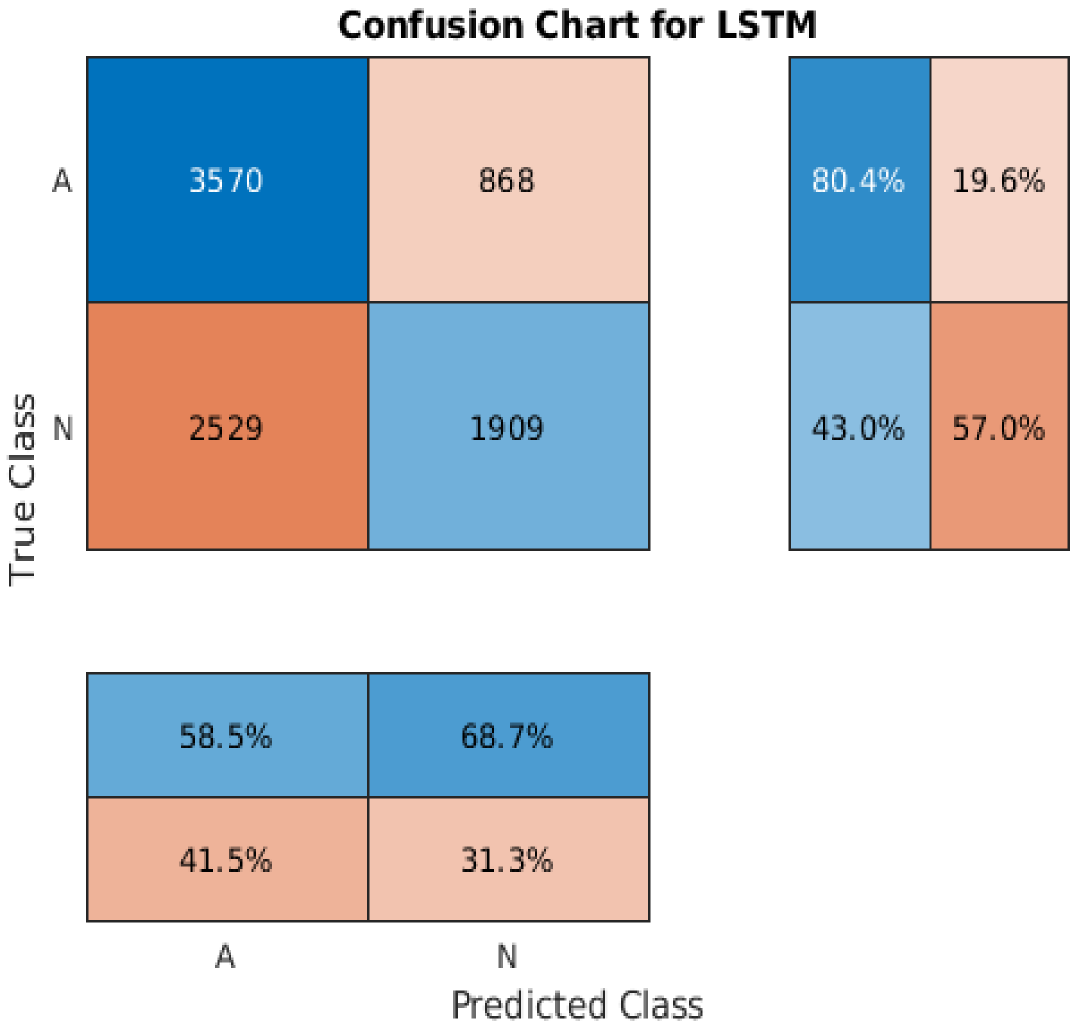
MACHINE LEARNING AND DEEP LEARNING



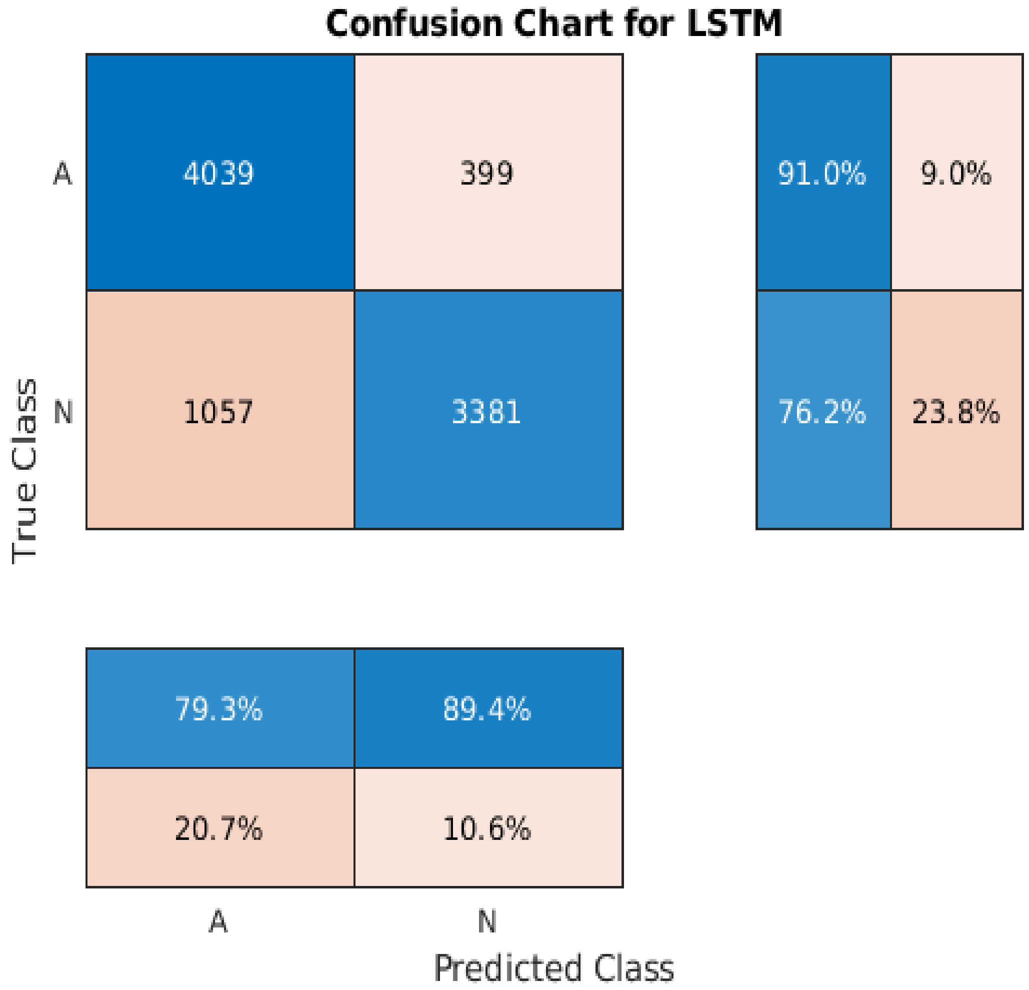


MACHINE LEARNING AND DEEP LEARNING

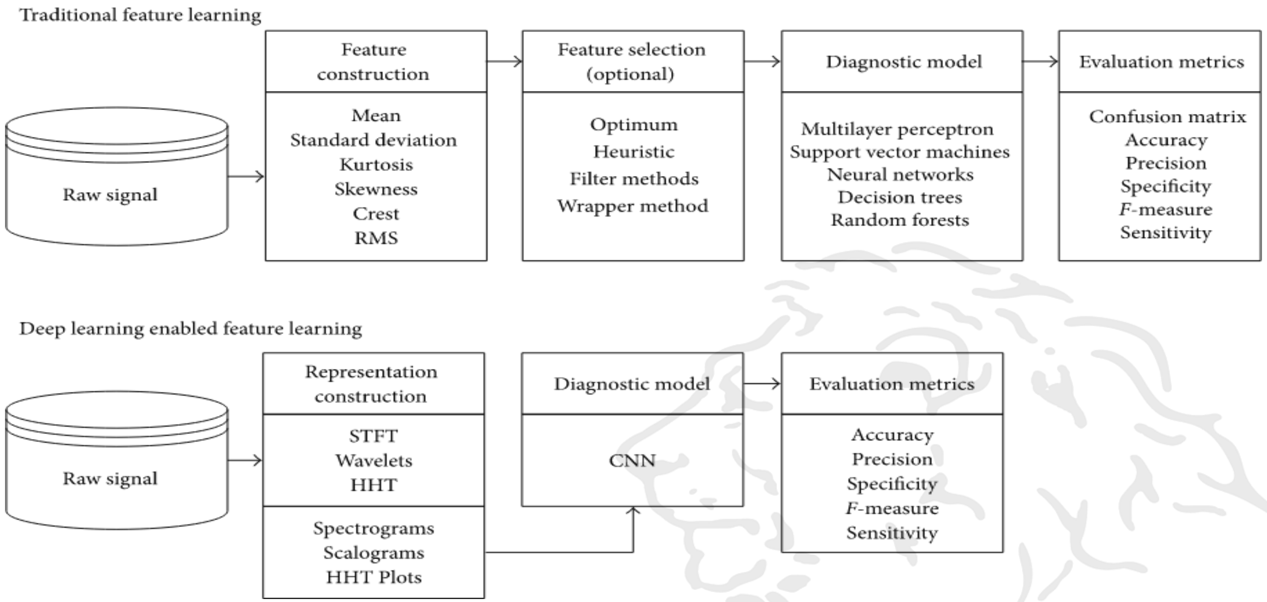
- **WITH RAW SIGNAL**

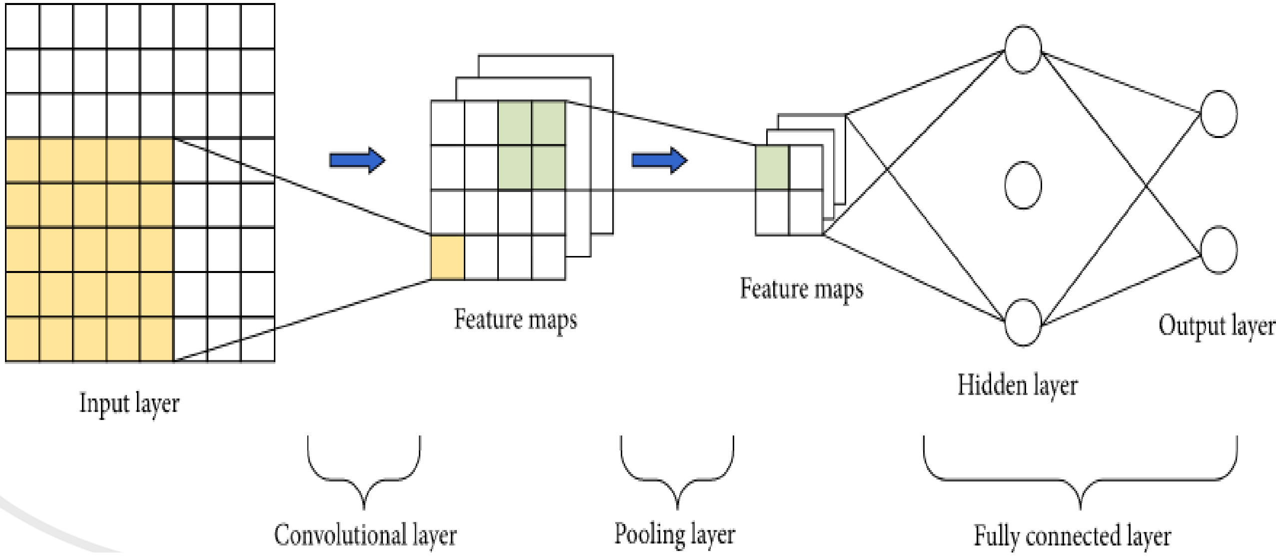


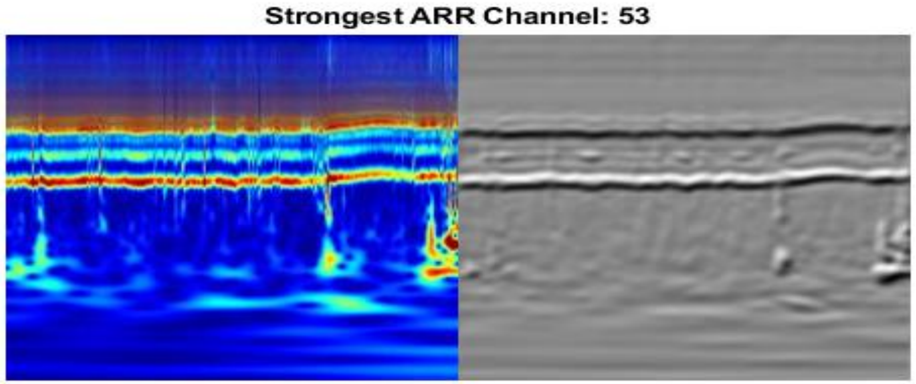
WITH TIME FREQUENCY SIGNAL

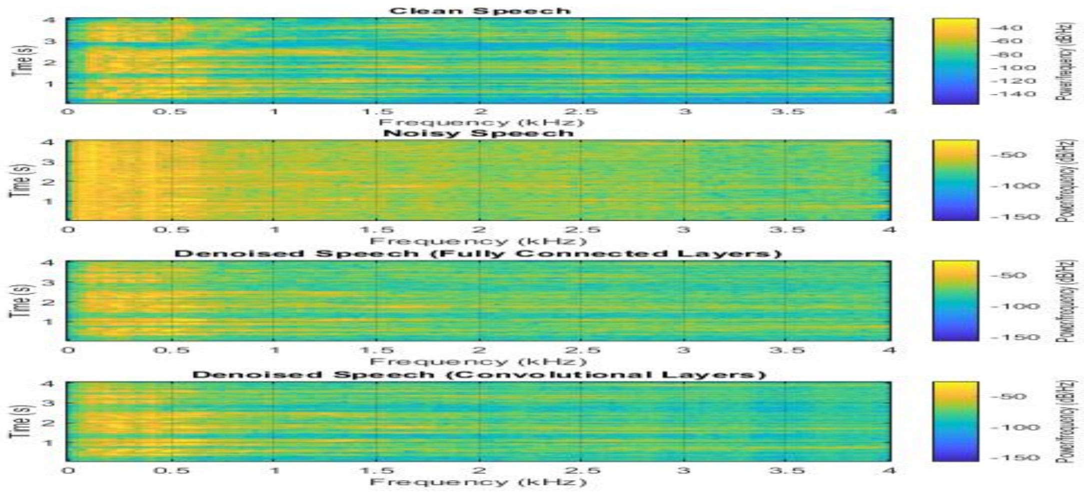


MACHINE LEARNING AND DEEP LEARNING





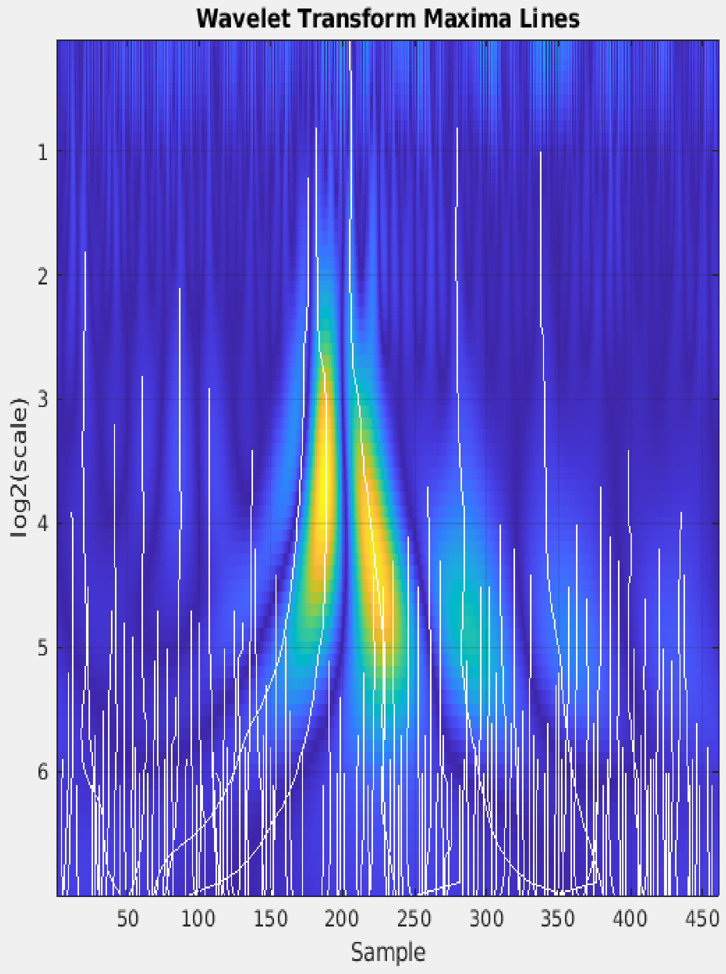




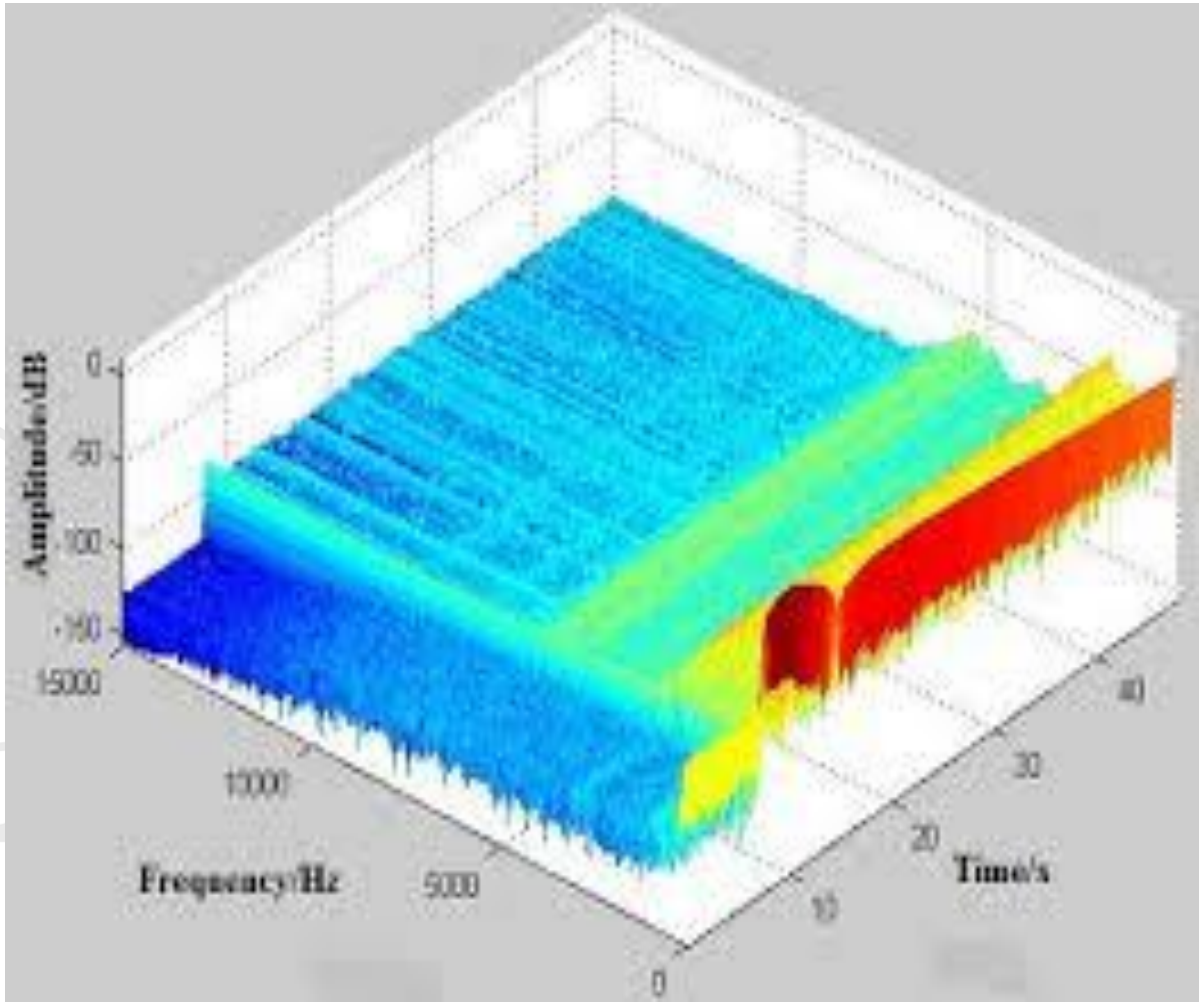
APPLICATION OF DEEP LEARNING

- **CRACK DETECTION**

OIL AND GAS LEAK DETECTION

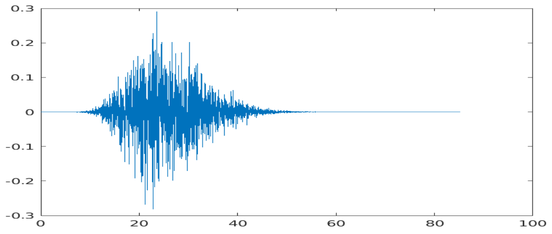


	Sample	Holder Expone
1	5	-2.155
2	9	-1.828
3	11	-0.398
4	15	-0.693
5	21	-0.302
6	23	-1.165
7	26	-2.234
8	28	-2.111
9	31	-1.882
10	33	-1.781
11	39	-0.762
12	41	-0.595
13	45	-2.265
14	48	-1.327
15	54	-2.104
16	56	-3.382
17	59	-2.367
18	61	-0.270
19	64	-2.207
20	69	-1.525
21	71	-1.280
22	76	-2.822
23	78	-1.699
24	84	-1.134
25	87	-0.178
26	92	-2.173
27	94	-1.624
28	98	-3.131
29	100	-1.484
30	102	-2.67[illegible]

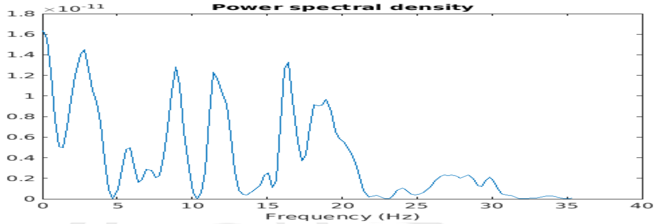


CONCLUSION

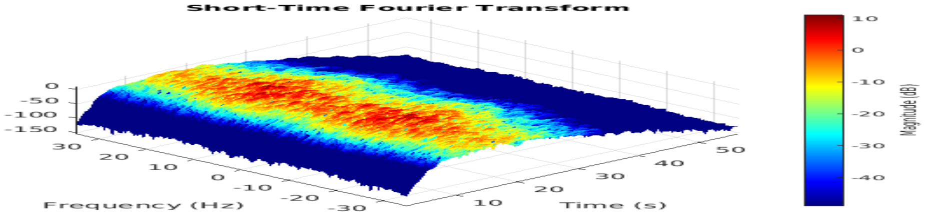
SIGNAL



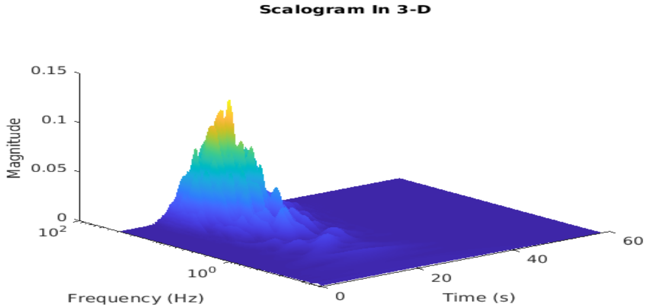
FOURIER TRANSFORM



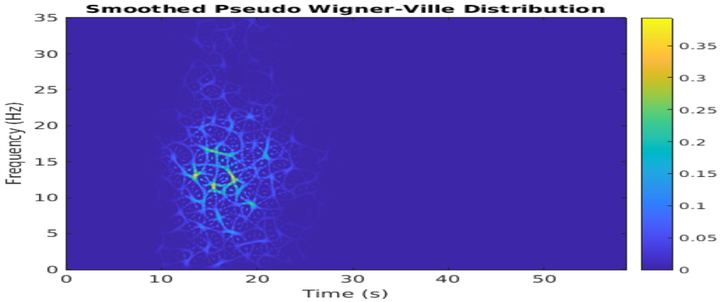
STFT TRANSFORM



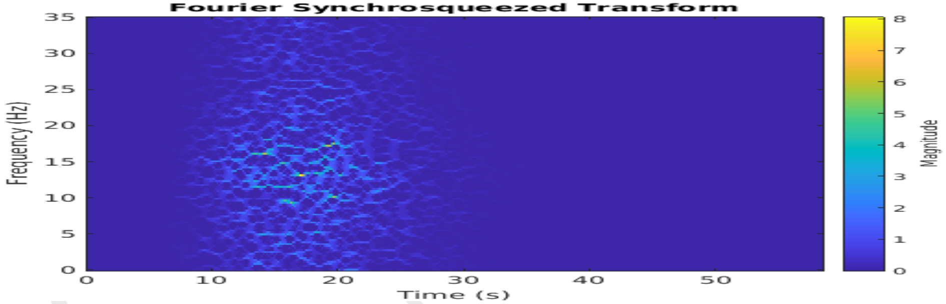
WAVELET



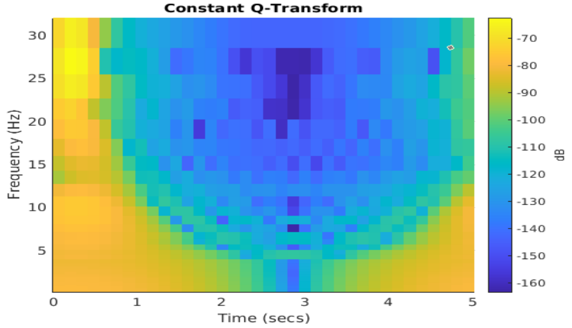
WIGNER VILLE



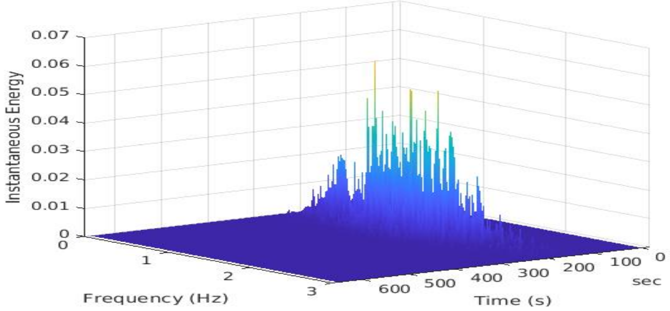
SYNCHROSQUEEZ ING



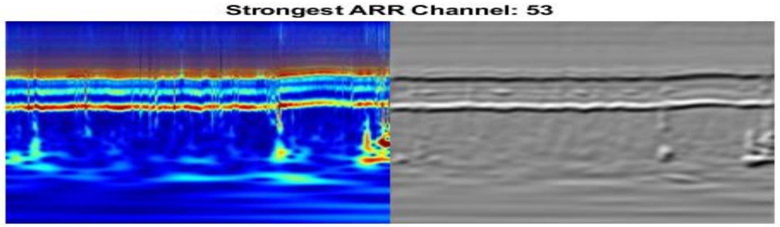
CONSTANT-Q



HILBERT SPACE



MACHINE LEARNING



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THANK YOU