CHAPTER 1
INTRODUCTION

Coconut oil, or copra oil, is an edible oil extracted from the kernel or meat of mature coconuts harvested from the coconut palm. There are several methods of extracting the oil from the nut, and can vary in methodology and ingredients based on culture, medical properties and general use. Dry processing requires that the meat be extracted from the shell and dried using fire, sunlight, or kilns to create copra. The copra is pressed or dissolved with solvents, producing the coconut oil and a high-protein, high-fibre mash. Here in the dry process the time consumption is very high. Hence to reduce the time consumption and to estimate the oil yield an alternative effective technology is needed. One of the effective technologies undergone here will reduce the wastage of coconut for the purpose of oil yield. This is achieved by signal processing of coconut water sound when it set to shake and estimates the oil yield non-invasively. This testing on coconut results in the estimation of oil yield in an easier way compared to old process such as drying (copra) and milling of coconut.

India positions third in territory and generation of coconut on the planet. The four southern states viz., Kerala, Tamilnadu, Karnataka and Andhra Pradesh are the huge coconuts cultivating states in India interpreting to more than 90 percent of domain and region. The coconuts cultivated in these regions have been utilized for the purpose of making coconut oil. The traditional method employs invasive coconut drying process this consumes more time, so it is needed that a four- fold increment in the estimation of oil yield must be done by embracing different advancements as compared to unscientific testing. One of the effective technologies discussed in this paper estimates the oil yield non-invasively and accurately. This is achieved by employing signal processing technique on the water sound obtained from the coconut when it is set to shake.

CHAPTER 2

LITERATURESURVEY

Alfian Kamil et.al," Investigation of potential impact for detection of Kopyor Coconut with Drop Test Method", Kopyor coconut is a mature coconut with distinct characteristics as compared to a normal coconut. Coconuts with three variations in mass such as 1.00kg, 1.15kg, 1.30 kg are used and dropped from three variations in drop height (0.3m,0.4m,0.5m). The results show that mass variations affect all impact parameters such as impulse, peak force and contact time. The drop height affects all impact parameters which reduce the accuracy of the result and therefore shaking and testing method is involved in the invention [1].

Sefiu Bello," Physical properties of Coconut Shell Nanoparticles", vol.12, 2016.Physical properties such as apparent density, bulk density, and of carbonized and uncarbonized coconut shell nano particles produced through top down approach have been studied.After 70 hours of milling respective compressibility indices and average particle sizes are obtained as 46.4% and 69.7%, 50.01nm and 14.29 nm respectively.It is an invasive technique which consumes a large amount of time and therefore a non-invasive coconut shaking device with less time consumption is employed in the invention [2].

Veera Shanthi Ram," Falling Walls Lab 2018"Old traditional method of knocking the coconuts and testing is implemented using striking mechanism which knocks the coconut, obviously produces a sound and this sound signal has multiple frequency components which vary differently for various types of coconut such as good, bad or spoiled ones is then processed to give the result. The identification of good, bad or spoiled coconuts is ascertained using knock test on coconut which does not give the estimation of oil yield. This is overcome by effective feature extraction method of signal processing algorithm in the invention [3].

CHAPTER 3

PROPOSED METHOD

3.1PROPOSED METHOD

The proposed method provides an easy implementable solution to estimate the oil yield accurately. This method involves MATLAB coding for signal processing technique. The feature extraction technique of acoustic signal is utilized to estimate and predict the oil yield. Discrimination of coconut quality can be investigated through property of acoustic signal from agitating coconut water present inside the shell. Eliminating the unwanted noise and extracting the required features from the retrieved audio signal is achieved. In this case, the physical features of acoustic signal such as dynamic range, crest factor, average time, minimum peak and maximum peak could be obtained. Here, to obtain precise oil yield coconuts are classified into four main categories based on the coconut water sound as listed in the table below:

Table 3.1 Classification of coconut according to their water sound

CLASSIFICATION OF COCONUT	**AMOUNT OF WATER CONTENT PRESENT**	**OIL YIELD BASED ON THEIR WATER CONTENT**
CLASS A	High amount of water	Produces low yield
CLASS B	Comparatively low than A	Produces moderate yield
CLASS C	Low amount of water	Produces high yield
CLASS D	Kernel is completely detached from the shell	Produces very high yield

3.2 FLOW CHART

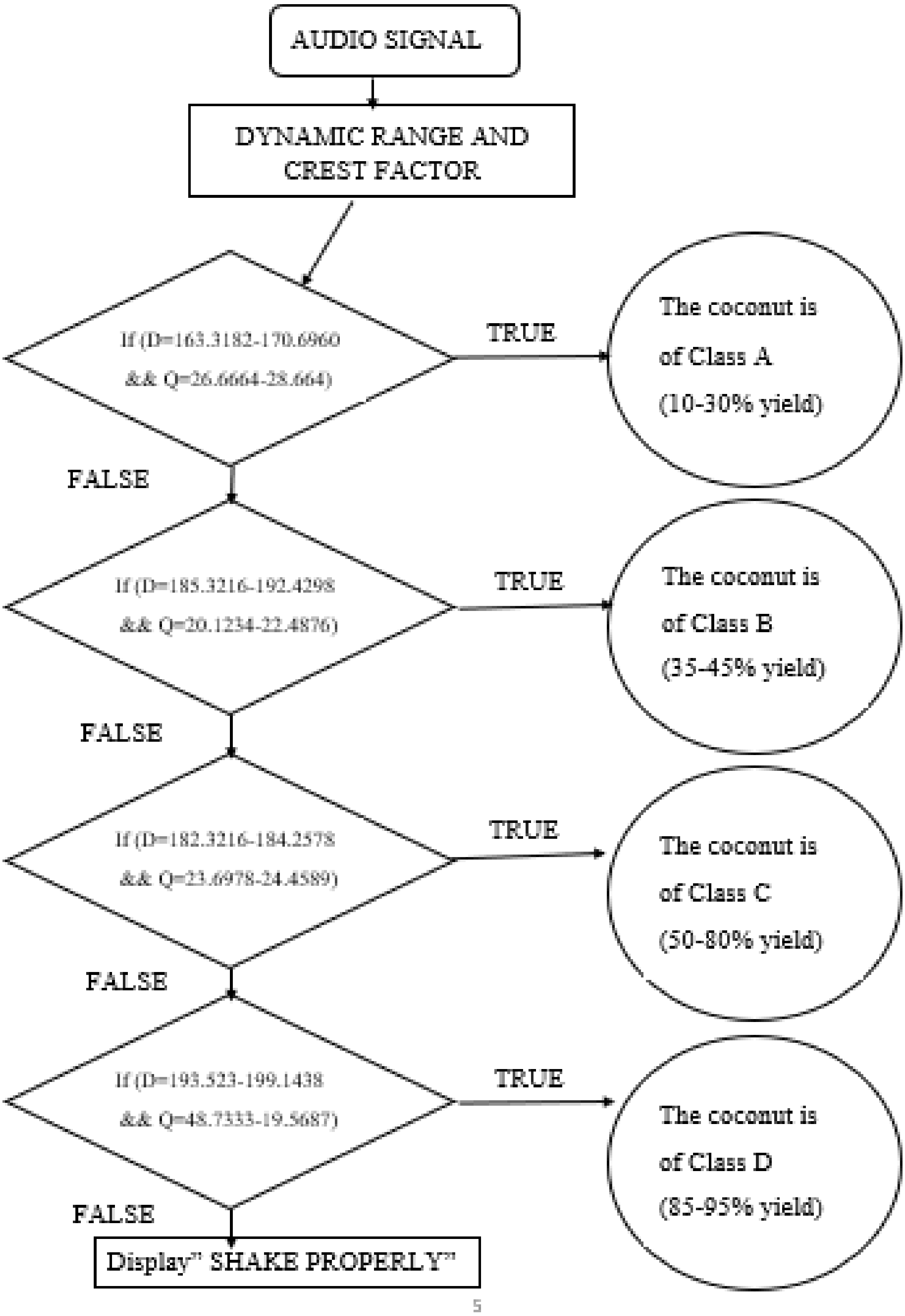


Fig 3.1 Flowchart of signal processing technique

3.3 EXPLANATION

1.Insert the sound file using audio read command.

2. Calculate the maximum value, minimum value, mean value, RMS value, Dynamic range, Crest factor and autocorrelation time by using the following formula

i) maxval = max(x)

ii) minval = min(x)

iii) u = mean(x)

iv) s = std(x)

v) D = 20*log10(maxvl/min(abs(nonzeros(x))))

vi)Q = 20*log10(maxval/s)

vii)ind = find (Rx>0.05, 1, 'last')

3.From the above parameters dynamic range and crest factor is taken for evaluating the coconut classification. The table below shows the various ranges of these parameters for the four classes of coconut.

Table3.3 Average of dynamic range and crest factor for each classification

Classification	**Dynamic range (D)**	**Crest factor (Q)**
Class A	163.3182-170.6960	26.6664-28.6664
Class B	193.523-199.1438	18.7333-19.5687
Class C	182.5421-184.2578	23.6978-24.4589
Class D	185.32162-192.4298	20.1234-22.4876

The values mentioned in the table3.2 is obtained from the training samples of the coconut.

4.If the dynamic range and the crest factor of the testing coconut is within the range then the oil yield is displayed respectively as mentioned in the flow chart.

CHAPTER 4

OUTPUT AND FUTURE SCOPE

4.1 OUTPUT OF CLASS A COCONUT

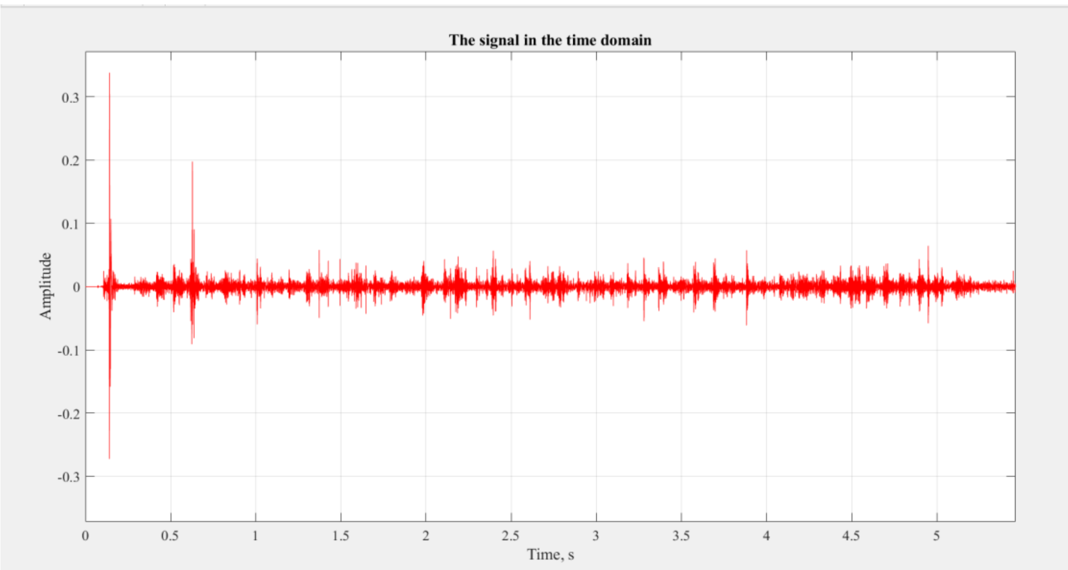


Fig 4.1 Response of the signal in time domain

As mentioned in the table 3.1 Class A coconut has amount of water, its time domain response is obtained as shown in the Fig 4.1.

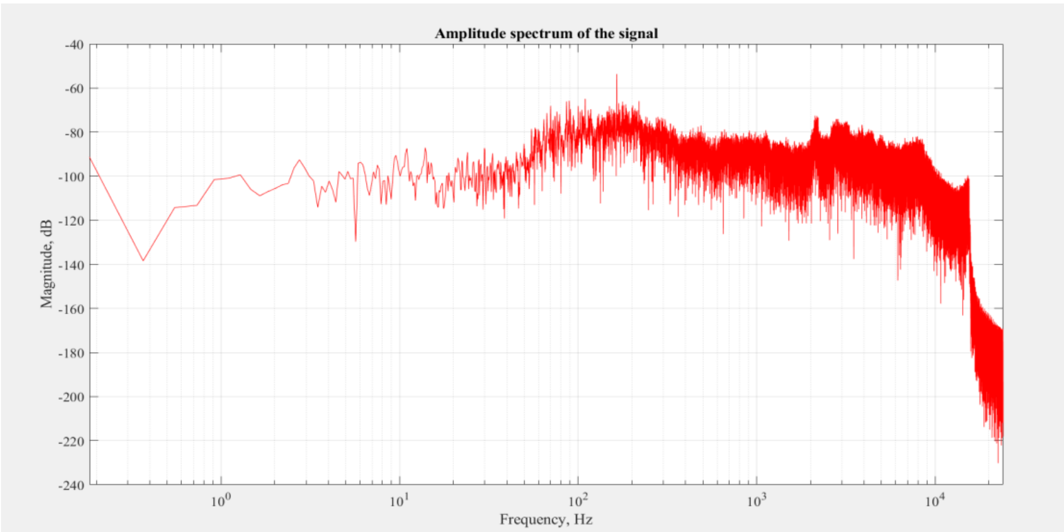


Fig 4.2 Amplitude spectrum of the signal

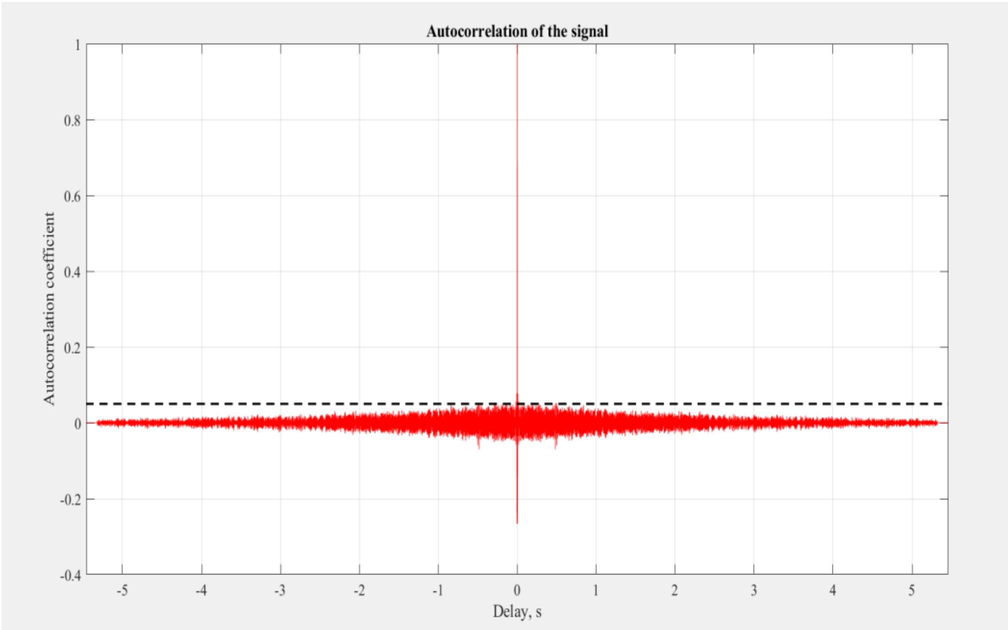


Fig 4.3 Autocorrelation response of the signal

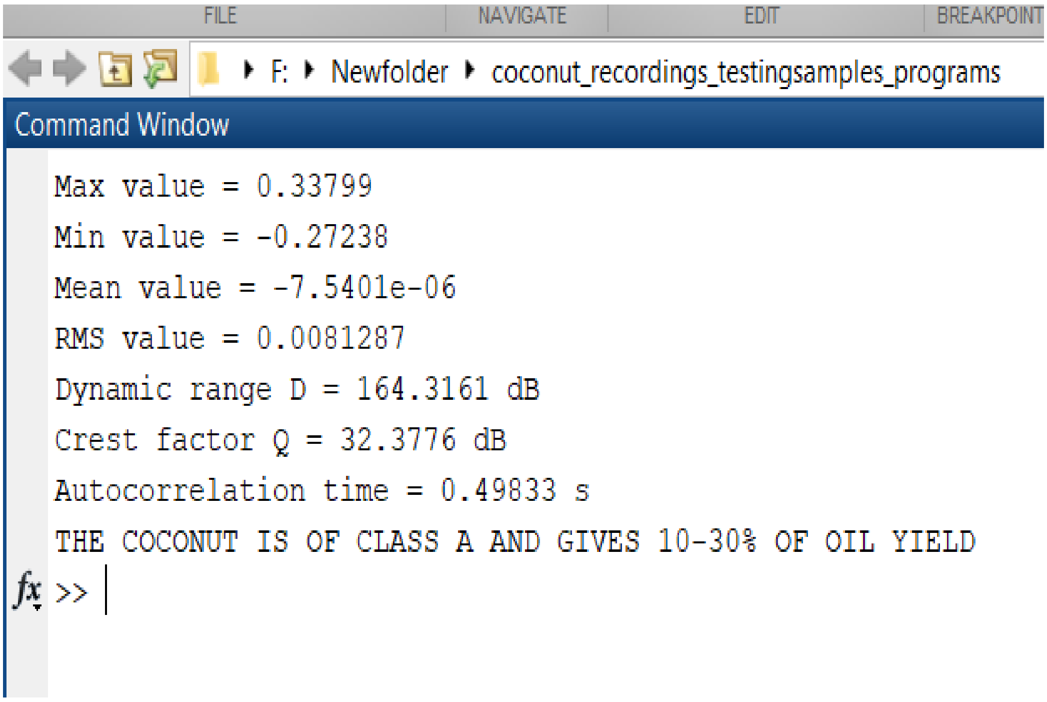


Fig 4.4 Estimated yield output of class A coconut

Here the dynamic range and crest factor of Class A coconut is obtained from the Fig 4.1 and the Fig 4.2. The autocorrelation is calculated from the Fig 4.4.

4.2 OUTPUT OF CLASS B COCONUT

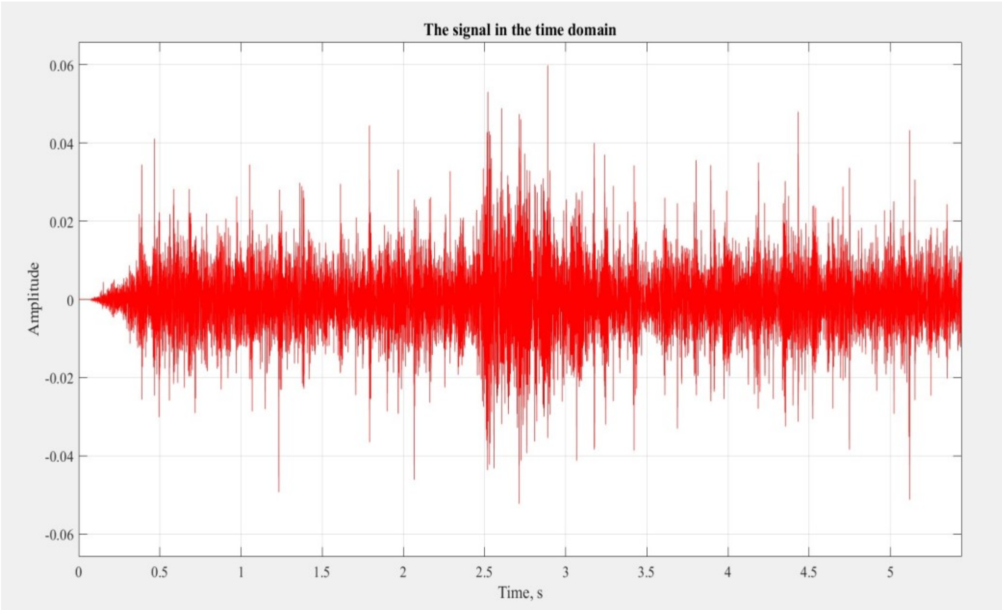


Fig 4.5 Response of the signal in time domain

As mentioned in the table 3.1 Class B coconut has low amount of water than A, its time domain response is obtained as shown in the Fig 4.5.

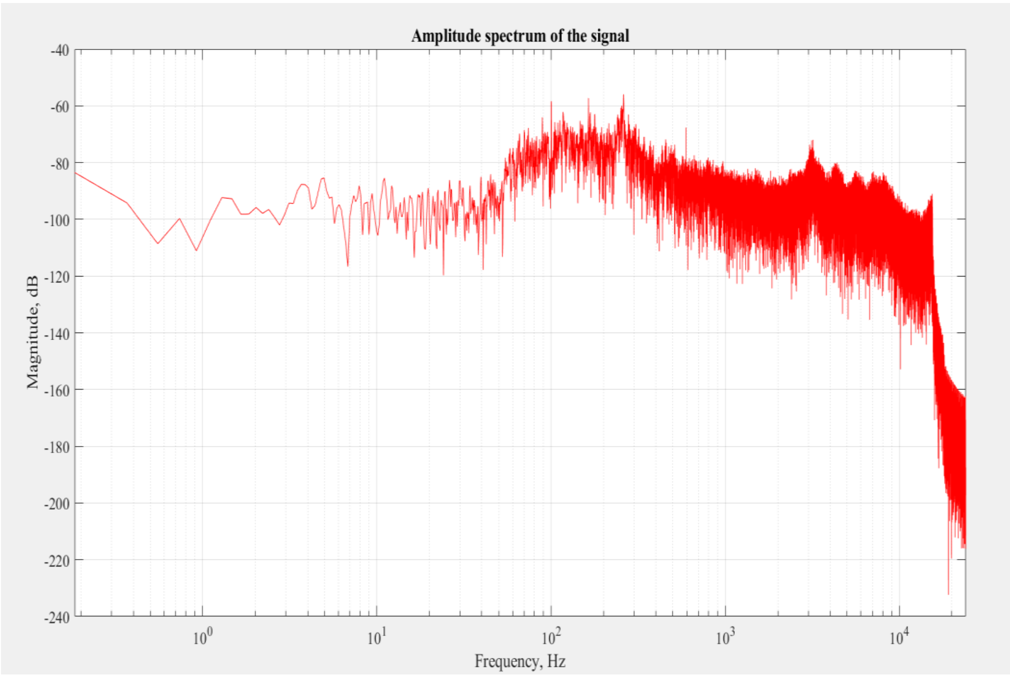


Fig 4.6 Amplitude spectrum of the signal

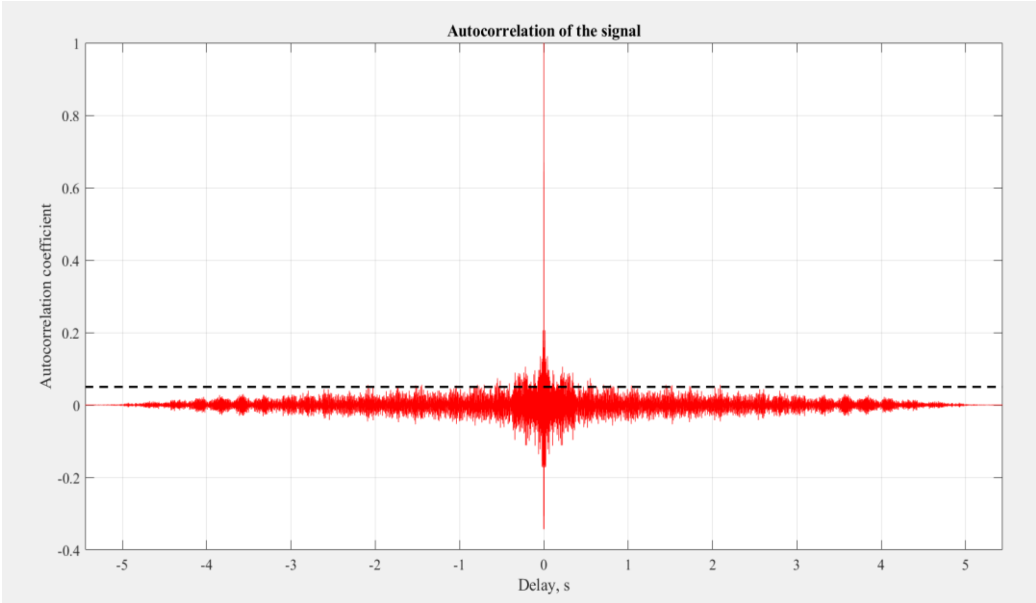
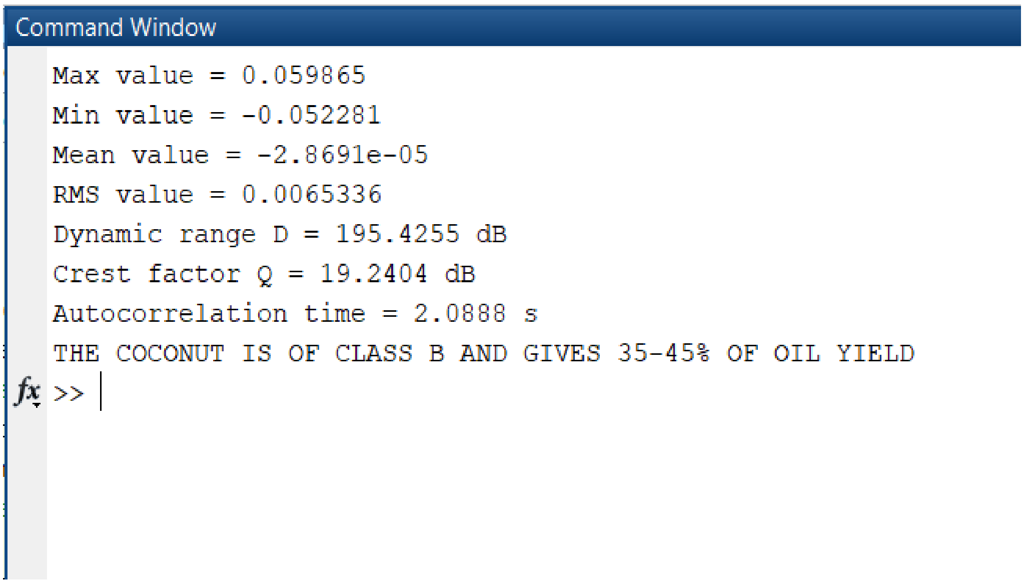


Fig 4.7 Autocorrelation response of the signal



```
Command Window
Max value = 0.059865
Min value = -0.052281
Mean value = -2.8691e-05
RMS value = 0.0065336
Dynamic range D = 195.4255 dB
Crest factor Q = 19.2404 dB
Autocorrelation time = 2.0888 s
THE COCONUT IS OF CLASS B AND GIVES 35-45% OF OIL YIELD
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Fig 4.8 Estimated yield output of class B coconut

Here the dynamic range and crest factor of Class B coconut is obtained from the Fig 4.5 and the Fig 4.6. The autocorrelation is calculated from the Fig 4.8.

4.3 OUTPUT OF CLASS C COCONUT

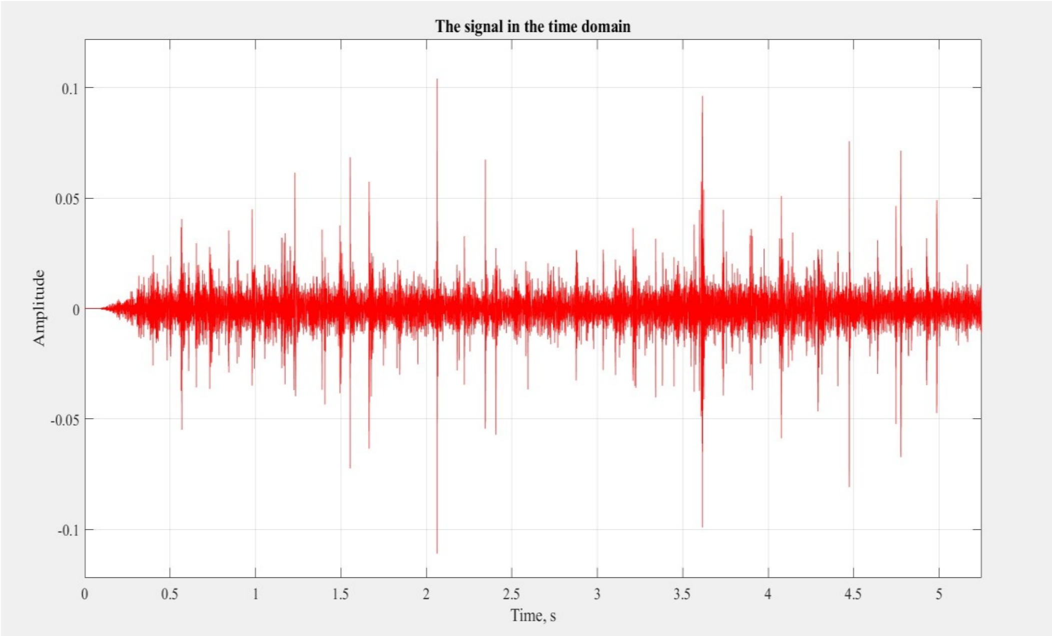

Fig 4.9 Response of the signal in time domain

As mentioned in the table 3.1 Class C coconut has high amount of water, its time domain response is obtained as shown in the Fig 4.9.

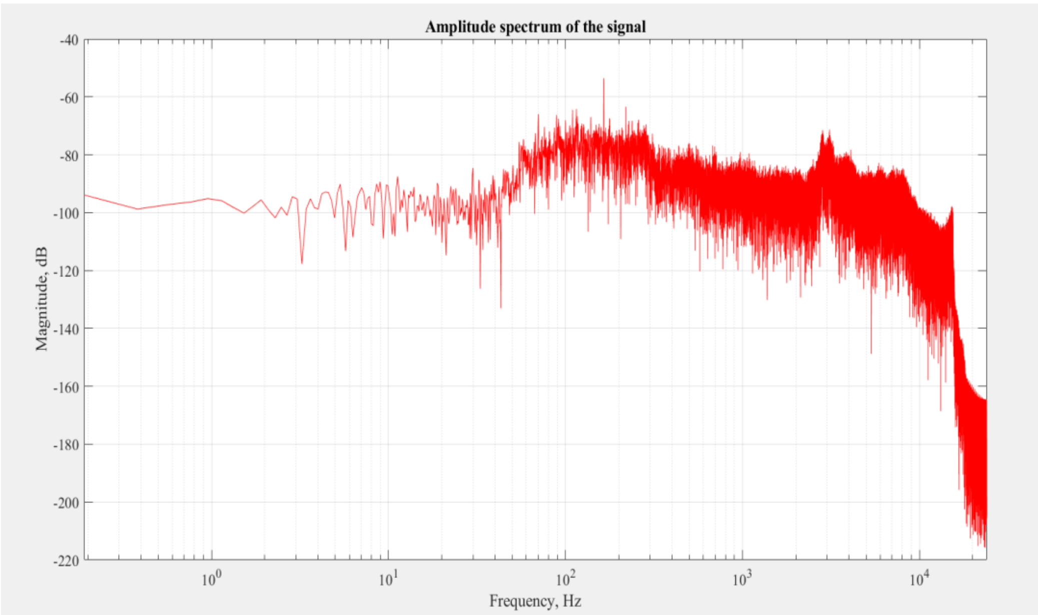

Fig 4.10 Amplitude spectrum of the signal

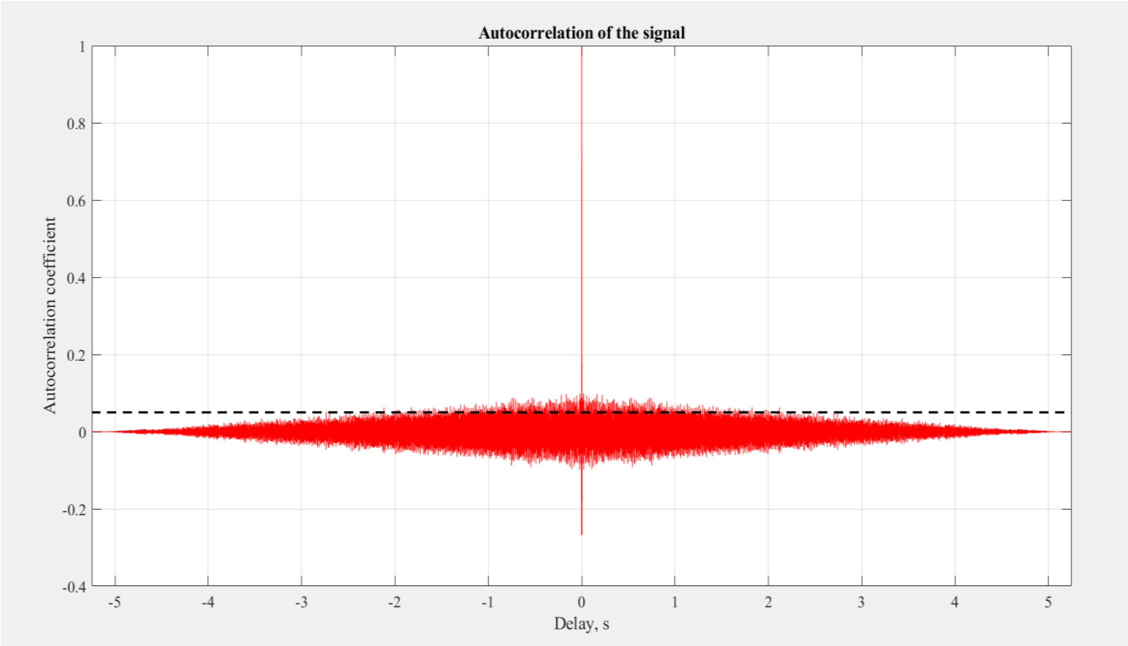

Fig 4.11 Autocorrelation response of the signal

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Command Window
Max value = 0.10415
Min value = -0.11095
Mean value = -1.2032e-05
RMS value = 0.0058761
Dynamic range D = 184.0402 dB
Crest factor Q = 24.9715 dB
Autocorrelation time = 2.7387 s
THE COCONUT IS OF CLASS C AND GIVES 50-80% OF OIL YIELD
fx >>
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Fig 4.12 Estimated yield output of class C coconut

Here the dynamic range and crest factor of Class C coconut is obtained from the Fig 4.9 and the Fig 4.10. The autocorrelation is calculated from the Fig 4.12.

4.4 OUPUT OF CLASS D COCONUT

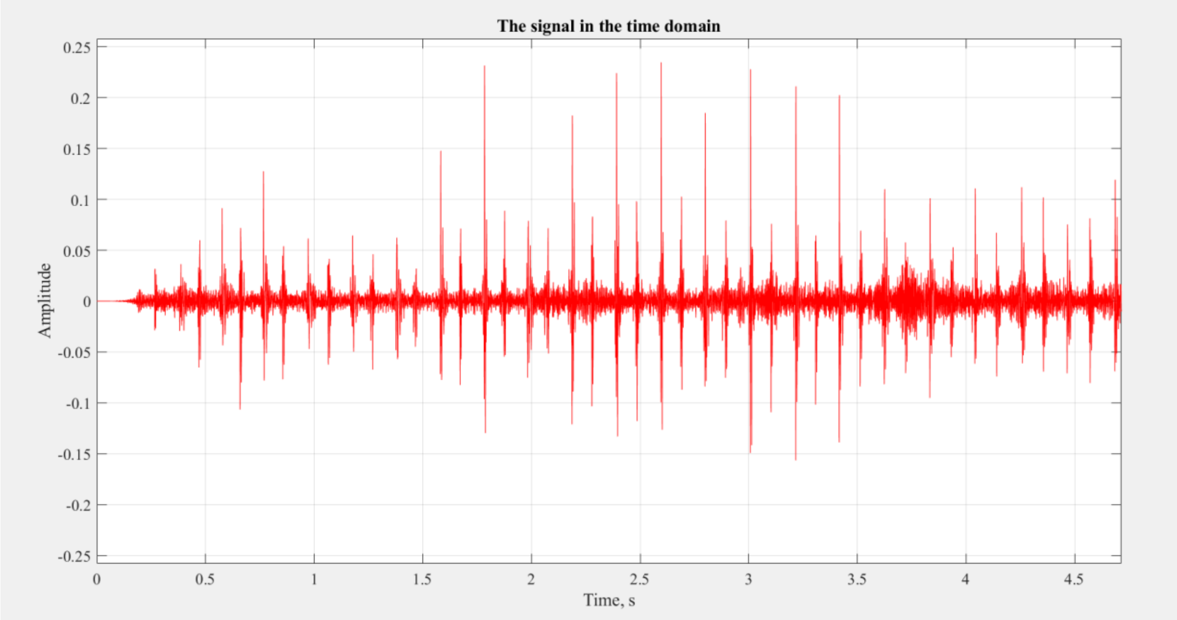

Fig 4.13 Response of the signal in time domain

As mentioned in the table 3.1 Class D coconut kernel is completely detached from the shell, its time domain response is obtained as shown in the Fig 4.1.

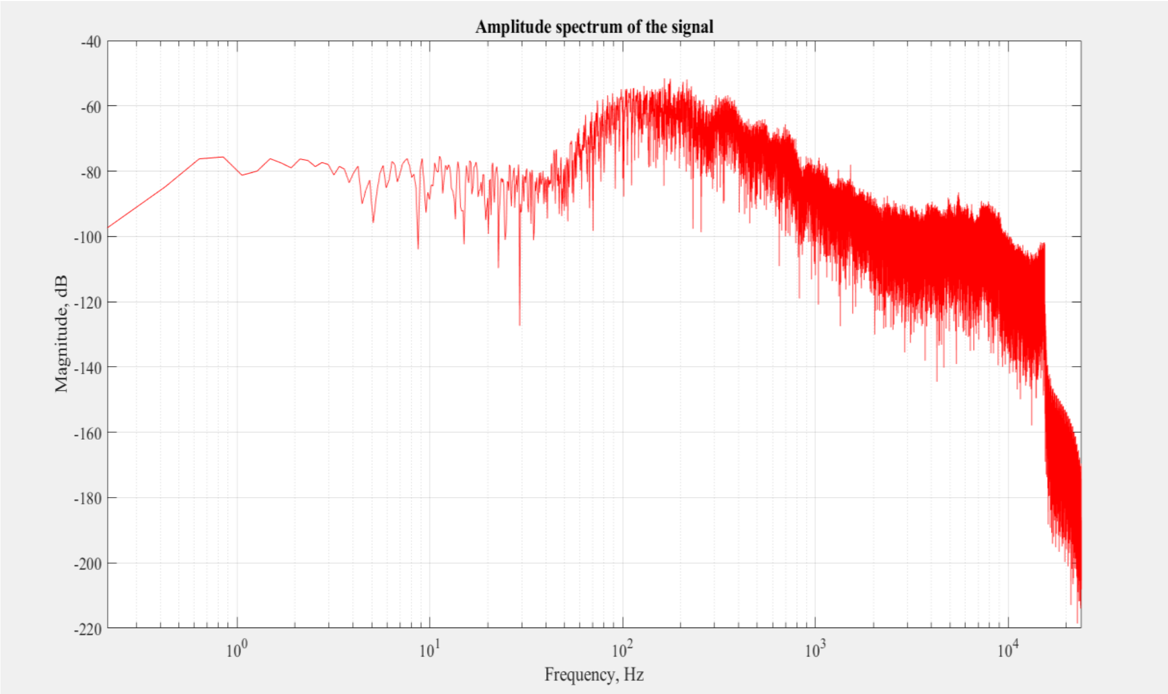

Fig 4.14 Amplitude spectrum of the signal

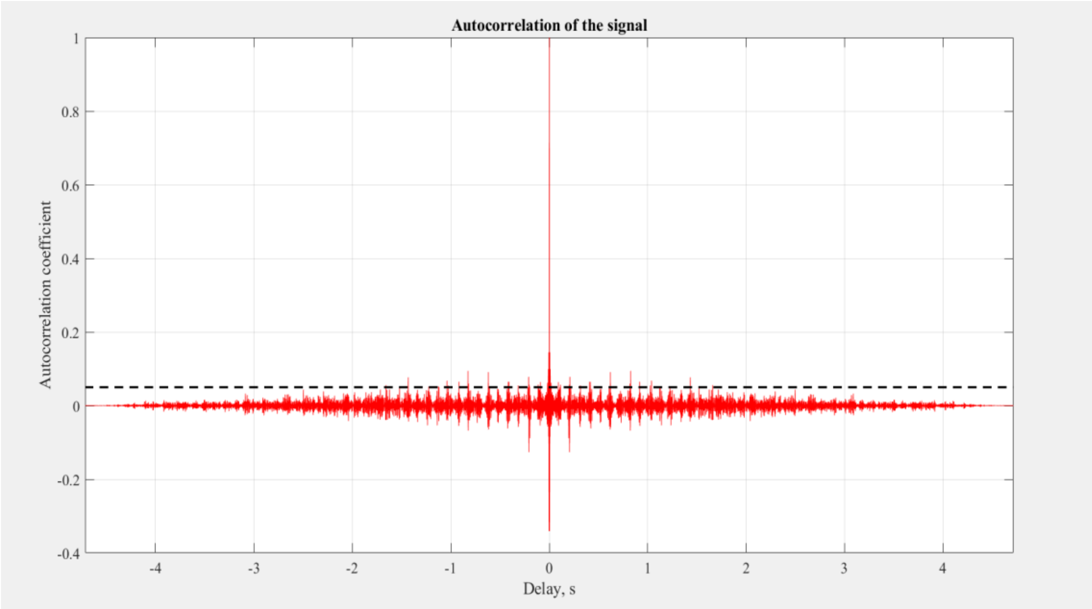

Fig 4.15 Autocorrelation response of the signal

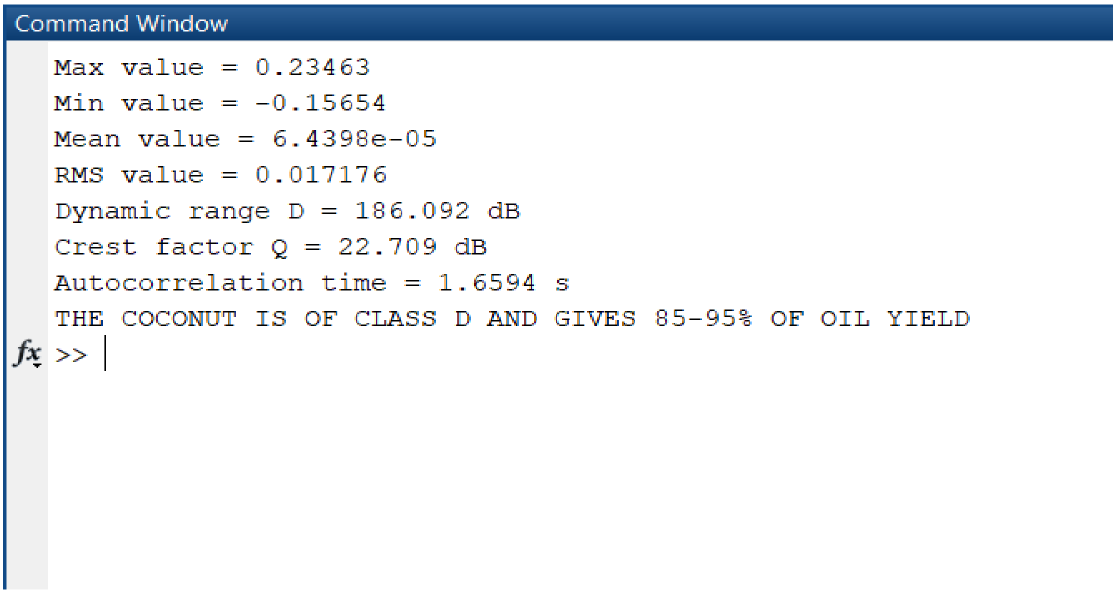

Fig 4.16 Estimated yield output of class D coconut

Here the dynamic range and crest factor of Class D coconut is obtained from the Fig 4.13 and the Fig 4.14. The autocorrelation is calculated from the Fig 4.16.

4.5 CONCLUSION AND FUTURE SCOPE

In this project, the sound of the coconut water is recorded individually and fed as an input to the MATLAB coding which results in more time consumption. So, to overcome this problem in future a shaking set up that could grip and tightly hold the coconut should be developed. Once the coconut is tightly held and set to vibration the coconut water sound is recorded in the microphone and automatically it will be given as an input to the coding section which gives the estimation of the oil yield.

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