Medical Signal Processing Lab
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Prof. S. Hajipour
Lab 5

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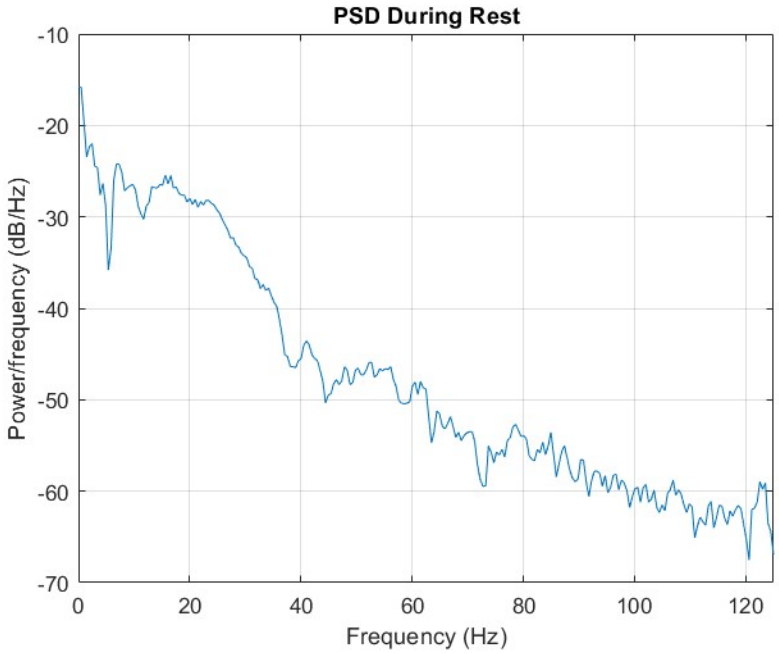
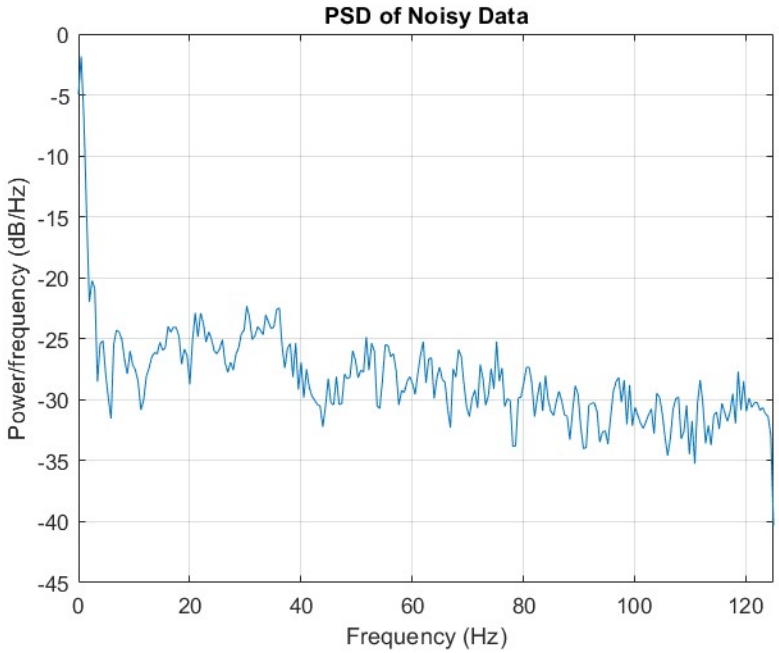
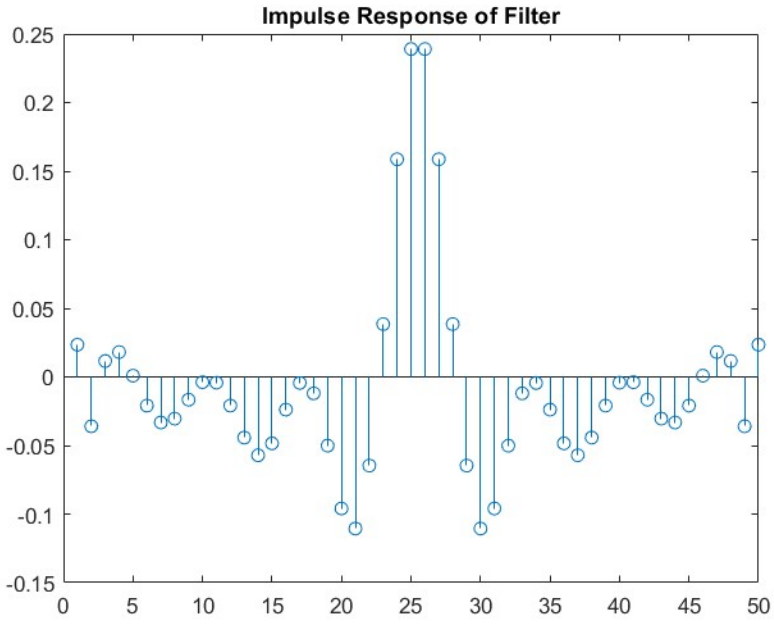
Part 1: Noise Reduction

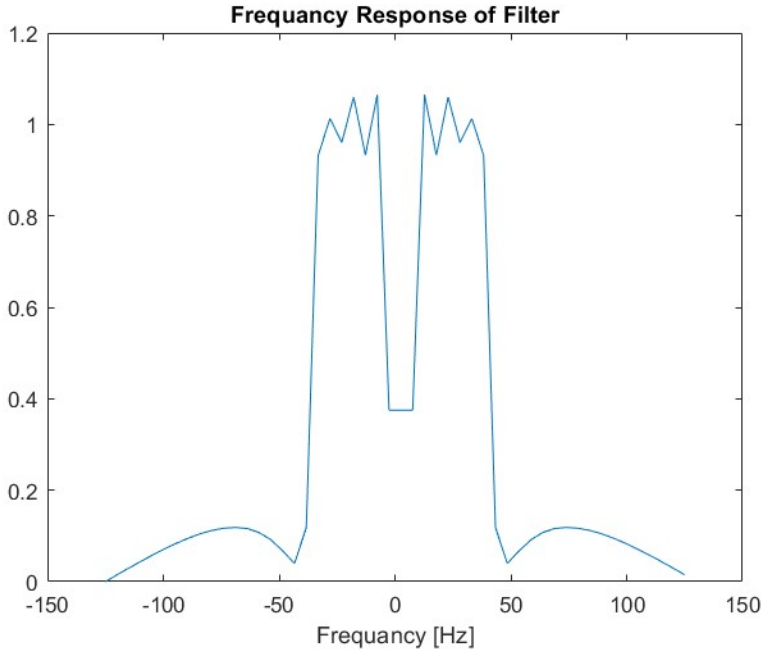
1-1)



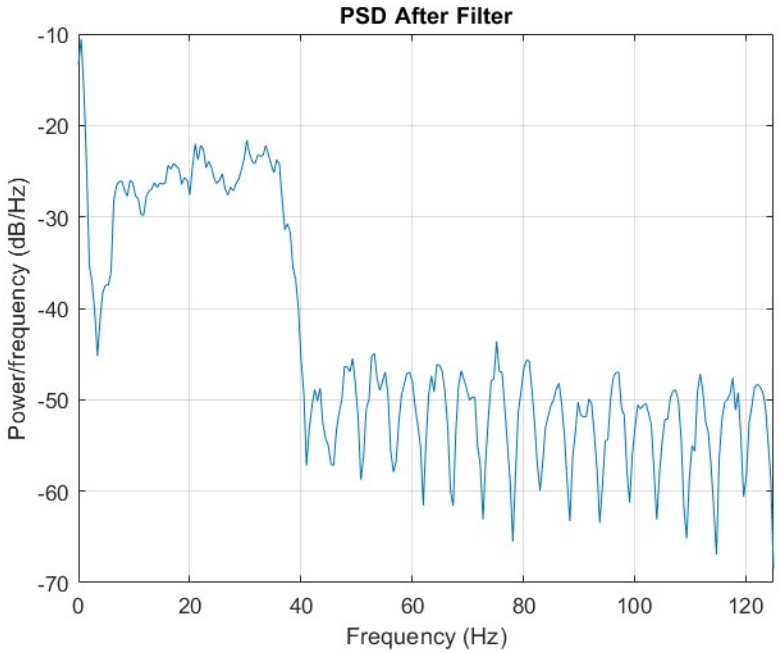


1-2)


Impulse Response of Filter
0.25
0.2
0.15
0.1
0.05
0
-0.05
-0.1
-0.15
0
5
10
15
20
25
30
35
40
45
50


Frequancy Response of Filter
1.2
1
0.8
0.6
0.4
0.2
0
-150
-100
-50
0
50
100
150
Frequancy [Hz]

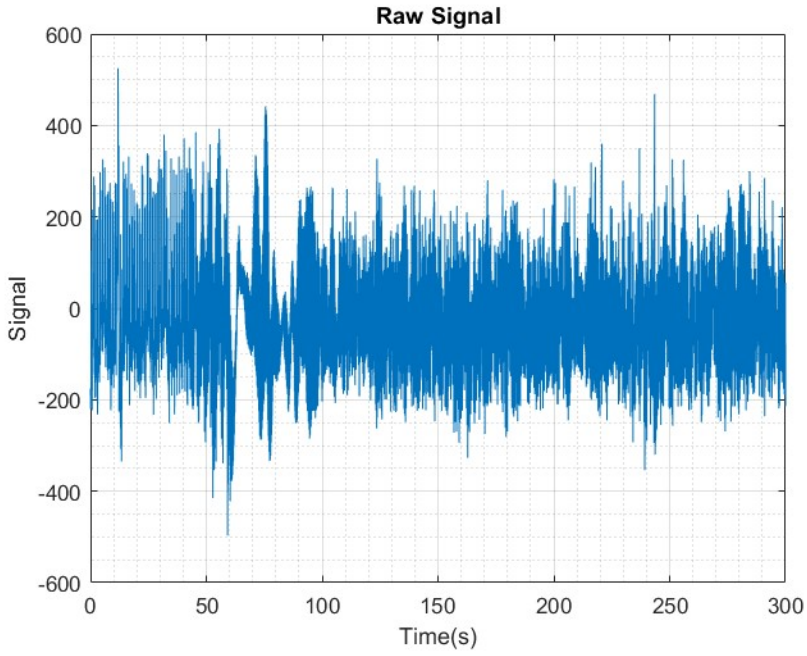
1-3)

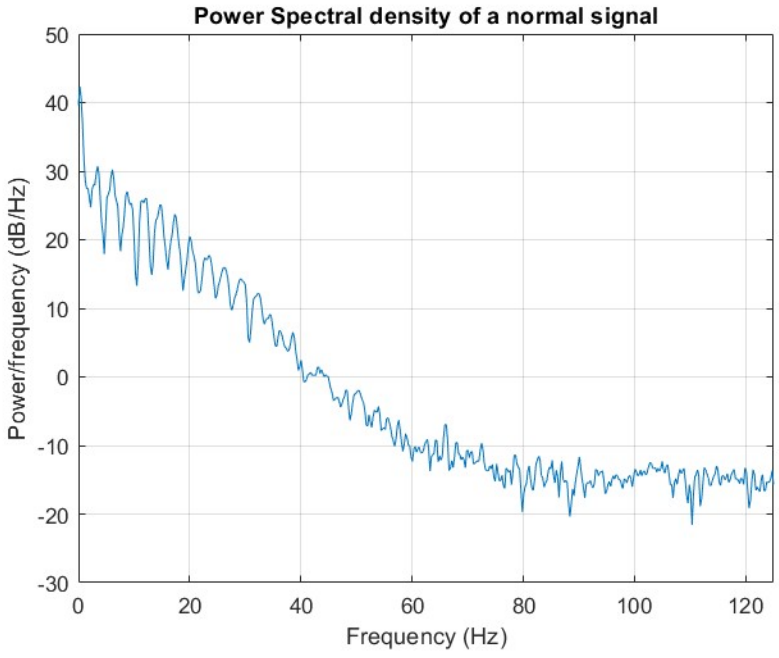


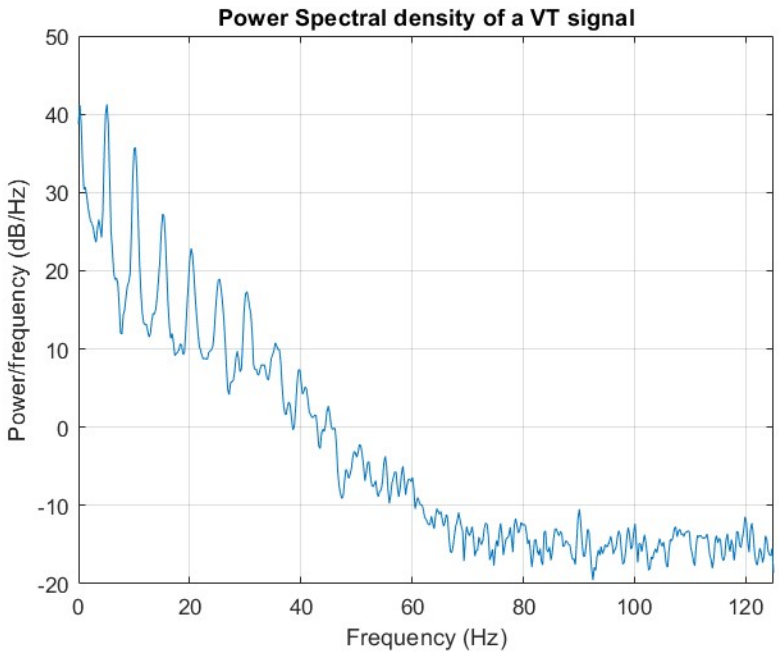
Our filter, substantially reduced the high frequency noise.

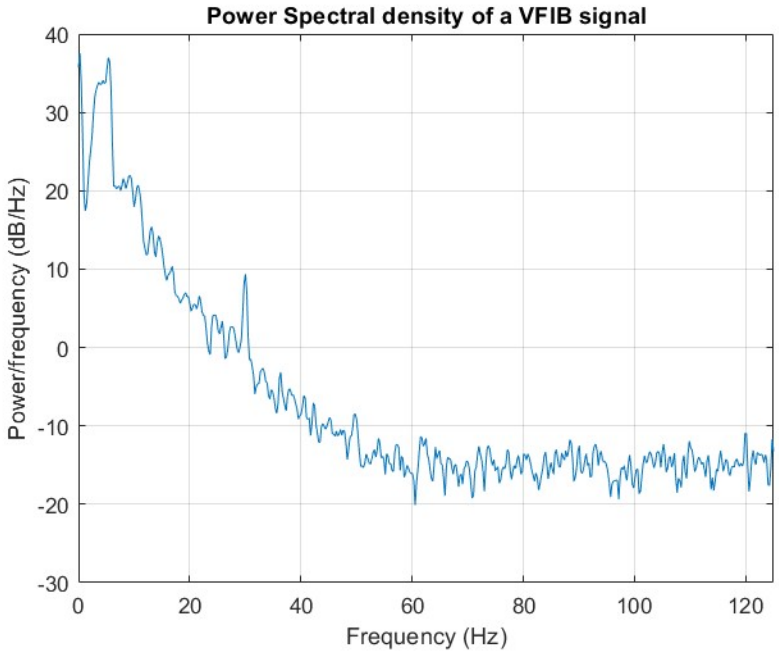
Part 2: Arrythmia detection

2-1)

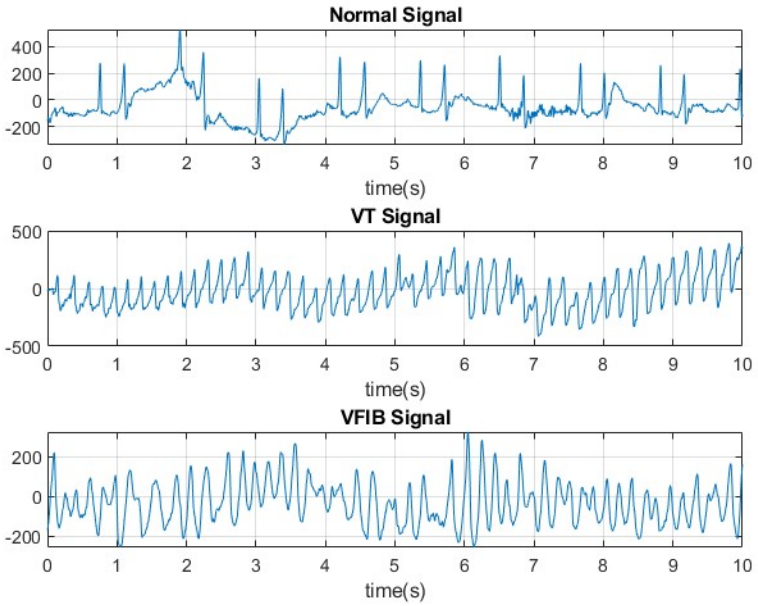





Power Spectral density of a VT signal
Power/frequency (dB/Hz)
Frequency (Hz)
50
40
30
20
10
0
-10
-20
0
20
40
60
80
100
120

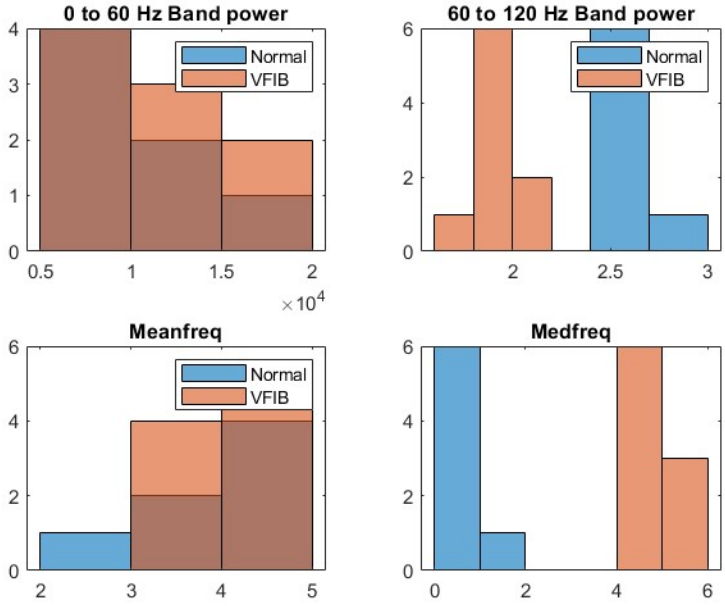

Power Spectral density of a VFIB signal
Power/frequency (dB/Hz)
Frequency (Hz)
40
30
20
10
0
-10
-20
-30
0
20
40
60
80
100
120

2-2)



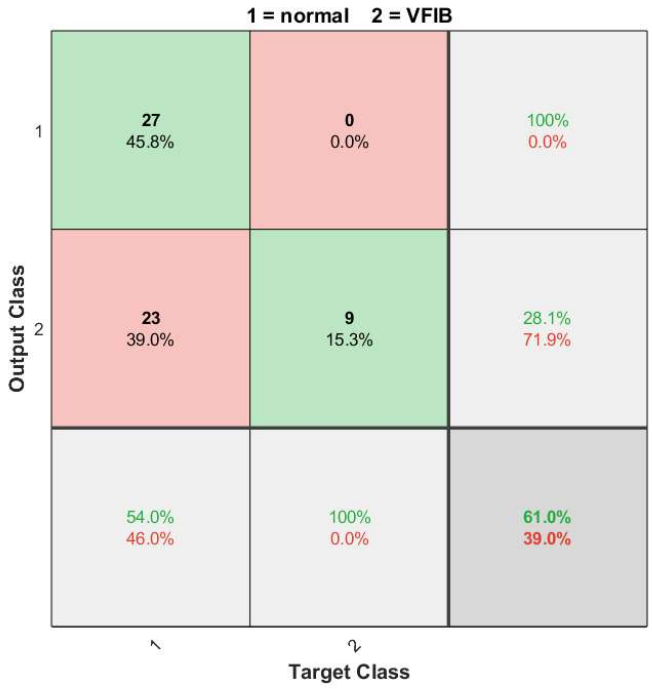
Judging from time domain and frequency domain analysis of signals, we can see that certain harmonics are present in arrythmia signals and that the peaks are sharper in normal signals. These features can be used for classification.

2-5)



We can use the median frequency and power in the 60 to 120 Hz band to classify VFIB signals from normal signals. The chosen threshold for median frequency is **4** and the threshold for band power is **2.4**.

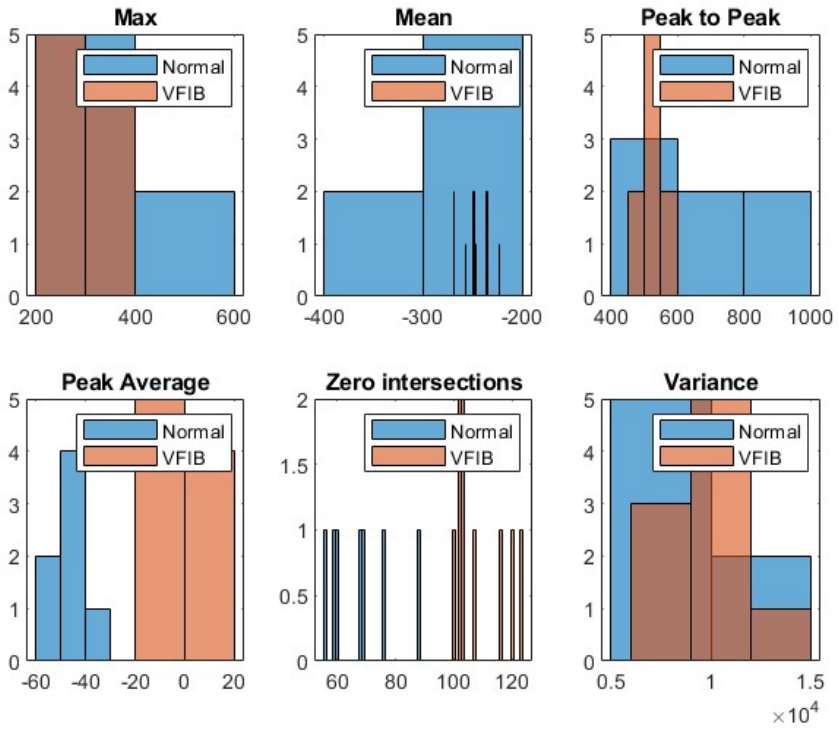
2-7)



Accuracy (%)	Sensitivity (%)	Specificity (%)
61	100	54

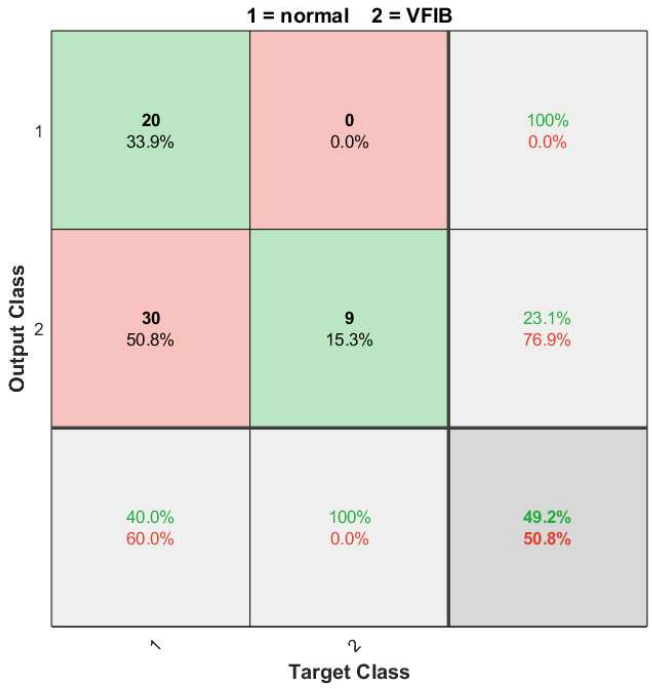
Our algorithm classifies most of other cases as VFIB which explains the low specificity.

2-9)



The number of intersections with zero and the peak average of a signal are suitable features for classification based on the above chart. The corresponding thresholds are 90 and -20.

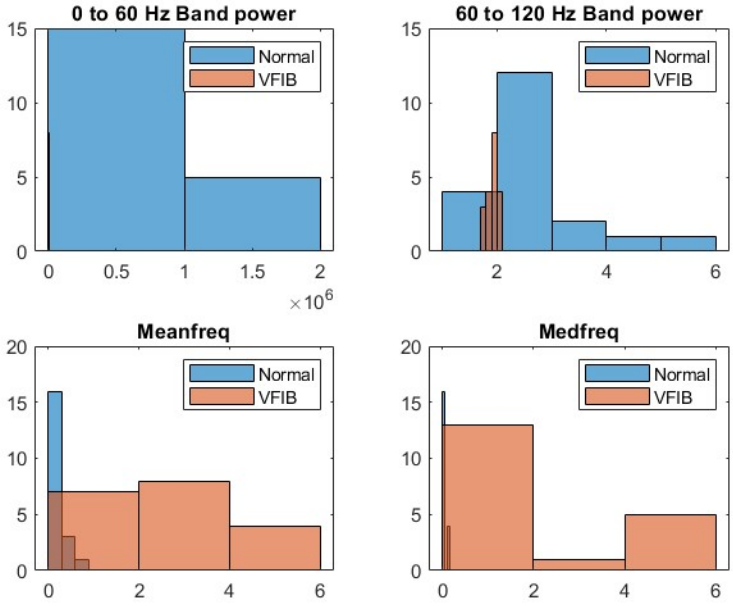
2-11)



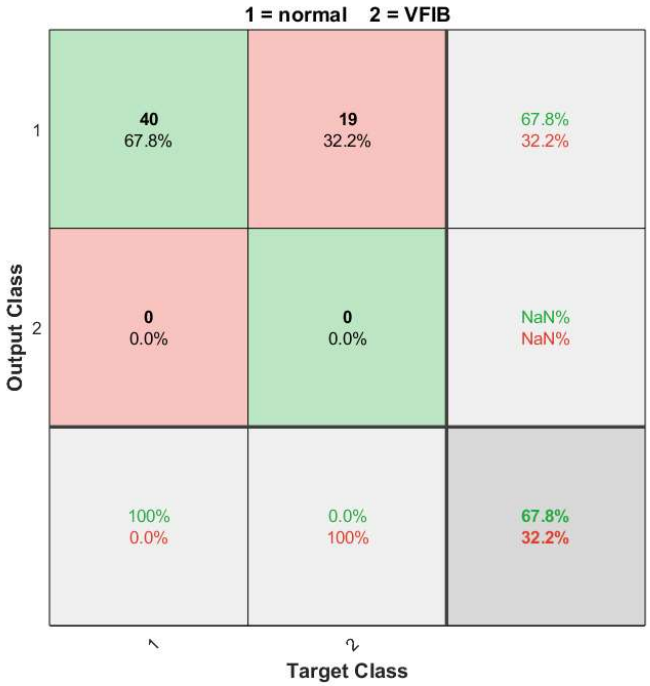
Accuracy (%)	Sensitivity (%)	Specificity (%)
49	100	40

Our algorithm classifies most of other cases as VFIB which explains the low specificity and Accuracy.

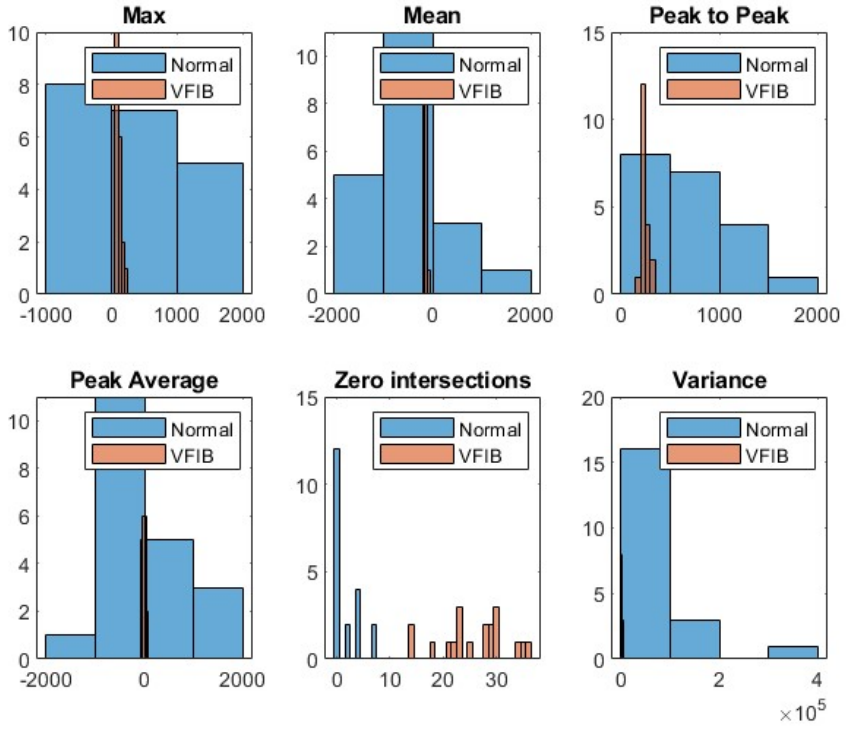
2-12)



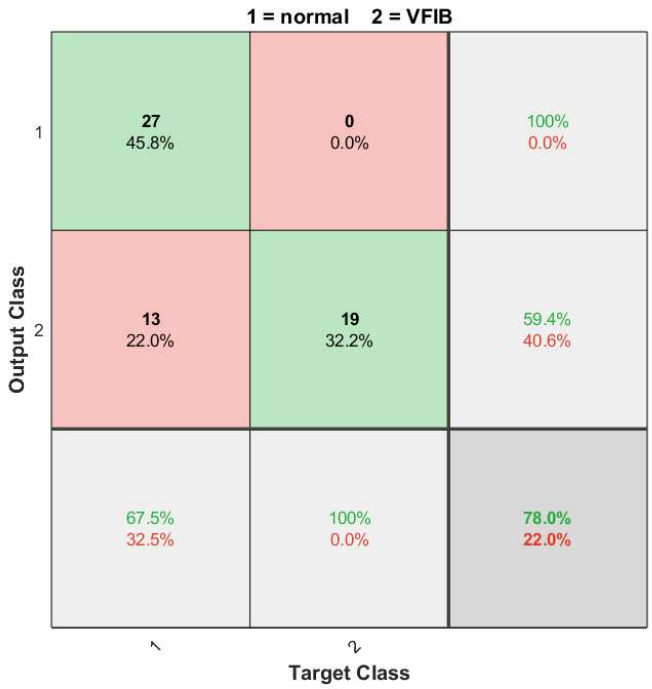
The mean frequency and median frequency are chosen as the classifying features for this sample.



Accuracy (%)	Sensitivity (%)	Specificity (%)
68	0	100



The number of zero intersections and variance are chosen as the classifying features for this signal.



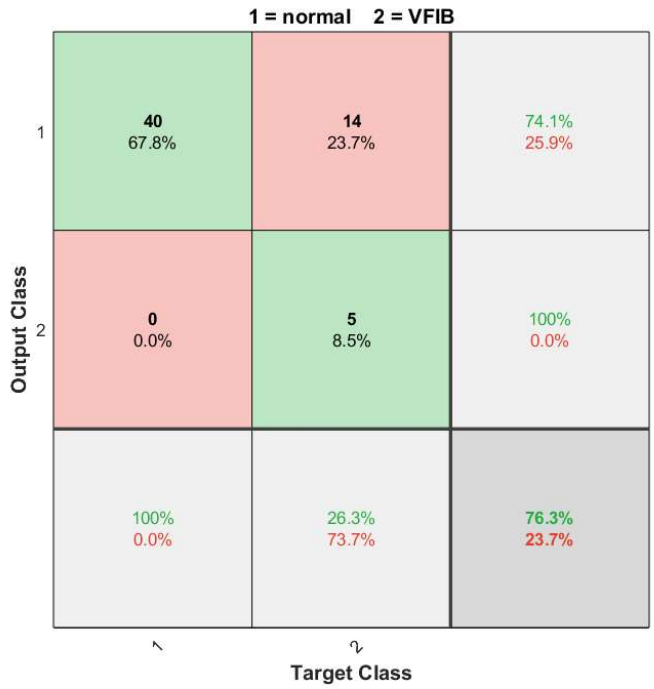
Accuracy (%)	Sensitivity (%)	Specificity (%)
78	100	68

2-13)

The best classifier on the second dataset outperforms the best classifier on the first dataset.

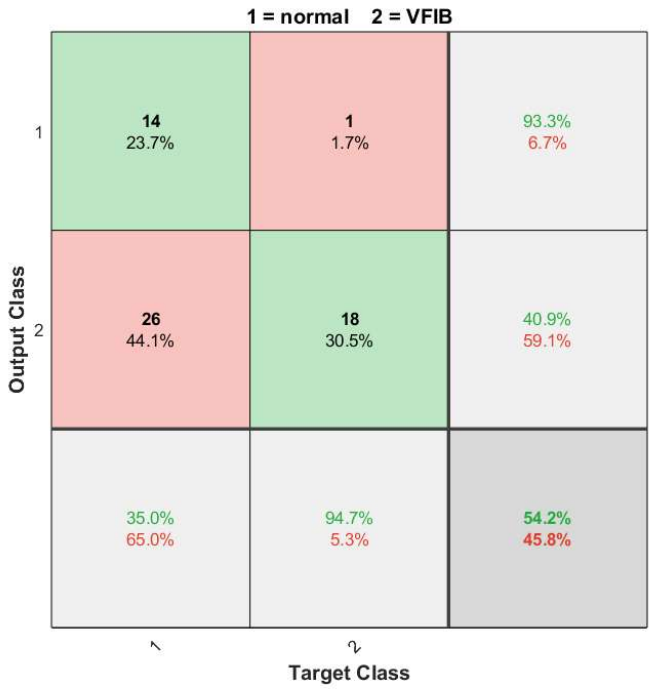
2-14)

Using the first classifier on the second dataset, we get the following results.



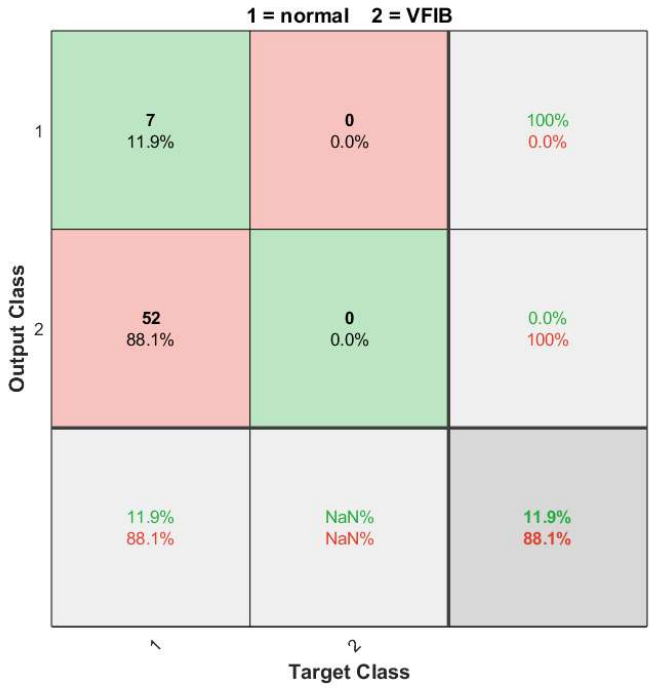
Accuracy (%)	Sensitivity (%)	Specificity (%)
76	26	100

Using the fourth classifier on the first dataset, we get the following results.



Accuracy (%)	Sensitivity (%)	Specificity (%)
54	95	35

2-15)



Accuracy (%)	Sensitivity (%)	Specificity (%)
12	NaN	12

Based on the above evaluation on the last dataset, we can see that our model produces false alarms in the presence of noise.