A Decision Tree Optimised SVM Model for Stress Detection using Biosignals: New Idea Implementation

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1 Idea Implementation Details

Replacing the 4-level Wavelet Decomposition for smoothening the signals, like in the original research paper, with a faster Short-Time Fourier Transform (STFT) filter for optimized time complexity and better accuracy.

1.1 Short-Time Fourier Transform (STFT)

STFT filtering provides sufficient smoothening and noise filtering while being time efficient. By applying STFT filtering to identify R-peaks, we eliminate the need for complex wavelet decompositions.

Time Complexity of Wavelet Decomposition is:

$$\mathcal{O}(N \cdot L)$$

where L is the number of decomposition levels, here 4.

Whereas, the total complexity of the STFT filter is:

$$O(N \log W)$$

Thus, the Short-Time Fourier Transform reduces the time complexity significantly, especially for large N and when L is significant. Since R-peaks are crucial for calculating QT, RR, and EDR intervals, employing STFT can significantly reduce the overall time complexity of the whole computational process.
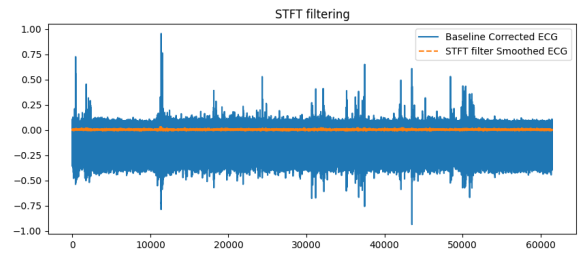
2 Results

2.1 Better Signal Smoothening

The plots after smoothening using both methods with respect to the baseline corrected signal are given below:
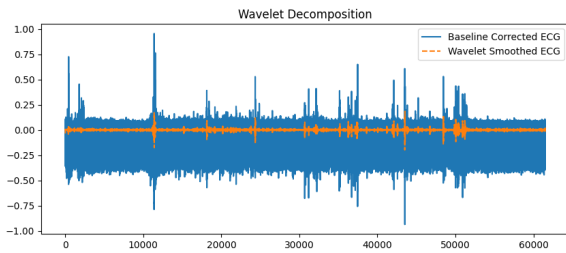
(a) Wavelet Decomposition

(b) STFT filtering

We can see that the STFT filter results in a smoother signal as compared to wavelet decomposition.

2.2 Optimized Execution Time

By performing smoothening by wavelet decomposition and STFT filtering, detecting R-peaks and forming features vector on the whole dataset, the execution time for both were the following:

| Method Used	Execution Time
Wavelet Decomposition	13.07 sec
STFT filtering	2.39 sec

We can see that STFT filtering on the dataset takes significantly less time than wavelet decomposition, hereby optimizing the overall time complexity.

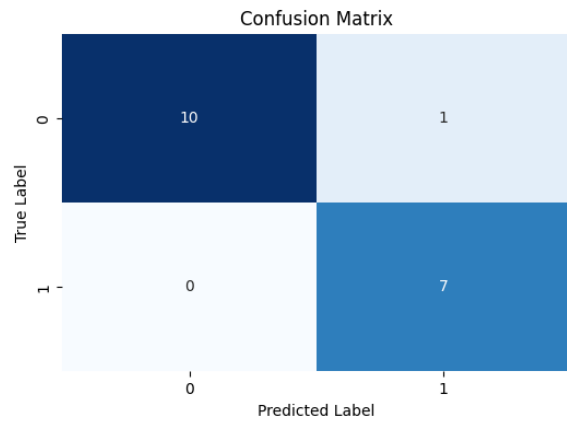## 2.3 Accuracy Comparision for Cubic SVM with Gaussian Model

The accuracies of the two methods are given below:

Method Used	Accuracy
Wavelet Decomposition	88.89%
STFT filtering	94.44%

The confusion matrices for the two methods are:
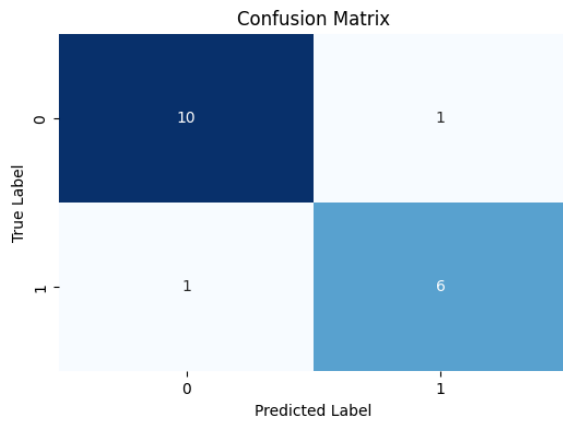
(c) Wavelet Decomposition
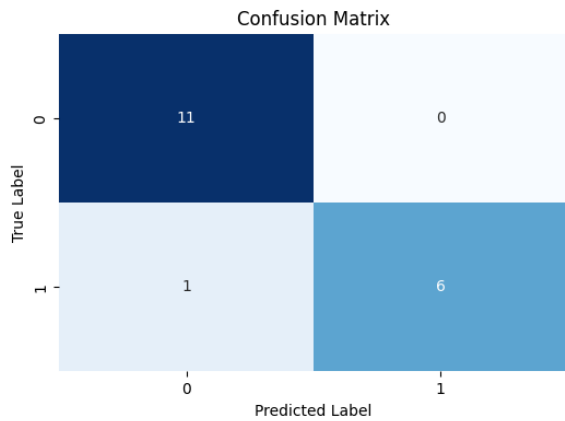

(d) STFT filtering

Therefore, the STFT filtering gives more accurate results for Cubic SVM with gaussian model.

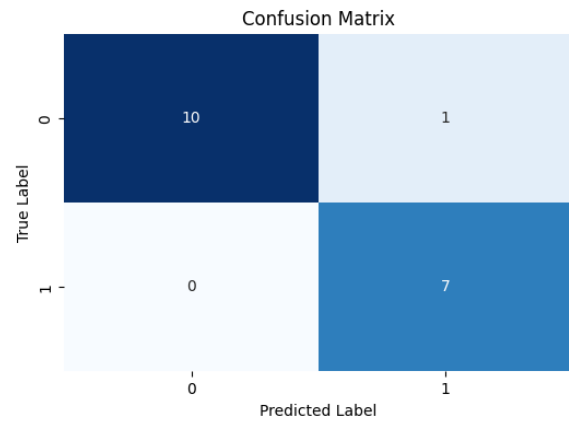## 2.4 Accuracy Comparision for Tree Optimized SVM Model

The accuracies of the two methods are given below:

Method Used	Accuracy
Wavelet Decomposition	94.44%
STFT filtering	94.44%

The confusion matrices for the two methods are:

(e) Wavelet Decomposition   (f) STFT filtering

Both wavelet decomposition and STFT filtering give equally accurate results, with Tree Optimized SVM model being more accurate than Cubic SVM with Gaussian model, as was the result in the original paper.

3   Conclusion

Therefore, the STFT filter results in better smoothening of baseline corrected signal, reduced execution time and better accuracy of models.