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Robust, Noise Immune Hidden Atrial Electrical Activity Signal Detection

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Abstract:* Cardiac arrhythmia diagnosis can be determined by using ECG analysis method. In determining the diseases of heart Features like the regularity and atrial activity must be considered. Heart function determining AEA-waves are hidden in other waves by using quick separation procedure separating of AEA-waves from ECG signals is difficult. By using "semiautomatic" method the AEA-waves can be detected by using linear combination of 12-lead ECG signals. For detection of hidden AEA-waves we are using Maximum energy ratio and a synthetic AEA signal variation which are processed by semiautomatic method. By advancing Semiautomatic method, by using the gradient ascent method the ratio-based cost function is created and maximized. The linear combiner method is the later variation when applied on a synthetic signal, combined with surface ECG leads.
Keywords: AEA Wave, Electrocardiogram, Motor Imagery, Schrodinger Wave Equation

I. INTRODUCTION

Signal processing is an authorized technology that encloses the fundamental theory, applications, algorithms, and implementations of processing of signals or transferring information contained in many different physical and symbolic forms.
Digital signal processing is used for improving the accuracy and reliability of digital communications. The analysing of DSP is very difficult.. Mainly DSP works on representation of levels or states of digital signal. The field of signal processing is a very important which makes the communications easier. For studying and processing of a voice signal speech recognition systems such as dictation software is required. The signals processed in the DSP are represented by samples of a continuous variable in a domain such as time, space, or frequency. In the signal processing there are two subfields such as analog signal processing and digital signal processing.

A. Applications

Digital signal processing has applications in different fields

1) Audio and video processing.
2) Audio signal processing.
3) Image processing.
4) Medical applications.

Heart diseases are often expressed as cardiac arrhythmia, presenting irregular electrical activity and mechanical activity of the heart will be abnormal. Arrhythmia symptoms include palpitations, dizziness, syncope, chest discomfort, stroke [3], and sometimes death. In order to successfully diagnose the arrhythmia type, the physician must carefully examine the 12-lead electrocardiogram signals, and evaluate its characteristics .The atrial electrical activity (AEA) waves (commonly referred to as P waves, or P^t or F wave during cardiac arrhythmias) constitute one of the main key features for diagnosis and the ratio between AEA waves number to QRS complexes number may indicate a certainty of arrhythmia. Detecting of AEA-waves is very important in some arrhythmias in which these AEA-waves are hidden in other ECG components. This difficulty might result in arrhythmia false diagnosis, e.g., atrial flutter can sometimes be misclassified as atrial or sinus tachycardia because the F wave is hidden in the T wave or looks like a P wave. In making the appropriate diagnosis of the arrhythmia tachycardia detection of AEA is more important, entitled wide QRS Tachycardia in which the differentiation between ventricular tachycardia(VT), abnormal supra ventricular tachycardia (Wolff-Parkinson-White syndrome), and supra ventricular tachycardia(SVT) with aberrancy is very important and has significant clinical and prognostic implications. As a result of inability to detect AEA-waves, in many cases, arrhythmia confirmative diagnosis takes place only during an invasive procedure (electrophysiology study—EPS). Past few decades vast research was conducted in the AEA detection field, but there is still a significantly insufficient ability in detecting hidden AEA-waves.

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II. LITERATURE SURVEY

In order to reduce QRS complexes and the T waves from the ECG signal adaptive filtering approach uses a reference impulse train Adaptive filtering method efficiently separates AEA is pin normal sinus rhythm but poor separation of AEA-waves from the QRS complexes. Each lead's slopes from the 12-leads are calculated; the detection of AEA is performed by assuming the P waves with relatively high slope after removal of QRS and T waves by using another method named Support vector machine. Validation of hidden AEA-wave is not thoroughly processed using Support vector machine. Low pass differentiation algorithm is used to detect AEA wave with derivative zero crossing point during appropriate search window related to QRS complexes, which presents phenomenal results in sinus rhythm and some pathologies. In the separation of atrioventricular, AEA detection is performed by QRS detection and tracking of the atrial rhythm by using clinical knowledge method .It performed better results in some ventricular arrhythmias and but did not on normal heart operation which deals with hidden AEA-waves. P and T wave can be detected by using Gibbs sampler and shows better results by removing those waves. In a wavelet transform and also filters the T wave brings out by recent method. In synchronization of heart beat and pulse, many algorithms were developed for the purpose of AEA detection. For the purpose of removing QRS & T waves mostly used method is the spatiotemporal QRST cancellation. In the blind source method, to create the ECG signal the AEA and the ventricular electrical activity are linearly mixed. The differentiation of the sources is carried out by using principal component analysis (PCA) or independent component analysis (ICA); these methods depend on the un correlated ness (in PCA) and independence (in ICA) of the AEA and the ventricular activity. we put forward, that from a linear combination of 12- lead ECG signals the atrial electrical activity can be recognize based on the ICA and PCA method, but there is no necessity having additional requirements between the AEA and ventricular activity. By detecting hidden AEA-waves different number of heart diseases can be found. In our method we systematically go through two variations, we use eight ECG leads instead of 12 ECG signals.

III. PROPOSED METHODS

A "semiautomatic" method is introduced with two variations. In both of them, the ECG signal is composed of two elements (sources)—ventricular and atrial, and we try to exploit mathematical methods for separation of the two sources, followed by detection of the AEA-waves exact time locations. To represent the AEA the general idea is to find a linear combination from the standard 12-lead ECG signals. The algorithm finds c weight coefficients, One weight coefficient for each ECG lead signal (channel). we chose c = 8 leads (I, II, $V1$,$V2$,$V3$,$V4$,$V5$,and$V6$). The linear combination using these weights should produce an output signal with emphasized AEA, as in

$$\mathbf{A}[k]=\mathbf{w}^T\mathbf{l}[k]$$

The variations in 'semiautomatic' method contain a preprocessing stage .In order to avoid common ECG noises like network noise ,baseline wander, etc. We use an eight-order band-pass Butterworth forward/backward filter with cut-off frequencies of 0.5and49.5Hz.

A. *Separation using Maximum Energy Ratio (SUMER)*

In this method ,the ECG signal is initially divided into two parts: a manually described segment that contains a single AEA-wave, and the undescribed surrounding segments .The main concept is forcing the linear combination of *c* ECG signals to converge to a signal that has the maximum ratio between the energy in the marked segment and the energy in the non- marked segments; this resulting ECG signal is expected to have amplified AEA-waves and reduced QRS and T waves .The SUMER method consists of the following steps:

1) Manually segmenting one AEA-wave, which is in effect equivalent to dividing the signals to a marked segment and residual unmarked segments?

2) The mean of each segment is subtracted. For the linear combination the energy ratio cost function can be obtained between marked segment and residual signal segments with initial random weight coefficients.

3) The cost function to its maximum can be optimized by up- dating the weight coefficients using the gradient ascent method. By adding iteratively the gradient of the function to the coefficients from the last iteration until the algorithm converges to a fixed value can be performed.

B. *AEA Detection using Synthetic AEA Signal*

In this variation, we use a known method that alter the classic linear combiner ,for removal of noise and artifacts ,such as blinks and

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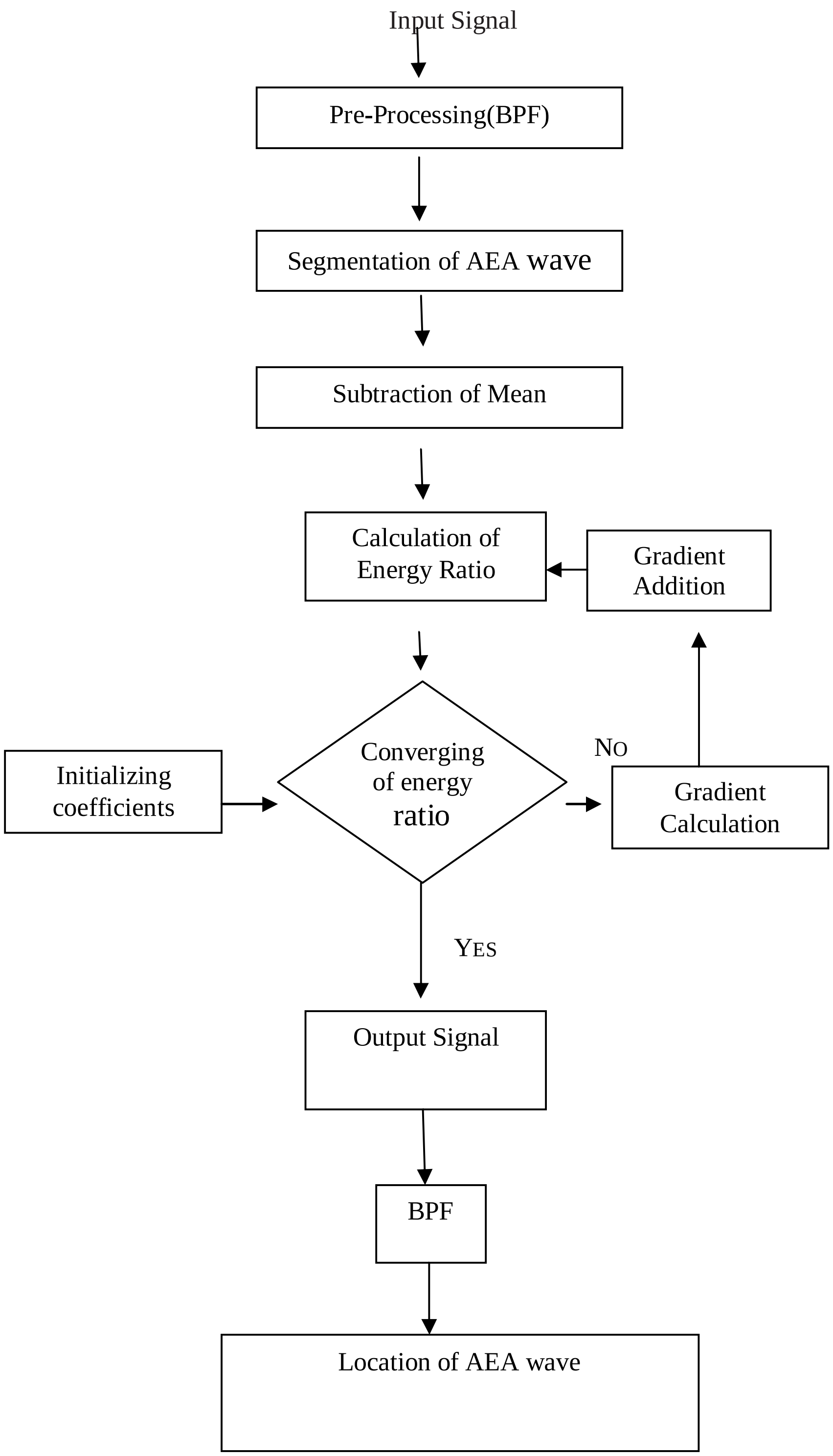
eye movements (EOG) artifacts cancellation from EEG recordings and ECG artifacts removal from EEG. This technique Adaptations and variations are widely used for many purposes, such as ventricular late potentials detection in ECG and event-related somatosensory evoked potential signals estimation. The main concept of the classic linear combiner for the noise removal task is subtracting an appropriate.



FLOW CHART FOR AEA DETECTION

IV. SIMULATION RESULTS

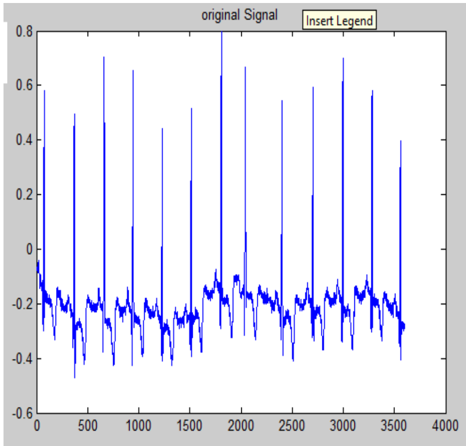


Fig 4.1 Original signal

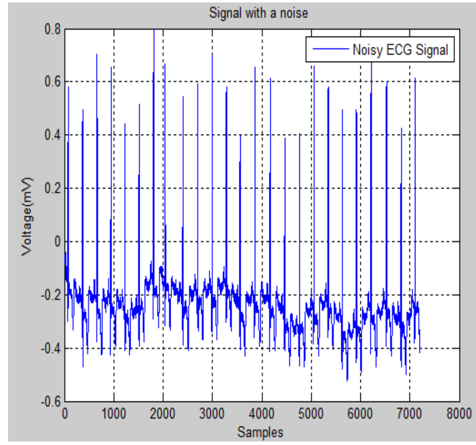


Fig 4.2 signal with noise

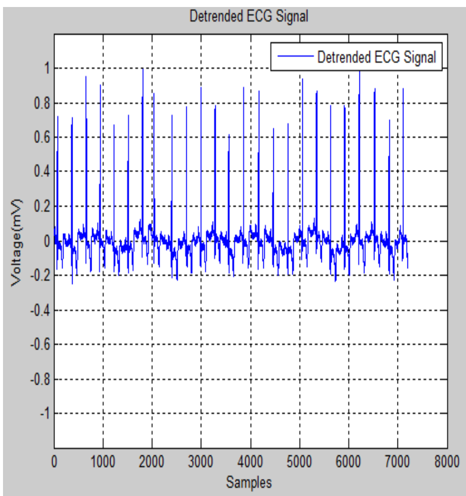


Fig 4.3 Detrended ECG Signal

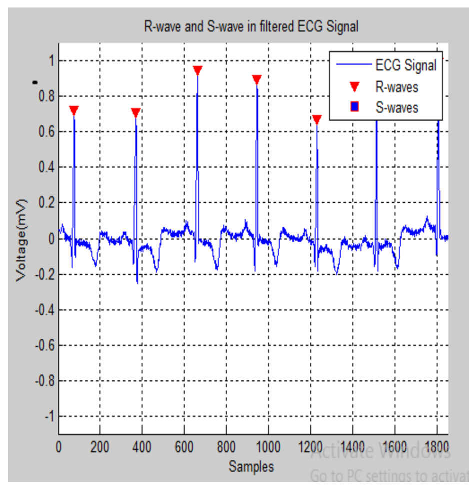


Fig 4.4 R-wave and S-wave in filtered ECG signal

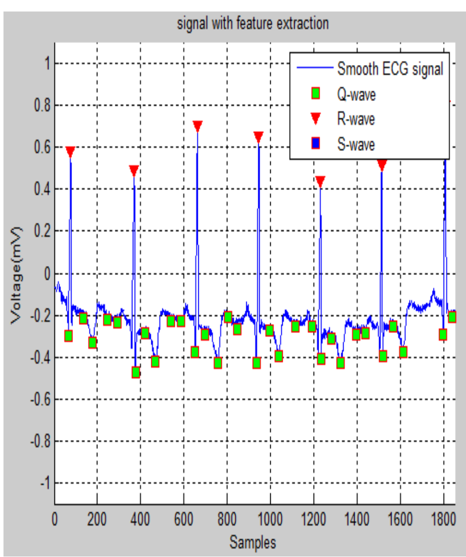


Fig 4.5 Signal With feature extraction

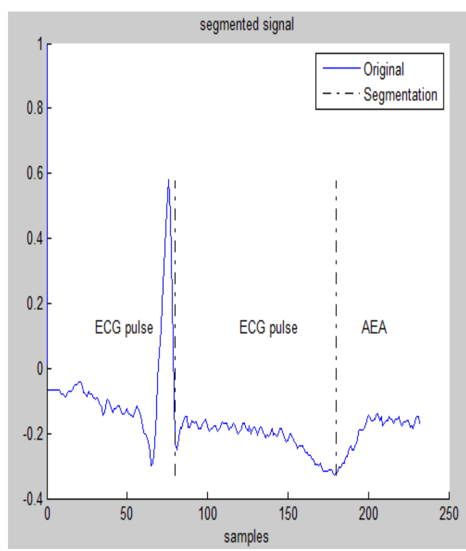


Fig 4.6 Segmented Signal

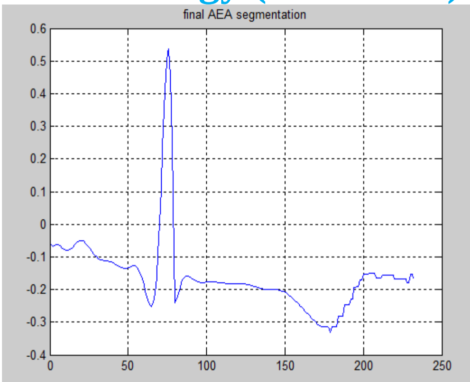


Fig 4.7 Final AEA Signal

V. CONCLUSION

By using present method the two types of AEA can be explained by the demonstrators which shows accurate results, that are finding out the hidden AEA waves are efficient rather than the existing methods .the AEA waves which are obtained by present method shows better results with less difficulties and running time. For the cardiologists ,in the variety of heart diseases detection of AEA plays major role the present method is the best one. By providing accurate report of the patient and giving treatment at starting stage by avoiding upcoming problems. This is the method which is fast and simple in the ECG apparatus used in the medical fields. The most important problem occurs in the present method is the separation of signal by electrically.

By using existing methods we can find out important and unhidden AEA wave. The possibility of finding AEA and the best results at initial without wrong report is somewhat risky**.** In the further advance days the ECG characteristics supports finding of AEA in diseases become automatized by sending T wave as first input to AEA wave.. By advancing the present method to finding out the AEA wave by detecting T wave. By using 12-lead ECG signals process the finding of diseases by automatically and also detecting AEA wave.

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