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Detection of Bundle Branch Block using Adaptive Bacterial Foraging Optimization and Neural Network

Padmavthi Kora [a,*], **Sri Rama Krishna Kalva** [b]

[a] *Dept of ECE, Gokraju Rangaraju Institute of Engineering and Technology, Hyderabad, India*
[b] *Dept. of ECE, V R Siddhartha Engineering College, Vijayawada, India*

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Abstract The medical practitioners analyze the electrical activity of the human heart so as to predict various ailments by studying the data collected from the Electrocardiogram (ECG). A Bundle Branch Block (BBB) is a type of heart disease which occurs when there is an obstruction along the pathway of an electrical impulse. This abnormality makes the heart beat irregular as there is an obstruction in the branches of heart, this results in pulses to travel slower than the usual. Our current study involved is to diagnose this heart problem using Adaptive Bacterial Foraging Optimization (ABFO) Algorithm. The Data collected from MIT/BIH arrhythmia BBB database applied to an ABFO Algorithm for obtaining best(important) feature from each ECG beat. These features later fed to Levenberg Marquardt Neural Network (LMNN) based classifier. The results show the proposed classification using ABFO is better than some recent algorithms reported in the literature.

1. Introduction

Globally heart diseases are the most prevalent cause for human mortality. Every year, 9.4 million deaths are attributed to high Blood Pressure (BP) including 51% deaths due to strokes and 45% deaths due to the coronary heart diseases. Most cardiac diseases are due to risk factors, such as unbalanced diet, high blood pressure, tobacco usage, obesity, diabetes and physical inactivity.

BBB developed when there was a block along the conduction path of electrical pulses in the heart. BBB makes it difficult for the heart to pump blood effectively through the heart circulatory system because the impulse deviates from the preferred path. This delay may be observed through the changes in the ECG. There are two types of BBB : Left Bundle Branch Block (LBBB) and Right Bundle Branch Block

* Corresponding author.

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(RBBB). ECG changes in Left Bundle Branch Block (LBBB) are

- Increased QRS complex duration (>0.12 s).
- Increased Q wave amplitude.
- Abnormal T wave.
- ECG changes in Right Bundle Branch Block (RBBB):
- Increased QRS complex duration (>0.12 s).
- RSR' format
- T wave inversion

as depicted in Figs. 1–3. ECG is the cost effective tool for analyzing the cardiac abnormalities. The diagnosis of the heart diseases by the physicians done by following a standard rule set (changes). In this project, our aim was to automate the above procedure so that it leads to correct diagnosis of the ailment of BBB. Good performance depends on the efficient and accurate detection of ECG features. Here in this paper ABFO technique used as the feature extraction (optimization) technique.

In recent years, many models are developed based on the evolutionary behaviors of living beings and have been applied for solving the practical real world issues. Among them, Bacterial Foraging Optimization (BFO) [27–29] may be a population based search optimization technique. Bacterial forage activity of *Escherichia coli (E. coli)* bacteria is used extensively as a model to solve many engineering applications. In Recent years, BFO has been applied with success to some engineering concepts such as, harmonic estimation [5], optimum management [7], reduction machine learning and transmission loss [6,25,26,34] and so on.

A scientific analysis of the simulated chemotaxis by the classical gradient descent search algorithm is explained in [9,10]. The analysis shows that varying the chemotaxis step-size can lead to better convergence as compared to a fixed step-size. The adaptation schemes, proposed for automatic adjustment of the step-size, are simple and do not impose any additional burden on the BFO algorithm regarding an excess number of functions. Several researchers have investigated the adaptation of step size in both deterministic and stochastic gradient descent optimization algorithms [11–16]

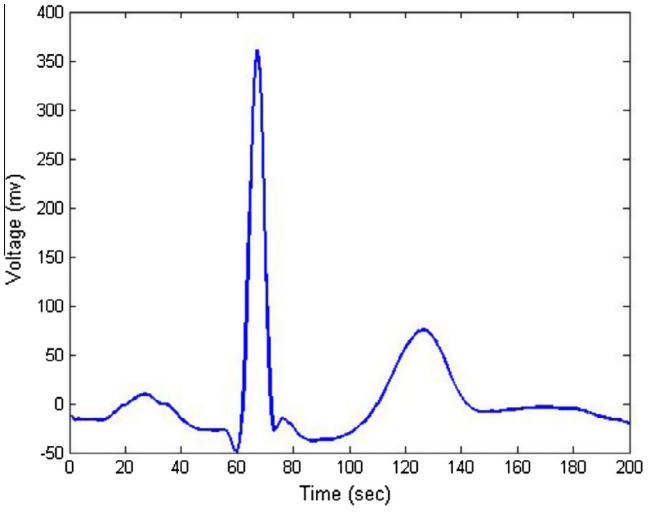

Figure 1 Normal beat.

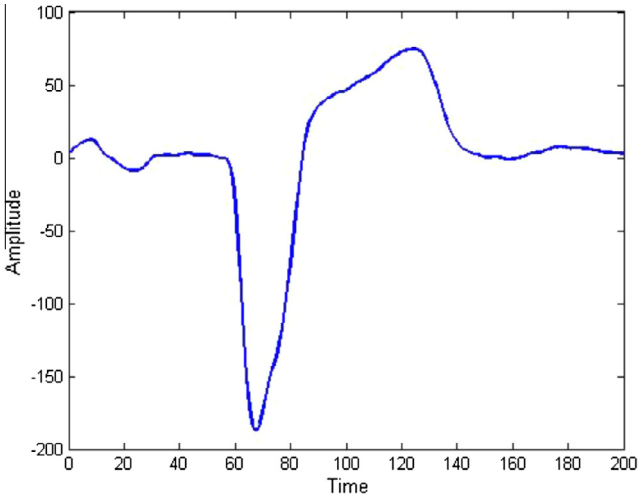

Figure 2 Left Bundle Branch Block.

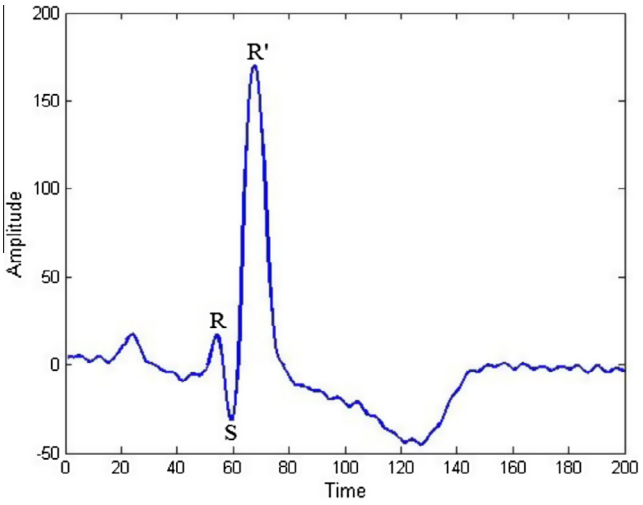

Figure 3 Right Bundle Branch Block.

in the context of training neural networks. Unlike the works cited in [11–16] adaptation schemes implemented in this paper for the chemotaxis step-size are not based on complex calculus techniques, such as Hessian matrix evaluation [17,18]. They are solely based on the fitness information of individual avoiding any oscillatory behavior around the optimum and accelerate the convergence of the bacterium toward an optimum.

The proposed ABFO compared with the Genetic Algorithm (GA) [20,21,4,19] which is a traditional algorithm for optimization of ECG features on the following performance measures such as convergence speed, and the accuracy in the final output. Bacterial foraging feature classification using neural network fuzzy learning implemented in [8].

The layout of the paper organized as follows. In Section 2, we outline the Preprocessing ECG such as Data collection, Noise removal and Segmentation of ECG into beats. In Section 3, we explained the Algorithm of classical BFO and modification to the BFO algorithm. Section 4 provides a classification of ABFO features. Section 5 contains results and Sections6 and 7 provide discussion and conclusions. The classification flow diagram shown in Fig. 4.

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