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A Method for Real-Time Correction of Data Defects in AF Based on Genetic Optimization

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Abstract: The electrical activity of the atrial fibrillation process is usually irregular and random. The P wave reflected by electrocardiogram is replaced by irregular and continuous low amplitude continuous baseline tremor wave (F wave), while the related data of ventricular activity is reflected in ECG, namely QRS wave group. To improve the accuracy of atrial fibrillation data analysis, better understand the law of atrial electrical activity, and analyze the physiological and pathological changes such as induced, sustained or spontaneous termination of atrial fibrillation. In this paper at the corresponding sampling position by interpolation down ventricular activity on real signals, to detect the QRS wave group of synchronous sampling, ECG and heart chamber ECG, QRS wave analysis to reduce interference, complete atrial fibrillation atrial activity depolarization, effectively determine the accurate identification of ventricular atrial electrogram signal. In addition, this research is a good basis for the identification of intracardiac electrogram in frequency domain.
Keywords: Atrial Fibrillation, Fuzzy domain, Data defect correction

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1. INTRODUCTION

With the rapid development of social economy, people's living standard is improving. The trend of population aging is accelerating. Atrial fibrillation is becoming a cardiovascular epidemic disease. It is of great scientific and theoretical significance for improving the clinical quality of atrial fibrillation disease and making treatment strategies to carry out the research on the acquisition and processing of computer heart signal.

Atrial fibrillation is the most common arrhythmia in a clinic, and the atrial activity coordination and injury condition of atrial mechanical function [1]. Intra atrial exciting conduction during atrial fibrillation in the direction of inconsistency, exciting frequency up to 300~600 times / min, the loss of atrial systolic function effectively. Although the protective effect of atrioventricular node can make the excited not all arrive at the ventricular rate (HR), but still as high as 100~160 / min, and the rhythm of absolute security order, so patients often have a fast heartbeat, consciously rule and irregular behavior such as pulse. Although atrial

fibrillation itself is not directly life-threatening, rapid ventricular rate in atrial fibrillation can cause haemodynamic deterioration and obvious symptoms, especially in patients. [2] The harm of atrial fibrillation to patients is mainly caused by other diseases, including heart failure, increased incidence of stroke, thromboembolism and malignant ventricular arrhythmias.

2. THE ANALYSIS OF REAL-TIME DATA

With the prevalence and prevalence of atrial fibrillation, and its severe complications, atrial fibrillation has become an important public health problem, which is also an important socio economic problem. The cost of medical treatment caused by atrial fibrillation. [3] According to statistics, in 2005 the British about direct medical patients of atrial fibrillation was 850 million euros, and by 2015 will rise to about 1 billion 800 million Euros, the British national health accounts for almost 1.2% of total expenditures. The United States each year for patients with atrial fibrillation treatment costs about $8 billion 650 million, including atrial fibrillation patients hospitalized for about 44% hospitalized patients with atrial fibrillation treatment, the fee is 29%, outpatient treatment fee of 23%, remaining only prescription drug costs. The cost of treatment for patients with atrial fibrillation in other developed countries is also a huge expenditure. Although there is no similar statistical survey in China, with the rapid increase of patients with atrial fibrillation, there is also a huge cost of medical expenses. Therefore, to carry out the research on the risk factors of atrial fibrillation, to early intervention and prevention of high-risk groups; at the same time, on the basis of atrial fibrillation in epidemiological studies, the information acquisition and processing of modern science and technology and computer technology to obtain effective AF patients, improve the quality of clinical diagnosis in patients with atrial fibrillation, and effective treatment strategies for patients with atrial fibrillation is a major topic in academic circles and the medical science and technology workers to be solved.

The P wave reflected by electrocardiogram is replaced by irregular and continuous low amplitude continuous baseline tremor wave (F wave), while the related data of ventricular activity is reflected in ECG, namely QRS wave group. To improve the accuracy of atrial fibrillation data analysis, better understand the law of atrial electrical activity, and analyze the physiological and pathological changes such as induced, sustained or spontaneous termination of atrial fibrillation. [4] In this paper at the corresponding sampling position by interpolation down ventricular activity on real signals, research, detection of QRS wave, QRS wave analysis to reduce interference, complete atrial fibrillation atrial activity depolarization, effectively determine the accurate identification of ventricular atrial electrogram signal.

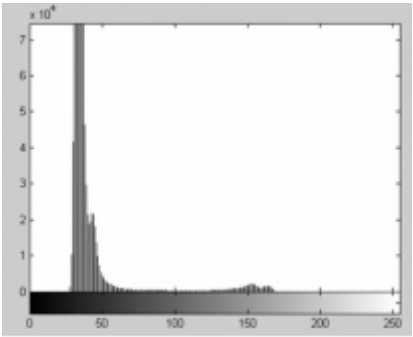

Fig.1. corresponding gray histogram

Our studies have shown that arrhythmia in patients with paroxysmal atrial fibrillation (PAF) is mainly caused by cells in muscle sleeves around one or more pulmonary veins. Although various types of catheter ablation has proven to be successful in the PAF were restored to sinus rhythm (with or without additional pharmacological intervention), some central of the success rate of 60-80%, a lot of persistent AF (pers AF) patients remained AF in pulmonary vein isolation or AF recurrence, require additional surgery. This shows that PV canella is involved in starting or maintaining the mechanism of AF.

Another way to explain the obvious chaotic electrical activity seen during AF is to use the frequency domain analysis. This involves the spectral analysis of atrial electrogram, in order to get the dominant frequency (DF) in different parts of the atrium, and based on the theory of AF maintained by the incident circuit, it leads to the pattern of frequency distribution in the atrium. A stable local high frequency source has previously been demonstrated in the sheep heart model and is believed to be responsible for AF maintenance. It is also found that the ablation of the DF site leads to a significant extension of the length of the AF cycle and compared with the ablation of the non major frequency sites. [5] These findings support the use of DF mapping to identify suitable ablation targets to improve outcomes, especially in patients with persistent AF.

3. ANALYSIS BASED ON FOURIER TRANSFORMATION

It is assumed that the DF loci and rotors with high frequency activity may play a fundamental role in maintaining atrial fibrillation. We are testing the behavior of high-frequency activity to verify whether it is cyclic or unstable over time, and develop several analytical methods to measure spatio-temporal behavior. In all methods, time stability DF is measured as cumulative percentage of DF in the same time range (within 0.25Hz or 0.5Hz) (measured in 2048 loci).

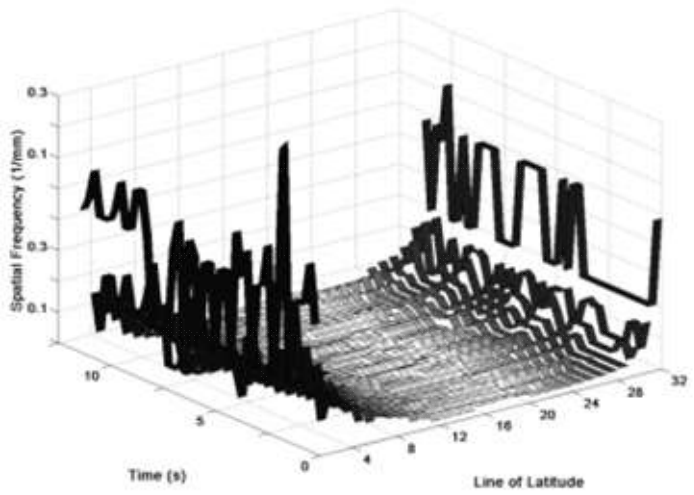

Fig.2. Maximum spatial Frequency about 21 seconds of data

Although the above method can be used to measure stability over time, but the selectivity is too large, any small movement DF position or value will lead to the point of being ignored as "unstable", once a point is considered "unstable" no longer see. At the same time, the resolution of the site is very high, and the strict assumption is that for the specified point, the time segment of all frames must have "constant" DF too hard to satisfy. An alternative "rotor method" is developed to allow identification of sites with cyclic behavior, called "rotors". In the 21 second long segment, we recognize the frame with the highest DF number in the related physiological range (5 to 8.5Hz), and map the DF map of the time and space of each point and the remaining frame of the frame and the corresponding points of its neighbors (the survey points around the 8 neighboring sites). This method is based on the rotor theory.

The log likelihood function with parameters is regarded as the objective function. According to the dynamic network fuzzy domain data samples, the corresponding constraint conditions of the parameters are obtained, and the data defect estimation model of the dynamic network fuzzy domain is constituted by the objective function and the constraint conditions.

That said, the dynamic network fuzzy domain data set contains a variable in the data set, the data set containing defect data, such as data representation, used to describe the observation value of the data set, said defect data set, the parameters of fuzzy domain data sets are estimated by genetic algorithm. The upper and lower bounds of variables are obtained from the data set of the dynamic network fuzzy domain, which are marked as. The logarithmic likelihood function of the mean and covariance matrix of the data variables in a dynamic network fuzzy domain is described as:

$$\mathrm{KL}(p(x),q(x)) = -\int p(x)\log\frac{q(x)}{p(x)}dx \geq -\log(\int q(x)dx) \tag{1}$$

It represents the corresponding covariance matrix of variables, which is used to describe vector of corresponding variables in fuzzy domain data and express the number of data records in dynamic network fuzzy field. The larger the logarithmic likelihood function is, the more accurate the estimation parameter is, and the original problem can be transformed to a corresponding single objective optimization problem that satisfies all the constraints.

$$H(x) = -\int f(x) \log f(x) dx \tag{2}$$

Among them, the lower and upper limit of the variables of the data of the dynamic network fuzzy domain are expressed respectively.

$$H(X) = -\int f(x_1, x_2, \ldots, x_N) \log f(x_1, x_2, \ldots, x_N) dX \tag{3}$$

It is assumed that the mutation probability is expressed, the mean value after the variation is expressed, and the parameters after the mutation are expressed. The evolution process is as follows:

$$\mathrm{KL}(p(x), q(x)) = \int p(x) \log \frac{p(x)}{q(x)} dx \tag{4}$$

It means that a random function with uniform distribution represents a random number, which represents the maximum iteration number of population variation. It represents the variation algebra of the current stage, and it is a parameter of non consistency degree.

In this paper, the iterative cut-off condition of population parameter estimation is the optimal parameter, and the corresponding adaptation function value interval is smaller than a given value, that is, the objective function value of optimal parameter after iteration cycle. When all the termination conditions are satisfied, the iteration is terminated and the optimal estimate is obtained.

4. CONCLUSION

With the advent of the network era, the demand for dynamic network data quality has also been gradually improved. The problem of data defect in fuzzy domain is common in dynamic network. Influenced by the dynamic network data processing operation, and now face the dynamic network with high real-time requirements need to speed up the iteration method of data correction of defects and more accurate estimation of defect data. In this paper, a method for real-time correction of data defects in AF based on genetic optimization is proposed. This method not only accelerates the estimation of the iterative speed of the data defect parameters of the fuzzy domain, but also improves the accuracy of the data defect correction.

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