شبكة المعلومات الجامعية

بسم الله الرحمن الرحيم

HOSSAM MAGHRABY

شبكة المعلومات الجامعية

شبكة المعلومات الجامعية

التوثيق الالكتروني والميكروفيلم

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جامعة عين شمس

التوثيق الإلكتروني والميكروفيلم

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شبكة المعلومات الجامعية

بالرسالة صفحات

لم ترد بالأصل

HOSSAM MAGHRABY

New Methods for Cardiac Arrhythmia Detection and Classification

By

Eng. Walid Ibrahim Ali Al-Atabany
Systems and Biomedical Engineering Department
Faculty of Engineering, Cairo University

A Thesis Submitted to the
Faculty of Engineering, Cairo University
In Partial Fulfillment of the Requirements for the
Degree of Master of Science
In
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chairman

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Abstract

Cardiac arrhythmias are alterations of cardiac rhythm that disrupt the normal synchronized contraction sequence of the heart and reduce the pumping efficiency. Causes include rate variations of the cardiac pacemaker, ectopic pacemaker sites, and abnormal propagation of pacing impulses through the specialized cardiac conduction system. Type and frequency of occurrence of arrhythmias provide an important indication of the electrical stability of the heart. In general, ventricular arrhythmias are the most serious and in fact can be life threatening in some cases. Therefore, the detection of such arrhythmias is essential to the life of the patient.

In this thesis, we consider four types of ventricular arrhythmias, which are premature ventricular complex (PVC), ventricular bigeminy (VB), ventricular tachycardia (VT) and ventricular fibrillation (VF). We proposed two new techniques to extract features from the ECG signal, which take into consideration the problem of characterizing the nonlinear dynamics (chaos theory) of the ECG signal and its variation with different arrhythmia types, where the source of the nonlinear behaviour of the ECG signal was first tested ((e.g. is it due to noise or come from chaotic system (Heart)?) using the *surrogate* test, which proved that, the underlying dynamics in the ECG signal come from chaotic system. In the first technique a new matrix, Phase space density matrix, was generated from the reconstructed state space of the ECG signal, and a number of features was extracted from it to form a feature vector to be used in the classification process. In the second technique a nonlinear dynamical signal analysis technique, recurrence quantification analysis (RQA), was applied to the ECG signal. It is an extension of a graphical method called recurrence plot analysis, and then the features of the QRA are used for further classification.

In this work we calculated the P-value for each feature to test the significance of each one to be used in the classification process, where the test show that, there are very significant differences between different types of arrhythmia when using the extracted features of both the techniques. Then three statistical classifiers are used in the classification: minimum distance classifier, Bayes minimum distance classifier, and k-

nearest neighbor classifier (k-NN), where results confirmed the robustness of the new techniques and demonstrate its value as diagnostic tools that can be implemented in modern cardiac monitors to assist physicians reach more accurate diagnostic rates.