信号处理 2010, 26(9) 1423-1427 DOI: ISSN: 1003-0530 CN: 11-2406/TN

论文

基于EMD和奇异值分解的心律失常分类方法

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摘要：

基于经验模态分解（Empirical Mode Decomposition，简称EMD）和奇异值分解（Singular Value Decomposition，简称SVD）理论，提出一种新的心律失常类型分类方法。首先，利用经验模态分解方法自适应地将心电信号（ECG）分解为一组固有模态函数（Intrinsic Mode Function，简称IMF）和一个残余分量，解决了目前广泛应用的小波分解方法中小波基选取困难以及分解结果不唯一的难题。利用这组固有模态函数构造初始特征向量矩阵，对初始特征向量矩阵进行奇异值分解，得到矩阵的奇异值。奇异值是矩阵的固有特征，具有较好的稳定性，根据奇异值计算奇异熵。最后依据奇异熵和马氏距离判别函数对心电信号的心律失常类型进行分类。实验结果表明，本方法能方便有效地对心律失常类型进行识别判断，可用于心电信号病理辅助诊断领域。

关键词： 心律失常 经验模态分解 奇异值分解 奇异熵 马氏距离

Arrhythmia Classification based on Empirical Mode Decomposition and Singular Value Decomposition

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Abstract:

Based on empirical mode decomposition (referred to as EMD) theory and singular value decomposition (referred to as SVD) theory, a new classification method of arrhythmia recognition is introduced in this paper. Firstly, by using empirical mode decomposition method, that is an adaptive decomposition method, an electrocardiogram (ECG) signal can be decomposed into a group of intrinsic mode function (referred to as IMF) and a residual component. At present, wavelet analysis method applied widely has two main problems, that wavelet basis function selection is difficult and decomposition result is not unique. Empirical mode decomposition method can resolve easily these two problems existing in wavelet analysis method. The initial feature vector matrix can be formed by these intrinsic mode functions that decomposed by empirical mode decomposition method. Then, the initial feature vector matrix is decomposed using singular value decomposition method, thereout, the singular values of the initial feature vector matrix can be calculated. As we know that, the singular values are intrinsic feature of initial feature vector matrix, and they have good stability. Make use of these singular values, the singular entropy of original feature vector matrix then can be calculated. Finally, in virtue of the singular entropy values and mahalanobis distance criterion function, compared with standard feature values of training samples, experimental data of ECG signals can be classified into different arrhythmia types. Experimental results show that, this new method can identify the type of arrhythmia easily and effectively, and can be used in the field of ECG pathological auxiliary diagnosis.

Keywords: Arrhythmia Empirical Mode Decomposition Singular Value Decomposition Singular Entropy Mahalanobis Distance

收稿日期 2009-11-16 修回日期 2010-03-20 网络版发布日期 2010-09-25

DOI:

基金项目:

哈尔滨理工大学校青年基金（2008XQJZ011)

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