

New Representation of Heart Rate and Evaluation of Geometric Features Extracted From It

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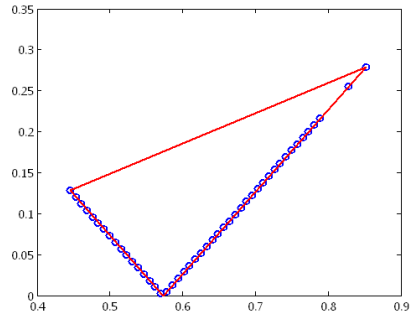
Heart rate is an indicator of heart's condition. Assessment of heart rate has been shown to aid clinical diagnosis and intervention strategies. It has been proved that nonlinear analysis of it might provide more valuable information for the physiological interpretation of heart rate fluctuations. However, the variety of contradictory reports in this field indicates that there is a need for a more rigorous investigation of methods as aids to clinical evaluation.

In this paper, a novel method for representation of heart rate has been introduced which is obtaining by using RR interval time series signal to plot the Triangle mapping consist of all the ordered pairs: $(RR_i, \text{abs}(\overline{RR} - RR_i))$, $i = 1, \dots, N$ where \overline{RR} is the mean of RR intervals.

We obtained a triangle from the distribution of these points and by analyzing it, we could extracted some geometric features which were evaluated in distinguishing four groups of subjects (Arrhythmia, Congestive Heart Failure (CHF), Atrial Fibrillation (AF) and Normal Sinus Rhythm (NSR)) obtained of Physionet database. Kruskal-Wallis test which is a nonparametric version of ANOVA analysis distribution was used to define the level of significance of each feature for different groups of subjects to demonstrate the usefulness of the proposed geometric features in biomedical applications. The results show that these features discriminate arrhythmia from NSR subjects by $p < 2E-4$; CHF from NSR by $p < 2E-3$; AF from NSR by $p < 7E-4$; CHF from arrhythmia by $p < 2E-2$; CHF from AF by $p < 6E-4$; and arrhythmia from AF by $p < 2E-3$.

Another advantage of this triangle mapping is that the points in this map overlapped with each other as a kind of compaction and so this map deletes the extra and useless information and just keeps the useful ones.

So it seems that this kind of mapping may be used as an efficient method for pathology detection.



Estimation a triangle for point's distribution in HRV phase space.