

QRS Morphological Analysis using a Two-Layered Self-Organizing Map for Heartbeat Classification

Mutsuo Kaneko*, Fumiaki Iseri, Takafumi Gotoh, Hidehiro Ohki, Naomichi Sueda and Tatsuya Yoneyama

R&D center, Fukuda Denshi Co, Ltd, Tokyo, Japan

Purpose: QRS complex classification in Holter electrocardiogram have been developed using the correlation coefficient methods. However, the accuracy of this traditional classification is not fully satisfied the clinical needs. In this paper, we propose an application of a two-layered self-organizing map (SOM) to classify QRS complexes to improve the accuracy. Methods: Our two-layered classification is performed in a slice SOM classification layer and a beat SOM one successively. First, each beats is divided in 10 sections. The characteristics of the section (slice wave) are calculated. An average level, height, amplitude of a peak, maximum slope and minimum slope are used for the characteristics. By learning these characteristics in the first SOM (slice SOM), the slice waves are classified in a qualitative attributes (flat line, up slope, down slope, mountain, valley etc). Second, QRS complexes are reconstructed as a line of the classified qualitative attributes and classified by the second SOM (beat SOM). We evaluated our method using MIT-BIH Arrhythmia Database of 17 cases 33,362 beats and compared with the accuracy of a standard cross correlation coefficient method. Five kinds of beat cords of normal, VPC, right bundle branch block, left bundle branch block and WPW are used for the comparison. We defined the error rate E_r by the following equation for a qualitative result comparison, $E_r = E_b/T_b$ where E_b is the number of the classification error beats and T_b is the total number of beats. Results: The classification error rate E_r in the case of the correlation coefficient method is 0.75% and proposed method is 0.41%. We confirmed that the accuracy in our method for the QRS complex analysis is significantly improved.