Implementation of the Genetic Algorithm and Particle Swarm to Optimize the Results of Neural Classifiers for ECG Beat Recognition

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Signal processing and data mining tools have been developed to enhance the computational capabilities so as to help clinicians in diagnosis and treatment. The presence of cardiac abnormalities is generally reflected in the shape of electrocardiogram (ECG) waveform and heart rate. The paper addresses a new QRS complex geometrical feature extraction technique as well as its application for optimal hybrid ECG rhythm type classification. Toward this objective, after detection and delineation of major events of the ECG signal via an appropriate algorithm, each QRS region and also its corresponding discrete wavelet transform (DWT) were supposed as virtual images and each of them was divided into eight polar sectors. Then, the curve length of each excerpted segment was calculated and was used as the element of the feature space. To propose a new classification strategy with adequate robustness against noise, artifacts and arrhythmic outliers, a fusion structure consisting of four Multi Layer Perceptron-Back Propagation (MLP-BP) neural networks with different topologies were designed and implemented. Afterwards, using particle swarm optimization (PSO) and genetic algorithm (GA), the obtained predicted labels of the constitutive neural networks were combined optimally to achieve higher operating characteristics. To show merits of the new hybrid algorithm, it was applied to 8 number of arrhythmias (Normal, LBBB, RBBB, PVC, APB, VE, PB, VF) belonging to 48 number of the MIT-BIH arrhythmia database and the average value of accuracy Acc=97.61% was achieved. To evaluate performance quality of the new proposed hybrid learning machine, the obtained results were compared with similar peer-reviewed studies in this area.