# Multi-Lead Discrete Wavelet-based ECG Arrhythmia Recognition via Sequential Particle Support Vector Machine Classifiers

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The aim of this study is to introduce a sequential heart arrhythmia classification method based on the analysis of multi-lead Discrete Wavelet Transform (DWT) derived metrics. To meet this end, after delineation of the QRS complexes, each complex and the corresponding chosen DWT scales are segmented. Next, for each resulted excerpted segment, second (variance), third (quasi-skewness), forth (quasi-kurtosis) order statistical moments and curve length (as a nonlinear moment) are calculated and used as elements of feature vector (therefore 20 measures for feature vector of each lead). The proposed features are afterwards used to tune the parameters of five sequentially operating particle Radial Basis Function (RBF)-based Support Vector Machine (SVM) classifiers implemented to multi lead records of MIT-BIH Arrhythmia Database (MITDB) for AP, NP, VE, NE, AAP, RC, VNF, PNF, NCPW, VF, PB, PVC, LBBB, RBBB and Normal categories. To increase the accuracy of the classification algorithm, the entire under study train database is divided into five groups Normal+LBBB+RBBB+APB+PB (Group#0), NP+VE+NE (Group#1), AAP+RC+PVC (Group#2), VNF+PNF (Group#3) and VF+NCPW (Group#4) and for each group a RBF-SVM classifier is tuned. In the proposed sequential particle classification algorithm, beats belonging to Group#0, Group#1, Group#2, Group#3 are recognized and isolated respectively from test database via classifier#0, classifier#1, classifier#2, classifier#3 and then arrhythmias of Group#4 are identified by the classifier#4. The proposed heart arrhythmia classification is applied to categorize the abovementioned arrhythmias and average values of Se = 99.34%, P+ = 99.60%, Sp = 99.63% and Acc = 98.64% are obtained.