Analysis of a Semiautomatic Algorithm for ECG Heartbeat Classification

M Llamedo, JP Martínez.
Aragon Inst of Eng Research, IIS Aragón, Univ of Zaragoza, Aragon, Spain

In this work, we present a semiautomatic algorithm for ECG heartbeat classification, based on a previously developed automatic classifier and a clustering algorithm. The objective is to develop and evaluate a semiautomatic algorithm based on previously developed automatic classifier, in order to increase its performance with minimum expert assistance. Both classifier and clustering algorithms include features from the RR interval series and morphology descriptors calculated from the wavelet transform. Integrating the decisions of both algorithms, the presented algorithm can work automatically or with several degrees of assistance, depending the user expertise. The algorithm was evaluated in the MIT-BIH Arrhythmia database for comparison purposes. In the automatic mode, the algorithm obtained performance figures slightly higher than the original automatic algorithm; but with 5 manually annotated heartbeats in 22 recordings, an improvement of 5% in accuracy (A), global sensitivity (S) and global positive predictive value (P^+) is achieved. For the full-assisted modes the algorithm achieved comparable performance with 55 times less annotation effort, and improved the performance with 42 times less effort. These results represent an improvement in the field of ECG heartbeats classification, concluding that the reference performance can be improved with an efficient use of the assistance provided to the algorithm.

				Normal		Suprav.		Ventr.		Total		
Operation mode	Observation	# Clusters	# MAHB/R	S	P^+	S	P^+	S	P^+	A	S	P^+
	de Chazal 2006	–	500	94	89	88	93	95	96	92	92	93
Semiautomatic	FA	12	12±0	99±0	86±2	87±3	99±0	95±1	99±0	94±1	94±1	95±1
		9	9±0	99±0	84±4	86±4	99±0	94±1	99±0	93±1	93±1	94±1
	SA	12	0.3±0	97±0	80±2	81±4	96±0	88±3	93±5	89±2	89±2	90±1
		9	0.3±0	97±1	78±3	82±4	96±1	89±3	99±0	89±2	89±2	91±1
Automatic		12	0	97±0	78±3	77±6	95±1	87±3	92±4	87±2	87±2	89±2
		9	0	97±1	73±3	74±6	95±1	84±4	96±1	85±2	85±2	88±1
	Llamedo 2011	–	0	95	79	77	88	81	88	84	84	85

MAHB/R: manually annotated heartbeats per recording. FA: fully assisted. SA: slightly assisted.