Noise-reduction and data-compressing of BSPM-signals with the help of synchronized averaging

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The mechanical working activity of the heart is preceded by electric activity, which can be shunted and measured with the help of electrodes on the surface of the body. This is called an ECG signal.

We can draw conclusions on the working of the heart from the heart's electric activity. A "fore sign" of a probable sudden heart attack may be the presence of the so-called ventricle late potential in the pulses of the ECG record. The reason for this is that the stimulus brunching gets, for some reason, significantly slower in a certain part of the heart muscles, and consequently a necessary electric condition of arrhythmia evolves, which directly endangers life.

The ventricle late potential is to be observed within the heart cycle at the beginning of the so-called ST-period. Since the sign that we are searching for is rather small "falls within the domain of noises" it demands precise sign processing. The aim is to process samples as little torsioned as possible and to work out a process that minimally changes the original sign. It makes the processing even more difficult that the working of the heart is "not periodical".

The process "to prevent the time base torsion" opens a time window above each QRS-complex and on the basis of their formal identity chooses the pulses that would get averaged in order to improve the sign/noise rate. The sign processing overlaps the time windows that represent individual pulses starting out from a preliminary reference point by observing the correlation coefficient, clusters the cycles according to their formal type (with the help of a given correlation threshold value) and runs the averaging with a so-called dominant group.

The process improves the overlapping of the pulses with the help of interpolation. Another possibility for grouping the periods is the so-called SPSA procedure (L. Gerencsér, Gy. Kozmann, Zs. Vágó: *The use of the SPSA method in ECG analysis: improved late potential estimation*), which basically means that the individual time windows each contain n pieces of sampling points, therefore each pulse can be taken as a point of a n dimensional space. The method searches the smallest sphere in the n dimensional space, which covers the point. It is, of course, possible that two different spheres give a better covering, so this can also provide a classification.

The benefit of this method is that it is sensitive to the base line wandering in contrast with the correlation method.

The cycles within one class are "more similar" than the ones belonging to other classes, therefore a better result is to be expected during the averaging. The point of averaging is that the accidental (white) noise "averages itself out", while the constantly present ventricle late potentials that return in each cycle of the ECG signal, arise.

Off course this signal processing method is useful not only in detection of ventricle late potentials, but in getting similar and significant pieces of information from ECG-signals.

The signal processing system was developed under MATLAB 5.3.