Modeling an Activation of Heart Ventricular Segments

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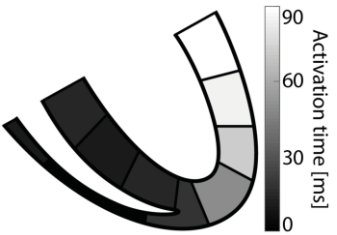
Background: Knowing activation times of specific myocardium segments can help to identify conduction disturbances which may, consequently, result in more targeted treatment of patients. Here, we present a 2D activation model evaluating activation of specific myocardium segments: 3 in the right ventricle, 3 in the left ventricle, 3 in the septum and 2 in the apex.
Methods: Precordial six-lead ECG signal was measured with a 5kHz sampling frequency. A total of 10 left bundle branch block (LBBB) and 5 right bundle branch block (RBBB) recordings were analyzed. The analysis includes following steps: 1) QRS complexes detection, 2) QRS complexes morphology clustering, 3) averaging of 100-1000 Hz envelograms (9x step 100 Hz) of dominant QRS complexes, 4) a genetic algorithm (GA) produces artificial averaged envelograms from (initially random) timing of myocardium segments. The task for GA is to produce envelograms the most similar to measured; then final timing should reflect real activation of examined myocardium segments.
Results: Presented activation model determined activation of left ventricular segments before right ventricular segments in all RBBB patients (mean 61.4 ± 13.7 ms) and activation of right ventricular segments before the left ventricle segments in all LBBB patients (mean 87.8 ± 15.8 ms). Computed activation of segments also created sequences related to input pathology.



Myocardial segments and computed activation times for LBBB recording

Conclusion: We introduced a new method determining activation times of myocardium segments; this is achieved non-invasively using only high-frequency ECG signal from precordial leads.