Implementation of deceleration capacity measurement algorithm in MatLab

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Abstract
Background: Impaired autonomic nervous system (ANS) tonus is involved into the pathogenesis of numerous cardiac diseases, such as atrial fibrillation and malignant ventricular arrhythmias. While numerous electrocardiographic (ECG) markers have been developed in an attempt of ANS tonus estimation, deceleration capacity (DC) proved to be an accurate marker of the vagal activity. *Methods*: 24-hours ambulatory ECG recordings of 110 patients were used in DC implementation. Automatic QRS detection and event classification was performed using PhysioNet Cardiovascular Signal Toolbox. Afterward, ectopic beats and non-sinus rhythms were manually excluded from analysis. DC measurement algorithm was implemented using MatLab version R2018a. *Results*: Deceleration capacity measurement was implemented using phase rectified signal averaging method in wavelet scale (s)=2 and timescale (T)=1. Normal consecutive sinus beats, varying less than 20% in duration compared to previous RR interval were included into analysis. On a long-term ECG recording, approximate 40.000 to 100.000 RR intervals are included into analysis. RR anchors are identified as RR intervals longer than preceding interval. Equal length segments preceding and succeeding RR anchors are selected. RR tachograms are phase rectified by aligning to each anchor RR interval and averaged. DC is calculated by formula DC=(X[0]+X[1]-X[-1]-X[-2])/4, where X[0] and X[1] are the averages of anchor RR and succeeding RR interval, while X[-1] and X[-2] are the averages of the two RR intervals preceding anchor RR interval. *Conclusion*: DC is one of the most accurate ECG marker of parasympathetic nervous system activity, having the advantage of not being influenced by artifacts, noise, ectopic beats or paroxysmal arrhythmias. DC can be easily implemented in MatLab and used in future clinical studies.

Keywords:
Autonomic Nervous System; Parasympathetic Nervous System; Ambulatory Electrocardiography; Cardiac Arrhythmias