TWA Simulator: a Graphical User Interface for T-wave Alternans

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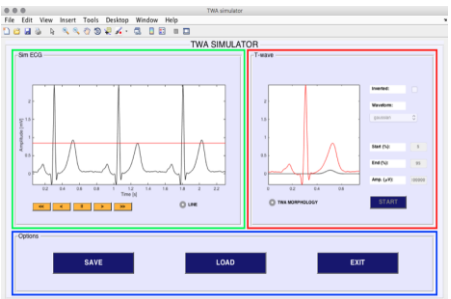
T-wave alternans (TWA) is an every-other-beat fluctuation of the T-wave amplitude and/or morphology, often at microvolt (invisible) levels. It is recognized by literature as an important risk index of severe ventricular arrhythmias, leading sometimes to sudden cardiac arrest. Many algorithms for automatic detection and quantification of TWA have been proposed in the last decade; when applied to the same electrocardiogram (ECG), they may provide a different TWA quantification, due to different hypotheses on TWA profile underlining their algorithms. Thus, interpretation of differences in TWA values provided by different methods is often difficult.

Aim of this work is to propose TWA Simulator as a useful tool to validate and compare TWA identification methods. TWA Simulator is a user-friendly MATLAB (release R2017b) graphical user interface (GUI) able to generate, model, visualize and store simulated ECG (SECG) affected by TWA of known morphology and amplitude (Figure). SECG is constructed by a N-fold repetition of a template, constituted by a real and clean ECG beat. Both N (number of beats) and RR inter-beat variability can be set by the user. Both direct and inverted TWA can be simulated. Direct TWA is simulated by adding a waveform to every other T wave; user may choose among four different TWA profiles (rectangular, triangular, gaussian and brownian), and has to set TWA amplitude as well as onset and offset (both within J point and T offset) of the alternating SECG segment. Inverted TWA is simulated by changing T-wave polarity in every-other SECG beat.



TWA Simulator

Availability of TWA Simulator would allow efficient validation and comparison of automatic TWA identification methods by helping interpretation of results. In addition, it may support future model-based TWA studies on TWA profiles.