Optimising Beat Selection and Averaging for ECGI to Enhance EGM Reconstruction Fidelity

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Electrocardiographic Imaging (ECGI) offers spatially resolved information on cardiac electrophysiology by solving an inverse problem. By strategically placing electrodes on the torso, ECGI captures body surface potentials (BSP) to reconstruct the underlying electrical activity as electrogram (EGM) on the epicardial surface. Single-beat BSP are typically used to solve the inverse problem. However, the presence of noise and artifacts within the chosen beat can significantly distort the reconstructed EGM.

This paper introduces a novel approach to to mitigate the impact of noise and artifacts on ECGI solutions by generating single averaged BSP beats. Our approach automatically identifies BSP segments with minimum RR-variability and selects consecutive artifact-free beats using entropy-based criteria. The proposed method aims to mitigate noise level by generating a single averaged beat with minimised noise and artifacts. We compared the proposed approach with alternatives and our results demonstrate the efficacy of this approach in reducing amplitude variability across selected beats before averaging, thereby enhancing the fidelity of reconstructed EGMs. Furthermore, our study establishes the optimal number of beats required during averaging. Specifically, we found that a minimum of 10 beats is necessary for computa-tion of ventricular repolarisation time, and 50 beats for atrial repolarisation time. The proposed approach provides a robust framework for automatic beat selection and averaging in ECGI, offering a more efficient, reliable, and objective approach compared to manual selection. .

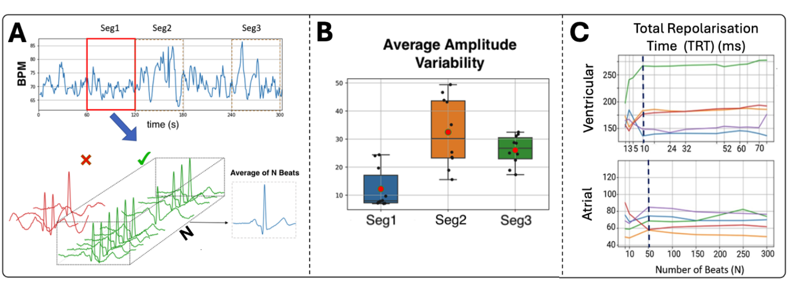

Figure: (A) Segment selection from BSP, rejection of artifactual beats, and averaging of *N* beats. (B) Average Amplitude Variability of three segments (C) Total Repolarisation Time (TRT) of Ventricles and Aria with different number of beats to establish the minimum number of beats.