PhysioZoo ECG: Digital electrocardiography biomarkers to assess cardiac conduction

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Introduction: The electrocardiogram (ECG) is a standard tool used in medical practice for identifying cardiac pathologies. Because the necessary expertise to interpret this tracing is not readily available in all medical institutions or at all in some large areas of developing countries, there is a need to create a data-driven approach that can automatically decrypt the information contained in this physiological time series. Yet, contrary to heart rate variability measures, a field which has seen the development of advanced toolboxes and software, very little open tools exist for ECG morphological analysis. The primary objective of this work was to identify, implement and validate important digital ECG biomarkers ("ecg-bm") for the purpose of creating a reference toolbox for ECG morphological analysis.

Methods: The epltd algorithm was used for R-peak detection. We used a zero-phase filter with passband 0.67Hz - 100Hz to remove baseline wander and high frequency noise. We used a Notch filter at 50/60Hz to remove the power-line interference. ECG fiducial points were detected using the well-known open source wavedet algorithms. A total of 36 biomarkers were identified and engineered including 12 extracted from intervals duration and 24 from waves characteristics. When a feature could not be computed for a given cycle because some fiducial points could not be estimated then it was considered as a NaN.

Results and discussion: the result of this work consists of a Python toolbox termed "ecg-bm" and its user interface termed "PhysioZoo ECG" for data visualization. The software will be made (at the time of the conference) freely available on the physiozoo.com open source platform. The ecg-bm toolbox may be used to provide new physiological information on cardiac conduction as well as used as a source of readily handcrafted features for training machine learning models.