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Analysis of a IncResU-Net Model for R-Peak Detection in ECG Signals

Authors : Beatriz Lafuente Alcázar, Yash Wani, Amit J. Nimunkar

Abstract : Cardiovascular Diseases (CVDs) are the leading cause of death globally, and around 80% of sudden cardiac deaths are due to arrhythmias or irregular heartbeats. The majority of these pathologies are revealed by either short-term or long-term alterations in the electrocardiogram (ECG) morphology. The ECG is the main diagnostic tool in cardiology. It is a non-invasive, pain free procedure that measures the heart's electrical activity and that allows the detecting of abnormal rhythms and underlying conditions. A cardiologist can diagnose a wide range of pathologies based on ECG's form alterations, but the human interpretation is subjective and it is contingent to error. Moreover, ECG records can be quite prolonged in time, which can further complicate visual diagnosis, and deeply retard disease detection. In this context, deep learning methods have risen as a promising strategy to extract relevant features and eliminate individual subjectivity in ECG analysis. They facilitate the computation of large sets of data and can provide early and precise diagnoses. Therefore, the cardiology field is one of the areas that can most benefit from the implementation of deep learning algorithms. In the present study, a deep learning algorithm is trained following a novel approach, using a combination of different databases as the training set. The goal of the algorithm is to achieve the detection of R-peaks in ECG signals. Its performance is further evaluated in ECG signals with different origins and features to test the model's ability to generalize its outcomes. Performance of the model for detection of R-peaks for clean and noisy ECGs is presented. The model is able to detect R-peaks in the presence of various types of noise, and when presented with data, it has not been trained. It is expected that this approach will increase the effectiveness and capacity of cardiologists to detect divergences in the normal cardiac activity of their patients.

Keywords : arrhythmia, deep learning, electrocardiogram, machine learning, R-peaks
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