Time-Frequency Representation-Based Transfer Learning Model for Cardiac Arrhythmias Diagnosis

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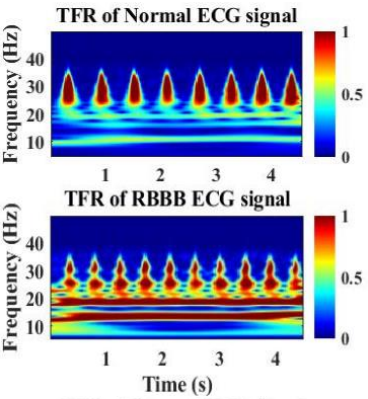
Heart abnormalities cause about 26% of the deaths of illnesses in the world; the cardiac arrhythmias (CAs) are the most common of them. The current standard manual interpretation of ECG for clinical detection of CA suffers from subjectivity. **Aims**: This study aimed to develop an automated abnormal pattern recognition method for the clinical decision. Capable of detecting eight possible CAs in 12-lead ECG records with improved reliability and sensitivity in early detection.



Proposal: An improved deep learning model was employed from a transfer learning perspective by using time-frequency representation (TFR) images of each recording.

Methods: A set of 6877 records coming from the CPSCS2018 database were filtered and normalized to avoid unnecessary processing information. Then, they were transformed into two-dimensional TFR images through the Wavelet Synchrosqueezing (WS) method. The use of images changes the traditional approach of the analysis of sequential signals, improving the speed of training without affecting classification accuracy. Then, it is important selecting a network that has been pre-trained with large data sets in image classification. The GoogleNet network was chosen for this purpose, modifying the weights of the inner layers using the TFR images to adapt the model to the CAs detection tasks. At the network output, the probabilities of CAs diseases were provided. A 10-fold cross-validation method was executed using the 70%, 15%, and 15% settings for the training, validation, and testing processes. Finally, different training hyperparameters were tested to find the best model.

Results: The model performed accurately identified distinct classes of CA, with an overall F2-score of 0.85 and G2-score of 0.632. This model had a high performance in detecting healthy subjects with an SP 93%. The official score of UIDT-UNAM team was F2-score of 0.723 and a G2-score of 0.483.