Atrial features-based prediction of sinus tachycardia using LSTM-RNN model

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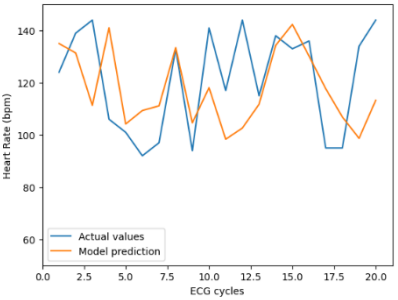
Background: Tachycardia is frequently encountered in the progression of paroxysmal to persistent Atrial Fibrillation (AF). The most effective AF algorithms incorporate both atrial and RR-interval features. However, the careful and complete intervention of P-wave in Sinus Tachycardia (ST) reveals pathological and autonomic dysfunctions and differentiates distinct arrhythmias.

Aim: The study attempts to determine the impact of atrial characteristics on predicting ST based on atrial features and RR-interval using a Long Short-Term Memory Recurrent Neural Network (LSTM-RNN) model.

Method: Electrocardiogram (ECG) is recorded in ST condition among five healthy volunteers (mean age 26.2 years, 4 males) after physical stress. ECGs are recorded from standard lead-II using the Mindray Beneheart R12 ECG machine. Each volunteer underwent a 10 s recording for six consequent times. A ten-day follow-up of the same procedure has been carried out for every participant. Atrial features like P-wave amplitude, duration, area, area/duration, duration/amplitude, and PR-interval, along with RR-interval, are utilized as inputs for the developed LSTM-RNN model. The proposed LSTM-RNN model operates based on multivariate time series forecasting.

Results: The developed LSTM model has the training and validation loss of having mean squared error values like 0.000023 and 0.2060. The model predicts the heart rate (bpm) for the subsequent 20 ECG cycles from previous samples.



Actual and Model predicted values of ECG cycles in sinus tachycardia.

Conclusion: The proposed LSTM-RNN model, with its low mean squared error, may be suitable for predicting AF and other arrhythmias. Moreover, this atrial feature and RR-interval based model may effectively distinguish AF from other atrial arrhythmias in the future.