Non-Invasive Atrial Fibrillation Driver Localization Using Recurrent Neural Networks and Body Surface Potentials

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Background. Atrial fibrillation (AF) underlying mechanism lies in complex and irregular propagation patterns which lead to atrial disfunction. Drivers which perpetuate this phenomenon are the main targets for ablation procedures. However, the location of drivers for ablation remains an open research issue.

Aim. We propose to locate the AF driver region by using body surface potentials (BSPs) and recurrent neural networks (RNNs).

Methods. Realistic computerized models of atria and torso are employed to simulate sinus rhythm (SR) and 13 different AF propagation patterns in the left (LA) and right atria (RA). AF driver location problem is addressed as a supervised classification problem: no AF - class 0; AF driver in LA region - class 1; AF driver in RA region - class 2. The target variable was assembled by manually classifying AF drivers (if any) into one region for each time instant. RNN input data are multivariable signals acquired from 64 BSP signals with a SNR = 20dB, which are the result of the forward problem from computerized models. We resampled signals from 500 down to 50 Hz to ensure a minimum input size of 1 second. Following, we trained a bidirectional LSTM layer of size 25 units with batches of size (50, 64). A 3 unit Softmax layer is added at the end to classify the output.

Results. We were able to locate the 100% and 92% of drivers in the training and test sets. Sensitivity values in the test set ranged from 0.82 to 1, whereas specificity ranged from 0.95 to 0.98.

Conclusions. The proposed model based on RNN could provide an insight on the location area of AF drivers using BSPs.

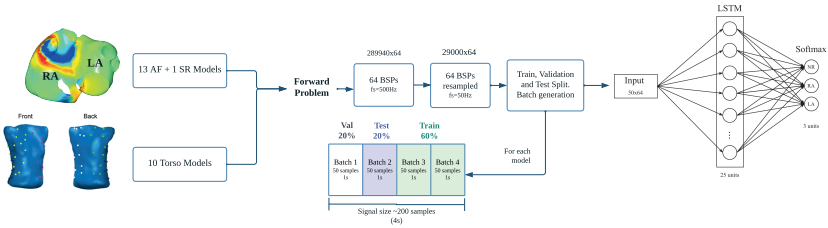

Figure 1: Framework to locate AF driver using RNNs based on bidirectional LSTMs.