IMPLEMENTING MACHINE LEARNING MODELS TO PREDICT CARDIOVASCULAR TARGET ENGAGEMENT IN RATS TREATED WITH VAGUS NERVE STIMULATION

Farid Yaghouby, Manni Mashaee, and Srikanth Vasudevan
[1]Division of Biomedical Physics, Office of Science and Engineering Laboratories, Center for Devices and Radiological Health, US Food and Drug Administration.

Abstract Text (350 words limit)

Vagus Nerve Stimulation (VNS) has been known as a safe and effective treatment for some clinical disorders such as epilepsy and sever depression. However, the long-term side effects of this approved neuromodulation therapy have not been thoroughly assessed. In order to study the cardiovascular side effects of VNS, we conducted chronic animal experiments using rats implanted with wireless physiological monitoring and neurostimulator devices. The experimental design involved stimulation of cervical vagus nerve on a daily basis for 5 days in a week. The experiment time horizon was 8 weeks, with consideration of a recovery time after surgical implementation of devices. VNS was conducted once a day with a duration of 10 minutes. For each simulation, continuous electrocardiogram (EKG) signals were analyzed for each rat, before and after the stimulation. Heart Rate Variability (HRV) analyses were performed to extract various parameters from recorded EKGs in 5-min windows. After removing noisy data, HRV parameters were grouped in three categories namely time-domain, frequency-domain, and nonlinear features. The main goal of this study is to build a model to forecast the post simulation effects on HRV parameters with adoptation of deep learning techniques. A variant of Recurrent Neural Networks (RNN) called Long Short-Term Memory (LSTM) architecture will be tested in the modeling procedure. Moreover, hyper parameters of the model such as different numbers of hidden layers and nodes in each layer will be validated to reach the optimum parameter set of based on our input data. The actual VNS responses in HRV variables will be used to assess the performance of the predictive model and for calibration purposes