UNIVERSITY of HOUSTON | ENGINEERING

Department of Biomedical Engineering

Thursday, July 2nd, 2020

11:00 AM

Defense held online via Zoom

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MS Thesis Defense

Dr. Nuri Ince, Faculty Advisor

"ADAPTIVE DETECTION OF BETA BURSTS OF LOCAL FIELD POTENTIALS RECORDED FROM SUBTHALAMIC NUCLEUS IN PATIENTS WITH PARKINSON'S DISEASE"

Abstract

Parkinson's Disease (PD) affects 1% of the world population, with this number expected to increase within the following years. Local field potentials (LFPs) recorded from deep brain stimulation (DBS) leads placed into the motor territory of the subthalamic nucleus (STN) can be us

ed to investigate the mechanism of PD and allows for further development of new therapeutic strategies. Beta band activity, which typically presents itself as bursts, has been continuously found in the LFP recordings of PD patients. These oscillations of neural activity have been shown to correlate with motor impairment and can be suppressed by dopaminergic medication and stimulation of the brain. A novel adaptive technique we developed uses local cosine packets to detect beta bursts in LFPs and segments the data appropriately using nondyadic segmentation. We show that the spectral entropy of these adaptively captured bursts previse patient symptoms accurately and may outperform the basic beta suppression approach, such as thresholding.

In this work, 120s of LFP data recorded in the resting state from chronic DBS leads of nine PD patients were segmented adaptively by entropy minimization. Using the recently developed algorithm, we performed the following: (i) adaptively segment STN LFP recordings into segments of 125ms or multiples of it, (ii) determine the entropy distribution of different time windows, (iii) correlate the change in entropy between unmedicated (OFF) and medicated (ON) states in different time windows with Unified Parkison's Disease Rating Scale (UPDRS) and computer-based measurements of bradykinesia. We found that as segment size increased, the difference in entropy between OFF and ON states enlarged. Based on entropy distribution, it was possible to determine whether a patient improved after the administration of medication. Similarly, the change of entropy in segments greater than or equal to 375ms was highly correlated with the UPDRS and keyboard scores. These findings suggest that beta bursts can be adaptively segmented without the use of a predetermined threshold, therefore allowing for robust quantification of disease severity. This could enable future closed-loop DBS algorithms to become more efficient and effective when stimulating based on beta bursts detection.

Zoom link: https://uofh.zoom.us/j/94222991143