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CLASSIFYING DEEP BRAIN NEURONAL ACTIVITIES BY BURSTING PARAMETERS

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Abstract. *A method for classifying neuronal activities from the deep brain nuclei, subthalamic nucleus (STN) and subtantia nigra (SNr) is proposed in this paper. Seven bursting relevant parameters, firing rate (FR), burst index (BI), pause index (PI), burst number (BN), spike number (SN), burst strength (BS) and spike strength (SS) were applied to analyze 54 trials of data from Parkinson's patients. Based on the statistical analysis, PI, BN, SN and SS showed significant difference between STN and SNr signals. Thus, the 4 significant parameters were further applied to construct a classifier by principal components analysis (PCA) and support vector machine (SVM). The effect of constructing a SVM classifier with and without performing PCA was also tested. Applying PCA which can transform parameters to orthogonal variables improved the accuracy rate of classification for 22% on average. The number of principal components used to develop the classifier was also assessed. Including the first 2 principal components obtained the best accuracy rate of classification in this study.*
Keywords: Deep brain stimulation (DBS), Neuronal spike, Burst, Subthalamic nucleus (STN), Principal components analysis (PCA), Support vector machine (SVM)

1. **Introduction.** Deep brain stimulation (DBS) is a surgical treatment which implants an electrical stimulator into specific brain nuclei for regulating neural activities to alleviate symptoms in motor performance. Parkinson's patients are the major population receiving DBS. Subthalamic nucleus (STN) is frequently the target nucleus [1-4]. Before practicing surgery for DBS, brain images are usually taken through magnetic resonance imaging (MRI) and computed topography (CT) to locate STN. However, the difficulty to find the location of STN is still large. The size of STN is similar to a grain of rice [2]. The shape and orientation of STN are variable [3]. Also, the location of STN may change slightly during surgery. To gain the effectiveness of DBS on STN, the optimal zone for stimulation is within 3mm [3]. To accomplish a precise implantation of stimulators, a probe for microelectrode recordings is often used to search for STN during surgery. Based on the distinction of neuronal activities between STN and its surrounding nuclei, neurologists can identify where the probe reaches. If the probe was within the optimal zone for placement, the information of probe trace will be useful for directing the implantation of stimulators.