

## Application of sliding window for burst and pause detection in spike trains

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Movement disorders are categorized as a group of neurological symptoms, signs, or diseases [1]. Basal ganglia and cerebral cortex are important parts of human brain, they work together to make human body movement well. Deep brain stimulation (DBS) is a neurosurgical procedure that allows targeted circuit-based neuromodulation and is commonly used for the treatment of movement disorders such as Parkinson disease, tremor, and dystonia [2]. During DBS, we perform microelectrode recording, and after spike sorting, we will get spike trains of single unit activity. When several spikes occur together in a short period of time or are separated by a short time interval, the researchers call such a cluster a burst. And there is no spike for a period is called pause. Both burst and pause can be important indicators of neural function and dysfunction.

Most methods used to detect burst and pause in spike trains relies on several parameters and fail to retain their temporal structure information.

The aim is to develop method for detection burst and pause more objective without too many parameters.

Firstly, each Spike in the Spike train is converted into a long sequence containing only “1” (a Spike) and “0” (no Spike) elements according to its timestamp, and bin size is 1ms.

Secondly, we select a finite length sliding window to be active on a Spike train from beginning to end to obtain a few fragments. Each fragment contains several “1” and/or “0”. In this way, each fragment can contain the temporal structure and Spike information of its corresponding fragment. We labeled each fragment as  $f_n$  ( $n > 0$ ).

Thirdly, we count the number of spikes in each fragment by adding up several "ones" (if any). We labeled the sum of each fragment as  $S_n$ . Then we subtract the sum of the number of spikes (“1”) in the fragment from the sum of the number of spikes (“1”) in the latter fragment, we call this difference as  $D_n$ . Such a difference represents the variation between each Fragment.

Last, we are going to do a definition of burst and pause with the help of changes of fragments.

We test this approach to analysis basal ganglia single unit activity in patients with movement disorders. The results show that use slide window to do burst and pause detection task, is more objective than other methods, because this method don't rely on too many parameters, just describe the changes among fragments. We will test this method on different basal ganglia spike trains.

### References

- 1) Bhatia K P et al. Consensus Statement on the classification of tremors. from the task force on tremor of the International Parkinson and Movement Disorder Society. *Movement Disorders*. 2018, 33(1): 75-87.
- 2) Ozel-Kizil E T et al. Secondary social anxiety in hyperkinesias. *Movement disorders*, 2008, 23(5): 641-645.