A Data Management Platform for Long-Term Neurobehavioral recordings in Parkinson's Disease

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Introduction

Deep Brain Stimulation (DBS) is an established therapy for patients with advanced Parkinson's disease. While for the last decades, neurostimulators only allowed to deliver electrical stimulation, newly commercially available devices are also capable to sense brain signals chronically. This, combined with wearable technology allows to study neurophysiology, symptoms, and behavior of patients in the ambulatory setting to better inform DBS therapy.

The aim of the project is to develop a versatile MATLAB-based platform to handle, organize, and synchronize multimodal neurobehavioral signals. This platform will serve as basis for further data analysis.

Materials and Methods

The dataset consists of passive long-term recordings in ambulatory environment offering 8 neurobehavioral signals : (1) estimated power of local field potential (LFP) of the subthalamic nucleus (STN) of the left hemisphere with a defined frequency range, (2) estimated power of LFP of the STN of the right hemisphere with a defined frequency range, (3) heart rate, (4) 3-axis accelerations, (5) reported circadian cycle, (6) fluctuations of motor symptoms evaluation, (7) fluctuations of psychological symptoms evaluation, and (8) medication intakes.

Results

Once multimodal data are registered into the platform, the visualization tool allows for a first non-quantitative exploration of the synchronized data for gaining insights into relationships between different neurobehavioral read-outs.

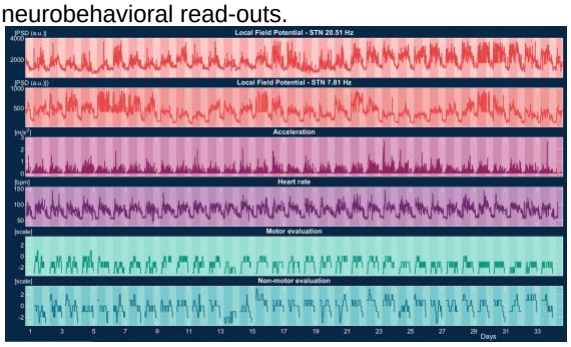

Fig. 1 Examplary visualization of all neurobehavioral streams with indication of the circadian cycle by darker shade of background for the awake state, and medication intake shown with dashed vertical line.

Exemplary analyses included the relationship of brain signals to the 24h circadian cycyles that revealed a preferred amplitude distribution between day and night.

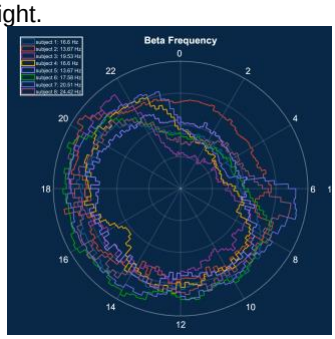

Fig. 2 Group (n=8) polar histogram representing the local field potential fluctuations over a 24-hour cycle; data averaged over 4 weeks.

Discussion

This platform, with its current strengths and potential future development, represents a significant step towards a deeper understanding of the relationship between brain activity, symptoms, and behavior in the in-and-out of hospital environment. Ultimately, this platform may help to conceptualize new neurophysiology-guided stimulation paradigms and leverage on-going clinical monitoring to optimize the treatment and management of patients.

References

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Acknowledgements

This master thesis has been conducted in the context of a large SNF funded project on Adaptive Closed-Loop Deep Brain stimulation at the Movement Disorders Center of the Departement of Neurology at the University hospital Bern (Principle Investigator: PD Dr. med. Gerd Tinkhauser, PhD).