Innovations
UNIVERSITY OF COLORADO
ANSCHUTZ MEDICAL CAMPUS

Identifying and Modifying Sleep State in Parkinson's Using Deep Brain Stimulation

Category

Deep Brain Stimulation (DBS) Software

Problem

Parkinson's disease (PD) patients often experience sleep dysfunction in DBS

Technology Overview

Software that can identify sleep state and alter DBS implants to improve sleep

IP Status

- Patent Pending
- Available for Exclusive or Non-Exclusive Licensing

Value Propositions

- Accurately identifies sleep state
- Could change/shut-off DBS implants to improve sleep in PD patients
- Saves battery power and decreases DBS surgery frequency

Market Advantages

- DBS devices market for PD will be $4B in 2025 with a CAGR of 8.2%
- Increase cases of the disease are driving the market

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Problem: Worldwide, more than 10 million people have Parkinson's disease (PD) and it is estimated 80-90% of these patients experience sleep dysfunction. Few therapeutic interventions exist to address sleep symptoms in PD and sleep dysfunction can result in diminished quality of life and increased morbidity and mortality. Deep brain stimulation (DBS) is used to treat the motor symptoms of PD and has been suggested as a potential treatment for sleep dysfunction in these patients. In this treatment, electrodes are implanted into the brain to deliver current pulses. The current state-of-the-art is nonadaptive: therapeutic stimulation does not respond to real-time changes in pathology. Adaptive stimulation, or closed-loop DBS, is the future of the field, and it involves changes in the stimulation pattern depending on sensors which record the patient's state. The next generation of implants will both record brain state and stimulate, opening the door for adaptive stimulation: stimulation that changes depending on the patient's brain state. Currently, there are no reliable methods for performing the translation from brain state to stimulation pattern.

Solution: A University of Colorado research team has developed software which can interpret brain patterns in order to determine whether the patient is awake or asleep that can be used with closed-loop DBS. The technology uses artificial neural networks to determine a patient's sleep state. It was trained from PD patients with implanted DBS electrodes in the subthalamic nucleus. This software could change or shut off DBS implants in order to encourage a more restful, lengthy and restorative sleep and save battery power. Using this model, they were able to match clinician-identified sleep stage with a mean accuracy of 91%. They also observed a mean classification accuracy of 91% for novel subjects. Performance of their model is shown in Figure 1.

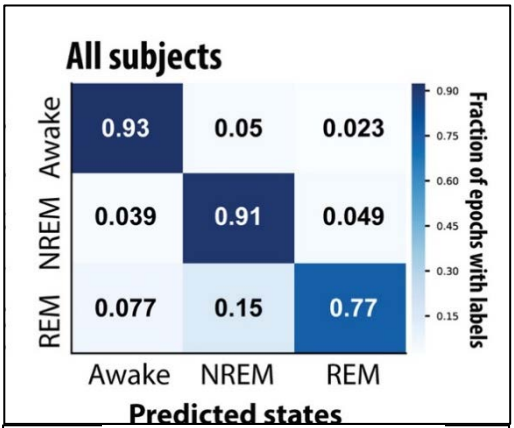

Figure 1 A confusion matrix showing the performance of this model identifying sleep state (REM, rapid eye movement; NREM, non-rapid eye movement).

Advantages and Value Propositions: This software is able to accurate identify sleep state in PD patients and could be used in a closed-loop DBS system in which the stimulation is changed in response to the sleep state detected. By altering DBS stimulation in real-time this software could serve as a useful treatment to improve sleep disfunction in PD patients. This could include turning off DBS implants to improve sleep, which would save battery and thus decrease the frequency of surgeries required to replace battery packs. This would serve a crucial unmet need in this patient population as there are currently no effective treatments for sleep dysfunction with a low side-effect burden.

Additional Documents and Sources:

"Software that identifies sleep states from deep brain signals." Provisional patent application No. 62/758,484 filed November 9, 2018; available under NDA.

Christensen E, Abosch A, Thompson J, et al. Inferring sleep stage from local field potentials recorded in the subthalamic nucleus of Parkinson's patients. *Journal Of Sleep Research.* 2018;28(4):e12806.

About CU Innovations

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