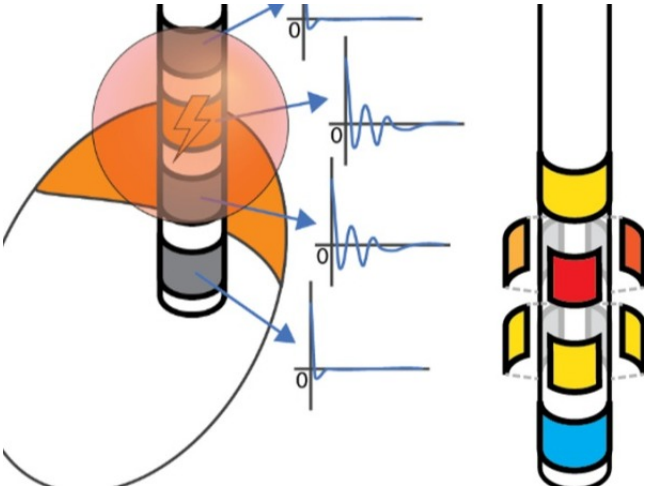
INNOVATION PARTNERSHIPS
UNIVERSITY OF MICHIGAN

Neuromodulation-Based Tools to Enable Novel Directional-Based Mapping During Awake and Asleep Surgery

TECHNOLOGY NUMBER: 2024-121



Technology ID
2024-121

Category
Software
Life Sciences

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OVERVIEW

Novel DLEP-based mapping enhances DBS surgery precision and programming for Parkinson's.

- Improves spatial specificity, clinical correlation, and programming efficiency over prior biomarkers and mapping methods
- Applications: Optimized DBS lead targeting, efficient programming, reduced surgery revisions, improved Parkinson's outcomes.

BACKGROUND

Deep brain stimulation (DBS) of the subthalamic nucleus (STN) is a cornerstone intervention for advanced Parkinson's disease (PD), with surgical outcomes hinging on accurate lead placement and personalized stimulation programming. Standard approaches refine imaging-based planning with intraoperative neurophysiologist-guided microelectrode recordings (MER), which are time-consuming, highly expertise-dependent, and require patient participation. This can potentially lead to discomfort and subjectivity. Postoperative programming, essential for maximizing therapeutic benefit, relies on iterative, trial-and-error clinical testing that can be lengthy and taxing for both the patient and the clinical teams. Although spectral features such as beta-band power have been proposed as aiding biomarkers, they show high variability, lack of consistency, and restricted use (often requiring awake surgery). There is thus an unmet need

for a reproducible, objective, and robust intraoperative marker that enables precise, spatially specific targeting and simplifies postoperative DBS programming.

INNOVATION

The new approach leverages DBS-induced local evoked potentials (DLEP, also known as evoked resonant neural activity, ERNA) as an intraoperative marker, directly comparing their efficacy to classic spectral features like beta and high-frequency oscillations (HFOs). In a recent study (medRxiv preprint doi: 10.1101/2025.06.14.25329308), DLEP demonstrated superior spatial localization accuracy. Correctly identifying optimal STN contacts in 100% of single-pulse cases and showing stronger correlation with clinical outcomes than spectral measures. Advanced signal processing enables artifact-free, monopolar DLEP recovery, even at the stimulating contact, enhancing spatial mapping resolution with standard clinical amplifiers. The consistency and specificity of DLEP mapping were validated across 39 DBS leads in 31 PD patients, highlighting the method's robustness under standard surgical protocols. This tool can guide both intraoperative targeting and postoperative programming, drastically improving procedural efficiency, reducing revision rates, and advancing personalized DBS therapy for Parkinson's disease.

ADDITIONAL INFORMATION

REFERENCES

Opri E, Isbaine F, Borgheai SB, Bence E, Deligani RJ, Willie JT, Gross RE, Au Yong N, Miocinovic S. Deep brain stimulation-induced local evoked potentials outperform spectral features in spatial and clinical STN mapping. J Neural Eng. 2025 Aug 29;22(4). doi: 10.1088/1741-2552/adf99f. PMID: 40780240