Improved Deep Brain Stimulation Target Selectivity (20150170, Dr. Shalom Michaeli)

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Neuromodulation: Precise and Efficient Stimulation

Target selectivity of neuromodulation, e.g., deep brain stimulation (DBS) therapy, is critical as the precise locus and pattern of the stimulation dictates the degree to which desired treatment responses are achieved and adverse side effects are avoided. A new concept for neuromodulation generates orientation selective and rotating electric fields that provide more precise and efficient stimulation, thus reducing side effects. These strategies identify a new course for selective neuromodulation paradigms. The new electrode uses shaped pulses and phase modulation of current to more selectively control the orientation of the field's gradients relative to axons (parallel orientation for maximum stimulation), and provides power efficient neuromodulation.

Mitigates DBS Side Effects

DBS, while an effective treatment of various neurological and psychological disorders, still has important side effects (e.g., potential tissue damage) due to non-selective stimulation. Standard neuromodulation systems control just the amplitude and frequency of the stimulus that drives each individual contact of the multichannel lead, thus the orientations of the electromagnetic stimulation is not controlled. This constant shape and frequency modulation limits the volume of neurons that can be consistently stimulated. In addition, neurons can adapt to continuous stimulation, resulting in diminished neuronal response and lessening neuromodulation efficacy. The novel electrode design provides more precise and efficient simulation by using orientation selective and rotating electric fields, where shaped pulses and phase modulation of the current more selectively control orientation of the field relative to axons (parallel orientation allows maximal stimulation). This new, more flexible approach allows selective tuning of the excitation to the relevant population of neurons or axons, eliminating tissue damage from excessive heat production and eddy currents, and offering a controllable strategy easily adapted to avoid seizures and other side effects (such as heat

damage). Furthermore, the new electrode design features geometric configurations that further improve performance.

BENEFITS AND FEATURES:

- Selective tuning to relevant neuronal or axonal populations
- Localized, precise and efficient stimulation
- Controllable strategy adaptable to avoid seizures and other side effects
- Can reduce/optimize power deposition
- May reduce tissue damage and other side effects from non-selective stimulation

APPLICATIONS:

- Parkinson's disease
- Epilepsy
- Dystonia
- Pain
- Essential tremor
- Spinal cord injury

Phase of Development - Proof of Concept demonstrated

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Publications
[Orientation selective deep brain stimulation](#)
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