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Randomized Deep Brain Stimulation Algorithm for Broad-Spectrum Treatment of Neurological Disorders

Researchers at Stanford University have developed a new stimulation algorithm for implantable brain stimulation devices that more reliably treats neurological disorders driven by abnormal synchronized brain activity. The device uses a pulse generator connected to electrodes with multiple stimulation sites and delivers pulses in a way that is intentionally randomized in two ways: which sites are activated, and when.

Current approaches like Coordinated Reset (CR) stimulation require the stimulation frequency to be carefully matched to the patient's pathological brain rhythm, and electrodes to be placed at precise, well-spaced locations. If either is off, stimulation can backfire and worsen synchrony. This invention removes both constraints. Stimulation sites are drawn randomly within a spatial range from one pulse to the next, and the time between pulses follows a Poisson distribution rather than a fixed interval. Computational results show the method desynchronizes abnormal brain activity across frequency ranges up to ten times the stimulation frequency, far beyond what CR achieves, and without requiring precise calibration of electrode placement or stimulation timing.

Applications

- Deep brain stimulation (DBS) for Parkinson's disease, essential tremor, and dystonia
- Epicortical and other invasive brain stimulation for epilepsy, chronic pain, and obsessive-compulsive disorder
- Spinal cord stimulation

- Simultaneous treatment of multiple symptom clusters linked to different pathological frequency bands

Advantages

- Desynchronizes abnormal brain activity across frequency ranges up to 10x the stimulation frequency, far exceeding CR
- Does not require precise electrode placement or spacing calibration, only a target spatial range
- Robust to mismatches between stimulation frequency and pathological oscillation frequency
- May address multiple symptoms simultaneously (e.g., tremor and akinesia) by targeting multiple frequency bands

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