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Select Optimal Therapeutic Parameters for Medical Stimulation Devices

Adaptive dual controller selects optimal parameters, measures outcomes

A Bayesian optimization algorithm can be used for selecting and tuning operational parameters of medical stimulation devices such as deep brain stimulators (DBS) and spinal cord stimulators. The algorithm helps select the optimal set of parameters to test so as to find the therapeutic minimum/maximum in as few evaluations as possible. This optimization approach may be used in a wide range of medical devices used to treat a variety of diseases. The system adaptively controls electronic stimulation devices (e.g., closed-loop stimulation devices) using a feedback controller and a Bayesian optimization loop. The adaptive dual controller handles process variation by both controlling the process and also perturbing the process to learn how it responds, leading to better future control. The algorithm could be embedded in devices that evaluate therapeutic outcomes (e.g., a tablet computer that uses a questionnaire to measure therapy effects, a computer that quantitatively measures therapy effects through robotic inputs, or an implanted device that measures biomarkers and directly adjusts therapy parameters).

Methodical, data-driven search

Current methods for selecting stimulation parameters simply rely on trial and error, so evaluating the efficacy of a set of stimulation parameters can take many minutes, hours, or even days. For example, a clinician working with a deep brain stimulation (DBS) patient may try several different settings to find a set of parameters that achieves a therapeutic effect while avoiding side effects. This algorithm replaces such trial-and-error attempts with a methodical, data-driven search. Bayesian optimization builds and uses a model of the therapeutic response to recommend parameters to find the therapeutic minimum/maximum in as few evaluations as possible.

Phase of Development

- Algorithm tested in a computational model.

Benefits

- Replaces trial-and-error attempts with a methodical, data-driven search
- Applicable to a wide range of medical devices used to treat a variety of diseases

Features

- Adaptive dual controller: feedback controller and Bayesian optimization loop
- Adaptively controls electronic stimulation devices
- Embedded in devices that evaluate therapeutic outcomes

Applications

Technology ID
20180212

Category
Engineering & Physical Sciences/Instrumentation, Sensors & Controls
Life Sciences/Human Health
Life Sciences/Medical Devices
Software & IT/Algorithms

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- Medical devices
- Electrical stimulation devices with controllable parameters (e.g., deep brain stimulators, spinal cord stimulators, peripheral nerve stimulators, drug pumps, transcranial electrical stimulation, transcranial alternating current stimulation, transcranial magnetic stimulation, and ultrasound therapies)
- Therapies for treating diseases such as Parkinson's disease, epilepsy, essential tremor, dystonia, depression, diabetes, obesity, obsessive compulsive disorder

Researchers

Tay Netoff, PhD

Associate Professor, Biomedical Engineering

External Link (www.neuroscience.umn.edu)

Andy Lamperski, PhD

Assistant Professor, Electrical and Computer Engineering

External Link (ece.umn.edu)

Bryan Moore

Assistant Professor, Neurology

External Link (www.neurology.umn.edu)

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