Electroceutical Therapeutics

Phase Agnostic Stimulation

For closed-loop bioelectric therapy

Patents & Publications:

US provisional patent applications filed in 2021

Chang J, Paydarfar D.
Chaos. 2021 Feb;31(2):023134

Chang J, Sridhar V, Paydarfar D.
Chaos. 2020 Dec;30(12):123113.

Applications:

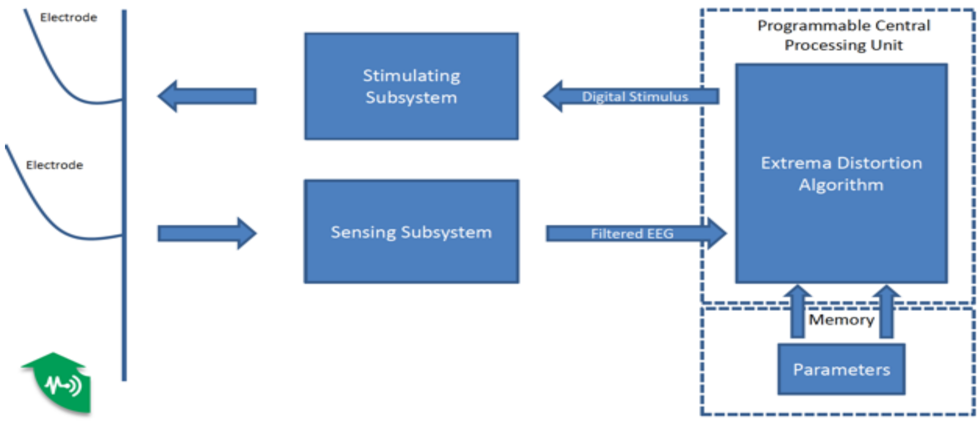
To improve existing devices or for new devices to treat:

- Parkinson's Disease and other tremors using Deep Brain Stimulation (DBS)
- Epilepsy
- Seizures
- Cardiac Arrythmia

Electroceutical therapeutics encompass technologies that stimulate or suppress activity of a specific set of nerves. The goal of such therapeutics is to correct abnormal firing patterns, restoring a healthy pattern of electrical activity traveling through a neural circuit. Examples of devices that employ electrostimulation are cardiac pacemakers, deep brain stimulation devices and cochlear implants. New bioelectronic devices are in development to treat a variety of diseases caused by pathological electrical waveforms.

Researchers face several challenges to develop devices that will readily be adopted by patients. For example, depending on the application, devices need to be designed to interface with a specific set of nerves, small enough to be implanted, durable and energy efficient. Citing a review article on bioelectric devices (PNAS December 3, 2019 116 (49) 24379-24382), "**One of the holy grails in bioelectronic medicine**, says (Dr. Kevin) Tracey, **is closed-loop therapy.** Such a device could not only talk to the nerves but also listen in on their conversations with the rest of the body to decipher how best to respond in real-time—whether by stimulating or blocking nerve signals" In other words, the ideal device will measure and, in real-time, provide the appropriate stimulus waveform to suppress or alter pathological oscillations.

Clayton researchers, Drs. Paydarfar and Chang at the Dell Medical School have developed tools to read and, in real-time, suppress pathological oscillations by applying an optimal stimulus waveform. To do this, they had to address another limitation in current devices, which is their reliance on simple waveforms that are empirically tuned by clinicians without altering the fundamental shape of the stimulus. This translates into devices that offer patients suboptimal therapy due to ineffective waveform stimulus, which cannot effectively correct pathologic oscillations. Our new system presents a much more specific way to effectively treat oscillopathies with non-traditional stimulus waveforms, obviating the need for phase specificity by employing algorithms that use reinforcement learning and extrema distortion.



Closed-loop therapy: Our new system comprises an electrode that reads a signal from a set of nerves, generates a phase-agnostic simulation using algorithms (reinforcement learning and extrema distortion) and then sends a signal through a second electrode to stimulate or suppress a waveform back to the targeted nerves.

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