

A method to improve the clinical utility of kilohertz frequency alternating current devices to treat neurological disorders

Unmet Need

Many neurological disorders, including pain and spasticity, are characterized by undesirable increases in sensory, motor, or autonomic nerve activity. Local application of kilohertz frequency alternating currents (KHFAC) can effectively and completely block the conduction of undesired hyperactivity through peripheral nerves and could be a therapeutic approach for alleviating disease symptoms. However, KHFAC nerve block produces an undesirable initial burst of action potentials (APs) prior to achieving block, known as onset response. This onset firing may result in muscle contraction and pain and is a significant impediment to potential applications of KHFAC nerve block. There are some existing approaches to reduce or eliminate the onset response, such as electrode geometry design and amplitude and frequency modulation of the applied signal. However, these approaches are often unable to completely eliminate onset firing and can be challenging for clinical implementation. Hence, there is an ongoing need for improved methods of KHFAC treatment.

Technology

Duke inventors have reported a method of pain-free blocking of neural activity intended to improve the clinical utility of KHFAC-based devices. Specifically, this is a novel engineering optimization approach to design blocking waveforms that eliminates the onset response by moving voltage-gated Na⁺ channels (VGSCs) to closed-state inactivation (CSI) without first opening. The inventors used computational models and particle swarm optimization (PSO) to design a charge-balanced 10 kHz biphasic current waveform that produced conduction block without onset firing in peripheral axons at specific locations and with specific diameters. This technology has been demonstrated in lab simulations.

Advantages

- Eliminates muscle contraction and pain associated with KHFAC therapies
- Could improve the treatment of neural disease

Duke
LICENSING
& VENTURES



Duke File (IDF)

T-006969

Inventor(s)

- Grill, Warren
- Yi, Guosheng

Links

- [From the lab of Dr. Warren Grill](#)

College

Pratt School of Engineering

For more information please contact

Mullins, Alexandria "Alex"

alex.mullins@duke.edu

symptoms such as pain and spasticity

Publications

- [Kilohertz waveforms optimized to produce closed-state Na⁺ channel inactivation eliminate onset response in nerve conduction block \(PLoS Computational Biology, 2020\)](#)
- [Published US Patent App 17/167,579](#)