Neuromodulation by High Frequency Ultrasound

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Technology description

The ability to selectively stimulate specific nerve fibrils in a complex nerve bundle is a long sought-after capability in biomedical research. The artificial excitation or inhibition of nerve cells allows researchers to either stimulate nerve function or block pain impulses. One method that accomplishes artificial stimulation is to place electrodes in direct contact with specific nerve fibrils. Another approach is to use a nerve cuff which involves placing multiple electrodes around the nerve to create an electric field designed to stimulate a specific nerve fiber. Unfortunately, the first method is invasive and fails to achieve the needed specificity. The nerve cuff, although an improvement, still falls short of the task of achieving complex motion.

In an exciting development, Dr. Bruce Towe and Dr. William Crisp of Arizona State University have demonstrated the ability to integrate micro-sized high frequency ultrasound transducers into electrodes to achieve neuromodulation. This allows the reduction of electric current that is typically required to achieve neural stimulation which will reduce stimulation pain as well as make possible other electrostimulation applications that are not currently possible. Many neurostimulation systems require implanting of electrodes, which is invasive and typically requires the use of leads that emerge from the subject's body. When electrodes are located on the surface of the subject; the electrical field required to stimulate the nerve fiber may cause significant pain. This new technology is wireless, and energy is transferred using acoustic energy to implanted piezostimulators.

Application area

This technology may be used to improve or create a variety of biomedical products including:

Improved functional electrical stimulation (FES) – Similar to commercially available Free-Hand™ but with improved nerve fibril focusing capability

Improved electrocutaneous stimulation for pain relief – with reduced shocking sensation common with commercial pain relief devices

Spinal neuroprostheses – Next generation devices to treat spinal cord injuries based on increased sensitivity and selective neurostimulation

A pudendal nerve stimulator for treatment of urinary incontinence – may be configured as a handheld device

Advantages

Noninvasive – Unlike existing technologies, the high frequency ultrasound nerve stimulation may be applied noninvasively
Reduction of current input – Less painful to patients allowing greater tolerance to treatments
Increased specificity – The ability to better focus impulses on specific nerve fibrils is an important improvement over existing technologies

Institution

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