Neuroengineering

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Development and Prospect of Neuromodulation Technology

Abstract

The Brain remains a mystery to us because scientists lack the tools to study it. However, this situation is start to change through rapid progress in the development of innovative neurotechnologies that are helping scientists to better understand the brain function, treat a wide range of brain disorders, and ultimately, develop the brain-machine interface and brain-like intelligence technology. The engineers use the engineering principles to develop quantitative tools and methods for the brain research. Scientists use these neurotechnologies for understanding the complex neural computation and behavior via recording and processing neural activities, as well as improve and repair brain function through modulating the neurons. Neuromodulation is the process by which nerve activity is modified through electrical, optical, thermal, cryogenic, acoustic, magnetic or chemical stimulation. Neuromodulation technology is a contemporary and emerging field that offers a cross-disciplinary approach for investigating neural circuits and treating neurological and psychiatric disorders. Neuromodulatory devices are developed and used for a growing number of indications including Parkinson's disease, pain, epilepsy cerebral palsy, or multiple sclerosis, anxiety, depression, psychosis, somatoform disorders and so on. What are the clinical needs that will drive the further advancement of neuromodulation technologies in the next decade? This presentation will introduce the development and application of current neuromodulation technologies, such as optical stimulation, deep brain stimulation (DBS), transcranial magnetic stimulation (TMS) and transcranial direct current stimulation (tDCS). Meanwhile, the development prospects of the focused ultrasound (FUS) neuromodulation will also be mentioned.