Cellular Level Studies and Coil System Design for Transcranial Magnetic Stimulation

Yiwen Meng

Abstract

Transcranial Magnetic Stimulation is a new neuromodulation technique to non-invasively treat human brain disorders like Depression, Parkinson's disease and PTSD. It uses pulsed signal to generate time varying magnetic field which would induce current into conductive tissues in human brain. Recently, there are mainly research interests in TMS, such as coil design, clinical trials, in-vitro and in-vivo studies.

Even though TMS has been approved to treat human brain disease in clinical trials, the basic mechanism or how does the neural issue react to TMS is still not well understood. Therefore, conducting in-vitro study on TMS would investigate how does TMS has influence on neural cells and neural tissues on main aspects like growth rate, morphology, axon length and other factors. Here, we conduct experiments with TMS on N27 dopaminergic neural cells, from the brain of mice, to investigate the effect on cell's growth rate. This study could give some preliminary result to understand the mechanism of TMS on neural cells.

Meanwhile, due to the limitation of patient's head size and fast decaying rate of field away from coil surface, designing an efficient and compact coil system is highly needed to treat deep brain regions. We have developed a variable coil system with combination of fixed single coil on top and variable Halo coil to realize deep brain stimulation with automatic control system and graphic user interface (GUI). In the meantime, doing thermal and mechanical analysis to investigate heating effect and electromagnetic force on the whole coil system is a big premise to build the system.