Biology and Medicine Through Mathematics Conference

2017

May 18th, 6:00 PM - 6:30 PM

# An Interdisciplinary Approach to Computational Neurostimulation

Madison Guitard
*Roger Williams University*, mguitard858@g.rwu.edu

Madison Guitard

# An Interdisciplinary Approach to Computational Neurostimulation

Transcranial direct current stimulation (tDCS) is a noninvasive neurological treatment that applies low doses of electrical current directly to a patient's head surface using scalp electrodes with the goal of modifying cortical excitability, which is the propensity of neurons in the brain to fire action potentials. This treatment has shown great promise as a medical intervention for neurodegenerative diseases such as Parkinson’s disease and Alzheimer’s disease. The central focus of our project is to determine and quantify the influence that individualized cranial tissue conductivities have on delivering an electric field from electrotherapies, such as tDCS, to a targeted region of the brain. Existing simulations of tDCS, as well as other modes of neurostimulation, typically choose average values for the conductivities of the scalp, skull, cerebrospinal fluid, and gray and white matter tissues, and so these simulations do not incorporate patient specific electrical conductivity variability. Therefore, it is currently unclear whether these standard values are appropriate and most effective for simulations for all patients. The goal of this research is to determine how variability in conductivity impacts tDCS simulation predictions. To achieve this goal, we are working to create a stochastic partial differential equation based mathematical model of tDCS, and assess the impact that differences in conductivities have on simulation efficacy. Our governing equations include the Laplace Equation, as well as several Dirichlet and Neumann boundary conditions that model tDCS treatment conditions. We are in the process of solving the Laplace equation in Cartesian coordinates and polar coordinates for an idealized two-dimensional geometry. We plan to then run numerical simulations in order to assess and quantify the importance of incorporating conductivity stochasticity into computational simulations of tDCS. We would like to be able to present our knowledge, and what we have learned from this research, to an audience at the conference through a poster in order to inform them of the forward movements we have made in increasing the efficiencies of neurostimulation treatments.