171. An Interdisciplinary Approach to Computational Neurostimulation

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Mathematical models of electrotherapies are proving to be a valuable accompaniment to these medical treatments; in particular, modeling the transcranial direct current stimulation (tDCS) mode provides a predictive component to assess and quantify voltage and electrical current distributions in the head cavity, which in turn gives a direct measure of treatment efficacy. One fundamental drawback of these simulations, however, is the fact that precise material conductivity values are unknown for a particular patient, and in addition, are highly variable within a tissue type. As these values greatly impact simulation results, simulation utility is highly dependent on them. To address this issue, we have imple-mented a mathematical model of tDCS using a stochastic partial differential equation coupled with mixed boundary conditions. The finite element method is used to solve our governing system, and Monte Carlo experiments over scalp, skull, brain fluid, and brain tissue variabilities are performed. Numerical simulations are performed on an idealized two dimensional mesh, and then extended to an MRI-derived three dimensional head geometry. Our preliminary results showcase the importance of incorporating and quantifying this conductivity uncertainty within mathematical models of tDCS.