Computational and imaging tools for targeting non-invasive brain stimulation

Organizers:

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Non-invasive transcranial electrical and magnetic brain stimulation (tDCS,tCS, and TMS) is rapidly becoming of increasing interest in both research and clinical communities. However, targeting stimulation for desired effects remains difficult and results are highly variable across individuals and stimulation schemes. Thus, there is a clear need to develop better understanding of how different stimulus approaches affect currents in the brain, taking into account the many factors involved. These factors include individual anatomical differences, anisotropic structures, the important role of current direction on stimulus effect, and the variety of stimulation technologies. In this symposium we bring together presentations from four different laboratories, all taking different and complementary approaches, with a variety of mathematical, imaging, and software platforms. The speakers will illustrate challenges and possibilities for both imaging and modeling approaches towards better understanding and control of transcranial stimulation. Participants can expect to learn about current challenges in non-invasive brain stimulation and the state-of-the-art in modeling and targeting methods. They will be exposed to a variety of approaches to subject-specific modeling and stimulus optimization and to methods and tools underlying current practice and future directions.

Learning Objectives:
1) What is the state-of-the-art of non-invasive brain stimulation and what are the critical current challenges?
2) What are state-of-the-art techniques to target specific brain structures with specific desired effects while minimizing the impact onto non-target regions? What is the role of subject-specific imaging and modeling, as contrasted with population-average approaches, in improving stimulation effectiveness?
3) What computational, imaging, and software tools are available, or needed, for more wide-spread simulation and optimization of brain stimulation?

Determining optimal electrode locations for tDCS

Dick Stegeman, Radboud University Nijmegen Medical Centre, Donders Institute for Brain, Cognition and Behaviour, Nijmegen, Netherlands

New numerical methods for electrode optimization and current density modeling in tCS

Sven Wagner, Institute for Biomagnetism and Biosignalanalysis, University of Münster, Münster Germany

Simulation, Visualization and Optimization of non-invasive brain stimulation using the SCIRun open-source software package

Moritz Dannhauer, SCI, Salt Lake City, United States

Targeting brain networks with TMS and tDCS

Michael Fox, M.D., Department of Neurology, Massachusetts General Hospital, Brigham and Women's Hospital, Boston, MA, United States