Computational study on spatially distributed sequential stimulation (SDSS)

Summer student project for May-August 2018, supervised by **Kei Masani**

Target Student Population(s)

Undergraduate student in Engineering Science, Biomedical Engineering, or Mechanical Engineering in years 1-4.

Brief Project Description

Transcutaneous neuromuscular electrical stimulation (NMES) is a rehabilitation tool used to help individuals with motor impairment. NMES-evoked muscle contractions during therapy is limited by the rapid onset of fatigue when delivered conventionally using a single electrode. Spatially distributed sequential stimulation (SDSS) is a novel neurostimulation method that has been developed with the purpose of reducing muscle fatigue in NMES-based rehabilitation or exercise. Although the effects of SDSS have been investigated in a clinical setting, no computational studies have been performed that allow for a greater understanding of the underlying mechanisms of the strategy. Finite element modeling for electrical neurostimulation methods is frequently used in established healthcare companies with neurostimulation-based products as a mode of understanding and improving existing stimulation strategies and technologies. In order to improve the SDSS stimulation method, a deeper understanding of SDSS-induced current density in the lower leg is needed. The purpose of this study is to (1) investigate the mechanism of the SDSS method, and (2) improve SDSS method by (a) optimizing physical parameters, and (b) developing and improved SDSS-based stimulation algorithm.

Expected Learning Outcomes

- Learn how to use AutoDesk Inventor for 3D modeling.
- Greater understanding of anatomy of the lower leg.
- Gain a better understanding of how we can model current flow in biological tissue.
- Possible to gain experience using MATLAB and/or COMSOL.
- Gain a better understanding of electrical neuromodulation applications.
- Further develop research skills such as how to effectively read and write scientific literature.

Expected Research Outcomes

Through this project, you will be contributing to an active research project in our laboratory and will be developing 3D models of the lower leg that will be used for future current flow simulations. Every effort will be made to recognize your contributions to the research projects and the journal and/or conference publications that come out of it.

Required technical Skills

- Extensive experience using CAD software (AutoCAD/SolidWorks/Inventor etc.)
- Experience with reading and critiquing scientific literature (optional)
- Experience with COMSOL (optional)
- Programming experience in MATLAB.

Funding

Funding for this project may be obtained through competitive scholarship: NSERC USRA and IBBME Director's Awards. It is the student's responsibility to apply in a timely manner, with the approval and assistance of their supervisor.

Application Details

To apply for this project, you must first complete the IBBME USRP application (Note: only need to do this once). Once you've done that, please email your updated CV and a statement of intent to Dr. Kei Masani (k.masani@utoronto.ca). Explain briefly why you are interested by the project and its outcomes, and why you would be a good fit for this project. Please also provide your latest transcript (can be unofficial) to help us assess your chances to obtain funding. The subject of your email should be "Summer Student Application: SDSS Project".