**Summer 2018 USRA Opportunities in MEG and Epilepsy Neuroimaging**
Supervisor: Teresa Cheung

The Research Project:
This is a collaborative project between Professor Douglas Cheyne at the Hospital for Sick Children/University of Toronto and Dr. Teresa Cheung, Surrey Memorial Hospital/Simon Fraser University, to assess current analysis techniques and establish standardized approach for surgical planning in intractable epilepsy using Magnetoencephalography (MEG). MEG is a non-invasive neuroimaging modality that is used to measure the magnetic fields associated with cortical neuronal function and dysfunction. The Hospital for Sick Children has pioneered the use of MEG for surgical planning in children with medically refractory epilepsy who are candidates for surgical removal of the epileptic focus. Epilepsy treatment programs at other Canadian hospitals are now expanding to include MEG technology, and there is an increasing need to standardize protocols associated with the collection, post processing and analysis of preoperative MEG data. This project aims to develop well-validated and automated data analysis pipelines to improve the clinical efficacy of MEG in surgical planning, and to translate more advanced analysis methods into clinical practice. This first stage of the project will assess currently used techniques at Canadian and international MEG sites in both child and adult clinical populations. The goal is to establish robust procedures for MEG data collection and analysis for the purpose of epilepsy diagnosis.

Qualifications we seek:
We are looking for a student with strong computer and programming skills particularly using Linux or Unix operating systems. Desirable (but not essential) skills include BASH and MATLAB scripting, Python and the use of machine learning algorithms, previous experience with MEG, EEG and/or MRI data analysis techniques and signal processing methods, or prior experience with other neuroimaging software packages such as SPM, Fieldtrip, FreeSurfer and/or FSL.

Your Role:
You will analyze spontaneous interictal MEG data from individual patients using existing techniques and compare them to new methodology being developed. You will also examine techniques and feasibility for automating epileptic spike detection and abnormal signal morphology identification through approaches like kurtosis and entropy. You will gain immersed interdisciplinary experience; both depth and breadth in non-invasive medical technologies; advanced computer skills such as programming stimulus paradigms, scripting algorithms and working in a multiplatform environment including Linux, Mac, and Windows; experience in data collection, signal processing, data analysis and data fusion of MRI, fMRI, DTI, MEG, EEG (ERP) of spontaneous, resting and event-related data; expertise with neuroimaging packages, mathematical and statistical knowledge such as univariate and multivariate analysis, structural equation modeling, independent component analysis and connectivity analysis; and skills biomedical instrumentation.

In addition, you will be immersed in a culture of technology transfer and innovation. You will gain a deep understanding of the medical technology industry, learn to communicate effectively across sectors, and acquire industry-relevant skills such as the handling of intellectual property. You will be part of a wider group with access to training and mentorship from investigators spanning disciplines such as Biomedical Engineering, Physics, Statistics, Computer Science, Neuroscience, Biomedical Physiology and Kinesiology (BPK), Psychology, and Applied Mathematics. You will be located at Surrey Memorial Hospital at the SFU ImageTech Lab and have opportunity to visit the MEG lab at the Hospital for Sick Children in Toronto. Both sites have access to state-of-the-art neuroimaging capabilities including MRI, MEG and EEG. Embedded in hospital settings, these training environments bridge technical, scientific and clinical realms that will prepare you for careers in both industry and academia.