Graduate Diploma in Health Research
PROGRAM – 2018 SUPERVISOR & PROJECT INFORMATION FORM

Please complete and return via email only (gdip.hres@utoronto.ca) by September 4, 2018 (forms received after this date will not be posted).

Supervisor Information

Name: William D Hutchison                Email: bill.hutchison@uhnresearch.ca

Degree(s): B.Sc.(Trinity), M.Sc (Pharmacol U of T), PhD. (Canb.)

SGS Department: Physiology and IMS

Academic Rank: Full Professor            Field of Research: Neuroscience

Research Institution Affiliation (if applicable): Krembil Brain Institute

Allocation of student contact time: 10 hrs
(number of hours per week YOU are available to the student for any concerns or to review progress)
**Project Information** (for posting on GDipHR website)

**Title**: Introperative microelectrode recordings during movement disorders surgery

**Description (max 500 words):**

Deep brain stimulation (DBS) is offered as standard therapy in cases of medically refractory movement disorders. DBS involves the bilateral implantation of two quadripolar electrode leads into deep nuclei of the basal ganglia and thalamus with a continuous electrical stimulation being delivered via a subcutaneous lead connected to a battery pack in the subclavicular area. The three most common targets employed are DBS of the 1) subthalamic nucleus for Parkinson’s disease, 2) ventral intermediate nucleus of the thalamus for tremor and 3) ventroposterior globus pallidus internus for dystonia/dyskinesias. Targets are acquired using a Leksell frame in 3 coordinates which is applied to the patients head and then a 3T MRI scan it take to reference subcortical structures to the frame coordinate system. In order to confirm target locations two fine microelectrodes are passed down incrementally towards the tentative imaging target to record the characteristic firing rates and patterns of the individual neurons in each nucleus along the track. During this time we can interrogate the neurons with small electrical currents or request the patient do specific motor or cognitive tasks to identify the types of neurons in each area. The two channels of data are saved to computer files and stored for offline analysis. Further data analysis on spike trains is conducted using in house Matlab scripts to probe the relationships of spikes to local field potential oscillations and methods have also been developed to study synaptic plasticity of the regions and how they related to motor and cognitive deficits.

Students would work in the operating room at the Toronto Western for the implant surgery and data collection but also have access and opportunity to present at a weekly journal club with the movement disorders group of Dr Lang and Fasano at the Toronto Western Hospital. In addition they will interact with some clinician scientist trainees working in neighbouring labs of Dr Andres Lozano MD PhD and Dr Robert Chen, MSc MBBChir. Current research projects are looking at mechanisms of action of DBS using different frequencies of electrical stimulation and their effects on neuronal firing in thalamus and subthalamic nucleus, synaptic plasticity in basal ganglia output nuclei with patterned stimulation trains at theta frequency and the effects of medications like levodopa on synaptic plasticity produced with long trains of stimulation. There is a large case load of some 100 patients per year across 3 functional stereotactic surgeons plus a 4th site in Medellin Colombia of about 30 cases per year with additional access to diffusion tract image (DTI) tracing to map the anatomical pathways associated with effective DBS contacts. There is a steady supply of information to process and experiments to complete so only the productivity of the student is the limiting factor to publishing results. Recent publications from our group include:


If human subjects are involved, have the appropriate Research Ethics Board approvals been obtained?
☐ YES ☐ NO ☐ Application Submitted ☐ N/A

Do you expect this work will be published within the 20 months?
☐ YES ☐ NO ☐ Uncertain
Student’s roles and responsibilities (please be as specific as possible):

Some or all of the following tasks may be requested:
Attend and help set up microelectrode equipment in operating room prior to DBS cases
Draw stereotactic maps. Attend microelectrode recordings sessions, learn signature neuronal signals that identify deep target nuclei
Annotate data files during data acquisition. Present stimulation tasks to patient during surgery.
Save files, transfer files to desktop workstations,
Process files using Spike2 software and in house documented methods for specific experiments
Process files using Matlab software for higher level pattern analysis, signal processing tools such as fast Fourier transforms of spikes and LFPs, spike to LFP coherence across a 2 channel 4X4 matrix.
Attend movement disorders journal club each Wednesday at 8 am. Present current papers relevant to the topics under research. interact with neurologists and movement disorders clinical fellows

Please indicate who will serve as the student’s direct report for daily oversight (PI, PhD student, technician, etc...):

Either the PI or visiting post-doc engineering professor from Netherlands, PhD student or
clinical fellow from Lozano’s lab