NEW MASTER OF BIOMEDICAL SCIENCE PROJECTS AVAILABLE FOR 2014 ENTRY

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Characterization of Nitinol as a neural recording and stimulating electrode material

*Supervisors:* Nick Opie, Sam John (Dept. of Electrical and Electronic Engineering)

*Aim:* Characterize the electrical properties of Nitinol and evaluate the feasibility of using Nitinol as a recording or stimulating electrode.

*Description:* This research will involve planning and conducting rigorous electrochemical evaluation of Nitinol and platinum. You will use standard electrochemical techniques to characterise the ability of Nitinol to record and stimulate neural tissue and compare it with the properties of platinum.

1) Characterization of the Electrode Array
   - Test Nitinol and Platinum electrodes at different times in saline. Electrodes are stored in accelerated testing conditions. (1 month)
     i) Electrochemical Impedance Spectroscopy (EIS)
     ii) Cyclic Voltammetry (CV) at different time points
     iii) Surface Morphology at each time point (Microscopic assessment)
     iv) Charge Injection (voltage transient analysis)

2) In-vivo recording properties of Nitinol
   - i) Test Nitinol and Platinum arrays in an in-vivo model and compare signal quality of the two arrays.
   - ii) Charge Injection (voltage transient analysis)


*Supervisors:* Tom Oxley, Sam John (DEEE), David Grayden (DEEE), Terrence O’Brien

*Aim:* To develop an autonomous interface to assist with functional brain mapping.

*Description:* Functional brain mapping is useful for preoperative planning and decision making during resective brain surgery in neurosurgical patients with conditions such as brain tumours, vascular lesions, and epilepsy. Electrocorticograms are used to map eloquent areas of the brain related to motor and sensory areas that must not be removed. Present techniques require the presence of a clinician to record the functional brain mapping. This project will focus on developing a fully autonomous platform for functional brain mapping using electrocorticograms.

Identification of different states of motor attentiveness in humans.

*Supervisors:* Tom Oxley, Sam John (DEEE), Terrence O’Brien

*Student:* Bachelors/Masters/Honours/industry project (capstone) in Biomedical Engineering, Science.

*Aim:* To identify different states of motor attentiveness and intent of volitional movement in human patients.

*Description:* Electrocorticograms (ECoG) recordings provide a means to evaluate and implement a brain computer interface. Optimal BCI require accurate feature extraction and signal processing to identify electrophysiological correlates of motor events. This project will focus on developing the experimental paradigms and analysis tools to record broadband ECoG from patients participating and identify the change in power spectrums during volitional movement.
Developing a behavioural ovine model for evaluation of a brain computer interface.

**Supervisors:** Tom Oxley, Sam John (DEEE), Nicholas Opie, Clive May (HFNI)

**Aim:** Develop an ovine model of volitional movement for a proof of principle brain computer interface.

**Description:** Brain computer interfaces rely of detecting changes in the broadband power spectrum. Animal studies evaluating the feasibility of brain computer interfaces use non-human primates and are expensive and not easily accessible. Preliminary experiments show distinct electrophysiological correlates of volitional movement in an ovine model and promises to provide an alternative animal model to evaluate feasibility of Brain computer interfaces. This study seeks to develop behavioural paradigms and experimental setup of volitional movement in an ovine model.

**Preferred:** Candidate will have experience in electrophysiological recording, signal processing and behavioural neuroscience. Some experience in LabVIEW and Matlab would be desired.

Feasibility of minimally-invasive deep brain stimulation

**Supervisors:** Tom Oxley, Sam John (DEEE), Terence O’Brien

**Aim:** To demonstrate proof of principle for stimulation of motor cortex, from within a cerebral vein.

1) Demonstrate homunculus mapping via endovascular stimulation of motor cortex from a cerebral vein.
2) Demonstrate beta desynchronisation using high frequency stimulation to motor cortex.
3) Evaluate histological response to chronic (weeks) stimulation.

**Description:** Having demonstrated proof concept for chronic recordings in an animal model, this project would continue our work to demonstrate capacity to stimulate cortical tissue. This would signify a potential paradigm shift in deep brain stimulation, and represent a less invasive method of achieving brain stimulation for treatment of movement disorders.