Title: Towards an efficient, novel and adaptive signaling system for deep brain stimulation
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Background:
Deep brain stimulation (DBS) is a surgical procedure involving the implantation of a battery-operated medical device called a neurostimulator or a pacemaker. The device has a signaling system which sends a continuous sequence of pre-determined electrical pulses to specific parts of the brain (such as the subthalamic nucleus) to block or eliminate abnormal nerve signals that cause certain symptoms (e.g. movement disorder).

DBS has provided remarkable therapeutic results in treating a variety of neurological related symptoms such Parkinson’s disease (PD), dystonia, chronic pain, major depression, essential tremor which is a common neurological movement disorders. Unlike other surgical treatments such as lesioning techniques in which selective damage (a lesion) to certain cells of the brain is done, DBS interacts directly with the brain cells in a controlled manner and its effects are reversible.

In a recent report by Parkinson’s Australia (http://www.parkinsons.org.au), it is found that 30 people are diagnosed with Parkinson’s every day; which is an increase of 17% over the last six years with 20% of people affected are of working age and an average person lives for about 12 years from diagnosis. Parkinson is found to be a commoner than prostate, bowel and many other cancers with an estimated burden of the disease for 2011-12 valued at $7.6 billion, an increase by over 48%.

The Food and Drug Administration (FDA) approved DBS as a treatment for essential tremor in 1997, and for Parkinson’s disease and dystonia in 2002 and 2003 respectively. Although DBS has proven helpful for many patients, many doctors recommend DBS only for patients whose symptoms cannot be adequately controlled with medications. DBS underlying mechanisms and principles are still not clear and there is a potential for serious complications and side effects. As a result, extensive research and development of new treatments and efficient signaling systems are needed.

Aims:
• The main aim of this major project is to carry out the preliminary tests required for the development of an efficient, novel and adaptive signaling system for deep brain stimulation (DBS); specifically for the treatment of Parkinson’s disease (PD). However, for the BE final year project, the student(s) will research a small part of this major project which will allow them to:
  o Find out how DBS systems work, their limitations and the type of signals used in these systems
  o Do a literature review of any previous work done to identify the relationship between the DBS signals used and the movement patterns (of e.g. a hand) of patients with PD
  o Learn how to use adaptive algorithms in control systems and signal analysis
  o Learn how to use EEGLAB (http://sccn.ucsd.edu/eeglab/) which is Matlab toolbox for processing Electroencephalography signals
  o Use EEGLAB to analyze a number of experiments (available online) and propose new signal analysis algorithms (http://sccn.ucsd.edu/~arno/fam2data/publicly_available_EEG_data.html)
  o Propose algorithms that can output and analyze the 3D motion of a moving subject (e.g. the hand or a senor attached to the hand) captured by the new LEAP motion sensor or the Microsoft Kinect