Complexity Science mini-project proposal 2011-12

Project title: Assessing the use of single channel commercial EEG headset for rudimentary brain-computer interfacing.

Background: Brain-computer interfacing (BCI) [1] is a technique that allows the communication of intent (thoughts) through brain activity alone. Through scalp electrode based electroencephalogram (EEG) recordings of brain signals under very specific conditions it is possible to classify activity based on specific intent (e.g 'yes' vs 'no'; 'up', vs 'down', 'left' or 'right'; etc.). BCI is a field which is of great use in individuals with muscle-wasting diseases and the resulting inability to communicate through any usual means. There are a few means of obtaining communication through BCI, and all usually require the use of expensive clinical EEG recording systems. With more than one type of "gaming" headset now on the market to perform BCI relatively inexpensively, it would be useful to be able to use these very simple systems to extract rudimentary BCI signals.

Objectives: The objectives of this project are to: a) access data from an off-the shelf BCI headset; b) create analysis software to process the recorded data, de-noise it etc. ready for classification; c) explore BCI paradigms that could be used with such headset; d) do a performance analysis of any system developed to assess suitability/ fitness for purpose.

What the student will do:

a) Familiarise themselves with the single channel Mindset BCI headset.
b) Run simplistic BCI trials in the Neural Engineering lab on volunteers, using appropriate stimuli.
c) Develop data analysis algorithms to de-noise the data.
d) Develop pattern analysis algorithms to search for relevant activity signatures in the data.
e) If appropriate develop new stimulus patterns with the intent of increasing data.
f) Assess performance of the system and present results.

Possible PhD project:

There is much scope for continuing this project into a PhD, there is a clear need to have a low-cost, portable, BCI headset for use "in the field". This usually means that data quality suffers – however it is our belief that this can be compensated for through more intelligent analysis of the measured data and through cleverer use appropriate stimuli to generate neural responses.

References

[1] Farwell, LA; Donchin, E (1988). "Talking off the top of your head: toward a mental prosthesis utilizing event-related brain potentials.". Electroencephalography and clinical neurophysiology 70 (6): 510–23. doi:10.1016/0013-4694(88)90149-6. PMID 2461285.