7B11  Neural Signal Analysis [5 credits]

Lecturers:  Professor Richard Reilly, School of Medicine, School of Engineering

Semester:  1

Module Organisation

The module runs for 12 weeks of the academic year and comprises three lectures per week. Total contact time is 33 hours.

Module Description

The purpose of this module is to equip students with basic and sophisticated mathematical tools for the analysis of neural data including EEG, MEG, fMRI and intracranial data. The tools will include harmonic analysis, filtering, independent component analysis and wavelets. All methods will be developed to answer specific questions on real data sets and the lectures will be accompanied by MATLAB-based analysis assignments throughout the semester. The scoring of the module will encourage this practical application of the methods by an even weighting of scores between the exam and the MATLAB-based assignments.

Prerequisites: 4C5 Digital Signal Processing

Learning Outcomes

On successful completion of this project the student will be able to:
1. Intuitively understand the meanings of the Fourier and Laplace Transforms.
2. Intuitively understand how filtering of digital signals works.
3. Analyse EEG data using the event-related potential technique and time-frequency methods.
4. Understand the meaning of fMRI and how to analyse it.
5. Derive graph theoretic measures of functional connectivity from neural data.
6. Build and test a computational model of a neural system.

Module Content

- The analysis of linear time-invariant systems.
- The sampling theorem.
- Noise and filtering.
- Electroencephalography: generators, analysis and interpretation.
- Intracranial data: sources, interpretation and analysis.
- Functional magnetic resonance imaging: origin of the BOLD signal and its analysis.
- Estimating connectivity patterns from neural signals.
- Computational modelling of neural systems.
Module Notes

Provided via Blackboard

Teaching Strategies
The course is lecture based, but a large emphasis is placed on accompanying MATLAB-based assignments. These assignments involve applying methods learned in lectures to real neural data.

Assessment Modes

Written Exam (50%), and learning assignments (50%).

Recommended Texts