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Functional Imaging

Semester 2 / January **10 Credits**

Each Course is composed of Modules & Activities.

Modules:

BOLD Signal	IMSc	NI4R
Experimental Design	IMSc	NI4R
Pre-processing	IMSc	NI4R
GLM	IMSc	NI4R
Statistical inferences	IMSc	NI4R
fMRI Issues	IMSc	NI4R
EEG	IMSc	NI4R
Neurophysiology Primer	IMSc	NI4R

Each Module is composed of Lectures, Reading Lists, MCQ self-assessments, & Discussion Boards.

These Modules are taught on the following Programmes, or are incorporated into blended Courses which teach students enrolled outwith the Edinburgh Imaging Academy:

- NI4R - Neuroimaging for Research programme
- IMSc - Imaging programme

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Modules include:

BOLD Signal:
BOLD Signal

Experimental Design:
Experimental design

Pre-processing:
Data processing

GLM:
The General Linear Model (GLM)

Statistical inferences:
Statistical inferences

fMRI Issues:
Issues: when activation tell us lies!

EEG:
Equipment, Recording and Physiology
MEEG – Data analysis and interpretation

Neurophysiology Primer:
NeuroPhysiology Primer

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BOLD Signal

Lecture 1
Title: BOLD Signal
Description: Blood Oxygen Level Dependent signal: origins and interpretations
Author(s): Dr. Cyril Pernet
Editor(s): Dr Andrew Farrall
Learning Objectives
Explain the origin of BOLD signal
- Describe its spatial and temporal characteristics
- Describe the physiology underlying BOLD signal
- Define activations and deactivations
- Outline the principles behind the BOLD signal response

Experimental Design

Lecture 1
Title: Experimental design
Description: Common fMRI experimental concepts and implementation
Author(s): Dr. Cyril Pernet
Editor(s): Dr. Andrew Farrall
Learning Objectives
- Outline the causes of fMRI noise
- Describe different fMRI design types
    - Blocked
    - Event-related
    - Mixed
    - Adaptation
- Explain the concept of “efficiency”
- Describe what is meant by statistical design

Pre-processing

Lecture 1
Title: Data processing
Description: Common fMRI data processing techniques
Author(s): Dr. Cyril Pernet, Dr. Andrew Farrall
Learning Objectives
- Understand the three main data processing steps: realignment, normalization, smoothing

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GLM

Lecture 1
Title: The General Linear Model (GLM)
Description: Performing statistics using the GLM
Author(s): Dr. Cyril Pernet, Dr. Andrew Farrall
Learning Objectives

- Explain the mathematics behind the GLM
- Know how to apply the GLM to fMRI
- Describe certain key concepts:
    - Design matrix
    - Linearity
    - Independence
    - Orthogonality
    - Variance
    - Contrasts

Statistical inferences

Lecture 1
Title: Statistical inferences
Description: Common fMRI data processing techniques
Author(s): Dr. Cyril Pernet, Dr. Andrew Farrall
Learning Objectives

- Describe multiple comparison correction procedures, and specifically:
    - Height Threshold
    - Bonferroni
    - Random Field Theory
    - False discovery Rate
- Discuss levels of inferences, specifically:
    - Set
    - Cluster
    - Voxel
- Know when circularity issues affect data

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fMRI Issues

Lecture 1
Title: Issues: when activations tell us lies!
Description: Common fMRI data processing techniques
Author(s): Dr. Cyril Pernet, Dr. Andrew Farrall
Learning Objectives

- Recognize, discuss, and know how to allow for these basic fMRI assumptions:
    - Processes investigated elicit changes in the haemodynamic response
    - Haemodynamic responses relate to the processes under study
    - Magnitude of haemodynamic change relates to the differential involvement of areas in a process
    - Decomposition of conditions and contrasting of images allow identification of key regions

EEG

Lecture 1
Title: Equipment, Recording and Physiology
Description: Introduction to magneto-electrophysiological recordings
Author(s): Dr. Cyril Pernet, Dr. Andrew Farrall
Learning Objectives

- Describe MEEG equipment
- Distinguish between the different types of electrophysiological recordings
- Explain the physiological principles
- Explain data recording
- List neural sources
- Outline principles behind neuronal communication

Lecture 2
Title: MEEG – Data analysis and interpretation
Description: Understanding MEEG data analysis
Author(s): Dr. Cyril Pernet, Dr. Alexa Morcom, Dr. Andrew Farrall
Learning Objectives

- Describe the principles behind and reasoning for data pre-processing
- Explain the origins of and assumptions which underlie ERP
- Explain the various types of data transformation performed before statistical analyses

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Neurophysiology Primer

Lecture 1
Title: NeuroPhysiology Primer
Description: Short Primer on brain cells and their links to neuro-imaging
Author(s): Dr Cyril Pernet
Editor(s): Dr Andrew Farrall
Learning Objectives

- Review the main cell types in the brain
- Review neural communication principles
- Highlight recent understanding of the connections between cell types and information processing
- Explain the links between the neural type and activity and brain imaging techniques.