



Organization for  
Human Brain Mapping

## Educational Courses

**Sunday, June 15, 2008**

*Corryong Hall 1 and 2 (Level 2)*

### **Basic MEG/EEG**

The increasing availability of MEG and the possibility to record EEG in the MR magnet emphasize the need for understanding the specificity of electrophysiological measures in functional brain mapping.

**Learning Objectives:** Having completed this course, participants will be able to:

- Understand the basic steps and options that need to be taken for electromagnetic mapping of neural mass activity using MEG and EEG; principles of designing an experimental protocol for clinical or basic research; discussion of the respective merits and limitations of MEG and EEG;
- Summarize the basic biophysics and methodology in signal processing to achieve image reconstruction and source localization from MEG/EEG surface maps (forward and inverse problems, estimators, regularization, statistical inference);
- Discuss innovative views on brain electromagnetic waves (oscillatory, induced, evoked activity) and their impact on experimental design and subsequent data analysis (time-frequency decompositions, coherence and phase synchronization).

**Target Audience:** A multidisciplinary audience (neurophysiologists, cognitive neuroscientists and engineers) interested in the potential of MEG/EEG as a brain mapping modality. This fourth edition of the HBM MEG/EEG course offers a review of the basics of electromagnetic brain mapping, with special emphasis on experimental practice and strong connection to neuroscience questions.

### **Course Schedule**

#### **Course Introduction and Motivation**

8:00–8:10 Introduction

**Sylvain Baillet, University of Paris, CNRS, La Salpetriere, Paris, France**

**Riitta Salmelin, Helsinki University of Technology, Espoo, Finland**

#### **Part I: Origins and Principles for the Non-Invasive Measurement of Neural Currents**

8:10–8:50 Electrophysiological Basis of MEG/EEG Signals

**Sylvain Baillet, University of Paris, CNRS, La Salpetriere, Paris, France**

8:50–9:30 MEG/EEG Instrumentation and Experimental Design

**Lauri Parkkonen, Helsinki University of Technology, Espoo, Finland**

9:30–9:45 Break

#### **Part II: Methods for MEG/EEG Brain Mapping**

9:45–10:25 Principles of MEG/EEG Forward Modelling

**Jens Haueisen, University Ilmenau, Germany**

10:25–11:05 From Scalp to Source Estimates: Imaging and Localizing  
**John C. Mosher, Los Alamos National Laboratory, Los Alamos, NM, USA**

11:05–11:20 Break

11:20–12:00 Statistical Inference for MEG-EEG Imaging  
**Dimitrios Pantazis, University of Southern California, CA, USA**

12:00–12:40 Wrap-up of Concepts with Software Demonstration  
**Francois Tadel, University of Paris, CNRS & INSERM, Neurospin, France**

12:40–13:40 Lunch

### **Part III: Oscillations and Networks**

13:40–14:10 Brain Rhythmic Activity and Imaging Dynamic Networks: From Coactivation to Causality  
**Jan Kujala, Helsinki University of Technology, Espoo, Finland**

14:10–14:50 Dynamic Causal Modelling  
**Rosalyn Moran, Functional Imaging Laboratory, London, UK**

14:50–15:05 Break

### **Part IV: MEG/EEG Brain Mapping in Practice**

15:05–15:45 MEG and Cognitive Neuroscience  
**Riitta Salmelin, Helsinki University of Technology, Espoo, Finland**

15:45–16:25 High-Density EEG in Clinical Use  
**Daniel Brandeis, University of Zurich, Zurich, Switzerland**

16:25–17:05 Clinical Use of MEG  
**Steven Stufflebeam, Athinoula A. Martinos Centre, Massachusetts General Hospital, Harvard, Charlestown, MA, USA**

**Sunday, June 15, 2008**

*Bellarine 6 (Level 5)*

#### **Advanced fMRI**

There has been explosive interest in the use of brain imaging to study cognitive and affective processes in recent years. A recent surge in integrative empirical work combines neuroimaging data with measures of human performance, physiology, and brain structure. Functional magnetic resonance imaging (fMRI) is a neuroimaging technique central to this endeavor, and research using fMRI is one of the fastest-growing areas in psychology, neuroscience, and related social sciences.

fMRI research is inherently cross-disciplinary in nature, and methods for acquiring and analyzing fMRI data are being rapidly developed. Thus, there is a need for continuing education on state-of-the-art methodological developments in fMRI acquisition and analysis.

**Learning Objectives:** Having completed this course, participants will be able to:

- Understand the potential and limitations inherent in fMRI acquisition and new advances in overcoming some of those limitations;
- Understand principles of multi-level univariate analysis and statistical inference (at individual participant and population levels) from frequentist and Bayesian perspectives;
- Understand multivariate modeling techniques and their uses and limitations, including data reduction procedures, functional/effective connectivity and path models, and application of classifier systems to fMRI data;
- Understand techniques that integrate fMRI data with structural brain data and electrophysiology;

- Understand the role of meta-analysis in establishing mappings between brain states and mental states, and review new developments in meta-analysis of functional neuroimaging data.

**Target Audience:** Research scientists with intermediate to advanced knowledge of fMRI techniques who wish to gain breadth and depth in their understanding of a variety of contemporary methods.

## Course Schedule

### Course Introduction

8:30–8:45 Introduction to the course  
**Tor D. Wager, Columbia University, New York, NY, USA**

### Part I: Fundamentals of Functional Neuroimaging

8:45–9:15 fMRI: Current Directions and Future Horizons  
**Rainer Goebel, Maastricht University, Maastricht, Netherlands**

9:15–10:00 Physics  
**Rasmus Birn, National Institutes of Mental Health, Bethesda, MD, USA**

10:00–10:15 Break

### Part II: Modeling and Analysis

10:15–11:00 Multilevel Linear Modeling: Within- and Between-Subjects Modeling of fMRI Time Series  
**Martin Lindquist, Columbia University, New York, NY, USA**

11:00–11:30 Thresholding and Multiple Comparisons  
**Tom Nichols, GlaxoSmithKline, London, UK**

11:30–12:15 Bayesian Analysis of Neuroimaging Data  
**DuBois Bowman, Emory University, Atlanta, GA, USA**

12:15–13:00 Lunch

### Part III: Connectivity and Classification

13:00–13:45 Multivariate Analysis: Data Reduction, Component Analyses, and Functional Parcellation  
**Jean-Baptiste Poline, Service Hospitalier Frédéric Joliot, Orsay, France**

13:45–14:30 Classifier Analyses and Prediction of Mental States From Brain Activity  
**Stephen LaConte, Baylor College of Medicine, Houston, TX, USA**

14:30–15:15 Functional and Effective Connectivity  
**Barry Horwitz, National Institute on Deafness and Other Communication Disorders, Bethesda, MD, USA**

15:15–15:30 Break

### Part IV: Multi-Modal and Multi-Study Approaches

15:30–16:00 DTI and fMRI Combination  
**Tim Behrens, University of Oxford, Oxford, UK**

16:00–16:45 fMRI and EEG Combination: Acquisition and Analysis  
**Mark Cohen, University of California, Los Angeles, CA, USA**

16:45–17:15 Meta-Analysis of Functional Neuroimaging Data  
**Tor D. Wager, Columbia University, New York, NY USA**

17:15–17:30 General question and answer with all speakers

**Sunday, June 15, 2008**

*Corryong Hall 3 & 4 (Level 2)*

**Diffusion Imaging and Tractography**

This course aims to provide an introduction to methods and applications of diffusion imaging and tractography.

**Learning Objectives:** Having completed this course, participants will be able to:

- Understand diffusion imaging acquisition, analysis and the biological basis of the diffusion signal;
- Describe methods available for local modeling and statistical comparison of white matter microstructure;
- Give examples of the use of fractional anisotropy as a marker of white matter integrity;
- Discuss tractography methods, including a critical appraisal of the opportunities and limitations of tractography;
- List examples of tractography in practice and discuss issues of validation.

**Target Audience:** A multidisciplinary audience who are new to the field of diffusion MR, or who have some basic experience in using the technique and wish to learn more about methods, applications, or limitations.

**Course Schedule**

**Course Introduction**

8:15–8:30 Introduction

**Heidi Johansen-Berg, University of Oxford, Oxford, UK**

**Part I: Diffusion Imaging Fundamentals**

8:30–9:00 Introduction to Diffusion Imaging

**Alan Connelly, Brain Research Institute, Melbourne, Australia**

9:00–9:30 Diffusion Image Analysis: Preprocessing and Local Modeling

**Carlo Pierpaoli, National Institutes of Health, Bethesda, MD, USA**

9:30–10:00 The Biological Basis of the Diffusion Signal

**Christian Beaulieu, University of Alberta, Edmonton, AB, Canada**

10:00–10:30 Break

**Part II: Local Measures of White Matter Microstructure**

10:30–11:00 Local Comparison of Diffusion MRI Parameters

**Steven Smith, University of Oxford, Oxford UK**

11:00–11:30 White Matter Changes Throughout the Lifespan: Development and Aging

**David Salat, Martinos Centre for Biomedical Imaging, Massachusetts General Hospital, Charlestown, MA, USA**

11:30–12:00 Individual Differences in White Matter Microstructure

**Heidi Johansen-Berg, University of Oxford, Oxford, UK**

12:00–13:00 Lunch

**Part III: Diffusion Tractography: Methods**

13:00–13:30 Introduction to Tractography

**Saad Jbabdi, University of Oxford, Oxford, UK**

13:30–14:00 Resolving Crossing Fibres

**Donald Tournier, Brain Research Institute, Melbourne, Australia**

14:00–14:30 What We Can and Can't Do with Tractography  
**Tim Behrens, University of Oxford, Oxford, UK**

14:30–15:00 Break

**Part IV: Diffusion Tractography: Interpretation and Applications**

15:00–15:30 Validation of Diffusion Tractography  
**Marc Tittgemeyer, Max-Planck-Institute for Neurological Research, Cologne, Germany**

15:30–16:00 Tractography for Surgical Targeting  
**Andreas Bartsch, University of Wuerzburg, Wuerzburg, Germany**

16:00–16:30 Connectivity Fingerprinting of the Cortex Using Tractography  
**Johannes Klein, Johann Wolfgang Goethe University of Frankfurt, Frankfurt, Germany**

16:30–17:00 Questions and Answer panel discussion with all speakers

**Sunday, June 15, 2008**

*Bellarine 7 (Level 5)*

**From Dynamic Modeling to Cognitive Neuroscience**

**Learning objectives:** Having completed this course, participants will be able to:

- Summarize new developments and research questions in modeling, ranging from single neuron models to macroscopic modelling of networks;
- Discuss how such approaches can lead to the design and analysis of cognitive neuroscience experiments;
- Identify major modelling software packages, for simulation of neuronal models and inversion of fMRI and M/EEG data.

**Target audience:** This course is designed to guide both modellers and cognitive neuroscientists through a variety of modelling approaches. Hands-on use of a variety of modeling software packages will be emphasized, including GENESIS, NEURON and Dynamic Causal Modelling. Customized Matlab scripts will be made available. Examples will be given of how such approaches lead to the design and analysis of cognitive neuroscience experiments.

**Course Schedule**

**Course Introduction**

8:00–8:10 Modeling in Cognitive Neuroscience  
**Karl Friston, Functional Imaging Laboratory, London, UK**

**Part I: Dynamical Systems Approach**

8:10–9:00 Neuronal and Neural Ensemble Dynamics [inc. NEURON and GENESIS]  
**Michael Breakspear, University of New South Wales, Randwick, Australia**

9:00–9:10 Discussion

9:10–9:55 Dynamic Models: From Neural Microcircuits to Cortical Regions  
**Steve Coombes, UCL, Nottingham, UK**

9:55–10:05 Discussion

10:05–10:20 Break

**Part II: From Dynamics to Computational Neuroscience**

10:20–11:05 Neural Masses, Cortical Fields and Connectivity

**Victor Jirsa, Florida Atlantic University, Boca Raton, FL**

11:05–11:15 Discussion

11:15–12:00 Formation and Structure of Visual Maps

**Geoffrey Goodhill, University of Queensland, Brisbane, Australia**

12:00–12:10 Discussion

12:10–13:20 Lunch

**Part III: Bayesian-Based Methods**

13:20–14:05 Dynamic Causal Modeling

**Karl Friston, University College London, London, UK**

14:05–14:15 Discussion

14:15–15:00 Stochastic Dynamics and Their Inversion

**Jean Daunizeau, University College London, London, UK**

15:00–15:10 Discussion

15:10–15:25 Break

**Part IV: Integrative Models**

15:25–16:10 Temporal Scales in the Brain

**Stefan Kiebel, Functional Imaging Laboratory, London, UK**

16:10–16:20 Discussion

16:20–17:05 Models in Cognitive Neuroscience

**Gustavo Deco, Universitat Pompeu Fabra, Barcelona, Spain**

17:05–17:15 Discussion

17:15–17:45 Discussion and Farewell

**Karl Friston, University College London, London, UK****Michael Breakspear, University of New South Wales, Randwick, Australia****Stefan Kiebel, Functional Imaging Laboratory, London, UK**