Organization for Human Brain Mapping

Educational Courses

Sunday, June 15, 2008

Corryong X (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 & 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, Helsinki, 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, Helsinki, 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
Richard M. Leahy, 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, Helsinki, 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, Helsinki, Finland

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

16:25 – 17:05 Clincial 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 Motivation
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
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 X (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;
- List methods and applications for local modeling of white matter microstructure and 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: Those who are new to the field of diffusion MRI

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 Modelling
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, Universität zu Lübeck, 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 Congnitive 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