The Connectome

Organizers:
Heidi Johansen-Berg, University of Oxford, UK
Ed Bullmore, University of Cambridge, UK

This course provides an introduction to the emerging science of brain ‘Connectomics’, the study of large-scale networks of structural and functional brain connections. Brain imaging data can provide powerful information for building maps of the ‘Human Connectome’. The morning session, ‘Building Connectomes’, will provide methodological introductions to the types of data that can be used to define the connectome, including diffusion MRI, resting state FMRI, EEG and MEG. This session will also introduce methods for modelling distributed brain networks, progressing from introductory concepts to more advanced discussions of challenging issues such as defining network nodes, integrating across modalities and grouping across individuals. The afternoon session, ‘Modelling and Mining Connectomes’, will include talks highlighting approaches to mining and visualising these complex datasets and will review how the connectomics approach has already provided novel insights into human brain organisation and its breakdown in disease. Dedicated discussion slots have been scheduled at the end of each session.

Learning Objectives: Having completed this course, participants will be able to:
1. Understand methods for acquisition and analysis of diffusion MRI, resting state FMRI, EEG and MEG data;
2. Understand network modelling methods for connectomics;
3. Give examples of approaches to visualising connectomes; and
4. Give examples of applications of connectomics to understanding brain function and dysfunction.

Target Audience: The target audience is researchers with an interest in using human imaging data for studying the connectome. Prior experience of human neuroimaging is expected. Background will be provided for those without experience of network modelling but some talks will address advanced methodological issues that would be of interest to people with experience in this field.

Course Schedule

I. Building Connectomes

8:00-8:30  Introduction to Connectomics and Overview of the Course
Heidi Johansen-Berg, University of Oxford, UK

8:30-9:00  MRI Acquisition and Analysis Strategies for Connectomics
Larry Wald, Harvard Medical School, USA

9:00-9:30  Diffusion Tractography and Structural Measures
Donald Tournier, Brain Research Institute, Melbourne, Australia

9:30-10:00 Overview of Intrinsic Connectivity Networks
Vince Calhoun, University of New Mexico, USA

10:00-10:30 Break
10:30-11:00  EEG/MEG and Brain Networks
Johanna Zumer, Radboud University Nijmegen, Netherlands

11:00-11:30  Overview of FMRI Network Modelling Methods in Task and Rest
Ed Bullmore, University of Cambridge, UK

11:30-12:00  Discussion and Q&A

12:00-13:00 Lunch

II. Modelling and Mining Connectomes

13:00-13:30  Advanced Network Modelling I: Dynamic Models; Multimodal Integration
Mark Woolrich, University of Oxford, UK

13:30-14:00  Advanced Network Modelling II
Gael Varoquaux, INSERM, Neurospin, France

14:00-14:30  Neuroinformatics for Connectomics
David Van Essen, Washington University, St Louis, USA

14:30-15:00  Brain Networks in Health and Disease
Ed Bullmore, University of Cambridge, UK

15:00-15:30 Break

15:30-16:00  Data Mining and Visualisation
Angie Laird, University of Texas, San Antonio, USA

16:00-16:30  State-Dependent and Disease-Related Variations in Functional Networks
Silvina Horovitz, NINDS, NIH, USA

16:30-17:00  Discussion and Q&A