FWF Der Wissenschaftsfonds. | Imaging the Mind Doctoral Program | UNIVERSITÄT SALZBURG

1st DK "Imaging the Mind" Winter School

Brain connectivity measured with EEG and fMRI

7th – 9th January 2016

This winter school equips PhD students in a series of lectures, discussions, and practical sessions with methodological knowledge on brain connectivity analysis of EEG and fMRI data, which is a central prerequisite for research carried out during the second phase of the Doctoral Program (2015-2019), focusing on connectivity and higher cognitive function.

WINTER SCHOOL LOCATION

Convention Hotel Gastagwirt
Alte Wr. Str. 37, 5301 Eugendorf
www.gastagwirt.at/en/

INFORMATION AND CONTACT

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SCHEDULE

Thursday, 7th January 2016		
14:00 – 14:15	Opening	M. Schabus & J. Perner
14:15 – 16:00	Lecture EEG "Introduction to analysis of noninvasive cognitive neurophysiology"	Denis Engemann
16:00 – 16:15	*Coffee break*	
16:15 – 18:15	Practical part EEG "Introduction to analysis of noninvasive cognitive neurophysiology"	Denis Engemann
	Dinner	

Friday, 8th January 2016		
09:00 – 11:00	Lecture EEG "Data-driven inference of functional brain networks"	Klaus Lehnertz
11:00 – 11:15	*Coffee break*	
11:15 – 13:15	Practical part EEG ""Data-driven inference of functional brain networks""	Klaus Lehnertz
13:15 – 14:15	*Lunch*	
14:15 – 16:15	Lecture fMRI "An introduction to fMRI and functional correlation"	Geoffrey Aguirre
16:15 – 16:30	*Coffee break*	
16:30 – 18:30	Practical part fMRI "An introduction to fMRI and functional correlation"	Geoffrey Aguirre
	Dinner	

Saturday, 9th January 2016		
08:00 – 10:00	Lecture fMRI "Dynamic Causal Modelling (DCM) for fMRI"	Peter Zeidman
10:00 – 10:15	*Coffee break*	
10:15 – 12:00	Practical part fMRI "Dynamic Causal Modelling (DCM) for fMRI"	Peter Zeidman
12:00	Closing & bus to skiing	

LECTURES AND WORKSHOPS WILL BE PROVIDED BY:

Dr. Denis Engemann

Unicog, CEA/INSERM Neurospin, France
https://github.com/dengemann

Introduction to analysis of noninvasive cognitive neurophysiology

Abstract:
Magnetoencephalography and electroencephalography (M/EEG) enable noninvasive time-resolved neuroimaging. Both modalities capture synchronous population-level behavior of ten thousands of neurons in realtime by measuring passively electromagnetic events with sensor arrays positioned outside of the head. Both methods possess overlapping but distinct response profiles. Typically, MEG recordings provide increased spatial resolution for a subset of cerebral sources, whereas, EEG recordings are less selective, hence, more sensitive to many cerebral sources. Fusion of MEG and EEG data at the modeling level has been shown to increase the spatial resolution. M/EEG can therefore be regarded as complementary windows on brain function. In this context, their high dimensionality not only poses statistical challenges but also rich opportunities. Over the last two decades this has led to abundant novel techniques of M/EEG processing. Corresponding scientific advances continue to characterize human behavior and cognition with respect to interactions of neurophysiological events in cerebral time, frequency and space. The lecture provides a brief introduction into biophysical principles and physiological sources of MEG and EEG. It will establish an overview on state of the art methods for cognitive neurophysiology. This includes four distinct but related subjects. 1) Statistical learning approaches to the analysis of temporal dynamics, 2) principles of time-frequency analysis using convolution and pattern matching methods, 3) functional connectivity, and 4) modern source localization using dense and sparse statistical priors. All aspects will be accompanied by references and hints with respect to software solutions and best practices.

Prof. Klaus Lehnertz

Department of Epileptology, University Hospital of Bonn, Germany
http://epileptologie-bonn.de/cms/front_content.php?idcat=202

Data-driven inference of functional brain networks

Abstract:
Complex networks are powerful representations of spatially extended systems -- such as the human brain -- and can advance our understanding of their dynamics. A large number of analysis techniques is now available that aim at inferring the underlying network properties from multivariate recordings of system observables. Despite great successes in various scientific fields, there still exist a number of problems, both conceptual and methodological, for which there are currently no satisfactory solutions. At the example of large-scale epileptic brain networks, I will present how the network approach can advance our understanding of the complex disease epilepsy and will discuss current shortcomings as well as possible research directions that may help to find better solutions.

Dr. Geoffrey Aguirre

University of Pennsylvania, USA
https://cfn.upenn.edu/aguirre/wiki/start

An introduction to fMRI and functional correlation

Abstract:
These lectures will introduce the basics of functional MRI and build to an understanding of how measures of correlated imaging signal across the brain relate to the macroscopic organization of brain activity. Part 1: MRI physics and the basics of BOLD fMRI — How MR images are derived from the properties of hydrogen atoms, how images are built across space, and the source of the BOLD functional MRI signal. Part 2: The Signal and the Noise — The properties of BOLD fMRI signals across time and space. BOLD fMRI as a linear system. Sources of non-neural signal in BOLD fMRI, such as motion and physiologic activity. Part 3: Correlation connections — Non-stationary smoothness in BOLD fMRI data. Parcellation of brain areas. Task and "rest" scanning conditions. Graph theoretic approaches.

Dr. Peter Zeidman

Wellcome Trust Centre for Neuroimaging, University College London, UK
http://www.peterzeidman.co.uk/

Dynamic Causal Modelling (DCM) for fMRI

Abstract:
DCM is a framework for inferring causal relationships between brain regions ('effective connectivity'). Models are needed to infer neural activity from the BOLD response, and DCM enables experimenters to create, estimate and compare models of fMRI timeseries. In this workshop, Peter Zeidman will provide a simple overview of DCM, before working through a practical example with empirical data.