DEPARTMENT OF CLINICAL NEUROSCIENCE

K8F3035, Imaging in Neuroscience: with a Focus on MEG and EEG Methods, 1.5 credits (hec)

Hjärnavbildning inom neurovetenskap: med fokus på metoderna MEG och EEG, 1,5 högskolepoäng

Third-cycle level / Forskarnivå

Approval

This syllabus was approved by the The Committee for Doctoral Education on 2023-11-16, and was last revised on 2025-04-11. The revised course syllabus is valid from spring semester 2025.

Responsible department

Department of Clinical Neuroscience, Faculty of Medicine

Prerequisite courses, or equivalent

Background in medicine, biomedicine, biology, psychology, cognitive science, medical imaging, computational biology or similar. At least basic medical statistics.

Purpose & Intended learning outcomes

Purpose

The main purpose of the course is to provide the students with a solid understanding of the tools available to analyze human brain activity data measured with magnetoencephalography (MEG) and electroencephalography (EEG). The students will develop the ability to critically review results provided by different methods, to select the most adequate tools and experimental designs to answer different questions and to compare their relative advantages.

Intended learning outcomes

After attending the course the student should be able to:
1) follow the usual preprocessing steps of MEG and EEG;
2) give an overview of different methods to analyze the data and explain when to use them;
3) conduct MEG and EEG analysis using several methods;
4) describe different aspects of experimental design to have in consideration when creating a

MEG and EEG study;
5) give a brief overview of the usage of MEG and EEG to study brain function;
6) give a brief overview of other techniques to study brain function non-invasively and describe their relative merits and challenges.

Course content

The course focuses on experimental design and analysis of MEG and EEG data. We will briefly introduce the basis of the MEG and EEG signal at a neural level, and how it is measured by the different sensor technologies applied in MEG and EEG. The data processing steps, before statistical analysis, will be explained. The application of general linear model analysis, parametric and nonparametric tests of MEG and EEG data will be explained, including correction for multiple comparisons. We will review experimental design considerations for developing MEG and EEG paradigms. The study of functional connectivity using MEG and EEG data will be introduced.

Forms of teaching and learning

The students will attend lectures, implement different steps of the data preprocessing and analysis during the hands-on sessions, present and discuss results.

Language of instruction

The course is given in English

Grading scale

Pass (G) /Fail (U)

Compulsory components & forms of assessment

Compulsory components

All parts of the course are mandatory. Absence can be compensated for by completion of an assignment on the material covered in the missed course instance.

Forms of assessment

The learning outcomes will be assessed throughout the course during the hands-on sessions where the students have to perform data analyses. The students will also complete a more extensive assignment based on one of the hands-on sessions. In the final day of the course the students will present and discuss their assignments with the rest of the group.

Course literature

Main book:
• Riitta Hari & Aina Puce (2017). MEG-EEG primer. New York, NY : Oxford University Press 2017

Additional articles:

• Maris E1, Oostenveld R. (2007). Nonparametric statistical testing of EEG- and MEG-data. Journal of Neuroscience Methods. Aug 15;164(1):177-90.
• Bastos, A. M., & Schoffelen, J.-M. (2016). A Tutorial Review of Functional Connectivity Analysis Methods and Their Interpretational Pitfalls. Frontiers in Systems Neuroscience, 9. https://doi.org/10.3389/fnsys.2015.00175