DEPARTMENT OF NEUROBIOLOGY, CARE SCIENCES AND SOCIETY

H1F6004, Imaging in Neuroscience: with a Focus on Functional Near Infrared Spectroscopy (fNIRS), 1.5 credits (hec)

Avbildning i neurovetenskap: med fokus på funktionell nära-infraröd spektroskopi (fNIRS), 1,5 högskolepoäng

Third-cycle level / *Forskarnivå*

Approval

This syllabus was approved by the The Committee for Doctoral Education on 2024-02-16, and is valid from autumn semester 2024.

Responsible department

Department of Neurobiology, Care Sciences and Society, Faculty of Medicine

Prerequisite courses, or equivalent

Educational background or research experience in relevant fields such as neurosciences, psychology, medicine, biomedicine, medical physics, medical imaging, computational biology, or any humanistic discipline employing neuroimaging as an experimental tool. Although not a prerequisite, it is an advantage to have a basic understanding of different statistical methods and programming skills in MATLAB, Python and R.

Purpose & Intended learning outcomes

Purpose

The course is designed to provide students with a solid understanding of functional Near-Infrared Spectroscopy (fNIRS) as a relatively new tool to measure brain activity and will emphasize both theoretical knowledge and practical skills of fNIRS. The students will gain expertise in the underlying principles of fNIRS, its instrumentation, and various analytical approaches. The primary goal is to empower students with the knowledge of this additional neuroimaging tool to design and execute advanced experiments, interpret fNIRS data effectively, and contribute to cutting edge research in neuroscience and related fields.

Intended learning outcomes

Upon completion of the fNIRS course, students should be able to:

Knowledge and understanding

- Explain the principles of fNIRS and its applications in neuroscience or related fields.
- Describe the preprocessing steps to remove noise in fNIRS signals

Competence and skills

- Perform an fNIRS experiment
- Conduct fundamental fNIRS processing/analysis using different methods

Judgement and approach

- Interpret fNIRS data with regard to brain structure and function
- Design fNIRS experiments and discuss how fNIRS can be integrated with other lab-based systems (i.e., mobility systems).

Course content

The course content mainly focuses on experimental design and analysis of fNIRS data. We will briefly introduce optical imaging principles, neurovascular coupling, and the hemodynamic response. Instrumentation, experimental design, and data acquisition techniques and analysis specific to fNIRS will be extensively covered. We will also give multiple examples of the diverse applications of fNIRS in cognitive neuroscience and clinical research. Advanced topics such as multimodal integration with other neuroimaging techniques, consensus guidelines and best practices of fNIRS, and ethical considerations in fNIRS research are also part of the course.

Forms of teaching and learning

The course consists of lectures, hands-on fNIRS practical sessions, group discussions and student presentations.

Language of instruction

The course is given in English

Grading scale

Pass (G) /Fail (U)

Compulsory components & forms of assessment

Compulsory components

All components of the course are mandatory. However, in specific situations, students may be

eligible for exemption from participating in certain course components. In such instances, the student may be required to fulfill a compensatory assignment.

Forms of assessment

Evaluation of learning outcomes will occur continuously during the course, primarily through hands-on fNIRS sessions wherein students will design fNIRS experiments and conduct fundamental data analyses. Additionally, students will complete a comprehensive assignment derived from the hands-on fNIRS sessions. On the concluding day of the course, students will present and engage in discussions about their assignments with the entire group.

Course literature

Recommended literature (but not limited to):

Yucel MA, Lu¨hmann AV, Scholkmann F, Gervain J, Dan I, Ayaz H, Boas D, Cooper RJ, Culver J, et al. Best practices for fNIRS publications. Neurophotonics. 2021 Jan;8(1):012101. doi: 10.1117/1.NPh.8.1.012101. Epub 2021 Jan 7. Erratum in: Neurophotonics. 2021 Jan;8(1):019802. PMID: 33442557; PMCID: PMC7793571.

Santosa, H.; Zhai, X.; Fishburn, F.; Huppert, T. The NIRS Brain AnalyzIR Toolbox. Algorithms 2018, 11, 73. https://doi.org/10.3390/a11050073