NRSN Summer School in Neuroscience
University of Oslo, 16-22 August 2015:

Understanding measurements in neuroscience

Register here Deadline: 22 May 2015

Summary

Advances in recording technology used to investigate brain function are about to change our understanding of the mechanisms underlying information processing and complex behaviours. Due to recent progress in *in vivo* large-scale electrical, optical and magnetic field recordings we are at a point where long-standing questions in neuroscience can be addressed. Novel techniques give us unique insights into brain function at multiple scales from molecular mechanisms and cell-specific contributions to neural microcircuits and complex neuronal networks underlying behaviours.

But what do these techniques measure and what can we interpret about brain function from these data? Every technique has its limitations and strengths when it comes to temporal and spatial resolution. This will influence the implications of results. Measurements of neural activity using, e.g., *in vivo* electrophysiology, have superior temporal precision compared to, e.g., optical methods using $Ca2+$ sensors, but lack the identification and localization of cells in the tissue obtained with optical techniques. Similar comparisons between other techniques illustrate the need for multi-scale analyses to understand brain function.

The aim of the summer school *Understanding measurements in neuroscience* is to give you a deeper understanding of what we actually measure with some state-of-the-art methods in neuroscience. The course will give you in-depth knowledge and training in critical thinking through lectures, seminars and discussions of the background and principles of the methods of focus, their pitfalls and caveats, and analysis and interpretation of data. Furthermore, you will be trained to interpret such data in the context of mathematical models of neuron function.

We will discuss how to compare measurements to ground truth in order to understand limitations of recorded data, reflecting on the difference between causal and correlational measures. Practical insights will be obtained through laboratory demonstrations of the recording techniques being discussed.

Using representative data sets, you will address challenges with data collection, analysis and interpretation of results in student projects throughout the course. Group work and student presentations will be key components both for student projects and paper discussions.

Organizers and lecturers

The summer school is organized by Centre for Integrative Neuroplasticity (CINPLA) at the University of Oslo, with support from the Norwegian Research School in Neuroscience (NRSN).

- **Special Guest Lecturer: Michael Häusser, University College London**
- Joel Glover, Institute of Basic Medical Sciences, UiO
- Erlend A. Nagelhus, Institute of Basic Medical Sciences, UiO
- Torkel Hafting, Institute of Basic Medical Sciences, UiO
- Marianne Fyhn, Department of Biosciences, UiO
- Koen Vervaeke, Department of Biosciences, UiO
- Gaute Einevoll, Department of Mathematical Sciences and Technology, NMBU, and Department of Physics, UiO
- Hans E. Plesser, Department of Mathematical Sciences and Technology, NMBU

Learning objectives

- You will be familiar with state-of-the-art recording methods in neuroscience.
- You will be able to identify and discuss strengths, limitations, pitfalls, caveats with different methods.
- You will acquire a set of tools you can use to analyse and reflect on other methods in neuroscience.

Learning activities

To maximize learning output, there will be strong emphasis on your involvement in activities, group work and student presentations. Lecturers will devote considerable time for discussions and interactions with the students.

The course will follow a pedagogical line starting from the action potential of a single cell with "ground truth" recordings using patch-clamp recordings, to ex vivo and in vivo recordings of spike activity, population activity and neural networks using extracellular recordings, voltage sensitive dye imaging and Ca^{2+} imaging with two-photon laser scanning microscopy, to the more indirect measures of brain activity such as EEG and fMRI. To ensure that you gain a deeper insight into how different recording techniques reflect the ground truth, you will each day use a basic computational compartment model of a neuron and compare it with experimental data.

The daily topics will be introduced by lectures giving the historical background and state-of-the-art of the different methods used to record activity in the brain. Thereafter, in order to be able to critically reflect upon interpretations of data from different methods, you will be introduced to strengths, limitations, shortcomings and pitfalls of the techniques. In the afternoon sessions, you will attend laboratory demonstrations of the methods in the laboratories of Hafting, Fyhn, Vervaeke, Nagelhus and Glover, and observe how the experiments are being performed and data collected. After the lab demos, you will be given

recorded data in order to get hands-on experience with experimental data from the different methods. Each day, you will analyse and discuss one seminal paper from the topic of the day, and on the following day, one group will present the paper and related seminar questions.

Student presentations

In order to facilitate social and scientific interactions from the very beginning of the course, students will be asked to prepare five minute presentations of their current PhD project during the first two days of the course. Furthermore, the students will be organised in groups presenting papers, leading discussions of seminar questions, data analyses and methodological considerations.

Target group

The summer school is intended for PhD candidates in neuroscience, and priority will be given to members of NRSN. Other participants may be accepted if there are still places available.

Practicalities

Arrival: Sunday 16 August 2015 by 18.00
Departure: Saturday 22 August 2015
Location: Department of Biosciences and Institute of Basic Medical Sciences, University of Oslo
Credits: The Faculty of Medicine at the University of Oslo recommends that participation in the summer school is accredited with 2 ECTS credits. Participants must apply to their respective universities in order to have the course formally approved as part of their PhD education.
Number of students: Max 30.
Course fee: Participation is free for members of NRSN.
Travel and accommodation: Participants from outside Oslo must book their own travel and accommodation. *Please do not book until you have a confirmed place in the summer school.* NRSN will reimburse the costs after the event for members of the research school. Participants who are not members of NRSN must cover their own expenses. The travel reimbursement is limited to 2000 NOK for the roundtrip, including public transportation (not taxi or private car) to and from the airport. The organizers have reserved rooms for the period 16-22 August 2015 at Scandic Holberg Hotel, and these rooms will be available for your reservation until 15 June 2015. To reserve a room, please contact the hotel at holberg@scandichotels.com or +47 23 15 72 00 and give the reservation code **45498145**. Please note that you will be charged for the hotel cost upon your departure. The amount will be reimbursed for those eligible for NRSN support. If you do not make your reservation at Holberg until 15 June 2015, or choose to stay at a different hotel, NRSN will reimburse you hotel costs up to the amount of 1200 NOK per day.
Meals: Lunch will be served every day, and the program includes three dinners/ social events.

Course overview

Day	Topic	Key lecturers
Sun 16 Aug	Arrival, welcome lecture, social	
Mon 17 Aug	Compartment neuron models	Einevoll
	Patch clamp	Vervaeke/Hafting
Tue 18 Aug	*In vivo* extracellular spike recordings	Fyhn/Hafting
	Voltage sensitive dye imaging	Glover
Wed 19 Aug	TBD	**Michael Hausser**
Thu 20 Aug	*In vivo* Ca^{2+} imaging with genetically encoded indicators	Vervaeke/Nagelhus
	Local field potential	Einevoll
Fri 21 Aug	EEG, MEG, & fMRI	Leknes
	Farewell party	

Schedule Monday 17 August

	Event	Topic
08.15-09.00	Lecture	Background/history
09.15-11.00	Lecture	State-of-the-art, tips, pitfalls
11.15-11.45	Lecture	Case study from forefront of neuroscience
11.45-12.30	Presentation	Student self-presentation, part 1
	Lunch break	
13.30-16.00	Activities	Practicals, lab demonstrations
16.00-18.00	Activities	Group work
18.15-19.00	Presentation	Student self-presentation, part 2
19.00-20.00	Dinner	
20.00-		Special event

Schedule Tuesday 18, Thursday 20, Friday 21 August

	Event	Topic
08.15-09.00	Presentation	Students present results from previous day
09.15-11.00	Lecture	State-of-the-art, tips, pitfalls
11.15-11.45	Lecture	Case study from forefront of neuroscience
	Lunch break	
12.45-15.15	Activities	Practicals, lab demonstrations
15.15-18.00	Activities	Group work
18.15-19.00	Lecture	Guest lecture
19.00-20.00	Dinner	
20.00-		Special event