LUNDS UNIVERSITET
Lunds Tekniska Högskola

Course syllabus

Mätning och modellering av centrala nervsystemets funktion
Measurement and Modeling of the Central Nervous System Function

EITN65, 7,5 credits, A (Second Cycle)

Valid for: 2023/24
Faculty: Faculty of Engineering, LTH
Decided by: PLED E
Date of Decision: 2023-04-11

General Information

Elective for: BME4-sbh, N4-nbm, Pi4-biek
Language of instruction: The course will be given in English on demand

Aim

To provide knowledge of how the nervous system works and how it's modeled at various levels, from cellular to higher brain functions. Understanding the processes of nerve impulses at the cellular level, and how these are measured and simulated. Understanding how the cells are connected in simple networks, and how these can be simulated. Understanding how the higher functions can be described, modeled and simulated. To understand how nerve signals can be measured through both invasive and non invasive methods. Understanding the basic electronics impedance, gain, and filtering, which is necessary to measure the signals. Understanding the basic signal analysis of nerve signals that spike sorting and correlation.

Learning outcomes

Knowledge and understanding
For a passing grade the student must

understand how neurons signals arise, connects and propagates

understand the modeling of neurons, both individually and in populations.

understand the requirements of measurement in order to register the nerve signals both

invasive and with surface electrodes.

Competences and skills
For a passing grade the student must

be able to reason about how the nervous system works at different levels and describe how these can be measured and simulated.

be able to describe the function of the nervous system at different levels and be able to set up a simulation of these.

be able to describe how nerve signals can be measured in different ways and which the demands are.

Judgement and approach
For a passing grade the student must

understand the ethical issues in the analysis of signals from the CNS and in the measurement of these.

be able to see the limitations of the results of analysis and modeling.

Contents

The course consists of lectures and 5 written assignments where students apply the different simulation and modeling methods. Lectures will include operation and modeling of the nervous system at different levels, and review of the simulation tools that will be used. The course also covers methods for nerve signals in vitro and in vivo, and the electronics required for this. The course ends with a small project where the students in pairs, select a problem and simulate its behavior or analyze its signals. Also included in the course is an ethics workshop on the relevant ethical questions.

Examination details

Grading scale: UG - (U,G) - (Fail, Pass)
Assessment: Approved course requires participation in ethics workshop, the assignments and approved report and presentation of the project.

The examiner, in consultation with Disability Support Services, may deviate from the regular form of examination in order to provide a permanently disabled student with a form of examination equivalent to that of a student without a disability.

Parts
Code: 0115. **Name:** Written Report.
Credits: 5. **Grading scale:** UG. **Assessment:** Approved written Report.
Code: 0215. **Name:** Assignments.
Credits: 2,5. **Grading scale:** UG. **Assessment:** Approved assignments.

Admission

Assumed prior knowledge: Basic courses in programming, physiology and signal processing.
The number of participants is limited to: 32

Selection: Number of credits within the programme. Priority is given to students enrolled on programmes that include the course in their curriculum.

Reading list

- Material is handed out at the lectures.
- Wulfram Gerstner, Werner M. Kistler, Richard Naud and Liam Paninski: Neuronal Dynamics. Cambridge University Press, 2014, ISBN: 978-1107635197. http://neuronaldynamics.epfl.ch/index.html.
- Paul Miller, Terrence J. Sejnowski and Tomaso A. Poggio: An introductory course in Computational Neuroscience. MIT Press, 2018.

Contact and other information

Course coordinator: Anders J Johansson, anders.j.johansson@eit.lth.se
Course homepage: http://www.eit.lth.se/course/eitn65
Further information: Teachers in LTH and the Faculty of Medicine is responsible for teaching. Lectures from other faculties can also occur.