neu240 - Computational Neuroscience - Introduction

Module label: Computational Neuroscience - Introduction
Module code: neu240
Credit points: 9.0 KP
Workload: 270 h
Used in course of study:
- Master's Programme Neuroscience > Background Modules

Contact person:
- Jutta Kretzberg

Authorized examiners:
- Alle hier genannten

Module counseling:
- Martin Greschner
- Jannis Hildebrandt

Entry requirements:
attendance in pre-meeting

Skills to be acquired in this module:
Neurosci. knowlg. Expt. methods Independent research + Scient. literature + Social skills
Interdiscipl. knowlg. ++ Maths/Stats/Progr. + Data present./disc. + Scientific English Ethics

Upon successful completion of this course, students
- have acquired good programming skills (in Matlab)
- are able to implement and apply algorithms
- have learned to handle scientific data independently
- have acquired theoretical and practical knowledge of advanced data analysis techniques
- know about computational model approaches on different levels of abstraction
- know how to perform model simulations for single cells and small neuronal networks
- can interpret simulation results in a neuroscientific context

Module contents:
This course consists of four weeks with different topics, which are introduced in lectures,
discussed in depth using selected literature in the seminar and consolidated in computer-based
hands-on exercises (in Matlab). Portfolio tasks, mainly interpretation of programming results are
given every day.

Week 1: Background and Matlab preparation week
- practice of programming principles (functions, scripts, if, loops, structures, cell arrays)
- revision of neuroscience backgrounds (neuron, membrane, spike)

Week 2: Spike train analysis
- response tuning, spike triggered average, receptive fields, linear-nonlinear model, spike
correlation, linear reconstruction, classification

Week 3: Neuron models
- Conductance-based single cell models using differential equations (passive membrane
equation, integrate and fire, Hodgkin Huxley, alpha synapses)

Week 4: Network models
- small networks (lateral inhibition, central pattern generator)
- larger networks (Integrate and fire networks, rate models, inhibition-excitation balance, learning)

Reader's advisory:
Dayan / Abbott: Theoretical Neuroscience: Computational and Mathematical Modeling of Neural
Systems. MIT Press (More text books will be suggested prior to the course).
Scripts for each course day will be provided prior to / during the course
Copies of scientific articles for the seminar will be provided prior to the course

Links:
Language of instruction: English
Duration (semesters): 1 Semester
Module frequency: jährlich
Module capacity: unlimited
Reference text:
Course in the first half of the semester
Modullevel: MM (Mastermodul)
Modulart: Wahlpflicht

Examination:
- Final exam of module: during the course

Type of examination:
- Portfolio, consisting of daily short tests,
programming exercises and short reports

Course type:
- Lecture: 1.00 SWS, 14 h
- Exercises: 4.00 SWS, 56 h
- Seminar: 1.00 SWS, 14 h
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