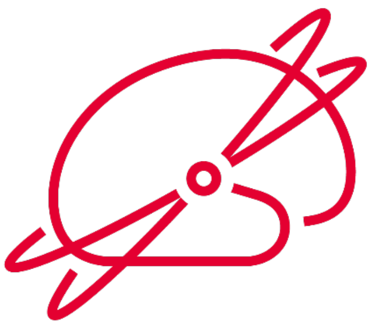
The university partnership
Denmark – China

Master's Programme in

Neuroscience and Neuroimaging



Academic regulations

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Legal Frame

Students enrolled in this programme are admitted as full-time students at University of Chinese Academy of Sciences.

The Academic regulations applies to students enrolled in the programme from 2019.

This master's programme is established within the framework of the following:

- Partnership Agreement between Graduate University of Chinese Academy of Sciences and University of Copenhagen (KU), Aarhus University (AU), University of Southern Denmark (SDU), Aalborg University (AAU), Roskilde University (RUC), Technical University of Denmark (DTU), Copenhagen Business School (CBS), IT University of Copenhagen (ITU), on the establishment of the Sino-Danish Centre for Education and Research, Graduate University of Chinese Academy of Sciences, signed on 12 April 2010
- Agreement between Graduate University of Chinese Academy of Sciences (GUCAS) and University of Copenhagen (KU), Aarhus University (AU), University of Southern Denmark (SDU), Aalborg University (AAU), Roskilde University (RUC), Technical University of Denmark (DTU), Copenhagen Business School (CBS), IT University of Copenhagen (ITU) concerning Master's Programmes at Sino-Danish Centre for Education and Research, Graduate University of Chinese Academy of Sciences, signed on 29 August 2011
- Agreement between Graduate University of Chinese Academy of Sciences and Aarhus University concerning Provision of the Master's Programme in Neuroscience and Neuroimaging at Sino-Danish Centre for Education and Research (SDC), Graduate University of Chinese Academy of Sciences, signed on 29 August 2011.

Students must observe and act accordingly to the following rules issued by the SDC Directors:

- Courses and Exams
- Exam regulations
- Thesis regulations 10 steps
- Avoid cheating on exams
- Student complaints

Students must also observe and act accordingly to Rules and Regulations for UCAS International Students. SDC rules are published on Moodle.

Title and degree

The degree awarded by Aarhus University is Master of Science in Neuroscience and Neuroimaging. The degree awarded by University of Chinese Academy of Sciences is Master of Neurobiology/Biophysics.

Duration

The master’s programme has a duration of two academic years equivalent to 120 ECTS points (European Credit Transfer System). 60 ECTS points correspond to one year of full-time studies.

When choosing thesis period *Danish/International students* must be aware of UCAS' 4 years limit for awarding diploma. UCAS' degree application procedure *STEP 10 CN* (see Thesis regulations 10 steps) has to be completed within four years from enrolment. This period includes leave of absence.

4-YEARS LIMIT

All SDC students must complete their Danish and UCAS degree within 4 years from the enrolment. This period includes leave of absence. It is possible to apply for an exemption due to illness or other extraordinary circumstances.

The 4-year limit for the Danish degree applies for the 2016 cohort and onward. Students in the 2012-2015 cohorts have to complete their studies before the 1st of January 2020 to obtain their Danish degree.

Admission requirements

Admission to the Master's programme in Neuroscience and Neuroimaging is based on a successfully completed bachelor's degree (or equivalent). Granting admission can be divided into three groups depending on the level of anatomical, mathematical, physiological, and digital signal processing and analysis skills of the student:

- Passed mathematics and digital signal processing and analysis. Eligible degrees include technical BSc degrees e.g. Electro-, Healthcare Technology-, Biomedical- Engineering, and Medicine and Technology Engineering as well as some natural science BSc degrees e.g. Physics, Nanoscience, Medical chemistry or equivalent.
- Passed neuroanatomy and physiology. Eligible BSc degrees include: Medicine, Pharmacology, Biomedicine, Molecular Medicine, Molecular Biomedicine or equivalent.
- Passed physiology and mathematics. Eligible BSc degrees include: Molecular Biology, Biochemistry and Molecular Biology or equivalent.
- High-level English language proficiency (General English language requirements - English B level)

General programme regulations

The language of instruction in the SDC master's programmes is English. Teaching, supervision and assessment will be carried out in English.

Students will be graded according to both the Chinese and the Danish grading scale. However, for the Master's Thesis, students will be graded according to the Chinese 4-point scale. See Thesis regulations 10 steps.

Leave of absence can be granted to students on the grounds of becoming a parent, illness, military service or exceptional circumstances.

Students who wish to complete degree programme elements at another university or institution of higher education in Denmark, China or abroad as part of their degree programme may apply the Teaching Committee for advance approval of transfer credit for planned subject elements.

DK	12	10	7	4	02	00	-3
CN	100-95	94-90	89-76	75-61	60	59-40	39-0

Students can maximum be granted 30 ECTS credit transfer.

Either the Teaching Committee or the SDC Directors may grant exemptions to the Academic regulations or other SDC rules. Applications for exemption are submitted to the SDC Secretariat

Qualifications

Purpose

The programme aims to combine the different approaches to neuroscience and neuroimaging from technical engineering to natural science and life science. Through this programme, graduates achieve a broad understanding of neuroscience from the molecular and cellular level to the physiological and anatomical level, giving them a wider and deeper understanding of the function of the nervous system and its disorders. At the same time, graduates will gain an understanding of the most widely used neuroimaging techniques, which will enable them to participate and perform both pre-clinical and clinical neuroimaging studies.
The unique combination of advanced imaging techniques and a broad knowledge of basic and clinical neuroscience topics will enable graduates to combine the diverse scientific fields involved in neuroscience research and thereby facilitate interdisciplinary research.

Qualification Profile

Knowledge
The graduates will have research-based knowledge in:

- Neuroanatomy and general physiology.
- Mathematics and statistics related to the field.
- Digital signal processing and analysis.
- Molecular Neurobiology.
- The different imaging modalities: ultra sound, MR, PET, SPECT, MEG, and EEG.
- Diseases of the nervous system.
- An in-depth understanding of the knowledge in the above topics that enables the graduate to scientifically reflect on this knowledge to identify scientific problems within neuroscience and/or neuroimaging.

Skills
The graduates will be able to:

- master technological skills within the topics of the education to perform scientific research, individually or as part of an interdisciplinary research collaboration.
- select the best scientific/technological approach to a given research problem based on the acquired theoretical, technical and practical skills from the courses of the education.
- develop, optimise, and implement new analysis and solution tools in neuroscience and neuroimaging alone or in collaboration with clinicians and/or researchers.
- communicate scientific achievements and professional topics to layman as well as the scientific community.

Competences
The graduates will be able to:

- Play a central role in the establishment of professional collaborations both interdisciplinary and within the disciplines of the education through the interdisciplinary approach combining topics form the technical, natural, and health sciences.
- Collaborate to develop and/or implement novel techniques and/or medicotechnical equipment.
- Educate health professionals in the use and operation of advanced neuroimaging equipment.
- Cope with complex and/or unpredictable scientific obstacles through the use of known methods in a novel setting or by developing new approaches.
- Keep updated within the neuroscience and neuroimaging field as well as within the chosen scientific specialisation.

Structure

The programme contains the following elements

Semester	Course / Programme element	Exam	Grading	Examiners	ECTS
1	Basic Neuroscience (BNS)	Assignment and written	7/100 scale	Internal	15
	Fundamental Biomedical Signal Processing (FBSP)	Written	7/100 scale	Internal	10
	Medical Imaging Techniques (MIT)	Written	7/100 scale	Internal	5
2	Magnetic Resonance Imaging (MRI)	Written	7/100 scale	Internal	5
	Pattern Recognition and Predictive Modelling in Neuroscience (PRPM)	Oral	7/100 scale	External	5
	Neuroscience in a Clinical Perspective (NCP)	Written	7/100 scale	Internal	5
	Magnetoencephalography and Electroencephalography (MEEG)	Oral	7/100 scale	Internal	5
	Integrative Neuroimaging (INI)	Assignment	7/100 scale	Internal	5
	One of the following electives must be chosen:				
	Advanced Neuroimaging	Oral	7/100 scale	Internal	5
	Advanced Neuroscience	Oral	7/100 scale	Internal	5
	Cognitive Science	Oral /synopsis	7/100 scale	Internal	5
3	Thesis	Assignment and oral	7/4 scale	External	60
4					

The first two semesters provide the common core of the programme. The first semester starts out with Basic Neuroscience and Fundamental Biomedical Signal Processing where the students, coming from very different backgrounds, acquire the necessary knowledge and competences needed to follow the tailored courses in the rest of the program. Later in the semester and in the second semester more advanced courses follow that integrate both neuroimaging and neuroscience.

At the end of the 2nd semester, the students will select one of three possible 2nd semester elective courses (5 ECTS). The 3rd and 4th semester is devoted to writing the master's thesis.

Course and exam descriptions

Basic Neuroscience

15 ECTS

CONTENT
The course introduces students to key concepts in neuroscience and neuroimaging. The course will be initiated with an overall description of the physiological function of, and the interactions between the different organ systems within animals. All in the content of neuroscience. Hereafter, the course will make an introduction to the molecular and cellular components of the central nervous system (CNS), their development and organization. The course will provide an elementary overview of the structures and functions of the nervous system, with special emphasis on functional systems responsible for sensorimotor, autonomous, and cognitive function, as well as their importance for major brain diseases within the fields of neurology, neurosurgery and psychiatry. Furthermore, there will be an introduction to the different signalling pathways, as well as an introduction to the electrical and receptor-neurotransmitter mediated signalling between neurons and other cells in the CNS. The fundamental principles of diagnostics and treatment of major brain diseases will be discussed including knowledge of the dysfunction of the different signalling systems. The course also includes a description of molecular aspects of the coupling between function, flow and metabolism of the brain. Based on this knowledge, the students will be introduced to the molecular neurobiological aspects underlying different brain imaging methods. Specifically focusing on the basis for our understanding of the biology linked to the use of positron emission tomography (PET), magnetic resonance spectroscopy (MRS), optical imaging, two-photon imaging and hyperpolarized MR-substances.

LEARNING OBJECTIVES
Knowledge
During the course, the student will gain knowledge in and understanding of:

- the basic structural and functional properties of neuronal and glial cells and their networks in the central nervous system.
- basic insights in the chemical and electrical signalling of neurons and glial cells, both in the developing, mature and diseased nervous system.
- basic human neuroanatomy.
- basic aspects of ligands used to map neurotransmitter systems.
- aspects of cerebral blood flow and its regulation as well as mapping of glucose metabolism.
- neurovascular coupling and its regulatory mechanisms.
- research relevant aspects, e.g., Alzheimer's disease, Parkinson's disease, multiple sclerosis, schizophrenia and stroke.

Skills
The students will be able to:

- demonstrate skills at a basic level related to the understanding of the general principles of the structure and function of cells in the central and peripheral nervous system.
- use and understand neuroanatomical nomenclature.
- identify neuroanatomical structures from brain images and illustrations.
- identify neural structures of importance for major brain diseases.
- point to suitable methodologies utilized to investigate properties of neurons and glial cells, including their interactions.
- display skills with respect to actions of pharmacological substances and other treatments of the nervous system at an introductory level.
- choose the best possible ligands for molecular cell type imaging reflecting their specific biological processes.

Competences
At the end of the course the student will be able to:

- work independently as well as in teams, in relation to trans-disciplinary scientific projects using a variety of methods.
- critically review published literature, understand the main brain structures and functions, and thereby indicate avenues for further neuroscience and neuroimaging research.
- formulate short lectures on the basic structure and function of the central nervous system and present these to the scientific community.
- navigate within the human nervous system and handle self-generated neuroanatomical data.
- Understand and reflect on the basic biological mechanisms and their interactions in molecular brain. imaging research.
- have a sound knowledge and a basic critical approach to scientific understanding in order to study more advanced topics within neuroscience and neuroimaging.

EXAMINATION

The final exam is a 4-hour written examination, where no aids are allowed. The examination will be based on the full course curriculum, and will be balanced to cover a broad range of the different topics covered during the course. In the examination paper, it will be indicated how much each main question contributes to the complete score of the final examination. The examination will be assessed by teachers and an internal examiner.

One final grade is awarded, combining the scores of the 30% hand-in assignments and the 70% final examination. The final grade will be awarded according to the 7-step/100 points grading scale.

The purpose of the examination is to assess the students' ability to:

- integrate knowledge of neuroanatomy, neurophysiology, neurotransmission, movement and sensation, complex brain functions, neuropharmacology, neuroimaging, neural blood flow, brain plasticity and stem cells.
- utilise the above-mentioned knowledge in a coherent understanding of the complex interplay between brain structures and functions; both at the macroscopic, cellular and molecular level.

RE-EXAMINATION

The re-examination will consist of a 4-hour written examination, where no aids will be allowed. The score of the re-examination will account for 100% of the grade. The examination will be based on the full course curriculum, and will be balanced to cover a broad range of the different topics covered during the course. In the examination paper, it will be indicated how much each main question contributes to the complete score of the final examination. The examination will be assessed by teachers and an internal censor.

GRADING

Grades are given according to the Danish 7 step and the Chinese 100 points grading scales.

Fundamental Biomedical Signal Processing

10 ECTS

CONTENT
The aim of this course is to provide the student with a basic foundation in signal processing techniques commonly encountered in biomedical applications. We begin the course with an introduction to computers, algorithms, and scientific computing. The goal of this part is to be able to write simple algorithms, including loops, functions, and conditional statements, which can be used for efficient analysis of data and signals. During this part the students are introduced to the MATLAB programming environment, which is used for signal processing in both this course and later ones.

The course then continues by covering relevant mathematical concepts from linear algebra and calculus, as well as their application, e.g., in the context of optimization and Fourier analysis.
The second part of the course covers topics from digital signal processing and analysis. First, the foundations of signal processing are introduced, e.g. analog to digital conversion, discrete time signals, Shannon's sampling theorem, convolution, and filters. This will be followed by an introduction to basic tools from stochastic signal processing, including autocorrelation and power spectrum. The course is concluded with image processing methods, with special emphasis on techniques relevant for the analysis of neuroimaging data.

LEARNING OBJECTIVES

Knowledge
At the end of the course the students will have gained knowledge of:
- Scientific computing
- Linear algebra and calculus in the context of biomedical signal processing
- Optimization
- Discrete Fourier analysis
- Digital filters
- Deterministic and stochastic discrete signals
- Autocorrelation function and power spectral density of a noisy signal
- Basic image processing techniques in two and three dimensions

Skills
During the course, the student will have obtained skills to be able to:
- Write simple algorithms to process data and analyze signals
- Use techniques from linear algebra and calculus to manipulate data
- Describe basic concepts for discrete-time signals e.g. sampling and quantization.
- Apply Shannon's sampling theorem.
- Apply the discrete Fourier transform.
- Design filters in both time-domain and frequency-domain.
- Explain the structure of simple FIR and IIR filters.
- Compare and relate deterministic and stochastic discrete signals.
- Calculate the autocorrelation functions of a random signal.
- Calculate the power spectral density of a random signal.
- Analyze 2D and 3D images using basic image processing techniques in MATLAB.

Competences
Through the course, the student is expected to gain the competences to be able to:
- Analyze and reflect on particular problems and identify relevant mathematical techniques for solving the problems.
- Provide concise description of solution strategies.
- Interpret and analyse digital signals and images.

EXAMINATION
The written examination will be in the format of mathematical and signal processing problems to be solved using MATLAB or pen and paper. In addition, essay questions may be formulated. The exam content will reflect the content of the course, with approximately 50% scientific computing and mathematics, and 50% signal- and image-processing. Each problem / question will be indicated how it contributes to the total grade. Duration of examination: 4 hours. All aids are allowed including dictionaries, text books and a computer for solving MATLAB problems. Internet connection is not allowed. No phones are allowed (not even used as a calculator).

RE-EXAMINATION
Will be in the same form as the original exam

GRADING
Grades are given according to the Danish 7 step and the Chinese 100 points grading scales.

Medical Imaging Techniques

5 ECTS

CONTENT
The aim of the MIT course is to give a short introduction to three imaging techniques frequently used in biomedical research and/or clinical practice: Optical imaging, X-ray imaging, and radionuclide imaging. The course will cover the theoretical background as well as practical utilization, strengths, and limitations of the various techniques.

Recommended student requirements:
Knowledge and competences within mathematics equivalent to the Neural Signal Processing course in the Neuroscience and Neuroimaging Master's program. Basic knowledge of physics and chemistry.

LEARNING OBJECTIVES

Knowledge
The student will gain knowledge of:

- interaction of light and ionising radiation with biological tissue.
- Methods and design of instrumentation used for optical imaging (luminescence, fluorescence, and super-resolution imaging), X-ray imaging (planar and CT), and radionuclide imaging (gamma camera, SPECT, and PET).
- the importance of optimisation of protocol and imaging parameters for a particular purpose.
- key specifications for different imaging systems.
- advantages and disadvantages of the different imaging techniques.

Skills
At the end of the course the student will be able to:

- understand and assess the performance of various imaging systems.
- identify the best imaging techniques to solve a particular problem in biomedical research and clinical practice.
- optimize protocol and key imaging parameters for best image quality.

Competences
This course enables the student to:

- contribute to implementation, optimisation, and development of imaging techniques for biomedical research and clinical practice.
- participate in imaging based biomedical research as a member of an interdisciplinary team.
- educate health professionals and others about basic principles of several imaging techniques.

EXAMINATION
3-hour written examination with a combination of 30 multiple choice questions (60%) and three essay questions (40%). For each question, it will be indicated how much it contributes to the exam.
Aids: A pocket calculator and a dictionary in paper format.
Graded by teachers and internal censor, using the Danish 7-step scale and the Chinese 100 points scale.

The purpose of the examination is to assess the student's ability to fulfil the learning objects of the course.

RE-EXAMINATION
Same format as original exam.

GRADING
Grades are given according to the Danish 7 step and the Chinese 100 points grading scales.

Magnetic Resonance Imaging

5 ECTS

CONTENT
Basic MRI covers the basic principles of magnetic resonance (MR) imaging and some research methods. This includes spin dynamics in a magnetic field, interaction of magnetization by radiofrequency pulses, principles of MR imaging using magnetic field gradients, relaxation of magnetization and contrast in images. The most important applications of MR will be introduced. These include angiography and blood flow measurement, perfusion and diffusion assessment and functional MRI. Besides, examples of the clinical use of MR imaging will be given.

LEARNING OBJECTIVES

Knowledge
The student should have knowledge of the basic principles of:
- magnetic dipole moments in a magnetic field.
- image formation.
- obtaining contrast in MR images.
- using MRI for various physiological measurements.
- clinical MRI.

Skills
- Possess overall knowledge of fundamental MRI and the clinical use of MRI.
- Understanding of which kind of research problems for which MR can be used.
- Understanding of the limitations of MR.

Competences
- Competence to be able to participate in research projects using MRI.
- Competence to be able to participate in evaluation of MR scanners for equipment purchasing.

EXAMINATION
Submission of small report from practical exercise is mandatory for attending the exam. The report will be written in small groups, and should typically be 5-10 pages. (Completing this will also qualify the student for the re-exam.)

Written examination. Combination of multiple choice and essay questions. For each question, it will be indicated how it contributes to the grade. Four hours. No aids except dictionaries. Internal censor.
The purpose of the examination is to assess the student's ability to:
- understand and explain the fundamentals of MRI.
- answer the teaching objectives in the lecture plan.
- describe applications of MRI in the clinic and research.
- describe basic principles of MR based angiography, diffusion, perfusion.
- know and describe safety issues.

RE-EXAMINATION
Will be in the same form as original exam

GRADING
Grades are given according to the Danish 7 step and the Chinese 100 points grading scales.

Pattern Recognition and Predictive Modelling in Neuroscience

5 ECTS

CONTENT
The aim of this course is to introduce pattern recognition and predictive modelling techniques and enable students to statistically analyse complex data sets as typically encountered in neuroscience. The course introduces topics in unsupervised and supervised learning beginning with presentations of unsupervised learning techniques such as k-means cluster analysis mixture models, as well as dimension reduction techniques. Within supervised learning, in addition, PRPM covers basic and advanced regression models for continuous and binary outcomes including penalized regression and support vector machines. The course emphasizes techniques for model training and assessment as well as variable selection.

Student requirements
Knowledge and competence within mathematics equivalent to the Mathematics course in the master's program. Basic knowledge in biostatistics (ANOVA, regression).

LEARNING OBJECTIVES

Knowledge
At the end of the course the student will be able to:
- understand mathematical and statistical principles in cluster analysis, mixture models expectation maximization, latent variable models, dimension reduction, regularised regression, support vector machines, classification, and model assessment and selection .
- critically reflect on theoretical and practical strengths and shortcomings of the approaches.

Skills
At the end of the course the student will be able to:
- apply unsupervised and supervised learning techniques particularly within neuroscience research.
- identify relevant techniques to solve particular problems, and discuss strengths and weaknesses of different approaches.
- concisely account for solution strategy and analysis results, as necessary for publication in scientific journals or prototyping machine learning algorithms.

Competences
At the end of the course the student will be able to:
- independently develop analysis strategies and apply combinations of statistical methodologies to solve research-based problems within neuroscience.
- become proficient in novel techniques (not covered in lectures) by studying and critically reviewing research articles.

EXAMINATION
Oral examination of the learning objectives. 20 min preparation. 20-minute examination including a 15-minute presentation by the student and 5 min. for questions. All aids allowed during preparation, only 1 sheet of notes from preparation during exam. External censor

The purpose of the exam is for the student to be able to:
- define and explain fundamental concepts within statistical learning.
- explain and apply clustering methods and mixture distributions.
- explain and apply linear and non-linear techniques for dimension reduction.
- explain and apply basic and advanced regression models and classification techniques for high-dimensional data.

- explain and apply central concepts within model evaluation, model selection and variable selection.
- identify and apply the methods introduced in the course for analysing data and discuss the advantages and disadvantages of the chosen methods.

RE-EXAMINATION
Will be in the same form as original exam.

GRADING
Grades are given according to the Danish 7 step and the Chinese 100 points grading scales.

Neuroscience in a Clinical Perspective

5 ECTS

CONTENT
This course builds upon the knowledge obtained in BNS with a focus on clinical perspectives of neuroscience and the methods used (e.g. EEG & other neurophysiologic methods as well as PET, autoradiography and radiochemistry). Although we may be interested in very basic questions about neuronal behavior or the optimization of MR coils, then in the end much of the research in neuroscience have implications for patients at some point. Similarly, patients have through various injuries and diseases helped neuroscientists to gain a better understanding of how the brain works, whereby, knowledge about patients also may help researchers in basic research. The goal is a broad introduction to various clinical aspects and the students will be given an introduction to common psychiatric disorders (e.g. affective disorders - unipolar (depression) and bipolar (manic-depressive); schizophrenia; OCD; addiction, etc.). In addition, the course also touches neurodegenerative diseases (e.g. Parkinson's and Alzheimer's diseases) and developmental disorders (e.g. Autism). In addition, students are introduced to neuropsychological issues following brain injury and how patient assessment is done and what rehabilitation and treatment perspectives are available.
Recommended student requirements
Knowledge equivalent to Basic Neuroscience, Fundamental Biomedical Signal Processing and Medical Imaging Techniques.

LEARNING OBJECTIVES

Knowledge
The course will enable the student to understand and reflect on:

- Central neuroscience topics related to both normal brain function and neuropsychiatric disorders.
- How neuroanatomy and transmission affects mental functions
- Basic features and applications of several important methodologies in clinical neuroscience such as assessment, symptoms, treatment, including general neuroscience methods

Skills
During the course, the student will acquire skills in:

- Basic insights into examination and assessment..
- The molecular basis of mental function in health and disease with particular focus on serotonergic, noradrenergic, and dopaminergic mechanisms.
- The behavioral disturbances affected by these neurotransmitters e.g. in neurodegenerative, psychiatric, and neuropsychological disorders from a biopsychosocial perspective.
- Identifying treatment perspectives of the described disorders.

Competences
At the end of the course the student will be able to:

- Select and certify the most suitable methodologies for studying neurological, psychiatric, and neuropsychological disorders.
- reflect on the cause of behavioural disturbances and propose research solutions.
- Have a basic foundation to critically review scientific publications dealing with neurological, psychiatric, and neuropsychological diseases.
- combine molecular, anatomical and signalling knowledge to gain insight and suggest research approaches in the study of diseases of the brain.

EXAMINATION

The exam is a 2-hour written multiple-choice examination without aids. For each question, it will be indicated how it contributes to the grade. Internal censor.

RE-EXAMINATION
Will be in the same form as original exam
GRADING
Grades are given according to the Danish 7 step and the Chinese 100 points grading scales.

Magnetoencephalography and Electroencephalography

5 ECTS

CONTENT

Synaptic signalling between neurons generates electric currents that are associated with electric and magnetic fields strong enough to be recorded non-invasively on the surface of the human head using electro- (EEG) and/or magnetoencephalography (MEG), respectively. MEG and EEG provide instantaneous and continuous information on human brain function. To fully appreciate their strengths and weaknesses, as well as their relationship to each other, considerable effort must be made to understand the complex relationship between measured M/EEG signals and the spatial-temporal configuration of their (bio)physical generators in the brain.

Such insight is not only key to correct interpretation of measurements, but also required for building a physiologically motivated model from which estimates of cortical source locations can be obtained. In order to successfully apply M/EEG to a neuroscientific question, and to relate published M/EEG literature to studies employing contemporary tomographic neuroimaging techniques, subtleties of instrumentation and practical challenges of data collection must be appreciated. To this end, we will provide students with the opportunity to perform hands-on laboratory exercises involving steps from preparation to acquisition and quality assurance. Even the most careful acquisitions result in datasets containing artefacts—signal components of both biological and non-biological origin that overshadow the (often subtle) neuronal responses of interest. Students are introduced to a selection of both canonical responses and common artefacts in computer exercises during which the recorded datasets are analysed.

The event-related paradigm is the workhorse of M/EEG-based scientific inquiry, and is therefore covered in detail in the context of sensory- and task-evoked responses. The extraction of quantifiable indices of brain function in both health and disease using the on-going, spontaneous fluctuations of M/EEG recordings is also briefly touched upon. The aim of the course is to provide students with a solid foundation from which to develop a deeper understanding of the study of human brain electrophysiology using state-of-the-art techniques and experimental paradigms.

LEARNING OBJECTIVES

Knowledge

Successful completion of the course will enable the student to:

- describe the biophysical model of the generators of the electric and magnetic fields that are measurable from outside the human head.
- characterise the coupling of EEG and MEG measurements to these fields, and the fundamental limitations on the signal information content imposed by physics.
- discuss method and parameter choices for obtaining spatially resolved estimates of current sources in the brain.

Skills

During the course, the student will learn to:

- identify artefactual M/EEG signal components and apply relevant signal processing tools for the mitigation of their effects on measures-of-interest.
- process M/EEG recordings and extract data features that address a physiologically or cognitively motivated question.

Competences

After the course, the students can:

- outline strategies for design, implementation, interpretation and adequate reporting of an event-related M/EEG experiment.
- reflect on ways to quantify experimental M/EEG data in order to reveal aspects of the underlying brain function.

- disseminate published literature and offer principled interpretation of results.

MODULE STRUCTURE AND TEACHING APPROACH

Lectures, group work and in-class presentations, M/EEG laboratory exercise (data collection), guided hands-on data viewing and analysis (in-class computer exercises).

EXAMINATION
30 min. oral examination. No aids.
Internal censor.

- Structure: random assignment of a known question, student presentation, examiners question, determination of grade.
- No aids during presentation or examination, but personal notes may be reviewed during short preparation period between assignment of question and presentation (1-5 minutes). Cell phones and internet access are not allowed.

RE-EXAM
Will be in the same form as original exam.

GRADING
Grades are given according to the Danish 7 step and the Chinese 100 points grading scales.

Integrative Neuroimaging

5 ECTS

CONTENT
Neuroimaging techniques are capable of probing physiology and function at molecular, cellular and system levels, in animal models and humans. However, each imaging modality has its unique strength and inherent limitations. Moreover, most imaging modalities are correlative in nature, precluding causal inferences. The aim of the Integrative Neuroimaging Course is to give the students the possibility to gain experience in the rapidly advancing field of multimodal imaging. The students will learn about when, why, and how to combine different imaging modalities. The course will provide the students with a "multimodal imaging framework" which will help them to critically interpret literature within the field and to optimally plan scientific projects in the field of brain imaging.

During the course, the following topics will be covered in overview lectures or exercises:

- Introduction into the concepts behind integrative multimodal imaging
- Introduction to standard neuroimaging analysis tools
- General analysis techniques useful for integration of modalities
- Integration of electrophysiology (EEG/ERP/MEG) and functional MRI
- Introduction to transcranial brain stimulation (TMS, TDCS) and deep brain stimulation
- Combining EEG and TMS/TDCS
- Neurostimulation and neuroimaging: TMS & fMRI, offline and online
- Integration of MR-related techniques: structural MRI (sMRI) and diffusion weighted MRI (DWI)
- Combining sMRI and functional MRI (fMRI)
- Combining DWI & fMRI
- Integrating DWI and TMS
- Integration of MR-based techniques with positron emission tomography

Recommended student requirements
Basic knowledge of the major brain mapping techniques (structural and functional MRI, diffusion sensitive MRI, PET, EEG, MEG)
Basic experience with Matlab, MRI and EEG data analysis software

LEARNING OBJECTIVES

Knowledge
By the end of the course, the student will have:

- Acquired in-depth knowledge about how the combined use of brain mapping modalities can help overcome modality-inherent weaknesses and to maximize the modality-specific scientific potential.
- Knowledge on standard analysis tools including statistical parametric mapping, analysis of event related potentials and unsupervised decomposition with applications in multimodal neuroimaging.
- Basic knowledge about how to model multimodal imaging data.
- Knowledge on how to critically review own and published multimodal results.
- The ability to understand, reflect over and explain how to best integrate two imaging modalities.
- Acquired knowledge to be able to identify neuroscientific questions that can best be studied with an integrative neuroimaging approach.

Skills
The student will be able to:

- design a multimodal neuroimaging study: Identify the most relevant neuroimaging techniques, choose the most appropriate analysis tools and discuss strengths and weaknesses of different approaches.
- explain how to incorporate interventional approaches (TMS, TDCS) in brain mapping studies.
- explain the technical and computational challenges of multimodal integration.

- use and understand standard tools for analysis of neuroimaging data.
- co-register multimodal imaging data and integrate data sets acquired in different imaging modalities for subsequent analysis.
- evaluate the choice of method for multimodal integration.
- evaluate and choose the most appropriate neurostimulation techniques and protocols.
- account for solution strategy and analysis of results, as necessary for publication in scientific journals.
- disseminate knowledge about integrative neuroimaging and discuss related professional and scientific topics with both peers and non-specialists.

Competences
This course provides the students with the capacity to:
- overview complex experimental situations that require the integration of two imaging modalities.
- plan and pursue interdisciplinary cooperation with researchers using complementary imaging modalities.
- develop new ideas on how to improve multimodal integration and implement novel applications for integrative neuroimaging.
- acquired knowledge to be able to identify neuroscientific questions that can best be studied with an integrative neuroimaging approach.

EXAMINATION
The exam is a 7-day take home assignment.
The evaluation of the course is based on a written report. At the end of the course, students are presented with a research paper. The students are to write a report including a short summery and a discussion/review of the paper.

The extent of this written report should be no more than four pages, excluding illustrations, references, tables and figures. The students should attempt to integrate the knowledge obtained during the course in the evaluation of the research.

The following questions may serve as inspiration during preparation of the report:
What is the central question that the paper addresses?
What are the hypotheses?
What are the main results?
How can the results be interpreted?
Are there technical aspects, which may hamper or limit the interpretation of the results?
What multimodal imaging techniques are used in the paper or how can multimodal imaging techniques help in addressing the research question?
Which experiments may help address the research question?
Does the paper make a significant contribution to the field?

Evaluation will be based on internal censorship.

RE-EXAMINATION
Will be in the same form as original exam.

GRADING
Grades are given according to the Danish 7 step and the Chinese 100 points grading scales.

Advanced Neuroimaging (elective)

5 ECTS

CONTENT
The course aims to give a comprehensive understanding of two important imaging modalities for neuroscience, MRI and PET. The emphasis will be on physical aspects including the relationship between design of key hardware components, signal processing and the quality of the final image data acquired. The course will provide the necessary skills for using MRI and PET in neuroscience.

Student requirements
Basic knowledge of Calculus, Physics, signal processing, and MRI. An understanding of basic medical imaging techniques. English language proficiency.

LEARNING OBJECTIVES

Knowledge
The student will gain knowledge about:

- theoretical description of spin dynamics, magnetisation, and interaction between field and tissue.
- design of magnet coil, gradient coil, RF coil, RF components in the RF transmission and receiving pathways.
- imaging methods for spectroscopy, contrast weighing, fast imaging, fMRI, ultra-high field MRI.
- principles and methods for production of PET tracers.
- design of detectors and other key hardware components for PET scanners.
- PET data acquisition, corrections, image reconstruction, and performance assessment.

Skills
At the end of the course the student will be able to

- reflect on the physical limitations and advantages of MRI and PET.
- perform data analysis and processing of data from MRI and PET studies.
- design and optimise advanced MRI and PET protocols for best data quality.

Competences
The course enables the student to

- contribute with essential knowledge about MRI and PET as a member of an inter-disciplinary research team.
- interpret data from MRI and PET relative to a scientific question.
- give advice regarding assessment and selection of optimal MRI and/or PET equipment suitable for various clinical and scientific purposes.

EXAMINATION
30 min oral examination without preparation time in one MRI topic and one PET topic drawn from a pool of at least 10 known topics.

RE-EXAMINATION
Same format as original exam

GRADING
Grades are given according to the Danish 7 step and the Chinese 100 points grading scales.

Advanced Neuroscience (elective)

5 ECTS

CONTENT
The objective of this course is to provide the student with a broad knowledge of current approaches for the study of neural function and behaviour.
The student should get an understanding of information processing in synapses, neurons and microcircuits; understand the experimental approaches used in analysing the neurophysiological basis of behaviour in intact animals, and understand the use of animal models in the study of neurological disease. The course includes a wide variety of animal model systems used in neuroscience research, and techniques for genetic manipulation in both invertebrate (e.g. C. elegans, Drosophila) and vertebrate models. The students should be able to critically read and present the current literature, and discuss the function and structure of neuronal circuits in relation to animal behaviour. This course provides an up-to-date knowledge of the neural basis for indirect measurements of global brain function such as PET and fMRI. As such, it provides insights useful when designing and interpreting experiments in human brain scanning studies. The course provides examples of genetics, signal processing, neural modelling and physiology used in the study of neural function in health and disease.

Recommended student requirements
Knowledge and understanding of basic neurobiology, physics, mathematics and signal processing, and electrophysiological and optical imaging methods, commensurate with a level at or above that which is the objective of the basic 1st. and 2nd.semester courses in neuroscience and neuroimaging. English language proficiency.

Module structure and teaching approach
Each subject will be covered by one original paper and possibly one review in double-lessons. One or two students (working as a team) will present the original paper (15 minutes), followed by a general discussion. In the second lesson a review may be presented by another student or by another pair of students (also 15 minutes presentations). Alternatively, only the original paper will be presented, and the review is expected to be read by the students in preparation. Both original papers and reviews will be used in the examination. Teachers will be from Chinese and Danish Universities affiliated with SDC. The teacher's role is primarily to guide the presentations in class, and to provide feedback.
All students are expected to actively participate in class. The course coordinators will (before the start of the course) allocate published papers/reviews for the students to present. It is a prerequisite for attending the oral exam that the student has presented two papers, one of these must be an individual presentation (to mimic the exam situation).

LEARNING OBJECTIVES

Knowledge
At the end of the course the student should be able to:

- demonstrate knowledge and understanding of molecular, genetic and physiological methods for measuring and manipulating brain function and behaviour.
- demonstrate an understanding of the strengths and limitations of the different animal models on the basis of their physiological and pathophysiological relevance, and understand how to select the best animal model(s).
- demonstrate knowledge and understanding of the molecular, dendritic, cellular and circuit organization and physiology of the CNS in relation to the behavioural requirements and evolutionary adaptations of the organism.

Skills
During the course, the student will obtain the ability to:

- evaluate results derived from experiments performed in animals in neuroscience research.
- argue for the relative merits of the above methods, and suggest new developments of methods and new physiological experiments.

- identify relevant animal models and experimental approaches to address a particular neuroscientific question.
- find, evaluate and present relevant current scientific literature.

Competences
By the end of the course the students have acquired the capacity to:
- critically understand modern molecular, cellular and behaviour-testing methods in relation to the analysis of neural information processing and brain function in health and disease.
- perform independent as well as in team work, trans-disciplinary scientific projects using a variety of physiological methods for the analysis of brain function.
- analytically evaluate his/her own and general knowledge and understanding of brain function, and indicate avenues for further improvements.

EXAMINATION
Exam format: Oral examination based on the papers/reviews presented during the course.
Examiners: Teachers from the course.
The exam duration will be 35 minutes (followed by 5 minutes for evaluation). The first part (15 minutes) consists of a paper presentation by the student, followed by 20 minutes of discussion.

Each student will be assigned a paper for presentation 48 hours prior to the examination. During the 48 hours, the student is expected to produce an exam-PowerPoint presentation of the paper. The exam-paper will not be the same as the one(s) the student has presented in class during the course, but will be one of the papers presented by other students during the course.
When evaluating the exam, it is important that the student has shown the ability to present the paper in a concise fashion, using effective presentation techniques. The main emphasis is on the ability to extract the important points of the paper, to argue why things have been included in the exam-presentation, to evaluate the paper in a critical fashion, and to put the findings and conclusions of the paper into a wider context, for instance based on the course literature and material found by the student.

RE-EXAMINATION
Will be in the same form as the original exam.

GRADING
Grades are given according to the Danish 7 step and the Chinese 100 points grading scales.

Cognitive Science (elective)

5 ECTS

CONTENT
The students will be introduced to cognitive science emphasising the functional aspects of the human brain that govern everyday behaviour, such as; attention, memory, problem solving, etc. The course is based on a number of lectures in combination with student participation in workshops and exercises. Here the students will conduct small behavioural experiments, typical relating to some of the classical studies in cognitive science (e.g. visual search (Treisman & Gelade, 1980), the serial positioning curve (Glazer and Cunitz, 1966) in free recall, etc.). The overall goal is to give the course participants a thorough introduction to cognitive science and behavioural methods.

Recommended student requirements
An understanding of the content covered in the courses BNS and NNPN. A basic knowledge of the major imaging techniques (structural and functional MRI, diffusion sensitive MRI, PET, EEG, MEG). English language proficiency.

Module structure and teaching approach
Combined lectures, with student activities. The student activities can take the form of small behavioural experiments that may provide the empirical data for one of the two final synopsis papers, classroom presentations, as well as group work.

LEARNING OBJECTIVES

Knowledge
During this course, the student will obtain:
- knowledge about the historical roots and foundation of cognitive science.
- knowledge about specific cognitive functions (e.g. memory, attention, emotions, etc.).
- knowledge of behavioural experiments that can provide the basis for further neuroscientific enquiries.

Skills
By the end of the course the student will be able to:
- disseminate theoretical knowledge about cognitive science and experimental results.
- conduct behavioural experiments investigating human cognition.
- devise, design, and set-up simple behavioural experiments within cognitive science.

Competences
The course provides the student with the ability to:
- critically review scientific publications dealing with topics relating to cognitive science, and cognitive neuroscience more broadly.
- select suitable methodologies for studying cognition.
- reflect behavioural test designs and propose research solutions.

EXAMINATION
The exam is an oral synopsis exam. Examiners will be Teachers from the course.

By 9 am the day before the exam, the student must hand in two synopsis papers, one theoretical and one empirical, the maximum size of a synopsis is three pages each (times new roman, pt. 12, 1.5 line spacing). The topics should not be too overlapping and needs to be approved by the course coordinator before the final exam. A synopsis is a short academic text, based on the course literature, and may include supplementary literature chosen by the student.

The oral part of the exam is 30 min. The student will enter the examination room and choose one of the two synopsis papers at random, which will be the basis for the exam. Then the student will have 7 min to make a brief presentation, followed by an examination based on the chosen synopsis (approximately 7 min) and the broader course curriculum (approximately 7 min), leaving the remaining time for the examiner and censor to discuss the final grade and give feedback.

RE-EXAMINATION
Will be in the same form as the original exam.
This is a new oral synopsis exam, based on new topics that are not too overlapping with previous chosen topics (for specifics on format please cf. to the above section), and these need to be approved by the course organiser before a re-examination.

GRADING
Grades are given according to the Danish 7 step and the Chinese 100 points grading scales.

Master Thesis

60 ECTS

CONTENT
The SDC Master's Degree in Neuroscience and Neuroimaging is concluded by a master thesis equivalent of 60 ECTS. The student should work independently with a research topic at a suitable research laboratory under the supervision of a Chinese and/or Danish university professor affiliated with the SDC. The student should prepare a dissertation of the conducted work at the end of the master thesis, which will be assessed together with an oral presentation of the work (the defence).

Module structure and teaching approach
Independent work in a research laboratory along with theoretical studies of the topic. Guided and supervised by a Chinese and a Danish university professor affiliated with the SDC.

LEARNING OBJECTIVES

Knowledge
During the study, the student will:
- obtain extensive knowledge and understanding in the research topic of the master study.
- reflect on the acquired knowledge to plan and execute scientific experiments.

Skills
The student will acquire:
- the ability to analyse, critically discuss, and review scientific articles.
- disseminating skills for the presentation of personal scientific data to the non-specialists and research community.

Competences
At the end of the study the student will be able to:
- define, describe and test scientific hypotheses.
- independently plan and conduct a larger scientific research project through the use of the theory and techniques obtained during the education.
- analyse, critically discuss and evaluate scientific problems.

EXAMINATION
Written report and oral examination.

The written report should contain the same sections as a scientific paper. Please include a section on method optimisation as appropriate.
The maximum length of the thesis is 132,000 characters excluding blanks (equivalent to approximately 60 normal pages). There is no minimum length of the thesis and it does not have to reach the maximum length.
Deadline for the written report is set by the SDC in Thesis Regulations. Guidelines for the Master's thesis will be displayed on Moodle.

Oral defence
The oral defence will take place after the thesis is handed in, following the deadlines set by the SDC.

Chinese students:
45 min oral presentation of the project followed by 45 min of questions from examiners.
Examiners: Chinese supervisor, Danish supervisor, external censor.

Danish/International students:
45 min oral presentation of the project followed by 45 min of questions from examiners.

Examiners: Chinese supervisor, Danish supervisor, external censor and for the Chinese grading also a Chinese expert.

RE-EXAMINATION
The same as the ordinary exam attempt. For more information, see Moodle's 10-step guide.

GRADING
For the Danish/international students, grades are given according to the Danish 7 step and the Chinese thesis grading scales.
For the Chinese students, grades are given according to the Danish 7 step grading scale only.

The details of the thesis procedure are described in SDC Thesis Regulations 10 Steps.

Commencement

Effective as of 01.09.2019

Changes to the Academic regulations

No changes yet.