GHENT UNIVERSITY

Course Specifications

Valid as from the academic year 2018-2019

Auditory Computation, Modelling and Devices (E092970)

Course size (nominal values; actual values may depend on programme)

Credits 3.0	Study time 90 h	Contact hrs	25.0 h

Course offerings and teaching methods in academic year 2020-2021

A (semester 2)	English	practicum	12.5 h
		self-reliant study activities	6.25 h
		lecture	12.5 h

Lecturers in academic year 2020-2021

Verhulst, Sarah	TW05	lecturer-in-charge

Offered in the following programmes in 2020-2021	crdts	offering
Master of Science in Biomedical Engineering	3	A
International Master of Science in Biomedical Engineering	3	A
Master of Science in Biomedical Engineering	3	A

Teaching languages

English

Keywords

Hearing, Auditory Signal Processing, Auditory Neuroscience, Auditory modelling, Assistive Device Algorithms (Hearing aids and cochlear implants).

Position of the course

This course covers neuro-engineering approaches to auditory signal processing and neuroscience, which is a core area in biomedical engineering applications that focus on sound perception and assistive hearing technology such as cochlear implants and hearing aids. The course teaches how the brain processes sound and how these processes can be modelled. Skills to analyse and design signal processing tools for auditory applications are developed. The topics range from basic auditory neuroscience to modelling these processes and developing signal processing tools that make use of this information to develop new technology (e.g., MP3, smart-phone apps, hearing-aid algorithms). The course offers hands on experience with the above concepts and combines lectures with lab exercises on auditory experiments to offer a comprehensive view of auditory neuro-engineering. With this background, students become acquainted with signal processing techniques and analysis methods for the fields of auditory signal processing, hearing technology, auditory brain-computer interfacing and the development of auditory EEG based techniques for hearing diagnostics.

Contents

1. Physical basis:
- General background of auditory neuroscience, sound perception and auditory computation;
- Auditory models of perception and computational models of the auditory system;
- Signal processing in assistive devices (hearing-aids, cochlear implants);
- Auditory EEG: Hearing Diagnostics, brain-computer interface, links between EEG and sound perception.

2. Application Oriented:
- Basics of quantifying sound perception and quality using alternative forced choice procedures in Matlab;
- Biomedical signal processing techniques and statistics to analyse auditory evoked brain potentials;
- Modelling auditory neuroscience processes and computer hearing (e.g., pre-processing of speech recognition systems);

- Signal processing and sound encoding in assistive devices such as hearing-aids and cochlear implants;
- Hands-on experience with auditory EEG and sound perception experiments.

Initial competences

Signal processing and filtering, basic knowledge of the EEG technique.

Final competences

1 Understand the basics of auditory neuroscience and signal processing. In particular: cochlear transformation, auditory nerve and brainstem encoding principles.
2 Model key auditory features of the auditory system: auditory filter-bank models, and functional auditory neuronal models.
3 Be able to identify and apply the signal processing techniques and statistics to analyse auditory biomedical signals (e.g., auditory EEG).
4 A thorough understanding of how signal processing in assistive listening devices is applied.
5 Skills to further develop biomedical technology related to auditory neuroscience and sound perception.

Conditions for credit contract

Access to this course unit via a credit contract is determined after successful competences assessment

Conditions for exam contract

This course unit cannot be taken via an exam contract

Teaching methods

Lecture, practicum, seminar, self-reliant study activities

Extra information on the teaching methods

The lectures will provide the necessary theoretical background to understand the topic, after which a practicum will be conducted on the same topic. This lab exercise comprises either a lab-experiment (e.g., EEG recording, psychophysics sound perception experiment) or computer simulations of auditory models, assistive hearing device technology. The students can work in group to complete the exercises and need to hand in a written report for each of 4 practica.

Learning materials and price

Slides, (e-)book chapters, publications

References

See course material

Course content-related study coaching

Students can make an appointment via email for further explanation of the course and for feedback on the group work.

Evaluation methods

end-of-term evaluation and continuous assessment

Examination methods in case of periodic evaluation during the first examination period

Written examination, open book examination, oral examination

Examination methods in case of periodic evaluation during the second examination period

Written examination, open book examination, oral examination

Examination methods in case of permanent evaluation

Assignment, report

Possibilities of retake in case of permanent evaluation

examination during the second examination period is possible in modified form

Extra information on the examination methods

During examination period: oral open-book exam
During classes: graded project reports, contribution to tasks

Calculation of the examination mark

Periodic evaluation = 70%
Permanent evaluation (activities during the semester) = 30%