GHENT UNIVERSITY

Course Specifications

Valid in the academic year 2023-2024

Medical Signal Processing and Statistics (E010390)

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

Credits 3.0 **Study time 90 h**

Course offerings and teaching methods in academic year 2023-2024

A (semester 2)	English	Gent	lecture
			seminar

Lecturers in academic year 2023-2024

Madhu, Nilesh	TW06	lecturer-in-charge
van Mierlo, Pieter	TW06	co-lecturer
Verhulst, Sarah	TW05	co-lecturer

Offered in the following programmes in 2023-2024	**crdts**	**offering**
Bachelor of Science in Engineering(main subject Biomedical Engineering)	3	A
Preparatory Course Master of Science in Biomedical Engineering	3	A

Teaching languages

English

Keywords

Practical biomedical signal processing, bootstrapping/permutation numerical statistics, filtering and noise reduction, independent component analysis, Python programming

Position of the course

This course teaches practical signal processing, clustering, noise reduction and artefact rejection as well as numerical statistical methods that will be implemented and programmed in a Python environment. Several types of biomedical signals will be treated as case studies (e.g. EEG, EGC, ...) and form a basis for the exercises in which the different techniques are introduced and applied. The analysis and programming skills acquired in this course provide insight about which possible signal analysis techniques are available and appropriate for a given biomedical signal type. This course bridges the more theoretical treatment of (digital) signal processing and filtering, as well as statistics and mathematics of the first two years of the Bsc program toward realistic and practical scenarios. This hands-on approach of applying and programming signal processing is an important cornerstone in biomedical engineering as it teaches analysis and programming skills that will be important for the advanced imaging and medical signal processing required for the Msc of biomedical engineering.

Contents

Theoretical basis:

- Linear regression and significance testing using numerical methods
- Filtering and artefact rejection
- Frequency domain analysis techniques (e.g. Fourier)
- PCA, ICA
- Pattern recognition and clustering
- Classification

Application Oriented:

- Programming biomedical signal processing and numerical statistical techniques in Python.
- Hands-on experience with common biomedical signals.

Initial competences

Systems and Signals, Basic Mathematics and Statistics

Final competences

1 Understand how practical numerical statistical and biomedical signal processing techniques work.
2 Be able to identify which signal processing and statistical methods are suitable for the biomedical dataset at hand.
3 Python programming skills to apply and implement biomedical signal processing and statistics.
4 Skills to search for and evaluate more advanced biomedical signal processing techniques required in Msc courses.

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

Seminar, Lecture

Extra information on the teaching methods

Lectures, guided practicals, python exercises

Learning materials and price

Course notes, copies of relevant sections from books and publications. All necessary material will be made available online.

References

Several chapters of the following books will be covered:
- Rangayyan, R. M., & Reddy, N. P. (2002). Biomedical signal analysis: a case-study approach. *Annals of Biomedical Engineering*, *30*(7), 983-983.
- Kirkwood, B. R., & Sterne, J. A. (2010). *Essential medical statistics*. John Wiley & Sons.
- Efron, B., & Tibshirani, R. J. (1994). *An introduction to the bootstrap*. CRC press.

Course content-related study coaching

Assessment moments

end-of-term and continuous assessment

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

Written assessment

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

Written assessment

Examination methods in case of permanent assessment

Assignment

Possibilities of retake in case of permanent assessment

not applicable

Extra information on the examination methods

end-of-term evaluation (50%) and continuous assessment via reports (50%), it is necessary to pass both parts to pass the course.

Calculation of the examination mark

The final score is based on a weighted average of the score obtained for the computer projects and the score obtained in the final exam. However, students must pass both parts to pass the course.
Calculation of score:
- Weight of computer projects = 1/2
- Weight of final exam = 1/2

If the score on any one component (projects or written exam) is less than 50%, then the final score will be reduced to 9/20.
If the score on the written exam is less than 40% then the final score will be reduced to the lowest score of 7/20, such that it cannot be considered for deliberation.