GHENT UNIVERSITY

Course Specifications

Valid as from the academic year 2024-2025

Fundamentals of Statistical Sensor Processing (E003422)

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

Credits 6.0 **Study time 180 h**

Course offerings and teaching methods in academic year 2025-2026

A (semester 1)	English	Gent	independent work	30.0h
			lecture	20.0h
			seminar	10.0h

Lecturers in academic year 2025-2026

Luong, Hiep	TW07	lecturer-in-charge
Aelterman, Jan	TW07	co-lecturer

Offered in the following programmes in 2025-2026	crdts	offering
Bridging Programme Master of Science in Bioinformatics(main subject Engineering)	6	A
Master of Science in Electrical Engineering (main subject Communication and Information Technology)	6	A
Master of Science in Electrical Engineering (main subject Electronic Circuits and Systems)	6	A
Master of Science in Bioinformatics(main subject Engineering)	6	A
Master of Science in Industrial Engineering and Operations Research(main subject Manufacturing and Supply Chain Engineering)	6	A
Master of Science in Industrial Engineering and Operations Research(main subject Transport and Mobility Engineering)	6	A
Master of Science in Computer Science Engineering	6	A
Master of Science in Industrial Engineering and Operations Research	6	A
Master of Science in Photonics Engineering	6	A

Teaching languages

English, Dutch

Keywords

Estimation, Decision, Detection, Mean Square Error, Maximum Likelihood, Bayesian Inference, Sensor Fusion

Position of the course

This introductory course provides insight into the available alternatives for estimating unknown quantities (estimation) or testing hypotheses (decision) from (sensor) data. Within this context, she also elaborates on combining (multimodal) sensor data (sensor fusion). These methods are of great importance in communication technology, signal processing, machine learning and data processing, among others.

Contents

This course consists of lectures, supplemented by guided self-study in preparation for guided exercise sessions.

- Introduction to Estimation and Detection Problems
- Definition of sensing and inverse problems as estimation and decision problems
- Classical estimation theory: Fisher estimate, unbiased minimum variance estimates, maximum probability estimates, Pearson's method of moments, linear estimates, least squares estimates
- Bayesian estimation theory
- Decision theory: classical decision, Bayesian decision
- Estimation and decision for sensor fusion (different sensor fusion strategies,

theoretical foundations, Likelihood ratio estimation, pixel-level fusion)
- Case studies of estimation & decision & sensor fusion
- Multimodal sensors & the influence of changing circumstances (changing data statistics)

Initial competences

Basic notions of Statistics and Probability.

Final competences

1 Modelling estimation or detection problems mathematically.
2 Determining and estimating the performance of optimal receiver structures.
3 Developing an intuition for appropriate estimation techniques and their advantages/disadvantages.
4 Developing an intuition for appropriate sensor fusion techniques and their advantages/disadvantages.
5 Considering the pros and cons of the different paradigms.

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, Independent work

Study material

Type: Slides

Name: Slides Fundamentals of Statistical Sensor Processing
Indicative price: Free or paid by faculty
Optional: no
Language : English
Available on Ufora : Yes

References

- S. Kay, "Fundamentals of Statistical Signal Processing, Volume 1: Estimation Theory" (Prentice Hall, 1993).
- S. Kay, "Fundamentals of Statistical Signal Processing, Volume 2: Detection Theory" (Prentice Hall, 1998).

Course content-related study coaching

The lecturers are available for explanations during and after the lectures. Students can contact teachers at any time.

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

Participation

Possibilities of retake in case of permanent assessment

not applicable

Extra information on the examination methods

- During examination period: written exam, open book
- Permanent evaluation: participation (tests) and preparation

Calculation of the examination mark

- First examination period: non-periodical (participation + preparation) 10%; periodic (exam) 90%.
- Second examination period: periodic (exam) 100%.