Course: Uncertainty in Sensor Data — credits: 5

Course code	ELVB25USD
Name	Uncertainty in Sensor Data
Study year	2025-2026
ECTS credits	5
Language	English
Coordinator	B.D. Williams
Modes of delivery	Project-based learning
Assessments	Uncertainty in Sensor Data - Assignment

Learning outcomes

Design
The novice professional considers different solutions to arrive at a detailed and well-founded (electrical) technical product / service / process based on the program of requirements and uses appropriate design methods and takes into account social interests and engineering standards.

Realisation
The novice professional realizes and validates a (prototype of a) product / service / process based on an (electrical) technical design and makes appropriate use of materials / techniques / instruments.

Maintenance
The starting professional ensures that an electrotechnical product/service/process functions in accordance with specific quality criteria by means of repair, maintenance or (use/maintenance) instructions.

Advice
The novice professional presents and documents substantiated results in accordance with engineering standards, draws logical conclusions, and provides advice on a (future) product/process/method in an electrical engineering context.

Content

In this module, the concepts and practice of sensor data fusion will be treated. This will be combined with techniques to reduce uncertainty in sensor data, in order to be able to design a reliable sensor system.

Professional products

- Smart system – A system that incorporates (multiple) sensor(s), data processing, and automation to analyse information, make decisions, and adapt to changing conditions, enhancing efficiency, performance, and user interaction or recommendations. *In this module: The sensor systems and data fusion processing.*
- System Design – An overview of components and interactions between different components of a system. It includes the design of software and hardware architecture, components, interfaces, and data. *In this module: A smart system including sensor fusion.*
- Software for a Smart System – The applications and algorithms that enable intelligent functionality, data processing, decision-making, and communication within a smart system. It typically includes embedded software, control software, and communication protocols to facilitate real-time operations, automation, and system integration. *In this module: Software for sensor fusion.*
- Simulations and calculations – Studying the performance of a process or system through the imitation of a physical system or design in a virtual environment or on paper. *In this module: Calculations on sensor fusion and various techniques related to reliability and reproducibility*
- Test documentation – The set of documents describing the testing process, including test plans, test cases, test results, and any error messages. It provides insight into the test strategy, the tests performed, and the results obtained to evaluate the quality of a product. *In this module: test plans and results on sensor measurements.*
- Test execution – Performing tests according to a predetermined test plan, checking the functionality, performance, or safety of a product or system. The goal is to identify errors or deficiencies and verify that the product meets specifications. *In this module: Testing sensor performance.*

Skills

- Smart System design – The interdisciplinary process of creating intelligent, connected systems that integrate sensors, data processing, control algorithms, and communication technologies to enable adaptive, autonomous, and efficient operation in complex environments. It involves hardware and software co-design, system integration, and consideration of factors like energy efficiency, scalability, reliability, and user interaction. *In this module: The data acquisition, reliability and processing of a smart system.*
- Producing Reliable data – Generating data that is accurate, consistent, and repeatable over time, ensuring it can be trusted for analysis, decision-making, and system validation. This can be achieved by considering for example repeatability, accuracy, precision, calibration, dynamic range, linearity and using noise reducing techniques.

- Simulating and calculating – Studying the performance of a process or system by means of a simulation of a physical system or a design in a virtual environment or on paper. In this module: calculations on sensor fusion and various techniques related to reliability and reproducibility.
- Testing – Evaluating a product, system, or component to verify that it functions correctly, meets specifications, and is free from errors or defects. *In this module: Testing sensor performance.*

Knowledge

- (Sensor) Data fusion – The process of combining data from multiple sensors to improve the accuracy, reliability, and completeness of information compared to using a single sensor by reducing noise, increasing redundancy, and providing a more comprehensive view of the environment. For example, via Kalman filtering
- Design, production and measurement reliability – The process of ensuring that a system or product is consistently functional (design reliability), manufactured with minimal defects (production reliability), and evaluated using accurate and repeatable measurements (measurement reliability) to guarantee overall quality and performance. For example, via techniques like: Design for six-sigma, Design of tolerances, Taguchi design of experiments, Gauge R&R, and Production control.

Included in programme(s)

Exchange Sensors and Smart Systems (autumn)
Minor Sensors and Smart Systems

School(s)

Institute of Engineering

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