Modulation and coding

Lecturer
Francois HORLIN (Coordinator)

Course mnemonic
ELEC-H401

ECTS credits
5 credits

Language(s) of instruction
English

Course period
Second term

Campus
Solbosch

Course content

Most existing communication systems (cellular, WiFi, xDSL...) are based on digital information exchanges. The aim of the course is to present the technologies deployed today to support the very high communication speeds expected by users. By the end of the course, students will understand the main techniques used in recent digital communications systems.

Objectives (and/or specific learning outcomes)

The course introduces the basic principles of digital communications. In particular, the course presents all the system components necessary to ensure reliable communication when the propagation channel introduces only additive noise.

Students will learn to:

- Understand digital modulations such as PAM, PSK, QAM and FSK
- Shape signals (halfroot Nyquist filter)
- Design the optimal receiver when the propagation channel is only corrupted by white noise
- Develop channel coding and decoding techniques to improve system robustness
- Design an iterative channel decoder applied to LDPC codes
- Understand the impact of synchronization errors on communication
- Design time/frequency synchronization algorithms
- Study system performance using Matlab simulations

Pre-requisits and co-requisits

Courses having this one as pre-requisit

ELEC-H422 | Wireless communication channels | 4 crédits, ELEC-H522 | Digital communications | 4 crédits, ELEC-Y548 | Photonics | 4 crédits and MEMO-H503 | Master thesis in Electrical Engineering | 24 crédits

Teaching method and learning activities

In addition to theory, a project is organized to implement the digital communication on a channel made up of optical fiber and coaxial cable. An experimental setup is made available to students by Orange. Students have the opportunity to apply their theoretical knowledge to the design of a real communication system. The course material consists of a set of slides. Scientific references are also provided at the beginning of each chapter.

Contribution to the teaching profile

This teaching unit contributes to the following competences:

- In-depth knowledge and understanding of exact sciences with the specificity of their application to engineering
- In-depth knowledge and understanding of integrated structural design methods in the framework of a global design strategy
- In-depth knowledge and understanding of the advanced methods and theories to schematize and model complex problems or processes
- Reformulate complex engineering problems in order to solve them (simplifying assumptions, reducing complexity)
- Correctly report on research or design results in the form of a technical report or in the form of a scientific paper
- Present and defend results in a scientifically sound way, using contemporary communication tools, for a national as well as for an international professional or lay audience
- Collaborate in a (multidisciplinary) team
- Work in an industrial environment with attention to safety, quality assurance, communication and reporting
- Develop, plan, execute and manage engineering projects at the level of a starting professional
- Think critically about and evaluate projects, systems and processes, particularly when based on incomplete, contradictory and/or redundant information
- A creative, problem-solving, result-driven and evidence-based attitude, aiming at innovation and applicability in industry and society
- A critical attitude towards one's own results and those of others
- An attitude of life-long learning as needed for the future development of his/her career

- Has an active knowledge of the theory and applications of electronics, information and communication technology, from component up to system level.
- Has a profound knowledge of either (i) nano- and opto-electronics and embedded systems, (ii) information and communication technology systems or (iii) measuring, modelling and control.
- Has a broad overview of the role of electronics, informatics and telecommunications in industry, business and society.
- Is able to analyse, specify, design, implement, test and evaluate individual electronic devices, components and algorithms, for signal-processing, communication and complex systems.
- Is able to model, simulate, measure and control electronic components and physical phenomena.

References, bibliography and recommended reading

John Proakis, Digital communications, Fourth Edition.

Course notes

Université virtuelle

Other information

Place(s) of teaching

Solbosch

Contact(s)

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Evaluation method(s)

Group work, Oral presentation and Written report

Determination of the mark (including the weighting of partial marks)

Oral: 60%

Report: 40%

Main language(s) of evaluation

English and French

Programmes

Programmes proposing this course at the Brussels School of Engineering

MA-IREL | Master of science in Electrical Engineering | finalité electronics and information technologies/unit 1