Digital communications

Lecturer
Francois HORLIN (Coordinator)

Course mnemonic
ELEC-H522

ECTS credits
4 credits

Language(s) of instruction
English

Course period
Second term

Campus
Solbosch

Course content

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

Objectives (and/or specific learning outcomes)

The students will:

- Understand the degradations caused by the frequency-selective channels and the techniques deployed in the recent systems to equalize the channel;
- Understand the impact of synchronization errors and design synchronization algorithms;
- Understand the concept of spatial diversity and the techniques exploiting the spatial dimension to multiply the communication capacity or coverage;
- Implement the resulting communication system and evaluate its performance analytically and with Matlab simulations;
- Learn to select the parameters to make the best trade-off between the performance/spectral efficiency/computational complexity.

More specifically the following topics will be covered:

- Maximum-likelihood channel equalizer
- Linear and decision-feedack channel equalizers
- Orthogonal frequency-division multiplexing (OFDM)
- Space-time diversity, space-time block codes
- Space-division multiplexing
- Impact of synchronization errors
- Time/frequency acquisition and tracking

Pre-requisits and co-requisits

Pre-requisites courses

ELEC-H401 | Modulation and coding | 5 crédits

Teaching method and learning activities

Besides the theory, a project is organized aiming at simulating a WiFi digital communication system with real hardware (USRP). The students have therefore the opportunity to apply their theoretical knowledge to a real communication system design. The support of the lecture is composed 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)
- Conceive, plan and execute a research project, based on an analysis of its objectives, existing knowledge and the relevant literature, with attention to innovation and valorization in industry and society
- 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
- The flexibility and adaptability to work in an international and/or intercultural context
- 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.

Course notes

Université virtuelle

Other information

Place(s) of teaching

Solbosch

Contact(s)

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Evaluation method(s)

Written report, Group work and Oral presentation

Main language(s) of evaluation

English

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 2