Universitat Autònoma de Barcelona

2022/2023

Multidisciplinary Applications in Telecommunications II

Code: 102694
ECTS Credits: 6

Degree	Type	Year	Semester
2500898 Telecommunication Systems Engineering	OT	4	2

Contact

Name: Pedro Antonio de Paco Sanchez
Email: pedro.depaco@uab.cat

Use of Languages

Principal working language: catalan (cat)
Some groups entirely in English: No
Some groups entirely in Catalan: No
Some groups entirely in Spanish: No

Teachers

Jordi Verdu Tirado

Prerequisites

It is recommended previously to take before

- Radiocommunications Systems
- Microwave Engineering
- Antennas

Objectives and Contextualisation

In a world of smart cities, smart vehicles, intelligent navigation systems, the acquisition of remote information or remote sensing becomes a fundamental tool in current applications and in those that have to come. With a world that is more connected and better characterized and with applications that are reinforced in the ubiquity of information access, remote sensing can be found in diverse applications and sectors such as aeronautics, security, health, automotive or navigation systems.

In this subject, we will examine the theoretical design and practical aspects of the current remote sensing or radar systems as well as their applications. From the spectral analysis of the radar signal, the theory of statistical detection, to the design of the antenna, receivers, transmitters, waveform design, and information extraction of the processed signals. Covering a wide range of both commercial and government applications, but with a particular emphasis on Automotive radar for a connected and autonomous vehicle.

This subject presents an introduction to the radar by providing the operational foundations and the engineering foundations of this technology. The nature of the radar presented here, together with the physical phenomena and applications of the system, lay the foundations for future activities in the radar field.

The main objectives are:

Acquire the knowledge that allows the initial understanding of radar technologies.

Acquire the knowledge needed to deal with the simulation techniques of remote sensing technologies in a basic way.

Competences

- Analyse and evaluate the social and environmental impact of technical solutions.
- Communication
- Develop ethics and professionalism.
- Develop personal attitude.
- Develop personal work habits.
- Develop thinking habits.
- Draft, develop and sign projects in the field of telecommunications engineering that, depending on the speciality, are aimed at the conception, development or exploitation of telecommunication and electronic networks, services and applications.
- Learn new methods and technologies, building on basic technological knowledge, to be able to adapt to new situations.
- Resolve problems with initiative and creativity. Make decisions. Communicate and transmit knowledge, skills and abilities, in awareness of the ethical and professional responsibilities involved in a telecommunications engineer's work.
- Work in a multidisciplinary group and in a multilingual environment, and communicate, both in writing and orally, knowledge, procedures, results and ideas related with telecommunications and electronics.
- Work in a team.

Learning Outcomes

1. "Reason inductively and deductively; i.e. infer general conclusions from private observations, and take on board the general concepts covered in other courses for specific applications."
2. Analyse ways in which telecommunications can help to reduce energy costs.
3. Apply conceptual, theoretical and practical telecommunication tools, as well as those of telecommunication systems and services to the development and exploitation of applications in a variety of different areas.
4. Communicate efficiently, orally and in writing, knowledge, results and skills, both professionally and to non-expert audiences.
5. Communicate solutions to problems in a thorough and concise manner. Write using formal mathematical language.
6. Critically evaluate the work done.
7. Demonstrate a pragmatic and flexible attitude for efficient implementation of telecommunications in developing and operating in areas of various kinds.
8. Develop critical thinking and reasoning.
9. Develop curiosity and creativity.
10. Develop independent learning strategies.
11. Develop, as part of a group, an innovative telecommunication application project.
12. Efficiently use ICT for the communication and transmission of ideas and results.
13. Evaluate the advantages and disadvantages of different conceptual and technological options for different telecommunication applications.
14. Generate ideas about new telecommunication applications and the techniques on which they are based.
15. Illustrate the use of telecommunications in renewable energy infrastructures.
16. Justify before an audience the feasibility of a new idea for a telecommunications application.
17. Manage available time and resources.
18. Mathematically formulate a problem from the basis of a descriptive statement.
19. Respect diversity in ideas, people and situations.
20. Work autonomously.
21. Work cooperatively.

Content

1. Introduction to radar
2. The radar equation
3. Matched filter
4. Calculation of Radar Cross Section
5. Influence of noise in the receiver
6. Continuous wave CW-RADAR
7. FMCW RADAR: Automotive Application.
8. Introduction
9. Applications
10. Radar Automotive Sector
    1. Radar Benchmark
    2. Spectrum Regulatory Framework
    3. Automotive Radar.
    4. Engineering Approach
    5. Range Estimation
    6. Radar Equation and Cross Section Radar
    7. Speed Measurement
    8. Role of the signal phase IF
    9. Angle of arrival

Methodology

CLASES DE TEORÍA: Exposición de contenidos de forma participativa con todos los alumnos.

EJERCICIOS Y PRÁCTICAS: Realización de ejercicios y prácticas en aula de teoría y en aula con ordenadores.

TRABAJOS AUTÓNOMOS: Realización de apuntes. Actividades. Estudio del temario.

TUTORÍAS: Tutorías individuales.

Annotation: Within the schedule set by the centre or degree programme, 15 minutes of one class will be reserved for students to evaluate their lecturers and their courses or modules through questionnaires.

Activities

Title	Hours	ECTS	Learning Outcomes
Type: Directed			
Exercises	12	0.48	1, 2, 3, 5, 18, 14, 15, 19
Laboratory	12	0.48	1, 3, 6, 13, 4, 7, 11, 9, 12, 17, 16, 19, 21
Theoretical classes	26	1.04	1, 3, 13, 8, 19
Type: Supervised			
Tutorship	6	0.24	1, 6, 9
Type: Autonomous			
Exercise and lab preparation	20	0.8	1, 3, 6, 13, 5, 7, 10, 8, 18, 17, 21, 20
Study	60	2.4	1, 3, 6, 13, 7, 10, 9, 8, 18, 17, 20

Assessment

LAB:

It will be evaluated the ability of the student to solve the problems through the delivered reports, autonomy in the resolution during the practice, the ability to work in a team with the colleagues of the group of practices and their diligence.

exam

There will be a mid-semester exam (Exam1) and an exam at the end of the semester (Exam2).

Final grade = 0.4 * Lab + 0.3 * Exam1 + 0.3 * Exam2

Minimum note of each exam = 3.5.

In case that one of the two parts of the subject is not approved, a re-evaluation exam will be carried out in the calendar assigned to this effect, where the student will retake exam1 and/or exam2.

The practical work will not be recoverable.

Assessment Activities

Title	Weighting	Hours	ECTS	Learning Outcomes
Exam 1	30%	2	0.08	1, 2, 3, 13, 5, 10, 8, 18, 14, 17, 15, 19, 20
Exam 2	30%	2	0.08	1, 2, 3, 13, 5, 10, 8, 18, 14, 17, 15, 19, 20
Laboratory Evaluation	40%	10	0.4	1, 3, 6, 13, 4, 7, 11, 9, 12, 17, 16, 19, 21

Bibliography

- Introduction to Radar Systems. Merrill I. Skolnik. Mc-Graw-Hill.

- Radar Principles. Peyton Z. Peebles. John Wiley & Sons.

- Microwave Remote Sensing: Active and Passive, Vol. I -- Microwave Remote Sensing Fundamentals and Radiometry. F. T. Ulaby, R. K. Moore, and A.K. Fung, Addison-Wesley, Advanced Book Program, Massachusetts.

Software

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