Radar and 5G Architectures and Systems

General information

Scope	Telecommunications Engineering
Language	INGLESE
Didactic Activity Type	Lecture
Holders	ROCCA PAOLO
Length	48 hours (48 hours Lecture)
Subject area	ING-INF/02

Contents

Bibliography/Study materials

- M. I. Skolnik, Introduction to Radar Systems. McGraw-Hill, 2001.
- M. I. Skolnik, Radar Handbook. McGraw-Hill, 2008.
- B. Edde, Radar: Principles, Technology, Applications. Prentice-Hall, 1995.
- G. Franceschetti and R. Lanari, Synthetic Aperture Radar Processing. CRC Press, 1999.
- H. Meikle, Modern Radar Systems. Artech House, 2008.
- M. A. Richards, J. A. Scheer, and W. A. Holm, Principles of Modern Radar: Basic Principles. SciTech, 2010.
- W. L. Melvin and J. A. Scheer, Principles of Modern Radar: Advanced Techniques. SciTech, 2013.
- W. L. Melvin and J. A. Scheer, Principles of Modern Radar: Radar Applications. SciTech, 2014.
- W.-D. Wirth, Radar Techniques Using Array Antennas. IET Radar, Sonar, and Navigation Series: The Institution of Engineering and Technology, 2013.
- J. R. Guerci, Cognitive Radar : The Knowledge-aided Fully Adaptive Approach. Artech House, 2010.
- A. Zaidi, F. Athley, J. Medbo, U. Gustavsson, G. Durisi, and X. Chen, 5G Physical Layer. Academic Press, 2018.

Course objectives and learning outcomes

The course is aimed to introduce the students to the basics of radar and 5G principles and to teach modern active architectures and systems focusing on electromagnetic functionalities and principal applications, also providing insights on the latest advances as well as envisaged evolutions of future radars and mobile communications.
The course is divided into six parts. The first two parts are devoted to present the general architecture of a radar system, the basic radar terminology, and the mathematical and physical description of the radar problem. The third part focuses on modern radar architectures, highlighting the relationships between radar requirements, system deployment, and design of the sensing layout. The fourth and fifth parts are aimed to discuss the principal functionalities of modern active radar systems and present a selection of electromagnetic radar applications. The last part is aimed at showing how the technologies and architectures typical of radar systems will be widely used in the new 5G mobile communications systems.
At the end of the course, the student is expected to become aware of the principles for external radar and 5G design (i.e., starting from the problem objectives and requirements/constraints specify the general architecture) and the internal design (i.e., starting from the general architecture specify the HW and SW implementations) and to acquire the knowledge for the study, analysis and design of modern and future radar and communications systems.

Entrance requirement

Basic courses of Mathematical Analysis, Electromagnetic Fields and Propagation, and Antennas.

Teaching and learning methods and activities

The teaching activity is organized as follows:
- 50% of theoretical frontal lessons related to the basic theory and methodological approaches for the analysis and solution of the problems that will be presented as case studies during the course;
- 25% of lessons dedicated to the development of exercises and the solution of case studies, also linked to examples of practical application;
- 25% of software exercises will complete the theoretical lessons and the exercises.
The educational material (e.g., exercises, in-depth material) will be made available on the course website indicated by the teacher at the beginning of the course.

Other information

Teaching Materials
Additional material (e.g., handouts, lab exercises) will be made available during the course on the site https://www.eledia.org/eledia-unitn/course/ .

Communications/Notices
In order to optimize the communication between teachers and students, all communications and notices (change in class schedule, calendar, exams, availability of teaching materials, etc ...) will be done via e-mail sent to the mailing list of the course which students are invited to register at the beginning of the lessons through the website https://www.eledia.org/eledia-unitn/course/ .

Additional details regarding the course can be found at https://www.eledia.org/eledia-unitn/course/ .

Test and assessment criteria

The exam consists of the development of a short project and the execution of a written questionnaire. More specifically:

Short Project
The short project consists in the development of an activity which regards the topics described in the course as well as innovative aspects in the field of radar and 5G architectures and systems. The maximum mark of the project part is 15. The activity at the choice of the student can be requested through a notification by email to the course holder. During the development of the project, the student will be assisted by a tutor identified at the beginning of the project.

Written Questionnaire
The written test consists of multiple-choice questions on the whole program of the course. The maximum mark of the written exam part is 15. During the written exam the use of notes, texts, or programmable calculators is not allowed. The useful formulas are summarized in a document available on the webpage of the course or will be made available the day of the exam.

The final mark is computed as the summation of the marks acquired in the project and written exam parts.