

EURECOM

ATW - Advanced Topics in Wireless (FUTURE OF COMMUNICATIONS)

Syllabus – Fall 2024

Instructor: Profs. from Comm-Sys Department Plus External speakers

Coordinator: Dirk Slock (+ Petros Elia)

slock@eurecom.fr (elia@eurecom.fr)

tel: 0493-00-8132

Office 329

Class Location and Time: Lecture room 152, Tuesday: 8:45am-12:00

Office Hours: By email with each instructor (zoom also works)

Course Pre-requisites: An understanding of Digital Communications, Statistical Signal Processing, Probabilities and Stochastic Processes, Networking, can be useful.

This course presents some recent or emerging HOT TOPICS within the area of communication systems. We emphasize emerging techniques to be used in future communications systems, but also in exciting research directions such as the use of AI in Communications, the links between communication, control and learning, the new area of quantum communications and computing, and modern advances in distributed computing and communications.

The course earns 5 ECTS

We cover hot topics for 5G such as "Massive MIMO", "network cooperation", "interference management", and the aforementioned hot topics on AI, Control, Computing and Quantum. These topics cover about half of the course.

In the remaining hours, external experts from industry leaders, reveal hot topics seen from the wireless networking industry.

Teaching and Learning Methods: Lectures, Exercise and Lab sessions (groups of multiple students).

Bibliography: Some overview papers will be distributed sin class, covering the different hot topics.

Requirements: Basic knowledge in statistical signal processing and probabilities, and digital communications. Basic MATLAB knowledge for the lab session - No C programming needed.

Description: Our society is evolving towards a society of "massive information" generated by a plethora of devices (cars, tablets, connected things) most of which will have to communicate at mind-blowing speeds. How does one design the networks of the

future that can face the challenges: How does one optimize the use of spectrum? How does one tackle massive interference? Modern networks will bring new concepts on the table to solve these problems, and we will address some of these in our course.

The course contains a theoretical part (about half) and a more practical part. In the theoretical part you will receive knowledge about key concepts of wireless system design currently being discussed for future application in wireless network, including hot topics like

- o MIMO and Massive MIMO
- o Interference management
- o Emerging techniques for 5G
- o AI in Communications and Control
- o Distributed Computing and Communications
- o Quantum Communications

In the practical part, you will learn from mainly external industrial experts about how wireless standards and products are being designed from industry to capture some of the theoretical concepts.

Learning outcomes: Understand key ideas behind the fantastic surge in performance in new communication networks. Understand the role of statistical data processing driving latest communication technologies such as MIMO and massive MIMO. Grasp new concepts for interference management. Learn basics regarding the intersections of Communications, Learning and Control, learn the new aspects of Distributed Computing and Communications, and delve into the new world of Quantum Communications and Computing. Learn from top industrial experts about the latest trends in research labs driving the development of broadband wireless and internet of things. Understand the role of industry cooperation towards common standards like 5G and 6G.

Nb hours: 42.00 including exercise session, research presentation

Grading Policy:

- Final Exam (40%.) 2 hours (all ATW documents allowed)
- Midterm Exam (25%) 1 hour approximately (all ATW documents allowed)
- Extra (research presentation, etc) (35%),
-