2IN5050 – Discovery of software defined radio

Instructors: Jacques ANTOINE
Department: DÉPARTEMENT SIGNAL, INFORMATION, COMMUNICATION
Language of instruction: FRANCAIS
Campus: CAMPUS DE PARIS - SACLAY
Workload (HEE): 40
On-site hours (HPE): 27,00

Description
The radio spectrum is a rare resource shared worldwide by many players for various applications (broadcasting of multimedia content, Internet of Things, 5G, satellite radio navigation systems, transport, etc.). This experimental module aims to allow students to immerse themselves in the world of radio and discover the underlying technologies through practice by participating in a challenge that consists of decoding broadcast signals.

Quarter number
Intensive week SG6 and SG8

Prerequisites (in terms of CS courses)
Signal processing, Modeling, Python. This elective may be an opportunity to put into practice concepts covered in other elective courses (which it is not necessary to have followed): Principles of wireless telecommunications, From information theory to IoT networks, Electronic Systems , Theory of communications, Mobile communications networks.

Syllabus
A first part of the experimental module is devoted to the discovery of the radio spectrum and radiocommunication systems. It introduces the key concepts of software defined radio (SDR, Software Defined Radio). The students have at their disposal two SDR type cards to design and build a transmitter and a receiver, validate it and test its performance. The objective is to learn all the steps necessary to transform data into a modulated signal, emit it and then detect the signals to decode the useful information, both from a theoretical point of view and functional and hardware architecture.

Secondly, a challenge will be issued to the students: choose a broadcasting

system and decode the corresponding signals; for example name of an FM(*) station (RDS(*) system) or position of a civil aircraft (ADS-B(*) system).

(*)ADS-B: Automatic dependent surveillance-broadcast; FM: Frequency Modulation; RDS: Radio Data System.

Schedule for the week:
• Introduction to SDR technology
• Contribution on terrestrial broadcasting systems and on the use of the radio spectrum
• Contribution on digital modulations and realization of a transmission between two SDR cards
• Challenges: choosing a broadcasting and decoding system

Class components (lecture, labs, etc.)
Practical work fed by some theoretical contributions.

Grading
A report will be submitted on the experimental work carried out. A presentation will be made at the end of the challenge to explain the choices made to decode the chosen broadcast system.

Course support, bibliography
Presentation of the standards studied. Course complements.

Resources
Teaching staff: Jacques Antoine, Raul De Lacerda
Software (GNU radio) and hardware (SDR card) tools.

Learning outcomes covered on the course
At the end of this course, students will be able to design and implement wireless digital communication systems from software radio cards. They will be familiar with the main parameters and the operation of a digital transmission chain.

Description of the skills acquired at the end of the course
C1.2 Modeling: using and developing the appropriate models, choosing the correct modeling scale and the relevant simplifying assumptions
C1.3 Solve: solve a problem with a practice of approximation, simulation, and experimentation
C2.1 Deepen a field of engineering sciences or a scientific discipline
C2.2 Import knowledge from other fields or disciplines
C6.3 Process data
C8.1 Build the collective to work as a team