

Radiofrequency Systems

Person in charge: Francis Chan Wai Po

Pre-requisites: Basic analogue electronics. IE.1.1.01

Organization: 18 h course, 3 h tutorials, 32 h practicals

Assessment: Short-answer questions and Practicals exercises

Overview

An increasing proportion of today's communication takes place over the radio-waves, spanning frequencies from some kHz to several GHz, whether it is mobile telephony, positioning, short-range wireless, sensor networks, or TV and radio. Such communications require a transmitter and a receiver. No matter how popular digital communications become, the antenna interface and transmission medium are likely to remain analogue. In this context, any actor working with wireless communications (no matter what the application) will require designers of radio-frequency systems for the transmission and reception of radio signals. In this scenario, a comprehensive understanding of the component (amplifiers, filters, mixers, ...) and systems (transmission, propagation, reception) is necessary.

Learning Objectives

The module aims at introducing the students to radiofrequency devices, circuits and systems. A solid theoretical basis is first given, with explanations on how RF is defined and characterized. For this, the module presents the architectures observed for transmitters and receivers. Thereafter, individual elements are presented (amplifiers, filters, mixers, ...), with explanation of the design constraints on each. The module lays emphasis on practical work which will illustrate the concepts on the one hand, and introduce students to the main design tools on the other hand.

Knowledge

- **Concept**
 - Radio wave transmission and propagation (channels, link budget, wideband and multiband)
 - Design of RF systems (transceiver architecture and characterisation)
 - Design of RF circuits (amplifiers, mixers, VCO, filters, matching, ...)
 - Advanced topics in RF systems: reconfigurable transceivers, cognitive radio..
- **Know-how**
 - Design and characterisation of RF circuits and systems : theory and practice (ADS, Cadence SystemVue).
 - Current trends in RF design.

Pedagogical Approach

Project-type practicals sessions on SystemVue and ADS.

Bibliography

- Course handouts by professors
- Silicon Earth: Introduction to the Microelectronics and Nanotechnology Revolution", Cressler, Cambridge, 2009
- Fundamentals of High-Frequency CMOS Analog Integrated Circuits", Leblibici, Leblibici, Cambridge, 2009
- Radio-Frequency Electronics: Circuits and Applications", Hagen, Cambridge, 2009
- Wireless Communication Systems: From RF Subsystems to 4G enabling Technologies", Du, Swamy, Cambridge, 2010
- Cognitive Radio, Software Defined Radio, and Adaptive Wireless Systems", Arslan (Editor), Springer, 2007
- Essentials of Cognitive Radio", Doyle, Cambridge, 2009
- RF Microelectronics", Razavi, Prentice Hall, 1998