

Digital Signal Processing

(3 ECTS – 1st semester)

Pedagogical Objectives

This teaching unit aims at training the students to digital signal processing, starting from an analog information, and by studying then all the elements of a data acquisition chain and data processing required for the signal exploitation. More precisely, this teaching unit describes all the methods and techniques allowing to understand and formalize:

- the acquisition of an analog signal,
- the frequency analysis of the resulting digital signal by using discrete Fourier transform and fast Fourier transform,
- discrete linear systems, with the introduction of finite/infinite impulse response (FIR/IIR) systems,
- digital filters synthesis.

Competences acquired by the student

At the end of this teaching unit, the students will be capable of:

- modeling and analyzing a digital acquisition chain of an analog signal
- analyzing the frequency content of a digital signal
- modeling and analyzing a digital system, more particularly in terms of digital filtering
- synthesizing digital filters with given specifications

in order to apply all these skills to industrial and/or research projects.

Curriculum

1st part (3 lecture courses et 2 tutorials) : sampling and frequency analysis

- a short review of continuous time signal processing (Fourier series and transform, Laplace transform, notion of continuous system, transfer function),
- data sampling: the Shannon theorem
- frequency analysis of discrete-time signals: discrete Fourier transform, fast Fourier transform

2nd part (1 lecture courses et 1 tutorial) : mathematical tools

- discrete systems, stability
- Z-transform
- discrete systems characterization: impulse/indicial response, recurrence, frequency response, transfer function

3rd part (2 lecture courses et 2 tutorials) : applications of digital signal processing

- digital filters: FIR, IIR systems, frequency responses
- digital filter synthesis