

**Organisation:**            *Face to face: 45 hours*                      *Homework: 45 hours*                      *total load: 90 h*

**Objectives:**

- To remind basic notions in signal processing, namely the transformation from the analog domain towards the digital domain (sampling/quantization) and frequency-domain analysis methods
- Introduction to some advanced signal enhancement techniques for noise-embedded measurements contexts in order to improve the output sensors signal-to-noise ratio (SNR): instances of some kinds of signals will be presented (speech, biomedical signals, biometric signals...)
- To introduce time-frequency analysis methods often used for the signal enhancement (in transmission) and extraction of its relevant parameters (after A-D conversion) in Pattern Recognition, in order to improve the global system robustness to adverse environments (interferences).

- N.B.: here we mean by « signal enhancement » (cf. title) all the approaches aiming at analyzing in a relevant way (extraction) and/or to reduce noise signal before its analysis.

**Keywords:**

Sampling, quantization, time-frequency analysis, parameters extraction, linear and adaptive filtering, noise reduction, multi-cadence filtering.

**Prerequisites:**

Basic knowledge in Fourier analysis and in Statistic

**Program:**

- A) Characterisation of different signals (recalls): deterministic/stochastic signals, notion of noise signals, Autocorrelation functions and Spectral Energy/Power Densities.
- B) Linear Filtering of Signals: convolution, invariant linear filters, filter transfer functions (in Z and frequency domains).
- C) Signal acquisition: analog-to-digital conversion, Sampling principle, quantization (SNR ratio).
- D) Digital linear filtering
- E) Time-frequency analysis: Discrete & Fast Fourier Transforms (DFT & FFT), Wavelets Transforms, Homomorphic Analysis (Cepstrum, LFCC, MFCC, Root-spectral...).
- F) Noise reduction: Wiener filter, Spectral Substraction , Adaptive filtering.
- G) Multi-cadence filtering: Filterbanks, complexity reduction

**Content:--**

**Evaluation:** Grading is as follows

Written Exam: 1st session = control (C1), 2nd session = control (C2), Final mark = Sup (C1,C2)

**Lecturers:**

Nesma Houmani, Jean-Louis Baldinger, Jérôme Boudy.

**Coordinator:** Jérôme Boudy

Jerome.boudy@telecom-sudparis.eu

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