| SIGNAL_S7_MAJ<br>Fall Semester<br>Graduate | Signal Processing and Mathematics | 6 credits<br>Lab: 41.7%<br>Final exam (3h): 58.3% |
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| **Prerequisite**: S5 & S6 Signal lectures | | |

| DST_2201 | Digital Signal Processing II | Language |
|---|---|---|
| Lecture: 16 | Tutorials: 18 | Lab work: 16 |

The first module focused on characterizing discrete-time signals and digital filter in time and frequency domains. This advanced module allows:

- The analysis of the frequency contents of a signal, the definition of SNR
- The characterization of the filters (linear phase, phase shifter) effect on spectrum
- The design of the filter / its transfer function to extract the wanted signal or attenuate the unwanted components
- The implementation of the designed filter
- The quantification of the enhancement brought by filtering in terms of SNR and periodogram

Illustrations will be made on ECG signals, images… Lab work on Matlab focuses on design and implementation of filters, comparison between average and AR(1) filtering.

| DST_2202 | Digital Communications | Language |
|---|---|---|
| Lecture: 8 | Tutorials: 8 | Lab work: 8 |

This module presents the digital techniques of signal transmission. The objective is to allow the students to characterize a simple communications system and determine its main performances. Lab work uses a simulation software for communications systems.

- Digital Baseband transmission: digital information representation, limited bandpass channel, intersymbol interferences, eye diagram, channel with Gaussian addition-noise, binary error rate.
- Digital modulations: main modulations principles (ASK, FSK, PSK, QAM), trajectories, constellations, spectrum efficiency, demodulation techniques, modulation performances in presence of noise.
- Introduction to channel-coding: linear-bloc codes, Hamming distance, syndrome, decoding and error correction.

| DST_2206 | Random signals | Language |
|---|---|---|
| Lecture: 12 | Tutorials: 12 | Lab work: 16 |

After a general introduction on random continuous and discrete-time processes, the second-order model in stationary case is only discussed using time-discrete signals. The characterization, filtering and model of signals originating from physical phenomena (speech, pressure measurement, communication signals) are viewed thanks to statistical tools.

- Random process. Second-order properties, covariance function
- Stationarity. Correlation function, application to delay estimation.
- Power spectral density and z-density. Example: detection of a sine wave inside noise.
- Mean estimator, autocorrelation estimator. Ergodism, estimators quality.
- PSD estimation: correlogram, periodogram. Wiener-Khintchine theorem, average periodogram, windowing.
- Linear filtering of processes. Interferences formula, multipath communication.
- Processes model. AR, ARMA model, vocal tract model.