Master Physique fondamentale et applications
Signal and image analysis

Responsables

Jean-marc THEMLIN
jean-marc.themlin@univ-amu.fr

Laurent NONY
laurent.nony@univ-amu.fr

Descriptions

Code : SPFBU36

Nature : Unité d'enseignement

Domaines : Sciences et Technologies

Informations

Composante : Faculté des Sciences

LANGUE(S) D'ENSEIGNEMENT

Anglais

CONTENU

Part A : Signals : Presents the essential tools commonly used to describe continuous-time (analog) and discrete-time signals, images and noise, mostly from a deterministic waveform point of view. Continuous-time waveforms are represented by direct mathematical expressions or by the use of orthogonal series representations such as the Fourier series. Properties of these waveforms, such as their DC value, root-mean-square (RMS) value, energy and power, magnitude and phase spectrum (through the Fourier transform), power spectral density, and bandwidth, are recalled or established. In the frequency-domain, analog and digital signals are represented by their Fourier transform. The Discrete Fourier Transform (DFT), when properly applied, allows the computation of spectra.

Part B : Systems : Used to manipulate analog or digital waveforms, exploiting various operations like scalar product, convolution and correlation. In addition, effects of linear filtering is introduced. Actual systems used in signal storage, transmission and modulation, multiplexing, video signal coding, lossy signal compression (principle of JPEG standard) will be explained.

Lab Sessions (practicals) :

- Lab 1 : Signal representation using GNU-Octave: Introduction to Octave scripts and functions, application to the sinc signal.
- Lab 2 : Representation of analog signals by discrete-time signals: Introduction to discrete sinusoids, discrete frequency and sampling, empirical discovery of the Shannon-Nyquist theorem.
- Lab 3 : Signal Parameter Estimation – Part A: Estimation of the parameters of a sinusoidal signal (of known frequency f0) using the scalar product; dependence on S/N ratio and on the precise knowledge of f0.
- Lab 4 : Signal Parameter Estimation – Part B: Estimation of the parameters of a sinusoidal signal (of unknown frequency), an empirical introduction to the Discrete Fourier Transform (DFT).
- Lab 5 : Signal recognition through Correlation: Retrieve the occurrence of replicas of a reference signal hidden in a noisy signal using sliding scalar product and “running” (“real-time”) correlation; application to Radar/Sonar signals.
- Lab 6 : FIR Filtering: From running correlation to convolution, to implement various digital filters, used e.g. to extract a sinusoid of known frequency in a composite signal.
- Lab 7 : Discrete Fourier Transform: Empirical and extensive self-paced exploration of the DFT tool, supported by a complete and specifically-designed “active” reference (a Jupyter notebook).
- Lab 8 : Image Processing and Filtering: Generalizes the convolution to 2D signals (images), digital filtering of images.

COMPÉTENCES À ACQUÉRIR

The students will be able to :

- Exploit Matlab® (or its open-source equivalent GNU-Octave) to develop useful and realistic “expert systems” in digital signal and image processing, e.g. signal estimation and identification.
- Become accustomed to modern means of performing personal or team work on scientific calculations and novel ways of sharing data, programs and results (through the use of the CoCalc® platform).
- Practice personal exploration through trials and enquiries, and thus develop adequate research skills in digital signal and image processing.

MODALITÉS D'ORGANISATION

We start with 9 hours of lectures and then go on to 8 laboratory sessions based on GNU Octave (a MatLab® equivalent) and implement their own solutions, e.g. in signal estimation and identification, ubiquitous issues in signal processing.

BIBLIOGRAPHIE, LECTURES RECOMMANDÉES

- Richard J.Tervo, Practical Signals Theory (with MatLab Applications), Wiley (2014)
- Hwei Hsu, Signals and Systems (2nd edition), Schaum's Outline Series, Mac Graw Hill (2011)
- Steven W. Smith, The Scientist and Engineer's Guide to Digital Signal Processing, www.dspguide.com.

PRÉ-REQUIS OBLIGATOIRES

Basic programming knowledge, preferably in MatLab or its open-source equivalent GNU Octave, basic mathematical background in Fourier series and transforms.

VOLUME HORAIRE

- Volume total: 30 heures
- Cours magistraux: 20 heures
- Travaux dirigés: 10 heures

CODES APOGÉE

- SPFBU36J [ELP]

M3C

Aucune donnée M3C trouvée

POUR PLUS D'INFORMATIONS

Aller sur le site de l'offre de formation...

Dernière modification le 18/06/2024