COM-303

Signal processing for communications

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Cursus	Sem.	Type
HES -SC	E	Obl.
Informatique	BA6	Opt.
Mineur en Systèmes de communication	E	Obl.
Science et ing. computationelles	MA2	Opt.
Systèmes de communication	BA6	Obl.

Language	English
Credits	6
Session	Summer
Semester	Spring
Exam	Written
Workload	180h
Weeks	14
Hours	**6 weekly**
Lecture	4 weekly
Exercises	2 weekly

Summary

Students learn digital signal processing theory, including discrete time, Fourier analysis, filter design, sampling, interpolation and quantization; they are introduced to image processing and data communication system design.

Content

1. Basic discrete-time signals and systems: signal classes and operations on discrete-time signals, signals as vectors in Hilbert space
2. Fourier Analysis: properties of Fourier transforms, DFT, DTFT; FFT.
3. Discrete-Time Systems: LTI filters, convolution and modulation; difference equations; FIR vs IIR, stability issues.
4. Z-transform: properties and regions of convergence, applications to linear systems.
5. Filter Design: FIR design methods, IIR design methods, filter structures.
6. Stochastic Signal Processing: random processes, spectral representation.
7. Interpolation and Sampling: the continuous-time paradigm, interpolationthe sampling theorem, aliasing.
8. Quantization: A/D and D/A converters.
9. Multi-rate signal processing: upsampling and downsampling, oversampling.
10. Multi-dimensional signals and processing: introduction to Image Processing.
11. Practical applications: digital communication system design, ADSL.

Keywords

signal processing, discrete-time, continuous-time, filter, filter design, sampling, aliasing, DSP, Fourier transform, FFT, modem, ADSL

Learning Prerequisites

Required courses

calculus, linear algebra

Recommended courses

Circuits and systems, basic probability theory

Important concepts to start the course

vectors and vector spaces, functions and sequences, infinite series

Learning Outcomes

By the end of the course, the student must be able to:

- Identify signals and signal types
- Recognize signal processing problems

- Apply the correct analysis tools to specific signals
- Check system stability
- Manipulate rational transfer functions
- Implement signal processing algorithms
- Design digital filters
- Interpret complex signal processing systems

Transversal skills

- Use a work methodology appropriate to the task.
- Assess one's own level of skill acquisition, and plan their on-going learning goals.
- Use both general and domain specific IT resources and tools

Teaching methods

Course with exercises in class and on the computer

Expected student activities

complete weekly homework, write numerical routines to implement core concepts

Assessment methods

midterm exam for bonus points and final exam for final grade.

Resources

Bibliography

Signal processing for Communications, EPFL Press, 2008, by P. Prandoni and M. Vetterli. The book is available for sale in printed form online and in bookstores; in iBook format on the Apple store and is also available as a free pdf file at http://www.sp4comm.org/

Ressources en bibliothèque

- Signal processing for Communications / Prandoni

Websites

- http://lcav.epfl.ch/sp4comm
- http://www.sp4comm.org/

Prerequisite for

adaptive signal processing, image processing, audio processing, advanced signal processing