

COM-303

Signal processing for communications

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Cursus	Sem.	Type
Auditeurs en ligne	E	Opt.
Communication systems	BA6	Obl.
Computer science	BA6	Opt.

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

Summary

Students learn digital signal processing theory, including discrete time, Fourier analysis, filter design, adaptive filtering, 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 and Adaptive Signal Processing: random processes, spectral representation, Optimal Least Squares adaptive filters.
7. Interpolation and Sampling: the continuous-time paradigm, interpolation the 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

- Signals 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 systems 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 sessions and coding examples and exercises in Python (Jupyter Notebooks)

Expected student activities

Complete weekly homework, explore and modify Jupyter Notebook examples

Assessment methods

Final exam fully determines final grade.

Supervision

Office hours	Yes
Assistants	Yes
Forum	Yes

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 & Vetterli](#)

Notes/Handbook

Lecture slides available for download at the beginning of the semester.
A complete online DSP MOOC is available on Coursera.

Websites

- <https://www.coursera.org/learn/dsp1/>
- <https://www.coursera.org/learn/dsp1/>
- <https://www.coursera.org/learn/dsp2/>
- <https://www.coursera.org/learn/dsp3/>
- <https://www.coursera.org/learn/dsp4/>

Moodle Link

- <https://go.epfl.ch/COM-303>

Prerequisite for

Adaptive signal processing, image processing