School of Computer and Communication Sciences
Audiovisual Communications Laboratory (LCAV)

Mathematical Foundations of Signal Processing
Fall Semester 2020

Lecturers	Dr. Matthieu Simeoni	`matthieu.simeoni`
	Dr. Benjamín Béjar Haro	`benjamin.bejarharo`
Teaching Assistant	Mrs. Michalina Pacholska	`michalina.pacholska`
Office Hours	`Monday from 10:00 to 11:00`	`Office BC 324`
Lectures	`Mondays from 14:00 to 17:00`	`Room INM 203`
Exercises	`Fridays from 15:00 to 17:00`	`Room INM 203`
Evaluation	30% `Mini Project`	
	70% `Final Exam (Written)`	

Development of the class

Lectures and exercise sessions will be done on-site and live-streamed for off-campus students. We will use Zoom for live-streaming so students are encouraged to download the Zoom app. The link for live-streaming will be communicated through the official class channels (moodle or e-mail).

Course Material

All related course material (slides, assignments, etc) will be posted on the class moodle: COM-514. Q&A and a forum for discussion will hosted in Piazza COM-514.

Textbook

Martin Vetterli, Jelena Kovačević and Vivek Goyal, *"Foundations of Signal Processing"*, Cambridge University Press, 2014. ISBN 9781107038608.
Open access at `http://www.fourierandwavelets.org`

Course Overview

The goal of this class is to present signal processing tools from an intuitive geometric point of view which is at the heart of all modern signal processing techniques from Fourier transforms and sampling theorems to time-frequency analysis and wavelets. The course is designed to provide the mathematical depth and rigor needed for the study of advanced topics in signal processing and also features introductions to current applications where such tools are crucial. In particular, several applications from medical and computational imaging will be studied.

Learning Outcomes

- Master the right tools to tackle advanced signal and data processing problems
- Have an intuitive understanding of signal processing through a geometrical approach
- Get to know the applications that are of interest today
- Learn about topics that are at the forefront of signal processing research

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Week	**Lectures** [M. Simeoni | B. Béjar]	**Exercises** [M. Pacholska]
Week 1 14 Sep – 20 Sep	[B. Béjar] Mon 14/09 INM203 Introduction Signals, Linear Systems and Fourier	Fri 18/09 INM203 Homework 1
Week 2 21 Sep – 27 Sep	No Lecture (Jeûne Fédéral)	Fri 25/09 INM203 Homework 2
Week 3 28 Sep – 04 Oct	[M. Simeoni] Mon 28/09 INM203 Linear Algebra Fundamentals for Representation Theory I	Fri 02/10 INM203 Homework 3
Week 4 05 Oct – 11 Oct	[M. Simeoni] Mon 05/10 INM203 Linear Algebra Fundamentals for Representation Theory II	Fri 09/10 INM203 Homework 4
Week 5 12 Oct – 18 Oct	[B. Béjar] Mon 12/10 INM203 Sampling and Interpolation I	Fri 16/10 INM203 Homework 5
Week 6 19 Oct – 25 Oct	[B. Béjar] Mon 19/10 INM203 Sampling and Interpolation II	Fri 23/10 INM203 Mini Project (1/2) Due on 08/11
Week 7 26 Oct – 01 Nov	[B. Béjar] Mon 26/10 INM203 Polynomial and Spline Approximation I	Fri 30/10 INM203 Homework 6
Week 8 02 Nov – 08 Nov	[B. Béjar] Mon 02/11 INM203 Polynomial and Spline Approximation I	Fri 06/11 INM203 Homework 7
Week 9 09 Nov – 15 Nov	[M. Simeoni] Mon 09/11 INM203 Regularized Inverse Problems I	Fri 13/11 INM203 Homework 8
Week 10 16 Nov – 22 Nov	[M. Simeoni] Mon 16/11 INM203 Regularized Inverse Problems II	Fri 20/11 INM203 Mini Project (2/2) Due on 04/12
Week 11 23 Nov – 29 Nov	[M. Simeoni] Mon 23/11 INM203 Computerized Tomography	Fri 27/11 INM203 Homework 9
Week 12 30 Nov – 06 Dec	[M. Simeoni] Mon 21/09 INM203 Finite Rate of Innovation I	Fri 04/12 INM203 Homework 10
Week 13 07 Dec – 13 Dec	[M. Simeoni – B. Béjar] Mon 14/10 INM203 Finite Rate of Innovation II Adaptive Filtering I	Fri 11/12 INM203 Homework 11
Week 14 14 Dec – 20 Dec	[B. Béjar] Adaptive Filtering II	Fri 18/12 INM203 Homework 12