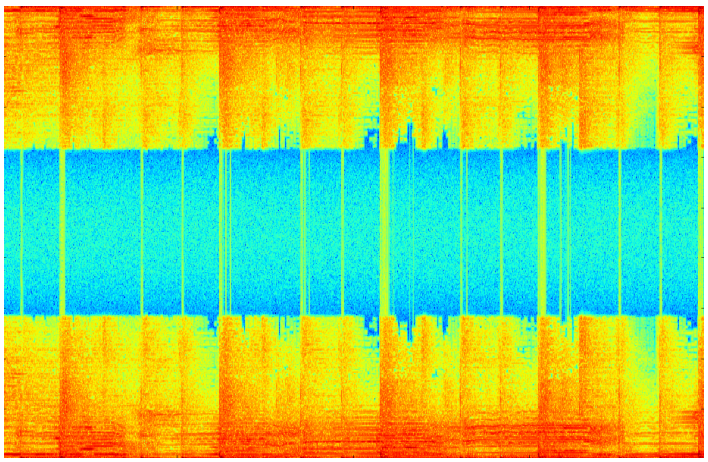
DIGITAL IMAGE AND SIGNAL PROCESSING.



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Objectives

The objective of this course is to present the fundamental mathematics and concepts of discrete-time signal and image processing. These topics will presented in the context of signal processing and then extended to image processing.

A large part of the course is devoted to practical projects, where the students will code various algorithms and compare theoretical results with simulation results. Students will have to complete three projects during the course and are welcomed to work in pairs and to submit a single document. The computations will be preferentially carried out in `julia` or `python`.

Evaluation

Type of examinations: Exam (1/2), lab reports (1/2).

Main progression steps

Theoretical courses and numerical projects will be carried out in parallel.

Bibliography & Resources

- Discrete-Time Signal Processing (3rd Edition). Alan V. Oppenheim, Ronald W. Schafer, and John R. Buck. Prentice-Hall Signal Processing Series
- A Wavelet Tour of Signal Processing: The Sparse Way. S. Mallat, Academic Press Inc.

Contents

Theoretical course

1. Discrete-time signals and systems
   (a) Properties of systems
   (b) Linear and time invariant (LTI) systems. convolution
   (c) Linear constant-coefficients difference equations
   (d) Frequency response of a stable LTI
2. The z-transform and filter design
   (a) z-transform properties. properties of the roc
   (b) z-transforms and LTI systems
   (c) Design of discrete-time iir filters and design of fir filters
3. The discrete fourier transform
   (a) Representation of periodic sequences: the discrete fourier series
   (b) Fourier representation of finite-duration sequences
   (c) Properties of the dft, linear convolution using the dft
   (d) Computation of the discrete fourier transform and fft algorithms
4. Image processing
   (a) Convolutions in space domain and fourier domain
   (b) Matrix representation of convolution and properties
   (c) Elementary image transforms, edge detection
   (d) Image filtering
5. Introduction to wavelets
   (a) Time frequency analysis
   (b) Continuous and discrete wavelets transform
   (c) Multi-resolution analysis

Numerical projecs

1. Signal filtering
2. Fourier analysis and circular convolution
3. Image processing
4. Wavelets analysis