Republic of Tunisia
Ministry of Higher Education and Scientific Research
University of Tunis El Manar
National Engineering School of Tunis
Signals&Smart SystemsLab(L3S)

Master program : Information Processing and Complexity of the Living
Mastère de recherche : Traitement de l'Information et Complexité du Vivant (TICV)
TC : Tronc commun, SPI : Option Signal Perception Image, Option BioS : Biosystémique

TICV MASTER

SPI – Learning Algorithms and Audio Applications

Semester: Fall, **Academic Year:** 2020/21

Instructor information

Name	Meriem JAÏDANE Professor
Contact Info	meriem.jaidane@enit.utm.tn
Office location / Affiliation	Ecole Nationale d'Ingénieurs de Tunis

Course Description

This course uses as prerequisites: Signals and Systems, Signal Processing, Digital Signal Processing generally taught in 1st and 2nd year to address system design in generic applications of optimal filtering. Students will learn to problematize generic situations where a linear and nonlinear optimization solution in a non-stationary context is required and that adaptive algorithms are used. The theoretical analysis of adaptive algorithms is done. They will apply this more precisely in audio signal processing. This is done from the "design" angle in order to develop the critical analysis of an optimal filtering method in the project spirit.

Objectives and LearningOutcomes

- Problematize generic situations where an optimization solution in a non-stationary context is required
- Analyze the performance of optimal and adaptive filters in stationary and non-stationary contexts in these different generic situations
- Design and analyze the performance of learning algorithms
- Audio applications

Prerequisites

- Signals and Systems basics
- Digital Signal Processing basics

Learning Resources

[1] Monson H. Hayes, *Statistical Signal processing and modeling*, Wiley,1996.
[2] Christian Jutten, *Filtrage linéaire optimal*, Polytech Grenoble,2010.
[3] J. Benesty, *Lectures in Adaptive Filtering and Spectral Analysis*, lecture L1 à L15 (ppt). http://externe.emt.inrs.ca/users/benesty/course.html
[4] Brian D. O. Anderson, John B. Moore, *Optimal Filtering*, Prentice Hall,1979.

[5] Maurice Bellanger, *Adaptive Digital Filters*, Signal processing and Communications Series, Marcel Dekker, 2nd Edition,2001.
[6] S. Haykin, *Adaptive Filter Theory*. Fourth Edition, Prentice Hall,2002.

Assessments

The final course grade will be calculated using the following categories:

Assessment	Percentage of Final Grade
Final exam: project	80%
Reading and problem sets	20%

Students will be assigned the following points, based on calculations coming from the course assessment section: **Grade** = gained points from a total of 20 points

Course Schedule

Lecture #	Theme/Topic	Learning Outcomes Addressed
#1 (1H30)	Generic Optimization Situation in a Non-Stationary Context	Keywords: Learning algorithms, Channel identification, Denoising, Signal prediction, Identification of the inverse of a channel, Right and left identification, Predistortion, ...
#2 (1H30)	Optimal filtering, criteria and structures	Keywords: Quadratic criteria, non-quadratic criteria, linear structures, non-linear structures, optimal filtering, optimal filter performance, ...
#3 (4x1H30)	Learning Algorithms and Performance in a Non-Stationary Context	Keywords: Adaptive algorithms, Learning algorithms, Performance of adaptive filters, deep learning case, theoretical analysis: convergence, parameter initialization, local minima problem and instability problems,….
#4 (3x1H30)	Designing Learning Algorithms and Audio Applications	Keywords: Acoustic echo cancellation, audio denoising, audio coding, loudspeaker pre-distortion,...
#5 (5x1H30)	Project	Article analysis and programming