# *IDENTIFICATION DES SYSTÈMES ET DÉCOMPOSITION PARCIMONIEUSE DES SIGNAUX*

# SYSTEM IDENTIFICATION AND SPARSE DECOMPOSITIONS

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| Lecturers : 16.0 | TC : 0.0 | PW : 0.0 | Autonomy : 0.0 | Study : 12.0 | Project : 0.0 | Language : FR

## Objectives

The understanding of physical phenomena coupled with the advancement of observation technologies, the needs of analysis, diagnosis and control of engineering systems make more and more use of experimental modeling. This modeling work is a prerequisite for the synthesis of control laws of dynamic systems or the analysis and processing of signals. The goal of this course is to provide advanced principles and methods of signal and system modeling. "System identification" aims to associate a mathematical model with a dynamic system on the basis of noisy data measured with sensors. The "sparse decomposition of signals" aims at a compact modeling of a signal via its decomposition in a dictionary.

Keywords : experimental modeling, system identification, parametric estimation, sparsity, dictionary of signals, time-frequency representations, compressed sensing, optimization

## Programme

Part I: Systems Identification
Introduction to Signal and System Modeling: System Point of View
Concept of model structure: definition and examples
Estimation methods based on the minimization of the prediction error
Elements for the analysis: identifiability, persistence of excitation, frequency richness of a signal
Asymptotic properties of the estimators: consistency, convergence in distribution

Part II: Sparse Decomposition of Signals

## Learning outcomes

- To understand the application issues of signals and systems modeling
- To construct and identify a model of system from experimental measurements
- To know the usual bases of representation of signals
- To determine a sparse representation of a signal

## Independent study

Objectifs :

Méhodes : The lectures are completed with 3 practical works under Matlab / Simulink:
BE 1: Implementation of identification methods on an example
BE 2: Sparse decomposition of signals
BE 3: Compressed Sensing

## Core texts

L. Ljung, *SYSTEM IDENTIFICATION: THEORY FOR THE USER*, PTR Prentice Hall, 1999
S. Mallat *A WAVELET TOUR OF SIGNAL PROCESSING, THE SPARSE WAY*, Academic Press, 2009
S. Boyd and L. Vandenberghe*CONVEX OPTIMIZATION*, Cambridge University Press, 2004

## Assessment

Final mark = 50% knowledge + 50% know-how
Knowledge = 100% final exam
Know-how = 100% continuous assessment