UCLouvain

linma1731

2024

Stochastic processes : Estimation and prediction

5.00 credits	30.0 h + 30.0 h	Q2

Teacher(s)	Bianchin Gianluca ;Vandendorpe Luc ;
Language :	English > French-friendly
Place of the course	Louvain-la-Neuve
Prerequisites	• LEPL1106 (or equivalent training in signals and systems) • LEPL1108 (or equivalent training in probabilities and statistics)
Main themes	The object of this course is to lead to a good understanding of stochastic processes, their most commonly used models and their properties, as well as the derivation of some of the most commonly used estimators for such processes : Wiener and Kalman filters, predictors and smoothers.
Learning outcomes	**At the end of this learning unit, the student is able to :** 1.1; 1.2; 1.3 3.1; 3.2; 3.3 4.2 At the end of this course, the students will be able to : 1 • Have a good understanding of and familiarity with random variables and stochastic processes ; • Characterize and use stable processes and their spectral properties; • Use the major estimators, and characterize their performances ; • Synthetize predictors, filters and smoothers, in both Wiener or Kalman frameworks.
Evaluation methods	• Project during the course semester (40% of the final mark) • Exam (60% of the final mark) • Other activities, such as quizzes and homework exercises, can be taken into account in the project grade • In case of a second session the mark obtained for the project remains unchanged with respect to that of the first session; the project cannot be redone for the second session. Precisions are given in the course outline (plan de cours) available on Moodle.
Teaching methods	Learning will be based on courses interlaced with practical exercise sessions (exercises done in class or in the computer room using Python or MATLAB upon request). In addition, the training includes a project to be realized by groups of 2 or 3 students.
Content	• Part 1 - Estimation: probability theory (reminder), Fisher and Bayesian estimation, bias, covariance, mean square error, Cramér--Rao bound, asymptotic properties, classical estimators (maximum likelihood, best linear unbiased, maximum a posteriori, conditional mean...), hidden Markov model, nonlinear filtering, particle filtering, Kalman filter. • Part 2 - Stochastic Processes and LTI Filters: complex random variables, stochastic processes, stationarity, ergodism, autocovariance, power spectral density, transformation by LTI systems, white noise, spectral factorization, finite-dimensional models (AR, MA, ARMA...), Wiener filter.
Inline resources	https://moodle.uclouvain.be/course/view.php?id=714
Bibliography	Les notes de cours des co-titulaires sont disponibles.
Faculty or entity in charge	MAP

Programmes containing this learning unit (UE)

Program title	Acronym	Credits	Prerequisite	Learning outcomes
Minor in Applied Mathematics	LMINOMAP	5		🔍
Specialization track in Applied Mathematics	FILMAP	5		🔍
Mineure Polytechnique	MINPOLY	5		🔍