# Discrete and Continuous Systems Optimisation

ECTS
6 credits

Component
INSTITUT NATIONAL DES SCIENCES APPLIQUEES TOULOUSE

Number of hours
68h

# Presentation

## Description

Programme (detailed contents):

Linear programming basic concepts – Graph modelling and algorithms for paths search, trees and maximal flows. Branch and bounds methods. Application areas: allocation, transportation, production planning and scheduling.

- Markov chains with continuous and discrete time. Basic queuing systems. Performance evaluation. Applications: computer and industrial systems.

- Basic concepts of Petri Nets – analysis by marking enumeration - Structural analysis- Applications: computer and industrial systems.

- Main concepts of nonlinear programming without and with constraints (equality or inequality types).

- Application to the control of linear systems with quadratic criterion (LGR, LQG) to reach to the resolution of Riccati equations. A parallel is performed with Model Predictive Control seen as a quadratic optimization problem on a finite horizon.

- Application to the dynamic programming

Documents:

- Lecture notes on "Linear programming, Graphs and network theory"

- Lecture notes on "Stochastic processes and queuing systems"

- Lecture notes on "Petri nets"

## Objectives

At the end of this module, the student will have understood and be able to explain (main concepts):

- different approaches to analyse, evaluate the performance of discrete event systems through different models (deterministic or stochastic, graphs) and to optimise them (linear programming)

- the optimisation methods for continuous systems :

-static (first and second order conditions)

- dynamic (dynamic programming)

- their applications to optimal or model predictive control

mainly for linear systems

The student will be able to:

- to analyse, model and solve an optimization problem of discrete systems by a linear programming or a graph, by applying relevant algorithms (simplex or usual graphs and networks algorithms)

- to model and to characterize: stationary Makovian processes with discrete state space (chains) and continuous or discrete time, queuing systems, to analyse their transient and stationary behaviours, to evaluate their performances

- to model and analyse discrete event systems by Petri nets

- to formalise and solve a quadratic criterion, nonlinear, without or with constraints optimisation problem in the case of systems with real variables

-to develop and design an optimal control law (LQG) for a linear or linearized process.

## Pre-requisites

Linear algebra - Probabilities - Dynamic systems (state concept). Basic elements in

logic systems and Petri nets.

# Useful info

## Place

Toulouse