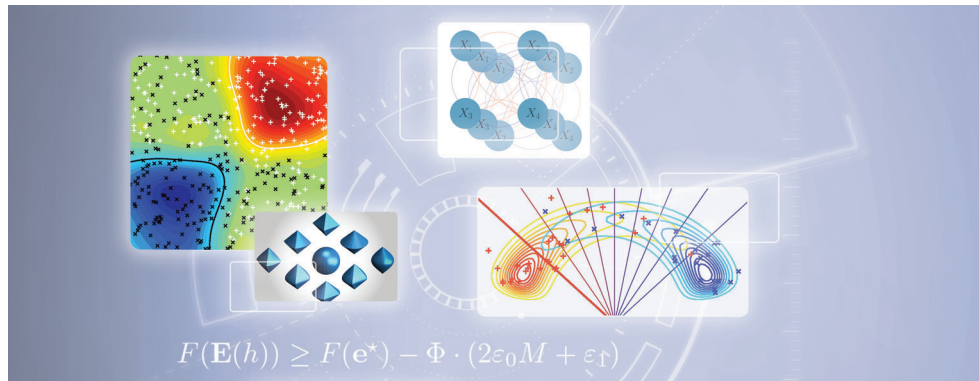


UTC

Master's Program

## Machine Learning and Optimization of Complex Systems



The AOS master's degree course focuses on learning theory/practice and optimization, as applied to autonomous interacting technology-intensive systems, the so-called systems of systems (SoS). These SoS are found in 'smart' vehicles able to communicate with each other, with smart transport system infrastructures, with airborne mini drones, and with sensor networks that exchange data in real time.

The systems studied implement machine learning, decision-making and action capabilities while interacting with their environment and with other systems. They must also be able to handle numerous sources of uncertainty that can impact performance and, consequently, how well the whole system functions.

The French government awards a 'Laboratory of Excellence' (Labex) quality label to a small number of research institutions of particular merit, and the award of this label also depends on the quality of the teaching dispensed. This master's degree is an integral part of UTC's Labex relating to systems of systems.

### Keywords

Statistical learning  
Deep learning  
Combinatorial optimization  
Decision-making under uncertainty and optimization  
Interaction models  
Interconnected networks  
« Smart » vehicles  
Systems of systems

## COURSE CONTENT

The course seeks to give students the knowledge and skills for designing, studying and implementing complex systems like these, and focuses on the following aspects of IT and systems:

- optimization, operations research (OR)
- data analysis, machine learning and deep learning protocols
- decision-making theory, robust optimization and stochastic programming
- complex systems, systems of systems (SoS)

## PROFESSIONAL OBJECTIVES

Conferring scientific and technological knowledge and skills of the highest level centred on systems learning protocols and optimization, equipping graduates for the design and modelling of innovative systems of systems (SoS), using a multidisciplinary approach.

## PROFESSIONAL OPPORTUNITIES

Students who successfully complete this AOS master's degree may choose to pursue a PhD, or to apply for professional positions in public or private research activities, in development and innovation as research scientists and experts, project managers, data scientists, etc.

## AOS COURSE CONTENTS/OPTIONS

Class/Course Modules (30 credits/semester)	Credits (CCs)
<b>Semester 1</b>	
Analysis of experimental data	6
Introduction to stochastic programming	3
Tools used in scientific computation	3
Methodology in control synthesis	3
Operational safety prediction	3
Introduction to discrete event system modelling	6
Algorithmics and data structures	6
Mastering IT systems	6
IT networking	6
Artificial Intelligence	6
Management, economics and setting up a business concern	4
Foreign language studies	4
<b>Semester 2</b>	
Introduction to systems engineering	6
Experimental protocols, instrumentation and information processing	6
System energy flows and transduction	5
Graph Theory and Combinatorial Optimization	6
Operational systems (OS)	6
Object-oriented programming	6
Multi-agent systems	6
Real time programming and computing	6
Controlling observation of dynamic and merging systems	6
Management, economics and setting up a business concern	4
Foreign language studies	4
<b>Semester 3 – 1st quarter</b>	
Optimization	3
Advanced systems engineering	3
Modelling uncertainty and its propagation	3
Biomimetics in systems of systems (SOS)	3
Modelling, control and observation of dynamic systems	3
Representing and assessing mobile system movements	3
Advanced machine learning	3
Foreign language studies	4
<b>Semester 3 – 2nd quarter</b>	
Modelling and optimization in discrete systems	3
Introduction to optimization under uncertainty	3
Introduction to decision theory	3
Technologies and algorithms for communications in SoSs	3
Deep learning	3
Foreign language studies	4
<b>Semester 4</b>	
Master's degree internship	30

### Useful Information

#### Target population

Students with having completed three years of undergraduate studies majoring in pure science, engineering sciences, or science and technology.

#### Admission

##### Year 1 : M1

Admission to the first year (M1) is decided on the merits of the application for students who have completed at least three years of undergraduate studies (first degree or equivalent).

##### Year 2 : M2

Direct admission to the second year (M2) is decided on the merits of the application for students who have completed at least four years of undergraduate studies (M1 or final year student-engineers enrolled at a recognized school of engineering).

#### Applications

The UTC master's degree application form can be downloaded as of March and should be returned, completed, to the Admissions Office before mid-June (the exact dates are to be found on the UTC website at [www.utc.fr/master](http://www.utc.fr/master)

