INSA INSTITUT NATIONAL DES SCIENCES APPLIQUÉES TOULOUSE

SEMESTER 9_5th YEAR ModIA

Practical info

Location(s)

Toulouse

Data Assimilation

ECTS
3 crédits

Hourly volume
69h

Introducing

Objectives

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

-The general concepts behind Data Assimilation
-The key step to predict the state of a system by combining models and observations: formal definition of a dynamical system, error specification, interpretation of results
-Methods fro handling nonlinearity and large scale
-Variationnal methods for Data Assimilation
-Ensemble methods for Data Assimilation

At the end of this module, the student should be able to:

-Analytically solve a vairaitonnal Data Assimilation problem
-Design a data assimilation system using a description of a system using partial differential equation
-Assess the performance of a system, question the relevance of the mathematical assumptions

Necessary prerequisites

Numerical algebra for large scale, statistical estimation, non-convex smooth optimization, numerical solution of PDEs

Practical info

Location(s)

Toulouse

Modeling & Finite Elements

ECTS
3 crédits

Hourly volume
68h

Introducing

Objectives

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

-How to model and to compute with the Finite Element Method (FEM) classical systems of PDEs.

At the end of this module, the student should be able to:

¿ write the weak (variational) form of the classical PDE models (with the corresponding energy minimization, symmetric case).
¿ Understand the mathematical analysis of classical PDE models.
¿ Model and compute with the FEM various classical phenomena (diffusive, convective, elasticity, etc.) which are ubiquitous in physics, process.
¿ Employ Finite Element libraries, e.g. Fenics (in Python)
¿ Implement advanced computational techniques in case of large-scale modeling (model reduction, coupling of numerical models and codes).

Necessary prerequisites

Fundamentals of PDE models, math. analysis,

Basic numerical methods-analysis.

Practical info

Location(s)

Toulouse

Design of experiments and metamodels

ECTS
3 crédits

Hourly volume
64h

Introducing

Objectives

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

-The main methods of experimental design
-Metamodelling for optimization / uncertainty quantification of a black-box function
-At least the two main families of metamodels : chaos polynomials and Gaussian processes
-Kernel customization to account for external knowledge
-Design of computer experiments
-Global sensitivity analysis

The student should be able:

Experimental Design part.
-Plan an experiment in the framework of a linear model

Metamodels part.
-At a theoretical level, to do computations for:
-covariance kernels and Gaussian process
-ANOVA decomposition, Sobol indices
-At a practical level, to perform the complete methodology for analyzing a black-box function :
-design of experiments
-metamodel construction / evaluation
-application to optimization / uncertainty quantification

Necessary prerequisites

Linear model, Gaussian vectors.

Practical info

Location(s)

Toulouse

[FRANCAIS] Processus de Poisson et applications

ECTS
4 crédits

Hourly volume
59h

Introducing

Objectives

At the end of this module, the student should be able to:

· Analyze and exploit the structure of a system to derive its reliability from the characteristics of its components.
· Model the recursive occurrences of the failures on a system or the claim times in insurance by Poisson processes.
· Compute or approximate the ruin probability of insurance derivatives. Use machine learning techniques in actuarial sciences.
· Know the theoretical foundations of the Monte-Carlo method and be able to make use of it within the scope of its applicability and limitations.

· Identify the specific linguistic characteristics of the English used in scientific contexts, and to present their work orally and in written form following this scientific style.
· Write a scientific report in English on their project, respecting the conventions of their field.
· Present project work orally in English and dialogue on key elements of their project in a structured manner.
· Select relevant information for specific audiences.
· Explain complex scientific and technical concepts to non-specialists.
· Adapt their expression for formal and informal presentations.

Necessary prerequisites

-Markov chains and applications (MIC3)
-Inferential Statistics (MIC3)
-Statistical Modelling (ModIA S7)

Practical info

Location(s)

Toulouse

Human sciences

ECTS
3 crédits

Hourly volume
41h

Introducing

Objectives

Aims
The student will learn how to:
¿ Analyze group situations using social psychology concepts
¿ Identify the ethical dimensions of these situations and take a stance
¿ Identify and understand HR-related information
¿ Analyze a team management situation in a theoretical context
¿ Formulate and justify managerial decisions
¿ Take an active role within the group
¿ Fulfill their career objectives, build a strategic plan and acquire job searching skills

Necessary prerequisites

None

Practical info

Location(s)

Toulouse

[FRANCAIS] Formation en entreprise 3

ECTS
14 crédits

Hourly volume

Practical info

Location(s)

Toulouse