

OPTIONAL COURSES (3/7)

Practical info

Location(s)

 Toulouse

Image



ECTS
3 crédits



Hourly volume
36h

Introducing

Location(s)

 Toulouse

Objectives

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

The image acquisition process, the basics and the use of optimization methods for solving inverses problems meet in image processing. The main applications are image restoration, segmentation and registration.

The student will be able to:
manipulate, implement and perform tests on novel image processing methods. In order to do so, the student will need to calculate the gradients, projections and proximal operators he needs to implement an algorithm adapted to structure of his problem.

Necessary prerequisites

- Basics in linear algebra
- Basics in non-linear optimization
- Basics in statistics and probability
- Basics in programming

Practical info

Data Assimilation



ECTS
3 crédits



Hourly volume
36h

Introducing

Objectives

At the end of this module, the student will have understood and will be able to:

(Data Assimilation part)

- write an optimal control problem formulation, both for ODE models and PDE models

- combine at best a PDE model with datasets.

- compute a gradient using the adjoint method.

- set up algorithms of parameters identification, model calibration (3D-Var, 4D-Var etc)

- explain the equivalencies between VDA, BLUE, Kalman filtering and Bayesian approach in the Linear-Quadratic-Gaussian case

- introduce prior probabilistic information via covariances matrix

(Model learning part)

- set up a model learning method from datasets and an a-priori given dictionary.
Both for ODE or (scalar) PDE models.

The student will be able to:

Set up the equations and the complete modeling chain

to perform parameters identification / model calibration / Variational Data Assimilation for PDE models.

Identify the dominant model terms from measurements .

Necessary prerequisites

Basics of: PDE models, differential calculus, optimisation, functional analysis, numerical schemes, Python programming.

Practical info

Location(s)

 Toulouse

[FRANCAIS] Volumes finis et Mécanique des fluides avancées



ECTS
3 crédits



Hourly volume
36h

Introducing

Basic skills in computational fluid mechanics (dynamics of incompressible flows, general principles of the finite volume method)

Objectives

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

- the different models used to describe the dynamics of turbulent flows
- the principles and the theoretical background of the finite volume methods used in computational fluid dynamics.

This course completes and deepens the basic notions of the S8 course entitled: "Numerical models and methods for fluid and structural mechanics".

The student will be able to:

- Understand the models used to describe the dynamics of turbulent flows,
- Know the underlying assumptions and the limits of validity of these models,
- Know/understand the main numerical methods used in CFD and apply them,
- Use a model and a numerical method adapted to the fluid mechanics problem to be solved and the desired accuracy.

Practical info

Location(s)

 Toulouse

Necessary prerequisites

Advanced modeling in computational structural mechanics



ECTS
3 crédits



Hourly volume
35h

Introducing

Objectives

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

A few advanced modelling methods in structural mechanics to tackle current real applications such as:

- computation of shell-type structures;
- use of CAD data for the computation;
- model and computation of contact problems between elastic bodies;
- image registration in view of performing data & model comparison in experimental mechanics.

The student will be able to:

On simple cases:

- Formulate and solve by the FEM beam models.
- Apprehend a computational technique based on the exact geometric representation in CAD (NURBS-based isogeometric analysis).
- Formulate and solve using various finite elements algorithms a frictionless contact problem
- Apprehend the data-driven (model-free) paradigm in computational mechanics.
- Identify material properties by image data - model comparison.

Necessary prerequisites

- Continuum mechanics.
- Elasticity modelling.
- Finite element method.

Practical info

Location(s)

 Toulouse

Reliability and Lifetime Analysis



ECTS
3 crédits



Hourly volume
36h

Introducing

Location(s)

 Toulouse

Objectives

At the end of this module, the student will be able to drive the following process and to explain the obtained conclusions

- Using the Reliability database in order to estimate the functions of interest
- Analyzing and exploiting the structure of a system to derive its reliability from the characteristics of its components
- Modeling the recursive occurrences of the failures on a system. Modeling the évolution of the system-state with time.
- Modeling the effect of maintenance and its planning according to the observations made on the system (dégradation process in particular)

Necessary prerequisites

- Markov chains and applications (MIC3)
- Inferential Statistics (MIC3)
- Statistical Modelling (GMM4)

Practical info

IA Frameworks (AIF)



ECTS
3 crédits



Hourly volume
37h

Introducing

Objectives

This course follows the Machine Learning and the High Dimensional & Deep Learning. At the end of this module, the student will be able to run efficiently these algorithms on various technology. It will also learn different algorithms on real dataset.

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

- Properties of container images.
- Properties of cloud computing.
- Main algorithms of Natural language processing. (Cleaning, Vectorization, Word embedding)
- Reinforcement learning.
- Main recommendation system algorithm.

The student will be able to:

- Clean, prepare, transform (munging) big data within Python or Spark frameworks.
- Identify the right tool to analyse these big data (virtual machine ,container, gpus, etc..) on different use case.
- Identify the right algorithm according to the data (recommendation system, NLP, reinforcement learning, cnn)
- Execute, optimize, these methods and algorithms in the best adapted framework and validate their performances.
- Learn by himself and develop a use case for a recent technology of his choice.

Necessary prerequisites

Exploratory Data Analysis
Machine Learning / Deep Learning
R and Python languages

Practical info

Location(s)

 Toulouse

Poisson processes and application to reliability and actuarial sciences



ECTS
3 crédits



Hourly volume
35h

Introducing

Location(s)

 Toulouse

Objectives

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

- Know and understand the Poisson process theory fundamentals.
- Estimate the rate of a homogeneous Poisson process and construct confidence intervals and statistical tests for such rate (theoretically and in practice with the R Statistical Software).
- Model the recursive occurrences of the failures on a system, or the claim times in Insurance by Poisson processes.

Necessary prerequisites

- Probability and Statistics (I2MIMT31)
- Statistics (I3MIMT41)
- Elements of Statistical Modeling (I4MATCEMS11)

Practical info
