INVERSE PROBLEMS

ECTS
5 credits

Component
École Nationale Supérieure d'Électrotechnique d'Électronique d'Informatique d'Hydraulique et des Télécommunications

In brief

Code: N9EN21

Presentation

Objectives

The objectives of this course is to learn and undestand various way to solve inverse problems. Depending on the student's area, applications wil be oriented toward photographic 3D-reconstruction methods or numerial problems with uncertainty. In the first, case, the problem is to obtain a 3D model of a scene i.e., its shape and its colour.In the second case, the main filtering methods based on the non-linear Bayesian filters (particle filter, Kalman filter, extended Kalman filter, ensemble Kalman filter) will be studied. For a given ODE/SDE, students have to identify the corresponding notion of integration, then should be able to propose an adapted filtering method.

Description

The content is twofold, with a focus on the student's preferred area:

- Filtering methods

- Introduction to filtering : Bayesian inference ; Filtering and smoothing principles, non-linear filtering ; Application to the linear and Gaussian case: Kalman filter.

- Uncertainty dynamics for ordinary differential equations (ODE) and stochastic differential equations (SDE): from partial differential equation to ODE (numerical schemes); Lyapunov exponent and chaotic system; stochastic processes; discrete/continuous Markov processes; Observable/measure dynamics duality

- Stochastic filtering: Particle filter; Ensemble Kalman filter; Stochastic smoother

Pre-requisites

Optimization, notion of probability and statistics, numerical linear algebra

Useful info

Place

Toulouse