Optimisation - E.D.P.

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

In brief

Code: N5EN04A

Presentation

Objectives

Partial Differential Equations
The aim is to understand and predict the behavior of complex systems, such as those from physics (weather, mechanics, etc.). The modeling of these problems involves ordinary differential equations (ODE), but also partial differential equations (PDE). The analysis of these models involves the study of the existence and uniqueness of solutions, the discretization of the problem and the resulting loss of information, as well as the resolution of the discrete problem with its numerical aspects.

Optimization
A taxonomy of optimization problems will be presented, in order to be able to situate a problem in relation to the theoretical and numerical tools used to solve the problems. Then, the different relations between the extrema of a derivable function (zero gradient, inertia of the Hessian matrix in the unconstrained case) will be developed, insisting on the rigorous application of the available necessary and sufficient conditions. The emphasis is on understanding the structure of the problem and the precise use of the mathematical conditions.

Description

Partial Differential Equations
- Examples of PDE problems - Taxonomy;
- Finite difference method:
  - Presentation of the method;
  - Consistency of the numerical scheme;
  - Stability and convergence of numerical schemes for evolution problems.

Optimization
- Example problems and mathematical modeling;
- Definition and classification of optimization problems;
- Differentiability of applications, limited developments;
- Convexity of applications, characterization by properties of derivatives;
- Existence and uniqueness of solutions of optimization problems;
- Necessary and sufficient conditions for local optimum for unconstrained problems;
- Solving least squares problems - introduction of Newton and Gauss-Newton methods.

Pre-requisites

Linear algebra, calculus of derivatives, analysis