Topological Optimisation

Component
École Nationale Supérieure d'Électrotechnique d'Électronique

In brief

- **Ametys Code:** N9EE33C
- **Open to exchange students:** Yes

Presentation

Objectives

The aim of the course is to present the fundamental principles of topological optimisation and the different ways of formulating an optimal design problem. It also aims to show the limitations of exhaustive or metaheuristic approaches and to explain the advantages of density methods associated with the adjoint for gradient calculation.

Description

This module introduces the topological optimisation approach and the motivations behind the optimal design of electromagnetic structures or devices. Students learn about the main formulations of the problem. The course highlights the difficulties associated with exhaustive methods or metaheuristics applied directly to solving topological optimisation problems, and explains why density-based approaches are a much more effective alternative. The use of the adjoint method to calculate the gradient is presented in detail using a comprehensive example applied to the design of a 2D magnetic circuit (magnetostatic equations). The practical work then allows us to implement a simple case of topological design, in particular the optimisation of pole pieces for a U-shaped 2D circuit, in order to link the theoretical aspects to an application inspired by a magnetic propulsion system.

Pre-requisites

The course requires a good understanding of partial differential equations and finite element methods. A basic knowledge of continuous optimisation (gradient, local optimum, simple constraints) and familiarity with a scientific language such as MATLAB or Python are recommended.