

Optimised sizing of electrical machines



Component
École Nationale
Supérieure
d'Électrotechnique
d'Électronique

In brief

- **Ametys Code:** N9EE27C
- **Open to exchange students:** Yes

Presentation

Objectives

Understand the principles, advantages and limitations of metaheuristics for the global optimisation of complex problems. Know how to apply and configure modern stochastic methods for the optimised dimensioning of electrical machines.

Description

This course introduces global optimisation techniques based on stochastic and metaheuristic approaches, which are now widely used in the advanced design of electrical machines and actuators. After presenting design issues (electromagnetic models, geometric and thermal constraints, multi-criteria objective functions), the course details the main families of metaheuristics: simulated annealing, tabu search, VNS, genetic algorithms and multistart strategies. The principles, parameter settings, exploration/exploitation mechanisms and stopping criteria are explained through numerous examples. A significant part of the course is devoted to the integration of these methods with physical or numerical models (FEM, analytical models, surrogate modelling, multi-fidelity approaches), as well as strategies for reducing computational costs in industrial design problems. Comprehensive case studies on synchronous motors with magnets allow the theoretical aspects to be linked to concrete applications. The ultimate goal is to give students operational mastery of metaheuristics for solving realistic design problems that are highly non-convex and may be noisy or multimodal.

Pre-requisites

- Fundamentals of numerical optimisation (gradients, descent methods, concepts of convexity).
- Basic knowledge of electromagnetism applied to electrical machines (field models, losses, torques).
- Concepts in numerical simulation (FEM or parametric modelling).
- A plus: having taken a course in unconstrained optimisation or classical continuous optimisation.