



Research master internship

Short-term scheduling of electric micro-grids under uncertainty

Key words

Operations Research, Combinatorial Optimization, Micro-grid scheduling, Stochastic programming, Mixed Integer Linear Programming

Content

Micro-grids are small-size electric systems aiming at supplying electricity for a small number of consumers (e.g. an isolated rural area, an eco-district, a university campus...). Micro-grids comprise local energy sources (diesel generators, photovoltaic panels, wind turbines...), electrical storage devices (batteries...) and loads. They can be connected or not to the main national electric grid.

One of the main challenges related to micro-grids management is their short-term scheduling. Micro-grids are namely faced with a high level of variability in the local demand for electricity and in the local production of electricity by renewable energy sources. Hence, to ensure that the production-demand balance is satisfied at all time, a detailed one-day ahead schedule determining how the other resources of the micro-grid should be used has to be built. In practice, this schedule will indicate, for each hour of the coming day, whether each diesel generator should be switched on/off, how much energy should be charge/discharge from the battery, how much energy should be traded with the main grid...

To address this challenge, the EDF R&D Chatou center has developed a decision support tool based on mathematical optimization, PILOT. The mixed-integer linear programming model embedded in PILOT relies on the assumption that all input data of the optimization problem are deterministically known. However, in practice, there are significant uncertainties in the problem input data, especially as it is difficult to accurately forecast the future demand and the future renewable energy production.

This master internship is devoted to studying an extension of the existing deterministic optimization model in which the uncertainties are explicitly taken into account. The new model is based on a two-stage stochastic programming framework and relies on a set of scenarios to represent the evaluation of the random parameters. This leads to the formulation of a large-size mixed-integer linear program.

The objective of the intern work will be to develop efficient solution approaches based on advanced mathematical programming techniques for this difficult problem.

Context

This project is funded by the Ile de France region via its DIM RFSI 2018 program. It is a collaboration between LRI (Laboratoire de Recherche en Informatique www.lri.fr) at University Paris Sud, CEDRIC (Centre d'Etude et de Recherche en Informatique et Communications) at the CNAM Paris and EDF R&D Chatou.

The student will be based on the Paris Sud campus (at the LRI) and will work under the joint supervision of Dr Céline Gicquel (LRI), Pr Safia Kedad-Sidhoum (CNAM) and Bruno Heili (EDF).

Desired qualifications

Student at Master's degree level (last year of engineering school or research master):

- Strong background in applied mathematics.
- Good knowledge in Operations Research: linear programming, integer programming, if possible stochastic programming.
- Interest in computer programming (C++ language) and algorithmic.

Practical information

Location: University Paris Sud - Campus d'Orsay – Bâtiment 660 - 91405 ORSAY Cedex

Start date: Between February and May 2019

Duration: 6-7 months

Payment: Around 500€ net per month

Contact

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