Smart grids, micro grids and new energy systems: stochastic and decentralized optimization

Scientific training period proposal

November 10, 2017

1 Organism, supervision and material conditions

Organism

Name: CERMICS, École des Ponts ParisTech

Address: 6 et 8 avenue Blaise Pascal, Cité Descartes, 77455 Marne la Vallée Cedex 2

Name: UMA, ENSTA ParisTech

Address: 828, boulevard des Maréchaux, 91762 Palaiseau Cedex

Supervision and material conditions

Address:
CERMICS, École des Ponts ParisTech,
6 et 8 avenue Blaise Pascal, Cité Descartes, 77455 Marne la Vallée Cedex 2

Supervisors:
Jean-Philippe CHANCELIER (CERMICS, jpc@cermics.enpc.fr, 01 64 15 36 38)
Pierre CARPENTIER (UMA, pierre.carpentier@ensta-paristech.fr, 01 81 87 21 10)
Michel DE LARA (CERMICS, delara@cermics.enpc.fr, 01 64 15 36 21)
Vincent LECLÈRE (CERMICS, leclerev@cermics.enpc.fr)

Number of students: 1 to 5

Material conditions: a financial gratification is offered

Dates: to be discussed

2 Proposal

Research domain

Mathematics, stochastic optimization, computer science, energy.

Subject

For most of them, the proposals on optimization of new energy systems are more applied and numerical than theoretical. Work can be done within an energy company, on innovative projects. Depending on the student demand, we will adapt and detail one of the following subjects.

1. Management of hydrogen production, storage and delivery

   By collaborating with the company PersEE, the student will set up models of production, storage and selling (on markets) of hydrogen, in a context where both prices and demand can be strongly stochastic.

2. Study of a Virtual Power Plant (VPP)

   By collaborating with energy companies, the student will study how to model a VPP that aggregates renewable energy production (solar, wind) and storage (transfer pumping stations), and how to optimize the VPP when energy is sold on different markets (day-ahead, intra-day, reserve).

3. Management of micro grids with storage

   By collaborating with the Institute for energy transition Efficacity, the student will set up models of management of micro grids — in houses, buildings, train stations — and develop resolution algorithms. Special emphasis will be put on storage of energy, that is expected to develop in the new energy systems (batteries, water pumping station, hydrogen). The student will study and develop mathematical models of storage adapted to optimal control, and will especially focus on the modelling of inertia and ageing.

4. Review and analysis of the literature at the intersection of optimization and smart grids

   Following the work done in three previous reports, the student will update the literature at the intersection of optimization and smart grids.