Call for PhD applications

Title: Robust Energy Management Strategy for Microgrids Under Uncertainty Applied to Energy Communities

Keywords: Microgrids, Renewable Energies, Optimization, Supervision, Energy communities, Flexibility, Resilience

Position: PhD
Fields of research: Electrical Engineering and Control
Duration : 3 years.
Hosting institutions :

- ESTIA Institut de Technologie, Laboratoire ESTIA-Recherche.
- Université de Bordeaux, IMS-lab, Automatic control group.

Contact ESTIA:
Adriana AGUILERA GONZALEZ
Ionel VECHIU
ESTIA Recherche - ESTIA Institute of Technology
Technopole Izarbel, 64210 BIDART - FRANCE
E-mail: a.aguilera-gonzalez@estia.fr
E-mail: i.vechiu@estia.fr

Contact IMS:
Tudor-Bogdan AIRIMITOAIE
Patrick LANUSSE
Laboratoire IMS – Université de Bordeaux
351 Cours de la Libération, 33405 Talence, France
E-mail: tudor-bogdan.airimitoaie@u-bordeaux.fr
E-mail: patrick.lanusse@ims-bordeaux.fr

Description of the research environment

ESTIA (http://www.estia.fr) develops three activities: training trilingual general engineers (250 graduates per year), research and transfer, running 3 business incubators and a technology park. ESTIA trains engineers in the fields of energy, embedded systems, mechanics, IT and industrial organization. ESTIA is a member of the *Conférence des Grandes Ecoles* and accredited by the *Commission des Titres d'Ingénieur*. In addition to its training mission, ESTIA develops collaborative projects with industrial companies in the Aquitaine region, France and Europe, through its multidisciplinary laboratory Estia-Recherche (https://www.estia.fr/recherche). To promote all of these activities, ESTIA runs and uses several technical platforms: EneR-GEA, Compositadour, PEPSS, Addimadour and the new Turbolab et Datalab platforms.

The IMS Laboratory is a joint research unit between the CNRS, the University of Bordeaux, and Bordeaux INP. It offers a unique scientific positioning in systems engineering, focusing on the integration of hardware, intelligence, and knowledge in communicating and human-centered systems. IMS supports both fundamental and project-based interdisciplinary research, with over one hundred active research grants targeting domains such as transportation, telecommunications, health, environment, and energy.

The selected doctoral candidate will focus on ***developing a robust energy management strategy for microgrids within energy communities, addressing uncertainties inherent in renewable energy sources and load demands***. He/she will join the Renewable Energy Integration (IEnR) team at ESTIA-Research and the CRONE team within the Automatic Control group of the IMS Laboratory. These teams possess extensive and diverse expertise in areas such as system modeling, learning and adaptation algorithms, system identification, energy efficiency and storage, power electronics, and the control and optimized management of energy flows. This research framework offers a rich environment for the development of innovative solutions to meet current energy challenges.

PhD subject

The doctoral thesis is part of a larger project called FlexiCommu whose overall subject is *about "Simulation and decision support tool for developing and optimally managing energy communities"*.

The proposed doctoral research will focus mainly on developing and validating robust energy management strategies for microgrids within energy communities, addressing uncertainties inherent in renewable energy sources and load demands. The objective is to design an energy system that is efficient, resilient, sustainable, and participatory, delivering tangible economic and environmental benefits to all community members. This research will involve advanced system modelling, the application of learning and adaptation algorithms, and implementing optimised control mechanisms to manage energy flows effectively. The outcomes are expected to advance energy management practices in decentralised energy systems significantly.

Proposed work plan

The proposed work includes the following steps:

- Identify and quantify the various sources of uncertainty, using stochastic modeling methods to represent these uncertainties realistically.
- Develop a robust optimization algorithm capable of handling uncertainties while maximizing energy efficiency. Integrate machine learning and artificial intelligence techniques to enhance the prediction and adaptation of management strategies.
- Design flexibility mechanisms to adjust energy production and consumption in real time, ensuring the resilience of the microgrid to unforeseen disturbances or extreme conditions.
- Facilitate coordination among the different actors in the energy community, including producers, consumers, and network managers, taking into account the conclusions from the FexiCommu global project.

The selected candidate for this research position will have access to the infrastructure of the ESTIA-Recherche and IMS laboratories.

EneR-GEA is a state-of-the-art platform centered around a modular and flexible electrical micro-grid. This micro-grid integrates various energy sources, storage systems, loads, emulators, and power converters to replicate real-world scenarios on a laboratory scale. Additionally, the platform features a building micro-grid demonstrator, further enhancing its capabilities.

By leveraging these resources, the candidate will be well-equipped to conduct high-quality experimental research.

Candidates Profile

The applicant must have a Master or an equivalent degree or be in the process of finalising a Master in Control/Electrical Engineering field. The following skills will be highly appreciated:

- Linear and nonlinear control.
- Artificial Intelligence knowledge
- Modelling and simulation of dynamic systems.
- Energy management optimisation.
- Renewable energy, electrical networks and flexibility.
- Matlab/Simulink and real-time simulation tools.
- Good English level.

This subject requires multidisciplinary skills in control engineering, electrical engineering, power electronics, real-time simulation and the implementation of control algorithms. The candidate must have a methodical and rigorous investigation approach and a real interest in teamwork. Proficiency in French would be especially valued.

Your rigor, sense of responsibility, and scientific curiosity will be key assets for this doctoral thesis.

Applications

The application file (CV with cover letter and all documents necessary to demonstrate your skills, including the names and contact details of two leading scientific figures who could be contacted to give their opinion on the candidate's work and abilities) must be sent electronically to:

- Adriana Aguilera González a.aguilera-gonzalez@estia.fr
- Tudor-Bogdan Airimitoaie tudor-bogdan.airimitoaie@u-bordeaux.fr

The formal evaluation of candidates will commence on March 1, 2025, and will continue until the position is successfully filled.

Thesis start date: September 2025.