Ph.D. position offer:
Digital Twin for Ageing Resilient Control of Hydrogen-Based Microgrids
16/06/2023

Keywords
hydrogen energy, electric power system, microgrid, aging, resilient control, digital twin, energy management, renewable energy, energy storage, optimization

Context
Reducing greenhouse gas emissions is a challenge for our planet. We must recourse to the installation of sources of renewable origin, decentralized by nature. The project aims to develop an aging resistant control for a microgrid including different sources and charges in link with energy storage.

The Ph.D. position is part of the ANR project Genial (Gestion d’éNergie d’un micro-réseAu à hydrogène résiLient au vieillissement- Stabilisation, résilience, optimisation sur cycle de vie). It is funded for a duration of 42 months.

Scientific Objectives
The focus of the Ph.D. thesis is on the development of an ageing resilient control of a microgrid. The main steps of the thesis will be as follows:
- Review of the related state-of-the-art,
- Collection of the necessary data and modeling of microgrid (digital twin),
- Definition of algorithms to be integrated in the digital twin,
- Adaptation of the algorithms including aging mechanisms in the digital twin,
- Define the control parameters to be adapted in real-time to reduce aging of components,
- Planning and integration of start/stop of components in accordance with the hydrogen microgrid into the digital twin,
- Contribution to experimental validation,
- Writing of the thesis document and defense.

The selected applicant will also be expected to:
- Publish in international journals and conferences,
- Participate in project meetings, in the writing of deliverables as well as in communication and dissemination events,
- Participate in the scientific activities of the respective laboratories and universities.

Expected qualifications
- Master’s or 5-year engineering degree in electrical engineering, applied mathematics or a related field,
- Interest for energy issues and research,
- Knowledge in power systems, renewable energy, hydrogen energy, optimization,
- Experience with Python and/or Matlab programming,
• Good level of written and oral English,
• A good level of French is a plus.

Supervision
The selected Ph.D. student will be supervised by:
• Dr. Daniela Chrenko, Associate Professor HDR at UBFC/UTBM and FEMTO-ST,
• Dr. Robin Roche, Associate Professor HDR at UBFC/UTBM and FEMTO-ST,
• Prof. Samir Jemei, Professor at UBFC/uFC and FEMTO-ST,
• Prof. Mickaël Hilairet, Professor at Ecole Centrale de Nantes and LS2N.

Application
Please send a motivation letter, a detailed CV and transcript of results to the following email addresses:
• daniela.chrenko@femto-st.fr
• robin.roche@femto-st.fr
• samir.jemei@femto-st.fr
• mickael.hilairet@ec-nantes.fr

Additional Information
Location : FEMTO-ST at Belfort, France
Date : october 2023 to september 2026
Financial support : ANR-22-CE05-0026, GENIAL project, https://anr.fr/Projet-ANR-22-CE05-0026
Salary (brut) : 2044 €/month

About the GENIAL project
GENIAL (Gestion d’éNergie d’un micro-réseAu à hydrogène résilient au vieillissement - Stabilisation, résilience, optimisation sur cycle de vie) is a research project funded by the French Research Agency (ANR) from 2023 to 2026. It focuses on the design of microgrids. They are composed of sources.loads (solar photovoltaic, fuel cell, electrolyser) associated with storage elements (battery, hydrogen tank) in order to meet this societal challenge. The decentralization of sources and storage elements leads to a complex energy system and requires a control integrating all the knowledge on the aging of the energy system in order to ensure the stability of the continuous micro-grid (DC), optimal efficiency and compliance with the constraints on the components (current/voltage, state of charge, etc.) during the period of use.

About UBFC and FEMTO-ST
Université Bourgogne Franche-Comté (UBFC) is a community of universities and institutions which gathers seven higher-education and research institutions. UBFC currently hosts more than 60,000 students and 8,800 staff. It spreads across 13 sites in the Bourgogne Franche-Comté region in France.

FEMTO-ST is a joint research unit of several UBFC institutions (Université de Franche-Comté, ENSMM, UTBM) and CNRS, the French national research center. With over 750 researchers and staff, it is a leading institute in the field of engineering sciences. Its Energy department is located in Belfort, France, and hosts the largest French research group in hydrogen energy. FEMTO-ST is a partner of FCLAB, a CNRS unit dedicated to applied hydrogen energy research and transfer. The SHARPAC team of the Energy department has a strong expertise in hydrogen energy systems, and especially in ageing-aware diagnostics and prognostics, and in energy and power management of systems integrating them.
FEMTO-ST also includes a multi-disciplinary humanities team, RECITS, with a focus on technological change.

For more information, see https://www.ubfc.fr/ and https://www.femto-st.fr/.