Subject: PhD position in the topic AI-Enhanced Monitoring for Photovoltaic Systems

Location:

Lucerne University of Applied Sciences and Arts (HSLU), Switzerland – Campus Horw

The PhD student will enroll at the doctoral school EEATS of the University of Grenoble-Alps

Start Date:

From 01.03.2025 onwards

Application Deadline:

The applications will be evaluated continuously until the position is filled.

About the Project:

The STAR-SOLAR project is a project aimed at promoting the adoption of residential photovoltaic (PV) systems through a socio-technical approach. As part of this project, we are seeking a highly motivated PhD student to focus on the development of an AI-enhanced monitoring tool for predictive maintenance and efficiency of PV systems.

The successful candidate will work on developing innovative AI algorithms and integrating IoT technologies to create a comprehensive monitoring system that can predict maintenance needs and optimize the performance of residential PV installations. The project will involve data collection, real-time performance analysis, and the implementation of advanced machine learning techniques.

State of the Art:

The integration of AI and IoT in renewable energy systems has shown significant potential in enhancing operational efficiency and reducing maintenance costs. Current research focuses on predictive maintenance frameworks, real-time monitoring, anomaly detection, and user engagement strategies. This PhD project aims to build on these advancements, contributing to the development of sustainable energy solutions.

Objectives:

The main objectives of the PhD project include:

- Developing a predictive maintenance framework utilizing machine learning algorithms.
- Designing an IoT-integrated monitoring system for continuous performance assessment.
- Implementing and evaluating various anomaly detection algorithms to enhance reliability.
- Optimizing energy production through data-driven analytics.
- Assessing the economic impact of AI-driven maintenance solutions.
- Creating user-friendly interfaces to promote engagement and informed decision-making.

International Collaboration set-up:

This is a joined supervision with G2Elab (Grenoble Electrical Engineering Laboratory) in France which is a joint research unit (CNRS / Grenoble INP - UGA, Grenoble Alpes University), in the field of Electrical Engineering Research.

The G2ELab also develops simulation and optimization methods and tools for the optimal management of energy systems. In addition to the physical models used to simulate a system, the acquisition of data and its exploitation to improve modelling have become classic with the advent of artificial intelligence. The ultimate stage, exploiting physical knowledge hybridized with data to offer diagnostic and predictive services, is the digital twin:
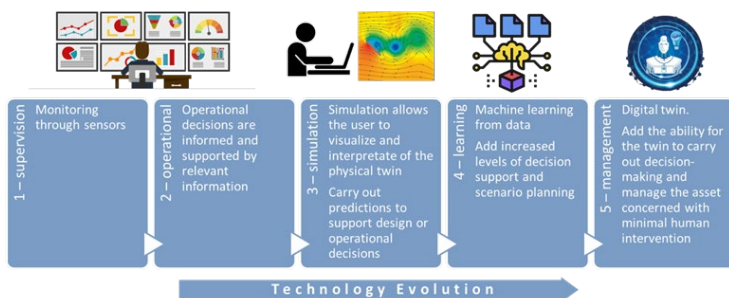

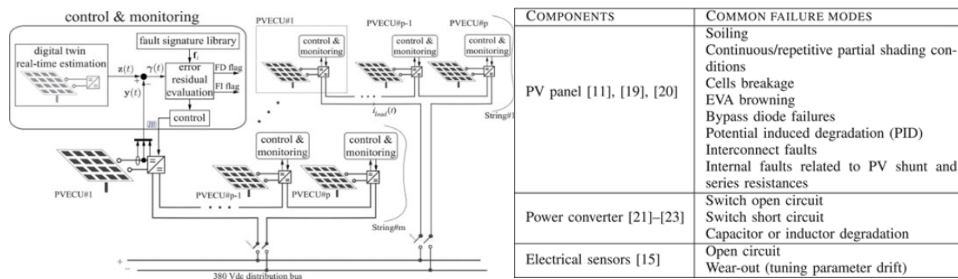Fig 1. Technological evolution from monitoring to digital twins (Adapted from [2])

Fig 2. PV Fault Diagnosis [3]

Literature references on Digital Twins:

[1] Thelen, A., Zhang, X., Fink, O., Lu, Y., Ghosh, S., Youn, B. D., ... & Hu, Z. (2022). A comprehensive review of digital twin—part 1: modelling and twinning enabling technologies. Structural and Multidisciplinary Optimization, 65(12), 354.

[2] Wagg, D. J., Worden, K., Barthorpe, R. J., & Gardner, P. (2020). Digital twins: state-of-the-art and future directions for modelling and simulation in engineering dynamics applications. ASCE-ASME Journal of Risk and Uncertainty in Engineering Systems, Part B: Mechanical Engineering, 6(3), 030901

[3] P. Jain, J. Poon, J. P. Singh, C. Spanos, S. R. Sanders and S. K. Panda, "A Digital Twin Approach for Fault Diagnosis in Distributed Photovoltaic Systems," in IEEE Transactions on Power Electronics, vol. 35, no. 1, pp. 940-956, Jan. 2020, doi: 10.1109/TPEL.2019.2911594

Candidate Profile:

We are looking for candidates with:

- A master's degree in electrical engineering, Computer Science, Renewable Energy, or a related field. Applications from Master students graduating before June 2025 are also welcome.
- Strong programming skills (Python, R, etc.) and experience with machine learning frameworks.
- Knowledge of photovoltaic systems and renewable energy technologies.
- Excellent analytical and problem-solving skills.
- Strong communication skills and the ability to work collaboratively in an interdisciplinary team.
- Fluency in English. Any other national language is an advantage.

What We Offer:

The successful candidate will benefit from:

- A stimulating research environment at HSLU and G2Elab, with access to cutting-edge resources.
- Opportunities for collaboration with international research partners.
- Financial support for conference participation and travel.
- A chance to contribute to innovative solutions in renewable energy and sustainability.
- The basic starting salary of a doctoral assistant is CHF 55'000.- gross per annum

Application Process:

Interested candidates should submit the following documents:

- A cover letter detailing their motivation and relevant experience.
- A current CV.
- Copies of academic transcripts.
- Contact information for two referees.

Please send your application to Yousra.sidqi@hslu.ch and benoit.delinchant@g2elab.grenoble-inp.fr .