Post-Doc proposal

Title: Diagnostics and predictive maintenance using Machine Learning (DoréMi)

Project start date: October 02, 2023

Contract duration: 12 months, possibly renewable once

Location: CRESTIC, Reims site, within the Control and Diagnosis of Discrete Event Systems (CDSED) team (https://crestic.univ-reims.fr/fr/equipe/cdsed).

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Keywords: Diagnosis, Automated Production System, machine learning, LSTM, Case-based reasoning

Project overview

The context of DoréMi is the diagnosis of undesirable behavior in Automated Production Systems (APS). The detection task consists in identifying the system's operating mode, generating alerts according to thresholds previously set on the basis of performance criteria, and thus rapidly detecting any deviation from the system's nominal behavior. The diagnostic task consists in isolating and identifying the faulty component. In this project, we propose to use one of the tools of the industry of the future: the Digital Twin (DT). The concept of DT consists in digitizing a factory and digitally reproducing its behavior. Most industrial solutions can be used to match a machine's desired behavior to virtual commissioning. In this project, we will use DT to generate training data and, more specifically, to inject faults into the digitized system, in order to obtain large quantities of observations of faulty cases without taking risks on real systems. We will be using URCA's Cellflex 4.0 platform and associated JNs for data acquisition and experimental validation, and will benefit from the computing capabilities of URCA's Romeo HPC platform.

In DoréMi, we aim to develop an intelligent diagnostic solution to replace traditional, often non-industrializable, solutions with a new method based on data learned from the simulation of normal and/or abnormal behavior from a DT, and to provide the human supervisory operator with feedback on the system's state of health. This project aims to test and improve a solution presented in (Saddem and Baptiste, 2022). It is a data-driven approach based on machine learning. Data will be provided by the DT of the Cellflex 4.0 automated cell. This project also aims to compare the solution developed in (Lang et al., 2021). The aim is to set up a relevant benchmark (dataset) taking into account the date of occurrence of faults and using URCA's Celflex4.0

platform and associated Digital Twins (the data acquisition part) and benefit from the computing capabilities of URCA's Romeo HPC platform (experimental validation part).

Responsibilities: The work consists in 1) improving and extending the exploratory results of on-line diagnosis of Automated Production Systems (SAP) controlled by Programmable Logic Controllers (PLC), based on the data in (Saddem and Baptiste, 2022), by optimizing the hyperparameters,2) comparing the diagnostic solution with that of (Lang et al, 2021) by setting up a relevant benchmark (dataset) taking into account the date of occurrence of faults using the digital twins of Celflex 4. 0, and 3) to publish the results by means of papers in one/two international conference(s) and to write a journal or review paper.

Profile and skills required

- PhD degree obtained after July 2020 (maximum 3 years before the date of recruitment).
- In-depth knowledge of machine learning and Python programming (NumPy, Pandas, TensorFlow, Scikit-learn libraries, etc.).
- Knowledge of automated production systems (especially discrete-event and hybrid systems).
- Ability to work in a team.
- Scientific rigor.
- Good oral and written English.

PhD graduates from URCA are not eligible.

How to apply

Send a cover letter and CV to ramla.saddem@univ-reims.fr.

References

Saddem, R. and Batiste D., (2022) Machine learning-based approach for online fault Diagnosis of Discrete Event System. In: 16th International Workshop on Discrete Event Systems. Septembre 7-9, 2022. Prague, République Tchèque.

Lang, S., Plenk, V., Schmid, U. (2021) A Case-Based Reasoning Approach for a Decision Support System in Manufacturing. In: Fujita H., Selamat A., Lin J.CW., Ali M. (eds) Advances and Trends in Artificial Intelligence. From Theory to Practice. IEA/AIE 2021. Lecture Notes in Computer Science, vol 12799. Springer, Cham.

https://www.univ-reims.fr/meserp/cellflex-4.0/cellflex-4.0,9503,27026.html

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