Methodology for evaluating the alignment of a multi-level CPPS digital twin

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Partenaires : (si applicable)
Laboratoire : DISP
Composante : (si applicable)

Nature du financement demandé : Stage M2,
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Résumé : (200 mots)
In our project, the digital twin of a production system is considered to be multi-level: component level (automation engineer), equipment level (automation engineer / production engineer) and line level (production engineer). A calibration of the numerical simulation models making up this digital twin is necessary to align these numerical models with the physical twin, in order to give the digital twin a sufficiently similar behavior to its physical twin. From the point of view of DT usage, an "acceptable" alignment is a behavioral and temporal deviation that does not call into question the purpose of the decision
The scientific objectives of the master internship are therefore:

(i) define indicators that characterize the alignment of a digital twin with respect to a physical twin;
(ii) Define methodology for evaluating the alignment of a multi-level CPPS digital twin.

Sujet développé :

Background and objectives of the master internship

The project aims to federate the digital models of automation engineers and production engineers, turning them into fully-fledged digital twins for the commissioning of *Cyber-Physical Production Systems* (CPPS), but also a management support tool for Industry 4.0 actors.
There are a multitude of definitions of a digital twin (DT), depending on the use cases and associated value creation. The definition chosen for the DT will correspond to the vision of the automation engineer and the production engineer. The AIF (*Alliance Industrie du Futur*) has published a report on DT as a "major lever for the digital transformation of industry". DT is defined as:

- an organized set of digital models representing a real-world entity to address specific issues and uses,
- updated in relation to reality, with a frequency and precision adapted to its issues and uses,
- with advanced operational tools for understanding, analyzing, forecasting and optimizing the operation and management of the real entity.

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Candidate profile

The candidate should have skills in production systems, operations management and associated tools/software (flow simulation, MES, etc.), discrete-event systems, communication and data exchange between equipment. In addition, the successful candidate should have a keen interest in software development.

Missions

The main stages of the thesis will be:

- State of the art on the alignment and synchronization of a digital model with the entity being modeled (physical and software)
- Define relevant indicators to characterize the alignment of a digital twin with its physical twin
- Propose a methodology for measuring indicators of the alignment of a digital twin with its physical twin

The proposed method will be tested on an automated line with its digital twin.
Participation in national and/or international conferences is expected. A good command of English is required.

Keywords

Digital twin, alignment indicators, decision support, simulation, data processing, industry 4.0

Working environment

The master internship will be carried out in the DISP laboratory. The DISP (Decision and Information Systems for Production system, UR4570) laboratory brings together researchers and teacher-researchers from the University of Lyon, with dual expertise in Industrial Engineering and Business Information Systems. In response to the scientific challenges posed by changes in the socio-economic world, it conducts research into the design and deployment of decision-support methods and information systems to improve the performance, agility and resilience of goods and services production systems and global supply chains. Its dual expertise, drawing on skills in Modeling, Operations Research, Simulation, Software Engineering, Artificial Intelligence, Planning, Scheduling and Decision Support, enables it to consider these complex systems in their technical, structural, organizational and human dimensions simultaneously. Its members are spread across 4 institutions of the University of Lyon: INSA Lyon, Université Lumière Lyon 2 and Université Claude Bernard Lyon 1, as the parent institutions, and Université Jean Monnet de Saint Etienne as a partner institution.

Application

The application must include :

- A detailed CV
- A cover letter outlining your motivation for the master internship.
- Grades from Master's program (M1, M2) or engineering school (L3, M1, M2) and any other documents deemed useful (letters of recommendation, for example)

After an initial selection process based on applications, the selected candidates will be interviewed by the master supervisors.
The master internship is scheduled to start in February 2025.
The internship allowance is approximately 600 € per month.
Applications should be sent by email to Sébastien HENRY sebastien.henry@univ-lyon1.fr