

Encadrement :

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Etablissement : Lyon 1

Laboratoire : laboratoire DISP

Profil recherché :

M1 Industrial Engineering / Computer Science

Financement: 600 € per month

Période de stage : spring semester

Compétences souhaitées :

Industrial supervision, industrial control system, data modeling, communication protocols (OPC UA).

Mots-clés:

Manufacturing system, Digital Twin, reference architecture

Context

This recruitment takes place as part of the ANR Digital Twin for Cyber Physical System (DT4CPS) project led by a consortium of 3 research laboratories (CReSTIC, QUARTZ and DISP). CPS (Cyber-Physical Systems) are systems composed of autonomous and collaborative entities equipped with computing capacity allowing them to interact with the physical world and making data available on the network. The DT4CPS project focuses more particularly on Cyber-Physical Production Systems (CPPS).

There are a multitude of definitions of a Digital Twin (DT) depending on the use cases and the associated value creation. The chosen definition of DT will correspond to the vision of the automation engineer and the manufacturing engineer. As such, the AIF (Alliance Industrie du Futur) recently published a report on the DT and the “Major lever of the digital transformation of industry”. It is defined there as being:

- an organized set of digital models representing a real-world entity to respond to specific issues and uses,
- updated in relation to reality, at a frequency and precision adapted to its problems and its uses,
- equipped with advanced operating tools to understand, analyze, predict and optimize the operation and management of the real entity.

Depending on this definition, the first problem is to be able to construct and validate a digital twin of a CPPS. The first scientific objective is therefore to propose a methodology allowing the implementation of a digital twin integrating the models and data necessary for both the automation engineer at level of industrial control system and the manufacturing engineer at the level of manufacturing operations management. For this, a data-oriented DT architecture must be proposed to manage the different data flows between twins (physical and digital) at each stage of their life cycle, in line with existing data standards in this context.

Missions

Propose a methodology and architecture for a multi-scale Digital Twin (equipment & production line) integrating models and data flows between physical twin and DT in order to provide technical interoperability solutions in the operational phase (implementation of a functional vector of data between the systems) and semantic (understanding of the data by the systems) between the DT and its physical twin by including all input/output flows.

Indeed, this interoperability is not ensured today due to the diversity of existing standards and partial observability which is limited to the functions currently deployed (control-command, traceability, quality, performance analysis, etc.) without integrating the needs of the DT. Please note, the geometric modeling phase of the DT (CAD) is time-consuming, so it will be considered available. The work will be based on models already existing at each partner of DT4CPS project.

Three deliverables are expected:

- State of the art on technical interoperability for manufacturing system
- Mapping of standards for technical and semantic interoperability
- Proposal of a DT architecture and data model for other work packages

Bibliographie

- [1] E. A. Lee, "Cyber-Physical Systems - Are Computing Foundations Adequate?," in *Position Paper for NSF Workshop On Cyber-Physical Systems*, 2006, vol. 2, pp. 1–9.
- [2] L. Monostori, "Cyber-physical production systems: Roots, expectations and R\&D challenges," *Procedia CIRP*, vol. 17, pp. 9–13, 2014, doi: 10.1016/j.procir.2014.03.115.
- [3] C. Semeraro, M. Lezoche, H. Panetto, and M. Dassisti, "Digital twin paradigm: A systematic literature review," *Comput. Ind.*, vol. 130, p. 103469, Sep. 2021, doi: 10.1016/J.COMPIND.2021.103469.
- [4] Y. Koren, X. Gu, and W. Guo, "Reconfigurable manufacturing systems: Principles, design, and future trends," *Front. Mech. Eng.*, vol. 13, no. 2, pp. 121–136, Jun. 2018, doi: 10.1007/S11465-018-0483-0/METRICS.
- [5] A. Bueno, M. Godinho Filho, and A. G. Frank, "Smart production planning and control in the Industry 4.0 context: A systematic literature review," *Comput. Ind. Eng.*, vol. 149, p. 106774, Nov. 2020, doi: 10.1016/J.CIE.2020.106774.
- [6] E. Negri, L. Fumagalli, and M. Macchi, "A Review of the Roles of Digital Twin in CPS-based Production Systems," *Procedia Manuf.*, vol. 11, pp. 939–948, Jan. 2017, doi: 10.1016/J.PROMFG.2017.07.198.

Recruitment conditions

Candidates must hold a doctorate or a recognized qualification at least equivalent to the national diploma required.

- The missions will be carried out in the Villeurbanne (69) Campus of Lyon Tech la Doua, DISP Lab, Bât. Léonard de Vinci, 21 av. Jean Capelle.
- The duration of the internship is 6 months
- Desired start date: 01/03/2024

Application procedure

The application file includes the following:

- Application cover letter
- Curriculum vitae
- Transcript of master grades

Further information

For further information concerning the position and application procedure, contact:

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