INTERNSHIP OFFER: Sustainable agri-food digital twin: reconstruction and application of the model using AI

SCIENTIFIC BACKGROUND:

The Industry of the Future, perceived as a major transformation in the industrial sector, remains a priority for industrialised nations. In this context, in order to maintain their competitiveness in this global evolution, industrial companies are striving to adopt new technologies such as the digital twin or artificial intelligence. France aspires to play a leading role in this dynamic, which is recognised as a significant challenge for the Nouvelle-Aquitaine region. The University of Bordeaux is actively involved on this front, notably through the GPR BEST and more specifically through its WP2: Smart design & organisation, but also through numerous other projects such as the major ACT project (Augmented University for Campus and world Transition).

According to (Julien and Martin, 2020), a digital twin (DT) is a dynamic virtual representation of an object (product, process or service) that enables analyses, simulations or predictions. By aggregating all the data necessary for the design, production and operation of an object, the digital twin also makes it possible to virtually define new products, processes and services in less time and at lower cost, without prototyping.

Artificial intelligence (AI) is a technology that enables computers and machines to simulate human learning, understanding, problem solving, decision making, creativity and autonomy (IBM). (Slama, 2022) highlighted the dual role that AI can play in the field of DT: reconstruction and application of a model.

Model reconstruction refers to the creation of a virtual representation based on raw data obtained from sensors. Digital twins rely on large quantities of collected data that are often incomplete, noisy and come in different formats and standards. The effective integration and analysis of this data, particularly in real time, is a major challenge. AI, with advanced data processing algorithms, is capable of processing complex models that create data-rich simulations.

The application involves the use of AI algorithms to optimise performance and support various objectives once the DT has been reconstructed. Using advanced data processing and analysis algorithms such as neural networks, AI can identify trends, anomalies and potential disruptions in real time, enabling faster decision making and intervention.

The consideration of the human aspect in a DT is an important issue. Human behaviour is integrated into this system with different roles: end users, knowledge and data producers, system integrators and evaluators/decision-makers. Each can be considered an expert in their field. As a result, evaluating the performance of a DT must go beyond a simple operational assessment of how well it works, and focus on how well it meets the needs of its users, understood in the broadest sense.

The assessment of the use of AI must be complete and integrate the operational aspects (good prediction), the organisational aspects of good integration into the processes and the functional aspects of good response to the needs of the users in the system. In addition, the assessment must also evaluate the environmental aspects, starting with the resource and energy consumption of the quantified production process and the AI system implemented. This assessment then sets out the sustainability of the AI system in terms of the environmental, societal and economic issues it covers.

INDUSTRIAL CONTEXT:

The IMS (Intégration du Matériau au Système) laboratory at the University of Bordeaux has joined forces with ITERG (Institut des corps gras et produits apparentés), an industrial technical centre, to set up a Joint Technology Unit (UMT) to develop the Digital Twin and AI in the subsidiary of producers/processors of fats (vegetable oils).

Over the last few years, digitalisation has played an important role in the industrial world. Many industrial groups want to enter the Industry 4.0 era. The UMT's long-term objective (5 years) is to create a digital twin of the factory, based on process and analytical data, which will take continuous improvement in this area to the next level. The improvements targeted by the UMT concern industrial processes involved in the processing and manufacture of vegetable oils extracted and refined from seeds and fruit.

Scientific question: how can the model of a DT be reconstructed and applied using AI, particularly in the context of the agri-food industry?

INTERNSHIP'S OBJECTIF :

The internship will take place in several structured stages, each aimed at developing the skills necessary to achieve the objectives.

1. Review of scientific literature

Conduct an in-depth literature review to build a mapping of application cases and technologies, practices or functionalities of AI-augmented digital twins in the general case and in the context of the agri-food industry in particular. This step will include:

- The identification and classification of practices, technologies and methods commonly used in the field.
- A comparative analysis of the approaches used, with a focus on the purposes (multi-criteria decision, optimization, simulation, etc.).
- The production of a synthetic mapping of relevant technologies and practices linked to UMT.

2. Analysis of industrial context

Study the specific context of ITERG for:

- Understand the technical and operational objectives.
- Identify solutions in line with the state of the art, in order to define a suitable digital twin model.
- Perform an analysis on the available (or necessary) data, while considering the methods of processing and exploiting this data.

3. Proof of concept

Design and test an AI-augmented digital twin prototype based on simulated data or real data from an ITERG case study. This phase will include:

- The development and testing of a first functional version of the prototype.
- The evaluation of feasibility, maintenance and performance to validate the model capabilities.

References:

Julien, N., & Martin, E. (2020). Le Jumeau Numerique: De L'intelligence Artificielle a L'industrie Agile. Dunod.

Slama, D. (2023). Rollout and go-to-market. In The Digital Playbook: A Practitioner's Guide to Smart, Connected Products and Solutions with AIoT. https://doi.org/10.1007/978-3-030-88221-1_15

https://www.ibm.com/fr-fr/topics/artificial-intelligence, consulté 22 octobre 2024

CANDIDATE PROFILE: Master 2 or 3rd year engineering student with an applied computing or industrial engineering background

Knowledge:

- Solid knowledge of the application of applied mathematics and data science in manufacturing.

- Good knowledge of AI and machine learning is required, particularly in R/Python

- Experience of programming in Java / Anylogic is a PLUS

Skills:

- Ability to organise, plan and prioritise tasks

- Ability to communicate and write up scientific results

- This work could be promoted through communication activities, writing articles for scientific journals or scientific conferences.

- Being autonomous in work organization

INTERNSHIP TERMS AND CONDITIONS :

Duration: 5-6 months from February/March 2025

Workplace : Laboratoire IMS – groupe Productique, 351 Cours de la Libération, 33405 Talence Cedex, France

Remuneration: 4,35 euros net/hour, 35 hours per week (~609 euros net per month)

CONTACT : Send CV, cover letter and M1/M2 transcripts to minh-phuoc.doan@ims-bordeaux.fr, simon.gorecki@ims-bordeaux.fr