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Challenges to AIML in Industry 4.0 applications

AI and ML have achieved remarkable success in public applications that are based on language, vision, and speech recognition. However, their implementation in industrial applications remains challenging. This presentation exposes the main challenges facing the implementing of AI-ML in real industrial settings. The first challenge is data readiness. Industrial data is often fragmented across multiple sources. They are often unstructured and not aligned with the operational objectives of AI-ML modeling. They are not enough in volume and contain imbalances in which rare but critical events are underrepresented. The second challenge lies in the need to understand the underlying industrial processes before using AI-ML. The physics that control these processes need to be known, thus the necessity of multidisciplinary collaboration that combines domain expertise, data engineering, communication network engineering and AI expertise. The third challenge is the necessity of creating a digital twin for each equipment. This entails a bidirectional exchange of knowledge that needs high velocity. Our methodology for addressing these issues has been shaped across projects in aerospace, oil and gas, mining, transportation, and manufacturing. Our solutions included augmenting underrepresented data, designing architectures that combine multiple perspectives on system behavior, and developing AI-ML solutions that respect the physics and the dynamics of industrial systems. In each case, success was possible because of the composition of a multidisciplinary team that included the domain expertise who guided the choice of state representations, reward/loss functions, and feature engineering. These experiences highlight the need for AI-ML algorithms that are specifically tailored to industrial applications. We also recommend that organizations pursuing Industry 4.0 initiatives to (1) invest in data collection and quality improvement, (2) embed domain expertise into every stage of AI design, and implementation and (3) encourage multidisciplinary teamwork to ensure that solutions are feasible and operationally relevant.

Keywords
Industry 4.0, Artificiel Intelligence, Machine Learning

Biography
Soumaya Yacout is Professor in the Department of Mathematics and Industrial Engineering at Polytechnique Montreal in Canada. She is also the owner, President and CEO of DEXIN Inc. She earned her doctoral degree in Operations Research, her bachelor's in mechanical engineering and her master's in industrial engineering. She designed and taught courses on quality engineering, reliability and maintenance, and discrete event simulation. Her main research is in the analytics of faults and maintenance. She has publications in peer-reviewed journals including Quality Engineering, International Journal of Production Research, Computers and Industrial Engineering, IEEE Transactions, Journal of Intelligent Manufacturing, Expert Systems with Applications, and papers in international conferences, some of which received the best paper award. She is the co-editor and the co-writer of a book on minimal repair and interoperability. She has a patent on data-driven maintenance with machine learning.

doi.org/10.51219/URForum.2025.Soumaya-Yacout ISBN: 978-1-917892-34-6