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Special session on:

Data-Driven Algorithms for Online Optimization in Smart Manufacturing

Proposed by:

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Aim and content of the invited session:

The rapid advancement of technologies, such as IoT, data analytics, and cyber-physical systems, has led to the rapid transformation of production landscapes toward smart manufacturing [1]. This transformation brings new challenges to optimization in manufacturing environments, where decision-making needs to be highly dynamic, adaptive, and data-driven. Statistical modeling and advanced data analytics techniques are becoming increasingly crucial in extracting actionable insights from the complex, high-dimensional data generated in smart manufacturing processes [2]. Traditional optimization techniques, including classical heuristics and meta-heuristics, often face limitations when applied to these dynamic and online problems due to their inability to quickly adapt to changing conditions and continuously evolving data streams [3]. As a result, there is a crucial need for innovative optimization approaches that are specifically tailored to the online and dynamic nature of these environments and can effectively handle the complexities and uncertainties inherent in smart manufacturing systems [4].

To address these challenges, there is an increasing shift towards data-driven optimization algorithms that can leverage the vast amounts of data generated by smart manufacturing systems. Advanced statistical modeling techniques can uncover complex patterns and relationships within the data. Machine learning approaches, particularly Reinforcement Learning (RL) and Deep Reinforcement Learning (DRL), offer powerful tools for online optimization in smart manufacturing. These algorithms can continuously learn from streaming data, make rapid adjustments to optimization strategies, and improve decision-making over time.

The integration of data-driven algorithms and advanced analytics in smart manufacturing not only enhances the ability to solve online optimization problems but also contributes to building intelligent systems that improve continuously. These methods can provide a competitive edge by enabling more efficient production planning, optimizing resource use, reducing downtime, and enhancing overall system resilience.

This special session on "Data-Driven Algorithms for Online Optimization in Smart Manufacturing" aims to share the latest advances in data-driven optimization algorithms and statistical modeling techniques designed for smart manufacturing. In particular, we are interested in methodologies that leverage real-time data to make rapid, informed decisions in complex, dynamic environments.

Topics of Interest

We invite high-quality submissions that address innovative data-driven optimization methods and applications related to dynamic and online problems in smart manufacturing. Potential topics of interest include, but are not limited to:

- Real-time decision-making and control in smart manufacturing environments.
- Dynamic resource allocation, scheduling, and routing in manufacturing systems.
- Real-time resource allocation in personalized manufacturing.
- Real-time human-machine collaboration for enhanced decision making in smart manufacturing.
- Online optimization for predictive maintenance and quality control.

- Applications of game theory, mathematical programming, and robust optimization in online manufacturing.
- Adaptive and evolving optimization algorithms for continuous production environments.
- Data-driven and model-based approaches to online optimization beyond traditional machine learning paradigms.
- Statistical modeling and data analytics for real-time decision-making in smart manufacturing.
- Exploratory data analytics for complex manufacturing processes.
- Optimization under uncertainty with dynamic constraints/objectives in smart manufacturing.

- [1]. Kusiak, A. (2018). Smart manufacturing. *International journal of production Research*, 56(1-2), 508-517.
- [2]. van Kollenburg, G. et al. (2023) Modeling Multivariate Relations in Multiblock Semiconductor Manufacturing Data Using Process PLS To Enhance Process Understanding. In *2023 Winter Simulation Conference*. 2333-2344
- [3]. Karimi-Mamaghan, M., Mohammadi, M., Meyer, P., Karimi-Mamaghan, A. M., & Talbi, E. G. (2022). Machine Learning at the service of Meta-heuristics for solving Combinatorial Optimization Problems: A state-of-the-art. *European Journal of Operational Research*, 296(2), 393-422.
- [4]. Nielsen, I., Dang, Q. V., Bocewicz, G., & Banaszak, Z. (2017). A methodology for implementation of mobile robot in adaptive manufacturing environments. *Journal of intelligent manufacturing*, 28, 1171-1188.