G-SCOP
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Titre de la thèse : Enhancing Robust Optimization in Industry 4.0 Manufacturing Scheduling by integrating Machine Learning to Traditional Optimization Techniques

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Description du sujet :

The field of Operations Research (OR) has been used extensively in various applications such as manufacturing shop scheduling, supply chain optimization, carbon emission reduction, etc. However, traditional OR techniques such as exact methods (e.g., Branch and Bound) can be time-consuming when applied to complex and large-scale problems. More importantly, these methods are not always suitable for real-world scenarios where decisions need to be made quickly to respond to unexpected changes in the environment, as required by Industry 4.0. To address this challenge, machine learning (ML) techniques can be integrated with optimization approaches to enhance their efficiency and robustness.

The objective of this thesis is to explore the use of ML to improve traditional optimization techniques for robust optimization in the context of Industry 4.0. Specifically, we will investigate the integration of ML and OR methods (such as Branch & Bound) for dynamic scheduling, where scheduling decisions need to be made in real-time to respond to unplanned events. However, the effectiveness of ML techniques depends on the availability and consistency of data. Therefore, we will explore the use of artificial simulation data to generate smart data that can be used in exact OR methods. This will ensure timely constraint satisfaction while optimizing performance.

We will begin by conducting a literature review on the combination of traditional optimization techniques and ML-based optimization techniques in the context of industry 4.0. Then, we will propose a combination approach that leverages ML to enhance OR methods such as Branch & Bound. The results of this study will provide valuable insights into the potential of using ML to improve OR techniques for robust optimization in the context of Industry 4.0. The proposed approach can be applied to other real-world optimization problems (such as inventory

management, carbon emission reduction, vehicle rooting problems, etc.), not just in manufacturing scheduling.

Overall, this thesis aims to provide a comprehensive investigation into the use of ML to improve traditional optimization techniques for robust optimization, with a specific focus on manufacturing scheduling. The practical implications of this study will be beneficial for decision-makers in the manufacturing industry, leading to significant cost savings and increased efficiency.

Some sources:

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Seeger, P. M., Yahouni, Z., & Alpan, G. (2022). Literature review on using data mining in production planning and scheduling within the context of cyber physical systems. *Journal of Industrial Information Integration, 6*(1), 100371.

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