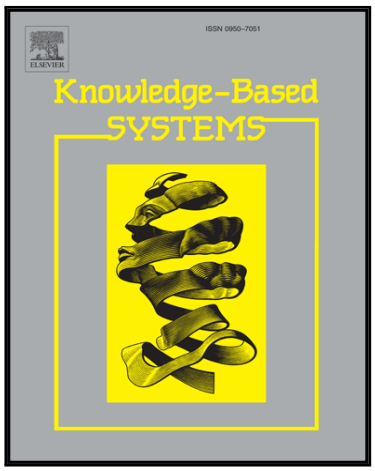

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A Prediction-based Online Soft Scheduling Algorithm for the Real-World Steelmaking-Continuous Casting Production

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Highlights

- An uncertain SCC scheduling problem arising from steelmaking industry is studied.
- A soft schedule that consists of critical decisions and characteristic indexes is introduced.
- A prediction-based online soft scheduling algorithm is proposed to solve this problem.
- A surrogate model predicts characteristic indexes with trade-off between cost and penalty.
- An e event-triggered dynamic optimization algorithm is proposed to obtain entire soft schedule.
- A heuristic method is proposed for dispatching jobs in real time.

Abstract: Optimal scheduling of steelmaking production contributes to boosting productivity, reducing costs and achieving sustainable manufacturing for an integrated steel company. However, the optimal schedule is always difficult to implement in the real-world production system, because its optimality and feasibility are affected by various uncertain factors. In this paper, we study an uncertain scheduling problem arising from the steelmaking-continuous casting (SCC) production process which considers the cost and penalty objectives. To solve this problem, we propose a prediction-based online soft scheduling (OLSS) algorithm which belongs to predictive-reactive approach. In the proposed algorithm, a surrogate model named Gaussian process regression (GPR) is used to predict the characteristic index, slack ratio, which is able to trade off the objectives between the cost and the penalty of cast-breaks. When new batches are released to the shop floor, the soft schedule including critical decisions and characteristic indexes is determined by a dynamic optimization algorithm based on the predicted value. In the reactive phase, a heuristic method is presented to determine other non-critical decisions. Finally, the computational results show that the OLSS outperforms other algorithms in penalty objective, and obtains approximate effects in cost objective.

Keywords: scheduling, uncertainty modelling, GPR, and steelmaking

1. Introduction

Steel consumption is an important indicator for measuring economic development, because the steel industry lays the ground for other important industries, such as the automobile, shipbuilding, construction, military industries and so on. The process flow of the modern steel industry can be divided into three production systems (as shown in **Fig.1**): ironmaking, steelmaking-continuous casting (SCC), and hot rolling (HR). Specifically, the SCC production system is the most important component but also the bottleneck of the steel industry. It receives high temperature liquid iron from

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