Batch Scheduling with Compatible Families and Setups: Enhanced MILP Formulations

Annalisa Castelletti[1,*], Renata Mansini[1], and Lorenzo Moreschini[2]

[1]Department of Information Engineering, University of Brescia, Brescia, Italy
[2]Department of Design, Polytechnic of Milan, Milan, Italy
[*]Corresponding author

Motivated by an industrial application in scraps melting, this study addresses a scheduling problem on a single batch-processing machine with limited capacity, where jobs correspond to heterogeneous scraps to be melted. Jobs must be assigned to batches and processed simultaneously minimizing the overall makespan. The duration of each batch is determined by its dominant job (the one with the longest processing time), while sequence-dependent setup times arise from transitions between dominant families of consecutive batches, defined as those with the highest melting-temperature requirement within each batch. We strengthen the MILP formulation introduced in [1] by presenting alternative decision variables that more explicitly capture batch composition and sequencing, together with new classes of valid inequalities that tighten the linear relaxation and reinforce the modeling of dominance and setup interactions. Preliminary computational experiments confirm the effectiveness of the proposed improvements and provide a performance comparison with the original formulation.

Keywords. Discrete and Combinatorial Optimization – Industrial Production – Scheduling and Timetabling.

References

[1] Annalisa Castelletti, Renata Mansini, and Lorenzo Moreschini. A new parallel-batch scheduling problem with non-identical jobs, compatible families, and setup times. *IFAC-PapersOnLine*, 59(10):1023–1028, 2025.