Algorithms For Solving The Job Rotation Problem With Heterogeneous Workers

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This study addresses the problem of assembly line balancing and worker assignment in job rotation scenarios (JRALWABP). The problem considers workers with heterogeneous capabilities for task execution. The objective is to maximize the number of distinct tasks performed by each worker and to minimize the average cycle time across all periods, subject to task precedence constraints. Initially, we evaluated two exact mixed-integer programming formulations (Models M1 and M2), considering the average cycle time as a constraint. Although these formulations were helpful as a reference, they proved infeasible for larger instances, highlighting the need for robust heuristics. In this context, we developed a strategy called HAJR2, which enhances the existing hybrid algorithm (HAJR1) through an iterative process that interleaves heuristics such as GRASP, Tabu Search, and a Genetic Algorithm, along with the introduction of the Pattern Injection Local Search (PILS) heuristic. The parameters of both the Tabu Search and Genetic Algorithm were tuned using Irace, and their execution was based on the same experimental setup, ensuring fair comparisons. Experiments on four instance families demonstrated that HAJR2 outperforms HAJR1 by increasing the average variety of tasks assigned without affecting the cycle time, and it proves more resilient in instances with a high task/worker incompatibility rate. This work refines the state of the art in heterogeneous worker job rotation scheduling, offering a practical and extensible foundation for real-world applications in assembly lines.

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