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An improved multi-objective Wild Horse optimization for the dual-resource-constrained flexible job shop scheduling problem: A comparative analysis with NSGA-II and a real case study

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ABSTRACT

The equipment manufacturing industry needs skilled workers to operate a specific set of machines following process specifications. Optimizing machine and worker assignments to achieve maximum efficiency is a critical problem for workshop managers. This paper investigates a multi-objective dual-resource-constrained flexible job shop scheduling problem. An improved wild horse optimization (IWHO) algorithm is developed to simultaneously optimize three objectives: makespan, maximum machine workload, and total machine workload. To evaluate the quality of individuals in multi-objective optimization, the Pareto fast non-dominated sorting method is used, and the crowding distance is calculated. To update the algorithm's solution, the crossover and mutation operations are used. Further, a local neighborhood search strategy is employed to enhance searchability and avoid trapping into the local optima. The benchmark of the flexible job shop scheduling problem is extended to create test instances, and the performance of the suggested IWHO algorithm is evaluated compared with the NSGA-II. The computational results show that the IWHO algorithm provides a non-dominated efficient set within a reasonable running time. Furthermore, a buffers and chain coupler assembly process is designed to analyze the practical value of the IWHO algorithm. The proposed solutions can be used to generate daily schedules for managing machines, workers, and production cycles.

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