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Genetic algorithm-based approach for makespan minimization in a flow shop with queue time limits and skipping jobs

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ABSTRACT

This study investigates a flow shop scheduling problem with queue time limits and skipping jobs, which are common scheduling requirements for semiconductor and printed circuit board manufacturing systems. These manufacturing systems involve the most complex processes, which are strictly controlled and constrained to manufacture high-quality products and satisfy dynamic customer orders. Further, queue times between consecutive stages are limited. Given that the queue times are limited, jobs must begin the next step within the maximum queue time after the jobs in the previous step are completed. In the considered flow shop, several jobs can skip the first step, referred to as skipping jobs. Skipping jobs exist because of multiple types of products processed in the same flow shop. For the considered flow shop, this paper proposes a mathematical programming formulation and a genetic algorithm to minimize the makespan. The GA demonstrated its strengths through comprehensive computational experiments, demonstrating its effectiveness and efficiency. As the problem size increased, the GA's performance improved noticeably, while maintaining acceptable computation times for real-world fab facilities. We also validated its performance in various scenarios involving queue time limits and skipping jobs, to further emphasize its capabilities.

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