Unit-Based Metaheuristics for Optimal Multipurpose Batch Plant Scheduling

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Abstract. The paper studies the scheduling challenge in multipurpose batch chemical production plants. The study focuses on advancing the efficiency of genetic algorithms in solving schedules for medium-to-long-term time horizon production. Current global-based approaches have excessively high dimensional chromosome representations for these scheduling problems. The paper proposes shifting from a global-based to a unit-based event point chromosome representation. The new unit-based representation exploits further characteristics of batch scheduling problems to reduce the intrinsic dimensionality of the problem. The investigation aims to reduce the problem's dimensionality and, in so doing, further streamline the scheduling process. The analysis compares state-of-the-art (SOTA) genetic algorithm unit-based approaches against two new global-based approaches. The study compares these algorithms using three well-known literature examples through extensive experimentation. The new models are tested in profit maximisation scenarios, showcasing several advantages, including reduced dimensionality, faster computation times, and improved accuracy. Results indicate a significant improvement in computational efficiency compared to established methods. This paper contributes to the ongoing research in this field by proposing a more effective scheduling tool for multipurpose batch plants, suggesting unit-based approaches as promising avenues for future investigations.

Keywords: Metaheuristics · Genetic Algorithms · Batch Process Scheduling