

New Hybrid Parallel Algorithm for Variable-sized Batch Splitting Scheduling with Alternative Machines in Job Shops

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Abstract: The batch splitting scheduling problem has recently become a major target in manufacturing systems, and the researchers have obtained great achievements, whereas most of existing related researches focus on equal-sized and consistent-sized batch splitting scheduling problem, and solve the problem by fixing the number of sub-batches, or the sub-batch sizes, or both. Under such circumstance and to provide a practical method for production scheduling in batch production mode, a study was made on the batch splitting scheduling problem on alternative machines, based on the objective to minimize the makespan. A scheduling approach was presented to address the variable-sized batch splitting scheduling problem in job shops trying to optimize both the number of sub-batches and the sub-batch sizes, based on differential evolution (DE), making full use of the finding that the sum of values of genes in one chromosome remains the same before and after mutation in DE. With considering before-arrival set-up time and processing time separately, a variable-sized batch splitting scheduling model was established and a new hybrid algorithm was brought forward to solve both the batch splitting problem and the batch scheduling problem. A new parallel chromosome representation was adopted, and the batch scheduling chromosome and the batch splitting chromosome were treated separately during the global search procedure, based on self-adaptive DE and genetic crossover operator, respectively. A new local search method was further designed to gain a better performance. A solution consists of the optimum number of sub-batches for each operation per job, the optimum batch size for each sub-batch and the optimum sequence of sub-batches. Computational experiments of four test instances and a realistic problem in a speaker workshop were performed to testify the effectiveness of the proposed scheduling method. The study takes advantage of DE's distinctive feature, and employs the algorithm as a solution approach, and thereby deepens and enriches the content of batch splitting scheduling.

Key words: variable-sized batch splitting, differential evolution, alternative machines, local search

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