論 文 の 要 旨

題　目　Efficient Scheduling for Production Systems with Alternative Machines
Using Genetic Algorithm Incorporating Effective Knowledge

（効果的な知識を組み込んだ遺伝的アルゴリズムによる
代替機械を有する生産システムのための高性能スケジューリング）

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Production scheduling is a decision making of allocating production resources to operations of jobs over time. The goal of production scheduling is to meet customer's needs with operating available resources in the most cost-efficient manner. Production systems in the real world manufacturing have various configurations. Flow shop and job shop type production systems are the most typical and important production systems. If an operation can be processed on multiple machines, they are referred to as flexible flow shop and flexible job shop. The scheduling problems for these production systems belong to NP-hard class and are known to be notoriously difficult to solve optimally. Therefore, heuristics and meta-heuristics are prominent approaches to solve the practical scale scheduling for these production systems. Heuristic is based on problem-specific knowledge and has advantage in calculation time. Priority or dispatching rules are the most used heuristics in scheduling. Genetic algorithm is one of the typical meta-heuristics used in scheduling and outperforms single heuristic if a certain amount of calculation time is allowed. However, there is room for improvement since genetic algorithm itself is a general approach without using domain-specific knowledge. The goal of this study is to develop efficient scheduling methods for the scheduling problems with alternative machines using genetic algorithm incorporating effective problem-specific knowledge. The content of dissertation is summarized as follow:

Chapter 1 describes the introduction of production scheduling including the background, the objective of dissertation, and literature review.

Chapter 2 demonstrates the efficiency of genetic algorithm incorporating local search, which is also called memetic algorithm. This section deals with flexible flow shop. Hill climbing in which new solution is searched using swapping two genes in a chromosome is adopted as a local search. Numerical experiments showed that incorporating the local search improves the performance of genetic algorithm. However, a genetic algorithm based on random key coding performed better than that of the memetic algorithm when the scale of the problems is large.

Chapter 3 focuses on flexible job shop scheduling problems using a random key coding based genetic algorithm incorporating heuristic rules. Five job selection rules and five machine selection rules were examined as heuristics for incorporation into the GA. Numerical experiments show that the combination of the (SL/RPN)+SPT rule for job selection and the (WINQ+RPT+PT)×PT rule for machine selection performs best for minimizing the mean tardiness of jobs in various conditions. Numerical experiments also show that applying the GA only to job selection or machine selection performs better than applying the GA both to job and machine selection.

Subsequently, chapter 4 investigates the effectiveness of due-date related information in heuristic rules incorporated into the genetic algorithm. Machine selection rules for flexible job shop scheduling problem are considered. Numerical results suggest that it is not necessary to include due-date related information in machine selection if the due-date related information is considered in job selection and load balancing is considered in machine selection appropriately.

Finally, the chapter 5 mentions the overall conclusions of the dissertation.