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A GENETIC ALGORITHM ENHANCED BY DOMINANCE PROPERTIES FOR SINGLE MACHINE SCHEDULING PROBLEMS WITH SETUP COSTS

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Abstract. *This paper considers a single machine scheduling problem in which n jobs are to be processed and a machine setup time is required when the machine switches jobs from one to the other. All jobs have a common due date that has been predetermined using the median of the set of sequenced jobs. The objective is to find an optimal sequence of the set of n jobs to minimize the sum of the job's setups and the cost of tardy or early jobs related to the common due date. In this research, dominance properties are developed by swapping the neighborhood jobs. The time complexity of the dominance properties is in $O(n^2)$ and it is very efficient when combined with the GA. To prevent earlier convergence of a Simple Genetic Algorithm (SGA), these dominance properties are further embedded in SGA to improve the efficiency and effectiveness of the global searching procedure. Analytical results in benchmark problems are presented and the computational algorithms are developed.*

1. Introduction.

Single-machine scheduling problems are one of the well-studied problems by many researchers. The application of single machine scheduling with setups can be found in minimizing the cycle time for pick and place (PAP) operations in Printed Circuit Board manufacturing company [24]; in a steel wire factory in China [22] and a sequencing problem in the weaving industry [2]. The results developed in the literature not only provide the insights into the single machine problem but also for more complicated environment such as flow shop or job shop.

The problem considered in this paper is to schedule a set of n jobs $\{j_1, j_2, \cdots, j_n\}$ on a single machine that is capable of processing only one job at a time without preemption. As explained in [6,30], all jobs are available at time zero, and a job j requires a processing time P_j. Job j belongs to a group $g_j \in \{1, \ldots, q\}$ (with $q \le n$). Setup or changeover times, which are given as two $q \times q$ matrices, are associated to these groups. This means that in a schedule where j_j is processed immediately after j_i where $i, j \in \{1, 2, \cdots, n\}$, there must be a setup time of at least S_{ij} time units between the completion time of j_i, denoted by C_i, and the start time of j_j, which is $C_j - P_j$. During this setup period, no other task can be performed by the machine and we assume that the cost of the setup operation is $c(g_i; g_j) \ge 0$ and let it be equal to Machine setup time S_{ij} which is included as sequence dependent. The objective is to complete all the jobs as close as possible to a