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SOLVING LARGE MULTILEVEL LOT-SIZING PROBLEMS WITH A SIMPLE HEURISTIC ALGORITHM BASED ON SEGMENTATION

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Abstract. *We have developed an effective heuristic algorithm based on a soft optimization approach for solving multilevel lot-sizing problems in a series assembly product structure [1,2]. The algorithm segments the solution space and directs searching in a direction where better solutions may exist, using the solution structure information of the multilevel lot-sizing problem, thus improving performance. We extend the algorithm to the general case of the multilevel lot-sizing problem with time-invariant cost structures and no restriction on product structure. Simulation experiments with the new algorithm and a genetic algorithm developed using the same considerations as in [3,4] but different implementations show the new algorithm to be effective.*
Keywords: Multilevel lot-sizing problem, Segmentation, Heuristics, Soft optimization approach, Genetic algorithm

1. Introduction.

The multilevel lot-sizing (MLLS) problem concerns how to determine the lot size for producing or procuring an item at each level so as to minimize the total costs of production setup and inventory holding. The problem plays an important role in the efficient operation of modern manufacturing and assembly processes. Optimal solution algorithms exist for the problem; however, only small instances can be solved in reasonable computational time because the problem is NP-hard [5]. Several researchers have developed optimization formulations and algorithms to solve variants of the MLLS problem. Early dynamic programming formulations used a network representation of the problem with a series structure [6,7] and an assembly structure [8]. Other approaches involve branch and bound algorithms [9,10] that use a converting approach to change the classical formulation of the general structure into a simple but expanded assembly structure.

As the MLLS problem is so common in practice, many heuristic approaches have also been developed, consisting first of the sequential application of single-level lot-sizing models to each component of the product structure [11,12], and later, the application of multilevel lot-sizing models. The multilevel models quantify item interdependencies and thus perform better than single-level models [13-15].

Recently, so-called metaheuristic algorithms have been developed to solve combination optimization problems defined in various applicable fields (for example, particle swarm optimization [16-18], genetic algorithm [19-21] and simulated annealing [22]). Also, several methods have been proposed to solve the MLLS problem with a low computational load