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A GA-PSO LAYERED ENCODING EVOLUTIONARY APPROACH TO 0/1 KNAPSACK OPTIMIZATION

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Abstract. *This paper presents a layered encoding cascade evolutionary approach to solve a 0/1 knapsack optimization problem. A layered encoding structure is proposed and developed based on the schema theorem and the concepts of cascade correlation and multi-population evolutionary algorithms. Genetic algorithm (GA) and particle swarm optimization (PSO) are combined with the proposed layered encoding structure to form a generic optimization model denoted as LGAPSO. In order to enhance the finding of both local and global optimum in the evolutionary search, the model adopts hill climbing evaluation criteria, feature of strength Pareto evolutionary approach (SPEA) as well as nondominated spread lengthen criteria. Four different sizes benchmark knapsack problems are studied using the proposed LGAPSO model. The performance of LGAPSO is compared to that of the ordinary multi-objective optimizers such as VEGA, NSGA, NPGA and SPEA. The proposed LGAPSO model is shown to be efficient in improving the search of knapsack's optimum, capable of gaining better Pareto trade-off front.*
Keywords: Genetic algorithm, Particle swarm optimization, Layered encoding, Multi-objective, Knapsack

1. **Introduction.** Knapsack problems have been studied intensively from the past decades [1-5]. Theoretical research interest mainly begins with the knapsack structure that allows the exploitation of a number of combinatorial properties [6]. The proven NP-complete nature of knapsack problem and its applicability to practical use such as capital budgeting and cargo loading have brought to the increase of research attention. The 0/1 knapsack problem has been a classical case study to evaluate and compare the performance of a developed optimizer or algorithm [7-9]. Knapsack problem has extremely large search space and is difficult to solve [10]. According to [9], due to the knapsack exponential complexity, solving knapsack problem can be seen as a way of solving large problem in number theory. Due to the popularity and practical importance of knapsack problem, the 0/1 multi-objective knapsack benchmark case study is used to assess the performance of the proposed LGAPSO model.

Many real world problems involve simultaneous optimizations of several conflicting objectives that make the finding of trade-off solutions difficult. In principle, the trade-off solutions are defined as the Pareto optimal set in which no other feasible solution that