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A NEW RANK-BASED ANT SYSTEM USING DIFFERENT SENSITIVE ANTS

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Abstract. *Recently, ant colony optimization (ACO), a new metaheuristic method inspired by the cooperative food retrieval of ants, has been successful in solving many combinatorial optimization problems. However, most ACO methods have the drawback of controlling the diversification of the search process. In this paper, we propose a new ACO method by improving the rank-based ant system, which uses different sensitive ants to the pheromone trail to keep the diversity of obtained solutions. Some ants select a path in the standard way among available paths, which means that they tend to select a path with a large amount of pheromone trail, some ants tend to select a path with a small amount of pheromone trail, and the others always select a path at random. In addition, this method selects solutions for the ranking list according not only to the tour length but also to the difference between each solution and the iteration-best one at each iteration. Some numerical experiments show that the proposed method can effectively find better solutions than existing methods.*

Keywords: Ant colony optimization, Diversification, Traveling salesman problem, Sensitivities of ants, Ranking method

1. **Introduction.** Recently, many metaheuristic methods based on the swarm intelligence such as genetic algorithm (GA) [1, 2], ant colony optimization (ACO) [3-19] and particle swarm optimization (PSO)[20-23] have been proposed to solve combinatorial optimization problems. Those methods make use of techniques inspired by the collective behavior in social creatures. In ACO, artificial ants of a colony independently search for solutions by communicating with each other through pheromone trails which are updated on the basis of obtained tentative solutions. The method has been successfully applied to many problems such as the routing problem (traveling salesman problem, network routing and vehicle routing), the assignment problem (quadratic assignment problem, graph coloring and generalized assignment problem) and the scheduling problem [3, 8, 10].

Since the first model of ACO called the ant system (AS) was proposed by Dorigo et al. [9], ACO method has been investigated and improved by various ideas [10]. However, most of them tend to be trapped at an undesirable local minimum. In order to overcome the drawback, the $MAX - MIN$ ant system has been proposed and its capability to avoid the search stagnation [16] has been shown. The method uses only the best so-far or iteration-best solution to update the pheromone trails, and imposes the bound on the pheromone trail to decrease the difference among them. It is reported that this method is more effective than other existing ACO methods. However, it does not so effectively make use of the diversity of solutions obtained at each iteration, which is the benefit of the population based method.