AGENT BASED DECISION MAKING SYSTEM FOR VRSD-PROBLEMS

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Abstract

Truck Dispatch and Delivery Problems (TDDP) is widely observed in our everyday life. The TDDP is a complex combinatorial optimization problem, in which the computational cost increases exponentially with the problem size. Therefore, it is extremely difficult to find an optimal solution in practical computational time. Consequently, for finding a (sub-)optimal solution, Simulated Annealing (SA), Genetic Algorithm (GA), Tabu Search (TS), and other methods have been recently proposed [1][2][3][4]. In Japan as well, since the 90’s, research related to the TDDP has been expanding, with representative examples being [5]. Igarashi et al. [5] propose an SA-based method and apply it to a real-world TDDP. The disadvantages of that method, however, are: (i) it needs manual setting of numerous weights corresponding to the components of the evaluation function, which is difficult for an inexperienced user; and (ii) it has a high computational cost, required to find a (sub-)optimal solution. Chen et al. [6] propose a Hierarchical Multiplex Structure (HIMS) computational model, and introduce the normalization of the components of the evaluation function, to simplify the setting of the corresponding weights. The evaluation function of the HIMS model, however, depends on the initial state of its components, which is able to have a negative effect on the quality of the obtained (sub-)optimal solution. Furthermore, for the TDDP, the components of the evaluation function, i.e., the evaluation criteria (e.g., running cost, loading ratio) are mutually conflicting, in a sense that the running cost should be minimized and, at the same time, the loading ratio should be maximized. With such evaluation criteria, it is difficult for a designer of a real-world application to set the corresponding weights, in a way that reflects the designer’s intention.

To overcome these issues, a method for solving real-world multi-objective TDDP is proposed, as described in the following. First, based on the concept of the fuzzy neighborhood degree [7], an integrated evaluation criterion is proposed. It has the following three characteristics: (i) each individual evaluation criterion is evaluated in the same [0, 1] interval, making the weight setting easier; (ii) based on the value of the integrated evaluation criterion, the quality of the solution of a TDDP can be estimated; and (iii) unlike the normalization method [6], the initial values of the individual evaluation criteria are not used, implying that the proposed integrated evaluation criterion does not depend on the initial state of its components.

Furthermore, in order to efficiently find a (sub-)optimal solution of a TDDP, a two stages heuristics search algorithm is proposed. The proposed method is (i) an SA-based method for finding a (sub-)optimal route for each vehicle; and (ii) an evolutionary computation (EC)-based method for finding a (sub-)optimal schedule for a group of vehicles. In this way by unifying the guaranteed convergence characteristics of the SA, with the fast computation characteristics of the EC the proposed method has the potential to efficiently find a high-quality solution. In addition, the TDDP is formulated from the viewpoint of real-world applications, and the support system for truck delivery and dispatch is implemented on a personal computer. The efficiency of the proposed integrated evaluation criterion and the proposed two stages heuristics search algorithm is demonstrated through experiments involving a real-world TDDP. This problem consists in delivering food products to a chain of 46 convenience stores located in Saitama prefecture, Japan.

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