

A Study of Urgency Vehicle Routing Disruption Management Problem

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Abstract—If a transit vehicle breaks down on a schedule trip, there are some vehicles in the system need to serve this trip and the former plan must be changed. For solving the urgency vehicle routing problem with disruption that may be vehicle breakdowns or traffic accidents in the logistics distribution system, through the analysis of the problem and the disruption measurement, the mathematics model is given based on the thought of disruption management. For the characteristics of the problem, a Lagrangian relaxation is given to simplify the model, and decompose the problem into two parts. The Lagrangian multiplier is given by subgradient method and the subproblems are solved by saving approach to gain the initial solution. A fast insertion algorithm is given to obtain a feasible solution for the primal problem. The results show that the algorithm designed in this paper performs very well for solving the urgency vehicle routing disruption management problem.

Index Terms—urgency vehicle scheduling problem; disruption management; Lagrangian heuristic; saving approach; insertion algorithm

I. INTRODUCTION

With the swift and dynamic development of information transmission and internet, the convenient e-commerce mode is being accepted gradually. Compared with the information flow and cash flow which are rapid and efficient, the efficiency of the logistics in e-commerce mode becomes the key of the high speed cycling of trading and the convenience for the customers. And the logistics distribution is always disrupted by some events. When such disruption happens, the allocation of

the vehicles within relative limited transport capacity becomes a problem to be solved. Vehicle routing problem is well-known as a NP hard problem. And the problem in this study which is VRP with vehicles breaks down is even. So it is necessary to give a solution which will cover benefits of all costumers, goods providers and logistics companies.

The idea[1-2] of disruption management is such an optimization thought which benefits of all costumers, goods providers and logistics companies will be considered synthetically. This theory has been adopted in the domain of flight plan [3], railway scheduling [4] and supply chain coordination [5] and so on. Especially, this idea has been got several fruitful productions, such as Carlson [6], Rosenberger [7], and Yan [8] and so on. Comparing to the flight plan, the disruption management problem in the distribution is more complex and defiant. In some previous studies, the authors have given the vehicle routing disruption management problem and some solution approaches based on the thought of disruption management. A disruption management model and an improved genetic algorithm were given to solve the VRP with the changes of time windows and delivery weight of customers [9]. An improved tabu search algorithm was given to solve the VRP with backhaul and time window [10].

The multi-depot urgent vehicle routing problem with vehicles break down has not yet been found in the papers at domestic or abroad. This study based on the multi-depot vehicle routing problem which is more complicated and practical than the single-depot vehicle routing problem. Some scholars have been doing researched in this field. And many methods have been used to solve MDVRP, such as two-phase heuristic method [11], variable neighborhood search [12], tabu heuristic [13] and genetic arithmetic [14]. From different point of view, these methods have obtained good results.

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