

Mixed Fleet of Electric and Conventional Vehicle Routing Under Traffic Restriction Policies in Urban Cities

Traffic restriction policies have been widely used in urban cities with the aim to relieve traffic congestion especially in rush hours. For example, in China, the traffic restrictions related to urban freight transport mainly include two types, i.e., the time window during which certain zones forbid all types of conventional freight vehicles to enter in, and heavy goods vehicles that are forbidden to enter the center of urban cities all daytime. These policies considerably affect the distribution decisions of urban logistics organizations as well as e-commerce organizations. Therefore, it is inevitable to consider the traffic restriction constraints when making decisions as to delivery fleet composition and routing decisions for city logistics distribution. With the public rising environment concern and government incentive policy, electric commercial vehicles (ECVs) have become an acceptable alternative to conventional internal combustion commercial vehicles (ICCVs) in urban logistics, especially in small package shipment. In China, driven by government push and encouragement, many express companies have a mixed fleet of ECVs and ICCVs. How to use the mixed fleet more effectively under the urban traffic restriction policies becomes a challenge and essential issue.

In this paper, we consider the routing problem arising in such an application scenario, and introduce the mixed fleet of electric and conventional vehicle routing with time windows under traffic restriction policies (MFECVRPTW-TR). Since some zones forbid certain types of vehicle to enter in during the restriction time window, the shortest path between each pair of nodes is actually vehicle type dependent instead of a constant in most VRPs. Under this consideration, firstly, we define the vehicle based shortest path problem under the traffic restriction policies and propose a fast algorithm to solve it. Then, we study the MFECVRPTW-TR with the consideration of vehicle based shortest path in real transportation network. The aim is to determine a fleet composition and each vehicle routing to service all customers, while the total cost is minimized. To address this problem, we propose a hybrid heuristic based on variable neighborhood search. Computational results on benchmark instances and new generated instances for MFECVRPTW-TR demonstrate the performance the proposed heuristic.