

Vehicle routing problems with alternative paths

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The class of vehicle routing problems involves the optimization of freight or passenger transportation activities. These problems are generally treated via the representation of the road network as a weighted complete graph. Each arc of the graph represents the shortest route for a possible origin-destination connection. Several attributes can be defined for one arc (travel time, travel cost ...), but the shortest route modelled by this arc is computed according to a single criterion, generally travel time. Consequently, some alternative routes proposing a different compromise between the attributes of the arcs are discarded from the solution space. We propose to consider these alternative routes and to evaluate their impact on solution algorithms and solution values through a multigraph representation of the road network. We point out the difficulties brought by this representation for general vehicle routing problems and we propose a dynamic programming solution method for the fixed sequence arc selection problem (FSASP). In the context of an on-demand transportation (ODT) problem, we propose a simple insertion algorithm based on iterative FSASP solving and a branch-and-price exact method. Computational experiments on modified instances from the literature and on realistic data issued from an ODT system in the French Doubs Central area underline the cost savings brought by the proposed methods using the multigraph model.

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