Optimizing the Location of Incident Response Vehicles for Congestion Mitigation

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Abstract

In this research, we study the location routing problem of incident response vehicle fleet in urban areas. The most studied objective in the literature is minimizing the response time in case of incidents. However, we present possible scenarios where this objective function is shown to disregard the overall time spent in congestion by the drivers. With this motivation, our objective is minimizing the expected total traffic congestion caused by the incidents. Given the traffic flow between any two nodes of the highway network for a certain time horizon, an incident occurring on a road segment that is not responded quickly blocks the traffic flow on the former road segments to a certain level and the number of road segments affected by the incidence and their congestion levels increase as the delay in incident response increases. We first provide a scenario-based multi-period stochastic formulation that determines the locations of the response vehicles at each period with the aim of minimizing the expected total traffic congestion over all possible scenarios, where each scenario, specifying a number of incidents with their location and occurrence time information, has a probability of occurrence. As the number of possible scenarios is extremely large for a real road network, we propose a Tabu Search heuristic that evaluates candidate solutions over a sample of scenarios. We apply our methods on a case study of Istanbul, one of the most congested cities in the world.

Keywords: Location Routing, Heuristic Algorithm, Accident Management, Accident Responder Vehicles

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