Impact of a Mixed Fleet on Urban Emissions Routing

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Abstract

Minimization of emissions has become an important issue for municipalities and logistics companies operating in urban areas. In urban areas, trucks must travel at the speed of traffic, which is time-dependent. Thus, we cannot determine an emissions-optimized speed. Instead, we derive the expected emissions from detailed speed observations. We are interested in how emissions-minimized routes change over the course of the day and when considering fleets of vehicles of different sizes. To solve this problem, we use the Comprehensive Emissions Model (CEM) to evaluate emissions. The CEM derives emissions from speed, load, and engine type. We use the CEM to evaluate our objective, and embed it within an existing local search procedure, which is a tabu-search heuristic that was originally developed for the time-dependent vehicle routing problem. The procedure is adapted to include the computation of time-dependent, expected emissions-minimized paths between each pair of customers on the route. For computational experiments, we use instances derived from a real road network dataset and 230 million speed observations. We compare the emissions-minimized routes with routes found with more traditional objective functions, e.g. minimizing distances, to understand how they differ. We then analyze how routes change with different fleet compositions, where emissions objectives can lead to quite different results than traditional costs objectives. Experiments show that up to 10% of emissions can be saved with a mixed fleet. We also intend to present results on how a more realistic combined cost objective consisting of fuel and driver costs would change the planned routes.

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