Constrained Vehicle Routing and speed optimization Problem (CVRsoP) for electric vehicles.

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1 Abstract

One of the goals of the EU is to achieve essentially CO2-free city logistics in major urban centers by developing and deploying new and sustainable fuels and propulsion systems. To meet European air quality standards, authorities of some major European cities have already introduced Low Emissions Zones where access to urban areas is limited to freight vehicles that satisfy certain emissions limits. This paper, therefore, copes with zero-emission last mile delivery.

Our model has its roots in the Pollution Routing Problem and in the Green Vehicle Routing Problem. In addition to acknowledging the previous view, we define the Constrained Vehicle Routing and speed optimization Problem (CVRsoP) for routing optimization of deliveries with electric vehicles having limited battery capacity. In this case not only the loads carried but also the driving speeds have a great impact on the driving range and the optimal routes for deliveries. The mathematical formulation leads to a non-linear model with mixed variables (discrete and continuous). We decompose the problem in two parts: a delivery routing problem, which is a classical CVRP, and a speed optimization problem.

Our approach is applied to extended benchmark instances and to realistic instances, using technical data of real electric trucks. Results provide optimal routings. Moreover insights can be driven on the preferable locations of depots in non-smooth geographic areas.