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# Interval Travel Times for Reliable City Logistics Vehicle Routing

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## Abstract

In city logistics, customers expect fast and reliable services, e.g., delivery at a promised delivery time. Due to varying traffic volumes and limited traffic infrastructure in urban areas, travel times are generally uncertain and differ during the day. In this environment, city logistics service providers have to fulfill deliveries cost-efficient and reliable. To ensure cost-efficient routing while satisfying promised delivery times, information on the variation of travel times between customers needs to be derived from real world data and integrated in the planning of delivery tours.

Recently, interval travel times (ITT) gained in importance in city logistics vehicle routing as they are able to represent the variation of travel times. In addition, ITT can be derived with relatively low effort due to low data requirements and straightforward calculation methods. Hence, ITT are a suitable travel time information model to enable cost-efficient and reliable routing in urban areas.

However, VRP solution methods for integrating ITT are still missing and real world size problem instances are computational challenging. Thus, we develop a metaheuristic solution approach that identifies tours with respect to efficiency and reliability by exploiting ITT. The developed solution approach is applied in a case study that considers floating car data (FCD) from the city of Braunschweig as a proxy for a typical medium sized European city. ITT are derived from the FCD and incorporated in the solution approach. Computational experiments show, that the incorporation of ITT increases reliability significantly while maintaining efficiency of routes.

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