Using Big Data for More Reliable and Sustainable Transportation Optimization

Prof. Dr. Jan Fabian Ehmke, Otto-von-Guericke-Universität Magdeburg, Management Science,
jan.ehmke@ovgu.de, www.ms.ovgu.de

Cost-efficient planning in transportation networks has been a traditional and well-established area of operations research. With the availability of large amounts of operational data, it is now possible to model and investigate more complex objective functions that allow for analyzing the trade-off between cost efficiency, reliability and sustainability of transportation. In this talk, we consider different ways of aggregating large amounts of operational data for these complex objectives. Based on different application examples of transportation planning, we investigate the additional value of more complex objectives for transportation optimization.

We begin with the efficient and reliable planning of attended home deliveries in urban areas, where logistics service providers face congested traffic networks, and customers expect deliveries in tight delivery time windows. We discuss strategies that maximize the profits of logistics service providers by accepting as many delivery requests as possible while assessing the potential impact of additional customer requests on the reliability of transportation.

The second application example is devoted to including information on the stochasticity of travel times in urban vehicle routing. In urban areas, speeds can vary significantly due to congestion over the course of the day, and the total cost and fuel consumption associated with different paths between customers can vary based on travel speed and the load on the vehicle. To compute cost-effective and environmental-friendly routes, we discuss how to include large amounts of detailed speed data in adapted shortest paths and vehicle routing algorithms.

The talk concludes with current work on identifying the most reliable path in a passenger's flight itinerary. To this end, we model the reliability of multi-leg itineraries and create probability distributions of flight arrival and departure times from large, publicly available flight databases. We develop a stochastic network search that allows for finding reliable paths in flight networks considering the travelers' individual travel time budgets and analyze the differences between conventional shortest travel time paths and the most reliable paths.