3rd LAST-MILE DELIVERY WORKSHOP

OTTO-VON-GUERICKE UNIVERSITY MAGDEBURG

JUNE 27 – 28, 2019

General information

After two insightful workshops in Mannheim and Rotterdam, we would like to welcome you to this year's Last-Mile Delivery Workshop in Magdeburg. Following the example of the first two workshops, in addition to the scientific talks, we have included a more practical session to discuss recent challenges of last-mile deliveries as well as a city tour for socializing and networking.

We are looking forward to discussions on recent innovations in last-mile deliveries, esp. through innovative optimization and analytics approaches.

Location:

The workshop takes place at the Otto-von-Guericke University Magdeburg. A map and directions are provided on the next page. The visiting address is:

Universitätsplatz 2
Universitätsbibliothek
39106 Magdeburg

All sessions take place in the conference room of the university library:

Universitätsbibliothek (Konferenzraum)

Presentations:

All presentations are scheduled for 40 minutes (except for the practice session on Friday). The speakers are asked to prepare a talk in English of 20 to 25 minutes, leaving enough time for questions and discussion.

City Tour:

A short walking tour of the city of Magdeburg will be offered on Thursday, June 27. The tour starts at 6:30 p.m. from Domplatz in front of Motel One.

Dinner:

Dinner will take place at restaurant "Hoflieferant" on Thursday, June 27 (not included). The address is Fürstenwall 3b, 39104 Magdeburg.

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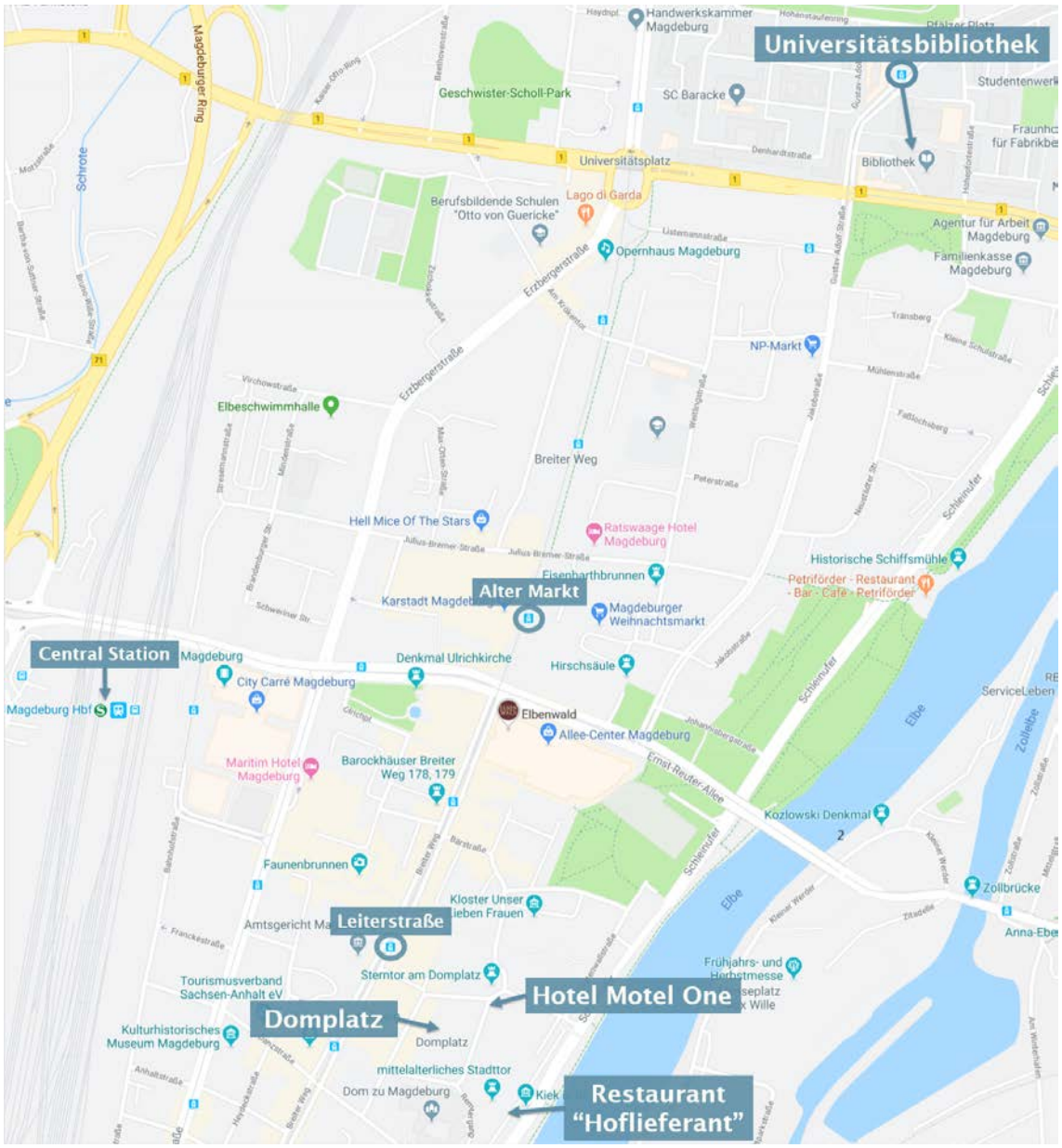
Directions



By train:

Walking: From the central station, it is a 25-minute walk to the university.
By tram: Exit the central station in the direction of the city center. Walk through the shopping center "City Carré" located in front of the station. Walk further along the station "City-Carré / Hauptbahnhof" until you reach the next stop "Alter Markt" (turn left at the next intersection). From there take tram line 2 heading "Alte Neustadt" and get off at "Universitätsbibliothek". Line 2 also takes you to "Domplatz" by taking the other direction ("Westerhüsen") to "Leiterstraße". Detailed information on Magdeburg public transport can be found at: *www.insa.de*.

By car:
Use "Gustav-Adolf-Straße 15, 39106 Magdeburg" to find the workshop location and parking spaces. If you come by car, please send us your license plate number beforehand.

Finding the seminar room:
After entering the university library building, the room is directly on the left-hand side.

Program Schedule

Thursday, June 27

From 13:00	Arrival & light Lunch
13:30	Welcome
13:40 – 15:15	**Session 1**
	Charlotte Köhler Flexible dynamic time window pricing for attended home deliveries
	Joydeep Paul The future of omni-channel retail: an operational perspective
	Jonas Schwamberger An assortment planning model for timeslot planning in attended home delivery
15:15 – 15:30	**Coffee Break**
15:30 – 17:30	**Session 2**
	Thomas Visser When microseconds add up: On the real-time performance of dynamic time slot management
	Niels Agatz Splitting shopping and delivery tasks in an on-demand personal shopper service
	Jeannette Hermanns Dynamic dispatching of a heterogeneous fleet in an urban area
17:30	**Hotel Check-in**
18:30	**City Walk** (Meeting Point: Domplatz in front of Motel One)
19:30	**Dinner at Hoflieferant** (not included)

Friday, June 28

08:45 – 10:45	**Session 3**
	Arthur Ansmann Approximate dynamic programming for the multi-depot same day delivery problem
	Kilian Seifried The traveling salesman problem with one truck and multiple drones
	Ann Melissa Campbell Use of autonomous delivery vehicles for urban deliveries
10:45 – 11:00	**Coffee Break**
11:00 – 12:15	**Practice Session**
	Ramin Scharifi vesper - Moving Parcel Lockers for Consolidated Deliveries
	Tino Henke Using mobile pick-up stations for last-mile deliveries
12:15 – 12:30	**Farewell & end of program**

Abstracts

Session 1

Charlotte Köhler

Flexible dynamic time window pricing for attended home deliveries

In the challenging environment of attended home deliveries, pricing of different delivery options can play a crucial role to ensure profitability and service quality of retailers. To differentiate between standard and premium delivery options, many retailers include time windows of various lengths and fees within their offer sets. Customers want short delivery time windows, but expect low delivery fees. However, longer time windows can help to maintain flexibility and profitability for the retailer. We present flexible dynamic time window pricing policies that measure the impact of short time windows on the underlying route plan during the booking process and set delivery fees accordingly. Our goal is to nudge customers to choose time windows that do not overly restrict the flexibility of route plans. To this end, we introduce three dynamic pricing policies that consider temporal and/or spatial routing and customer characteristics. We consider customer behavior through a nested logit model, which is able to mimic customer choice for time windows of multiple lengths. We perform a computational study considering realistic travel and demand data to investigate the effectiveness of flexible dynamic time window pricing. Our pricing policies are able to outperform static pricing policies that reflect current business practice.

Joydeep Paul

The future of omni-channel retail: an operational perspective

The lines between online and offline retail are blurring in the age of omni-channel retail. We model the complex interactions between the different marketing and operational factors to provide insights under what conditions omni-channel grocery retail can be profitable. We consider the operational costs of each channel and analyze how economies of scale will shape their profitability and hence, their future market shares.

Jonas Schwamberger, Arne Strauss, Moritz Fleischmann

An assortment planning model for timeslot planning in attended home delivery

We consider the timeslot planning problem in attended home delivery. The problem can be interpreted as a particular assortment planning problem. One of the core ingredients is the modelling of customer choice behavior. In this presentation, we introduce a generic assortment planning model that lends itself to an efficient solution approach and discuss its applicability to timeslot planning.

Session 2

Thomas Visser

When microseconds add up: on the real-time performance of dynamic time slot management

To facilitate attended home delivery of online purchases, customers are offered a menu of time slots to choose from. Dynamic time slot management is a class of methods to make such a time slot offer, which is dynamically constructed taking into account previously placed orders, with as aim the maximization of the expected number of customers. In this paper, we present a model to overcome a crucial challenge which hinders the widespread adoption of dynamic time slot management in practice. In our model, we incorporate the decision time needed to construct a time slot offer, and the time which it takes a customer to select a time slot from such an offer. Because customers typically do not choose instantaneously, a time slot offer might be invalidated by other customers that place an order in the meantime. We show that state-of-the-art dynamic time slot management procedures are not equipped to deal with this, resulting in poor performance or long response times, i.e., waiting times experienced by customers. We present several procedures to deal with this. We illustrate their performance using experiments in which a real-time order process is simulated with up to 8000 customer arriving in a time span of as much as 80000 seconds or as little as 8 milliseconds.

Alp Arslan, **Niels Agatz**, Mathias Klapp

Splitting shopping and delivery tasks in an on-demand personal shopper service

We introduce an online personal shopper service, a type of last-mile delivery system operating as intermediary between online customers and brick and mortar stores. This service receives online customer requests, each potentially having shopping requirements from multiple stores, and arrange the deliveries of these requests to customers. We study the benefits of splitting customer orders into smaller delivery tasks served by different shoppers in parallel and clustering tasks from multiple orders sharing a common pickup location. We develop an online optimization algorithm to solve a personal shopping problem integrating request splitting, task to shopper assignment, and routing problems. In the numerical experiment section, we show that one can increase the number of customers served, and decrease the average service time per request by splitting customer requests into smaller tasks and efficiently consolidating these into shoppers.

Jeannette A. L. Hermanns, Barrett W. Thomas, Marlin W. Ulmer, Dirk C. Mattfeld

Dynamic dispatching of a heterogeneous fleet in an urban area

This research analyzes the potential of heterogeneous fleets in urban delivery routing. Due to cost pressure, environmental restrictions, and workforce shortages, service providers are testing a variety of different vehicle types such as trucks, cargo bikes, or even autonomous delivery vehicles. The vehicle types differ in several dimensions including capacity, and range. Importantly, the vehicles have different delivery processes as well as different parking and delivery times that can depend on the area of the city in which deliveries occur.
In this talk, we use such a given heterogeneous fleet to serve dynamically requesting customers. Each customer expects delivery from a depot before a deadline. Either we can serve a customer with our own vehicles or we need to outsource the delivery to an expensive third party. Our objective is to minimize the expected third party costs.
We present a heuristic method that exploits the individual strengths of the vehicles. Specifically, we identify features that indicate good assignment strategies of customers to vehicles. The features are based on customer, vehicle, and routing attributes. In order to ensure the flexibility of the assignment with respect to future services, we pair this method with an estimation of the value of future demands. Results indicate that both assignment and estimation provide significant improvements compared to a reactive strategy.

Session 3

Artur Ansmann, Marlin W. Ulmer, Dirk C. Mattfeld

Approximate dynamic programming for the multi-depot same day delivery problem

In this talk, we investigate the multi-depot same day delivery problem (MDSDDP). In this problem, a dispatcher must decide to which customers same day delivery services are offered, which vehicle is dispatched for delivery and at which depot the goods should be loaded. The objective is to maximize the number of customers that receive their delivery via same day delivery service. The dispatcher therefore must utilize the given infrastructure (i.e. the depots and vehicles) as efficiently as possible without violating working hour restrictions of the drivers. Due to the timeliness of same day delivery services, the dispatcher must make decisions fast and under uncertainty.
We model this sequential decision problem as a discrete finite Markov Decision Process, in which the decision points correspond to the time at which a customer issues a request during a predefined service time period. We develop a cost threshold based acceptance decision policy and extend it to an anticipatory cost based acceptance decision policy using approximate dynamic programming. We compare both policies with a myopic decision policy serving as a benchmark within a simulation study. Within this study, we evaluate the performance of the decision policies for different prototypical customer demand patterns.

Kilian Seifried

The traveling salesman problem with one truck and multiple drones

We develop a novel mixed-integer programming (MIP) formulation for a traveling salesman problem with a truck-drone team, consisting of one truck and multiple drones, that carries out a set of deliveries. Our model takes an approach different from other MIP formulations in the literature. Benchmarks show that it can compete with those as well as with purpose-built exact solution methods but has the advantage of being easily implementable with an off-the-shelf solver. Additionally, we present an even tighter formulation for a special case where the drone range is non-binding. We conduct several numerical experiments to explore the performance of the model and to gain insights into the problem with multiple drones.

Ann Melissa Campbell, Sarah Reed

Use of autonomous delivery vehicles for urban deliveries

We will examine the idea of having deliveries made by an autonomous vehicle. The vehicle will still have a "driver". The driver will take the packages from the vehicle and deliver them to doors of the recipients on foot. With an autonomous vehicle, though, the driver will not have to find a parking spot for the vehicle before departing the vehicle to make the deliveries. The vehicle should be able to find its own parking spot or circulate until the driver is ready to be picked up and transported to its next location. This application of this new technology raises questions such as where the driver should be dropped off and, more importantly, what savings does this technology offer in terms of the completion time of the route? We will examine these questions in an urban environment, where the deliveries occur at the intersections of a grid. We can analytically derive the cost of the optimal solution. We will compare with more traditional approaches.

Practice Session

Tino Henke, Saba Pakdel, Trong Dai Pham, Thi Kim Nhung Phan

Using mobile pick-up stations for last-mile deliveries

Because of continuously growing e-commerce and increasing urbanization, many innovative last-mile delivery concepts have been introduced in recent years. One of such concepts considers the usage of mobile pick-up stations. Mobile pick-up stations contain several lockers for storing a limited number of parcels to be collected by customers. Moreover, each station can be moved to a different location on each day to enable convenient access for customers. However, for sparsely populated areas, conventional home deliveries may still be more efficient for the logistics service provider than operating with mobile pick-up stations. Thus, we regard an optimization problem in which a given set of customers needs to be partitioned into clusters served either by mobile pick-up stations or by home deliveries. Moreover, temporary locations for the pick-up stations as well as routes for home deliveries have to be determined such that total delivery costs can be minimized. In our presentation, we will discuss a sequential three-stage heuristic. Customer clusters are determined on the first stage, the best delivery option for each cluster is identified on the second stage, and a simulated annealing-based local search is performed on the last stage. Extensive numerical experiments evaluate the performance of the proposed heuristic and provide valuable managerial insights into the benefits of using mobile pick-up stations.

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Chair of Logistics and Supply Chain Management

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