Parking condition and parking search in the city of Zurich

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Abstract

Parking search exist in many cities. However, since the searching vehicles are not easy to be distinguished from normal travelers, it is rather difficult to model the parking search traffic.

Here, a case study is provided based on a central area in the city of Zurich. The case study is carried out based on the macroscopic parking model proposed in Cao and Menendez (2015). Preliminary findings are written in this document whereas more information of parking conditions in Zurich will be introduced in the presentation.

Keywords

Cruising-for-parking, traffic performance, parking usage, delay, searching time

1 Introduction

Parking search exist in many cities. However, since the searching vehicles are not easy to be distinguished from normal travelers, it is rather difficult to model the parking search traffic.

Here, a case study is provided based on a central area in the city of Zurich. The case study is carried out based on the macroscopic parking model proposed in Cao and Menendez (2015). Preliminary findings are written in this document whereas more information of parking conditions in Zurich will be introduced in the presentation.

2 The parking supply and the road network

In this section, a case study is given based on the central shopping area Jelmoli, within the city of Zurich, Switzerland. This area is located in the old town with many shopping centers but also a lot of offices from the financial sector. The radius of the area is 300 meters. The area contains a total of 539 parking spaces for public usage, including 207 on-street parking spaces and 332 off-street parking spaces. As the area is rather small, we consider the sum of 539 parking spaces as the capacity of the parking supply. Figure 1 shows the parking conditions and network in the area.

(a) (b) (c)

Figure 1: layout of the area. (a) garages in the area. (b) on-street parking spaces in the area. (c) the streets in the area.

- Off-street parking: 332 spaces inside the area.
  Parkhaus Jelmoli: Steinmühleplatz 1, 8001 Zürich. 222 Plätze.
  Parkhaus Talgarten: Nüschelerstrasse 31, 8001 Zürich. 110 Plätze.

- On-street parking: 207 public parking spaces, and another 78 parking spaces only for delivery and private usage. The maximum parking duration allowed is 120 mintues for most of them.
- Streets/links: there are in total 106 streets/links in this area, with a total length of 7.7 link kilometers. Assuming the streets have two directions, and one lane per direction on average, then the network is 2*7.7=15.4 lane kilometers. There are two streets with only a small portion inside the area, their lengths are 263 meters, and 175 meters. Since their lengths are quite small compare to the network length, they are still included.

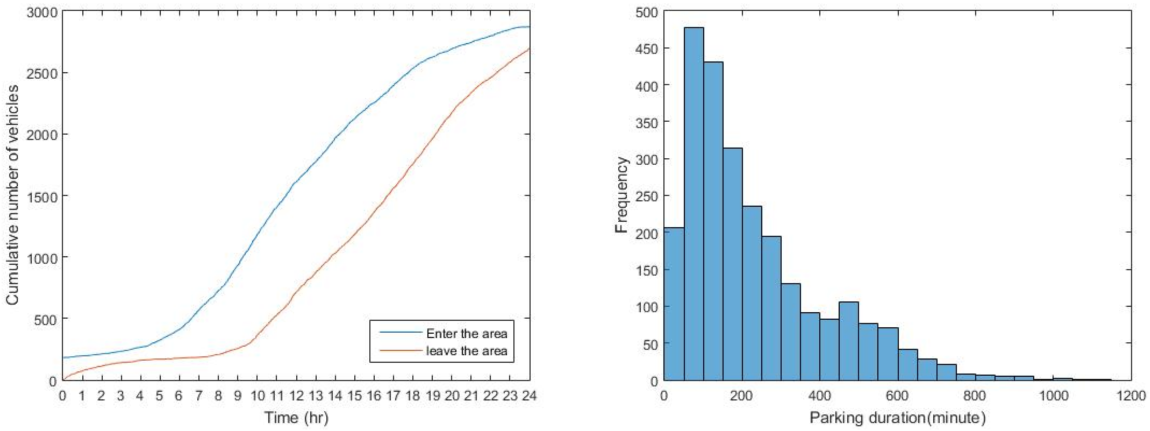
Additionally, we assume that the average free flow travel time is v=15 km/hr (this includes time spent at intersections), the critical traffic density is kc=25 veh/km, and the jam density is kj=55 veh/km (Ortigosa et al. 2014).

3 Traffic and parking demand

The daily traffic data arriving to this network has been simulated based on previous measurements in an agent based model Matsim (Waraich and Axhausen, 2012). There are 2534 agents entering the area during a typical working day. Figure 2(a) shows the cumulative number of vehicles that enter the area and leave the area. Figure 2(b) shows the histogram of the durations of the activities of the travellers. The average parking duration is 227 minutes. The shape of the histogram is similar to a gamma distribution with the shape parameter being 1.6 and the scale parameter being 142.

After the calibration of the parking demand with the real parking occupancy in public parking spaces in the area, the results show that approximately 77% of the daily traffic uses public parking space, the other 23% uses private parking. If we assume vehicles start to search since they enter this small area, the searching demand can be seen as 77 % (for each time slice) of the trips. 23% of the trips are assigned to dedicated parking spaces in the center (e.g., private parking houses, parking provided by their company or employer) and thus do not search for parking. Figure 2(a) shows the total demand (including both, the one for public and the one for private parking spaces).

Also, at the beginning of the day, i.e., at 00:00, there is a total of 183 vehicles inside the area, they mostly entered the area during the previous day. This pattern repeats itself, as at the very end of the day, i.e., 24:00, there is also some vehicles in the area.



(a) (b)

Figure 2: (a) Cumulative number of vehicles enter and leave the area. (b) Histogram of the parking durations.

4 Parking usage estimation and cruising analysis

We assume all parking spaces (whether they are on-street or off-street) are uniformly distributed in the area, travellers take the first they see (i.e., users are indifferent to different parking spaces). In this case, the trips heading to garage and on-street parking are not distinguished. The activity start times are not used, instead, the macroscopic model is used to find the time they start-to-search for parking and access the parking space.

As we discussed above, assuming that 77% of all travellers need to park in public parking spaces (for each time slice), and using the model we proposed in chapter 2, we find that the total searching time is 6310 minutes, i.e., 105 hours in one day. In other words, each traveler spends on average 3.0 minutes searching for parking. However, the main searching delay occurs between 11:00 and 15:00, because that is the period when the parking system approaches saturation (i.e, 100% occupancy). Figure 4(a) shows the parking occupancy inside the area. Figure 4(b) shows the model results with the cumulative number of vehicles that enter the area, access parking, depart parking, and leave the area. Figure 5 shows the number of searchers along the number of available parking spaces over time.

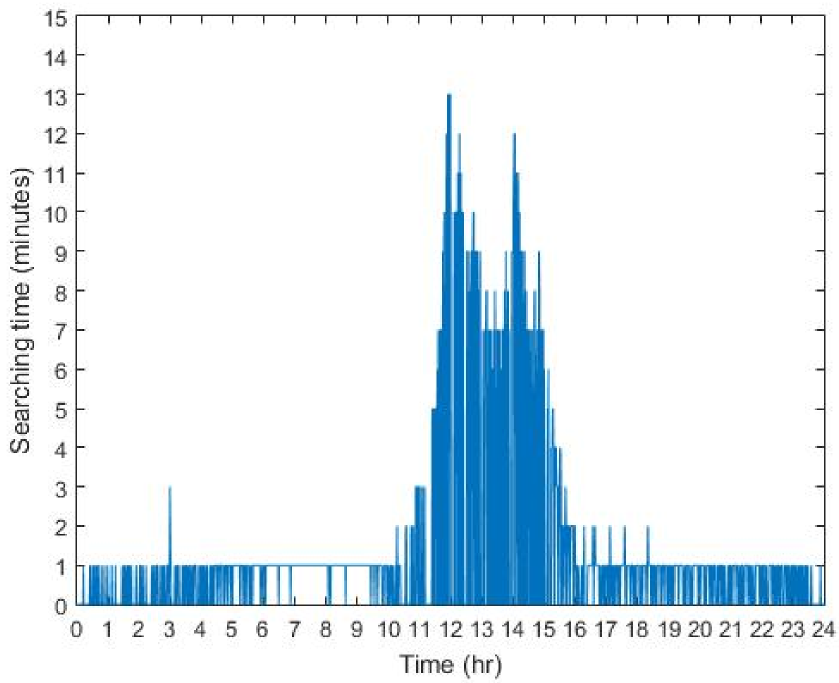
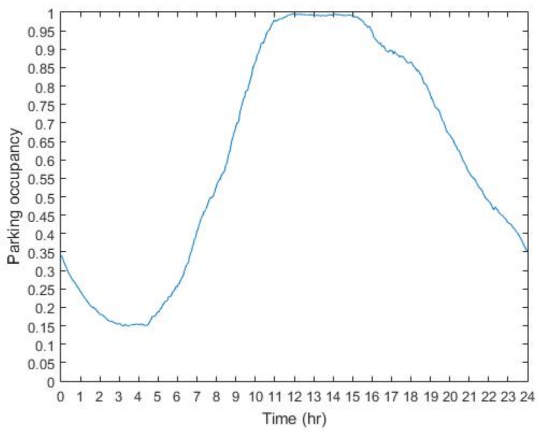
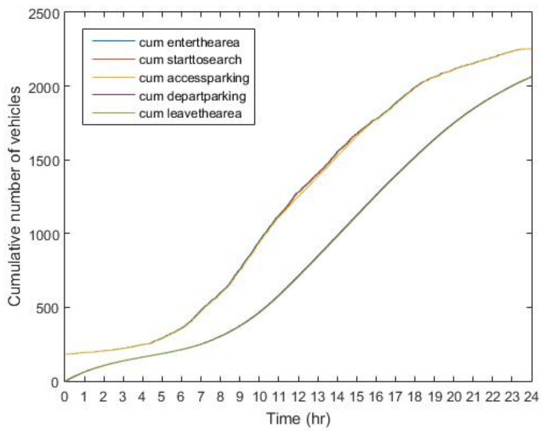


Figure 3: Searching time assuming FIFO.



(a)

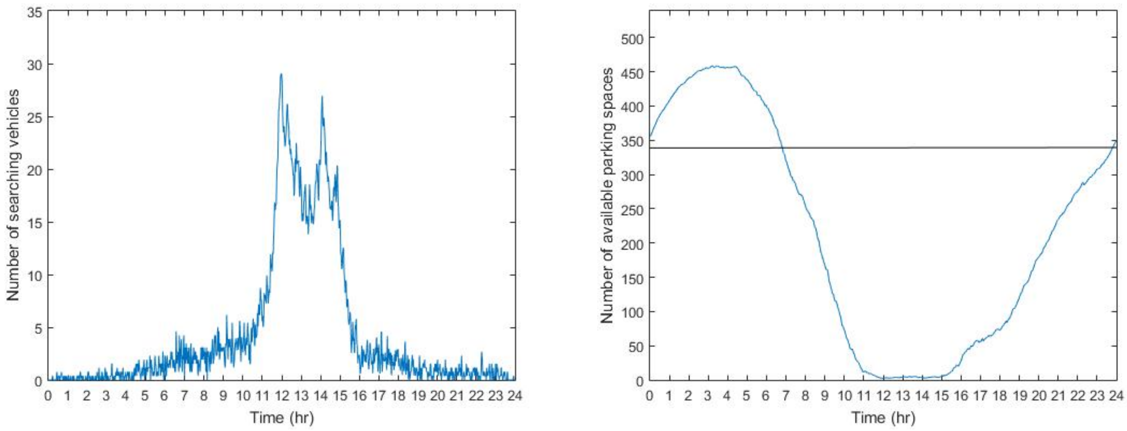


(b)

Figure 4: (a) Parking occupancy inside the area. (b) Cumulative number of vehicles that enter the area, find parking, depart parking, and leave the area.

In Figure 5, it is shown that:

- between 06:00 and approximately 11:00:
  - The number of searching vehicles increases at a very low rate.
  - The number of available parking spaces drops continuously until all parking spaces are occupied.
- between 11:00 and 16:00:



(a) (b)

Figure 5: (a) Number of searchers. (b) Number of available parking spaces.

  - The number of searching vehicles increases significantly and reaches a peak of approximately 30 vehicles at around 12:00, then it starts to fluctuates, at around 14:00, it reaches another peak of 27 searching vehicles, then it starts to drop and reaches nearly zero at the end of this period.
  - All parking spaces are occupied during this period, i.e., when a parking space becomes available, it is immediately taken.
- between 16:00 and 22:00:
  - The number of searching vehicles stays at a very low level, i.e., nearly zero.
  - The parking system starts to become undersaturated, more and more parking spaces become available.

5 Comparison between estimated parking occupancy and real data

For comparison, we have collected parking occupancy data inside the area. Figure 6 and Figure 7 show the number of available parking spaces on 8th-9th March 2016 (Tuesday and Wednesday) from the two garages, Jemoli and Talgarten.

Notice that, the figures shown are only approximate. Values are aggregated over 1 hour intervals. The authors do not have access to the raw data, and thus can only provide the records in the format on shown in these two figures. Despite this lack of precision, it is clear that the predicted pattern is very similar to those observed in realty.

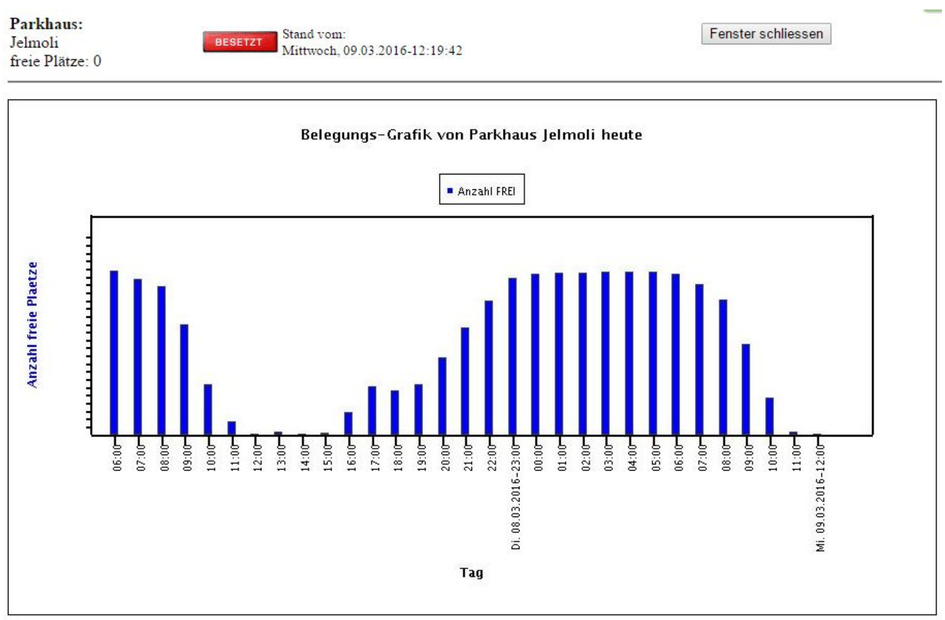


Figure 6: Number of available parking spaces in parking garage Jelmoli (06:00 on 08.03.2016 Tuesday - 12:00 on 09.03.2016 Wednesday). Data source: parkleitsystem stadt Zurich (city of Zurich), http://www.pls-zh.ch/.

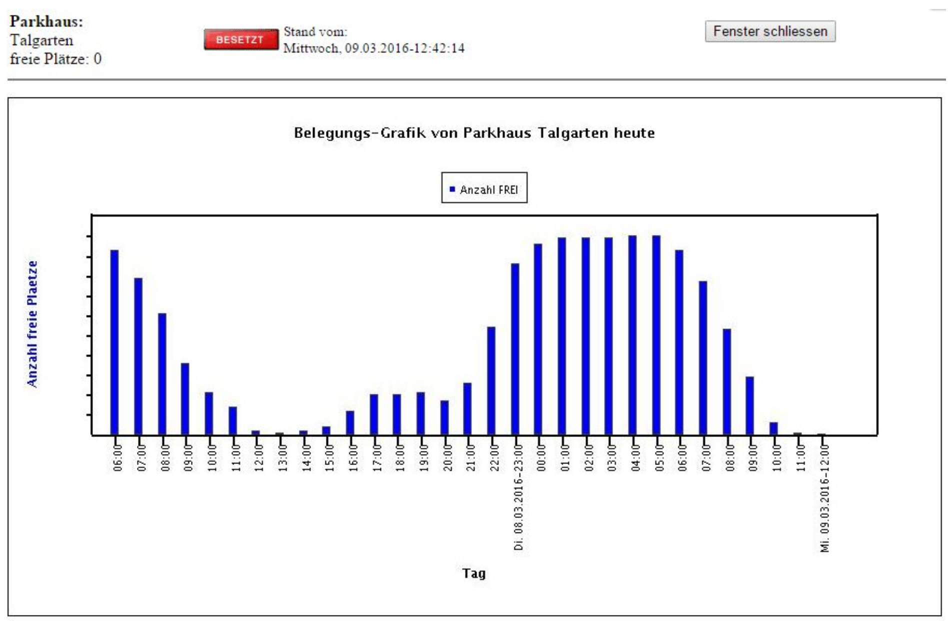


Figure 7: Number of available parking spaces in parking garage Talgarten (06:00 on 08.03.2016 Tuesday - 12:00 on 09.03.2016 Wednesday).Data source: parkleitsystem stadt Zurich (city of Zurich), http://www.pls-zh.ch/.

In the city of Zurich, the on-street parking spaces are (mostly) free of charge in the late night and the early morning (between 22:00 and 8:00) while parking garages require parking fee the whole time. Hence, vehicles that arrive and leave within this period of time would choose on-street parking. This can be seen in Figure 5 (b) between 00:00 and 8:00 where the number of available parking spaces first increases then drops. However, since Figure 6 and 7 refer to parking garages only, they cannot show such tendencies.

The number of available parking spaces drops in the morning from 06:00 on and reaches saturation between 11:00 and 12:00. The saturation holds till the afternoon between 15:00 and 16:00. Comparing this to Figure 4, the saturation of the system is proved to be true in reality, the time of the 100% occupancy is comparatively close to our estimation.

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