CHAPTER 13

Parking

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13.1 Basic Information

Entry point to documentation:

`http://matsim.org/extensions` → parking

Invoking the module:

`http://matsim.org/javadoc` → parking → `RunParkingExample` class

Selected publications:

Waraich and Axhausen (2012); Waraich et al. (2013a); Waraich (2014); Waraich et al. (2014b)

13.2 Introduction

The MATSim simulation, by default, does not consider parking infrastructure or supply constraints. However, this can lead to artificially high car traffic to city centers in the model, often not the case in the real world, due to limited parking. The modeling of parking is also important because traffic-related policies can be designed around parking; e.g., raising prices for parking at certain times of the day, or reducing parking supply in an area, can impact travel demand.

This chapter describes work done to bridge this gap via parking models for MATSim .

13.3 Models

For technical reasons, parking modeling efforts in MATSim were divided in two parts: parking choice and parking search, described in the following two subsections.

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13.3.1 Parking Choice Model

The first approach for modeling did not change the MATSim traffic simulation; it extended it to capture parking supply through `controler listeners` and event handling. This means that no rerouting due to parking took place during the simulation. However, changed routes could be incorporated in a post-processing step, as described in Waraich and Axhausen (2012).

In the most general case, a parking choice model performed the following simulation steps; when a vehicle arrived at a destination in MATSim, the parking choice model assigned a parking spot in the agent's area, according to a customizable algorithm (e.g., utility maximization). The assigned parking place was marked as occupied on arrival and became unoccupied again when the agent departed, allowing the model to simulate supply side constraints with the same temporal resolution as the basic MATSim model.

A simple parking choice model version was able to consider only walk distance minimization, ignoring other user preferences and park at the closest available public parking. A simple model like this was able to partially solve one of the main problems of the un-constrained parking model in MATSim; it made an area with little parking less attractive as a car destination due to longer walk distances. Parking model integration with MATSim was achieved by adding a term for the parking operation to the agent's overall plan scoring function, as follows:

$$S_{parking} = S_{walking} + S_{parking\ costs} + S_{parking\ search\ time} \tag{13.1}$$

Beyond walking distance disutility, this scoring function could also include additional features like cost, or even estimated parking search times, using models like Horni et al. (2013a).

A Zürich city study, which implemented a parking choice model and included trade-off between walk distance and parking cost, was presented in Waraich and Axhausen (2012). This study also distinguished between public, private and reserved parking, where only certain people (e.g., disabled) or certain vehicles could park (e.g., electric vehicles). Figure 13.1 shows parking choice models employed in this study, where a distinction between public, private and reserved parking was made. In Waraich et al. (2013c), another study for modeling parking in MATSim was reviewed, exploring individual gender and age parking preferences. Utility function parameters used in this study were based on a stated preference survey in Switzerland.

13.3.2 Parking Search

The parking choice model presented in the previous section could capture many relevant aspects of parking. However, it did not model parking search behavior; studies conducted around the world suggest that, on average, around 30 % of city centers traffic could be due to parking search traffic Shoup (2004). Thus, it seems extremely important to capture parking search related traffic in transportation models.

A first idea about model parking search traffic in MATSim was presented in Waraich et al. (2012). The basic idea came from surveys suggesting that people select certain strategies they think will be beneficial for them when starting the parking search process (Axhausen and Polak, 1989). Proof of this concept for development was attempted, using within-day replanning (see Chapter 30 and Dobler et al. (2012)). However, this path was aborted after development of several initial strategies, where performance and integration issues led to dead ends (Waraich et al., 2013c); performance after optimization was around 24 times slower than the original runs without parking operations.

An alternative path closer to the idea presented in Waraich et al. (2012) was successfully attempted, using a JDEQSim based model (see Section 4.3.2) with within-day support and travel time approximation, as seen in PSim (see Chapter 39, Fourie et al. (2013)). This removed overhead,

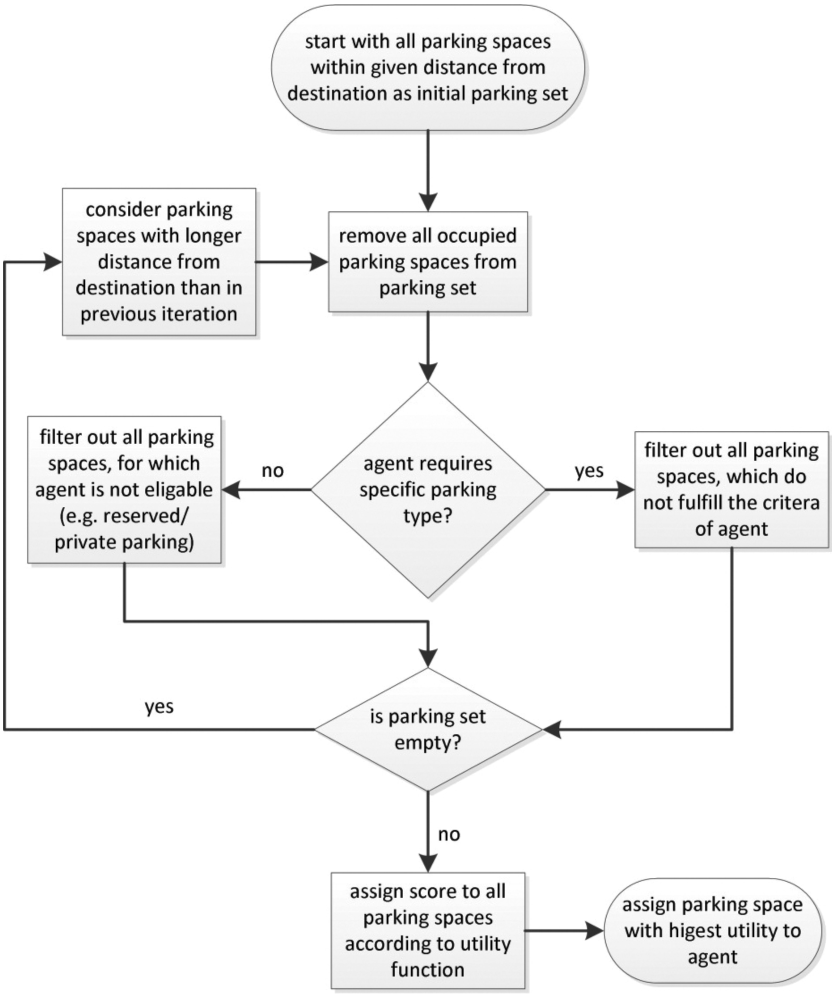

Figure 13.1: Parking choice algorithm.

Source: Waraich and Axhausen (2012)

present in the previous approach, enabling flexibility to implement many of the parking strategies presented in Axhausen and Polak (1989) and beyond. Publication of this approach's first results are expected in 2015.

Unfortunately, the approach is not available in packaged form to other users of MATSim.

13.4 Applications

Clearly, the parking model applications presented were important, diverse and especially well-suited for policy design; one example of traffic policy design by means of targeted reduction of parking supply was presented in Waraich and Axhausen (2012). Waraich et al. (2013c) explained an application of performance-based pricing for parking in MATSim, where iteratively parking prices were adapted to match demand. An integration of parking choice and electric vehicle charging was presented in Waraich et al. (2014a) for a Zürich case study and Bemetz and Hohenfellner (2014) described an even more sophisticated test model for parking and EV (Electric Vehicle) charging, with various types of charging speed and prices.

13.5 Usage

A general parking choice model was included in the parking contribution of MATSim, which provided various extension interfaces; examples were included in the parking contribution to provide help with extension.