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OPTIMIZING PARKING PRICES USING AN AGENT BASED APPROACH

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Motivation

- Studies around the globe have shown, that around 30% traffic at city centres is contributed by cruising for parking [1].
- One idea to reduce parking search traffic is to adapt parking price according to demand. A method to iteratively find such an «optimal price» has been proposed by D. Shoup and is currently being tested in San Francisco called SFpark [2,3].
- With SFpark drivers can find the parking suitable for them using real-time information about available parking and price. The parking prices are set per street block and time of day. The prices are increased/decreased on a monthly basis taking parking occupancy into account.

Contribution: In order to investigate possible effects of such "parking price optimization" in other cities, we extended an agent-based traffic simulation with a parking model and the parking price optimization algorithm and applied it to the city of Zurich.

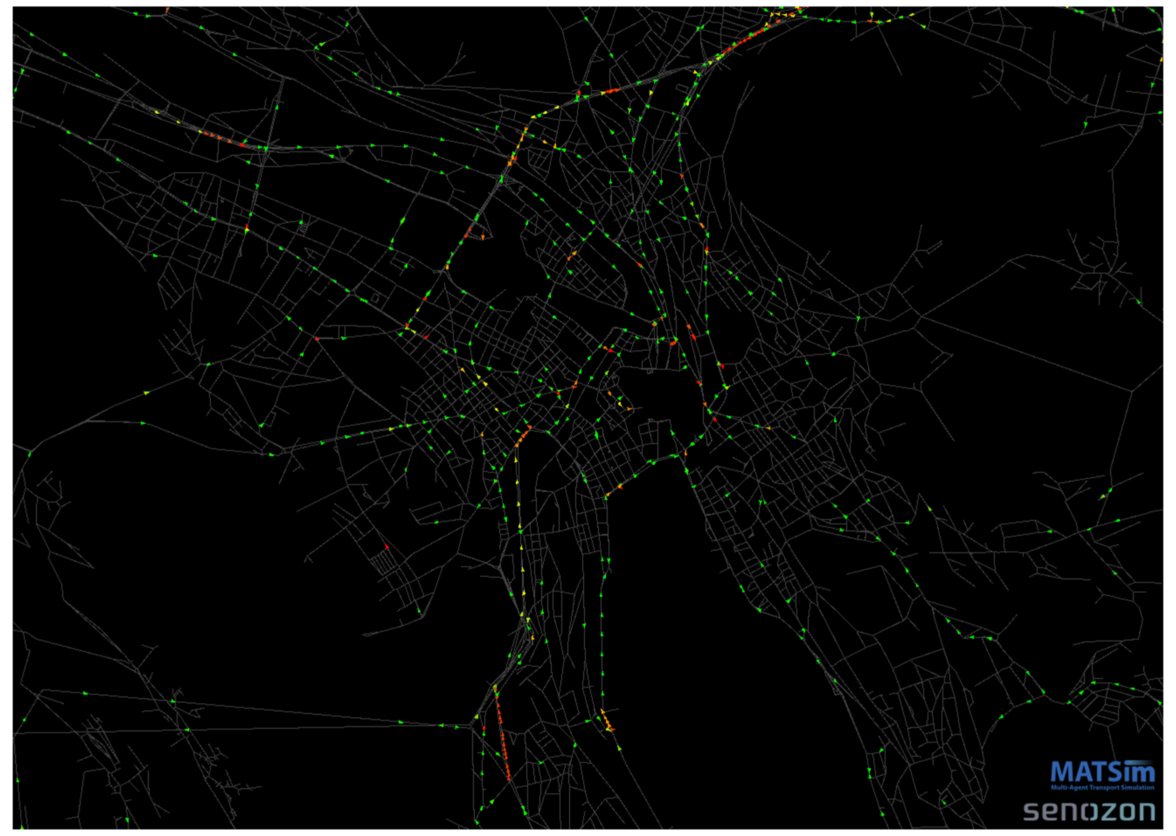

Figure 1: Agent-based traffic simulation with MATSim for Zurich

The Parking Model

The parking model presented in this paper extends previous work by the authors with regards to agent based modeling of parking choice and search [4,5]. We have integrated our parking model into the agent based traffic simulation MATSim [6].

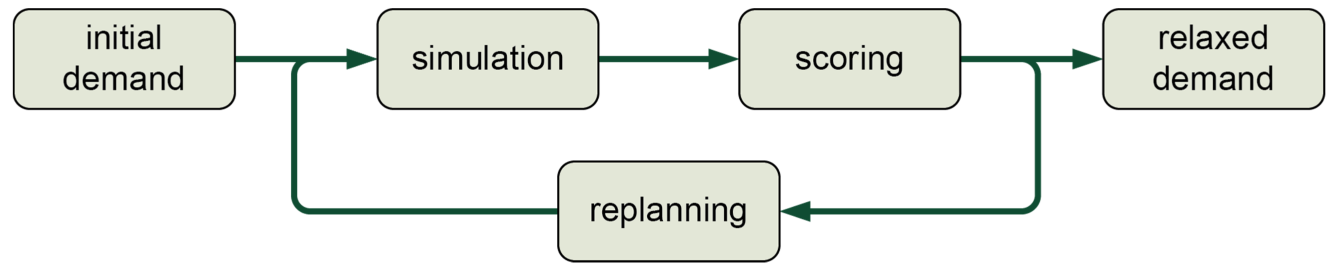

Figure 2: Co-evolutionary simulation process of MATSim

Utility function

The parking availability can influence other decision of the agent, such as mode or location choice. This is implemented by extending the utility function in MATSim:

$$U_{parking,i} = U_{P_{cost},i} + U_{P_{searchTime},i} + U_{P_{walk},i} + \cdots + \epsilon_i$$

$$U_{plan,i} = \sum U_{travelTime,i} + U_{travelCost,i} + U_{performActivity,i} + \cdots + \sum \boldsymbol{U_{parking,i}}$$

The estimation of the parking utility function parameters is based on a stated choice survey with 1'200 respondents from Switzerland. Interactions were estimated for income, age, gender and activity duration.

Parking selection

Agent's are assumed to have mobile devices on-board while traveling, giving them real-time information about parking availability and price as in SFPark. The parking choice is made according to the agent's personal utility function.

Experiments

Zurich scenario

- 10% population sample: 72'000 agents
- Planning network with 60'000 links
- 50'000 on-street parking, 16'000 garage parking and over 200'000 private parking
- Initial price at parking: Current prices
- Increase price after iteration, if occupancy above 85%, else reduce price (± 0.25 CHF/h)
- Different price in morning and afternoon

Price change (on-street vs. garage parking)

After price optimization, prices at most garage parking were reduced significantly, while the prices at some on-street parking increased, which is plausible: The garage parking in areas with lower demand are forced to lower prices, as it is hard for them to compete with neighbouring on-street parking, which is often located closer to the agent's destination.

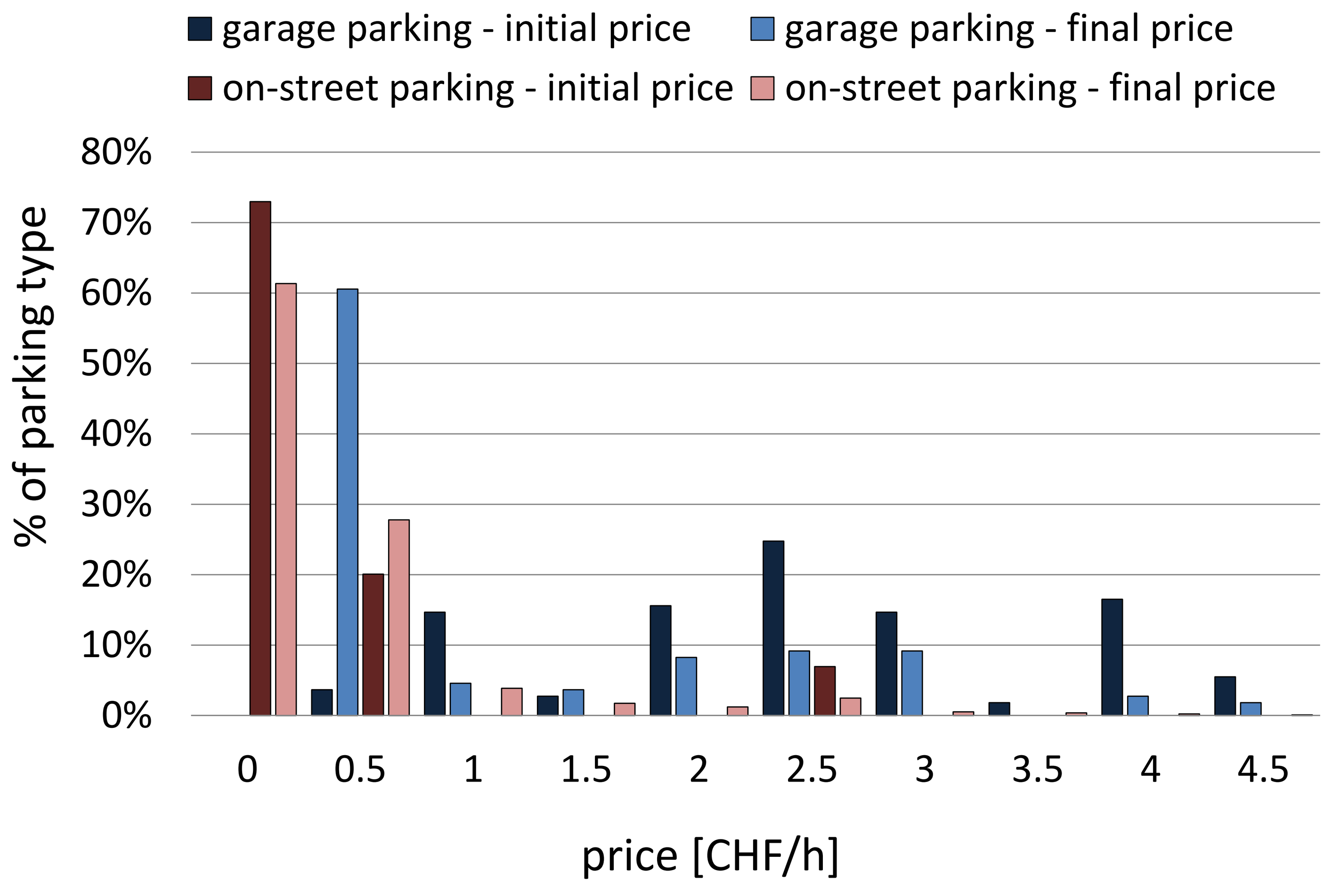

Figure 3: Parking fee change at garage and on-street parking due to parking price optimization

City revenue decreased

- In our simulation, the revenue for the city fell by 11%, especially due to the fall in garage parking prices. Neither the increase in on-street parking price, nor the increase in garage parking demand could cover this deficit.
- By introducing a minimal parking price (as done by SFpark), the revenue reduction in our scenario could possibly be avoided.

Conclusions

- Our model can help to find the spatial distribution of the price changes after applying "parking price optimization" to a city and possible implications for policy makers, e.g. changes in revenue and therefore help the policy design process.
- Although it seems plausible, that parking search traffic could be reduced due to such "parking price optimization", it is unclear, if this reduction is only due to the 85% target parking occupancy or also due to the complex pricing, which makes random search difficult.

References

[1] Shoup, D. (2004) The ideal source of local public revenue. *Regional Science and Urban Economics*, *34*(6), 753-784.

[2] Shoup, D. (2006) Cruising for parking. *Transport Policy*, *13*(6), 479-486.

[3] SFpark (2012), SFpark, webpage, http://sfpark.org, last time accessed July 2012.

[4] Waraich, R.A. and K.W. Axhausen (2012) An Agent-based Parking Choice Model, paper presented at the *91st Annual Meeting of the Transportation Research Board*, Washington, D.C., January 2012.

[5] Waraich, R.A., C. Dobler and K.W. Axhausen (2012) Modelling Parking Search Behaviour with an Agent-Based Approach, paper presented at the *13th International Conference on Travel Behaviour Research*, Toronto, July 2012.

[6] MATSim-T (2012) Multi Agent Transportation Simulation Toolkit, webpage, http://www.matsim.org, last time accessed June 2012.

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