Eidgenössische Technische Hochschule Zürich
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Evaluation of Dynamic Public Transport Pricing with MATSIM

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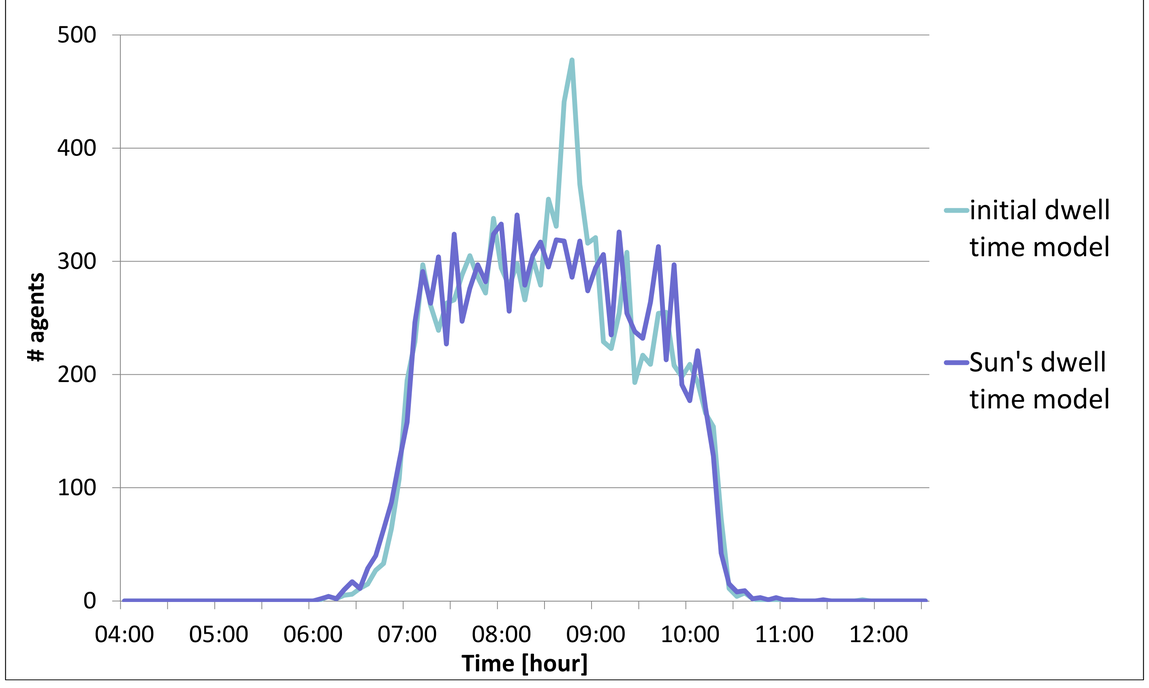
Thesis aim

With emergence of digital fare payment systems, the resolution of problems such as growing amount of air pollution or concentration of peak hour congestion becomes feasible by the implementation of dynamic pricing schemes. But, because of the complexity and the difficult acceptance of these strategies by the population, research is needed to show clearly any benefits brought.

Methodology

In this thesis, the agent based simulator MATSim is used to study the effects of the First-Best pricing strategy for a simple corridor scenario. Three types of externalities are internalized by agents who cause them: crowdedness in PT vehicles (Tirachini, 2013), in-vehicle delay due to boarding or alighting times and waiting delay when agents cannot board a full bus (Kaddoura, 2013). In addition to that, a new dwell time model considering the friction effects at boarding and alighting is implemented (Sun et al., 2013).

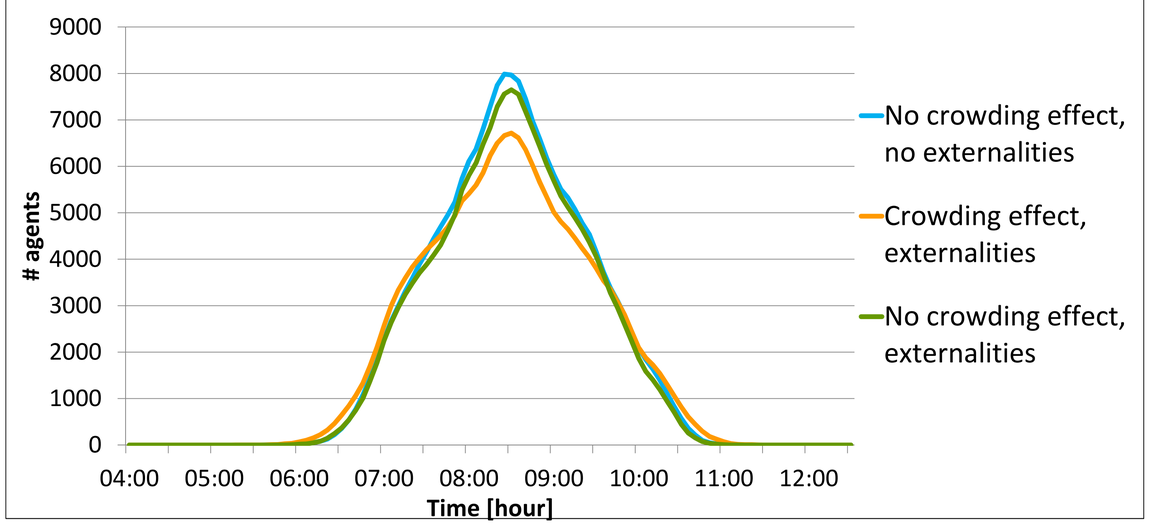
PT boarding distribution: peak spread due to new dwell time model



Sun's dwell time model

The dwell time increases strongly if boarding occurs in a nearly full bus. Because of that, the agents set their departures earlier and later and the boarding peak is spread.

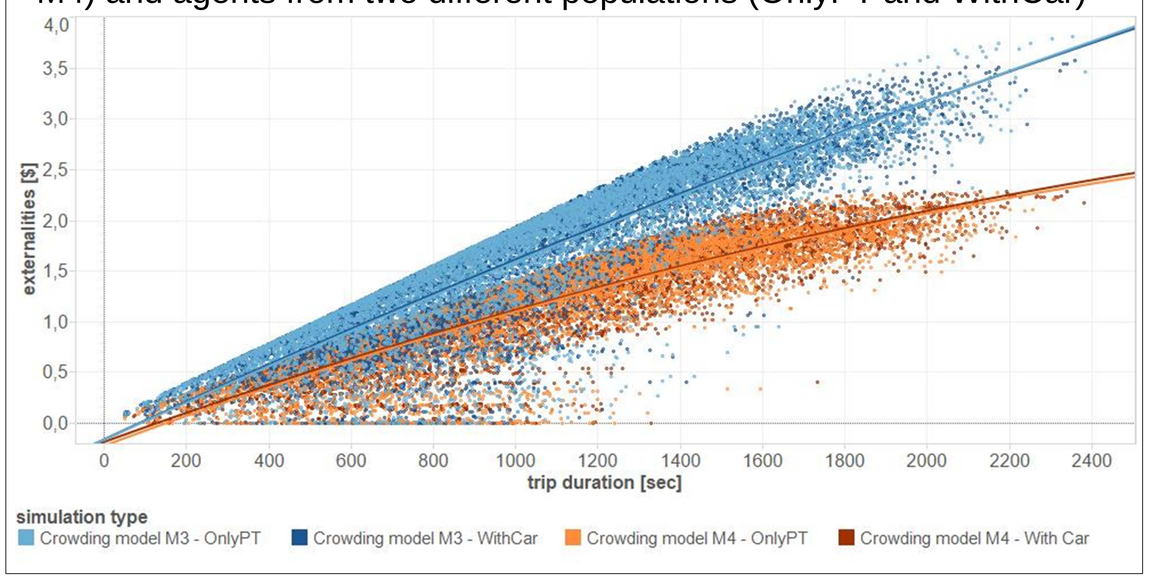
Effects of the implementation of the crowding effect and externalities



Crowding effects and externalities

The implementation of crowding effects in MATSim leads to results such as peak spreading, diminution of the travel times at the peak and increasing the percentage of PT users. The last point even suggests that the implementation of a crowding effect may ameliorate the congestion on the roads. In addition to that, the implementation of externalities increases the benefits cited above and reproduces real behaviors: PT users with higher flexibility make changes in their plans in order to avoid the periods where the externalities are higher.

Relation externalities over trip duration for two crowding models (M3, M4) and agents from two different populations (OnlyPT and WithCar)



Second-Best pricing strategy

The relations found between the trip duration and the externality to pay (or fare) has allowed to design a Second-Best pricing strategy depending of this variable, periods of the day and groups of stops. This new strategy decreases the crowdedness, but less than First-Best pricing. However, these results confirm that MATSim is appropriate for the development of pricing strategies.

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