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Large scale use of collective taxis: a multi-agent approach

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1 Introduction

In metropolitan areas the current transportation system, based on private car use, imposes a heavy burden on society in terms of energy consumption and external costs. Social exclusion is also an issue, as the system is inaccessible to various categories of people. All this calls for new solutions which would bring a more efficient use of environmental and financial resources. This work is aimed to explore the use of on-call collective taxi service as a mean to mitigate urban traffic problems. This idea is not new; however, its application has always encountered size barriers which are yet to be overcome. Collective taxis - or more in general -demand responsive transport, have been, and still are, sporadically implemented in western countries; but their application is usually intended to answer to some special needs or to be used in some special area.

The main claim of this work is that the use of such services at a large scale could help to reduce the use of private cars. A large scale collective taxi system will be outlined and modeled in a framework which allows the assessment of its practical feasibility and potential. Traditional transport modeling does not seem to be well placed for this, having known limits assessing the potential of new transport modes in general and of innovative transport systems in particular. Here, an agent-based micro-simulation approach is proposed. This allows to model the system at high spatial resolution, but also to consider the behaviour of single individuals. Agent based modelling is a suitable tool to implement direct interaction between demand (agent-based) and supply (collective taxis) and, therefore, predict the potential of a large scale collective taxi system and evaluate its operational feasibility. This approach is modular, thus flexible, and other analyses can be performed in the future, like the evaluation of policy impacts or the evaluation of societal costs and benefits of different scenarios.
2 Context

An already existing simulation tool, MATSim-T (Multi-Agent Transport Simulation Toolkit, Balmer, 2007) will be the basis for this work. MATSim is an agent-based activity-based traffic microsimulation tool, which produces individual daily transport demand as output. The tool will be extended to represent all the different aspects of the new system. Presently, collective taxi is not considered as an option in the mode choice process of MATSim-T. A transport mode is assigned to each agent depending on the socio-demographics characteristics and distances involved and this choice is not optimized at successive stages. A new mode choice module will be introduced into MATSim, where monetary costs are explicitly considered and agents seek maximum satisfaction within their budget constraints. Every actor of the transport system, both on the supply and the demand side, can be simulated in MATSim-T according to the agent paradigm. In the current version each traveller of the real system is modelled as an individual agent while the supply side is modelled as fixed constraints of the system. A new agent representing the collective taxi operator will be introduced in MATSim. In the context of this project a general framework for the implementation of suppliers as agents will be set up.

3 Contents

The main contribution to this work will be the introduction of the collective taxi operator in the system. The specific taxi system is conceived as a proximity transport expected to link the start/destination with the nearest point of the public transport network. The access to the network would become more convenient also in areas where public transport is not directly available. Some of the most important aspects to be modelled are the location of the stations of the taxis, the pricing and waiting time for the customer. Initially a static approach will be used, the characteristics of the taxi system will be considered fixed and modelled as constraints. In a successive stage, the operator will be modelled as an agent and will be able to modify its offer from iteration to iteration trying to optimize itself according to a specified target function. A series of simulation experiments will be conducted with the taxi mode as a full mode. First, such experiments will be performed to test the functionality of the new mode choice module integrating the taxi system as an alternative. Afterwards both the simple static approach and the dynamic one will be used and a first assessment of the system’s potential for the test area, the Zurich agglomeration area, will be computed.
By the time IATBR will take place the modelling part will be completed including the agent based approach for the taxi operator, and the first simulation experiments run. The paper thus, will deliver two main scientific results. A preliminary analysis of the possibility to extend the use of collective taxi far beyond their current size limits and the effects that such a system would have in term of traffic mitigation. But it will deliver also an improved evaluating tool, able to simulate different transport modes and assess their capacity to attract customers according to their characteristics.

4 References


