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On the use of on-line services in transport simulation

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Abstract

In this paper, we introduce a new approach for collecting data for transport simulation models that is using on-line services in order to outsource parts of the modeling and computation of simulation models. We describe our approach of using on-line services as part of a simulation model and we present our experiences of applying the approach to a case study using the ASIMUT model, where the travelers between two neighbour cities in Southern Sweden are modeled. The results from our case study shows that the use of on-line services for data collection in transport simulation can bring advantages to the simulation model, for example, in terms of reduced needs for modeling of the transport system as well as computation inside the simulation model and improved access to the most recent information. We also noticed some limitations, such as the inability to access to information regarding the future such as timetables and no control over data provided by third-party services. However, we argue that there are solutions for each of the identified limitations, and therefore we believe that the suggested approach might provide a unique opportunity for future transportation simulation models.

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1. Introduction

Transportation simulation is one of the most common approaches for supporting the decision making in transportation planning through, e.g., enabling to predict the impacts of new transportation policies and infrastructure investments. Based on the questions that a simulation model needs to answer, different types of data needs to be pro- vided to the simulation model. These data ranges from socio-demographic attributes of people to the transportation network data.

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The traditional approaches for preparing input for simulation models are usually about analyzing his- torical data, national surveys and censuses, and calculating origin-destination matrices. In traditional approaches, the data is either built into the model, or the data needs to be fed into the model manually by the modeler. The traditional data preparation approaches are complex and time-consuming since some of the data preparation work needs to be done manually. Furthermore, the data cannot be changed frequently due to the complex and long procedure of data preparation; therefore, these data are prepared and used as static data.

In this paper, we introduce a novel alternative approach to the traditional approaches for data collection and preparation. Since, in the suggested approach, most of the steps in the modeling and computation are done by third-party services, the input to the simulation can be changed dynamically. Moreover, on-line travel planner systems are becoming more popular these days. This means that people's travel behavior is most probably changing based on suggestions provided by these systems. Therefore, the use of on-line travel planners for estimating people's travel behavior can increase the accuracy of the travel behavior modeling in simulation systems. In this paper, we empirically investigate the advantages and limitations of our proposed approach for modeling, computation, and data preparation in an agent-based simulator for urban passenger transport (ASIMUT)[8].

2. Related work

The predominant type of passenger transport analysis models, which are used by public authorities on regional, national, and international levels in order to support their decision-making, is the so-called macro-level models. Macro- level models are based on highly aggregate data, and they are often described as top-down models as they are built with the purpose to reproduce known (aggregate) transport statistics, typically on national level. Examples of models of this type are the Swedish national passenger transport modeling system (Sampers)[1], and TRANS-TOOLS[9], which is an EU-level model for passenger and freight transport modeling[5,12]. Macro-level models are in general steady-state models, where time is not explicitly modeled, even though they might include components that are based on dynamic modeling. This means that, for example, bus and train departures in macro-level models are typically modeled using frequencies and average travel times instead of using timetables.

As macro-level models use aggregate data, it can be argued that the amount of data that needs to be collected, and included in the model, can be considered to be rather reasonable; at least when comparing with micro-level modes, which we discuss below. Moreover, in macro-level models, the data is in general included as a part of the model.

Micro-level models are those models where individual entities are studied over time, and they are therefore often referred to as dynamic models. Dynamic models are often used by public authorities, in order to study traffic in congested areas. Agent-based models are a special type of micro-level models, where some or more of the modeled entities are represented as agents. Agent-based models are often referred to as bottom-up models since the behavior of the modeled individuals, and the interactions between individuals are modeled and validated, and the outcome of the model is a consequence of how the individuals are modeled. An example of an agent-based passenger transport model is ASIMUT[8], which we use in this paper to show the proposed data collection approach. ASIMUT is discussed further in section 4.

From a data perspective, agent-based models (or micro-level models in general) are more data intensive, as they require data describing all the modeled entities (e.g. [13,10,2,6,7]). Obviously, it is possible to use statistical distributions in order to model the diverse behavior of the individuals, but such an approach still requires quite some effort on collecting micro-level data that represents the modeled population. As agent-based models are dynamic in nature, they also need data that allows to model entities over time, such as timetables for buses and trains. Obviously, this means that the amount of data that needs to be collected and included in the models can be quite large, in particular when studying large scenarios. Therefore, it is not always possible to build agent-based models where all of the required data is included as a part of the model, which is the case for the macro-level models discussed above.

Agent-based models are therefore sometimes modeling frameworks, which includes building blocks that can be used in order to build different analysis models. An example is the MATSim modeling framework [3], which can be used in order to construct different types of passenger and freight transport models.

Through the use of modeling frameworks, it is possible to develop models using a minimum amount of data, as