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Generating Dynamic Activity-Travel Schedules

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Abstract

While making decisions, governments and policy makers are supported by models in order to estimate the impact of their decisions on society as a whole. Transportation models compromise a major example of such decision supporting models. After all, transportation models are applied to monitor travel behaviour, to evaluate policy decisions, to assess the environmental impact of traffic, etc. To this end, transportation models previously consisted of aggregate, trip-based models to estimate travel demand.

During the past decade, activity based-transportation models entered the area of transportation modelling. Such models assume that travel patterns are the result of activity schedules that individuals execute in their attempt to achieve certain goals. Therefore, activity-based models aim at simulating the individual decision-making behaviour concerning several activity-travel related dimensions simultaneously. For instance one decision compromises the following facets: which activity to perform at which location, when to start this activity and for how long, which transport mode along which route to use in order to get to the desired location, who will accompany the individual during the course of the activity, etc. The resulting activity-travel schedules constitute the basis of the assignment of the individual routes to the transportation network, and as such estimating aggregate travel demand. (Ettema and Timmermans, 1997; Timmermans, 2000)

Such activity-based transportation models offer the opportunity of predicting travel demand more accurately as they provide a more profound insight into individual activity-travel schedules. Furthermore these models enable estimating more realistically the impact of a policy on transportation related issues, for instance traffic safety, environmental pollution and land use patterns.

Yet, the majority of such models is still quite static. Therefore, dynamic activity-based models are introduced quite recently in this research area. These models attempt at simulating the dynamic decision-making process of individuals interacting with the environment. For this purpose, agents simultaneously enter the transportation network and determine dynamically their activity schedules and routes. This signifies that, after having determined an activity schedule for each agent, the system executes the schedules of all agents simultaneously, i.e. all agents are processed in a given time step before going to the next time step. (Arentze, *et al.*, 2005)

In the course of each time step, actual travel times are estimated and updated. Furthermore the effect of possible unforeseen events in the course of the execution of activities – e.g. negative or

positive delays – or unexpected travel times, causing a mismatch between a scheduled and actual end time of an episode, can be simulated. After all, the resulting time-surplus or time-lack situation at the moment of completing an episode can trigger short-term rescheduling. In addition, long-term learning can be incorporated into this model as well as an agent – after having executed the entire schedule – will update his knowledge and beliefs with respect to the different attributes concerning his activity and travel behaviour. (Arentze, *et al.*, 2005)

Before being able to account for the above described processes of rescheduling and learning, the dynamic activity-travel schedules need to be captured in a model. The goal of this research thus consists of developing such activity-based scheduling algorithm. The present research aims at contributing to this purpose, relying on modelling techniques that originate from the area of scheduling and planning. The selected micro simulation technique will have to take into consideration a range of temporal and spatial constraints, for instance coupling constrains, opening hours of shops and public authorities, availability of transport mode and available time windows in which the activity can take place. To this end some previous researches point the way to the area of operational research, e.g. the pickup and delivery problem with time windows (Recker, 1995), the area of project network scheduling, e.g. resource-constrained project scheduling (Icmeli, 1993), or the area of artificial intelligence, e.g. (relational) reinforcement learning (Arentze and Timmermans, 2003; Charypar and Nagel, 2005; Džeroski, *et al.*, 2001) or Bayesian updating (Jha, *et al.*, 1998).

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