CHAPTER 67

Dublin

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67.1 Introduction

To demonstrate a new spatial choice model, a microsimulation of urban traffic flows for the greater Dublin region was implemented using MATSim. The scenario simulated leisure activities and commuting trips completed by individuals using private cars over a twenty-four hour period. For commuting trips, detailed information from the Irish Census was used; a new spatial choice model, inspired by the radiation model, was developed for leisure trips. The effectiveness of the approach was validated using hourly data from count stations on the main motorways around Dublin City. The results show that the microsimulation accurately reproduced traffic volumes.

67.2 Study Area

County Dublin, in Ireland, covers an area of approximately 115 square kilometers and encompasses several administrative areas. Dublin is a coastal county with the Irish Sea lying to the east. To capture both intra-city and inter-city flows, the scenario considered individuals who live or work in Dublin, capturing those who commute to or out of Dublin, as well as those who live and work there.

67.3 Network

To capture the desired study area for the scenario, the network consisted of all roads in the greater Dublin region and major roads for the remainder of the country. The road network was a mix of motorway, national routes and local roads and was extracted from OSM, along with other information such as speed limits and number of traffic lanes. This OSM network was prepared for use in

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MATSim. This study focused on private vehicles; the public transport network was not considered, but can be incorporated into the microsimulation in future studies.

67.4 Population Generation

The population for this scenario consisted of all car drivers who live or work in the greater Dublin region and was prepared from a variety of data sets. To obtain home and work locations, the 2011 Irish Census was used, particularly a census subset called POWSCAR (Place of Work, School or College Census of Anonymised Records). This provided home and work locations, mode of commuting transport used, time of departure for work or school and a variety of socio-economic data at an individual level. The individuals relevant to this scenario (drivers who live or work in Dublin) were extracted from the data set. In POWSCAR, home locations are anonymized by aggregating them into a statistical unit called the small area, consisting of 80 to 100 households. In the greater Dublin region, this represents a street or an apartment complex. We translated this to an individual address point by selecting a random address point within the small area. For this process, we used a commercial database of addresses and their coordinates in Ireland called Geodirectory. To account for non-workers, we used census statistics to generate the spatial distribution of the number of sick, unemployed and retired persons along with car ownership details to produce the non-working population for the greater Dublin region. These were also assigned to individual address points, providing us with a population of 600 000 agents for the scenario (see Figure 67.1).

67.5 Demand Generation

Individuals from the population were assigned work and school locations according to POWSCAR (Figure 67.1). In POWSCAR, work and school locations are given at a 250 meters grid level and we translated them into individual address points using Geodirectory. For school and collage locations, the address point was checked using NACE (from the French title 'Nomenclature générale des Activités économiques dans les Communautés Européennes') codes, to confirm its status as an educational institute. Departure times for work and school were assigned using a Gaussian curve centered at the declared 30 minute departure time from POWSCAR. INTS (Irish National Travel Survey) was used to create non-commuter demand for the road network. Through a survey, the INTS collected a 24 hour travel diary for an Irish population sample recording journey origin, destination, departure time and mode. We extracted the private car mode and combined the data with the commuter data to create a 24 hour activity chain for each individual in the population.

67.6 Activity Locations

A set of activity locations were obtained from an in-car navigation system's POIs (Points of Interest) database and augmented with additional POIs from OSM. While work locations were assigned from demand generation, locations for secondary activities, such as shopping and leisure, were not specified in the INTS and so had to be modeled to create spatial and temporal activity chains for the population. We developed a radiation model variant that applied emission-absorption ideas to compute interaction probabilities for a set of origins and destinations. The radiation model was parameter-free and distance decay was replaced by a ranked-based decay (Simini et al., 2012). While generally used for modeling movement between regions or cities, we used this approach to produce probabilities of selecting different locations capable of fulfilling a given activity. Where the radiation model uses known populations of locations to produce region ranking, we used attractiveness scores for areas and facilities that could fulfill an activity. A facility, venue or area's

Figure 67.1: The distribution of work (upper image) and home (lower image) locations for part of the Dublin scenario.

attractiveness was derived from venue size, which was calculated using domain knowledge and the model was calibrated with trip distribution patterns from social media check-in statistics. This radiation model variant was used to assign locations to secondary activities in the agents' day chains for the Dublin scenario demand.

67.7 Validation and Results

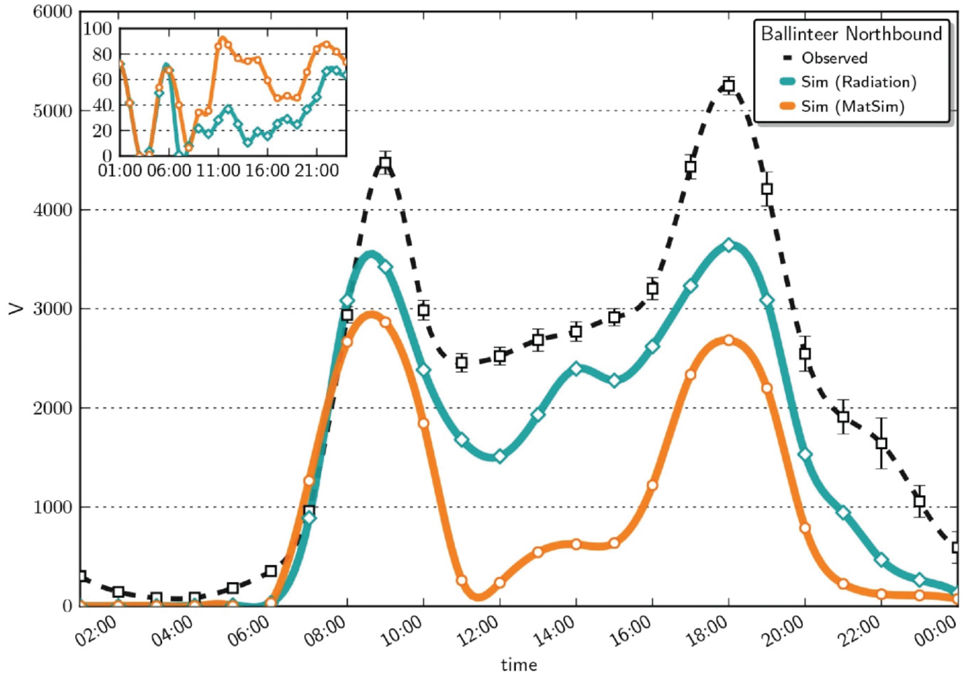
Network, population and demand data were prepared for use with MATSim. For efficiency reasons, a 25 % sample of the population was used for the simulation. The location choice model described above was used to generate the initial demand. On each interaction of the simulation, agents could be rerouted or rescheduled according to the MATSim default settings, but the locations defined in activity chains remained constant. The simulation reached a stable state after 350 iterations. The road volume data output was scaled according to the sample used, aggregated to an hourly count and compared to the observed count data from 6 count stations on motorways around Dublin. In order to compare the effect of the new location choice model, the simulation was re-run using the MATSim nearest neighbor algorithm for selecting secondary activities' locations.

67.8 Achieved Results

Aggregated hourly counts were compared with those observed at the 6 count stations which determine the number of vehicles traveling in two directions. A typical hourly distribution was obtained by averaging mid-week traffic volumes for a 3 month period. The results produced by the radiation model showed a stronger correlation between simulated and observed counts than those from the nearest neighbor approach. Figure 67.2 shows hourly observed and simulated count data for two count stations; the inset shows the relative percentage error for the two approaches being tested. The results indicate that both techniques are effective for estimating commuter traffic during morning and evening peaks. This was to be expected as the location of school and work activities were provided from real world data, but it did confirm the MATSim routing algorithm effectiveness. For daytime traffic, which consisted mostly of secondary activities, our variant of the radiation model outperformed the nearest neighbor approach; it included individuals who were willing to travel further for better opportunities, producing more accurate results.

67.9 Associated Projects and Where to Find More

The Dublin scenario validation results demonstrated the effectiveness of MATSim as a traffic simulation tool and also showed the power of our spatial choice model which adapted the radiation model to predict individual movement at a small spatial scale. In the future, the research will be expanded by considering a multimodal transport network and scaling the scenario from an urban simulation to a national one. Full details of the Dublin scenario can be found in McArdle et al. (2012) and McArdle et al. (2014).



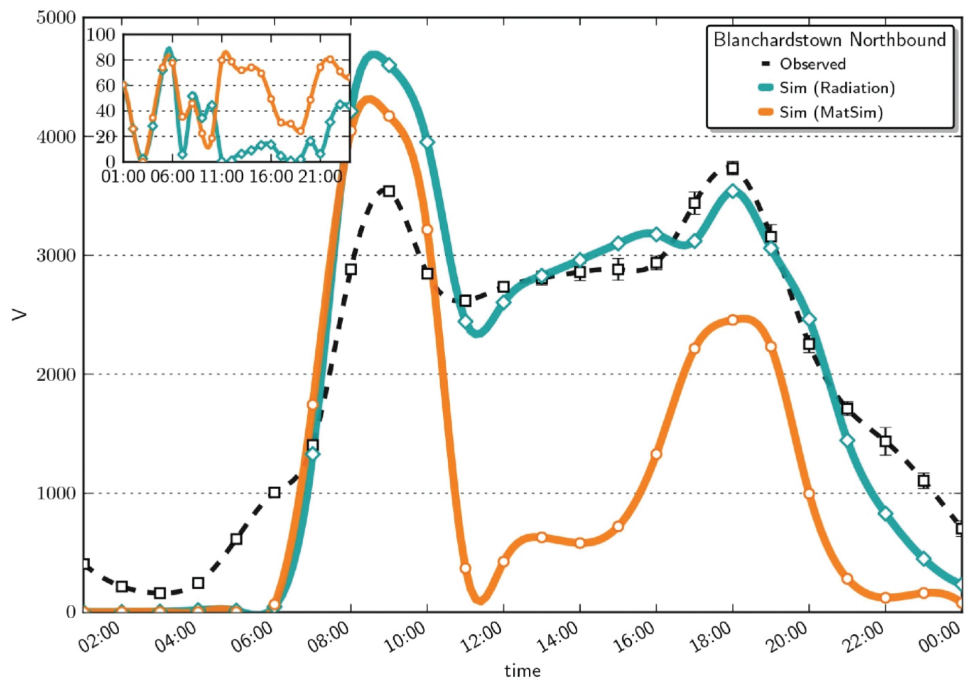


Figure 67.2: Hourly observed traffic volumes (dashed line) compared to the estimated traffic volumes produced by MATSim using the radiation model (green line) and nearest neighbor model (orange line).