Examining Demographic Heterogeneities in Melbourne's MATSim Model

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Abstract

Studies have shown that daily activity patterns and transportation mode choices vary significantly among demographic groups, including differences across age groups and between male and female travellers. This necessitates the incorporation of these factors into transport models, designed to examine behaviour change interventions at an individual level. This study presents recent developments in Melbourne's MATSim-based transport model called Activity-based and Agent-based Transport of Melbourne (AToM) (Jafari, Singh, et al., 2021), where we employed a cluster-based approach to model demographic differences in individuals' choice of activities and travel mode.

AToM comprises an activity-based transport demand model, a MATSim-based transport simulation model, and a series of simulation input generation and output post-processing tools. The activity-based model creates a synthetic population for Melbourne, assigns a chain of activities to each synthetic person, as well as timing and location of these activities. It also assigns a preliminary transport mode for travelling to each activity, primarily used when assigning activity locations. During the MATSim traffic simulation, travel modes and routes are dynamically assigned considering congestion, public transport schedules, and delays. The initial version of AToM considered only two sub-populations: workers and non-workers, with mode shift innovation enabled solely for the worker population. In the present model, we have integrated the demographic differences in activities and mode choice behaviour into the simulation model.

Firstly, travellers in Melbourne were divided based on the Victorian Integrated Survey of Travel and Activity (VISTA) 2012-18 into Sex (M/F) and Age (5-year intervals) groups. Next, we calculated the probabilities of different activity chains for each of these cohorts. K-means clustering was employed to segment Melbourne travellers into five distinct clusters based on activity-chain probabilities.

The activity-based transport demand generation algorithm developed by Both et al. (2021) was used to generate transport demand for travellers from each cluster separately. The output represented a 10% sample of Melbourne's population, including their trips and activity itineraries.

Separate mode choice models were estimated for travellers of each cluster using VISTA 2012-18 data, filtered for trips that started and ended in Greater Melbourne with one of the travel modes: Walking, Cycling, Public Transport, or Driving. We used Google's Distance Matrix API to estimate travel times for walking, cycling, public transport, and driving, reflecting a typical mid-week workday in January 2022. We then used multinomial logistic regression to estimate the choice parameters for each cluster, utilizing the estimated parameters for creating the scoring function of the MATSim model. The same road and public transport network used in AToM was utilized. This network was generated using the algorithm developed by Jafari, Both, et al., (2021), with OpenStreetMap and GTFS data for October 2019 as primary inputs. The mode choice functionality of the resulting MATSim model was calibrated using real-world travel survey data. Traffic count data for walking, cycling, and driving, as well as train station survey data, were used to analyse traffic volumes.

This demographic cluster-based approach in building city-scale simulation models provides more nuanced and detailed insights into Melbourne's transport demand. It also enables the examination of heterogeneities in transport behaviour changes under different scenarios and across different neighbourhoods with different demographic compositions using the simulation model.

References

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