Multi-agent transport simulation of South African commuters

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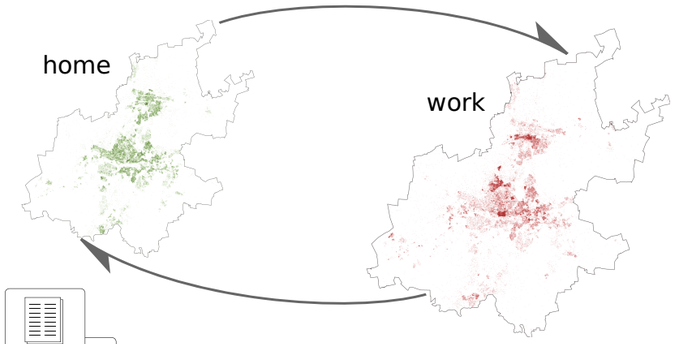
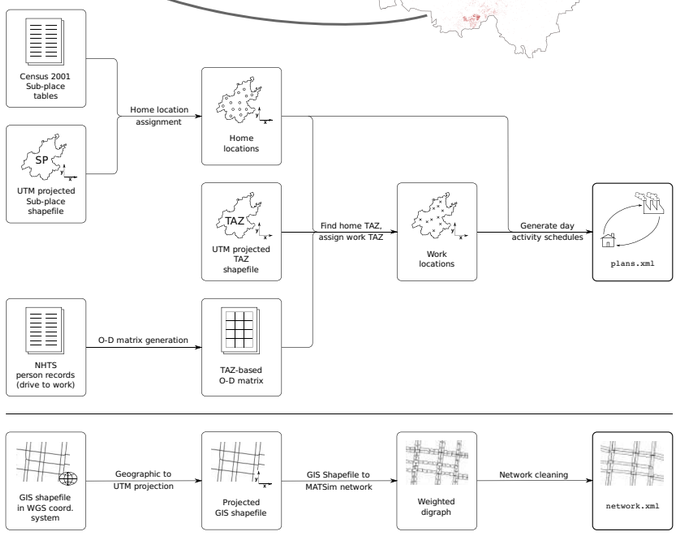




1. Data preparation procedure

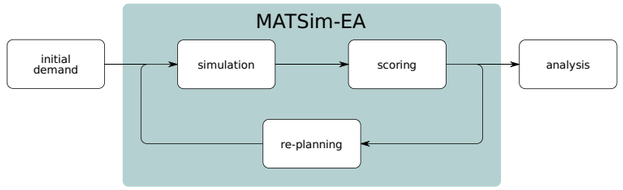
We only model the primary activity chain, so we require home and work locations for our synthetic population of private vehicle commuters. Each home location (scattered points top left) is derived from processed census data, and associated with a work location derived from National Household Travel Survey data. We interpret GIS centreline shapefiles to arrive at a network description. The diagram above illustrates the process flow to create our initial transport demand (`plans.xml`) and `network.xml` file, which form the minimum required input to a MATSim simulation.

Gauteng Province:

8.8 million people

33.9% of National GDP

~10% of entire continent's GDP



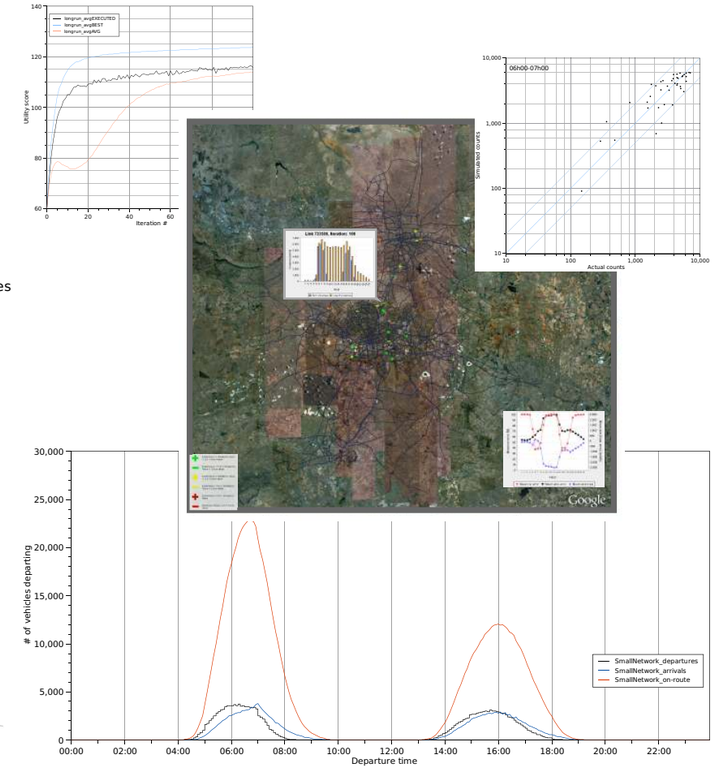
2.(a) MATSim operation

MATSim employs an Evolutionary Algorithm (EA) approach of systematic relaxation to arrive at an equilibrium state where no commuter can perform better by employing any of the re-planning strategies available to it. These strategies include, but are not limited to, changing activity timings, re-routing travel legs based on the previous iteration's link travel times, and even shuffling or removing activities in the day activity schedule.

Each agent starts with an initial plan, derived in the previous step, which serves as the basis of all further plans the agent commits to memory. Agents discard poor performing plans in favour of better ones, to simulate individual and system learning.

2.(b) Large-scale stochastic queue simulation

Snapshot of MATSim simulation of Gauteng's private vehicle traffic taken at 06:22:35. MATSim keeps detailed records of all agent activities on a per second-basis, making it possible to view an individual traveller's actvitity chain (top), or the home locations of all agents traveling across a link (bottom).



3. Simulation output

Some of the post-simulation analyses MATSim performs. Top left is a plot of average plan utility scores vs. number of iterations. To its right is a simulated vs. actual traffic counts comparison for the morning peak hour. The Google Earth image shows count station locations and error bias, as well as the counts histogram of a south-bound count station, and summary error information. The bottom plot depicts a time-based histogram of departure and arrival times, and time spent en route.

Abstract

Transport demand planning in South Africa is a neglected field of study, using obsolete methods to model an extremely complex, dynamic system composed of an eclectic mix of First and Third World transport technologies, infrastructure and economic participants.

Our research group investigated the capability of the transport microsimulation package, MATSim, to capture the unique dynamics that emerge in the South African metropolitan context. Our initial implementation models the passenger vehicle traffic of the Gauteng province, South Africa's densely populated economic hub. Initial results are promising, with simulated traffic counts on important road network links closely following the trends observed in reality during the morning and afternoon traffic peaks.

The poster illustrates the development of the initial implementation, and focuses on the procedures followed to interpret and transform source data into a format suitable for MATSim. Efforts are underway to extend the initial implementation to include public transport and commercial traffic, as well as the highly interactive minibus-taxi paratransit mode.

MATSim
Multi-Agent Transport Simulation
http://www.matsim.org

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