Urban Mobility Evaluation Using Small-Area Geography and High-Resolution Population Data (P15-5698)

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Summary

- High-resolution and big data resources have brought challenges and opportunities in urban mobility modeling.
- Volunteered geographic information and high-resolution population data, together with Census Transportation Planning Products (CTPP) data, can help modeling and evaluating urban mobility scenarios on a unified platform.
- We developed the Toolbox for Urban Mobility Simulation (TUMS) system to simulate urban transportation systems with microscopic approach at global level.
- The major features of the TUMS are:
  - ✓ Open-source and independent platform
  - ✓ Open data and unified data structure
  - ✓ Large-scale microscopic traffic simulation
  - ✓ Two levels of visualization

Urban Mobility Modeling

The **T**oolbox for **U**rban **M**obility **S**imulations (**TUMS**) system consists of three major modules, as shown in Figure 1. It runs on different operation systems.

- **Data Processing**
  - ✓ Volunteered geographic information, OpenStreetMap, provides road network data. Figure 2 shows an example in Alexandria city.
  - ✓ High-resolution population data, LandScan, estimate mobility dynamics and trip numbers. Figure 3 shows both data time and night time population distributions.
  - ✓ Open data, such as CTPP, provides TAZ zones (Figure 2) and helps building the travel demand models.

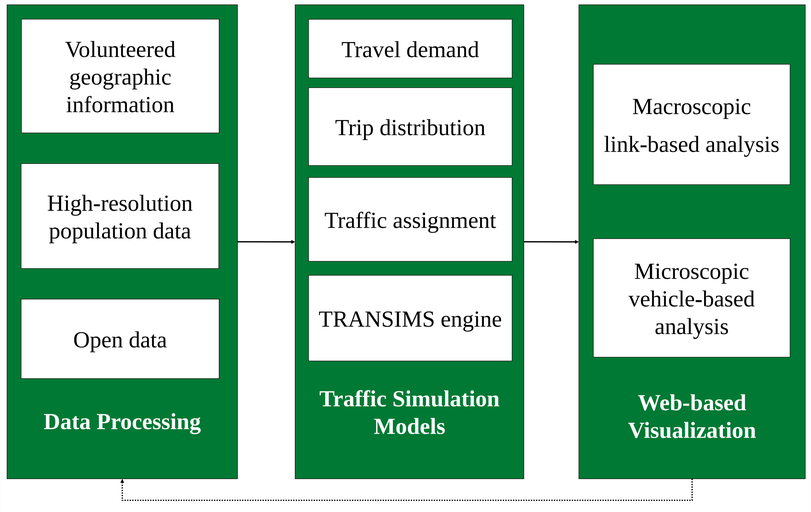

Figure 1 The TUMS System Architecture

Figure 2 Alexandria City Streets Network and Traffic Analysis Zones (TAZs)

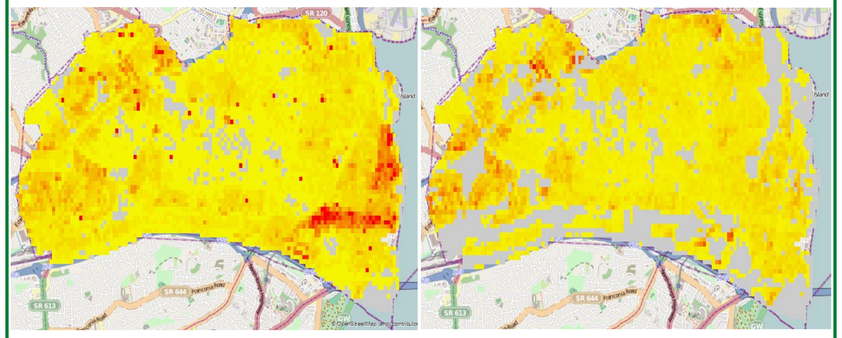

Figure 3 Alexandria city LandScan population data cells: Daytime (left) and Nighttime (right); red: higher population; yellow: lower population; grey: zero

- **Traffic Simulation Models**
  - ✓ Travel demand modeling: the number of trips (VPC ratio) and travelers departure time choices (S curve)
  - ✓ Trip distribution modeling: origin-destination matrix for emergency evacuation scenarios.
  - ✓ Traffic Assignment modeling: road netowrk access and routing issues. Comparing the impacts of spatial and temporal resolutions. The results is show in Figure 4.
  - ✓ Small-area geography data improve simulation accuracy.
  - ✓ Use TRANSIMS as traffic engine for large-scale macroscopic and microscopic simulations.

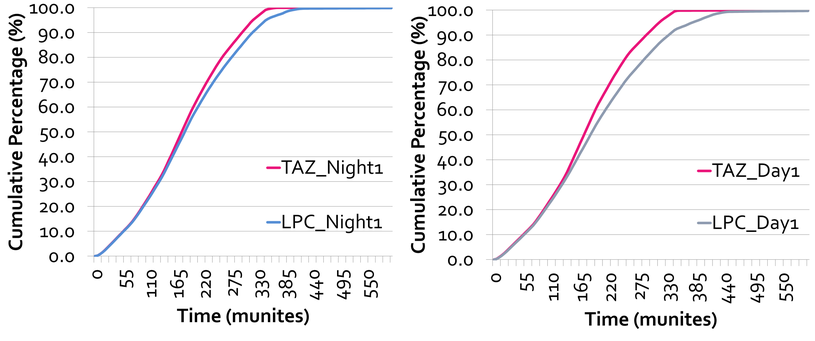

Figure 4 Impacts of Spatial and Temporal Resolution s in Alexandria City Evacuation Efficiency Studies

- **Web-based Visualization**
  - ✓ National and global study for large-scale geospatial area.
  - ✓ Link-based macroscopic visualization for network performance analysis, as Figure 5.
  - ✓ Vehicle-based microscopic visualization for driving behavior monitoring, as Figure 6.

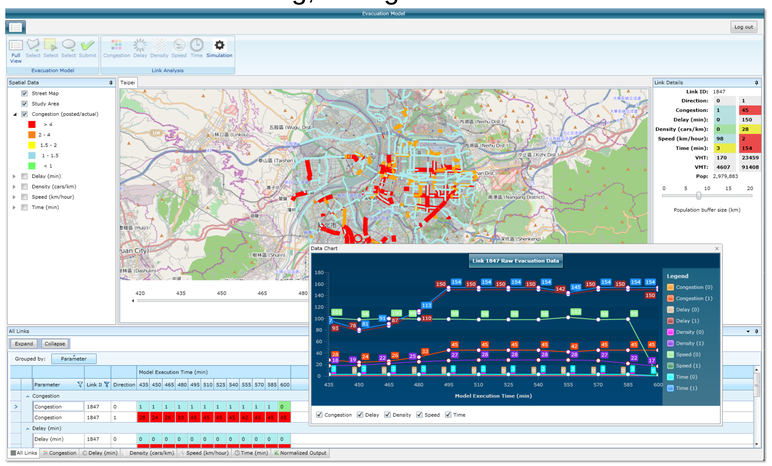

Figure 5 Link-based Macroscopic Visualization tool

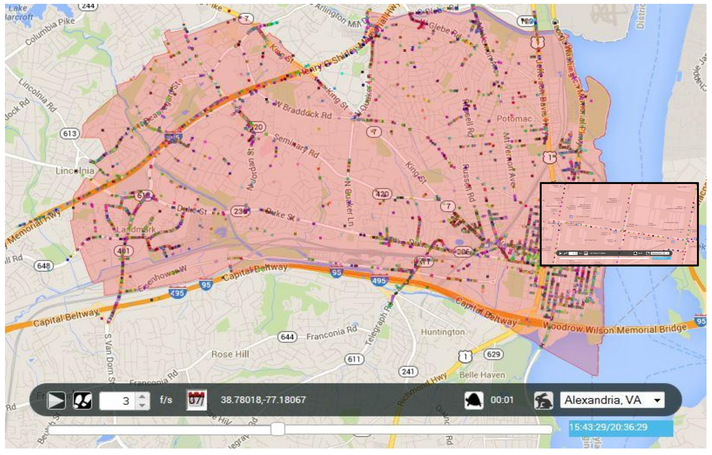

Figure 6 Vehicle-based Microscopic Visualization in Alexandria

Discussions

- The TUMS can simulate world-wide transportation and mobility scenarios with open data, unified data preparation, and two levels of visualization
- CTPP provides high-resolution level (TAZ) origin-destination traffic flows to benefit microscopic traffic simulation.
- The large margin errors for small area geography can use high-resolution population distribution data as adjustment.

Acknowledgments

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