Calibrating a Region-wide Microsimulation Model: Maricopa Association of Governments

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Purpose

• Add analysis of operations and traffic simulation modeling to the services MAG offers to its member agencies

• Build a model to complement MAG’s regional travel demand model that:
  • Has the **operational sensitivity** to capture effects of signal operations, ITS projects
  • Is able to capture the **mobility benefits** of major projects whose impacts will be felt throughout Central Phoenix
  • Accurately portrays the traffic impacts of **transit improvements**, namely on high-capacity transit corridors
  • Provides a **calibrated base model** from which smaller, more focused studies can be derived
Approach

• Study Design Stage
  • Solicit stakeholder input/support
  • Plan model framework, design parameters, and geographic scope

• Model Data Preparation
  • Assemble traffic count and signal timing data
  • Develop simulation model network

• Framework Development and Testing
  • Test, calibrate, and validate the model

• Training
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Design

• A model congruous with the regional travel demand model
  • **Objective:** To achieve a degree of integration with the regional travel demand model such that they can share key model data seamlessly
  • **Solution:** A simulation model in TransModeler capable of reading all file formats and data structures of the regional model in TransCAD and sharing a common zonal system (and, hence, ready exchange of origin-destination matrices)

• A multi-resolution traffic simulation model
  • **Objective:** A simulation model with an appropriate balance of high-fidelity treatment of traffic flow phenomena and practical computational performance
  • **Solution:** A microsimulation model enabling selective application of lower-resolution (e.g., meso) and multi-resolution (e.g., hybrid micro-meso) models
Development

1. Preparation of highly detailed lane-level geography/geometry
2. Import of centroids and connectors from regional model
3. Auto-adjustment of TAZ connectivity
4. Manual addition of centroids along study area boundary
Development: Geography/Geometry
Development: Centroids/Connectors
1: Produce Initial Estimate of O-D Traffic Demand from Regional Travel Demand Model
2: Simulation-based Dynamic Traffic Assignment to Equilibrate Route Choices
3: Compare 15-min. Simulated Volumes with 15-min. Segment and Turning Counts
4: Simulation-based Dynamic O-D Estimation to Improve Match with Counts
Iterate Steps 2-4: Repeat DTA to “recalibrate” route choice to the changes in demand resultant from the ODME step.
Validation: 15-minute INRIX Speeds

Visual comparison model speeds with INRIX speeds to ensure start, severity, duration of bottlenecks

Targeted adjustment of trip table to improve match with bottlenecks while maintaining goodness-of-fit with counts
ODME (Step 4) later extended to incorporate observed speeds simultaneously with counts.
Visual Audit

Do route choices comport with expectations, local knowledge?
Visual Audit

Do route choices comport with expectations, local knowledge?

Query paths traversing critical link, turning movement, or arbitrary link sequence

Query used paths by origin and destination
Goodness of Fit: RMSE

How well does the model match observed data?

<table>
<thead>
<tr>
<th></th>
<th>AM Peak</th>
<th>PM Peak</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0600-0659</td>
<td>0700-0759</td>
</tr>
<tr>
<td>Collector (N=62)</td>
<td>93.44%</td>
<td>73.86%</td>
</tr>
<tr>
<td>Arterial (N=1,162)</td>
<td>52.31%</td>
<td>40.18%</td>
</tr>
<tr>
<td>Ramp (N=49)</td>
<td>48.81%</td>
<td>45.98%</td>
</tr>
<tr>
<td>Freeway/Expressway</td>
<td><strong>14.06%</strong></td>
<td><strong>14.28%</strong></td>
</tr>
<tr>
<td>(N=220)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>All (N=1,493)</td>
<td>33.03%</td>
<td>29.37%</td>
</tr>
</tbody>
</table>
Goodness of Fit: AM Scatter Plots

How well does the model match AM counts?

\[ y = 0.9115x - 54.279 \]
\[ R^2 = 0.9475 \]

\[ y = 0.9302x - 45.489 \]
\[ R^2 = 0.9375 \]

\[ y = 0.9254x - 36.982 \]
\[ R^2 = 0.9419 \]
Goodness of Fit: PM Scatter Plots

How well does the model match PM counts?

\[
y = 0.9383x - 221.49 \quad \text{R}^2 = 0.9511
\]

\[
y = 0.924x - 46.772 \quad \text{R}^2 = 0.939
\]

\[
y = 0.9175x - 73.142 \quad \text{R}^2 = 0.9249
\]
Goodness of Fit: Spatial Pattern of Fit

What is the spatial distribution of the percent errors?

AM

PM
Validation: Bottleneck Matching

How well does the model reflect critical bottlenecks in the study area?
Applications

• US-60/Grand Avenue COMPASS Study
• Old Town Peoria Traffic Study
• Various analyses of traffic interchange redesigns and other roadway improvements