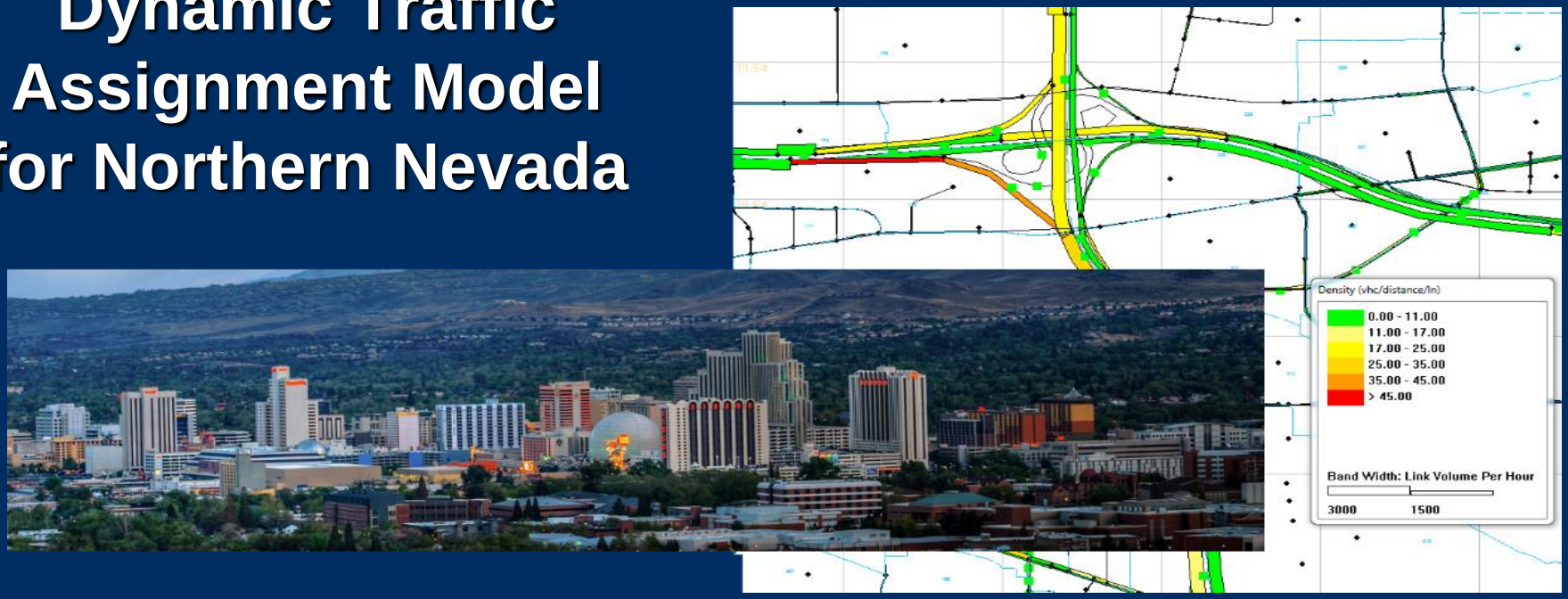
Lessons Learned from Development of a Dynamic Traffic Assignment Model for Northern Nevada



Ali Gholami, Ph.D.
Center for Advanced Transportation Education and Research University of Nevada, Reno
Zong Tian, Ph.D., PE,
Center for Advanced Transportation Education and Research University of Nevada, Reno
Xuesong Zhou, Ph.D.
School of Sustainable Engineering and the Built Environment, Arizona State University

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Static Traffic Assignment (STA)

- **V/C can be more than 1**
- **No spill back**
- The assigned **link volume can be considered as demand**—trips desired to traverse the link—instead of the actual flow.
- In a static model, **FIFO** means that all vehicles traveling on the link experience the same travel time. What this implies is that there is no overtaking between vehicles and, in particular, this means **no overtaking between vehicles that exit the link by different turning movements**.
- As there is no explicit representation of individual lanes in static models, there can be **no distinction between the traffic conditions on different lanes of the same link**. There is no way to represent the fact, for example, that the outside lane of a freeway is at a crawl due to an oversaturated off-ramp, while the other lanes are moving at a higher speed.

STA

- **Other limitations** include, for example, modeling of signal synchronization, modeling of lane-based effects, such as high-occupancy vehicle (HOV) or high occupancy toll (HOT) lanes, as they require representing the special lane as a parallel link. Most intelligent transportation systems (ITS)–related applications, such as traveler information systems and advanced network control schemes (e.g., adaptive control and ramp metering), are beyond the modeling capabilities of static assignment models.
- The widely recognized advantages of static models, including **the ability to solve large-scale problems**, to converge to precise equilibriums and to provide consistency of solutions (if a proper algorithm is used with a sufficient number of iterations) have been aiding policy–project decision making for agencies for decades.

DTA definition

- Dynamic traffic assignment is **based on experienced travel costs**.
- At the moment that the link inflow becomes equal to the outflow, then **the congestion continues to spread upstream** into whichever upstream links are feeding traffic into the congested link. **The outflows of these links are thus reduced**, and the process repeats as described above. This **queue spillback** process also describes how a long queue (congested traffic) can be represented over a sequence of links in a dynamic traffic model.

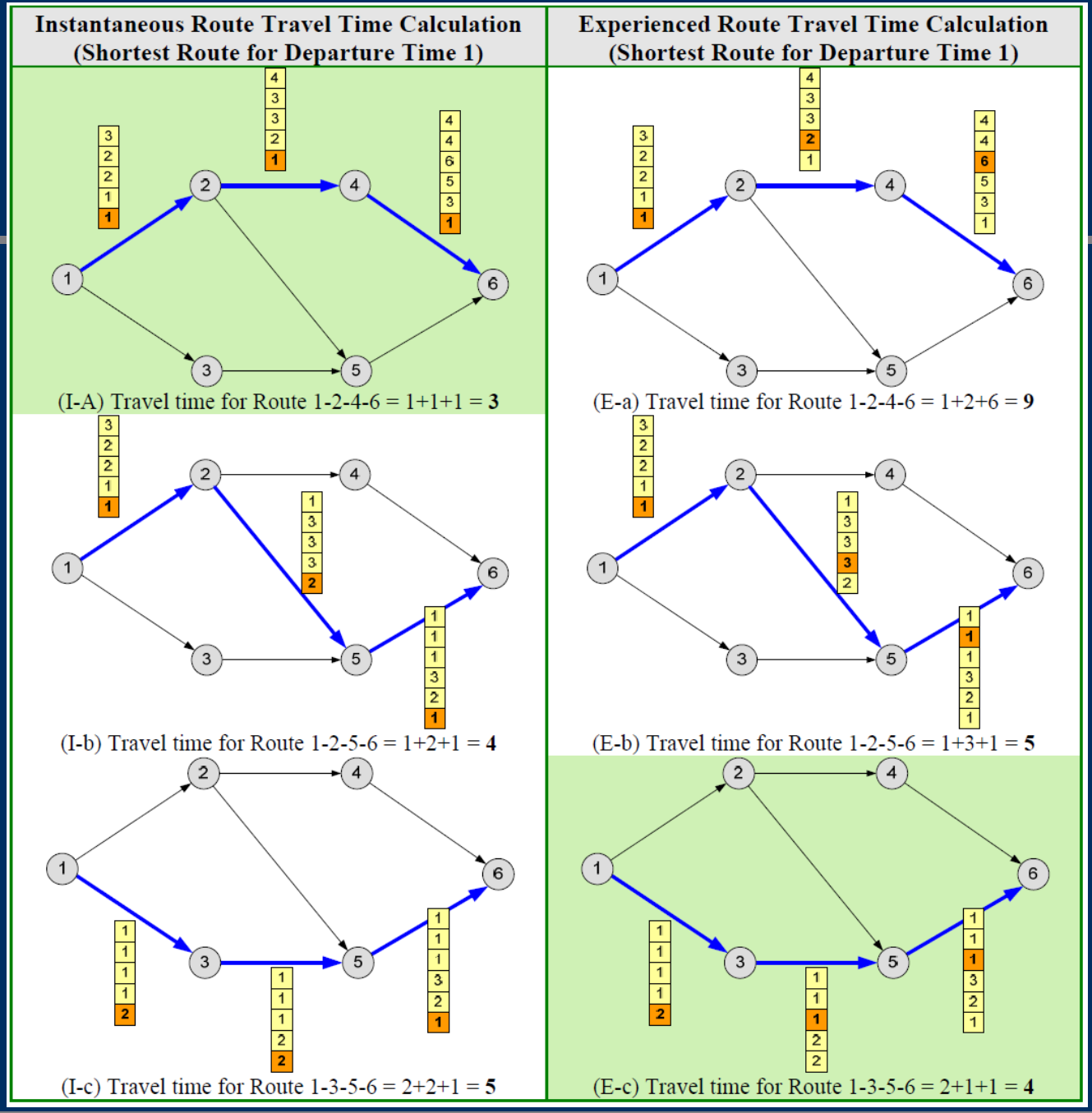
Lesson

DTA and STA are different!

Example

Source: Dynamic Traffic Assignment: A Primer.

TRANSPORTATION RESEARCH Number E-C153 June 2011



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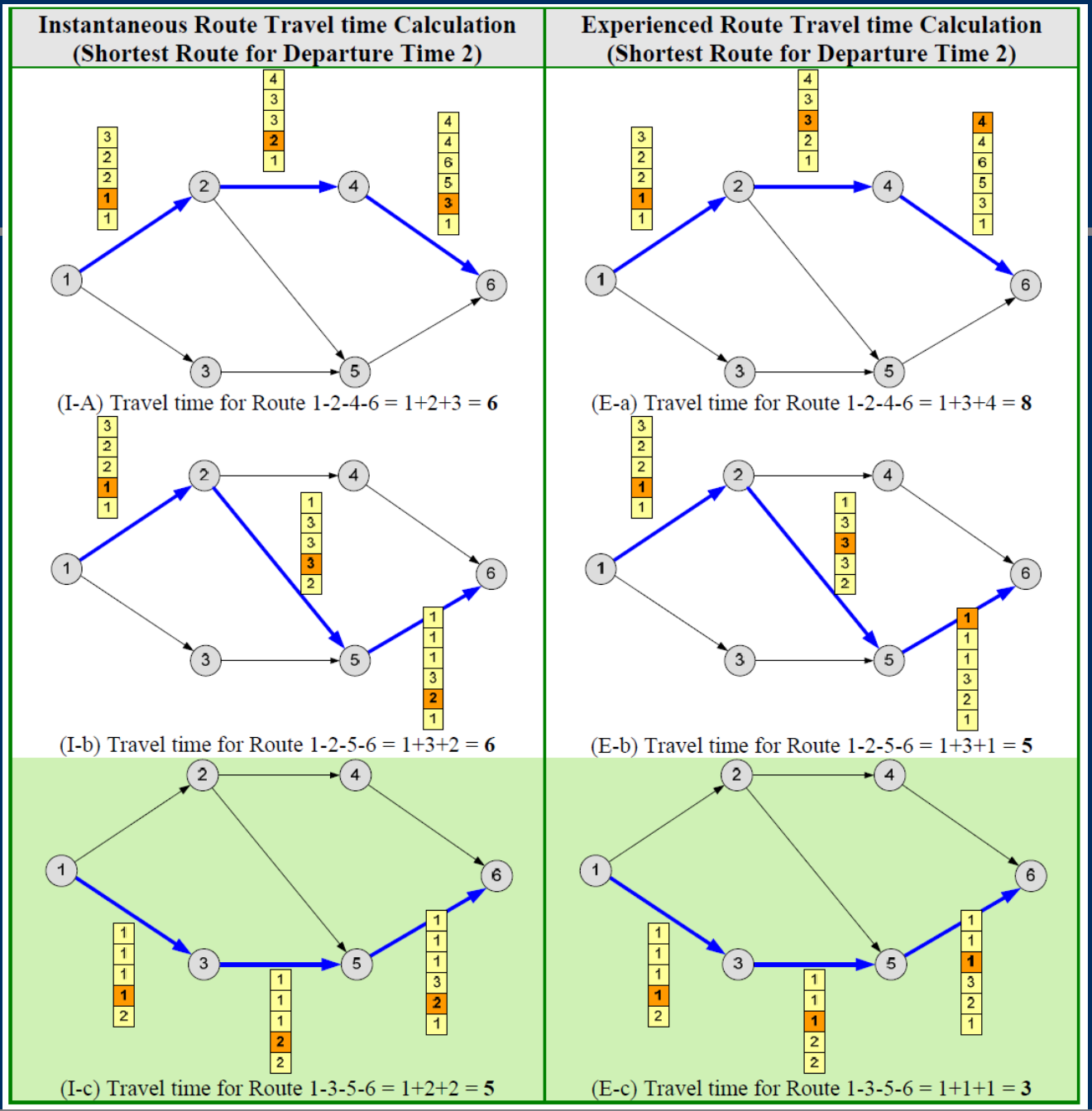


DTA Software Packages

- DTALite
- DynusT
- DynaMIT-R, DYNASMART-X, DynaMIT-P and DYNASMRAT-P
- Dynameq
- TransModeler
- …

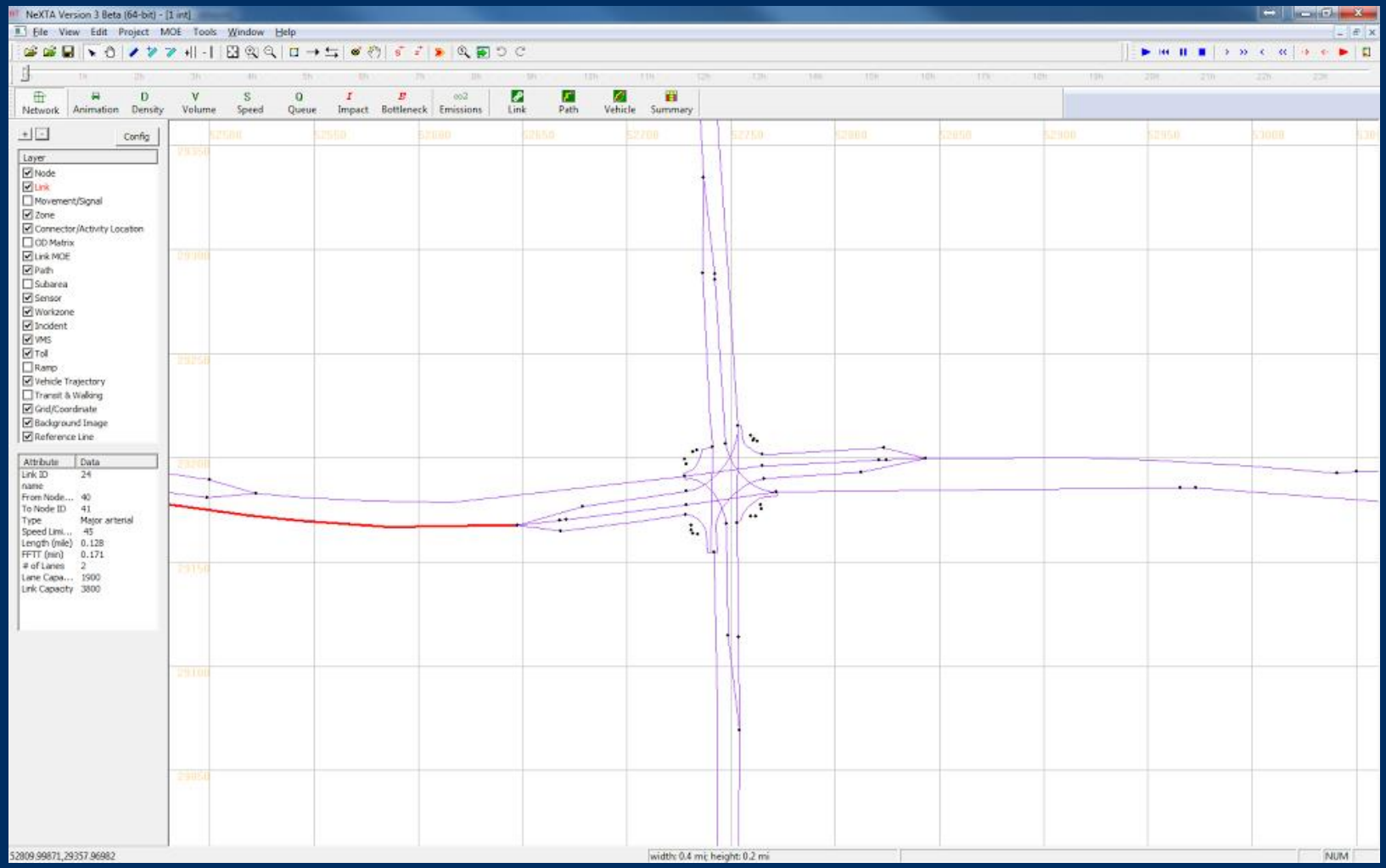
Challenges for Model Comparison

- Traffic simulation tools differ significantly
  - Software architecture
    - Data structures, loop implementation, procedures
  - Modeling features, assumptions, simplifications
    - Vehicle and user classes, value of time (VOT)
    - Network representation
      - Lanes, lane groups, turn bays
    - Shortest path, vehicle propagation algorithms
  - Default parameters
  - Visualization and output generation

Lesson

DTA software packages are different!

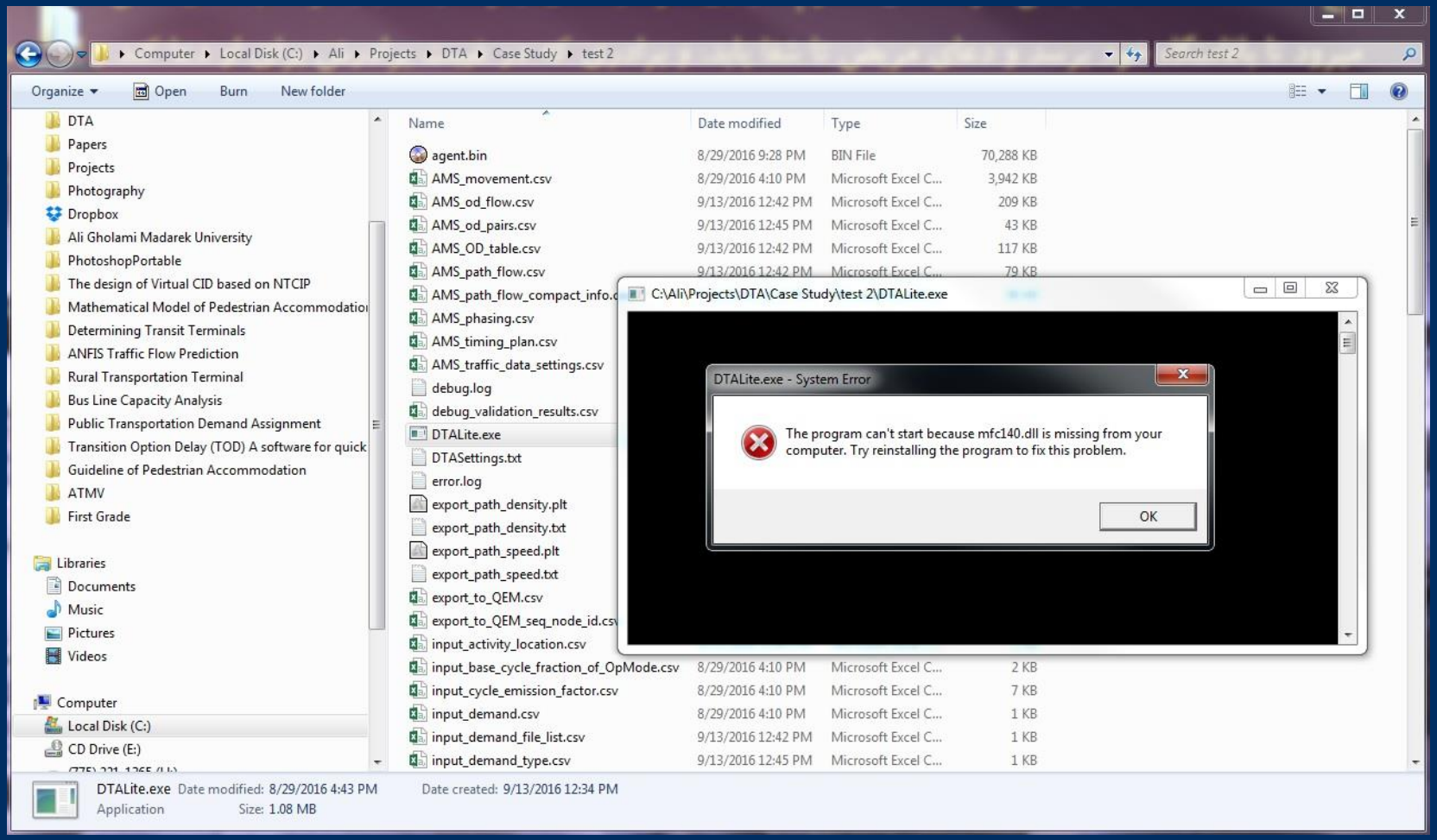
Example


NeXTA Version 3 Beta (64-bit) - [1 int]
File View Edit Project MOE Tools Window Help
Network Animation Density Volume Speed Queue Impact Bottleneck Emissions Link Path Vehicle Summary
Config
Layer
Node
Link
Movement/Signal
Zone
Connector/Activity Location
OD Matrix
Link MOE
Path
Subarea
Sensor
Workzone
Incident
VMS
Toll
Ramp
Vehicle Trajectory
Transit & Walking
Grid/Coordinate
Background Image
Reference Line
Attribute Data
Link ID 24
name
From Node... 40
To Node ID 41
Type Major arterial
Speed Limi... 45
Length (mile) 0.128
FFTT (min) 0.171
# of Lanes 2
Lane Capa... 1900
Link Capacity 3800
52809.99871,29357.96982
width: 0.4 mi; height: 0.2 mi
NUM

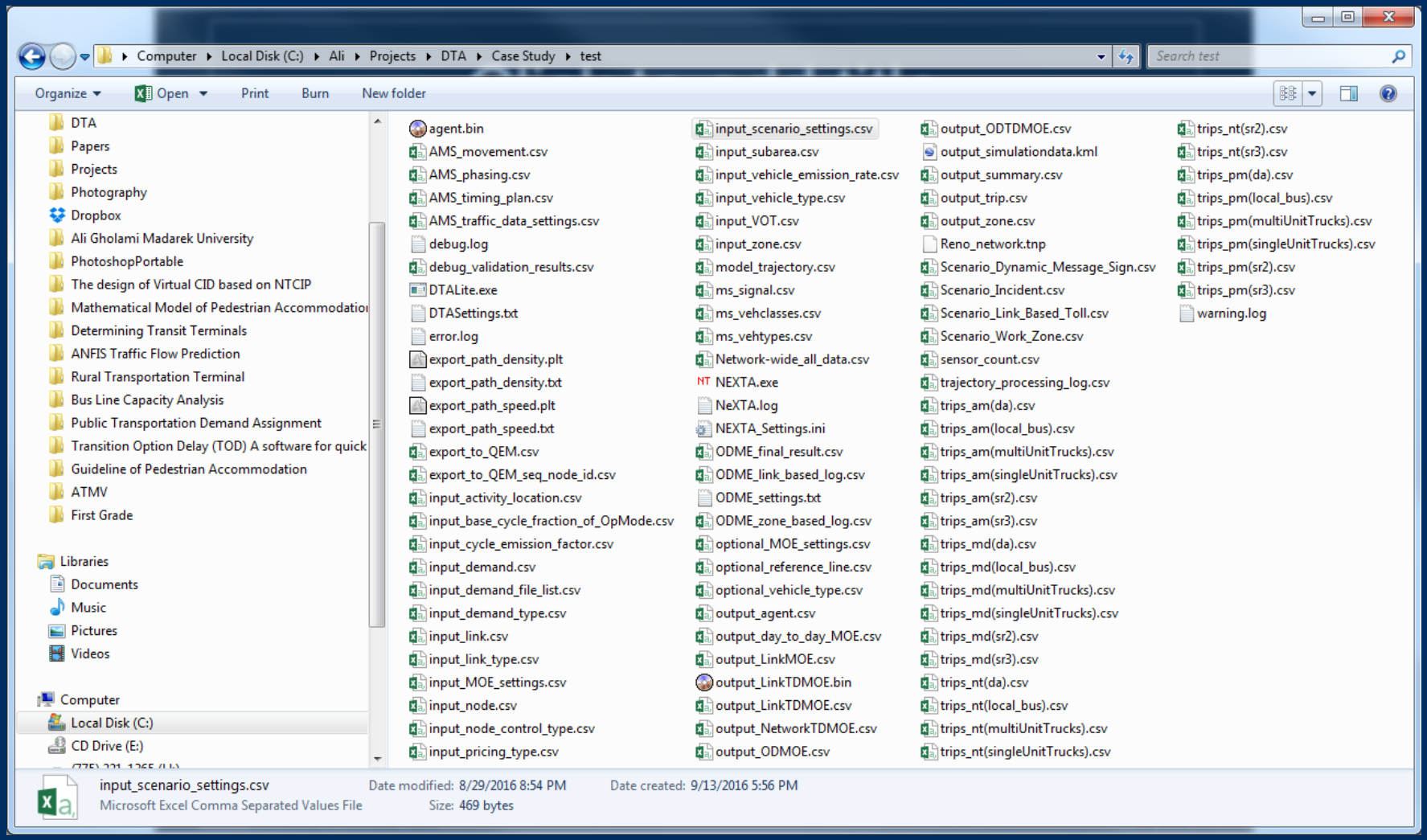
Lesson

Expect learning curve!

Example


Computer ▸ Local Disk (C:) ▸ Ali ▸ Projects ▸ DTA ▸ Case Study ▸ test 2
Search test 2
Organize
Open
Burn
New folder
DTA
Papers
Projects
Photography
Dropbox
Ali Gholami Madarek University
PhotoshopPortable
The design of Virtual CID based on NTCIP
Mathematical Model of Pedestrian Accommodatio
Determining Transit Terminals
ANFIS Traffic Flow Prediction
Rural Transportation Terminal
Bus Line Capacity Analysis
Public Transportation Demand Assignment
Transition Option Delay (TOD) A software for quick
Guideline of Pedestrian Accommodation
ATMV
First Grade
Libraries
Documents
Music
Pictures
Videos
Computer
Local Disk (C:)
CD Drive (E:)
Name
Date modified
Type
Size
agent.bin 8/29/2016 9:28 PM BIN File 70,288 KB
AMS_movement.csv 8/29/2016 4:10 PM Microsoft Excel C... 3,942 KB
AMS_od_flow.csv 9/13/2016 12:42 PM Microsoft Excel C... 209 KB
AMS_od_pairs.csv 9/13/2016 12:45 PM Microsoft Excel C... 43 KB
AMS_OD_table.csv 9/13/2016 12:42 PM Microsoft Excel C... 117 KB
AMS_path_flow.csv 9/13/2016 12:42 PM Microsoft Excel C... 79 KB
AMS_path_flow_compact_info.c
AMS_phasing.csv
AMS_timing_plan.csv
AMS_traffic_data_settings.csv
debug.log
debug_validation_results.csv
DTALite.exe
DTASettings.txt
error.log
export_path_density.plt
export_path_density.txt
export_path_speed.plt
export_path_speed.txt
export_to_QEM.csv
export_to_QEM_seq_node_id.csv
input_activity_location.csv
input_base_cycle_fraction_of_OpMode.csv 8/29/2016 4:10 PM Microsoft Excel C... 2 KB
input_cycle_emission_factor.csv 8/29/2016 4:10 PM Microsoft Excel C... 7 KB
input_demand.csv 8/29/2016 4:10 PM Microsoft Excel C... 1 KB
input_demand_file_list.csv 9/13/2016 12:42 PM Microsoft Excel C... 1 KB
input_demand_type.csv 9/13/2016 12:45 PM Microsoft Excel C... 1 KB
C:\Ali\Projects\DTA\Case Study\test 2\DTALite.exe
DTALite.exe - System Error
The program can't start because mfc140.dll is missing from your computer. Try reinstalling the program to fix this problem.
OK
DTALite.exe Date modified: 8/29/2016 4:43 PM Date created: 9/13/2016 12:34 PM
Application Size: 1.08 MB

Another Example



Dynamic Origin-Destination Demand Matrix Estimation (ODME) in DTALite

File Group	Input file list	Remark	Output file list	Remark
Demand	1. input_demand.csv or input_agent.csv	Demand content for specifying distribution	1. output_agent.csv	Final estimation results represented in terms of agent trajectory format
	2. input_demand_file_list.csv	Demand file specification, specify temporal departure time distribution	2. ODME_zone_based_log.csv 3. ODME_final_result.csv	Zone based production based ratio; Iteration by iteration zone based total production adjustment
Sensor	1. input_link.csv	Store count_sensor_id, speed_sensor_id for referring sensor data	1. ODME_link_based_log.csv	Iteration by iteration link based flow adjustment
	2. sensor_count.csv	Link based sensor count data		
	3. sensor_speed.csv (optional)		2. debug_validation_results.csv	Link based simulated vs. observed results
Scenario	1. input_scenario_settings.csv	ODME and assignment settings	1. output_summary.csv	Iteration-by-iteration UE and ODME statistics
	2. DTASettings.txt	Default settings for sequential ODME run		
	3. scenario_work_zone.csv	Specify the capacity reduction scenarios in the estimation and prediction stages		

Sample Data

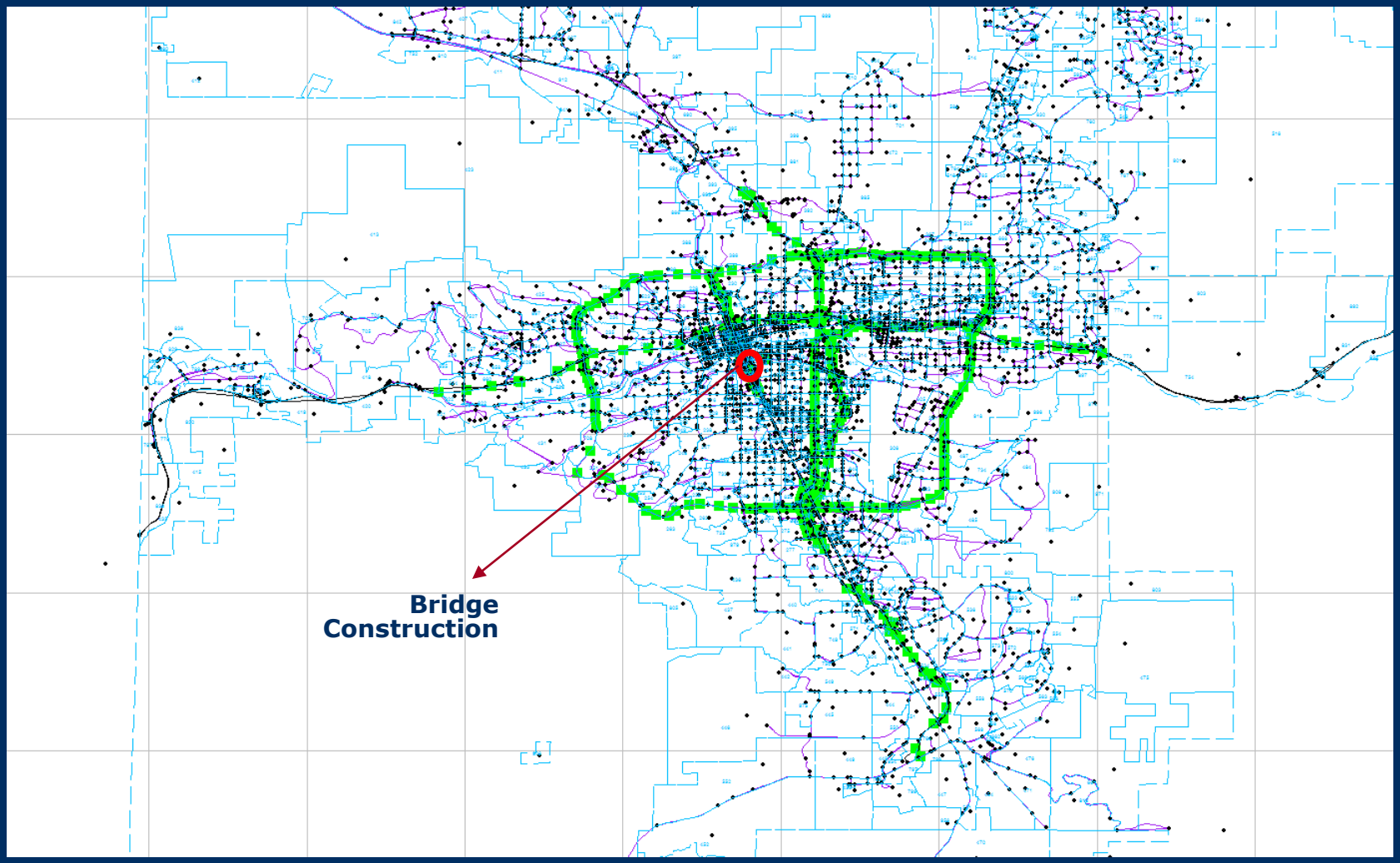
Sample data in sensor_count.csv

count_sensor_id	from_node_id	to_node_id	day_no	start_time_in_min	end_time_in_min	link_count	speed	travel_time_in_min	lane_density
5010->4958	5010	4958	1	990	1050	49.5			
4958->5010	4958	5010	1	990	1050	74.5			
4952->5022	4952	5022	1	990	1050	221.5			

Sample data in input_link.csv

link_id	from_node_id	to_node_id	direction	length	number_of_lanes	speed_limit	lane_cap	count_sensor_id	speed_sensor_id
1285	1285	5018	1	0.2384	7	21	1428.6	1285->5018	
1286	1286	11125	1	0.466	7	21	1428.6	1286->11125	
1289	1289	4952	1	0.2427	7	21	1428.6	1289->4952	

Sensor Data



Scenario Settings

Data Field	Value	Notes
number_of_iterations	50	The total number of iterations for ODME
traffic_flow_model	1	This parameter defines a specific traffic flow model used in both assignment and ODME of DTALite; 1 indicates a point queue model in this example. The selection of Newell's KW model is also feasible.
signal_representation_model	0	This parameter defines a specific signal control for DTALite.
traffic_assignment_method	3	This assignment method of "3" is dedicated to ODME
ODME_start_iteration	20	It defines the first iterative assignment period to converge to the user equilibrium state, and could generate a sufficient number of paths for path flow adjustment. The iteration number also indicate that ODME will begin at the 21th iteration.
ODME_end_iteration	50	It defines that ODME will end at the 50th iterations.
ODME_max_percentage_deviation_wrt_hist_demand	40	The maximum percentage of demand deviation from base-line dynamic demand.
ODME_step_size	0.05	Moving size of each step in path flow adjustment algorithm
calibration_data_start_time_in_min	990	This and the following parameter specify the time window for ODME to use the sensor data. Note that, users can prepare a long period of sensor data, say from 0 to 24 hours, but only use part of sensor data, say between min 990 and 1050, for calibration.
calibration_data_end_time_in_min	1050	

Data Collection

- Part 1. Data for model calibration
  - 24-hour link volumes
    - Retrieved data from TRINA
    - I-80, I-580, McCarran, Virginia, and Kietzke
    - 693 links in total (icl. 119 ramps)
    - Approximately 200 links extracted
  - Travel speed and travel times
    - National Performance Management Research Data Set (NPMRDS) data from HERE
    - Travel times for April 2015 (5-min interval)
    - Extracted and mapped Nevada data
    - Converted travel times to speed
    - 240 links in total
    - To match the data with DTA network
- Part 2. Data for case studies
  - Link volume data for work zone

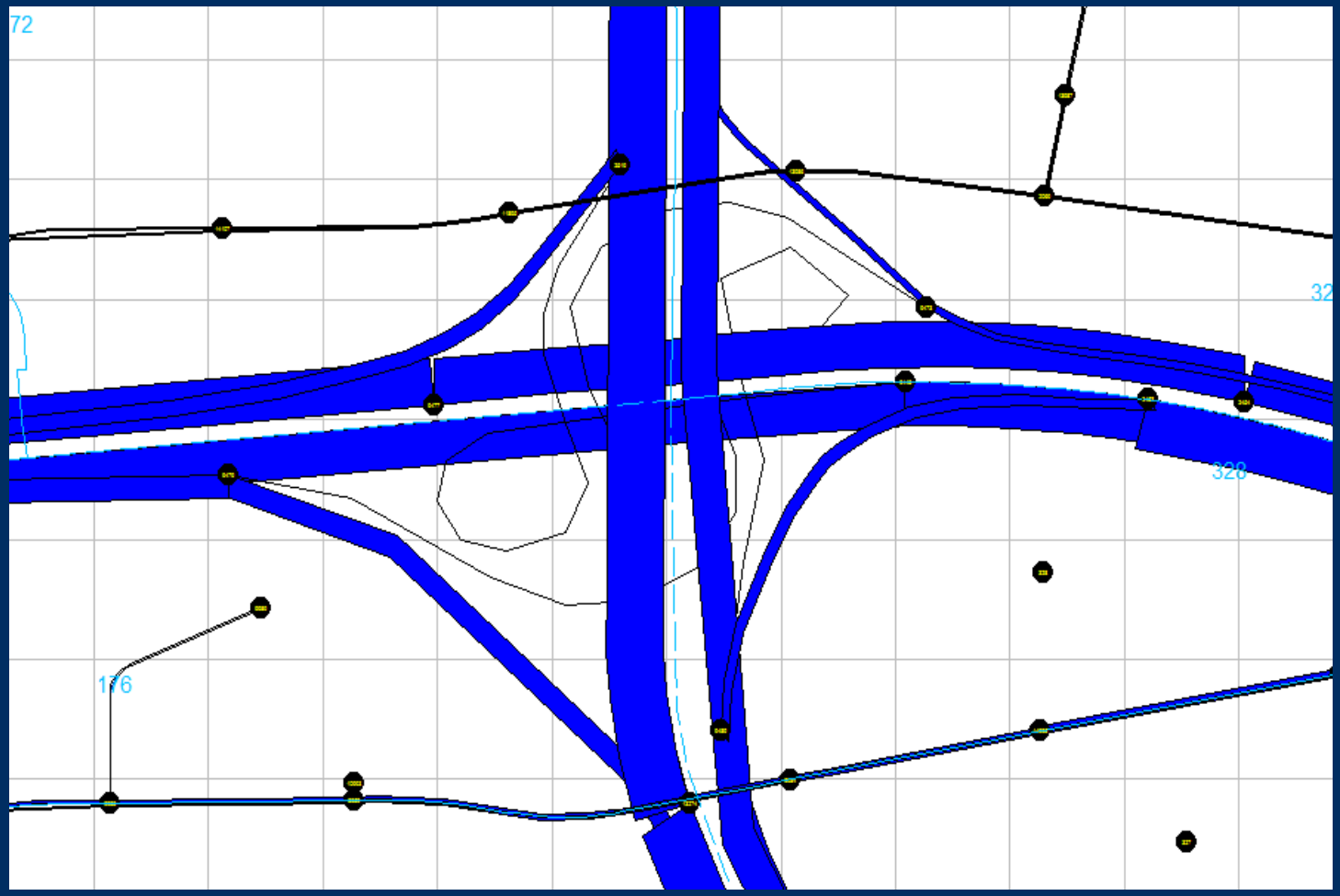
Model consistency with TransCAD

- Links
  - Consistent with TransCAD
  - Modified # of lanes to match reality
- Zones/Demand
  - Consistent with TransCAD
- Control types
  - Not available from Reno TransCAD model

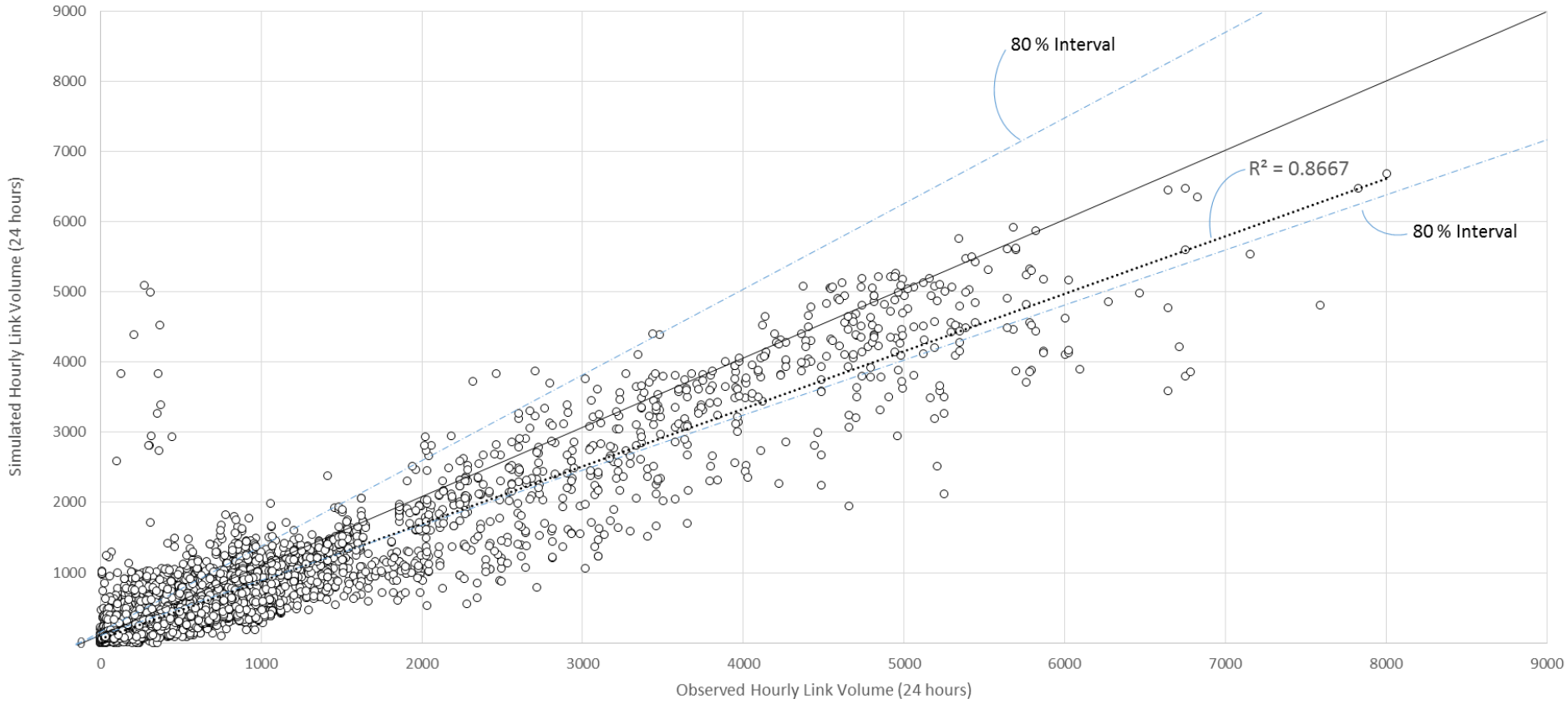
Lesson

Do not trust import/export buttons!

Example



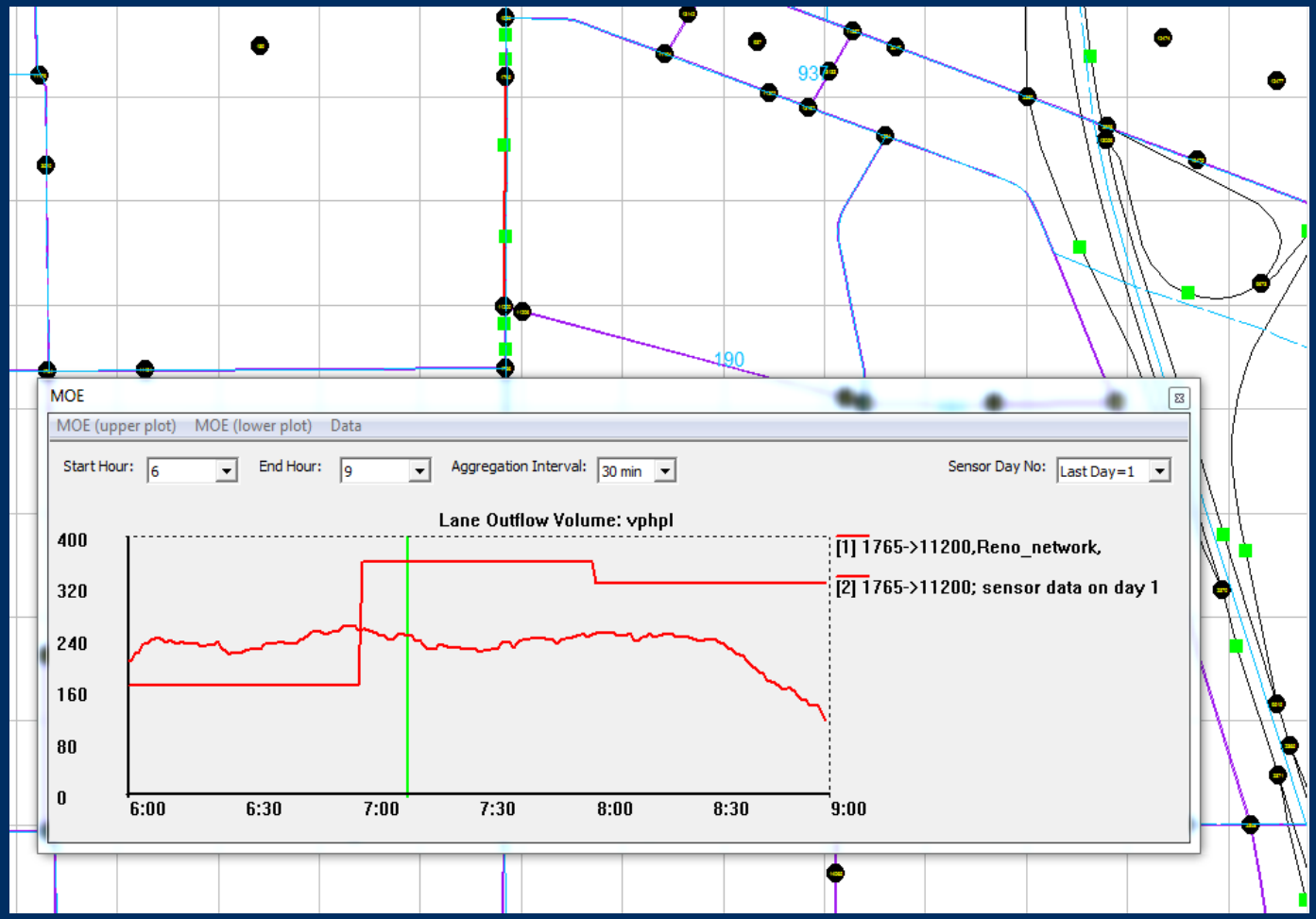
24 Hours


80 % Interval
R² = 0.8667
80 % Interval
Simulated Hourly Link Volume (24 hours)
Observed Hourly Link Volume (24 hours)
0
1000
2000
3000
4000
5000
6000
7000
8000
9000

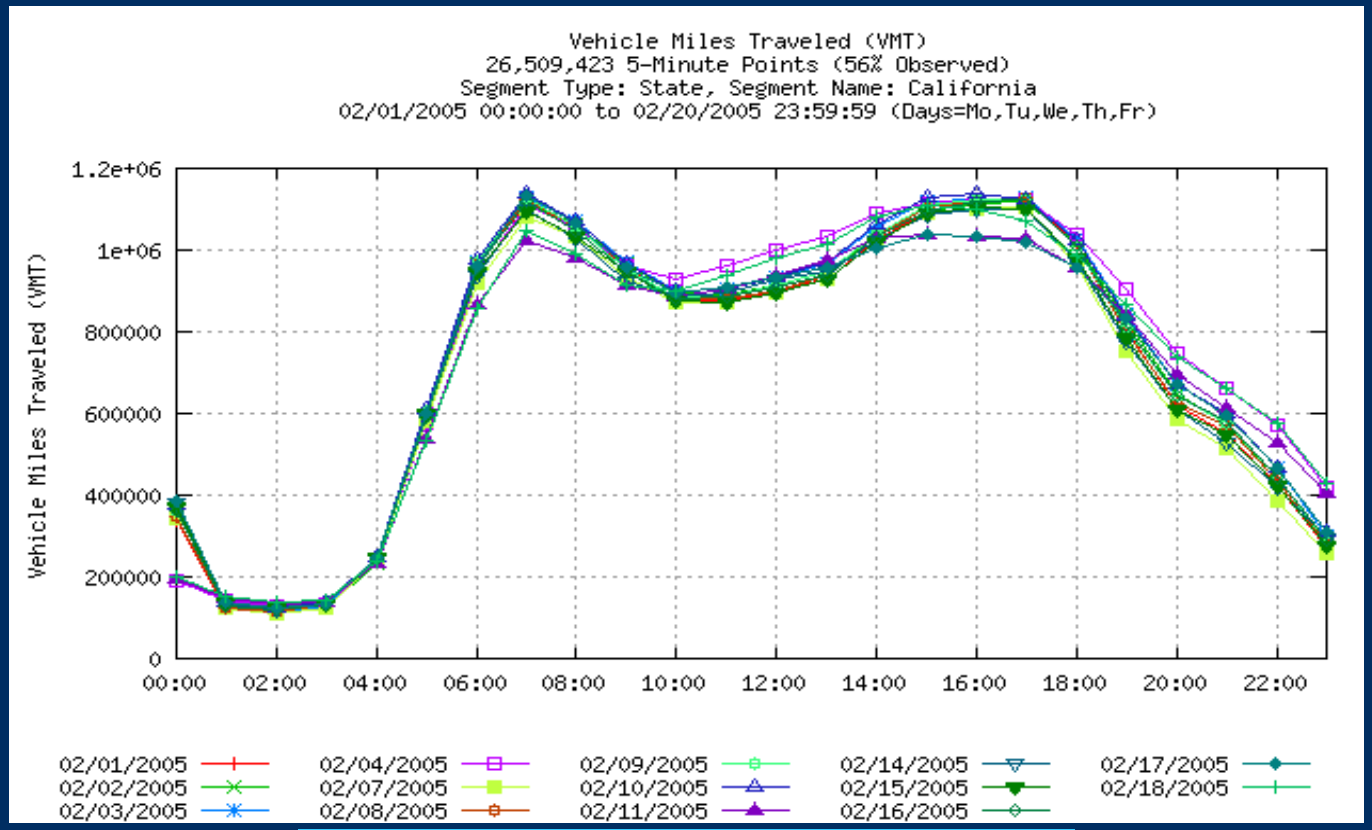
Lesson

Something is wrong with STA demand matrix!

Example

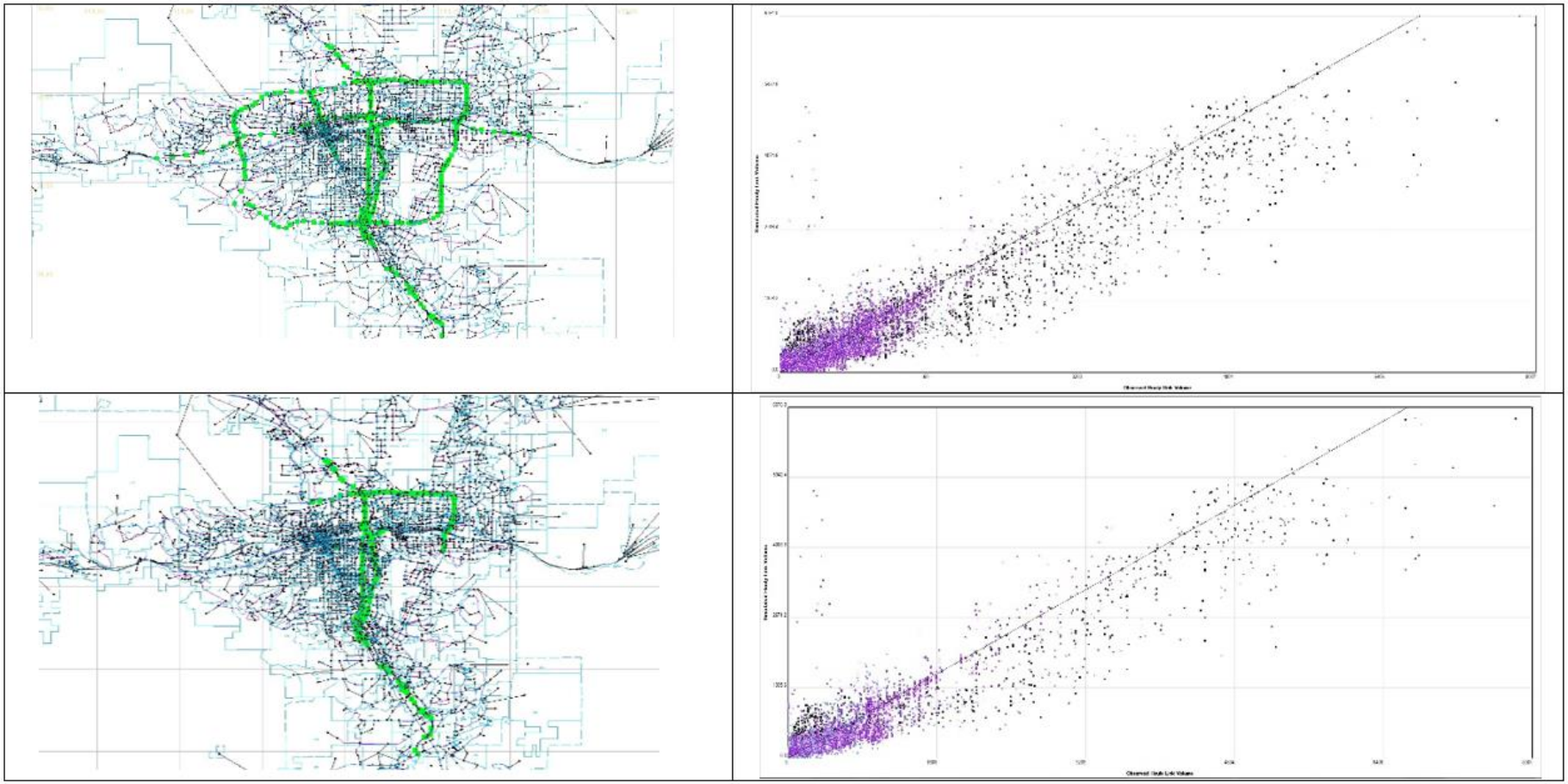

MOE
MOE (upper plot)
MOE (lower plot)
Data
Start Hour: 6
End Hour: 9
Aggregation Interval: 30 min
Sensor Day No: Last Day=1
Lane Outflow Volume: vphpl
400
320
240
160
80
0
6:00
6:30
7:00
7:30
8:00
8:30
9:00
[1] 1765->11200,Reno_network,
[2] 1765->11200; sensor data on day 1
190

Need to Load Time-dependent Demand Profile



- Weekday demand profile in California,
- Feb, 2005 Source: PeMS

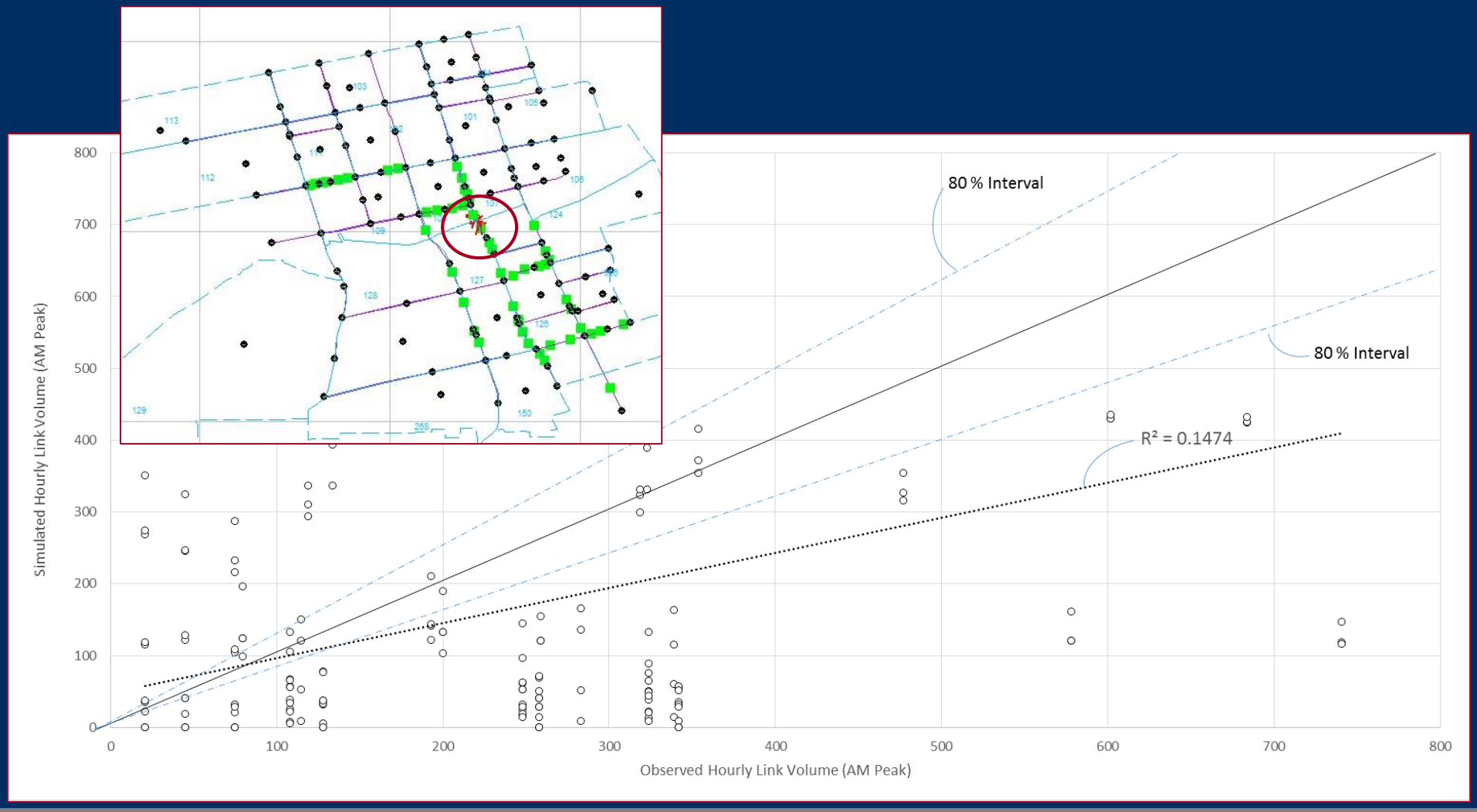
Sensitivity analysis on number of detectors



Lesson

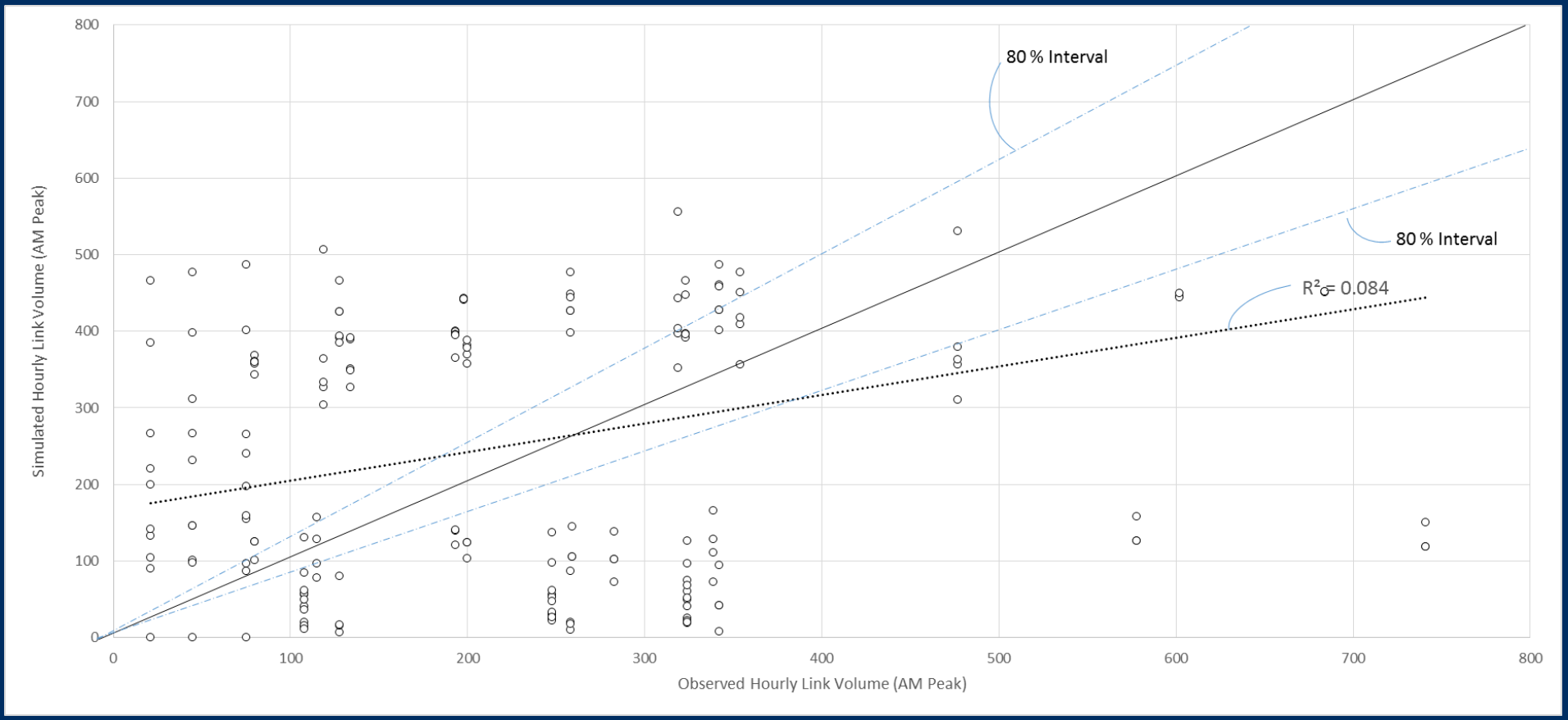
A good model is more important than extensive data!

Case Study Region AM Peak Calibration on Subarea



Case Study Region AM Peak

Calibration on whole network



Lesson

DTA is not that much good for TIA! Focus on freeways!

Instead of Summary

Path of love seemed easy at first, what came was many hardships

Hafez's Sonnets

Thank you!

Questions or Comments?