TransModeler Training
5- Simulation Types

presented to

Caltrans, District 1-Eureka

presented by

Shaghayegh (Rira) Shabanian, CS

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Think Forward

July & August 2018

Model Review

- Result of ODME for AM is coded to run DTA and simulation in AM
- Still need to review the results of ODME:
  why at some locations output volume is significantly different from the observed volume
- Check un-signalized intersection for proper control policy (yield/stop sign)
- Review signal timing. Still see some problems**
  are ring/barriers correct? Are concurrent movements going together?
  Are permitted/protected green used correctly?
  Is each phase associated with the right detector? Are detector locations/size/mode correct?
  Are right turns coded correctly? (default is RTOR)
  Are signal timing (cycle length/offset/lost time/recall mode) coded correctly?
  Offset along Harris st
- Use weighted average to define vehicle fleet for AM and PM***

Simulation Types

- DTA
  - Route Choice - When more than one route is available
  - Outputs segment and turning travel time
- One-shot Simulation
  - Network Loading - When only one route is available or historical travel time is available
  - Outputs segment volume and congested time
- Batch
  - Multiple one-shot simulation to achieve higher level of confidence
  - # of runs are associated with the desired confidence level
- PlayBack
  - When simulation is recorded or trajectory file is saved in output.

DTA vs. STA

- Both implement user equilibrium to assign vehicles to available routes.
- In DTA, Network and demand can change over time during the simulation (temporary lane blockage, demand fluctuations)
- In DTA, shortest path can change in each interval.
- In DTA, capacity and storage limit the entering vehicles, queue forms
- In DTA, congestion in one interval affects the next interval route choice.

Notes on DTA

- DTA in congested networks can hard to converge. However, it may still provide more realistic results compared to static assignment, *but further details are needed*.
- It is reasonable to adjust the link and turning movement travel time from a DTA model, if it is against observed data.
- Specially, observed data can be used to set a limit on maximum delay or minimum speed on links or at intersections.
- This helps to get a more realistic simulation results out of a not-completely converged DTA.
- However, difficulty exists in moving this into future scenario evaluations

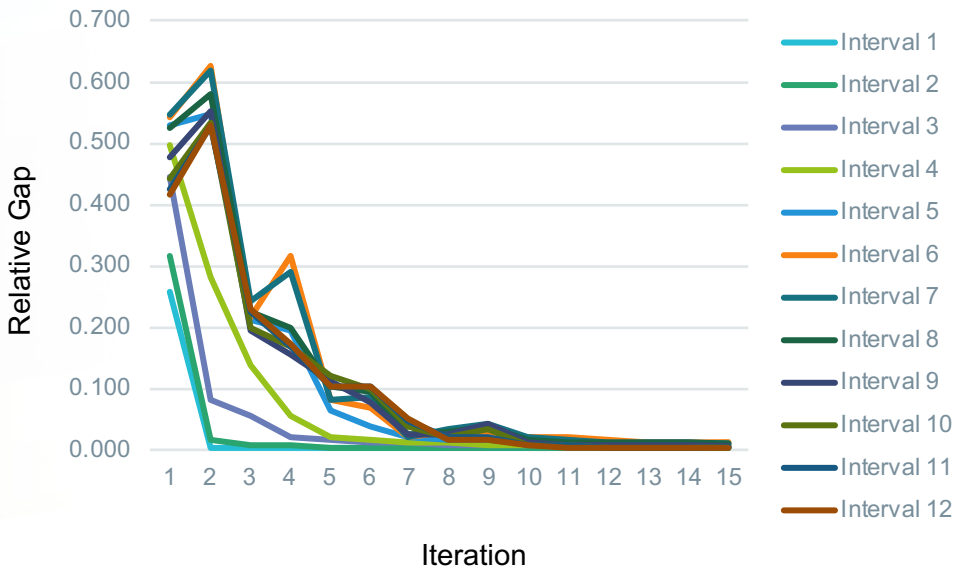
DTA Convergence

- Relative GAP, (similar to the STA definition)
  - » No mathematical guarantee of convergence for stochastic simulation based model

$$Gap^{\tau} = \frac{\sum_{i \in I} \sum_{k \in K_i} f_k^{\tau} t_k^{\tau} - \sum_{i \in I} d_i^{\tau} t_{\min,i}^{\tau}}{\sum_{i \in I} d_i^{\tau} t_{\min,i}^{\tau}}$$

where:

Gap^{τ}	= Relative gap in time interval τ
I	= Set of all O-D pairs i
K_i	= Set of paths used by trips traveling between O-D pair i
f_k^{τ}	= Number of trips taking path k (i.e. path flow) in time interval τ
t_k^{τ}	= Travel time on path k in time interval τ
d_i^{τ}	= Demand departing in time interval τ
$t_{\min,i}^{\tau}$	= Travel time on shortest path between O-D pair i in time interval τ



- Still, might be better than STA to replicate real-world congestion
- If not completely converged, travel time table should be validated/modified before being used in one-shot assignment.

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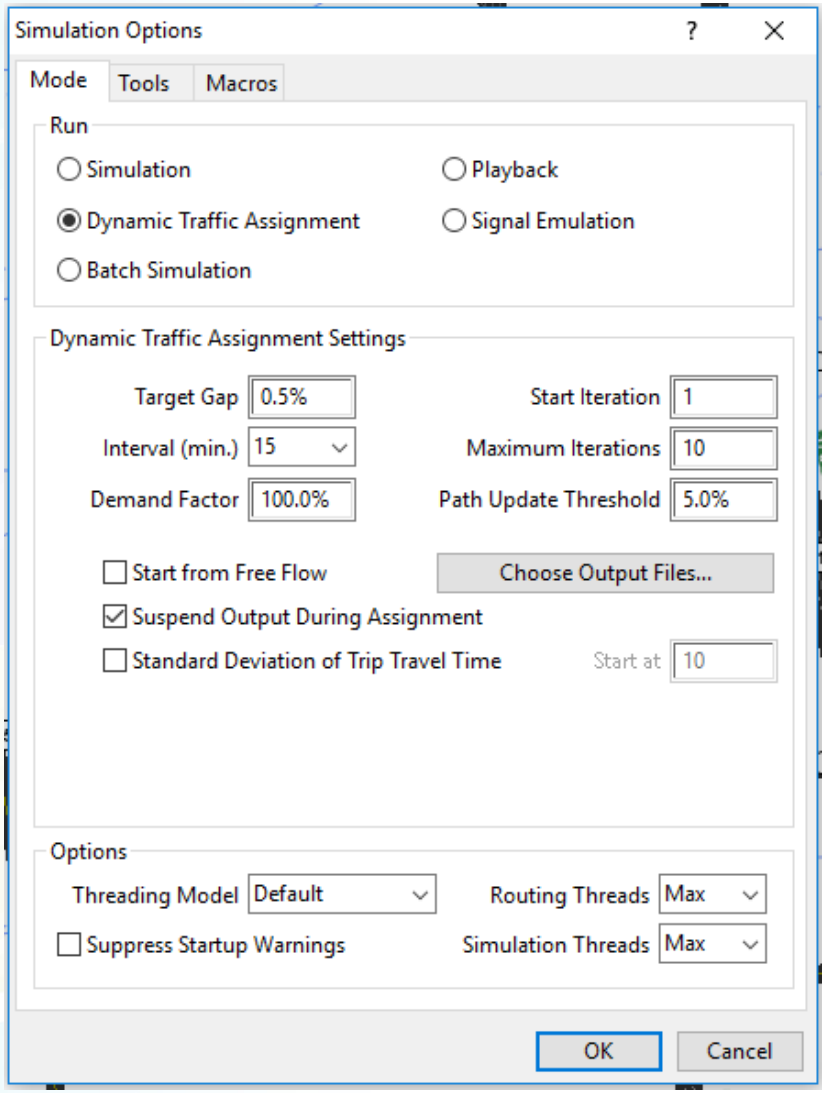
DTA - Settings



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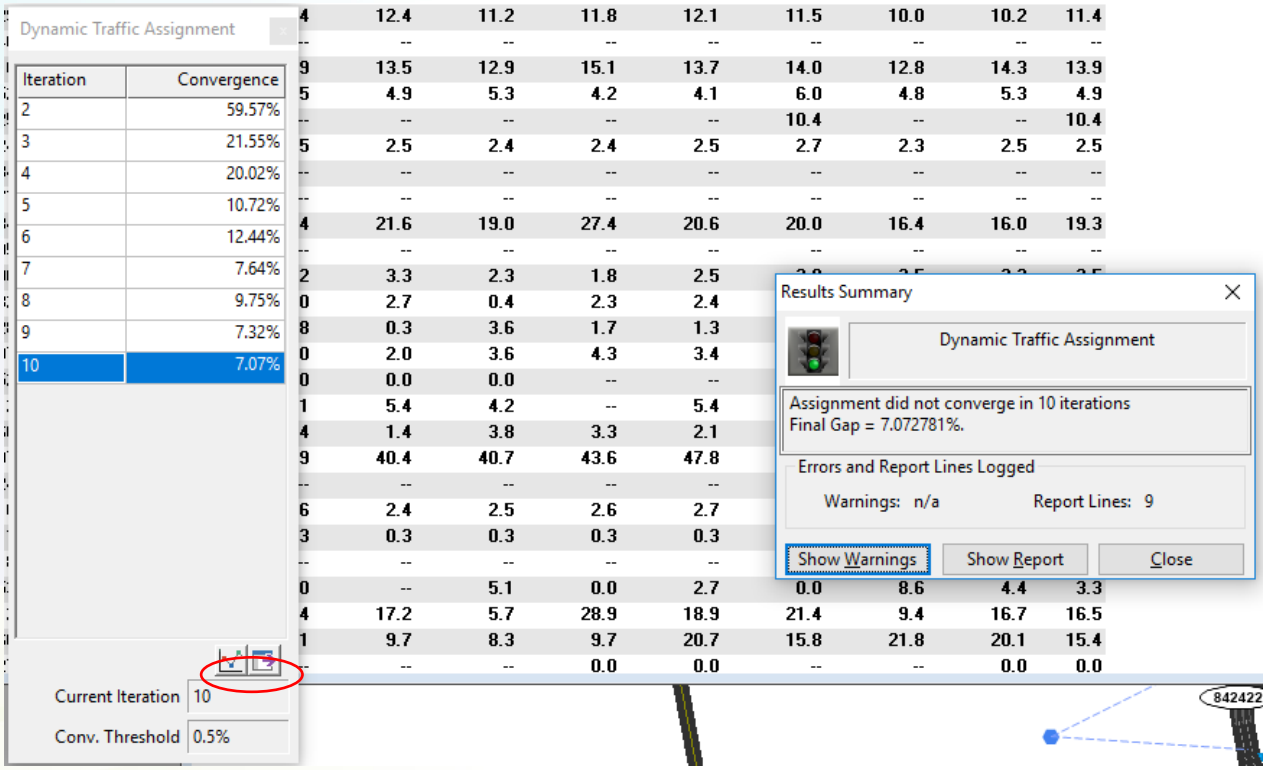
DTA - Result

- Relative Gap



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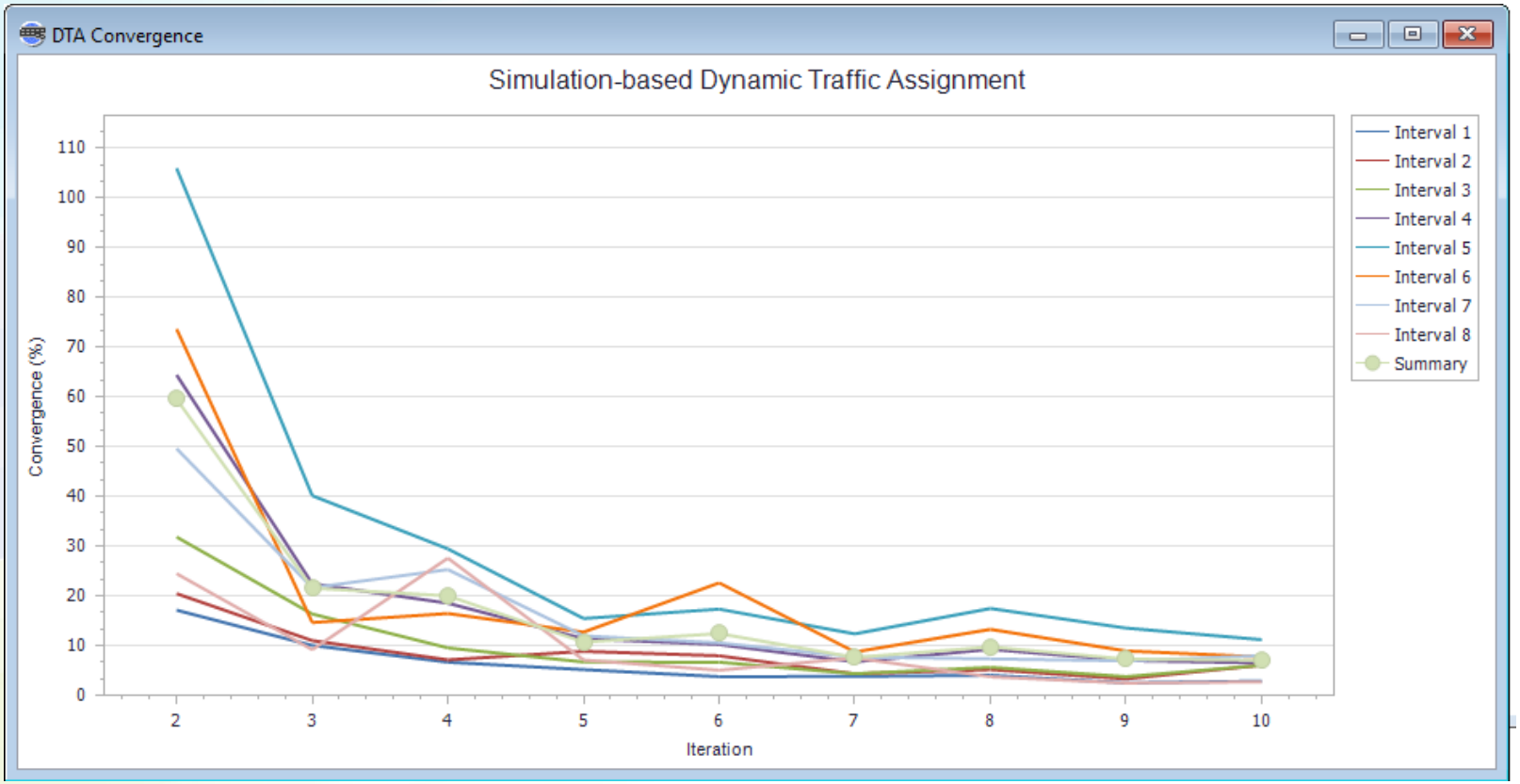
DTA - Result

- Relative Gap



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DTA – Historical Travel Time Tables

- Most important outputs of DTA are:

Historical Travel Times.bin
Turning Delays.bin

Other files include:
X* DTA Convergence.bin
X trips missed turns.bin
X trips no path.bin
X trips.bin
X trips.pth
Path.pth
Segment Time Variability

All of these files can be very helpful to evaluate the route choice that DTA creates, and also to spot issues/ problems. Please read and explore these files. (.bin files can be open separately, *.pth files can be accessed through interface toolbars such as critical path, etc)

DTA – Evaluation

- Sort from highest delay in each 15 minute and start from top locations not only the magnitude of delay, but its fluctuation over time is important and shows DTA was not appropriately converged.

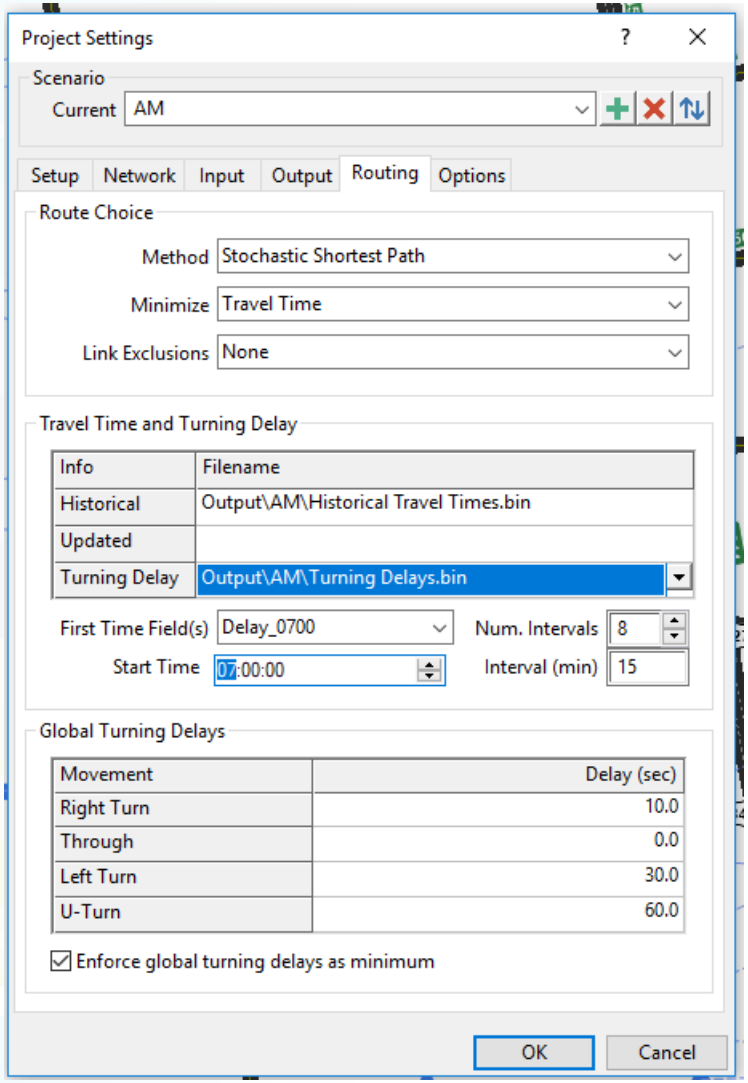
Dataview1 - Turning Delays

FromLink	Node	ToLink	Dir	Type	Facility	Delay_0700	Delay_0715	Delay_0730	Delay_0745	Delay_0800	Delay_0815	Delay_0830	Delay_0845	Delay
4598	842641	4452	NW	L	--	133.9	176.6	177.7	176.5	111.9	175.7	175.0	53.8	147.6
8012	842043	5107	SE	T	--	75.8	69.1	57.7	37.6	65.7	73.9	68.4	67.3	64.4
8023	53	4841	S	T	--	68.1	102.1	117.5	344.7	630.2	290.2	238.0	11.6	225.3
6791	842755	8014	E	T	--	66.9	71.7	76.5	64.8	62.8	55.6	50.1	56.9	63.7
6791	842755	6789	E	L	--	63.9	70.7	72.5	41.9	69.5	66.5	58.0	67.7	63.8
6789	842755	8014	SW	L	--	58.7	64.1	63.1	95.3	59.2	70.4	63.5	68.9	67.9
5253	842043	5107	SW	L	--	45.9	40.4	40.7	43.6	47.8	46.7	48.9	66.6	47.6
5068	842755	6791	N	L	--	45.3	44.1	67.5	63.8	60.0	53.1	64.1	50.9	56.1
4086	842370	4641	E	L	--	41.3	1.5	15.1	0.3	13.9	26.8	14.9	15.7	16.2
5079	842709	4614	NE	L	--	39.7	49.8	53.5	52.8	51.9	54.1	54.9	54.3	51.4
4783	842757	4796	N	L	--	39.1	37.5	38.9	40.2	16.0	27.0	28.6	46.8	34.3
7642	842709	4331	SW	T	--	29.4	51.4	70.8	53.9	50.8	57.7	51.7	53.7	52.4
7642	842709	4613	SW	L	--	28.7	50.3	58.7	61.0	59.6	67.4	84.8	58.6	58.6
8030	842447	4951	S	L	--	27.5	22.8	20.5	52.1	74.0	36.6	9.2	13.2	32.0
4331	842709	4614	N	L	--	27.3	32.2	6.5	71.1	37.8	21.9	50.6	73.4	40.1
3765	842150	4822	E	L	--	26.9	24.6	22.6	20.1	20.7	22.3	21.3	25.0	22.9
4614	842709	4613	E	T	--	26.2	33.6	41.4	39.8	41.4	47.2	42.1	41.5	39.2
7964	842449	4597	W	T	--	25.5	19.7	23.0	20.4	22.6	20.7	19.8	22.8	21.8
4614	842709	7642	E	L	--	25.1	30.2	38.3	53.5	50.8	45.5	52.7	48.5	43.1
8021	842427	4101	E	T	--	23.8	21.3	19.2	16.7	19.1	14.5	17.2	18.3	18.8
5253	842708	4612	NE	R	--	22.1	0.3	23.1	5.3	5.2	0.3	0.8	0.4	7.2
7964	842449	8030	W	L	--	22.0	19.1	22.2	27.7	19.4	15.5	16.8	22.8	20.7
4796	842757	7616	E	L	--	20.0	19.9	23.8	28.6	37.0	22.8	20.9	26.2	24.9
5253	842708	7990	NE	L	--	20.0	21.7	23.2	21.5	21.5	23.2	24.5	23.3	22.4
4331	842709	4613	N	R	--	19.8	19.0	29.8	29.7	42.1	38.3	41.3	46.7	33.3
7633	65	8024	N	T	--	19.4	16.8	14.9	15.5	12.0	15.5	13.0	14.6	15.2
3891	842264	5045	E	L	--	19.4	76.1	5.8	65.0	49.2	5.4	48.3	32.5	37.7

Running One-shot simulation

- DTA outputs paths and segment travel time/turning movement delays, but does not provides link volumes
- To obtain link volumes, a one-shot simulation is run WITH THE RESULTS OF DTA AS INPUT
- This run will duplicate the last iteration in DTA, and will output segment and turning movement volume
- Now we can compare the turning movement volumes with original observed intersection counts!
- Please note that there will be a discrepancy between model volume after ODME, and model volume after simulation. Remember that ODME was static process that would ignore signal timing, capacity limitation, etc. the more congested a network is, the higher will be this discrepancy.

Running One-shot simulation



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Simulation Result

- Compare segment volume vs coded segment count
  identify locations with high discrepancy
  which of these locations were better replicated during ODME?
  Pay attention to locations where model volume is zero
  so far I observed model outputs are systematically lower than counts
  run one time with 15% blanket increase in demand (Demand→ OD Matrices→ Trip Matrix Settings→ Unit scaling factor)
- Compare turning movement volume vs coded intersection counts
- Compare model route travel time vs floating car runs
  make a selection set of nodes that define routes start/end, use shortest path skim in the output feature.

Follow up

- Explore ODME for AM
  Count at 4&H, More volume on H SB than on 4 WB!
  5&H *
  Count at 5&E
  make sure TurningCount.bin is correct
  if you change anything in TurningCount.bin, you need to update segment synthetic count around modified intersections. ODME should be re-run

- Run DTA for AM (with 50 iterations), evaluate the outputs
  watch the simulation during the run

- Run one-shot simulation for AM, compare modeled and observed volume and travel time
  repeat it with 15% increased in demand