Framework for Multi-Resolution Analyses of Advanced Traffic Management Strategies

presented by

Mohammed Hadi, Ph.D., PE
Florida International University

May 7, 2015
Needs for the Framework

• Performance measurement and estimation is increasingly needed
• Combinations of advanced modeling tools are needed for advanced strategies
  – Congested conditions
  – Managed lanes (ML) and congestion pricing
  – Construction, event, and incident impacts
  – ATDM, smart work zones, incident management, and integrated corridor management
  – Automated and connected vehicles
• Tools and methods are becoming available, however integration of tools is needed for effective modeling
Objectives

- Investigate the ability of combinations of tools in estimating performance and analyzing congestion and advanced strategies
- Recommend a framework for use in support of agency analysis and modeling processes
- Apply and assess the recommended framework in the modeling of use cases
Multi-Resolution Simulation

Isolated Models
Regional Demand Model
Meso
Micro

Partial Multiresolution Models
Trip tables from Regional Models feeding either Meso or Micro
Regional Demand Model
Meso-DTA
Micro-DTA
Regional Demand Model

Full Multiresolution Models
Interactions between Regional Demands to Meso and Meso to Micro
Regional Demand Model
Meso-DTA
Micro-DTA
Regional Demand Model

Framework Focus

• Support partial multi-resolution with direct connection from demand models to meso- or micro-simulation
  – However, the use cases will focus on full multi-resolution
• Accommodates different tools
  – Tools and components selected base on user requirements
• Off-the-shelf and agency developed tools and utilities (e.g., ELTOD and FITSEVAL)
• Support planning and operation
  – Model developed for one purpose can be used for different purposes
Proposed Framework Components

• Data sources, data analytics, and related tools
• Multi-level modeling tools
  – Analytical/sketch planning
  – Macro, meso, micro simulation and DTA tools
  – Other modeling tools
• Output analysis and alternative trade off support tools
Proposed Framework Components

Data Sources
- Regional Planning Model
  - FSUTMS
- Additional Data Sources
- ITSDCAP

Support Environment
- ISSTA
  - Tool Assessment
  - Conversion Tool
  - OD Matrix Estimation
  - Output/Alternative Analysis

Modeling Tools
- Analytical
  - FITSEVAL
  - HCM Procedure
  - ELTOD
- Macro/Mesoscopic DTA
  - DTALite
  - VISUM
  - Cube Avenue
  - DynaMex
  - DynsuT
- Microscopic Simulation
  - VISSIM
  - AIMSUN
  - CORSIM
  - Transmodeler
- Other Modeling Tools
  - MOVES
  - SSAM
  - TCA
  - SHRP2 Reliability
  - AV/CV

*: The data files are interfaced through the csv format.
Data Sources and Tools

• Demand models
  – Network data
  – Initial demand matrices
• Counts, speed, occupancy, and travel times based on ITS traffic detectors
• Travel time and O-D matching measurements based on AVI or AVL technologies
• Private sector data
• Statistics office data
• Advanced strategy data (incident, work zone, ML pricing, ramp metering rates, etc.)
• Turning movement counts, travel time measurements, and signal control from existing studies from previous studies
ITSDCAP Functionality

• Aggregation and cleaning of data from multiple sources
• Grouping and clustering of data
• Performance measurements and dashboard
• Real-time information sharing
• Prediction of system performance and impacts
• Decision support tools
• Benefit-cost analysis of advanced strategies
• Transportation model support
Data from Multiple Sources

- SunGuide data (TSS, TVT data, incident, DMS, etc.)
- Central data warehouse (RITTS or STEWARD)
- Weather data
- Managed lane dynamic congestion pricing rates
- Work zones ➔ D6
- Crash data (CAR System and Signal4)
- Signal control and ramp metering
- 511 data
- MDT transit data
- Private sector data
- AVI data (Bluetooth, Wi-Fi, ETC)
- Statistics office station data
- Connected vehicles
Example I TSDCAP Outputs
Modeling Support Tools

- Off-the-shelf (commercially available or open source) supplemented by developed tools
- Conversion support – from demand model and real-world data to modeling tools
- Calibration and convergence support
- Time-Dependent demand estimation – Demand model outputs (ABM and 4 step), automatic vehicle identification combined with counts, and tool specific ODME
- Signal timing optimization
- Output/alternative trade off analysis support
Modeling Tools

- Demand forecasting models
- Macroscopic and mesoscopic simulation based DTA tools – VISUM, Dynasmart, DynusT, Cube Avenue, Dynameq, DTALite
- Microscopic simulation tools: TransModeler, VISSIM, CORSIM, AIMSUN, Paramics
  - DTA capabilities significantly vary
- Analytical/sketch planning tools – ELTOD, HCM Facility Procedures, FITSEVAL
- Other modeling tools: MOVES, SSAM, SHRP2 Reliability Procedures, Automated/Connected Vehicle Modeling extensions, advanced strategy APIs
Exploration Network
Test Network
Example Test Applications

- Interchange modification
- Managed lanes
  - Test different levels of assignment: ELTOD, meso, and micro
- Integration with FITSEVAL
  - Model ATDM strategies
- Freight Modeling
- Initial automated vehicle/connected vehicle modeling