http://mitams.org
Agenda

- Agency Needs and Expectations
- Data hub and Multi-Resolution Networks
- Sequential InSITE ABM-DTALite integration
- Day-to-Day and Within-Day SILK AgBM-DTALite Integration
- ARPA-E iPretii Technology (Application)
Agency Needs and Expectations

Maryland State Highway Administration (Lead agency)
- Performance based planning and programming
- Increased focus on operations and mainstreaming TSM&O
- System efficiency and reliability are key drivers

Baltimore Metropolitan Council (Partner agency)
- Improve simulation capacity in estimating duration and location of delay
- Improve travel time estimates by time of day
- Improve volume and LOS measures (reliability) abandoning V/C ratios
- Travel Demand Management policies, especially pricing.
Overall design of Data Hub and 3 Levels Model Integration

Three Levels of Model Integration

1. Statewide: MSTM-DTALite
2. BMC MPO: InSITE ABM-DTALite
3. Subareas/Corridors SILK AgBM-DTALite
1. Macroscopic
   - Regional Evaluations
   - Project Screening
   - Long Distance Travel
   - Title Sheet Forecasts

2. Mesoscopic
   - Dynamic Traffic Assignment
   - Project Forecasting
   - Turning Movement Forecasts
   - Transit Evaluations

3. Microscopic
   - TOD Studies
   - Active Transportation Evaluation
   - Transportation /Land Use Studies
   - Microsimulation
Data Hub: Multi-Resolution Network

- SHA Centerline File
- HPMS Data

Routable Multi-Resolution GIS Network with Model Attributes

GIS GUI to Dynamically Select Detailed Study Area

Multi-Resolution Model Network

Segments Assigned to levels:
1. Macroscopic – MSTM Zone
2. Mesoscopic – BMC Zones/Census Block Groups
3. Microscopic – Parcel Level/Census Block

Selects Area to be run at levels 2 or 3, remaining model structure will be run at level 1 resolution

Captures national, regional, and local travel flows without exceeding software zone limits or excessive run times
Summary

1. The network file contains a variety of attributes (from sources such as HERE, INRIX, Centerline, HPMS) required for DTA, model calibration and validation.

2. It allows quick sub area analyses by leveraging the three levels of the network at different resolutions.

3. Reduces the need to add details to the network on an ad-hoc basis to support project level forecasting and analysis.
Current MITAMS C10 Approach

Three integrated models:

a. InSITE-DTALite – BMC MPO
b. SILK AgBM-DTALite – Subareas/Corridors
c. MSTM-DTALite – Statewide MD
BMC InSITE Activity-Based Model

Long-Term Choices
- Auto Ownership, Work Location, School Location, E-ZPass, Transit Pass

Tour Generation
- Daily Activity Pattern (including Work/School Travel)
  - School Escorting Model
    - Fully Joint Travel
  - Individual Nonmandatory Travel

Tour-Level Choices
- Mandatory Tour Destination & Time of Day
- Joint Tour Destination & Time of Day
  - Individual Nonmandatory Tour Destination & Time of Day
  - All Tour Stop Generation & Mode Choice

Stop/Trip-Level Choices
- Stop (Trip) Level Destination, Time of Day, and Mode Choice
InSITE-DTALite: Sequential Integration

InSITE – Activity Based Demand Model
- Daily schedule of activities
- Activity locations (points) and times (30 min)
- Tour/trip formation, mode choice

Complete roster of tours and trips
- Origin/destination/time
- Person/household characteristics
- Simulated value of time

Travel Times from Vehicle Trajectories, Aggregated to Half Hour Periods

DTALite – Dynamic Traffic Assignment

Convergence check
- converged
- not converged

End
InSITE-DTALite
ABM Features

- **Disaggregate demand at all levels**
  - Travel and Activity analyses for different population segments

- **Chaining of trips according to temporal and spatial constraints**
  - Dependency in the decisions of travel and activity participation
  - Decisions based on time available to travel and location of activities

- **Fine time resolution for the demand**

- **Activity-based Accessibility Measure**
  - Utility-based measure considering constraints, scheduling, and preferences of the travelers.
InSITE-DTALite
Model Innovations

• **Simulated Values of Time**
  o Captures the heterogeneity in VOT by agents and travel purposes
  o Support the analysis of tolling scenarios and others.

• **Intra-Household Interactions**
  o Decisions based on lifestyle choices and household constraints
  o Participation in joint activities and joint travel.

• **Convergence Paradigm**
InSITE-DTALite
Applications

- **Corridor planning studies**
  a. Tolling/HOV/HOT Lane analysis
  b. Low cost improvements analysis – bottleneck mitigation
  c. Land use change – Development impacts
  d. Mobile Source Emissions – Hot spot analysis improved drive cycles, VMT mix
  e. Transit improvements – bus only lanes/bus on shoulder
  f. Traffic management and operations – CMP, ITS,

- **Regional planning studies**
  a. Land use Transportation connection – access to jobs, combined cost of transportation and housing
  b. Demographic structure changes – aging of the population and travel
  c. System performance – evaluation of LRP goals and objectives
  d. Goods movement (SHRP2 C20 grant – Freight tour roster)
  e. Pricing Policy – Trust fund evaluation (VMT tax)
  f. And others.
SILK AgBM-DTALite Overview

1. Two levels of integration
   • Day-to-day integration
   • Within-day integration

2. Travel behavior dimensions
   • Mode/departure time/route choices
   • En-route diversion
Presented by
Integrated Designs, Inc.
November 17, 2006

Model Re-calibration using
Limited Local Data

Estimation Dataset \( F \)

Behavioral Model

Decision: \( C(E) \in M \)
Decision probabilities and
Confidence log-odds \( s \),
that \( C(E) = m \)

Local Dataset: \( E \)
e.g. TPB-BMC Survey

Denote:
Choice set: \( M \)
Chosen alternative: \( m \)

Denote:

choice priors

\( p(m) \)

Bayes’ Rule

\( p(s|m) \)

\( p(m|s(E)) \)
Model Applications

- Applications in transportation planning and TSM&O traffic management
  - Multimodal shifts and peak spreading in a future year scenario (completed)
  - Mode/route/departure time responses to land and urban development (completed)
  - Real-time responses to VMS, ramp metering, dynamic lane control, etc. (ongoing)
  - Work zone management (Future)
Application: Traffic Management
Accident without Re-Routing

I-95 SB Incident Scenario

Space (mile)

Time (hour)

5 AM 6 AM 7 AM 8 AM 9 AM 10 AM

5 mph 15 mph 25 mph 35 mph 45 mph 55 mph

Exit 29
Exit 30
Exit 31
Exit 32

DMS1
DMS2
DMS3
DMS4
With DMS Traffic Management

I-95 SB Diversion Scenario

Space (mile) vs. Time (hour) for Exit 29 to Exit 32 with DMS Traffic Management.

Legend:
- 5 mph
- 15 mph
- 25 mph
- 35 mph
- 45 mph
- 55 mph
iP RETTii  Nov. 2015~May 2018

Integrated,
Personalized,
Real-time Traveler Information and Incentive
Incentive Structure

- Personalized information
- Customized incentives
- Loyalty program
- Gaming
- Social networking
- Peer influence

Long-Term Incentives
- Destination: DOE HQ
- Preferred Arrival: 8am
- Join new Ride-Sharing Program
  - 1000 pts
- Eco Drive Target for May 2015:
  - 25 MPG
  - Current: 20 MPG

Pre-Trip Incentives
- Eco-Driving
  - Tip: Brake more softly.
  - Current: 25 MPG
- Accident Ahead
  - Detour
  - 20 min. vs. 35 min.
  - +50 pts

Real-Time Incentives
- Eco-Driving
  - Tip: Brake more softly.
  - 25 MPG
- Accident Ahead
  - Detour
  - 20 min. vs. 35 min.
  - +50 pts
- You saved 15 min.
- You saved others 10 min.

Total Points: 15414
- Rank: Among friends 3 out of 15
- Among all users Top 23%
System Model

SILK Travel Behavior Model

Behavior prediction without incentives

Behavior response prediction

No change behavior?

Yes

Personalized incentives

Travel mode

Departure time

Pre-trip route

En-route diversion

Driving style

Update agent i

Habitual behavior

Agent i

Energy Estimator

Details in Section 2.1.2

1-sec time scale

5-sec time scale

DTALite Dynamic Network Simulator

Current and predicted network conditions, vehicle trajectories

Agent List

Agent 1

Agent 2

Agent i

Agent n

No

no active agents?

Yes

BUE
Control Optimizer

Control Decisions

- Whether or not to incentivize a particular user
- Which travel choice(s) to influence
- Type and intensity of personalized incentive to be delivered.

Key Performance Targets

- Computational efficiency
- Solution quality
- Robustness
- Redundancy and resilience
- Accomplishing control objectives with minimum resource
Thank You!

Questions, Comments, and Suggestions are Welcome. Please Contact:

Lei Zhang, Ph.D.
Associate Professor
Director,
National Transportation Center
Department of Civil and
Environmental Engineering

1173 Glenn Martin Hall,
University of Maryland
College Park, MD 20742
Email: lei@umd.edu
Phone: 301-405-2881