Implementation of Weather-Responsive Traffic Estimation and Prediction System (Wx-TrEPS) in Utah DOT

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WRTM Meeting
Sept. 26, 2013
Presentation Overview

- What is TrEPS?
- What is Wx-TrEPS?
- WRTM Application of Wx-TrEPS
- Utah DOT Implementation
- Preliminary Results from Utah DOT
- Next Steps
What is TrEPS?

TrEPS is a dynamic traffic modeling and assignment tool that estimates road-specific traffic conditions over broad geographic areas.

- Models individual roads
- Models individual vehicle movements
- Vehicle movements governed by flow models
- Vehicle paths governed by optimization models
- Primary output is a collection of vehicle trajectories
What is TrEPS?

**ESTIMATION**

Current traffic conditions

**PREDICTION**

Prediction (no intervention)

Prediction (with intervention)
What is Wx-TrEPS?

Includes weather adjustment factors to estimate impacts of weather on estimated and predicted conditions.

Weather-sensitive traffic operations model

**Estimation**: weather-sensitive traffic simulation-assignment model

**Prediction**: weather-sensitive traffic simulation-assignment model

Weather-responsive traffic management strategies

Weather data

- Weather monitoring systems
- Weather forecast
- Alert weather conditions
What is Wx-TrEPS?

Supply-side Parameter Calibration

Weather Adjustment Factor (WAF)
- Free-flow speed,
- Saturation flow rate,
- Section capacity,
- etc.

Weather Scenario Specification
- Rain intensity ($r$)
- Snow intensity ($s$)
- Visibility ($v$)

Simulate Traffic Flow under Adverse Weather
WRTM Application of Wx-TrEPS

Traffic Advisory
Variable Message Sign
• Speed reduction
• Optional detour
• Travel penalty (extra delay) warning

Traffic Control
Variable Speed Limits via VMS
Signal Control
Ramp Metering

Evaluate the effectiveness of advisory/control strategies
WRTM Application of Wx-TrEPS

1. Identify and select study networks
2. Calibrate and validate off-line and on-line Wx-TrEPS models
3. Identify existing or recommended WRTM strategies
4. Implement and evaluate WRTM strategies using Wx-TrEPS
Recent Applications of Wx-TrEPS

- Long Island, NY
- Chicago, IL
- Salt Lake City, UT
- Irvine, CA
Recent Applications of Wx-TrEPS – Evaluation of WRTM Strategies

Used Wx-TrEPS model to estimate effectiveness of different WRTM strategies:

- Demand Management
- Variable Speed Limits
- Optional Detour VMS
Utah DOT Implementation

Use Wx-TrEPs to analyze and evaluate weather responsive traffic signal timing plans on Riverdale Road in Ogden, Utah. (off-line and in real-time)

<table>
<thead>
<tr>
<th>Intersection ID</th>
<th>Location</th>
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</thead>
<tbody>
<tr>
<td>5000</td>
<td>700 West</td>
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<tr>
<td>5001</td>
<td>900 West</td>
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<tr>
<td>5002</td>
<td>1000 West</td>
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<td>5005</td>
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<td>Wall</td>
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<td>5008</td>
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<tr>
<td>5009</td>
<td>300 West</td>
</tr>
<tr>
<td>5010</td>
<td>Grand 9th St</td>
</tr>
<tr>
<td>5020</td>
<td>550 West</td>
</tr>
</tbody>
</table>
Utah DOT Implementation

• Work with UDOT to deploy and utilize TrEPS models calibrated for Salt Lake City network as a decision-support tool for evaluating signal timing strategies under various weather conditions.

• Conduct off-line assessments including performance evaluation of existing signal timing plans on the Riverdale corridor.

• Deploy Wx-TrEPS for real-time traffic signal management.
Preliminary Implementation Results

- Compared link, intersection and corridor performance measures with and without the use of weather-responsive signal plans
  - Travel Time
  - Throughput
  - Stopped Time
  - Travel Time Reliability
**Aggregated total travel time** is the sum of travel times that vehicles have spent on the Riverdale Corridor.

<table>
<thead>
<tr>
<th>Scenario</th>
<th>normal weather</th>
<th>snow &amp; do-nothing</th>
<th>snow &amp; weather-responsive plan</th>
</tr>
</thead>
<tbody>
<tr>
<td>total travel time (min)</td>
<td>70388.4</td>
<td>83511.1</td>
<td>80484.6</td>
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<tr>
<td>percentage increase</td>
<td>0.0%</td>
<td>18.6%</td>
<td>14.3%</td>
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</table>

3.63% Reduction Due to WR Signal Plan
**Preliminary Implementation Results**

- **Aggregated total stopped time** is the sum of stopped times that experienced by vehicles on the Riverdale Corridor.

<table>
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<th></th>
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<th>snow &amp; do-nothing</th>
<th>snow &amp; weather-responsive plan</th>
</tr>
</thead>
<tbody>
<tr>
<td>total stopped time (min)</td>
<td>15920.39</td>
<td>25820.61</td>
<td>22343.57</td>
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<tr>
<td>percentage increase</td>
<td>0.0%</td>
<td>62.2%</td>
<td>40.3%</td>
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</table>

13.47% Reduction Due to WR Signal Plan
Next Steps

- Develop and calibrate a smaller network for use in real-time analyses
- Brief UDOT about Wx-TrEPS use and system requirements
- Integrate Wx-TrEPS in UDOT’s signal timing planning and operations
- Support UDOT’s use of Wx-TrEPS model for signal control decision-making during the coming winter
  - Planning (e.g., optimizing signal control plans)
  - Operations (e.g., weather-responsive signal plan implementation decision support)
Project Stakeholders

- UDOT
  - Mark Taylor

- USDOT
  - Roemer Alfelor

- NWU
  - Hani Mahmassani, Jiwon Kim, Tian Hou

- SAIC
  - Bobby Haas (haasr@saic.com)
Questions?