Integrated Modeling for Road Condition Prediction (IMRCP)

Background

Intelligent transportation system deployments have enabled great advances in operational awareness and response based on the data they gather on the current state of the roadways. The next step in decision support is to forecast road conditions and build awareness of potential degradations before problems occur. Real-time traffic simulations and road weather models can forecast network traffic and road weather conditions before they occur, providing a basis for anticipatory and expedited response. These predictive methods can further assess the potential effects of implementing response strategies for traffic and demand management. Travelers could make forecast-enabled travel and routing decisions based on fastest or most reliable travel times.

This convergence of opportunities led the Federal Highway Administration's (FHWA) Road Weather Management Program (RWMP) to initiate research into and demonstration of Integrated Modeling for Road Condition Prediction (IMRCP). IMRCP capabilities could provide a practical tool for state and local transportation agencies to support operational decisions, maintenance planning, and traveler information at strategic and tactical levels.

Objective

The objective of the IMRCP is to demonstrate the integration of traffic, weather, and operational event forecasts to predict integrated road conditions. Elements of the forecast include atmospheric and road weather conditions, hydrology, traffic demand and management strategies, work zones, winter maintenance operations, incidents, and special events.

Evaluation of the IMRCP demonstration assesses the potential application benefits for transportation operators and maintenance providers. It is envisioned that the integrated forecasts may be useful to transportation system operators and travelers in decision support, providing alerts of road conditions, and routing for travel and maintenance.

IMRCP System Description

The IMRCP provides an integrated view of forecast road weather and traffic conditions for a given road network. The IMRCP model draws input from hydrological and traffic data sources and a diverse set of weather event sensors to generate estimates of current conditions and forecasts of future conditions. Forecast outputs are available through a web interface on maps, in reports, and in subscriptions.

Traffic data sources such as advanced transportation management systems (ATMS) provide volumes and speeds, freeway control and traffic signal operations data, incident reports, and plans for work zones and special events. Current and forecast atmospheric and hydrological conditions are drawn from National Weather Service sources. State and local agencies provide specialized road weather conditions such as pavement temperatures. Data collected from the various sources are indexed, stored, and archived in a heterogeneous data store.

While atmospheric and hydrological forecasts, work zones, and special events data are taken from external sources, the IMRCP synthesizes road weather and traffic condition predictions with embedded best-in-class forecast models. In the current implementation, road weather conditions are estimated across the network using field measurements of conditions and predicted from atmospheric forecast conditions using the METRo model. Current traffic conditions

are similarly estimated from detector stations and demand models and are predicted from road weather, incident, and demand forecasts using the TrEPS/DYNASMART model.

The IMRCP provides prediction data on web-based maps, reports, and subscriptions. The map enables users to select layers for roadway, regional atmospheric, and point-specific alert data. A traffic-focused map, for example, could display traffic, precipitation intensity, and traffic incident alerts. Available map layers also include select route travel times, weather radar, NWS advisories and warnings, and local road condition alerts. All data are available in reports and subscriptions that can be accessed by other systems. Maps and reports can also display archived data.

Demonstration Study Area

A portion of the Kansas City metro area along a congested interstate corridor and surrounding arterials has been used for a demonstration study and evaluation area. The Kansas City area is subject to highly variable weather conditions and local recurring congestion typical of U.S. urban/suburban settings. The I-435 corridor along the southern part of the metro carries heavy commuter traffic in both directions and for much of its length runs along a streamway with historically significant flood risk. The corridor is well-instrumented for traffic, weather, and hydrology.

Evaluation

A core national group of stakeholders monitored and provided input to the concept development and demonstration. Smaller work groups of stakeholder representatives and subject matter experts also assisted in identifying and resolving technical questions.

The Kansas City area stakeholders for the IMRCP included Kansas City Scout, Operation Green Light, and the City of Overland Park. These agencies provided a high-level assessment of the value of advanced notification provided by integrated prediction and identified gaps and opportunities for system improvement.
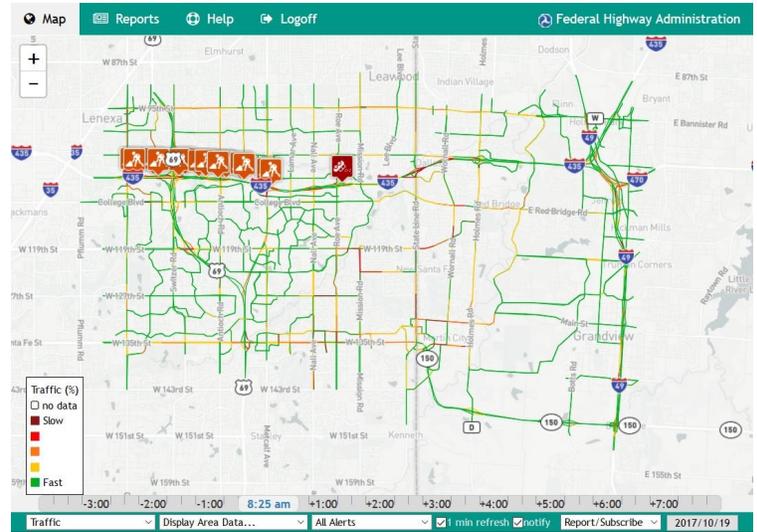
Study Area Traffic and Weather Features	
2006 Road Network Links	870 Road Network Nodes
205 Traffic Signals	20 StormWatch Sites
1 Automated Surface Observing System (ASOS) Station	5 Advanced Hydrological Prediction Service (AHPS) Stations
141 Vehicle Detectors	53 Ramp Detectors
15 Dynamic Messaging Signs	

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