Putting Research into Practice: New System Measures Travel-Time Reliability to Reduce Traffic Delays

What Was the Need?

Improving traffic efficiency has become a key goal of traffic operations managers. In heavy traffic periods, MnDOT’s Regional Transportation Management Center (RTMC) coordinates with Minnesota State Patrol and MnDOT Maintenance Services to detect and quickly respond to freeway incidents in the Twin Cities. The RTMC works with the Freeway Incident Response Safety Team to assist and remove stranded vehicles using MnDOT emergency road service trucks. RTMC also updates real-time road condition information on its 511 traveler information system.

MnDOT and RTMC measure delay and congestion on the metropolitan freeway system, reporting the data in annual reports like the 2017 Congestion Report. While useful, this data offers little predictive value on its own. MnDOT’s metropolitan freeway system features 4,000 loop detectors that transmit traffic data every 30 seconds; this data informs the congestion and delay reports.

Correlating this data with locations on the freeway system and various operating conditions, such as weather and traffic incidents, is time-consuming. But the data could be used to systematically evaluate traffic delays and develop strategies to mitigate congestion.

What Was Our Goal?

In this project, investigators sought to develop a system for automatically accessing weather, crash and traffic data to assess travel-time reliability—the variability in travel times for any given route. Travel-time reliability measures are becoming the key indicators for transportation system operations and management.

What Did We Implement?

Investigators developed a new travel-time reliability measurement system (TTRMS) that integrates different types of data (such as weather, traffic, incident, work zone and special event) acquired from multiple sources and automatically produces various types of travel-time reliability measures for selected corridors following user-specified operating conditions and time periods.

How Did We Do It?

Investigators began by developing a detailed design of the TTRMS architecture—its modules, their functions and their interactions. The team then developed a work-zone data input module, where detailed lane configurations of a given work zone can be specified. Developers designed a travel-time reliability calculation module as the core of the new system that can automatically access MnDOT’s traffic data archive, its incident database and the National Oceanic and Atmospheric Administration’s weather database. It can
also accept a set of input data for work zones, such as lane-closure periods and locations. The reliability calculation module was then integrated with user interfaces and reporting modules. Finally the integrated system was tested with the real data gathered in 2012 and 2013 from Interstates 35E and 35W, U.S. Highway 169 and State Highway 100.

What Was the Impact?
The system generated accurate travel-time reliability measures for the test periods and given operating conditions. In particular, the output measures were automatically generated in both table and graphical formats, thus saving traffic engineers significant amount of time and effort.

The TTRMS includes map-based interfaces, which provide administrators and general users with substantial flexibility in defining corridors, specifying operating conditions and selecting types of measures depending on the purposes of applications.

To test the new system’s performance, the research team used the TTRMS to evaluate traffic strategies deployed for the February 2018 Super Bowl in Minneapolis. Two weeks before the event, reliability was low for the freeway system serving the football stadium. During the week of the Super Bowl, MnDOT and the Department of Public Safety aggressively managed traffic incidents to keep traffic moving, and reliability rose substantially despite the increase in tourist traffic. In the days immediately after the Super Bowl, operational strategies returned to normal levels, and reliability fell to previous levels. Results suggest that aggressive incident management during this exceptionally high-volume regional event enhanced traffic efficiency.

What’s Next?
Further enhancements to the TTRMS should include automating inputs for work zone data, such as lane closures, changes in work zone locations and time periods. Future research could help traffic operations prioritize resources and develop short-term and long-term freeway improvements, including studies of bottlenecks and the freeway network’s vulnerability and resilience for natural events and large-scale incidents.

"Travel-time reliability is another way of looking at congestion and at strategies for making it more tolerable. It used to take several hours, even days, to process travel-time reliability data. The TTRMS processes it in minutes."

—Brian Kary, Director, MnDOT Regional Transportation Management Center

“Since we can’t continually expand the roadways to accommodate traffic, the next best method for relieving congestion is to make the traffic system more efficient and reliable.”

—Eil Kwon, Professor, University of Minnesota Duluth Department of Civil Engineering

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