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RESEARCH SERVICES

OFFICE OF POLICY ANALYSIS, RESEARCH & INNOVATION

TECHNICAL SUMMARY

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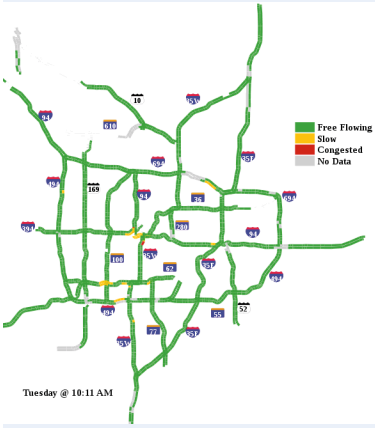
PROJECT COST:
$58,000



This project used traffic flow data already collected by loop detectors in Twin Cities expressways.

A Data-Driven Method for Determining Road Recovery Times After Snowfall

Researchers conducted a feasibility study to develop an automated procedure that uses traffic flow data rather than human judgment to determine when road conditions are recovered. This procedure could reduce service cost by deploying plows more efficiently.

What Was the Need?

After a snowfall, plowing operations on a given route continue until a point referred to as the bare-lane-regain time, which is when roads meet a minimum standard for safe travel.

Traditionally, snowplow operators have been responsible for determining these bare-lane-regain times based on operators' observations. This procedure involves an element of subjectivity, and therefore the potential for human error, particularly at the end of long shifts. It also adds a nonplowing task for operators at a time when plowing should be their primary focus.

If the determination of when clear pavement has been achieved is based on data rather than human judgment, local agencies can make better decisions during and after a snowfall about which routes need continued plowing and which do not. This data is also valuable for evaluating plowing performance and making improvements over time.

What Was Our Goal?

Loop detectors installed every half mile in the Twin Cities Metropolitan Area expressways already collect traffic flow data every 30 seconds. This study was an initial attempt to use that data to estimate the bare-lane-regain time after snow events and to use those estimates to make snowplowing decisions.

What Did We Do?

After a literature review to identify winter maintenance performance measures related to traffic flow data used by state departments of transportation, researchers analyzed traffic speed data during several snow events on the Twin Cities freeway network to identify speed variation patterns under different snow conditions as well as the reported bare-lane-regain times from those events.

Investigators then used that information to develop an automated procedure to estimate traffic speed change points, including the speed reduction starting time, low speed time, recovery starting time, speed recovered time to either free-flow or congested speed, and road condition recovered (RCR) time.

Researchers applied this procedure to data collected during four snow events in the winter of 2011-2012. They analyzed two freeway routes for each event. One route had 14 segments in both directions, while the other had a single segment for each direction. Finally, the data-determined RCR times were compared to reported bare-lane-regain times to evaluate how well the data-based estimates match plow operators' observations. RCR times were calculated for each route segment while the bare-lane-regain times were reported for each route as a whole.

What Did We Learn?

Researchers found two types of speed recovery patterns: those where speed is affected only by road condition and continuously recovers to its free-flow speed level, and those

continued

"It would be valuable not to have to rely on plow operators to determine bare-lane-regain times. They are busy with plowing and reporting, and forcing them to make a subjective judgment can introduce errors."

—Eil Kwon,
Director, Northland Advanced Transportation Systems Research Laboratory, University of Minnesota–Duluth

"An automated process will make decision-making more efficient by eliminating any doubt about whether we need to keep sending plows along routes. The data we collect is also valuable as a measure to evaluate and improve plowing performance."

—Tom Peters,
Maintenance Research & Training Engineer, MnDOT Office of Maintenance

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While identifying when roads are clear enough after a snow event to end plowing operations is critical to providing service cost-effectively, no other state is currently investigating the possibility of making that determination with data rather than human judgment.

where speed is also affected by traffic flow and stops at a certain level before reaching its free-flow speed.

RCR times matched operator-estimated bare-lane-regain times closely in three out of four of the evaluated events. In Event 1, no segment had more than a 30-minute difference in RCR and bare-lane-regain times, while Events 2 and 4 had differences of 30 minutes or less in 64 percent and 65 percent of segments, respectively, and differences of 45 minutes or less in 93 percent and 72 percent of segments, respectively.

Event 3 showed significant gaps between the estimated RCR and the reported bare-lane-regain times; they were within 30 minutes of each other in only 44 percent of cases. Event 3 was unique in that speeds at reported bare-lane-regain times were close to or in excess of posted speed limits, while speeds at the recovery starting time were relatively low, indicating a significant amount of speed reduction before the recovery started.

What's Next?

This project was the first attempt to use data rather than plow operator observations to determine when roads have recovered sufficiently after a winter snow event. While promising, the procedure is not yet ready for wide deployment. A second phase, which will collect more detailed data from more routes, is already in progress.

The discrepancy between RCR and bare-lane-regain times seen in Event 3 suggests the need to re-evaluate and improve the procedure to determine the recovery start time data point. It also raises questions about the feasibility of having speed values that exceed the speed limits at the bare-lane-regain time.

The loop detectors that collect traffic flow data are currently installed only on certain interstates in the Twin Cities area. Since the procedures considered by this study can only be applied to routes where those detectors have been deployed, wider implementation would be contingent upon increased use of those devices.

This Technical Summary pertains to Report 2012-40, "Estimation of Winter Snow Operation Performance Measures with Traffic Data," published December 2012. The full report can be accessed at http://www.lrrb.org/PDF/201240.pdf.