UTC Spotlight

University Transportation Centers Program

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U.S. Department of Transportation, Research and Innovative Technology Administration

Photo by: Richard Myers-Walls

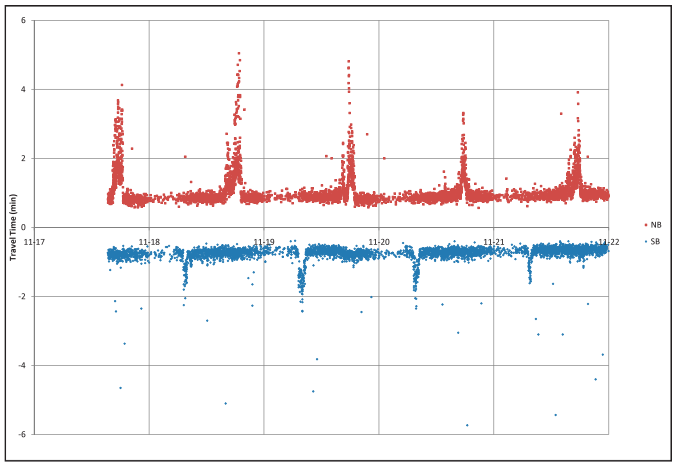
This monthly report from the University Transportation Centers Program highlights some of the recent accomplishments and products from one of the University Transportation Centers (UTCs) managed by the U.S. Department of Transportation's Research and Innovative Technology Administration.

Innovative Solution Helps NEXTRANS Model Travel-Time Reliability

Researchers at Purdue University and the NEXTRANS Center (Region V Regional University Transportation Center) are applying cutting-edge technology to develop a model that can accurately measure travel-time reliability. This model may provide a new basis for transportation professionals to monitor the performance and benefits of activities implemented on roadway networks.

Travel-time reliability is a key performance measure in any transportation system. It affects the routes commuters choose, impacts the on-time reliability of freight shipments, and reflects the efficiency of the transportation system to serve citizens, businesses, and visitors. The traditional measure of a transportation system's performance has been a level-of-service measure that is largely based on traffic density during peak hours. However, despite its importance to users, there is currently no standard method for calculating travel-time reliability. An average travel time does not account for day-to-day or time-of-day variability because commuters might be getting to work early one day and experiencing unexpected and substantial delays the next. Travel-time reliability is therefore defined by the Federal Highway Administration not by an average but "the consistency or dependability in travel times, as measured from day-to-day and/or across different times of the day."

The concept of travel-time reliability opens up new possibilities for evaluating the effectiveness of highway improvements, incident response systems, and new vehicle/highway technologies. A change that does not result in better level-of-service might still be justified if it significantly improves travel-time reliability. Such improvements stabilize commuters' route-choice decisions and help improve scheduling of freight deliveries – resulting in a significant improvement in system-wide performance and productivity.



Travel Time along the I-69 corridor, north of Indianapolis, for the week of November 17th. Each point on this graph represents the time it takes for a detected vehicle to travel from one Bluetooth device to another. Red dots plot the northbound travel time; blue dots plot the southbound travel time.

The Road to Modeling Travel-Time Reliability

- In 2007, The Joint Transportation Research Program at Purdue University, in conjunction with the Indiana Department of Transportation, began investigating the development of travel-time reliability models. This study utilized a floating car technique to gather data in which test vehicles were driven from one location to another and travel time recorded. Because this method limits the amount of data that can feasibly be collected, researchers were able to calculate the variability in travel time between different runs, but not develop a model that could successfully measure reliability in other contexts.

- In early 2008, NEXTRANS began a supplemental study, obtaining speed data from loop detectors on Indiana highways. Traffic data was collected, including speeds and volumes obtained from loop detectors installed along I-65 and I-70 corridors in Indianapolis. In addition, weather data was retrieved from Weather Underground and integrated with the traffic information. While this yielded a great deal of data, there is no definitive algorithm for converting speed measurements into travel time, and the researchers were only able to measure the effect of weather and volume on the average speed.

- In November 2008, NEXTRANS researchers turned to a technique developed by the Indiana Department of Transportation in 2007, in which consumer electronics are tracked to obtain travel-time reliability data. NEXTRANS researchers chained three Bluetooth cases at various points along the roadside of I-69, just north of Indianapolis. These cost-effective units are able to pick up signals from global positioning system devices and cellular phones in passing cars, allowing them to track the travel time of 5 to 6 percent of vehicles. By connecting the data obtained to the speed, volume, and density data previously obtained from loop detectors, researchers were able to determine the factors that influence travel time. They have created and are currently testing a preliminary time series duration model, allowing them to measure travel-time reliability and how it is affected by parameters such as traffic speed, volume, and occupancy.

The Future

This model makes it possible for future researchers to utilize loop detector data to determine travel-time reliability. Because loop detectors are already widely in place, NEXTRANS researchers have successfully utilized new technology to more effectively leverage existing technology. Now that the model has been created, researchers are going back to the loop detector data gathered during the second stage of the study, using it to determine how parameters such as weather influence travel time.

Photo by: Richard Myers-Walls

Professor Fred Mannering and Research Assistant Mary Martchouk discuss research results.

Researchers hope this model will provide a new way to monitor the performance and benefits of roadway improvements. Roadways may eventually have a separate travel-time reliability rating similar to the traditional A through F scale used to measure level-of-service. Travel-time reliability information will also be useful for strategies targeted to mitigate congestion and decrease delay due to traffic-influencing events (inclement weather, traffic incidents, construction, etc.) Predictable travel times will help shippers and freight carriers remain competitive, and will save millions of American drivers time and money.

This study also serves as an example of how obstacles foster innovation. When old methods proved ineffective, NEXTRANS researchers utilized new and existing technologies in an innovative and cost-effective manner, ultimately obtaining the data necessary to begin developing an accurate model.

About This Project

"Analysis of Travel-Time Reliability on Indiana Interstates," is currently being investigated by Professor Fred Mannering and Research Assistant Mary Martchouk at Purdue University. This project is sponsored by the NEXTRANS Center as a supplement to a 2007 JTRP/INDOT study titled "Travel-Time Reliability in Indiana," which was investigated by Professor Fred Mannering; Professor Kumares Sinha, Director, JTRP; Nadia Gkritza, Ph.D.; and Research Assistant Lakhwinder Singh.

Jay Wasson (INDOT), Jim Sturdevant (INDOT), and Professor Darcy Bullock (Purdue) developed the technique utilized in this project to obtain travel-time reliability data from consumer electronics.

Professor Srinivas Peeta is the Director of the NEXTRANS Center, Region V Regional University Transportation Center, headquartered at Purdue University. For more information, please visit www.purdue.edu/dp/nextrans