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Tracking Trucks to Improve Performance

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TRACKING TRUCKS TO IMPROVE PERFORMANCE

A project explores different methods for obtaining freight metrics to improve the efficiency of Oregon's highway system.

The Issue

Freight transportation is an important part of Oregon's economy, and the Oregon Department of Transportation, or ODOT, continually observes the highway system to make sure it is running as smoothly as possible. By monitoring the progress of individual trucks, ODOT can obtain performance metrics such as travel time, travel delays, and origin-destination flows. This information can help identify slow passages or bottlenecks in the highway system.Typical ways of obtaining these metrics, however, may involve purchasing expensive equipment, and may also raise privacy concerns if each truck is required to carry a tracking unit. To avoid these difficulties, Portland State University researcher Chris Monsere explored a simpler way to get freight performance measures using a probabilistic approach.

The Research

Vehicle reidentification is the process of matching vehicles from one point on the roadway to the next. With the process developed by Monsere this can be done anonymously, and inexpensively, using tracking methods that are already in place. Oregon's highways, like elsewhere in the US, are dotted with weigh-in-motion (WIM) and automatic vehicle classification (AVC) stations. At these stations, vehicle attributes including truck weight, axle spacing and axle weight are recorded.

This information is collected for reasons unrelated to freight efficiency; for example, truck weight data from WIM stations is often used in bridge design, to learn the average weight of vehicles that will be passing over the bridge. Monsere and his research team used archived data to single out trucks passing through one WIM station, and then attempted to find those same trucks in the data from a second WIM station, several hundred miles from the first. Using the axle weight, axle spacing, and truck weight, they matched the records to reidentify the trucks as they passed through the second station. Though the researchers were able to detect that the same truck had passed each point, they had no information on the identity of the driver or freight company, so no privacy concerns were raised.

THE ISSUE

Slow passages or bottlenecks in the highway system can delay freight transport. Freight performance metrics can help improve the speed of transport, but may be difficult to obtain.

THE RESEARCH

This project developed an economically sound method of freight-tracking, without the need for sophisticated new technology. The method:

- Works using existing equipment that is already in place along Oregon's highways;
- Achieves a 90% accuracy rate in reidentifying trucks as they pass through two stations;
- Provides ODOT with an expanded set of data on the movement of freight throughout the state's highway system.

THE IMPLICATIONS

Truck reidentification is a non-invasive, inexpensive method of tracking freight. It may prove helpful not only in Oregon but in other states as well, for gathering travel-time data and other performance measures.

Photo: Freight traffic on an Oregon highway

PROJECT INFORMATION

TITLE: Exploratory Methods for Truck Re-identification in a Statewide Network Based on Axle Weight and Axle Spacing Data to Enhance Freight Metrics

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MORE INFORMATION
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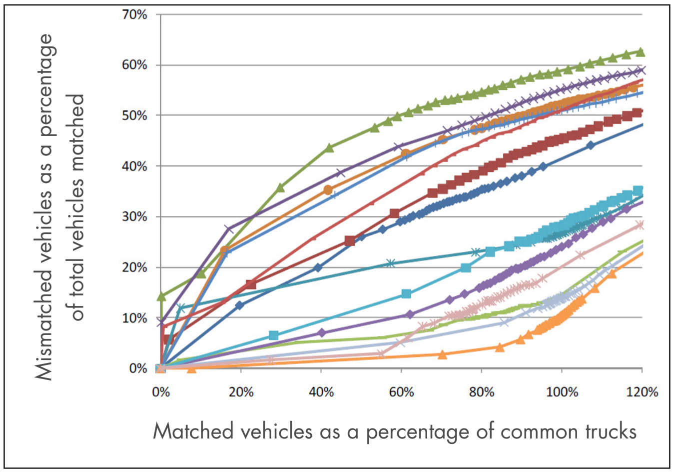
Since some of the trucks that Monsere and his team tested (about 20-35 percent of them) were carrying Green Light transponders, which also register at the WIM stations, these particular trucks provided the needed data to test how well the reidentification methods were working. They were able to match 95 percent of the trucks passing through the stations with 90 percent accuracy. The percentage of trucks that could be identified fell sharply as accuracies rose above 90 percent: only 40 percent of the trucks could be reidentified at 98 percent accuracy.

In Phase 1 of the project, the researchers used a Bayesian algorithm to calculate the probability of a match between two vehicles at the upstream and downstream stations. In Phase 2, they explored the possibility of using a neural network model to predict the results. They found that while both methods worked, the Bayesian method was more accurate. During Phase 2 of the project, Monsere and his team also did a comprehensive analysis to determine what factors impacted the accuracy of the results. They found that sensor accuracy and volumes had the greatest impacts on accuracy, whereas the distance between the two data points had less of an impact. They also identified an imperfection in the system: there is no mechanism to account for trucks that enter the highway somewhere between the two checkpoints, passing through the second station without passing through the first. This has the potential to muddy up the results, but even with these limitations, the reidentification system — with a 90% rate of accuracy, on average — works well enough to be put into practice.



Percentage of error versus the total number of vehicles matched.

The colored lines represent pairs of WIM stations. The x axis shows matched vehicles; the y axis shows mismatched vehicles. This graph illustrates how accuracy decreases as more trucks go through.

Implications

For Oregon, the data obtained by Monsere may provide ways to refine and fine-tune the highway system. Having a bank of information on average travel times is helpful for many purposes not limited to freight transportation: for example, the same or similar metrics could improve the highways for commuter traffic as well. The Green Light transponders carried by some of Oregon's trucks offered a preliminary set of data that has now been expanded.

Monsere's method of probabilistic truck reidentification may come in even handier in other states, where a much smaller percentage of freight traffic is equipped with transponders to begin with.