



Project Summary

Texas Department of Transportation

0-5453: Strategies for Improving Travel Time Reliability

Background

Deterministic network models, in which link travel time is a function of link volume, have been used by the Texas Department of Transportation (TxDOT) in performing traffic assignment in the four-step transportation planning process. Such models consider only the deterministic or average link travel time. They do not incorporate the concept of travel time reliability. In reality, link travel time is subject to day-to-day variation, especially when the link is congested. The variation may be due to incidents, weather, vehicle composition, driving behavior, or other random events. It is known that a driver's route choice and departure time choice decisions for a trip depend on both the average travel time of the available routes and the travel time reliability of each of the routes. Incorporating travel time reliability in traffic assignment can potentially improve the precision of the forecast link traffic conditions and evaluation of network performance.

What the Researchers Did

This research developed two traffic assignment approaches that incorporate travel time reliability (or uncertainty) in the modeling process. The first traffic assignment approach, called *traffic assignment with a fixed origin-destination matrix*, assumes that drivers do not change their departure time, but may respond to travel time uncertainty by changing routes. The second traffic assignment approach, called *traffic assignment with departure time choice*, models the changes in both the driver's route choice and departure time choice decisions. To assist planners and engineers in evaluating network performance, and in comparing different network designs, a method to compute and present the network's capacity reliability was also developed.

A suite of programs, called Travel Time Reliability Program Suite, has been coded to assist transportation planners and engineers in implementing the two traffic assignment approaches in Version 4.8 of TransCAD.

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What They Found

A critical element in performing traffic assignment using a standard user-equilibrium algorithm is the link performance function. In deterministic models, this link performance function is the link travel time expressed as a deterministic function of the link volume. In this research, link performance functions, called *equivalent link disutility functions*, that take into account both the average link travel time and the travel time variance, were derived. They are consistent with three types of route choice behaviors drivers may show. A method to conduct driver surveys leading to an estimate of the coefficient of the function has been developed. To perform traffic assignment with travel time reliability consideration, a transportation modeler can still use a standard user-equilibrium algorithm (such as the one provided by TransCAD) but simply replace the standard link performance function with the calibrated *equivalent link disutility function*.

In the morning peak period, when the network has the highest level of congestion, traffic assignment with travel time reliability has the most significant impact. The equivalent link disutility function for *risk averse drivers*, who prefer a route with a longer average travel time but better travel time reliability (smaller travel time variance) when faced with work-start time constraints, is the most appropriate in describing the route choice behavior. A survey conducted in El Paso has verified that, during the morning commute, the average driver is risk averse. The traffic assignment results have shown that these drivers tend to prefer links which have longer average travel time but are less congested, and avoid the highly congested links. This has an effect of spreading the traffic more uniformly across the network, and leads to an improvement in the network's capacity reliability.

What This Means

This research has developed two traffic assignment approaches and the accompanying software that enables transportation planners and engineers to perform traffic assignment in the morning commuting period when the network has travel time uncertainty. Compared to the existing deterministic models used by TxDOT, the new models represent the route choice and departure time choice decisions of the risk averse drivers. Therefore, an improvement in the precision and accuracy in the modeling results is expected.

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