Commercial Remote Sensing & Spatial Information Technologies Program for Reliable Transportation Systems Planning (Cooperative Agreement # RITARS-12-H-UNCC)

The University of North Carolina at Charlotte

Executive Summary

There has been a paradigm shift in focus from intersection-level to corridor- and area-level analysis and performance measures in recent years. The possibility of capturing dynamic and continuous travel time and/or speed data by responsible governing agencies or obtaining it from private sources such as HERE, INRIX, TomTom, etc. opens many pragmatic avenues to assess reliability of transportation network and make better decisions. Reliability is considered as the most viable performance measure with potential to be widely used for transportation system planning, project prioritization, and allocation of resources. However, the quality of travel time data to accurately assess reliability, for links with varying traffic and network characteristics, is still unclear and merits investigation. The first part of the project focused on collecting, processing and comparing the accuracy of link-level travel time estimates from selected technologies / data sources for both freeway and arterial streets.

Traditional indicators of reliability range from travel time percentiles to travel time indices and variance based measures. Examples include average travel time, planning time (PT) or 95th percentile travel time, planning time index (PTI), buffer time (BT), buffer time index (BTI), travel time index (TTI), λ skew, and λ variance. These performance measures may yield varying outcomes that could be applicable for different purposes (quantify level of congestion or reliability, before and after studies, or compare one link with another link for prioritization). Further, all these performance measures are confined by time-of-the-day and the day-of-the-week. However, travel time variation due to congestion depends on the time-of-the-day, the day-of-the-week, and the week-of-the-year (multiple dimensions). The second part of the project focused on 1) evaluating relationships between selected travel time, travel time percentile, index and variance based performance measures, 2) establishing and identifying suitable performance measure based on application and purpose, and, 3) demonstrating the use of a multi-dimensional performance measure.

Decision support tools (DSTs) help develop performance-based congestion management plans, identify links (to divert traffic due to an incident) for incident management and re-routing traffic over time (say, up to 2 hours after a fatal crash), and assist planners and engineers in their day-to-day activities (mobility and safety improvements at link- or corridor-level). These DSTs also support transportation network users make reliable route, mode and departure time decisions. The third part of the project focused on the development and implementation of DSTs that would help practitioners to:

1) examine spatial variations in the condition of the transportation network based on various performance measures,
2) assess the performance of links along a selected corridor in the transportation network,
3) identify and rank top “N” unreliable links in the transportation network,
4) assess the performance of a link by time-of-the-day and day-of-the-week during a year,
5) retrieve and report performance measures data for any further analysis, and,
6) evaluate the effect of an incident on nearby links in the transportation network.

Findings & Outputs

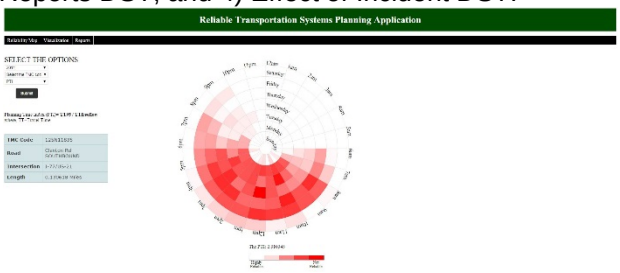
Travel time data for the Charlotte region in the state of North Carolina, for the years 2009 to 2013, was gathered, processed and used for research and illustration of the working of the of DSTs.

The travel time data from Bluetooth detectors and INRIX are reasonably close to manually captured travel time data along the freeway corridor than when compared to arterial street corridors. For arterial streets, travel times from INRIX are observed to be more promising when compared to the travel times from the Bluetooth detectors.

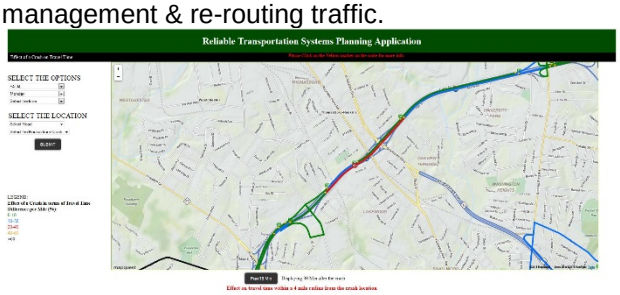
The average travel time was observed to be correlated with all the travel time and travel time variations related performance measures. It can be used as the expected travel time and to quantify the affect of a transportation project (before-after evaluations). BT was observed to be correlated with almost every other measure, while BTI was observed to be correlated with most of the reliability measures considered in this project. BTI can be used for

evaluating the condition of the facility as well as comparing the performance of any two links in the network. It also provides adequate information about the congestion or level of reliability of the link. The proposed reliability measure, Cronbach's α, was observed to be a better estimator of expected travel time when compared to traditional travel time performance measures.

Four interactive web-based DSTs with analytical and visual capabilities were developed to assist practitioners make decisions pertaining to transportation system. They are: 1) Reliability Mapping DST, 2) "HeatChart" Visualization DST, 3) Reports DST, and 4) Effect of Incident DST.



The Reliability Mapping DST has seamless transition from macroscopic level (transportation network-level) to details at a microscopic level (link-level). The macroscopic level details assist decision-makers and practitioners in transportation planning and development of performance-based congestion management plans. The microscopic level details help engineers in identifying site-specific solutions and improvements. This DST also helps identify top 'N' (10, 25 and 50) unreliable links in the transportation network for prioritization and allocation of resources. The "HeatChart" visualization DST helps visualize the intensity and duration of the selected performance measure by time-of-the-day and week-of-the-day. The Reports DST retrieves, disseminates and reports travel time and reliability measures by time-of-the-day and day-of-the-week. The Effect of Incident DST shows the effect of an incident over time and space. This DST helps identify critical links to divert traffic due to an incident; incident management & re-routing traffic.



Products & Outcomes

1. Final reports [Volume 1 - Comparative Evaluation of Link-level Travel Time from Different Technologies and Sources; Volume 2 - Comparative Evaluation of Travel Time Related Performance Measures; Volume 3 - Decision Support Tools (DSTs) Implementation and User Guide].
2. Web-based interactive DSTs with analytical and visual capabilities.
3. Tech Brief (Planning Reliable Transportation Systems using CRS&SI Technology).
4. Application Video
5. Reliable Transportation Systems Planning Workshop, February 20, 2015, Charlotte, NC.
6. Disseminate outcomes (5 conference proceedings publications; 9 presentations at international, national, regional & local meetings/conferences).

Post Project Initiatives

1. Disseminate outcomes (5 journal & conference proceedings publications; 4 presentations at international & national conferences).
2. Monetizing Reliability to Evaluate the Impact of Transportation Alternatives. Project funded by North Carolina Department of Transportation.
3. Proposed initiatives and discussions to expand the scope of the DSTs.
4. Assist with travel time vendor evaluations.

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