UNIVERSITY TRANSPORTATION RESEARCH CENTER

RESEARCH BRIEF

PROJECT TITLE: DATA DRIVEN PERFORMANCE MEASURES FOR EFFECTIVE MANAGEMENT OF COMPLEX TRANSPORTATION NETWORKS

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In the past, transportation data was collected through the limited deployment of infrastructure-based sensors and manual spot counts and surveys. Massive on-line data being collected on a nearly 24/7 basis enable researchers and transportation managers alike to quantify a number of realistic "performance measures" that allow transportation agencies to make timely and proactive decisions. However, there are great needs to integrate and mine the massive on-line operational data with performance measurements not only to make long-term strategic planning decisions but also for the execution of relatively short-term tactical decisions.

The primary objective of this research is to present and evaluate performance measures that can be quantified with "on-line data". In order to provide a full evaluation of a system's performance other than the commonly used performance measurements, this research aims to develop new methodologies that will both integrate different data sources and offer data-driven performance measurements to improved understanding of the transportation systems.

The major data sources explored in this research includes: Traffic volume counts, probe vehicle data, statewide crash records, weight-in-motion data, infrastructure-based sensor data, and on-line open source travel time and other crowdsourcing data. Based on the available data, data-driven approaches have been proposed to integrate different data sources and drive operational and safety performance measures.

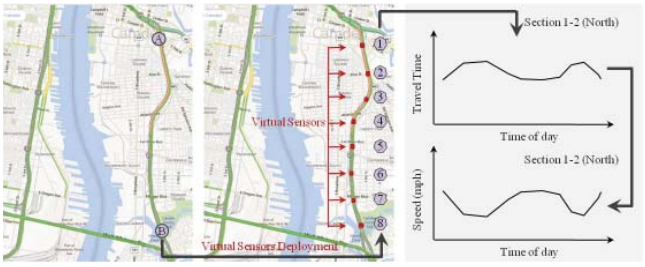

Fig 1. Using virtual sensor data for the quantification of performance measures

Particularly, performance measures related to travel time reliability, incident duration, and secondary crashes occurred in the transportation networks have been emphasized. Specifically, improved travel time estimation approaches based on probe vehicle data have been developed for estimating traffic delays and travel time reliability analysis. Second, structure learning algorithms based on Bayesian Networks approach were proposed to mine incident records and predict incident durations. Finally, both sensor-based approach and virtual-sensor-based approach have been developed to explore traffic sensor data as well as on-line traffic information for identifying secondary crashes.

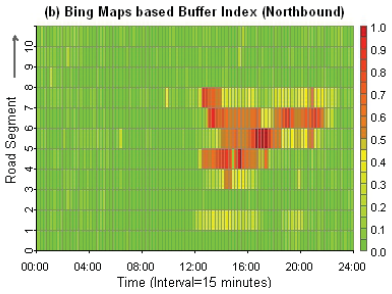

Fig 2. Buffer index analysis using virtual sensor data

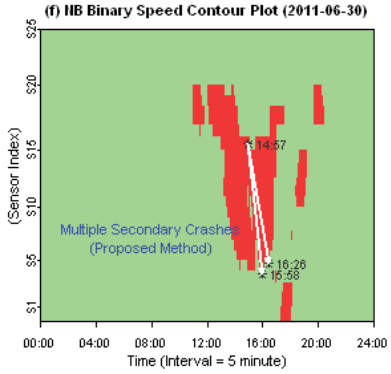

Fig 3. Identification of a secondary crash based on sensor data

The findings illustrated using the actual case studies illustrated that how the key performance measures can be used to understand the performance of their systems. This research suggests that by mining existing traffic related data sources, these performance measures can be more efficiently and accurately quantified without major expenditures in additional data collection technologies.

Publications Related to This Research

- H. Yang, B. Bartin, and K. Ozbay (2013). Identifying Secondary Crashes on Freeways Using Sensor Data. In Transportation Research Record: Journal of Transportation Research Board (In Press).
- S. Demiroluk and K. Ozbay (2014). Adaptive Learning in Bayesian Networks for Incident Duration Prediction. Transportation Research Record: Journal of Transportation Research Board (Forthcoming).
- E. F. Morgul, H. Yang, A. Kurkcu, K. Ozbay, B. Bartin, C. Kamga, R. Salloum (2014). Virtual Sensors: A Web-based Real-Time Data Collection Methodology for Transportation Operation Performance Analysis. Transportation Research Record: Journal of Transportation Research Board (Forthcoming).
- H. Yang, K. Ozbay, E. F. Morgul, B. Bartin, K. Xie (2014). K. Development of an On-line Scalable Approach for Identifying Secondary Crashes. Transportation Research Record: Journal of Transportation Research Board (Forthcoming).