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Measurement and Prediction of Transit System Performance Using Probe Data Generated through DSRC and non-DSRC Technologies

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Project 2008
October 2024

Introduction

The wireless communication revolution has enabled the tracking of transit vehicles in real time, which offers new possibilities for measuring (and therefore improving) transit performance. These possibilities are strengthened by the emergence of message standards for describing the behavior of vehicles. Two standards have been particularly notable within the transportation space: dedicated short-range communication (DSRC) and the general transit feed specification (GTFS). This research chronicles the potentials of DSRC and the lessons learned from its use before its discontinuation, as well as the potentials of GTFS Realtime (RT) for transit performance measurement. Although DSRC was originally designed as way for vehicles to communicate with each other and despite the substantial investment by the federal government and private companies to create products using DSRC, the tech did not become the standard and was eventually sunset to re allocate the valuable associated Wi-Fi bandwidth. GTFS-RT was designed for transit and has been widely embraced by agencies.

Study Methods

This study explores five full days of GTFS-RT VehiclePosition data from five different California transit systems to generate and test a protocol of imputing bus arrival and departure times. The agencies included are the Modesto Area Express (MAX), the Alameda-Contra Costa Transit District (AC Transit), Monterey-Salinas Transit (MST), the Big Blue Bus (BBB), and the Orange County Transportation Authority (OCTA).

The imputed times are tested against the limited stop time data available from the GTFS-RT TripUpdate data using several assessment metrics. An innovation of this evaluation approach is that it relies entirely on GTFS data available to the public—and no other data source. The imputation requires two key steps. In the first step, the scheduled routes are cut into segments between each successive stop. In the second step, the vehicle location data are applied to each segment and combined with derived vehicle speed data associated with the stop locations to impute arrival and departure times.

To expedite computing time and yield output data for detailed sub-route analysis, this research first parsed the GTFS static information to identify unique "variants" for each route and component segments for each variant. In this nomenclature, a "variant" refers to a set of trips on a given route that have the same set of stops in the same order and follow an identical path as defined by the associated vertices in the GTFS schedule data. A "segment" refers to the portion of that path that connects two consecutive transit stops.

Analysis of GTFS Realtime data can provide can create metrics that serve as tools for transit agencies to assess their own networks over time and compare them to other systems employing the same metrics in order to improve service.

Findings

Findings from this study demonstrate the added potential of probe data for enabling a granular understanding of transit service. The metrics presented emphasize tools for transit agencies to assess their own networks as well as comparable metrics for transit agencies to assess their systems over time and to compare them to other systems employing the same metrics. While other efforts have looked at larger units, this work focuses on sub-trip components and then brings those together for broader high-level analysis. This breaks data into segments, which are defined spatially (distance) as the scheduled path of the vehicle between two adjacent stops and temporally (time) as the time from the arrival at the initial stop to the arrival at the next stop. By combining the special and temporal information from segments, it is possible to generate an array of useful performance measures.

While performance measurement within the context of transit agencies can take many forms, this report focuses on the aspect that is most pertinent to the riding public, namely schedule adherence. This concept cuts to the heart of public transportation and how it serves communities. People value predictability, and much of transit's perception, positive and negative, flows from its reliability. The schedule published by a transit agency, such as a syllabus for a college class, is a contract that sets expectations (although GTFS Realtime does provide some wiggle room by offering users updates to schedule deviations). The extent to which those expectations are upheld often determines customer satisfaction with transit service. Poor satisfaction undermines transit by disappointing users, driving away riders, and depressing public support from the allocation of space to the allocation of subsidies.

Policy/Practice Recommendations

The goal of the proposed probe-based performance measures is to provide detailed information to stakeholders on where and when schedule deviations are occurring to guide policies that will result in a more reliable service delivery. Using this approach can improve stakeholder understanding of metrics related to how long a vehicle idles at a stop (dwell time); at what time the trip begins and the cascading effects of even a few minutes late start; when, where, and even why a transit vehicle deviates from its scheduled path; and more. Increased understanding of these metrics can lead to the improvement of transit performance, which means agencies are better able to serve their communities' mobility needs.

About the Author

Dr. Newmark is an Associate Professor in the Department of Design and Planning at Morgan State University. His research focuses on improving the sustainability of travel, particularly through the analysis of transit data.

To Learn More

For more details about the study, download the full report at transweb.sjsu.edu/research/2008

MTI is a University Transportation Center sponsored by the U.S. Department of Transportation's Office of the Assistant Secretary for Research and Technology and by Caltrans. The Institute is located within San José State University's Lucas Graduate School of Business.