University of Cincinnati

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I, Nathan Wessel, hereby submit this original work as part of the requirements for the degree of Master of Arts in Geography.

It is entitled:

Discovering the Space-Time Dimensions of Schedule Padding and Delay from GTFS and Real-time Transit Data

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Discovering the Space-Time Dimensions
of Schedule Padding and Delay
from GTFS and Real-Time Transit Data

Thesis submitted in May of 2015 to the
Graduate School of the University of Cincinnati
In partial fulfillment of the requirements for the degree of

Master of Arts

In the Department of Geography
of the College of Arts and Sciences by

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Abstract

Schedule padding is the extra time added to transit schedules due to expected random variability in travel times throughout a route. To this point, methods for applying padding to certain route segments and times have been relatively unsophisticated, largely reacting to observed changes in travel time variability relative to the existing schedule. By comparing schedule data and real-time vehicle locations, we aim to locate the segments of routes that are most affected by this random variability, and thus have the most padding. These segments could most benefit from targeted delay reduction techniques, such as signal prioritization or multi-door boarding. We also outline cartographic methods that could be used to depict such results to lay people and policy-makers. Our approach is relevant to any city with both General Transit Feed Specification (GTFS) data and a real-time vehicle location feed, though we take a single large city as our case study.

For this research, we focus on Toronto, Ontario, and the Toronto Transit Commission. We use real-time transit vehicle locations, obtained from a publicly available API, to establish what we take to be a reasonable maximum speed for each segment of a route, or any set of routes. We then compare this ideal performance to the scheduled performance, derived from GTFS data, where the difference between the two can be interpreted as the amount of schedule padding on a segment at a particular time. Since schedule padding is a response to stochastic delay, this technique should lead us to the spatio-temporal locations of the most significant sources of delay and guide attempts to reduce delay and maintain acceptable on-time performance.

Results suggest that choke-points are observed to crop up in expected places, like downtown at rush-hour, or near major signalized intersections. What is interesting is that we are able to begin to quantify delays in one part of a transit system, and compare them to other delays anywhere else in the same system. This should help to guide infrastructure investments that can minimize the impacts of random delay and to justify such expenses with explicit potential time or money savings.

Transit *delay* has been discussed extensively in the literature and in the press, but this delay is relative to a schedule which can be fairly arbitrary. This thesis is novel in its emphasis on schedule padding as a signal of avoidable delay below the level of the scheduled expectation.

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University of Cincinnati

Date: 4/29/2015

I, Nathan Wessel, hereby submit this original work as part of the requirements for the degree of Master of Arts in Geography.

It is entitled:

Discovering the Space-Time Dimensions of Schedule Padding and Delay from GTFS and Real-time Transit Data

Student's name: Nathan Wessel

This work and its defense approved by:

Committee chair: Michael Widener, Ph.D.

Committee member: Tomasz Stepinski, Ph.D.

Committee member: Paul Zender, M.F.A.

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