Research Centre for Integrated Transport Innovation (rCITI)

Let us take you there

Crowdsourced Traffic Data

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RESEARCH ARTICLE

Characterizing multicity urban traffic conditions using crowdsourced data

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Abstract

Road traffic congestion continues to manifest and propagate in cities around the world. The recent technological advancements in intelligent traveler information have a strong influence on the route choice behavior of drivers by enabling them to be more flexible in selecting their routes. Measuring traffic congestion in a city, understanding its spatial dispersion, and investigating whether the congestion patterns are stable (temporally, such as on a day-to-day basis) are critical to developing effective traffic management strategies. In this study, with the help of Google Maps API, we gather traffic speed data of 29 cities across the world over a 40-day period. We present generalized congestion and network stability metrics to compare congestion levels between these cities. We find that (a) traffic congestion is related to macroeconomic characteristics such as per capita income and population density of these cities, (b) congestion patterns are mostly stable on a day-to-day basis, and (c) the rate of spatial dispersion of congestion is smaller in congested cities, i.e., the spatial heterogeneity is less sensitive to increase in delays. This study compares the traffic conditions across global cities on a common data set using crowdsourced data which is becoming readily available for research purposes. This information can potentially assist practitioners to tailor macroscopic network congestion and reliability management policies. The comparison of different cities can also lead to benchmarking and standardization of the policies that have been used to date.

RESEARCH ARTICLE

A simple crowdsourced delay-based traffic signal control

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Abstract

Current transportation management systems rely on physical sensors that use traffic volume and queue-lengths. These physical sensors incur significant capital and maintenance costs. The ubiquity of mobile devices has made possible access to accurate and cheap traffic delay data. However, current traffic signal control algorithms do not accommodate the use of such data. In this paper, we propose a novel parsimonious model to utilize real-time crowdsourced delay data for traffic signal management. We demonstrate the versatility and effectiveness of the data and the proposed model on seven different intersections across three cities and two countries. This signal system provides an opportunity to leapfrog from physical sensors to low-cost, reliable crowdsourced data.

Introduction

Congestion has literally put our cities at the “crossroads.” Signals are a common strategy to manage traffic at junctions through prioritization of traffic movements while ensuring the efficient and safe flow of traffic. Ever since the inception of traffic signals to manage conflicts at traffic junctions, increasing congestion has driven the pursuit towards optimal phase structure, cycle length and green times that would minimize delay and/or maximize throughput.

Traditionally, the high cost and limited access to delay data meant that most adaptive traffic signal systems relied on volume and queue length data. Notable systems of this type include
Emerging Data
Spatial Heterogeneity

Multicity Traffic conditions

Network Stability

Congestion Formation and Dissipation
Correlations

<table>
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<th>Parameter</th>
<th>Estimated coefficient</th>
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<tbody>
<tr>
<td>Population density</td>
<td>20.5 ***</td>
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<tr>
<td>GDP per capita</td>
<td>-4.75 ***</td>
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<tr>
<td>PM2.5/PM10</td>
<td>0.884 ***</td>
</tr>
<tr>
<td>Constant</td>
<td>-0.045</td>
</tr>
<tr>
<td>Goodness of fit</td>
<td>-12.0</td>
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<tr>
<td>No. of observations</td>
<td>29</td>
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</table>

*** significant at 99% confidence interval

https://doi.org/10.1371/journal.pone.021845.t001
Bangkok Preliminary Results

Longdo Traffic Data which is openly available is extremely useful and most importantly FREE!!
1. Study area

Weather data: Keep all weather conditions and Wind Speed $\leq 10$km/h
2. Method (Congestion Index, CI)

The example of CI data

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<th>$V_{it}$</th>
<th>$V_{fit}$</th>
<th>$CI_{it}$</th>
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</table>

Different distances between stations and links
2. Method (Copula)

- The concept of Copula was proposed by Sklar.
- Copulas are functions that associate multivariate distribution functions of random variables with their one-dimensional marginal distribution functions.
- We are using Bivariate Gaussian Copula, Gumbel Copula, Clayton Copula, Frank Copula, Joe Copula.

![No dependency](image1.png)

![Positive dependency](image2.png)
4. The results (Correlation analysis)

- The more congested the traffic is, the more air pollutants are emitted by vehicles.

- The morning and evening peak periods
**Theorem**: Given a fixed cycle time, a green time that ensures clearance of queues is

\[ g_i^* = \frac{(T_i/\mu_i)}{\sum_j(T_j/\mu_j)} (C - L). \]

This policy is stable only if \( \lambda_i \leq \frac{(C-L)}{\sum_j(T_j/\mu_j)} \)

**Max Pressure Term**: \( P_i = T_i/\mu_i \)
Traffic signal controller that relies on crowdsourced data (e.g., Google etc.).

a) **Cost-effective installation** – 50% in cost and 10% of time than others.

b) **Cost-effective maintenance** – 1% of time needed compared to others.

c) **Delay Reduction** ~20%

d) **Reduction in Emissions** ~8%

e) **Improvement in Safety** ~18%
Adaptive Traffic Signal, Indonesia

![Diagram of traffic signal setup and data validation graph]

Arrowhead: Banda

Delay Reduction (%)

- Banda: 17.5%
- Lombok: 27%

UNSW Sydney  rCITI
Adaptive Traffic Signal, Mumbai

Removed evening peak through synchronization.
THANK YOU!