A SPATIAL ANALYSIS OF BUS DELAYS FROM GIS, GTFS & GPS DATA

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Deviation from static bus schedule...

- Increased perceived cost for a bus trip
Real-time bus information...

...the philosophy behind providing dynamic bus information is to get more out of what we have.

but, what type and quality of information?

* future bus arrival time at a stop
* its accuracy

“...to be useful travelers must trust the information being provided to them.”

**Real-time bus information..**

Some basic requirements to produce real-time bus arrival information:

<table>
<thead>
<tr>
<th>schedule data</th>
<th>real-time bus locations</th>
<th>prediction algorithms</th>
</tr>
</thead>
<tbody>
<tr>
<td>- where and when the agency plans for each bus to be</td>
<td>- where the bus is right now</td>
<td>- use various data types and prediction techniques</td>
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</tbody>
</table>

But, sometimes, a real-time system also tells you lies......

It might report a bus is
- **early** when it's on time or even late
- **late** when it's on time or even early

... mainly due to the lack of our understanding about the dynamics of bus delays in a route!

Objectives:

... well, primarily, the analysis of bus delays
Case study route

Route 91:
Calgary, Alberta, Canada
Spatial analysis

- Datasources
  - GPS
  - GTFS
  - GIS
**BUS SPEEDS...**

**A SINGLE ROUND TRIP**

**MULTIPLE TRIPS**
TIME SPACE DIAGRAM...

A SINGLE ROUND TRIP

MULTIPLE TRIPS
❖ BUS SPEED ≈ ZERO…

A SINGLE ROUND TRIP

MULTIPLE TRIPS
**BUS DELAYS @ BUS STOPS…**

- Delays at bus stops excluding time points:
  - Mean = 18 s
  - Median = 11 s
  - Standard deviation = 19 s

- Delays at time points:
  - Mean = 63 s
  - Median = 30 s
  - Standard deviation = 95 s
**BUS DELAYS @ TRAFFIC SIGNALS...**

- **Delays at traffic signals [through]**
  - Mean = 22 s
  - Median = 18 s
  - Standard deviation = 17 s

- **Delays at traffic signals [left turn]**
  - Mean = 49 s
  - Median = 34 s
  - Standard deviation = 48 s
Variations in delays among various locations
temporal analysis

- Data sources
  - APC
  - Environment Canada
### Running Time for a round trip

- ↑ 1 minute @ **morning peak**
- ↑ 2.5 minutes @ **afternoon peak**
- ↓ 2 minutes @ **weekends**
- ↓ 3 minutes @ **holidays**
- ↑ 1 minute @ **winter**
- ↑ 1 minute @ **snow**

### Dwell Time at a bus stop

- ↓ 2 sec @ **winter**
- ↓ 1 sec @ **snow**
- ↑ 4 sec @ **one boarding passenger**
- ↑ 3 sec @ **one alighting passenger**

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**KEY FINDINGS**

[TEMPORAL ANALYSIS OF ONE YEAR APC DATA FOR THE CASE STUDY ROUTE]

[significant @ 95% con. Level, multiple linear regression]
Thank you