CASPT12

Obtaining public transport level-of-service measures using in-vehicle GPS data and freely available GIS web-based tools

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Agenda

- Motivation
- Introduction
- Proposed Methodology
- Case of Application
- Conclusions

Motivation

- Congestion affects directly onto the performance of a public transport system
  - **Control strategies**: mitigate the negative effects

- Implementing these strategies requires the ability to COLLECT and PROCESS detailed level-of-service (LOS) data
  - Vehicle loads / Travel Times / Arrival Times

Motivation

- Information techonology, such as in-vehicle GPS, has provided the chance of using public transport vehicles as probes for estimating LOS measures

- Having LOS data helps transport operators, planners and users to support their decisions
  - Headway control strategies are based on GPS measures

Motivation

- Problem?
  - Processing of «**too much data**» is labour intensive and quite expensive

- Solution?
  - A quick and flexible procedure for estimating important LOS measures using **freely available map and geographic software**

Introduction

- Several valid techniques have been proposed for estimating LOS measures, with different difficulties
  - Software availability
  - Few flexibility on distance/time aggregation

- A methodology to obtain LOS measures without spatial and time constraints is desirable
  - LOS **at stop level** is preferrable for some applications

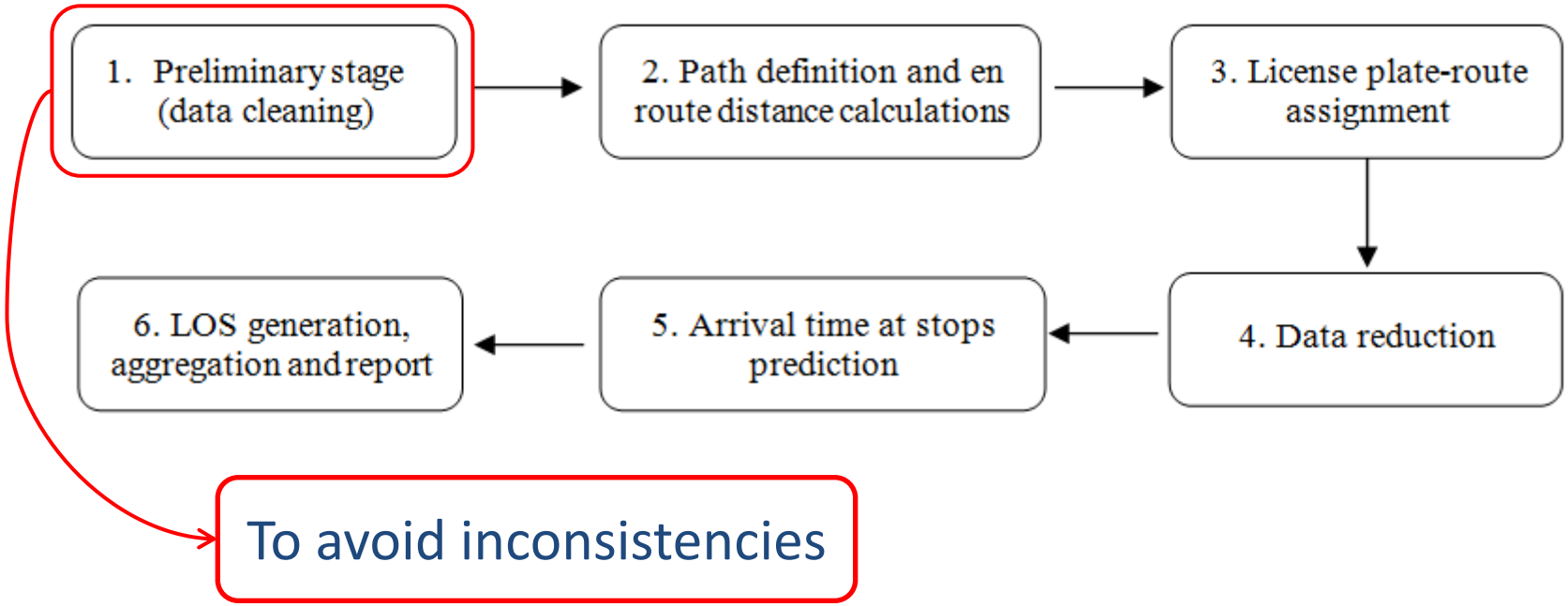
Proposed Methodology

- Requirements

– Bus stop data	Location and Route association
– In-vehicle data	GPS information every 30 seconds
– Software requirements • Database tools • Google Maps™	Freely Available

Proposed Methodology

- Six main steps



Proposed Methodology

- En route distance calculation

Paraderos de Transantiago

Tipo de Unidad de Negocio

Troncal

Unidad de Negocio

Troncal 4

Servicios

427-R

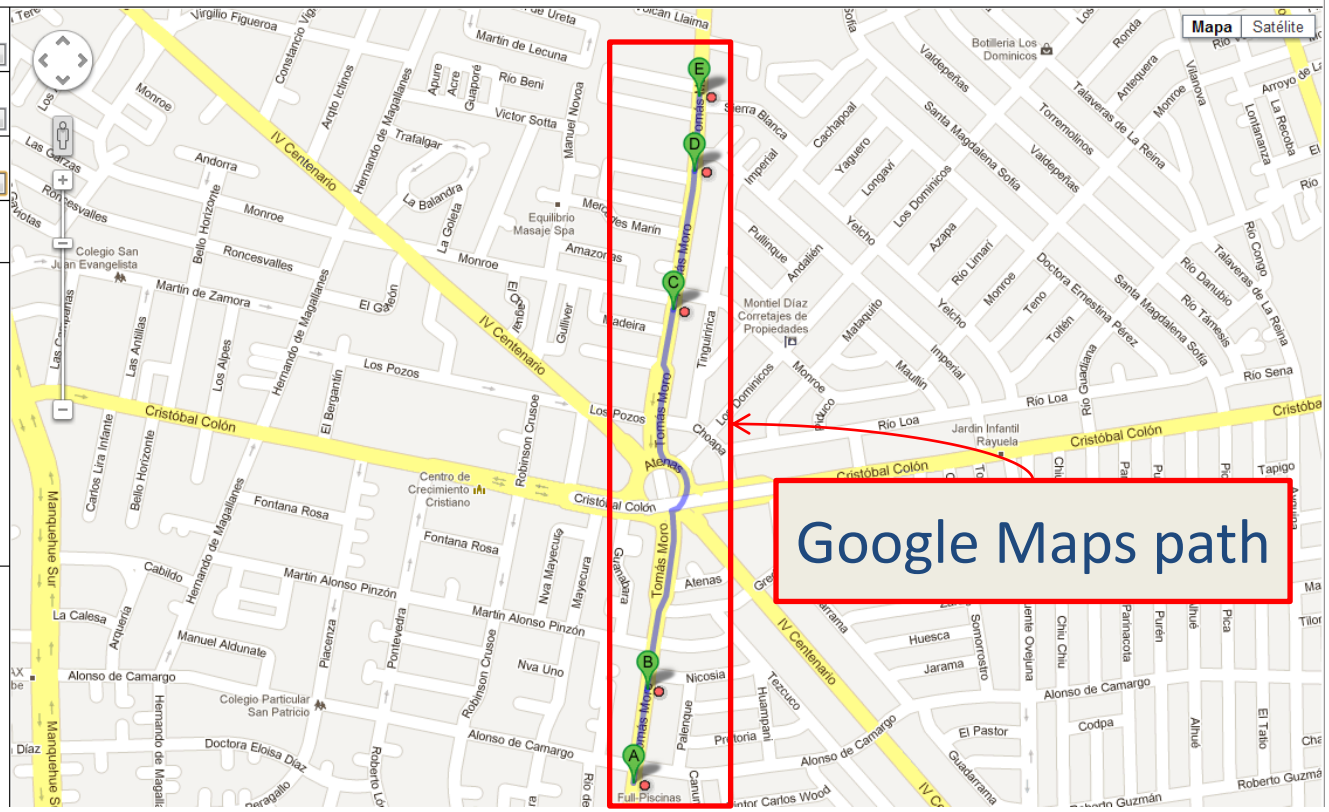
Resultados

Total de Paraderos: 76

Distancia Total: 3317 mts.

Servicio	O	D	Orden	d	d_	OK
427-R	1	2	1	113	111	1
427-R	2	3	2	503	504	1
427-R	3	4	3	192	152	1
427-R	4	5	4	287	286	1
427-R	5	6	5	305	305	1
427-R	6	7	6	498	500	1
427-R	7	8	7	269	269	1
427-R	8	9	8	334	334	1
427-R	9	10	9	656	450	1
427-R	10	11	12	160	160	1

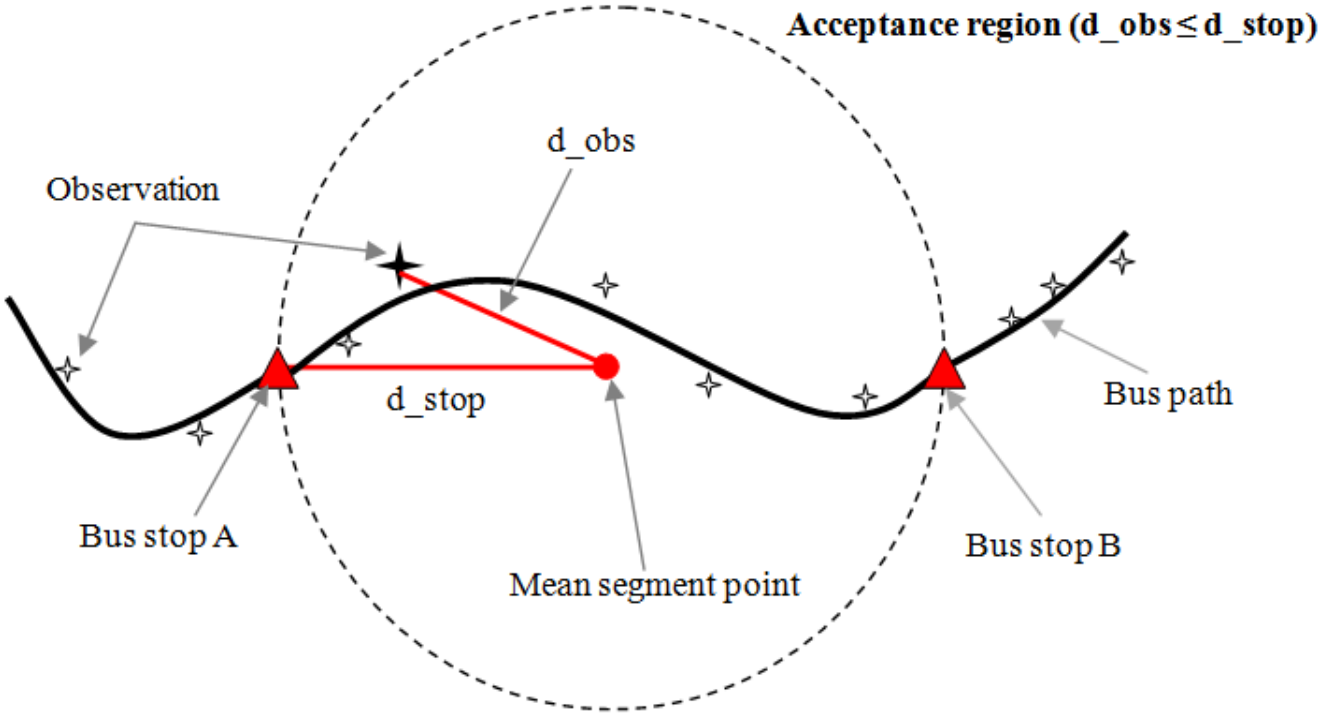
Google Maps distances



Google Maps path

Proposed Methodology

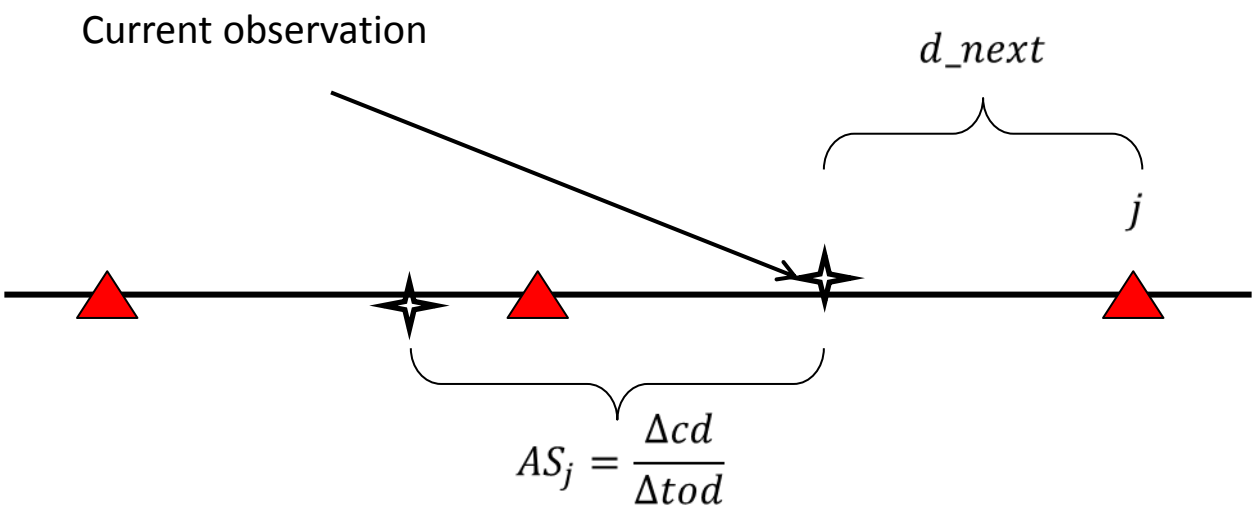
- Data reduction
  - Identify different bus expeditions



Proposed Methodology

- Arrival time prediction
  - Time of the current observation **plus** the estimated time to go through the remaining distance to the next stop

$$T^{j}_{arrival} = tod_j + \frac{d_next}{AS_j}$$



Case of Application

- Santiago's Public Transport System – Transantiago
  - 141 Transantiago services reported on a departure time choice survey (Arellana et al, 2012)
  - LOS measures calculated [periods of 15, 30 and 60 minutes]
    - **Travel time** at route segments (mean and standard deviation)
    - **Expected waiting time** at service stops
- Average processing time – all buses, all days
  - Computation and aggregation of LOS measures for one service and one day in only **six seconds**
    - Travel times: 24 seconds
    - Expected waiting times: 28 seconds

Promisingly fast

Conclusions

- **<u>Six step procedure</u>** to obtain LOS measures at any spatial and temporal aggregation level, using freely available map and geographic software

- Our procedure should be widely applicable and offers three major benefits over other methods:
  - Relatively **low cost** in terms of software requirements
  - Results are obtained relatively **quickly**
  - Information can be available at **any spatial and temporal aggregation level**

Conclusions

- All stages can be implemented using **freely available software**
  - Google Maps™ instead of GIS software to perform geographic-based calculations
  - Some algorithms were coded in MATLAB and Microsoft SQL Server, but can be coded in cheaper alternatives, such as Octave and MySQL

Conclusions

- An interesting extension of our procedure would be the development of a **planning tool for public transport users**
  - Study alternatives for travelling between two points in the city across different times of the day
  - Using historical information, users could get an idea of the different LOS that Transantiago offers during the day, in order to make better informed choices

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