Using Real Traffic Data for ITS Simulation: Procedure and Validation

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Introduction

- Traffic-related problems such as CO2 emissions, accidents, noise and environment pollution are critical issues for city authorities.
- Traffic management solutions require the use of simulators.
  - To capture in detail all characteristics and dependencies associated to real-life traffic.
- We propose a procedure for traffic flow tuning in order to build realistic mobility models.

DFROUTER Operation Analysis

- INPUT:
  - Induction loop counts for the different roads of Valencia.
  - We selected a typical Monday in November during the peak hour (8h00 - 9h00)..
- OUTPUT:
  - Estimation of the actual routes and vehicle count that match such input.

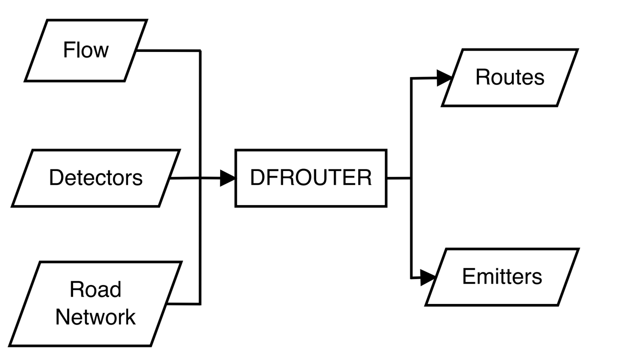


Figure 1: Flowchart of DRFOUTER

- After completing DFROUTERs process we observe:
  - Significant mismatches between the generated traffic and the real traffic of Valencia used as reference.
  - DFROUTER's output is 238.4% greater than reference data.

Proposed Heuristics - Iterative heuristic

Algorithm 1 Iterative heuristic.

Require: Road Network, flow, detectors files, n_{max} and ε
Ensure: Vehicle-Street-Segment-info file

$\alpha \leftarrow$ calculate reference number of vehicles
$\varphi^0_{min} \leftarrow 0, \varphi_0 \leftarrow \varphi^0_{max} \leftarrow 1, \tau_{s,0} \leftarrow \frac{\sigma_s}{\omega_s} \cdot \varphi_0$
Process input files with DFROUTER
$n \leftarrow 1$
$\beta_1 \leftarrow$ Vehicle count per street ID
$\varphi_1 \leftarrow \frac{\alpha}{\beta_1}$
$\tau_{s,1} \leftarrow \frac{\sigma_s}{\omega_s} \cdot \varphi_1$
Create a file with information about vehicles, segments and streets
Apply $\tau_{s,1}$ to all street IDs ($\tau_{s,n}$)
$\varphi^1_{min} \leftarrow \varphi^0_{min}, \varphi^1_{max} \leftarrow \varphi_1$
while $\left|\frac{\beta_n}{\alpha} - 1\right| > \varepsilon$ **and** $n < n_{max}$ **do**
  Process input files with DFROUTER
  $n \leftarrow n + 1$
  $\beta_n \leftarrow$ Vehicle count per street ID
  if $\left|\frac{\beta_n}{\alpha} - 1\right| > \varepsilon$ **then**
    if $\beta_n > \alpha$ **then**
      $\varphi^n_{max} \leftarrow \varphi_{n-1}, \varphi^n_{min} \leftarrow \varphi^{n-1}_{min}$
    else if $\beta_n < \alpha$ **then**
      $\varphi^n_{max} \leftarrow \varphi^{n-1}_{max}, \varphi^n_{min} \leftarrow \varphi_{n-1}$
    end if
    $\varphi_n \leftarrow \frac{\varphi^n_{max} + \varphi^n_{min}}{2}$
    $\tau_{s,n} \leftarrow \frac{\sigma_s}{\omega_s} \cdot \varphi_n$ to all street IDs ($\tau_{s,n}$)
  end if
end while

Adopted Strategy

- 1. Calculate the adjustment factor:

$$\varphi_1 = \frac{\alpha}{\beta_1}, \varphi_n = \frac{\varphi^n_{min} + \varphi^n_{max}}{2}$$

- 2. Normalize traffic:

$$\tau_{s,n} = \frac{\sigma_s}{\omega_s} \cdot \varphi_n$$

- 3. Calculate new input based previous DFROUTER's output until:

$$\left|\frac{\beta_n}{\alpha} - 1\right| < \varepsilon \ or \ n = n_{max}$$

Validation of Iterative heuristic

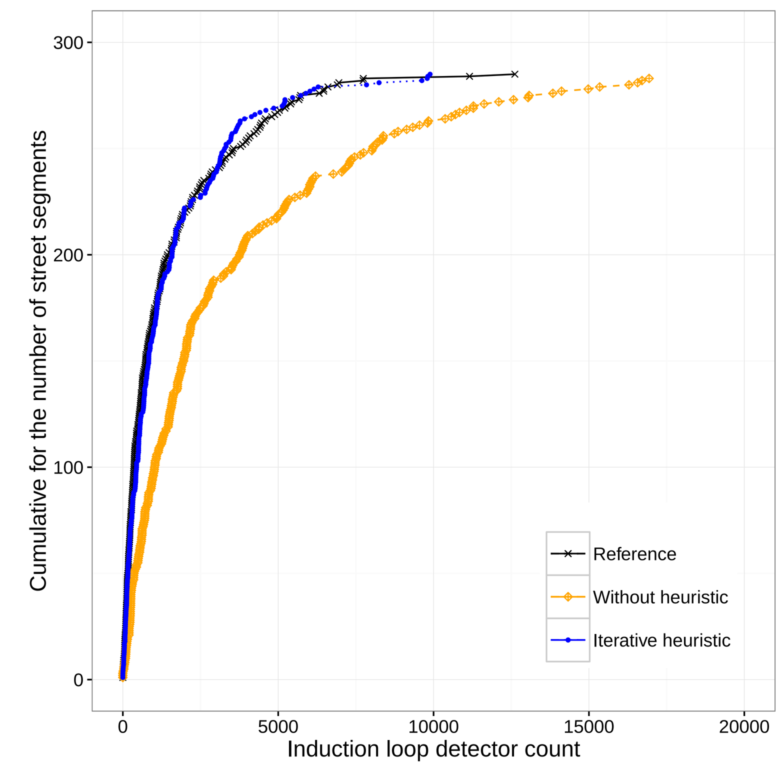
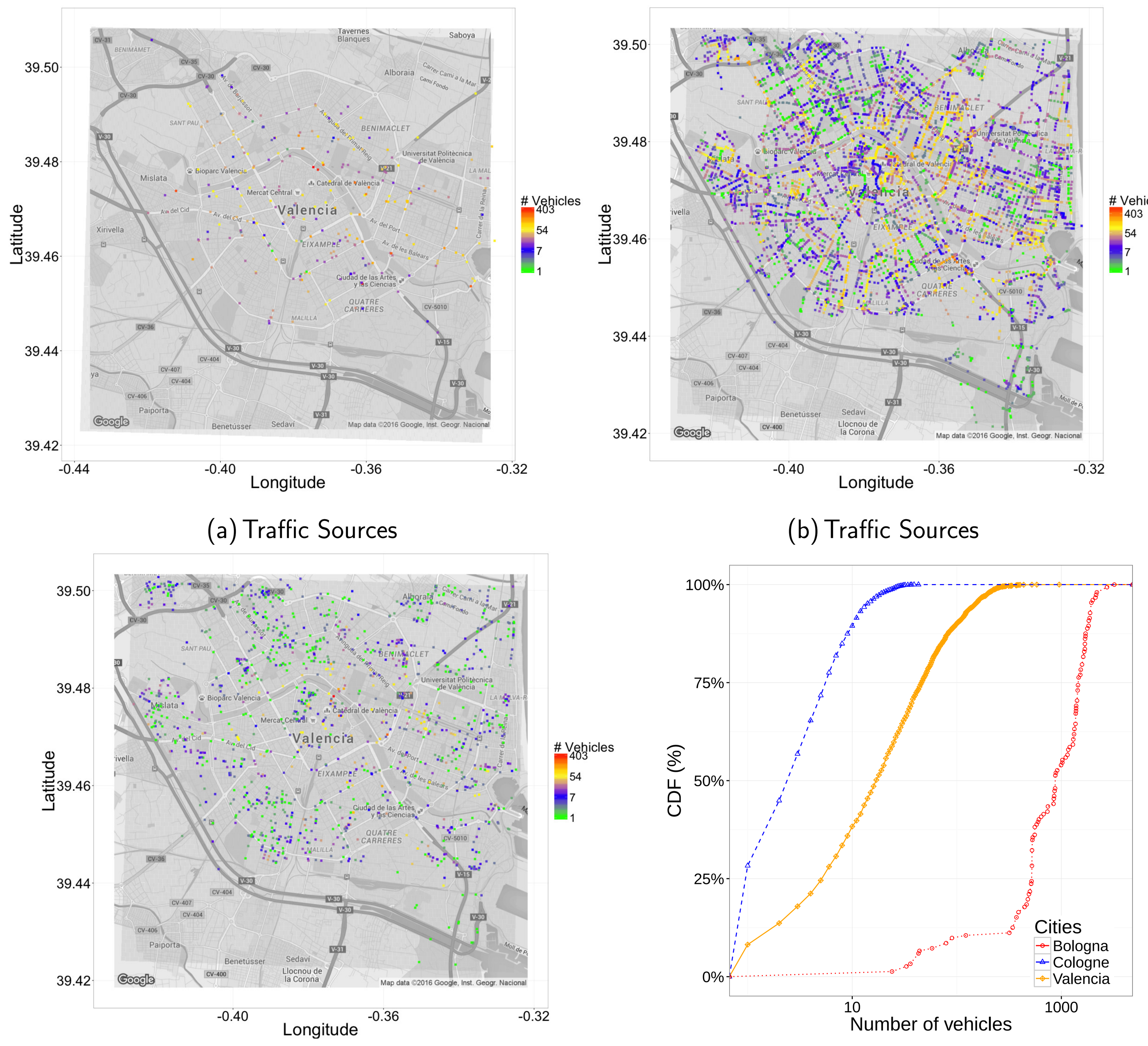


Figure 2: Adjustment of vehicles in Valencia using the proposed heuristic

Simulation Results



(a) Traffic Sources (b) Traffic Sources (c) Traffic Destination (d) CDF

Figure 3: Geographical distribution of traffic sources (a, b, c) and CDF for number of vehicle per traffic dispersion.

Conclusion and Future work

- DFROUTER + Iterative heuristic = Good approximation to real traffic distribution.
- Validation against real traffic data for Valencia
  - We observe a good traffic dispersion throughout the different streets.
  - Traffic is flowing through a high number of street segments.
  - There is a clear asymmetry between streets/avenues with low and high traffic levels, as occurs in real situations.
- The results achieved
  - Allow us to be satisfied with the generated O-D matrix.
  - Enable making an analysis of possible traffic optimizations during peak hours, improving travel times and reducing CO2 emissions.

Acknowledgments

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