Visual Analysis of Floating Taxi Data based on selection areas

Andreas Keler, Jukka M. Krisp

Applied Geoinformatics, Institute of Geography, University of Augsburg
The idea (1)

• Designing a geovisualization tool for interactive inspection of traffic (taxi FCD) and air quality (static sensors) in areas of interest over time

• Areas of interest may have varying size and shape, (and time component,) including POIs like “my house”, “the place I work” or “where I want to go”

• Multiple selected areas are represented in a “global view”, where each area is classified by selected average information (interactive map with multiple locations, optionally with slider tool for changing time windows)
The idea (2)

• Possible aim: Exploratory data analysis based on areas of interest with recent and historical travel time information (statistical methods) and additional information

  – Multiple successive selections are connected by semantic relations (POIs), topological relations (same road network) and temporal relations (working hours)

  – Each selection area is product of personal interest ("personalized traffic information")

  – Additional: Visual representation of relations between selected areas
Similar approaches

Wang et al. (2013)

Liu et al. (2011)

Ferreira et al. (2013)

Tominski et al. (2012)

Guo et al. (2011)
Selecting segments

- **Dynamic spatial query:** cases of path-segment-circle intersections

  ![Diagram](image)

  Tominski et al. (2012)

- **Selection areas as**
  - Path segments included as partitions (node positions)
  - Movement trajectories as partitions by record (obj_id)

  ![Selection circle and road selector](image)
The data

• **FCD** (historical) from taxis and buses
  obtained from Wireless and Sensor networks Lab (WnSN), Shanghai Jiao Tong University

• **Air quality data** (static monitoring stations), (Zheng et al. 2014)
  Microsoft Research (ongoing project)

• **Street data from OpenStreetMap** (OSM)

• **Google traffic layer**
  – Road-segment-wise traffic information
    (every 5 till 10 minutes)
  – Method from Tostes et al. (2013)
The method

1. User defines polygons based on one selected point (POI) or on one line (selected road segment)
2. Sequence of user is recorded (ID, pol_ID, time, type, name)
3. Defined Polygons are enriched with average information on traffic states, air quality and travel times (different modes)

Examples for selection areas in a global view with

- FCD records as points
- Classified road partitions
Case study: Different aspects of traffic and its correlation with air pollution

- Relation between global and local view of derived (averaged) traffic flow parameters and the comparison with additional interpolated data on fine particulate matter (PM2.5)

- Graphical data representations include 3D surface extrusions and other visualization techniques based on density estimation, interpolation and weighting of taxi FCD records and trajectory partitions within selected areas
Possible displays of a local view on FCD with

(a) road selector on road network;
(b) extrusion of road segments based on taxi density;
(c) coloration based on average velocity ranges;
(d) graph of average velocity;
(e) proportion of interpolated PM2.5 values and
(f) associated graph.
Test results

- Selected crossings classified by quality of traffic congestion (5 classes)
- Important: connectivity (OSM) for estimating travel times

<table>
<thead>
<tr>
<th>ID</th>
<th>Sel_area</th>
<th>Sel_lon</th>
<th>Sel_lat</th>
<th>Sel_ID</th>
</tr>
</thead>
<tbody>
<tr>
<td>388</td>
<td>Wai Huan Hu Qing Ping Li Jiao Qiao</td>
<td>121.358094</td>
<td>31.183053</td>
<td>301</td>
</tr>
<tr>
<td>389</td>
<td>849 Hong Xu Lu</td>
<td>121.388660</td>
<td>31.193598</td>
<td>302</td>
</tr>
<tr>
<td>390</td>
<td>827 Zhong Shan Xi Lu</td>
<td>121.412212</td>
<td>31.205220</td>
<td>303</td>
</tr>
<tr>
<td>391</td>
<td>1885 Cao Bao Lu</td>
<td>121.367646</td>
<td>31.158105</td>
<td>304</td>
</tr>
<tr>
<td>392</td>
<td>1619 Gu Dai Lu</td>
<td>121.379107</td>
<td>31.136764</td>
<td>305</td>
</tr>
<tr>
<td>393</td>
<td>Xin Zhuang Li Jiao</td>
<td>121.389511</td>
<td>31.118375</td>
<td>306</td>
</tr>
<tr>
<td>394</td>
<td>708 Wu Zhong Lu</td>
<td>121.394401</td>
<td>31.180858</td>
<td>307</td>
</tr>
<tr>
<td>395</td>
<td>2 Wu Zhong Lu</td>
<td>121.421279</td>
<td>31.189230</td>
<td>308</td>
</tr>
<tr>
<td>396</td>
<td>71 Cao Xi Lu</td>
<td>121.436061</td>
<td>31.179283</td>
<td>309</td>
</tr>
<tr>
<td>397</td>
<td>688 Cao Bao Lu</td>
<td>121.403223</td>
<td>31.162119</td>
<td>310</td>
</tr>
<tr>
<td>398</td>
<td>Hu Min Lu Fu Lu</td>
<td>121.419189</td>
<td>31.148112</td>
<td>311</td>
</tr>
<tr>
<td>399</td>
<td>76 Liu Zhou Lu</td>
<td>121.429660</td>
<td>31.156339</td>
<td>312</td>
</tr>
<tr>
<td>400</td>
<td>710 Shang Zhong Xi Lu</td>
<td>121.418159</td>
<td>31.131703</td>
<td>313</td>
</tr>
</tbody>
</table>
Outlook (1)

• How to represent different traffic situations on one and the same crossing visually? Example: different times of the day

• Defined preference of selection areas useful? Frequency of inspection needed, not only order (temporal) and definition (local knowledge) of selection areas

• In case of multiple POIs in the same selection area or overlapping selection areas: Weighting of different POIs within selected area based on distance?
Outlook (2)

• Questions that result from first test:
  – Is extension of traffic map possible with more interactivity?
  – Helpful tool for commuters?
  – Extension for visual analysis process?

• Evaluation of the test implementation:
  – “ease of use” for a potential user – evaluation with individual selection areas
  – Results: Initial point for conception of GUI for visual analysis of FCD?
Thank you for your attention!
References (1)


References (2)
