

See discussions, stats, and author profiles for this publication at: <https://www.researchgate.net/publication/282274847>

Harmonizing Level of Detail in OpenStreetMap Based Maps

Conference Paper · September 2014

CITATIONS

4

READS

122

2 authors, including:



Guillaume Touya

Institut national de l'information géographique et forestière

84 PUBLICATIONS 886 CITATIONS

SEE PROFILE

Some of the authors of this publication are also working on these related projects:



CARGEN View project



DeepMapGen View project

Harmonizing Level of Detail in OpenStreetMap Based Maps

G. Touya¹, M. Baley¹

¹COGIT – IGN France, 73 avenue de Paris 94165 Saint-Mandé France
Email: guillaume.touya{at}ign.fr

1. Introduction

As OpenStreetMap (OSM) is growing larger every day, practical applications based on OSM data are flourishing, but the initial goal of the project was to produce open topographical maps. A quick look at the default map output provided by OSM shows that it is difficult to create good legible maps out of the huge amount of data in OSM. One of the main obstacles to the creation of good legible maps from OSM data is the heterogeneity of its level of detail (LoD). This heterogeneity is troublesome for large scale maps, the focus of this paper, as undetailed objects are often inconsistent with the detailed features of the map (Touya 2012). The understanding of a map is highly dependent on the way the reader grasps spatial relation between map objects. As a consequence, LoD inconsistencies are mainly damaging when occurring between spatially related objects (Figure 1).



Figure 1: Buildings should be inside the built-up area to make it a readable spatial relation.

In order to remove the LoD inconsistencies, the preliminary step is to infer the level of detail of each OSM object. This is not the focus of the paper, so we consider that this LoD has already been inferred using the method from (Touya & Brando 2013).

Dealing with LoD inconsistencies in large scale maps requires the transformation of undetailed objects to make them consistent with detailed objects when objects share a spatial relation that helps understanding the map. We call such a process harmonizing LoD, implying that the harmonization increases LoD or at least preserves it, while map generalization (Sester et al. 2014) decreases LoD by simplifying the detailed objects. The automation of harmonization raises two questions. Is it possible to automatically harmonize OSM maps? Is it meaningful to transform data without any information on ground truth to make it more detailed? The ongoing work presented in this paper seeks to explore both questions by experimenting first attempts of automatic harmonization on OSM data.

In the second section presents several automatic harmonization methods for cases identified in the OSM dataset. The third part shows some experimental results and the fifth part draws conclusions and explores further research.

2. Harmonization Operations for OpenStreetMap Data

In this section, three cases of LoD inconsistencies are highlighted and methods are proposed to achieve harmonization in such cases.

2.1 Complete Aggregations

Geographical datasets often comprise high level objects that are aggregates of lower level objects of the dataset: a city is an aggregate of buildings, roads and parks for instance. In OpenStreetMap, such aggregate objects are very common and are generally less detailed than their components. This generates the most frequent LoD inconsistencies with components that lie just outside the aggregate (Figure 1). Harmonizing such inconsistencies consist in extending the aggregate to include the objects that are obvious components of the aggregate. Figure 2 shows the three steps of the proposed harmonization algorithm: (i) buffers are computed around the components to include, (ii) buffers are merged to the aggregate, and (iii) the outline is simplified to get a consistent resolution all along, as far as possible.

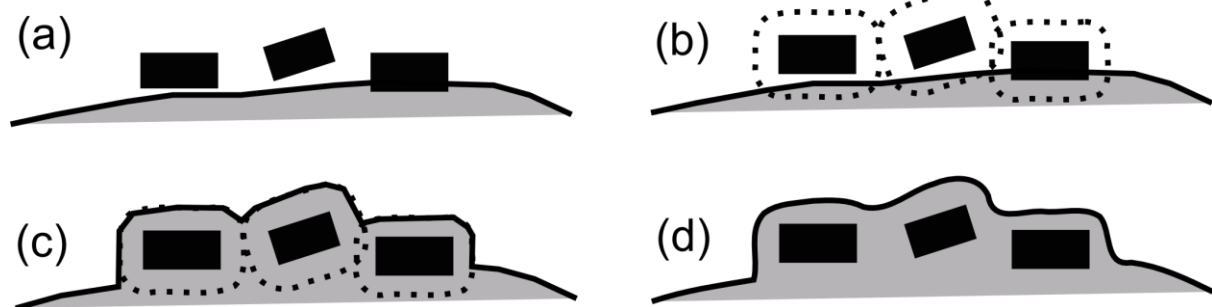


Figure 2: Steps to extend built-up areas. (a) Initial state (b) compute buffers of buildings (c) merge the built-up area with the buffers (d) simplify to preserve resolution.

2.2 Relocate

Relocation deals with inconsistencies where the positional accuracy is the most significant aspect of the lack of detail, i.e. some undetailed objects are clearly misplaced regarding some detailed objects. Misplaced objects should be displaced in the map to improve its readability. For instance, trees are often poorly detailed because hard to capture precisely and tree alignments often overlap road symbols. The algorithm proposed to relocate the trees removes the overlap and forces the alignment (Figure 3). Tree alignments on the right and on the left of a road are first identified. Then, right and left offset lines are computed, on which trees are projected to be aligned and off the road symbol. When a tree is at a crossroad, the projected position is the intersection of both offset lines.



Figure 3: Inaccurate trees overlap a road – harmonization aligns them on a road offset.

2.3 Re-Delimit

Re-delimitation is the modification of an undetailed object, with a more detailed outline, using the detailed objects in relation to figure out the more detailed outline. For instance, a detailed cycle way cannot intersect the outline of an undetailed lake captured on satellite images. The cycle way has a certain width, so the harmonized lake outline cannot be adjacent to the cycle way, a gap between the cycle way and the lake must be added.

Figure 5 shows that, sometimes, paths crossing a lake are just bridges. To avoid bad harmonization in such cases, the re-delimitation algorithm is improved with a pre-step that automatically identifies parts of a path that belong to a bridge. Two characteristics of bridge sections are used for the identification:

- The middle of a bridge is more “inside” the lake than its extremities (Figure 4a and b),
- The angle between the bridge and the nearest lake shore is close to 90° (Figure 4c and d).

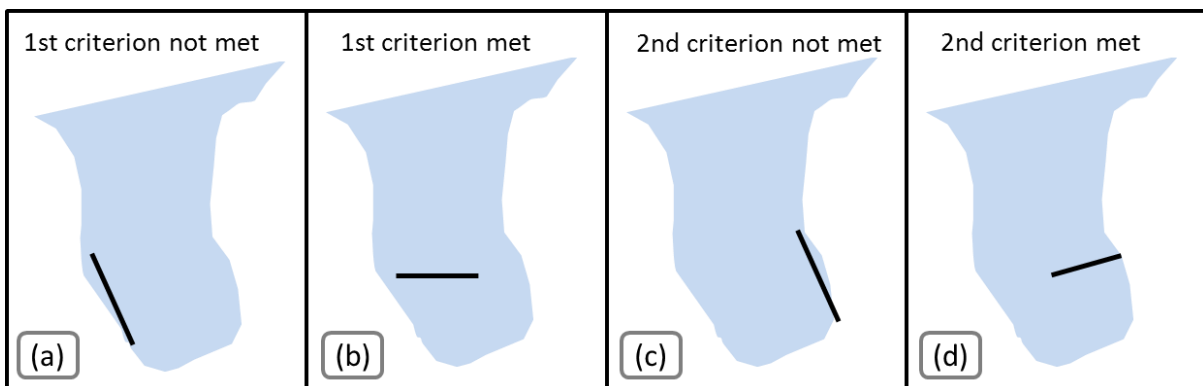


Figure 4: Criteria to characterize bridge segments.

3. Experiments

All presented algorithms have been implemented on the open source software GeOxygene (Bucher et al. 2012). Several datasets were extracted all over the world, but mostly in France. French datasets are useful as they can easily be compared to the authoritative maps we have access to, produced by IGN, the French mapping agency. Figure 5 shows some results of the lake re-delimitation algorithm.

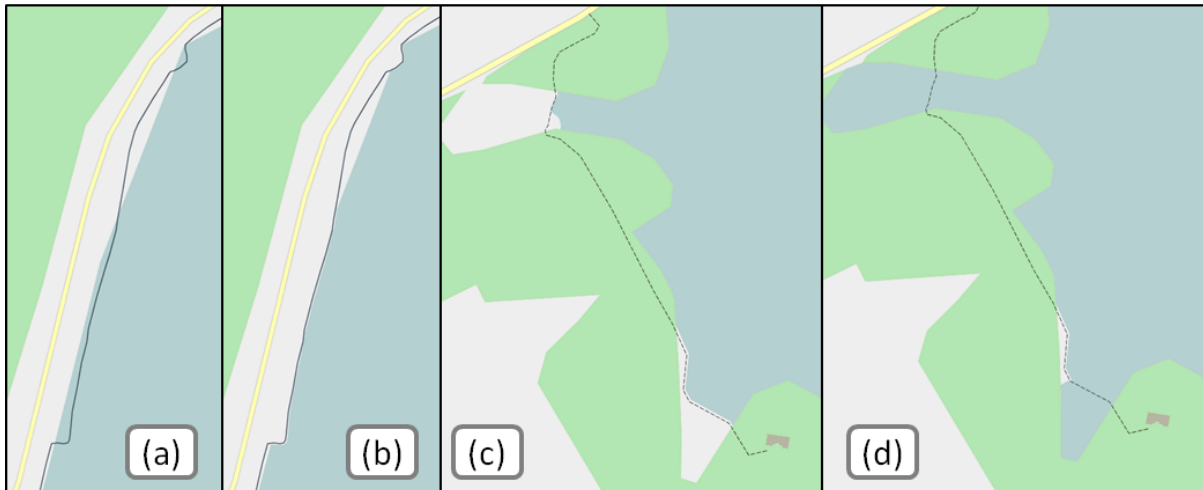


Figure 5: (a) a cycle way intersecting a lake (b) harmonized lake outline (c) case with bridges: bad harmonization (d) harmonization with automatic detection of bridges.

Experiments on large datasets confirmed our assumption on the difficulty to find the best parameter values for harmonization algorithms. For instance, there is no obvious value for defining how far a building can be to be considered as “just outside” a built-up area. Harmonization algorithms parameters are context-dependent: parameters values are adapted to some situations and other situations require different parameter values. For instance, Figure 6a clearing uses the standard set of parameters empirically defined, but does not look like the real clearing drawn in the IGN map (Figure 6c). A specific set of parameters, which fails for most other cases, gives, here, much better results. Consequently, a knowledge base will be required to achieve the automation of harmonization in a complete map.

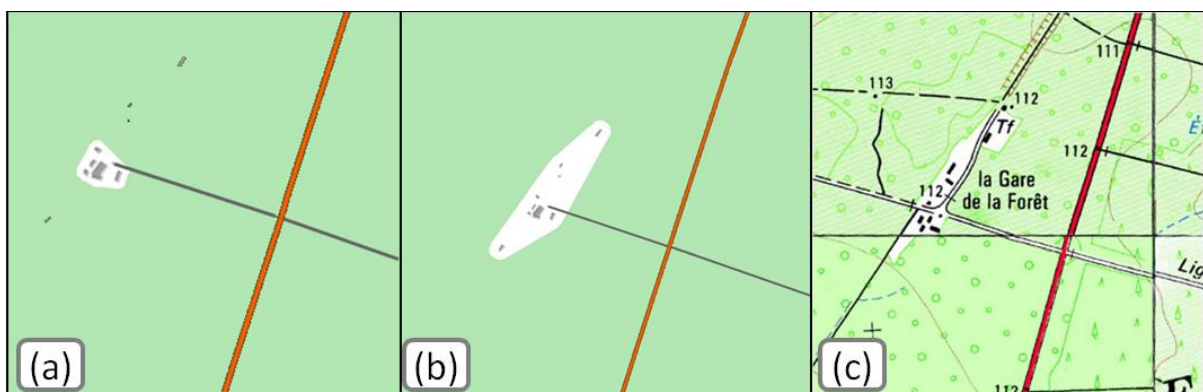


Figure 6: The clearing created with the standard parameters (a) does not look like the clearing in the IGN map (c); different parameter values give closer results (b).

A first basic evaluation was carried out by comparison with detailed authoritative datasets. A manual matching helped comparing the harmonized features with their authoritative counterpart. Shape and positional similarity measures show that the harmonized features are

closer to “reality” than the initial OSM features. Further quantitative evaluation is planned to confirm the first assumptions made on these experiments.

4. Conclusion and Further Work

To conclude, this paper introduces a new cartography problem raised by OpenStreetMap data, namely LoD harmonization, which improves the LoD of some undetailed objects in large scale maps to remove inconsistencies. Several types of harmonization operations are proposed and experimented on OSM datasets.

Further research should clearly focus on harmonization processes, to be able to automatically chain harmonization operations using a knowledge base, and solve complex problems that involve many objects like generalization or conflation processes (Harrie and Sarjakoski 2002, Touya et al. 2013). Furthermore, as harmonization operations transform data into something realistic but false, evaluation methods should be improved and user tests should be investigated, to know if map user better understand harmonized maps.

References

- Bucher B, Brasebin M, Buard E, Grosso E, Mustière S and Perret J, 2012, GeOxygene: Built on top of the expertness of the french NMA to host and share advanced GI science research results. In: Bocher E, Neteler M (eds) *Geospatial Free and Open Source Software in the 21st Century*. LNG&C, Springer, Berlin, 21–33.
- Harrie L, Sarjakoski T, 2002, Simultaneous graphic generalization of vector data sets. *Geoinformatica* 6(3):233–261.
- Sester M, Jokar Arsanjani J, Klammer R, Burghardt D and Haurert JH, 2014, Integrating and generalising volunteered geographic information. In: Burghardt D, Duchêne C and Mackaness W (eds), *Abstracting Geographic Information in a Data Rich World*, LNG&C. Springer, Berlin, 119–155.
- Touya G, 2012, What is the level of detail of OpenStreetMap? In: *Workshop on Role of Volunteered Geographic Information in Advancing Science: Quality and Credibility*, Columbus, USA.
- Touya G, Brando C, 2013, Detecting Level-of-Detail inconsistencies in volunteered geographic information data sets. *Cartographica* 48(2):134–143.
- Touya G, Coupé A, Le Jollec J, Dorie O, Fuchs F, Conflation optimized by least squares to maintain geographic shapes. *ISPRS International Journal of Geo-Information* 2(3):621–644.