

Using shape, proximity and functionality to define neighborhoods with morphologically similar buildings

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Introduction

Theoretical overview

Urban Morphology

Building shapes

Methodology

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Process overview

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Conclusions

References



What, how, and why ?

- ▶ Trying to cluster morphologically similar buildings in an urban context
- ▶ Using features derived from simple building representations
- ▶ Clustering using a geo-constrained Self-Organizing Map (geo-SOM)
- ▶ Find (in-)homogeneous places in cities, compare internal morphologies of cities, etc.

Definitions and approaches

Literally the *study of urban form*, with several approaches (Kropf, 2017)

- ▶ Typo-morphological (evolution of building types)
- ▶ Configurational (topological relations, influence of spatial configuration)
- ▶ Historico-geographical (townplan study, hierarchy of elements)
- ▶ Spatial analytical (complex systems, physical and socio-economical dynamics)

Similar works

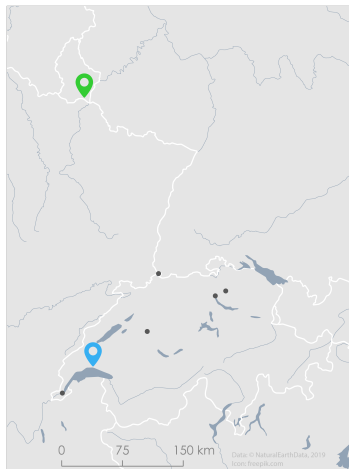
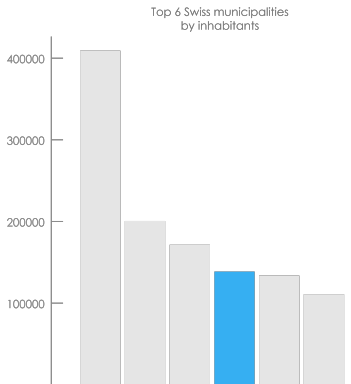
- ▶ Schirmer and Axhausen (2015;2019) proposed a set of features at multiple scales on which to apply clustering. They used it to quantitatively describe the urban morphology
- ▶ Steiniger *et al.* (2008) morphologically characterized building geometries and classified them for cartographic generalization
- ▶ Fan, Zipf, and Fu (2014)
- ▶ Dillenburg (2008)

Similar works

- ▶ Schirmer and Axhausen (2015;2019)
- ▶ Steiniger *et al.* (2008)
- ▶ Fan, Zipf, and Fu (2014) used a turning function to find similar footprints of buildings. They tried to classify the morphologies into (functional) types. They also developed a rule-based approach to estimate the type of a building according to its characteristics
- ▶ Dillenburger (2008) developed a bitmap-based index to retrieve parcels with similar buildings according to three characteristics: visibility, proximities of buildings, and orientation

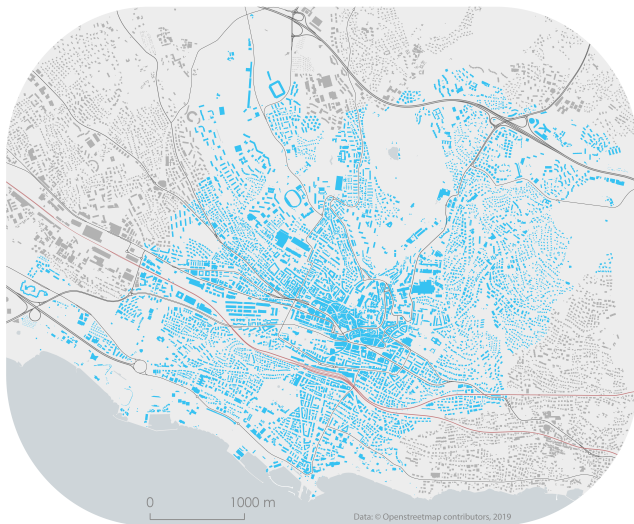
Case study

Lausanne, Switzerland



Case study

Lausanne Municipality



OpenStreetMap data - Gathering footprints

- ▶ Open data generated by multiple contributors
- ▶ Available on a global scale but unevenly distributed
- ▶ Quality depending on several factors (available imagery, familiarity of the cartographer, etc.)

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- ▶ Limits: High geometrical variability, features of interest not sufficiently filled

Swisstopo data - Computing height

- ▶ Digital Elevation Model, 2016, 2m resolution, 0.5m accuracy
- ▶ Digital Surface Model, 2016, 2m resolution, 0.5m accuracy
- ▶ Compute the difference and assign mean value of cells intersecting each building
- ▶ Give the general impression on the building height

Buildings and housing registry - Retrieving categories

- ▶ Central registry maintained by the Federal Statistical Office
- ▶ Data input by the municipalities
- ▶ General categories (6) and specific classes (26) adapted from EUROSTAT
- ▶ Quality assurance ?

Indicators derived - Feature creation

- ▶ Features based on the footprint geometry and the height
- ▶ Inspired by Schirmer and Axhausen (2015) with several additions (oriented envelope, compactness)
- ▶ Quite redundant and the question of which are the most suitable remains open



General intended pipeline

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Feature selection

NON

- ▶ Difficultés d'un choix non supervisé
- ▶ Réduction en fonction de ce qu'elles distinguent
- ▶ Distinction parmi les variables similaires

Clustering based on features

NON

- ▶ Pourquoi ?
- ▶ Qualité
- ▶ Interprétations

Model-based clustering

- ▶ Using the method implemented by Ceuleux *et al.* (2014)
- ▶ Simultaneously selects the number of clusters and a set of *relevant* features
- ▶ Interprétations

Geo-SOM and clustering

- ▶ Principe de fonctionnement
- ▶ Paramètres influençables
- ▶ Clustering basé sur la geosom

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Future works

- ▶ Monitor the development of ML (Mapillary) and gamification solutions (StreetComplete) in the completion of height and number of stories



Future works



Thanks for your attention

Slides, routines (and more) are available on *GitHub*
<https://github.com/Raphbub/>

For any further questions, remarks or suggestions
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