

A Contemporary Nolli Map: Using OpenStreetMap Data to Represent Urban Public Spaces

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Abstract:

More than 250 years ago, Giovanni Battista Nolli, an Italian architect, engineer and cartographer, was concerned with how and where space is or is not publicly accessible. In his map 'La nuova topografia di Roma Comasco', he mapped publicly accessible interior and exterior spaces of Rome with an impressively high level of detail as a figure-ground map. Since Nolli's time, both the character and diversity of public spaces as well as cartographic technology have changed. This research project aims to adapt some ideas behind Nolli's map for today's circumstances on the basis of open data, and seeks to develop methods for processing volunteered geographical information from OpenStreetMap (OSM) to identify, categorize, and map public spaces based on thematic and geometric information.



Figure 1. Detail of Nolli's monochrome map of Rome. The common figure-ground arrangement of conventional city maps appears more nuanced, showing publicly accessible space as "carved out" from the background of buildings (Tice, 2005). Source: Wikimedia

There have been few attempts to adapt Nolli's map for today. Dovey and Pafka (2020), for example, have mapped the publicness of space, defined by access and control, using city data for different sites of Melbourne, Australia. Ji and Ding (2021) have conducted a field survey of a neighborhood in Nanjing, China, and adapted Nolli's design principles to their mapping of public spaces. Hwang and Koile (2005) developed a machine learning approach to define the publicness of main streets in Boston, USA, according to the user's interpretation of the public domain. However, none of the past work has developed a framework to use internationally available data from OpenStreetMap in order to identify and map public spaces in various cities.

In the first step of this work, 58 different definitions of public space, publicness and closely related concepts like the public realm were extracted from mostly Western, urban planning and sociology literature, and 41 aspects of the definitions were identified and consolidated by an iterative coding procedure. Among the aspects included most frequently in the reviewed definitions were accessibility, specific use and activities, democratic function, control, operation, ownership, the general public, and social interaction.

In a second step, the identified aspects of publicness were analyzed regarding a possible operationalization in the context of the available data. Some of the identified aspects have to be further operationalized and broken down into more specific sub-aspects, e.g., accessibility. Some of the identified aspects and sub-aspects have corresponding tags in OSM (e.g., opening hours, entrance fee, legal access), some could be potentially presumed from tags (e.g., ownership and accessibility derived from type of space), some could be potentially inferred from geometry (e.g., access to non-defined areas), and for some aspects we did not find data in OSM that would allow for a direct visualization (e.g., conducted activities, interaction). As a result, public accessibility was chosen as the defining aspect of public spaces for this research project, because this indicator offered the most comprehensive data base and aligns most closely with Nolli's original approach.

For the analysis, only ground floor and outdoor elements are considered. With the map visualization in mind, the goal of the data processing is an overlap- and hole-free data set with polygons only and information about the public accessibility and the space type for each polygon. The geometric prerequisites are relevant as in OSM areas can be undefined, different elements can overlap and apart from polygons, line and point geometries are often used.

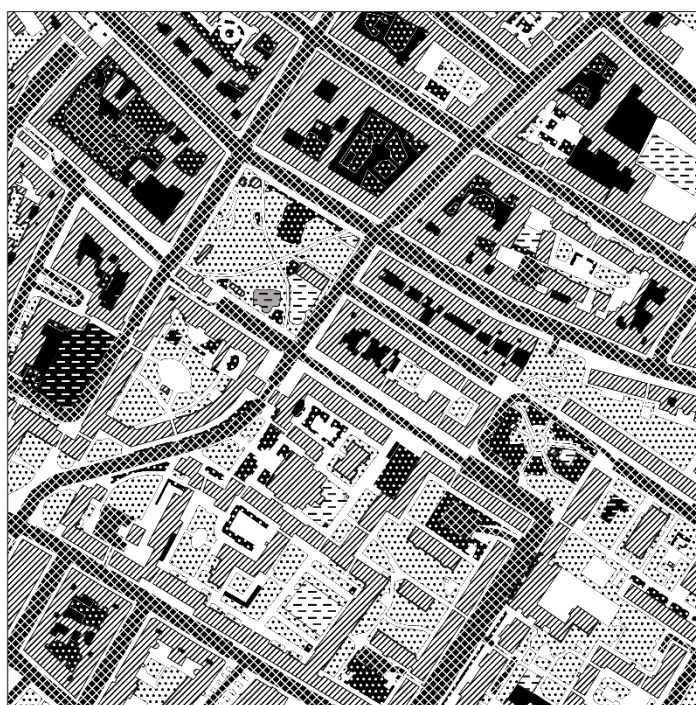
The data processing is implemented as Python scripts based on existing OSM and geodata libraries. The scripts along with an example application are available as open source on GitHub¹. Main steps of the geometric and thematic data analysis include the inference of public accessibility based on OSM tags, the identification of inaccessible, enclosed areas, e.g., within fences or backyards, the conversion from road and path line geometries to polygons, the inferring and categorizing of space types and the merging and cropping of overlapping areas. The resulting geometries with attributes describing the public accessibility and the space type are exported as GeoJSON and are then visualized in QGIS.

As part of two case studies, the developed methods are applied to different neighborhoods in the city of Vienna, Austria. This step also includes an evaluation of the quality and the completeness of the available data in the area of research in regard to the relevant tags and geometries. The OSM database was checked and expanded in the case study areas based on orthophotos, official geodata and field surveys. For the visualization, the two dimensions of public accessibility and space type were combined. Design principles were adopted from Ji and Ding's work (2021).

One case study was conducted for a 500x500m area around Rabenhof, a big public housing unit in Vienna's third district. The area was chosen because public housing from the interwar period is an important part of Vienna's cityscape. It is characterized by mostly housing as well as some recreational and leisure facilities, social infrastructure and street space. The map of public space shows many accessible backyards, which aligns with the typical building structure of the public housing units. Often, multiple buildings are connected and have building passages (here clipped from building geometries), which give public access to backyards.

The maps can give insights about the quantity, type and potential of public space in the examined cases. The scientific contribution of the project lies in the clarification, operationalization, and visualization of public space. From a cartographic point of view, furthermore, the potential and the application of a classic of cartography, the Nolli map, for nowadays become visible.

The publication of the data processing methods as open source allows further collaborative development as well as adaptations for similar research and visualizations in other cities. With OSM as a global database used, applications for other cities in other regions of the world are possible and could result in interesting comparisons. However, the underlying definitions of public space may not be equally applicable to non-Western cities and will most likely require adjustments.



Space types and public accessibility:	play and sports - public access
building	play and sports - restricted access
traffic area	play and sports - no access
greenspace - public access	open space or undefined space - public access
greenspace - no access	undefined space - no access

Map data from OpenStreetMap as of May 6, 2023

Figure 2. Map of publicly accessible space around Rabenhof, 1030 Vienna, Austria

References

- Dovey, K., & Pafka, E. (2020). Mapping the Publicness of Public Space: An access/control typology. In V. Mehta & D. Palazzo (Eds.), *Companion to public space* (pp. 234–248). Routledge.
- Hwang, J.-E., & Koile, K. (2005). Heuristic Nolli Map: A Preliminary Study in Representing the Public Domain in Urban Space. Paper 273. In CUPUM05 (Chair), *Proceedings of Computers in Urban Planning and Urban Management*.
- Ji, H., & Ding, W. (2021). Mapping urban public spaces based on the Nolli map method. *Frontiers of Architectural Research*, 10(3), 540–554. <https://doi.org/10.1016/j.foar.2021.04.001>
- Tice, J. (2005). The Nolli Map and Urban Theory. <http://nolli.uoregon.edu/urbanTheory.html>

¹ <https://github.com/ester-t-s/osm-public-space-mapper>