Extraction and Use of Geometry Data to Obtain 3D Buildings on a Web Map

Josefa Gómez, Abdelhamid Tayebi, Juan Casado
Computer Science Department.
University of Alcalá
28871 Alcalá de Henares. Madrid.
Email: josefa.gomezp@uah.es

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Presenter

Josefa Gómez Pérez was born in 1984. She received the BS and MS in Telecommunications Engineering from the University Polytechnic of Cartagena, Spain, in 2005 and 2007, respectively, and the PhD in Telecommunications Engineering from the University of Alcala, Spain, in 2011. She has worked as an assistant professor since 2012 at the University of Alcalá. She also worked as a faculty researcher at the Hong Kong University in 2011 and at the Instituto de Telecomunicaçoes of Lisbon in 2014. She has participated in 37 research projects with Spanish and European companies. She has published 23 papers in peer-reviewed journals, a book, two book chapters, and more than 40 conference contributions at national and international symposia. Her research interests are optimization and analysis of antennas, design of graphical user interfaces and the study of propagation for mobile communications or wireless networks in both outdoor and indoor environments.

Outline

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2. Experimental results using OpenStreetMap.
3. Experimental results using OSM Buildings.
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Introduction

- This work shows a comparison between two different techniques to obtain 3D buildings on a web map.
- The first one is based on the XYZ Tiles server of **OSM Buildings** and the second one is based on the Overpass servers of the collaborative project **OpenStreetMap**.
- Several simulations have been carried out to analyze their performance.
- Benefits and limitations of both methods are discussed.

Experimental results using OpenStreetMap

- The Overpass API is a read-only API that serves up custom selected parts of the OpenStreetMap map data.
- It acts as a database over the web: the client sends a query to the API and gets back the data set that corresponds to the query.
- Requests can be written in XML language or Overpass Query Language (Overpass QL).
- Some Overpass servers like *Main Overpass API Instance* and *Kumi Systems Overpass API* provide no restrictions to access OpenStreetMap data.

Experimental results using OpenStreetMap

COMPARISON BETWEEN OVERPASS SERVERS

- Area of 9438 km^2 that contains 70.683 polygons representing buildings shapes. The following statistics were obtained:

	Kumi Systems Overpass API	Main Overpass API Instance
Mean	11s 639ms	12s 119ms
Standard Deviation	3s 412ms	3s 343ms
Maximum	18s 355ms	18s 107ms
Minimum	8s 169ms	7s 263ms

- No relevant performance difference between overpass servers is found.

Experimental results using OSM Buildings

- One of the main characteristics of OSM Buildings is the use of GeoJSON (a format for encoding a variety of geographic data structures).

- It is an open standard format designed for representing simple geographical features, along with their non-spatial attributes.

- To request data to OSM Buildings, a XYZ Tile API is used.

- This API divides the earth surface in rectangular regions according to a zoom size. In this case, only a value of 15 as zoom size is available.

Experimental results using OSM Buildings

- OSM Buildings impose strong and limiting restrictions to access their data.
- The characteristics of the restrictions are not clearly specified, in contrast with the transparency on Overpass server restrictions.
- Experimentally the limitations found are on the number of requests that can be performed concurrently.
- This restricts the maximum area to retrieve concurrently to approximately 100 tiles.

Experimental results using OSM Buildings

COMPARISON BETWEEN OVERPASS AND OSM BUILDINGS

- Area of 42 km^2 that contains 42 tiles of zoom level 15. The following statistics were obtained:

	Kumi Systems Overpass API	OSM Buildings
Mean	4s 605ms	3s 9478ms
Standard Deviation	1s 694ms	0s 391ms
Maximum	8s 953ms	4s 7209ms
Minimum	3s 212ms	3s 338ms
Geometries	28.394	25.590

Experimental results using OSM Buildings

- OSM Buildings is a more reliable API in the sense that it presents a minimal standard deviation in the mean request time.

- Overpass API provides a greater bandwidth for data extraction on a single request. If a request to OSM Buildings had not been performed concurrently, the request time would be greater by a factor of the number of tiles.

- The number of extracted geometries in the whole area is different.
  - OpenStreetMap data are improved daily by users that update, correct and polish.
  - The new buildings added to OpenStreetMap that were not there when OSM Buildings extracted their data will not be in their API until they update them.

Building height reconstruction

- Buildings have different attributes that describe them. The most important is the ground shape of the building.
- Others, like the **height**, are not always present.
- To solve this problem multiple actions can be performed.
  - Using the levels building attribute, which denotes the number of building levels that the building has, multiplied by a factor the denotes the building level height is quite effective
  - When no attributes of the building can be used to know its height, the solutions found are to use a statistical value like the average or median height of the K nearest buildings surrounding each building with a missing height value.

Building height reconstruction

Fig. 1. OpenStreetMap raw building data.

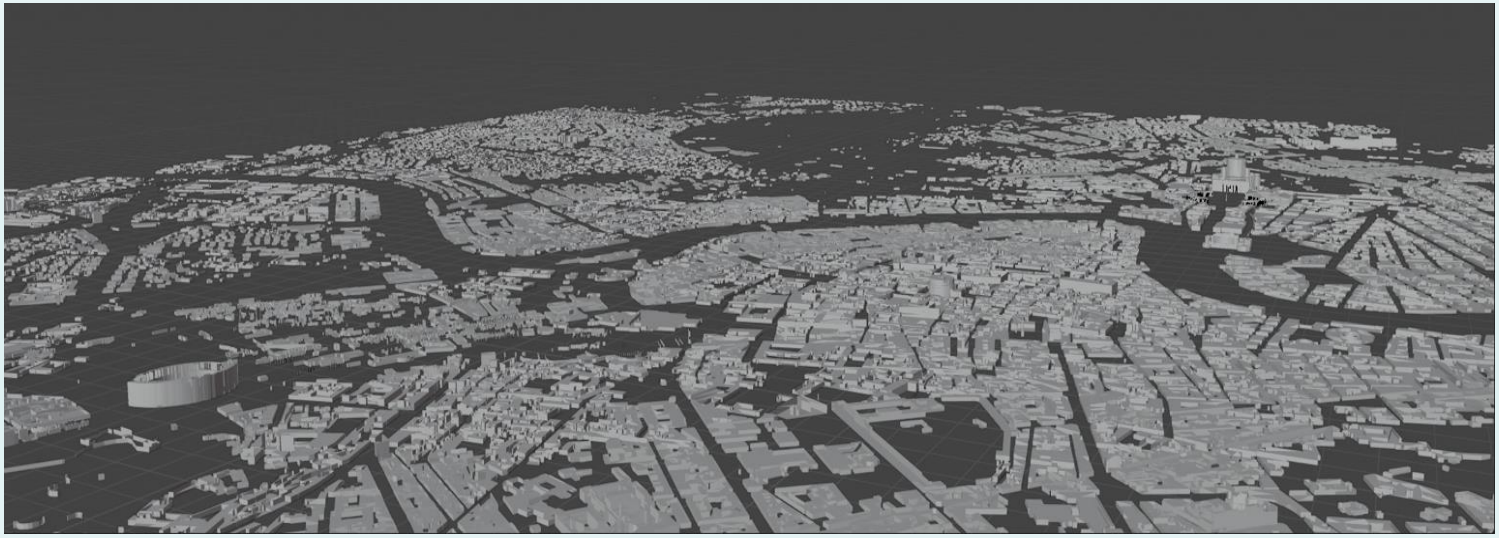

Fig. 2. OpenStreetMap building data with infered building height.

Conclusions

- The two APIs presented from which to extract building shapes presents their own strengths and faults. Some of them are shared by both since at the end they use OpenStreetMap data. Overpass is the default access point to use these data but needs extra processing on the client side to transform it to a standard data format like GeoJSON. OSM Buildings, on the other hand, presents strict access limitations that almost prevents to use it.
- Since the biggest downside of both APIs (the missing building height attribute) is shared by both of them, and the mean request time for large areas is low enough and similar between them, the selected API is the one with lower access restrictions: Kumi Systems Overpass API.

Thank you for your attention!

Josefa.gomezp@uah.es