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Visualization of Geographic Data in Blender

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ABSTRACT

This paper describes practical experience with the implementation and visualization of geographic data in Blender. Blender is a very popular open-source program primarily focused on 3D graphics, including a wide range of tools from model preparation and animation to final rendering. Given its popularity, it also implements support for a number of graphic formats from 2D and 3D graphics, as well as very useful add-ons that extend its functionality even further. One of these extensions is the implementation of geographic data that can be loaded from different sources. This contribution describes not only the actual ways of obtaining this data, but also how it is often modified to produce the best possible rendered visualizations.

Keywords

3D graphics, visualization, geographic data, mesh, Blender

1. INTRODUCTION

Data visualizations is usually defined as images that can be easily reused by modifying the underlying information, typically stored in a data file [Dou21a]. Data visualization is useful for data cleaning, exploring data structure, detecting outliers and unusual groups, identifying trends and clusters, spotting local patterns, evaluating modeling output, and presenting results. [Unw20a]

Geographic data (often referred as geospatial data in the scientific literature) [Kra20a] is information that describes the characteristics and locations of objects on Earth. It can include data on natural features such as rivers, mountains and forests, as well as human activities such as cities, roads and national boundaries [Wu24a]. Geographic data can be acquired in a variety of ways, including satellite imagery, GPS and terrain exploration. They are critical for planning, resource management and decision-making in many areas such as urban planning, transport and environmental protection. Their standardization is defined in ISO/TC2 11. [Geo25a]

The main goal in visualizing geographic data is usually to obtain visual authenticity that corresponds as closely as possible to the reality. This goal can be achieved to a large degree, but it requires careful and time-consuming manual work by 3D graphic engineers and powerful hardware for fast processing of large amounts of graphical data. So a compromise is usually sought - the mentioned 3D models are often automatically generated using modern technologies [Rom23a], which speeds up the whole process considerably. However, this is usually at the expense of the quality and possible errors that may appear in object geometry or texture mapping. An example of such errors can be seen in Figure 1. This is a visualization of a part of the city of Zlin from the 3D satellite map of Google Maps.

Figure 1. Example of wrong texture mapping on a building [Goo25a]

This paper describes the visualization of geographic data in Blender. In the second chapter, a brief description of publicly available geographic data databases that can be used for this purpose is presented. In the following chapter, the basic characteristics of Blender are presented, and four options for obtaining geographic data are described in subsections. Chapter 4 provides a simple analysis of the data obtained, as well as an overview of the most common modifications that are performed on such data in Blender in order to facilitate further graphical modifications or easy and fast rendering.

2. GEOGRAPHIC DATA DATABASES

There are a large number of databases with geographic information [Uni24a]. They differ in the types and amount of data they contain, availability, licensing, etc. Table 1 contains a short description of those databases that most often provide data for Blender.

Name	Characteristic/Advantages	Disadvantages	Availability	References
Google Maps	Very complex with many useful features (geospatial information, navigation, searching places, actual traffic information, etc.)	Registration required, including credit/debit card information	Partially free, some data paid	[Goo25b]
ArcGIS	Secure and scalable software as a service, which allows to improve decision-making by collecting and managing data, easily sharing maps and apps within web GIS	Limited support for developers	21-day trial version for free, and after that the access is paid	[Arc25a]
MapBox	AI-powered location technology for automakers, mobile app developers, and logistics services, easy to customizable, fast access to data	Very complex for simple projects	proprietary software license with flexible prices	[Map25a]
OpenStreetMap	Versatile mapping tool that provides detailed and up-to-date mapping data map of the whole world, each user can put data	Risk of poor quality or false data	Open database free to use	[Ope25a]
SRTM	Detailed elevation data with a resolution of 1 arc-second (~ 30 meters) and 3 arc-seconds (~ 90 meters) for global coverage	Elevation data only	Free to use	[Mis18a]

Table 1. Overview of databases with geographic data that are often used in conjunction with Blender

3. BLENDER AND DATA IMPORT

Blender is the free and open source 3D creation suite. It supports the entirety of the 3D pipeline—modeling, rigging, animation, simulation, rendering, compositing and motion tracking, even video editing and game creation. Advanced users employ Blender's API for Python scripting to customize the application and write specialized tools; often these are included in Blender's future releases. Blender is well suited to individuals and small studios who benefit from its unified pipeline and responsive development process. [Ble25a]

The Python scripts mentioned above are most relevant for our purpose - they can provide direct access to databases with geographic information. Another possibility is that we can get this information in some non-standard file format. Using a script, they can be converted to display correctly in the Blender environment.

Table 2 lists the basic characteristics of standalone applications and Blender extensions. These are the most popular software tools currently used to import geographic data into a 3D scene in Blender.

Figure 2. 3D model of the center of Zlín in Blender acquired by Blender GIS script

Name	Type of tool	Characteristic	Availability	References
Earth Data	Desktop application	Can directly retrieve data from Google Maps; chosen geographic data is performed in the *.gltf, .fbx or .obj formats, which can be imported into Blender	Very limited free access - access to more data is paid	[Ope24a]
Earth Studio Tools	Blender add-on	Uses data from Google Maps as a source, specifically output from Google Earth Studio application	Free to use (MIT license)	[Ima21a]
Blosm	Blender add-on	Supports data from following databases: Google Maps, ArcGIS, MapBox and OpenStreetMap, free version allows download pure models from OpenStreetMap - paid version adds textures	Free/paid	[Blo23a]
Blender GIS	Blender add-on	Primarily scaled to SRTM (landscape data) and OpenStreetMap (other data), models from OpenStreetMap database have a basic simple topology and no textures (Figure 2)	Free to use	[Ble22a]

Table 2. Basic characteristics of software tools for importing geographic data into Blender

4. ANALYSIS AND MODIFICATIOS

Once the geographic data is imported into Blender, we can render it. An example of a rendered image is shown in Figure 3. It is a view of the Zlín Square, where all 3D models are acquired from Google Maps by Earth Data application. The Eevee rendering engine with default settings was used.

It is also helpful to make multiple renders of images or animations and then evaluate the results to see how well they match our ideas. The purpose of these models is obviously crucial. The usual attempt is to achieve the highest fidelity matching the reality. In Figure 3, the image is quite far from realistic - the models are deformed in some places, the textures are poor quality and incorrectly mapped on many models.

All adjustments can be divided into several parts - geometry/topology modifications, material/texture modifications and additional modifications to increase the efficiency of further work.

Geometry and texture modifications

When modifying the geometry, we use the fact that imported data is always represented as polygonal (mesh) objects in Blender. There are a large number of graphical tools for modifying them. The first thing should probably be to analyze the number of vertices in order to remove redundant vertices.

Modifying textures can be divided into two parts - changing their mappings and editing the textures themselves. Changing the mapping usually involves re-generating the UV map and possibly manually improving it using common transformations. The texture itself can then be edited and improved according to this map in a 2D raster graphics editor.

Further modifications

There are other modifications that are not intended to improve the visualization, but to make it easier to work with these models in the future. The first thing might be to merge multiple objects into one. When importing, a large number of objects are inserted, which can be up to thousands for larger maps.

The merge should automatically be followed by the removal of multiple vertices, as it is very likely that some will be in the same location or close to each other. This can be followed by unification of the materials together with their textures and uv maps.

Other changes can be made to models or textures as needed. Blender offers a huge range of graphical tools for these operations. For rendering, there are still other tasks such as creating a good composition, correct lighting, camera settings etc.

5. CONCLUSION

This paper describes the current possibilities of loading geographic data into Blender. Geographic databases are characterized by huge amounts of data. This is caused by the use of technologies, which make the work of 3D graphic engineers easier. On the other hand, they generate a large number of vertices, many of which are redundant.

Above mentioned software tools have been tested on specific models. Blender GIS is completely free and

without any registration - with its help, the user can quickly and easily obtain geometrically simple 3D landscape models and other models such as buildings or roads. The disadvantage, however, is the absence of details and textures. Other tools or data sources that use are licensed. For a fee one can have access to more detailed models and textures.

6. ACKNOWLEDGMENTS

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Figure 3. Rendered image of geographic data from Google Maps in Blender (data without modification)