Planning, establishment and applications of 3D city database in Graz

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Abstract. The development of 3D building database and its applications for the whole city of Graz is presented. From analyze of existed geo-information to automatically setting up database for 3D object management, the main steps are described. The major applications, like that in the areas of architecture, planning, internet etc. are introduced.

Keywords. 3D building model, 3D object database, geo-information, automatic modeling

1. Introduction

When the 3D modeling was discussed at beginning in 1995, the first question was that do we need 3D model for local governmental management, the answer was clear: yes, because it would save money and time for different projects, on the other side it gives the new possibility and new prospect for the citizen in Graz. The second question was that: how much it would cost? No direct answer, but we try to minimize the cost. After the first project, 3D model of Schlossberg in Graz was created manually using the existed Geo-Data, we knew that it had no chance to finish 3D modeling for the whole Graz in this way. So since then the way that we are following is establishing 3D model by the existed data automatically.

The first step is to have an examine of existed data. Graz has detailed roof measurements from aerial images and the digital terrain model (DTM) is captured by means of photogrammetry and is supplemented from terrestrial measurement from time to time. Based on these two kinds of data the 3D building model is triangulated automatically.

In order to managing the 3D buildings in Graz, which are about 60,000, in the way that it should be easy for accessing and editing, be possible be called in different level of details either by means of geodesic coordinates or address, Oracle database and plugins for Autodesk VIZ are implemented.

The applications of 3D building model are engaged in different areas, such as in architecture, city planning and internet. In the near future it should be used in tourism and e-business.

2. Geoinformation

The geoinformation which be used for automatic 3D model establishment,

• Aerial images with interial and external orientation parameters;
• Orthophotos;
• Digital terrain model with photogrammetric and terrestrial completed broken lines;
• Address database will be described.

2.1 Photogrammetry

The surveying department of city Graz implements photogrammetry for about 15 years, at beginning, detailed rules for the measurements are defined in the way that each element in the
nature should be captured with individual code. In order to keep the actuality of the aerial images the aero-image flight in scale about 1:4000 is taken every 4 years for whole Graz. The planimetric accuracy is about ±15cm and that for height is ca. ±18cm. For automatic texture mapping of roof and terrain the digital aerial images with interial and external orientation parameters or orthophotos are used.

2.2 Digital Terrain Model (DTM)
As base for 3D city model the DTM is as important as the roof measurement itself. In Graz the DTM is captured by means of photogrammetry and completed by terrestrial data. By setup 3D Model the DTM is again inserted the broken lines from photogrammetry.

2.3 Address database
The address database was merged into the 3D database so that it can be navigated by addresses. If logical area of a building is defined as the maximum geometric area with its logical limitation, the 3D model and address database is connected by means of geodesic coordinates and logical area of building.

3. Automatic establishment of 3D database
The procedure is straightforward by means of triangulation. The roofs are read in and its elements are sorted by codes. Some small changes, like the logical relationship, the geometric dependence, the closeness of elements due to accuracy of measurement etc. are made before the triangulation.

Figure 1. example of Photogrammetric measurement
Figure 2. DTM with broken lines
Figure 3. Roof Model after automatic conversion, (a) line model (b) solid model
4. Database management

The most important database management tasks are like following:

• Import and export data from DB
• Editing either geometric or radiometric elements
• Converting to internet database

At present there are 3 formats can be read in the system and again exported, dxf, dwg and vrm. Due to the storage requirement in the database, to be imported data must be saved in the right layer structure. Editing procedure is done with plugins based on Autodesk VIZ 4, the plugins deliver not only the right tools for normal editing tasks, it connects the overlay direct to the 3D database. Some other features like automatic mapping of roof and terrain textures onto the 3D model are also included. For presentation in internet there are interface between 3D database in oracle and mysql database which be used on internet server. These interfaces make it possible to define the facade texture resolution for internet server.

5. Applications of 3D database

The planning department of city Graz has direct connection to the 3D database, and plugins based on Autodesk VIZ 4.0 for planning tools are installed by the architectural member. So the planning tasks can be done in 3 dimensional way which based on the 3D environment from the database online.

One of a most recent development of Graz 3D model is the presentation in internet as shown in Fig. 5.

6. Conclusion and remarks

Data collection is one of the major issues for creation of 3D database. The data may be used for different purposes, but they should always be captured with height information and be coded as detailed as possible. For buildings there must be a logical definition and connection for their elements, in the way like object oriented measurements.

Based on the data, more than 90% of the buildings can be automatic triangulated into 3D model. Manual correction of geometry must be done by complicated roof structure. Until today all of facade texture are mapping manually. Hope in
the near future this also can be done automatically.

During last 8 years for 3D city model developing and application in the local community of Graz, it has been convinced that it will play more and more part in different areas, like that architecture, city planning and development, tourism and internet applications.

The whole procedure from planning, Geoinformation preparation, 3D database establishment to 3D model application in different areas are introduced in this paper. Due to the paper size limitation, it presents mostly with graphics in order to give a overview of the 3D Technology that city Graz initialized, supported and finally implicated.

References

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