Working with Semantic 3D City Models - Tools based on CityGML and 3DCityDB

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A brief introduction to CityGML and 3DCityDB
3D City Models in CityGML

Application independent Geospatial Information Model for semantic 3D city and landscape models

- comprises different thematic areas (buildings, vegetation, water, terrain, traffic, tunnels, bridges etc.)

- Internat ‘I Standard of the Open Geospatial Consortium
  - V1.0.0 adopted in 08/2008; V2.0.0 adopted in 3/2012

- Data model (UML) + Exchange format (based on GML3)

CityGML represents

- 3D geometry, 3D topology, semantics, and appearance

- in 5 discrete scales (Levels of Detail, LOD)
Learn more about CityGML

► [http://www.3dcitydb.org/3dcitydb/CityGMLCourse/](http://www.3dcitydb.org/3dcitydb/CityGMLCourse/)
3D City Database (3DCityDB)

► “A free Open Source (Apache License, Version 2.0) package consisting of a database schema and a set of software tools to import, manage, analyse, visualize, and export virtual 3D city models according to the CityGML standard.” (The latest major release: v3.3.0)

► The 3D City Database is currently being developed jointly by the following cooperation partners lead by Prof. Thomas H. Kolbe

- Chair of Geoinformatics, Technical University of Munich
- virtualcitySYSTEMS GmbH, Berlin
- M.O.S.S. Computer Grafik Systeme GmbH, Taufkirchen
3D City Database software suite

► **3D City Database**
  - Oracle/PostGIS Relational Geodatabase Schema
  - SQL scripts and functions

► **Import/Export Tool**
  - CityGML Import/Export of arbitrary file sizes (>>4GB)
  - KML/COLLADA/glTF Exporter for 3D visualization
  - Plugins (e.g. Spreadsheet Generator)

► **Web Feature Service**
  - Implemented against the OGC WFS 2.0 interface
  - Satisfies the *WFS Simple* conformance class

► **3DCityDB-Web-Map-Client (or called 3D Web Client)**
  - Static web client for interactive 3D exploration and manipulation
  - Cloud-based linking of 3D objects with thematic data
Output datasets from 3DCityDB
Different display forms of visualization models

- **LoD0 - Footprint**
- **LoD1 - Extruded**
- **LoD2 – Geometry only**
- **LoD2 – Geometry & Textures**
A simple grid-based tiling strategy for the export of visualization models

<table>
<thead>
<tr>
<th>Latitude</th>
<th>Longitude</th>
</tr>
</thead>
<tbody>
<tr>
<td>(0, 2)</td>
<td>(1, 2)</td>
</tr>
<tr>
<td>(0, 1)</td>
<td>(1, 1)</td>
</tr>
<tr>
<td>(0, 0)</td>
<td>(1, 0)</td>
</tr>
</tbody>
</table>

Tiles

0 1 2
0 1 1
0 1 1

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Efficient determination of which data tiles should be loaded

A data tile is visible only when its diagonal length lie within the visibility range defined by the minimum and maximum limit in screen pixel.
We need to find a way for interactive 3D visualization and exploration of 3D city models on the web…
General concept: Coupling of Cloud Service and 3DCityDB

- **Visualization model on the web**
- **Online Spreadsheet in Cloud-Service**

**Logical link**

**Export** e.g. KML/glTF

**Integration**
System Architecture of the 3D Web Client

3D Web Client

- Interaction
- Attribute Display and Query
- Map Layer Control
- Object handling e.g. Highlighting
- Tiling Manager
- ... many more Features

Virtual Globe Visualization Engine

User Interface

- Interaction

Visualization model

Online Spreadsheet

Terrain Server

Imagery Server

Database

Export

Request

Response

Export

Export

Export

logical link

CityGML

3D City DB

CityGML Database

3D City DB

3D City DB
Attribute Information of the selected City Object

Toolbox for Controlling and Management of the Data Layers

Status Indicator
Visit our GitHub Page for more details:
https://github.com/3dcitydb
Learn more about 3DCityDB

► http://www.3dcitydb.org/3dcitydb/documentation/
Practical Exercise
Course Data (1)

- City
  - Berlin
- Format
  - CityGML (.gml)
- Spatial Reference
  - SRID: 25833
- Feature Type
  - Building
- Number of Buildings
  - 954
Course Data (2)
Practical Exercise

1. Import CityGML
2. 3DCityDB Setup
3. CityGML Export
4. Spreadsheet Export
5. KML/COLLADA/glTF Export
6. 3D Visualization using the 3D Web Client
7. START HERE

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Practical Exercise – Example Results (1)
Practical Exercise – Example Results (2)
Practical Exercise – Example Results (3)
Practical Exercise – Example Results (4)
Let‘s start the practical exercise now!
Please download the tutorial using the following link:

https://www.gis.bgu.tum.de/fileadmin/w00bov/www/Dokumente/Projekte/3DCityDB/3DCityDB_V3.3_Hands-On_Tutorial.pdf