THE UPDATING PROCESS FOR 3D CITY MODEL OBJECTS

Commission III
Session: TS02E – 3D Modelling

Khairul Hafiz Sharkawi,
Edward Eric Duncan

3D GIS Lab, Faculty of Geoinformation and Real Estate,
Universiti Teknologi Malaysia

Introduction

• New developments, constructions and renovations are inevitable especially in urban areas.

• Entities such as buildings will change through time

• Keeping track of these development activities is important
Introduction

XXV International Federation of Surveyors
FIG 2014 Congress, Kuala Lumpur, Malaysia, 16 – 21 June 2014

Dubai

1990

2003

1995

2010

Shanghai

www.facebook.com/MJCFlyZone
Introduction
Introduction

• 3D city models represent real cities

• Changes should be tracked and recorded – to keep the 3D city models up-to-date and relevant for analyses

• Detecting and updating the changes are important but replacing the whole existing data will cause loss of valuable information

• Selective updating is needed in order to update the changes while retaining the existing data
CityGML

Building Schema in CityGML (Kolbe, 2009)

Spatial representation of LoD2 building and UML instance diagram for the structure of CityGML feature (Groger and Plumer, 2012)
3D Segmentation

- 3D building is always generated as 1 object in most database/applications
- Limited interpretation of building parts
- Lack of semantic information
3D Segmentation

The segmentation process

- Obtain the vertices and edges information
- Extract Semantics
- Determine parent geometries
- Semantics Model?
  - Yes: Extract Semantics, Determine parent geometries
  - No: Any additional semantic data?
    - Yes: Select a starting face, Split into sub-polygons (max=4 vertices), Validate sub-polygons, Obtain new nodes and edges information, Update nodes array, Determine sub-polygons clusters, Segmentation end
    - No: Move to adjacent face, Whether all faces had been visited?
      - Yes: Determine sub-polygons clusters, Segmentation end
      - No: Go back to Select a starting face

a) Original building
b) Segmented model

Segmentation result
Detecting Changes

<table>
<thead>
<tr>
<th></th>
<th>Current Data</th>
<th>New Data</th>
</tr>
</thead>
<tbody>
<tr>
<td>Original Building</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Segmented Building</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Changes Detected</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The updating process

FIG 2014 Congress, Kuala Lumpur

Updating Process

- The change detection process will be done by comparing the new data against the existing data.

- Segmentation will allow building parts to be defined and enable changed structures to be localized.

- The change detection results will be used for the updating process.
Updating Process

<table>
<thead>
<tr>
<th>Current Data (Semantics)</th>
<th>New Data (Semantics)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Original Building</strong></td>
<td></td>
</tr>
<tr>
<td>Building A</td>
<td>Building A</td>
</tr>
<tr>
<td>Wall</td>
<td>Wall</td>
</tr>
<tr>
<td>Roof</td>
<td>Roof</td>
</tr>
<tr>
<td><strong>Segmented Building</strong></td>
<td></td>
</tr>
<tr>
<td>Building A</td>
<td>Building A</td>
</tr>
<tr>
<td>BP1</td>
<td>BP2</td>
</tr>
<tr>
<td>Wall</td>
<td>Wall</td>
</tr>
<tr>
<td>Roof</td>
<td>Roof</td>
</tr>
<tr>
<td><strong>Selected Data For Updating Process</strong></td>
<td></td>
</tr>
<tr>
<td>Building A</td>
<td></td>
</tr>
<tr>
<td>BP1</td>
<td>BP2</td>
</tr>
<tr>
<td>BP3</td>
<td></td>
</tr>
<tr>
<td>Roof</td>
<td>Roof</td>
</tr>
<tr>
<td>Wall</td>
<td>Wall</td>
</tr>
</tbody>
</table>

The updating process...

Conclusions

- Updating 3D city models can be very difficult especially for large cities.
- Replacing the whole model is easier but the action might cause the loss of data.
- The proposed method should be able to update the 3D building based on the changes that occurred and retain existing information.
Conclusions

• The proposed segmentation technique for buildings in 3D city model should be able to add more information on the building, semantically and geometrically.

• For future work, integration of the proposed method with façade detection method should enable the support for higher LoD (LoD3) models.

Acknowledgment

• Malaysian Peninsular Land Surveyors Board (LJT).
Thank you for your attention!

hafiz.sharkawi@gmail.com