3D CITY/LANDSCAPE MODELING NON-BUILDING THEMATIC: VEGETATION

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Introduction

• 3D City model for urban development.
• Many research of 3D City modeling are more focused on building geometry, whereas non-building objects are also important.
• The modeled objects are vegetations in campus of Institut Teknologi Bandung (ITB)-Jatinangor.
• City Geography Markup Language (CityGML) as an exchange file for 3D city model.

Haydarpasa Train Station and Port (Buhur, et.al., 2009)
Related Work

• Calculation of Tree Height and Canopy Crown from Drone Images Using Segmentation (Lim, et al., 2015)
  • Data: DTM, orthophoto, and DSM from aerial photography
  • Estimating tree position, tree height, and crown diameter

• LOD Generation for Urban Scenes (Verdie, et al., 2015)
  • 3D modeling of mesh
  • 3D modeling process: classification, abstraction, and reconstruction

Result of segmentation & tree identification (Lim, et al., 2015)

LoD 0-3 for ground, trees, and buildings (Verdie, et al., 2015)
**Data & Methods**

**Data:**
- DSM
- Orthophoto

**Methods:**
- Manual segmentation for tree position and crown diameter
- Manual classification for tree species
- Semi-automatic calculating the tree height
Segmentation & Classification

**Manual methods:** 3050 points of tree
- Tree position
- Crown diameter
- Tree species

**Automatic methods:**
(Other research, on progress)
- Group of trees

(Luthfiya, 2017)
**Result**

**Models template (LoD1-3)**

- **LoD 1:**
  Two intersecting polygons 90° (appearance, semantic)

- **LoD 2:**
  Following the real tree geometry (appearance, semantic, geometry)

- **LoD 3:**
  Following the real tree geometry, but more detail than LoD 2 (appearance, semantic, geometry, and topology)

Example: Coniferous Tree
Result

Models template (LoD 2)

- Tree species, based on OGC CityGML document (2012), were classified into 11 species

```
<table>
<thead>
<tr>
<th>Shrub</th>
<th>Low Plants</th>
<th>Medium Plants</th>
<th>High Plants</th>
</tr>
</thead>
<tbody>
<tr>
<td>112 polygons</td>
<td>96 polygons</td>
<td>96 polygons</td>
<td>80 polygons</td>
</tr>
<tr>
<td>Grasses</td>
<td>Ferns</td>
<td>Coniferous Tree</td>
<td>Deciduous Tree</td>
</tr>
<tr>
<td>36 polygons</td>
<td>84 polygons</td>
<td>46 polygons</td>
<td>112 polygons</td>
</tr>
<tr>
<td>Bushes</td>
<td>Aquatic Plants</td>
<td>Climber</td>
<td>Unknown</td>
</tr>
<tr>
<td>112 polygons</td>
<td>22 polygons</td>
<td>24 polygons</td>
<td>52 polygons</td>
</tr>
</tbody>
</table>
```
Result & Discussion

3D Model (terrain, building, and vegetation) of ITB-Jatinangor in CityGML
Result & Discussion

- Visualization in LoD 3 is more informative and interesting than the lower level.
- Data size of LoD 3 is bigger than lower level.
- The selection of LOD depends on the needs of its users.
- The form of some vegetation models didn’t close to the real object.
Conclusion

• Vegetation modeling is an important thing in 3D city modeling.
• Tree position, tree height, crown diameter, and tree species were obtained from orthophoto and DSM.
• Model of individual tree can be saved as CityGML file from LoD 1 to 3 based on information needs (appearance, semantic, geometry, and topology)
• Integrating and modeling data into 3D city model becomes an interesting challenge for advance research, especially for automation process.

THANK YOU