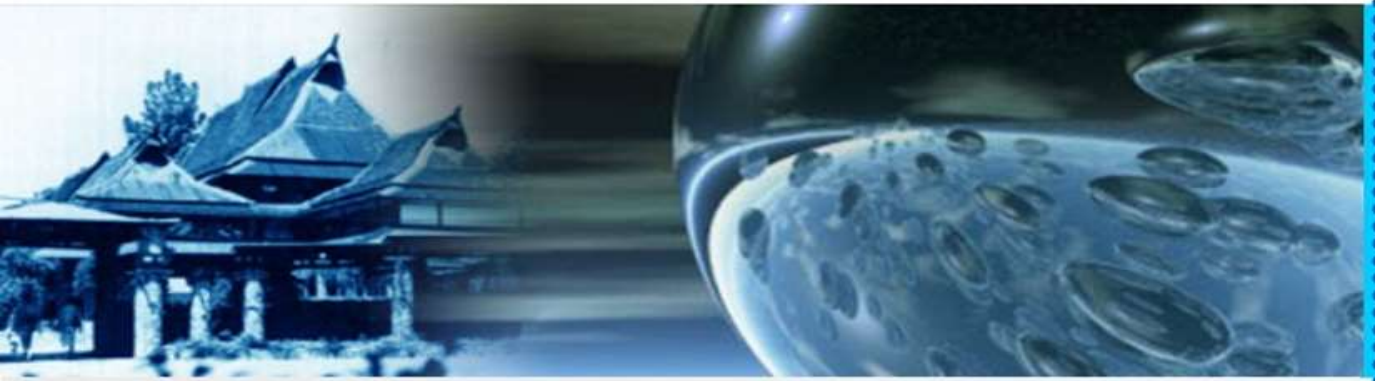

3D CITY/LANDSCAPE MODELING NON-BUILDING THEMATIC: VEGETATION

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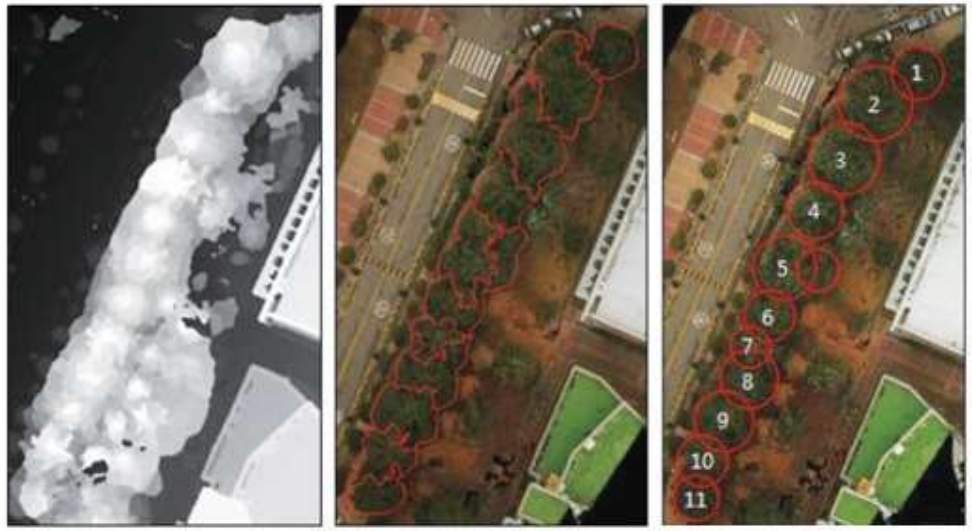
Introduction

- 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)

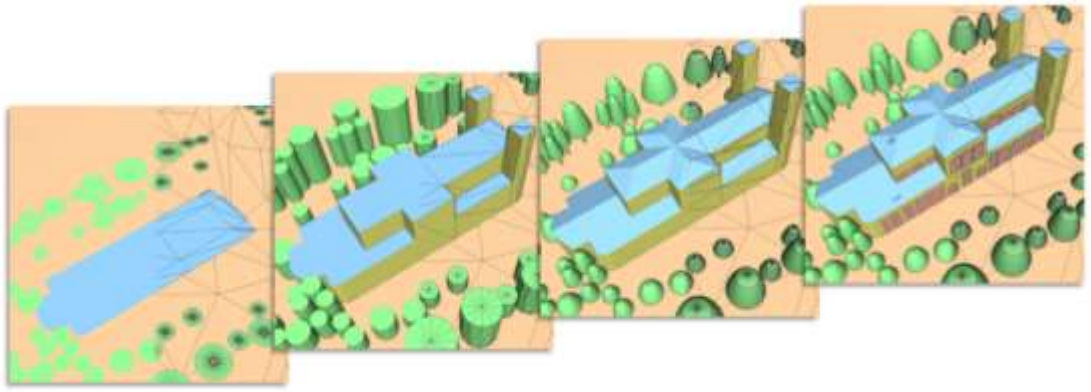
Related Work

- **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



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

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



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

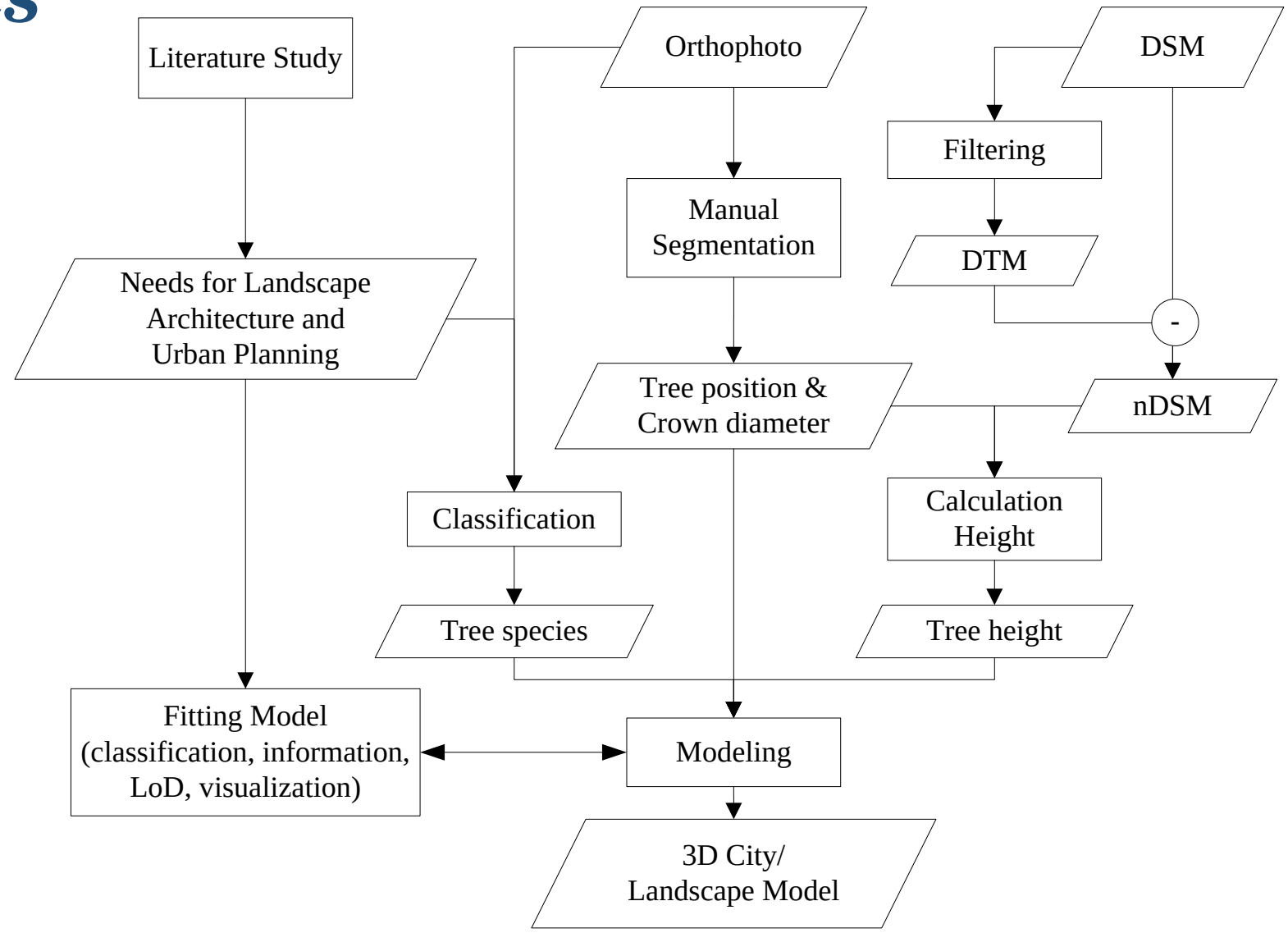
Data & Methods

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 tree

(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

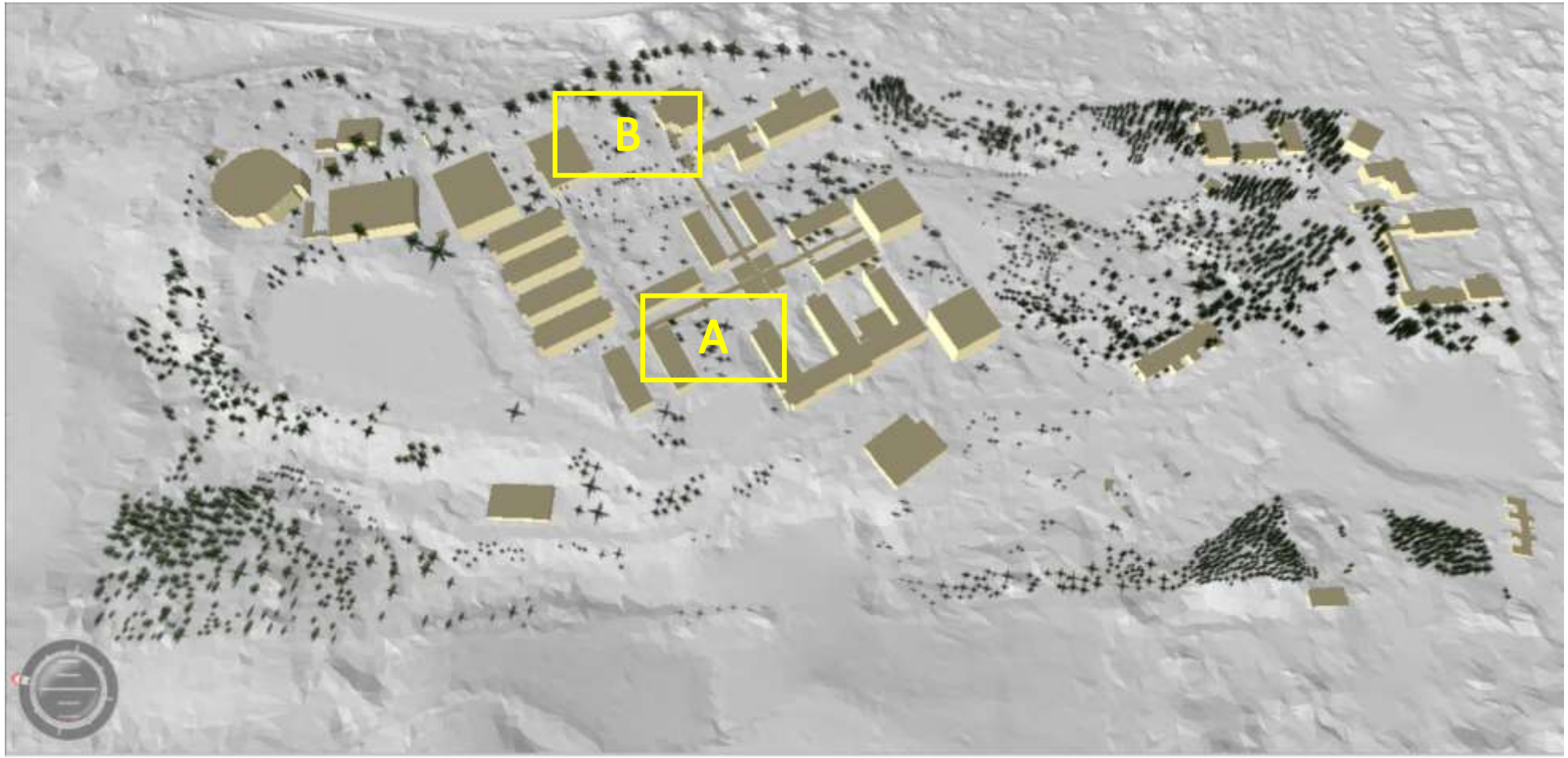
Models template (LoD 2)

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

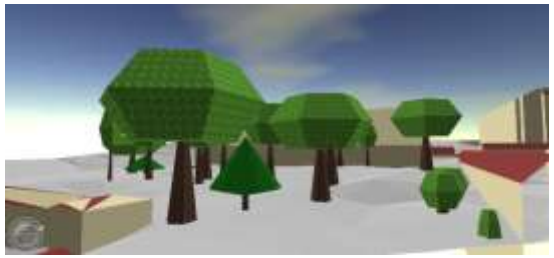
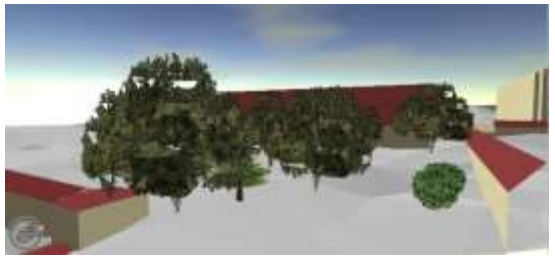
Shrub	Low Plants	Medium Plants	High Plants
			
112 polygons	96 polygons	96 polygons	80 polygons
Grasses	**Ferns**	**Coniferous Tree**	**Deciduous Tree**
			
36 polygons	84 polygons	46 polygons	112 polygons
Bushes	**Aquatic Plants**	**Climber**	**Unknown**
			
112 polygons	22 polygons	24 polygons	52 polygons

Result & Discussion

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



Result & Discussion

	Real Image	LoD 1	LoD 2	LoD 3
A				
B				

- 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