Charles E. Schmidt College of Science

Object-Based Urban Land Cover Classification using LiDAR and Aerial Photography

Donna Selch, Dr. Caiyun Zhang

GeoScience; Florida Atlantic University

Classification of urban land cover is important in many areas of science including green space analysis, mapping urban growth, city planning and economic development. While aerial photography is typically used for such analysis due to its high spatial resolution, it provides clues to the land use / land cover with respect only to visual clues. LiDAR data contains elevation data that is useful in differentiating spectrally similar vegetation and impervious features which have distinctly different elevations. However, LiDAR contains no scene information. Therefore the fusion of LiDAR data with aerial photography is beneficial providing more accurate classification analysis. By combining the two types of remotely sensed imagery most of the disadvantages associated with either data is atoned. This study revealed that overall accuracy from urban land cover classification improved using fused imagery over using aerial photographs alone showing how LiDAR data can improve classification analysis.

Mapping Urban Land Cover using Multi-Scale Segmentation and LiDAR Data

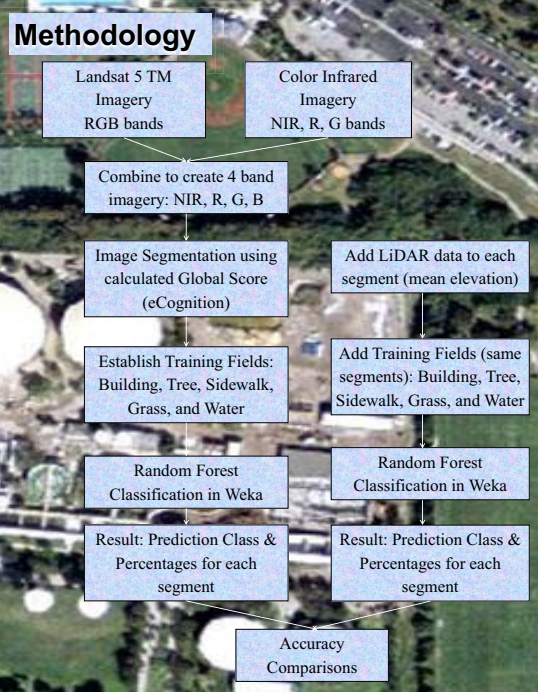
Donna Selch, Department of Geosciences,
Florida Atlantic University, Boca Raton, Florida

Abstract

Classification of urban land cover is important in many areas of science including green space analysis, mapping urban growth, city planning and economic development. While aerial photography is typically used for such analysis due to its high spatial resolution, it provides clues to the land use / land cover with respect only to visual clues. LiDAR data contains elevation data that is useful in differentiating spectrally similar vegetation and impervious features which have distinctly different elevations. However, LiDAR contains no scene information. Therefore the fusion of LiDAR data with aerial photography is beneficial providing more accurate classification analysis. By combining the two types of remotely sensed imagery most of the disadvantages associated with either data is atoned. This study revealed that overall accuracy from urban land cover classification improved using fused imagery over using aerial photographs alone showing how LiDAR data can improve classification analysis.

Object based classification is often chosen to integrate data with different properties (Kressler, et al., no date). However, shadows from tall building and tress can obscure or incorrectly classify other features (O'Neil-Dunne et al., 2012). LiDAR data can be used in conjunction with OBIA to increase the accuracy of image segmentation and classification (Blaschke, 2010, Blaschke et al., 2012).

Methodology



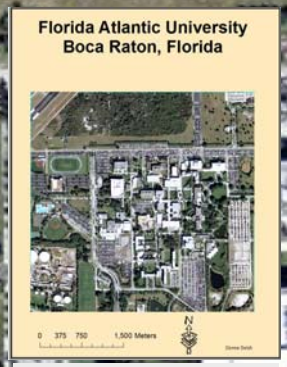


Figure 1: True color aerial image of study site – Florida Atlantic University Boca Raton (main campus)

Figure 3: Subset of Study Image showing the 30 Scale Parameter Segments

Global Score	Scale
1	10
0.852	20
0.830	30
0.853	40
0.867	50
0.892	60
0.925	70
0.946	80
0.981	90
1	100

Table 1: Comparison of Global Score to Scale

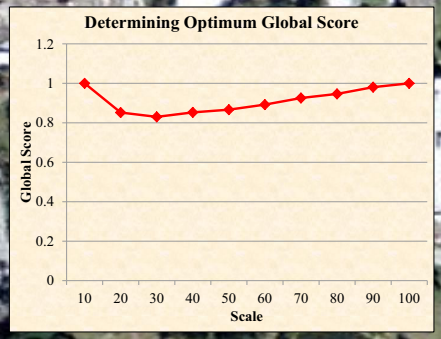


Figure 2: Graphed Comparison of Global Score to Scale

Research Statement & Question

This project examines what impact LiDAR data has on object based image analysis in urban land use / land cover classifications. Many classifications use a variety of spectral, textural, and spatial characteristics to identify or predict land use. However many features have similar characteristics. Tops of building might be made of the same core materials as some sidewalks. Therefore spectral information might not be as helpful. My research question asks the following question: Including LiDAR data into OBIA land use Random Forest classification analysis will have what influence on prediction?

Attribute	Count	Min	Max	Sum	Standard Deviation	Mean	Mean %
Building	3439	0.3	0.992	2186.21	0.125	0.632	63.2
Tree	4011	0.286	0.992	2802.926	0.177	0.699	69.9
Water	2	0.504	1	1.504	0.248	0.752	75.2
Sidewalk	792	0.284	1	551.13	0.123	0.696	69.6
Grass	837	0.284	0.99	545.738	0.176	0.652	65.2

Table 2: Results of OBIA only Random Forest Land Use Classification

Attribute	Count	Min	Max	Sum	Standard Deviation	Mean	Mean %
Building	1237	0.502	1	1055.694	0.102	0.853	85.3
Tree	1915	0	1	1705.504	0.138	0.891	89.1
Water	-	-	-	-	-	-	-
Sidewalk	1222	0.502	1	1053.014	0.102	0.862	86.2
Grass	1253	0.502	1	1026.734	0.117	0.819	81.9

Table 3: Result of LiDAR and OBIA Random Forest Land Use Classification

Results

- The results of the classifications show that on average classification only using aerial imagery results in a 66.8% accuracy of land use / land cover.
- Adding the knowledge of elevation increases the accuracy 19% to 85.8%.
- The Lidar data is extremely useful to accurately classify land use / land cover.
- Spectral information may be similar but the elevation would reveal the classes to be completely different.
- For example, both grass and trees may hold similar spectral information, yet one can use elevation data to separate the two classes.

Attribute	OBIA %	OBIA & LiDAR %	% Difference
Building	63.2	85.3	+22.1
Tree	69.9	89.1	+19.2
Water	75.2	-	-
Sidewalk	69.6	86.2	+16.6
Grass	65.2	81.9	+16.7
Total	**66.8**	**85.8**	**+19.0**

Table 4: Comparison of Results OBIA only versus OBIA & LiDAR

Conclusions

Later analysis of this research did reveal a few potential errors. Part of FAU's main campus has an elevated walkway that connects the second floors of many buildings. My threshold values had eliminated the possibility of "sidewalks" at that elevation. As a result, they were incorrectly identified as buildings (since they had similar spectral characteristics). In addition, another building on campus has an elevated garden. Again, my threshold had eliminated the possibility of a rooftop garden so it was incorrectly identified as trees. However, these errors are few and understandable. The elevation data overall provided a very acceptable land cover prediction of the study site.

References

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