Where the Sidewalk Ends: Using Object-Based Classification to Identify Sidewalks

Elizabeth Clapp
Geography 582
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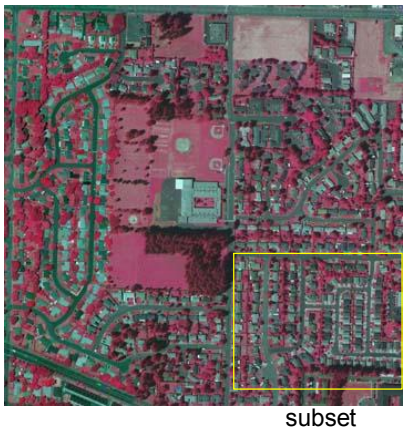
Introduction

- Many people have trouble adhering to traditional fitness regimens
- “Daily life activities” may impact overall fitness
- Researchers have used street networks for connectivity studies
- Chin et al. (2008) compared connectivity using street vs. pedestrian networks
- Results: connectivity increased up to 120% when pedestrian networks were factored into the analyses

Research Question: Can sidewalks be identified with object-based classification methods?

Data & Study Area:

- High resolution aerial photo (6-inch)
- June 2006, Metro
- Tax lots, 2006, RLIS
- Gresham, OR



subset

Methods

- Data pre-processing, preparation
- Incorporate thematic data: classify taxlots
- Classify vegetation in “roads plus” area
- First Classification of street
- First Classification of sidewalk
- Second classification of sidewalk
- Second classification of street
- Compile statistics about classes

Data pre-processing, preparation

- Convert image from .jpeg to .img
- Re-project image to that of thematic data (tax lots from RLIS)
- Sub-set image due to memory issues
- Clip tax lot to study area
- Create attribute in tax lot data (road = 0 or 1)

Incorporate Thematic Data: tax lots

General strategy: classify easy objects first, narrow down unclassified area

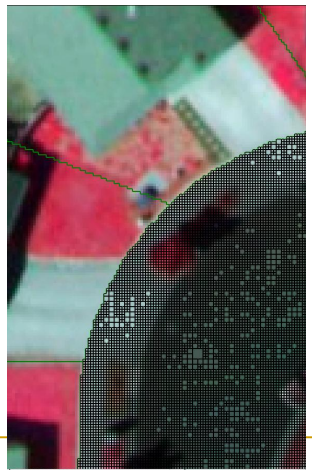
- Coarse chessboard classification
- Strange tax lot shapes

Classify Tax lot: Attribute

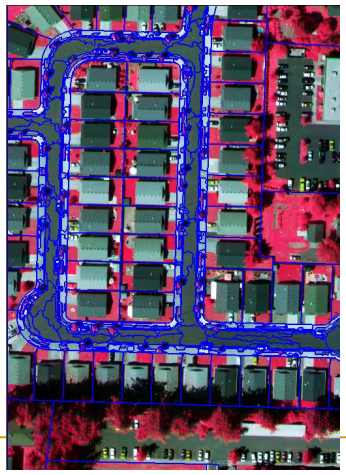
- Road = 0
- Left with "roads plus" to classify

Re-segment: Vegetation & Sidewalks

Quadtree Segmentation
non-taxlot areas: 1 pixel



Multiresolution segment
region grow: scale = 40



Classify Vegetation: Spectral Info.

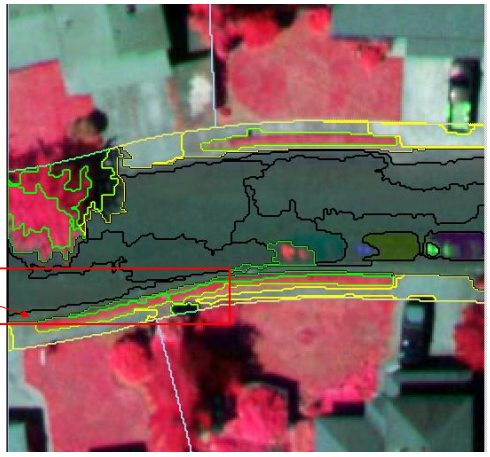
- NIR ratio>=.305
- Included vegetation shadows

Challenges to Classifying Sidewalk

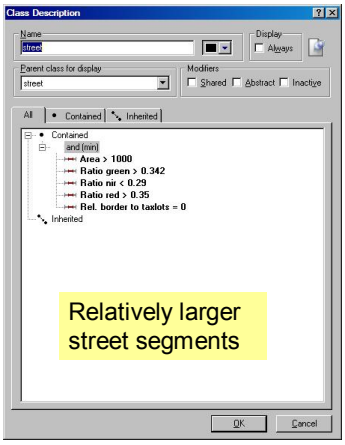
- Spectrally, street and sidewalk very similar
- Strips of vegetation between taxlot and sidewalk
- Dead vegetation or un-landscaped parkway confused for sidewalk
- Cars blocking sidewalk
- Vegetation covering sidewalk – causes smaller, irregularly shaped segments
- Odd shaped “sliver” segments

Manual Editing

- Cut segment
- Merge segment

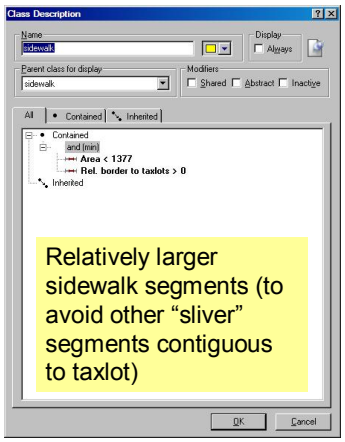


Classification of Street: Area, Spectral, Relation to Object



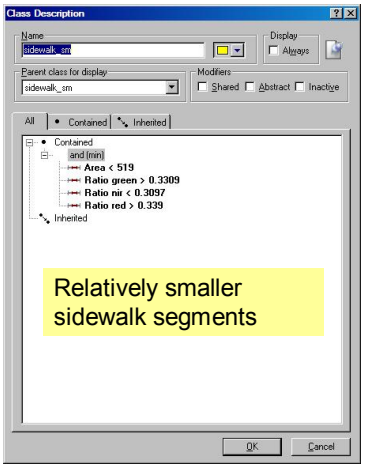
Relatively larger street segments

Classification of Sidewalk: Area & Relation to Object



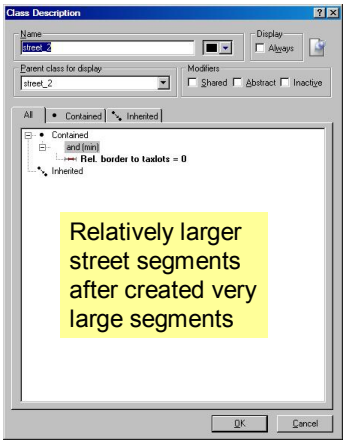
Relatively larger sidewalk segments (to avoid other "sliver" segments contiguous to taxlot)

Classification of Sidewalk_sm: Area & Spectral

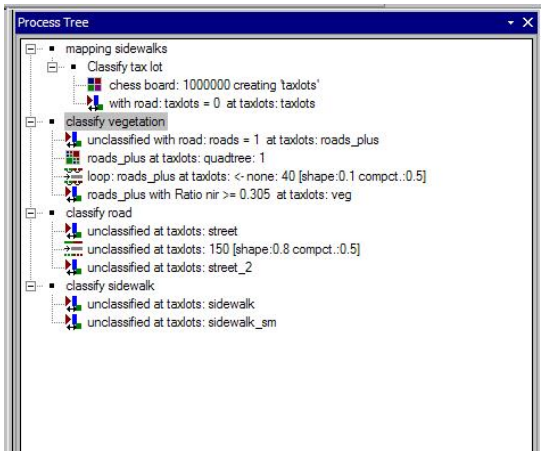


Relatively smaller sidewalk segments

Classification of Street_2: Relation to Object



Process Tree



Results

Results: Mean (Standard Deviation)

Class	Area	Ratio Red	Ratio NIR	Ratio Green	Relative Border to Tax Lot
Sidewalk (n=124)	371 (347)	.35 (.04)	.31 (.06)	.34 (.02)	.30 (.16)
Sidewalk_sm (n=39)	144 (149)	.36 (.01)	.29 (.01)	.35 (.01)	0
Street (n=45)	2593 (1981)	.37 (.01)	.28 (.01)	.35 (.00)	.01 (.04)
Street_2 (n=17)	1266 (1287)	.36 (.01)	.29 (.02)	.35 (.01)	.01 (.03)
Vegetation (n=528)	N/A	.29 (.05)	.39 (.07)	.32 (.03)	N/A

Conclusions

- Leaf-off image would be preferable
- Object-based classification requires iterative process of segmenting & classifying
- On-line user forum very helpful
- Use thematic data as much as possible
- Be clear about defining “sidewalk” at onset
- Future plan: accuracy assessment using digitized sidewalk as ground truth

References

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- Randall, T.A. & Baetz, B.W. (2001). Evaluating pedestrian connectivity for suburban sustainability. Journal of Urban Planning and Development, 127, 1-15.
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