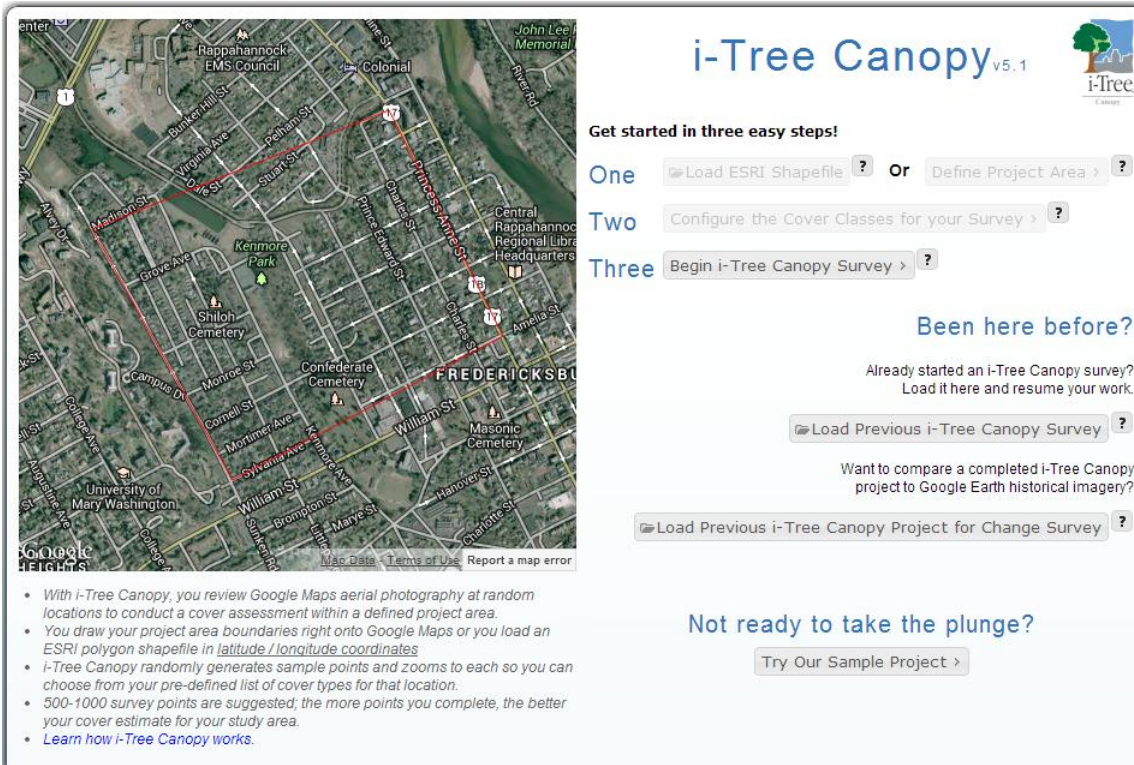


i-Tree Canopy, a Web-based Tool for Rapid UTC Analysis and Planning



i-Tree Canopy v5.1

Get started in three easy steps!

One ? Or ?

Two ?

Three ?

Been here before?

Already started an i-Tree Canopy survey?
Load it here and resume your work.

?

Want to compare a completed i-Tree Canopy project to Google Earth historical imagery?

?

Not ready to take the plunge?

>

- With i-Tree Canopy, you review Google Maps aerial photography at random locations to conduct a cover assessment within a defined project area.
- You draw your project area boundaries right onto Google Maps or you load an ESRI polygon shapefile in [latitude / longitude coordinates](#)
- i-Tree Canopy randomly generates sample points and zooms to each so you can choose from your pre-defined list of cover types for that location.
- 500-1000 survey points are suggested; the more points you complete, the better your cover estimate for your study area.
- [Learn how i-Tree Canopy works.](#)

**Won Hoi Hwang
Virginia Tech**

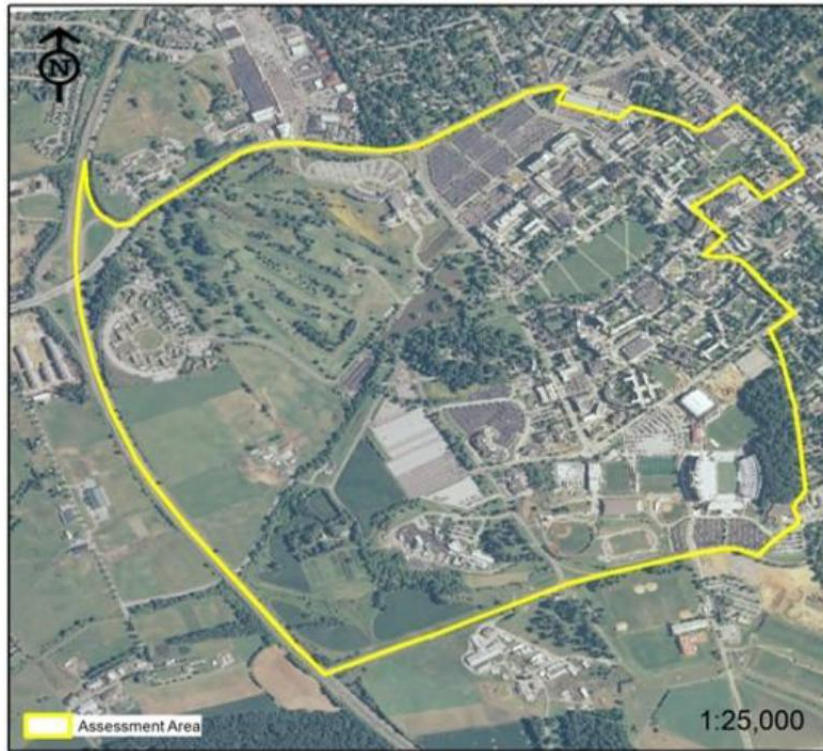
What is i-Tree Canopy?

- A tool designed to allow user to easily and accurately estimate tree and other cover classes within their city or any area they like
- A survey approach in which a human processor visually interprets randomly sampled points on aerial imagery (Google Earth) to estimate the proportions of ground cover classes

Pros & Cons

- i-Tree Canopy provides greater accessibility to UTC assessment:
 - faster UTC assessment
 - little knowledge required
 - no specialized software or remote sensing data required
- i-Tree Canopy has inherent limitations related to sampling methods.
 - Sample sizes affect precision of the UTC estimates.
 - No wall-to-wall classification map provided.

Cast Study: Virginia Tech Campus



Study Area

- Moderately urbanized land
- 885 acres of the central campus

UTC Assessments

- 4 land cover classes including water, impervious surface, non-tree vegetation, and tree canopy

Cast Study: Virginia Tech Campus (Cont'd)



Blacksburg UTC Assessment
 - Overall accuracy ----- 96%

Estimated proportions of ground cover on campus:

- Water ----- 1.1%
- Impervious Surface 33.1%
- Non-tree Vegetation 45.6%
- Tree Canopy ----- 16.1%**

Image Classification Map

i-Tree Canopy over-estimated impervious surfaces while under-estimated tree canopy.

PI sample sizes of ≥ 250 points

- Mean and CV stabilized
- UTC and other ground covers estimates were consistent with IC method.

Results of i-Tree Canopy Assessments

	10 points				12 points				25 points				50 points			
	WA ¹	IS	VA	TC	WA	IS	VA	TC	WA	IS	VA	TC	WA	IS	VA	TC
Mean ² (%)	0.0	36.0	45.0	18.0	0.8	31.7	50.0	17.1	0.8	41.2	45.2	12.8	0.8	42.2	43.0	14.0
SD ³	0.0	16.5	19.0	12.3	2.6	10.2	14.0	10.3	1.7	11.3	8.9	7.5	1.0	6.1	5.8	4.2
CV ³ (%)	0.0	45.7	42.2	68.3	0.0	32.4	29.1	61.3	210.8	27.5	19.6	58.6	129.1	14.4	13.6	30.2
	100 points				250 points				500 points				1000 points			
	WA	IS	VA	TC	WA	IS	VA	TC	WA	IS	VA	TC	WA	IS	VA	TC
Mean (%)	0.0	36.0	48.0	14.0	1.0	38.8	45.8	14.4	0.9	38.4	46.3	14.5	1.1	38.0	45.4	14.9
SD	1.0	6.1	7.6	2.5	0.5	2.4	1.7	1.8	0.4	2.0	1.8	1.3	0.3	1.3	1.2	0.9
CV (%)	161.0	16.9	15.5	17.8	54.2	6.2	3.7	12.6	51.5	5.2	3.9	9.0	29.2	3.4	2.7	6.0

¹ WA (water); IS (impervious surface); VA (non-tree vegetation); and TC (tree canopy)

² Mean of 10 replicated assessments at each point sample size

³ SD (standard deviation); CV (coefficient of variation)

Three Basic Steps to Estimate UTC and Other Ground Covers

Step 1:
Define study area

- Import a file that delimits the boundary of your area of analysis (e.g. city boundary).

Step 2:
Define ground cover classes

- Name the land cover classes to classify (e.g. tree, grass, building).

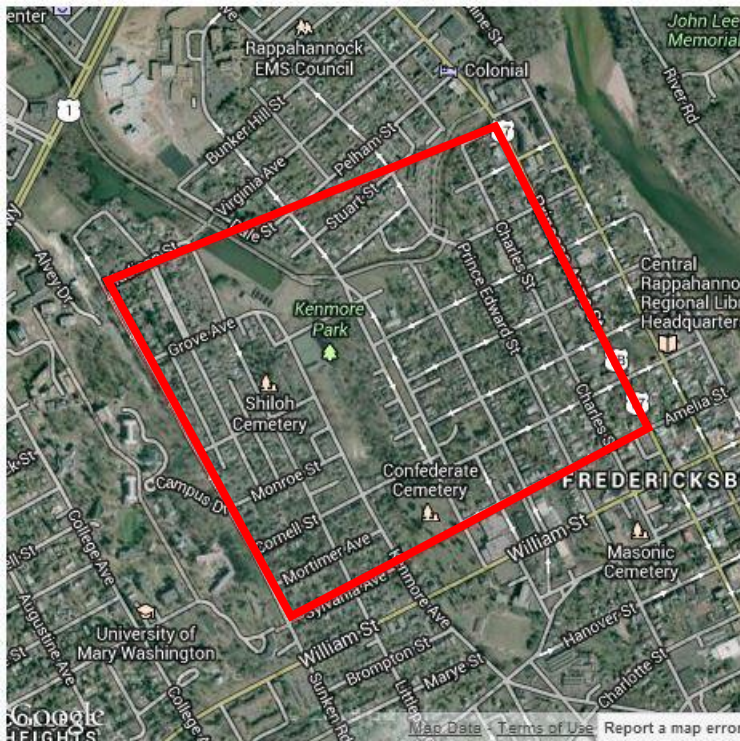
Step 3:
Define sample size &
interpret random points

- Start classifying (interpreting) each point that will be located randomly within the boundary file.

Exercise: Estimate UTC and Other Ground Covers using i-Tree Canopy

STEP 1: define the boundary of your area of analysis (e.g. city boundary).

- Digitize project boundary
- Import a shapefile through:
 - [ESRI US Census 2000 TIGER data](#) or [US Census Cartographic Boundary Files](#)
 - Detailed information is available at the website.



i-Tree Canopy v5.1

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Exercise: Estimate UTC and Other Ground Covers using i-Tree Canopy (cont'd)

STEP 2: Name the cover classes (up to 15 classes) to classify

Configure the Cover Classes for your Survey > ?

2

	Cover Class	Abbreviation	Description	Show Estimation
1	Tree	T	Tree, non-shrub	<input checked="" type="checkbox"/>
2	Non-Tree	NT	All other surfaces	<input checked="" type="checkbox"/>

1

+ Add new cover class

Add Record [X]

Cover Class

Abbreviation

Description

Show Estimation

Submit Cancel

✎ Edit cover class

Edit Record [X]

Cover Class

Abbreviation

Description

Show Estimation

Submit Cancel

3

Exercise: Estimate UTC and Other Ground Covers using i-Tree Canopy (cont'd)

STEP 3: Start classifying (interpreting) each point that will be located randomly within the boundary file.

How it works | **Report** | **Export** | Start Over | Exit ?

Map | Satellite

3

Pitt St

First Christian Church

Google

Map Data - Terms of Use | Report a map error

Remember, the more points you survey, the lower your Standard Error, and the more precise your sampling will be. More points surveyed provide for a better estimation of Land Cover across your study area.

1

i-Tree Canopy v5.1

Percent Cover (\pm SE)

Class	Mean	SE
WA	0.00	± 0.00
IS 01	50.0	± 25.0
IS 02	12.5	± 12.5
VP	37.5	± 21.7
TC	0.00	± 0.00
NI	0.00	± 0.00

Id	Cover Class	Latitude	Longitude
1	B Impervious	38.30492	-77.464
2	NB Impervious	38.30397	-77.471
3	Vegetation and Pervious	38.30545	-77.471
4	NB Impervious	38.30683	-77.467
5	NB Impervious	38.30649	-77.470
6	NB Impervious	38.30942	-77.465
7	Vegetation and Pervious	38.30442	-77.470
8	Vegetation and Pervious	38.30326	-77.471
9	Tree Canopy	38.30619	-77.467

2

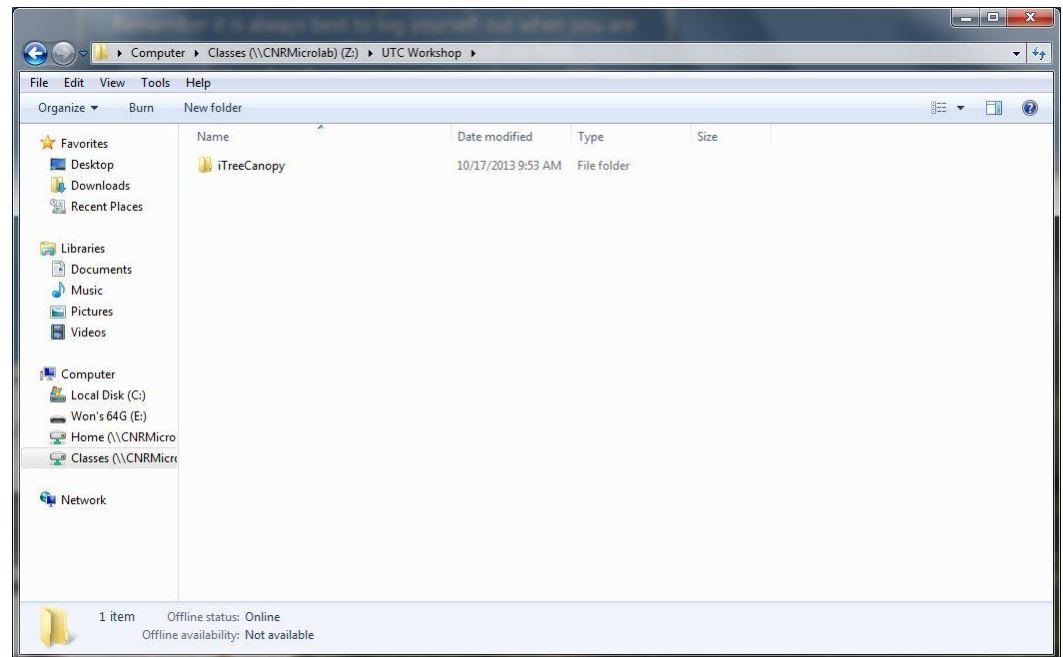
3

Save Your Data

Save Data | Save Early. Save Often. Don't lose your project data!

Exercise: Estimate UTC and Other Ground Covers using i-Tree Canopy (cont'd)

- Let's do your own works.
- We will have 50 samples points per each person.
- Project boundary and land cover classes are available in “iTreeCanopy” folder at Z:\UTC Workshop\
 - Project area boundary shapefile: **UTC_ExerciseArea.shp**
 - Pre-defined land cover classes: **UTC_LC Classes**

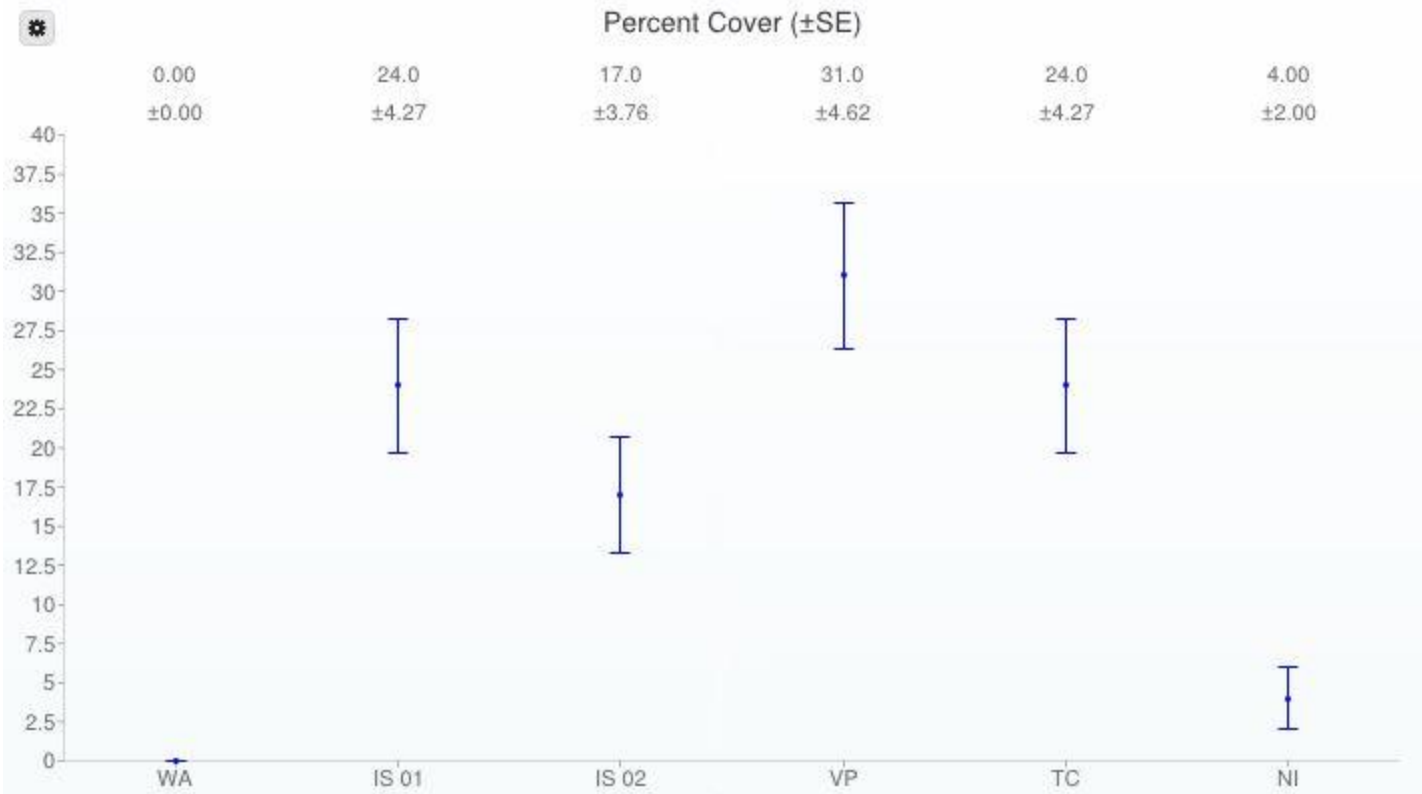


Attributions of Uncertainty to Interpret Points (Richardson and Moskal, 2013)

- Height, edge, shadow, and their combination
- Interior forest canopy



Summary of UTC and Other Ground Cover Estimation



Cover Class	Description	Abbr.	Points	% Cover
Water	water	WA	0	0.00 ±0.00
NB Impervious	non-building impervious	IS 01	24	24.0 ±4.27
B Impervious	building impervious	IS 02	17	17.0 ±3.76
Vegetation and Pervious	Vegetation and pervious	VP	31	31.0 ±4.62
Tree Canopy	tree canopy	TC	24	24.0 ±4.27
Non-interpretible	points, which are not interpretable	NI	4	4.00 ±2.00

Comparing Two Methods: Image Classification vs. i-Tree Canopy

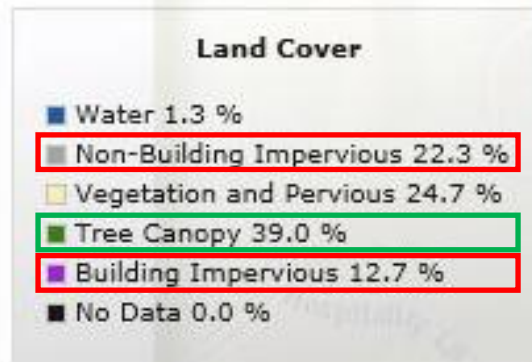
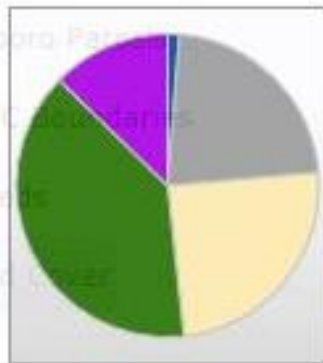
- i-Tree Canopy (100 points)

Cover Class	Description	Abbr.	Points	% Cover
Water	water	WA	0	0.00 ±0.00
NB Impervious	non-building impervious	IS 01	24	24.0 ±4.27
B Impervious	building impervious	IS 02	17	17.0 ±3.76
Vegetation and Pervious	Vegetation and pervious	VP	31	31.0 ±4.62
Tree Canopy	tree canopy	TC	24	24.0 ±4.27
Non-interpretable	points, which are not interpretable	NI	4	4.00 ±2.00

- i-Tree Canopy (200 points)

Cover Class	Description	Abbr.	Points	% Cover
Water	water	WA	3	1.50 ±0.87
NB Impervious	non-building impervious	IS 01	47	23.5 ±3.00
B Impervious	building impervious	IS 02	40	20.0 ±2.83
Vegetation and Pervious	Vegetation and pervious	VP	59	29.5 ±3.22
Tree Canopy	tree canopy	TC	46	23.0 ±2.98
Non-interpretable	points, which are not interpretable	NI	5	2.50 ±1.12

- UTC Mapper



i-Tree Canopy over-estimated impervious surfaces while under-estimated tree canopy.

Comparing Two Methods: Image Classification vs. i-Tree Canopy (cont'd)

	UTC Mapper	i-Tree 100	i-Tree 200	i-Tree 500*
WA	1.30	0.00	1.50	4.2
IS 01	22.30	24.00	23.50	26.0
IS 02	12.70	17.00	20.00	19.4
VP	24.70	31.00	29.50	31.2
TC	39.00	24.00	23.00	19.6
NI	-	4.00	2.50	0

	Analyst 1	Analyst 2	Analyst 3	Analyst 4	Analyst 5	Analyst 6	Analyst 7	Analyst 8	Analyst 9	Analyst 10	Total	%
WA	0	4	0	2	2	0	1	8	1	3	21	4.2
IS 01	9	16	15	18	13	7	16	9	12	15	130	26.0
IS 02	13	6	11	6	8	12	4	18	11	8	97	19.4
VP	13	16	14	15	12	16	21	11	25	13	156	31.2
TC	15	10	10	9	15	15	8	4	1	11	98	19.6
NI	0	0	0	0	0	0	0	0	0	0	0	0.0
	50	52	50	50	50	50	50	50	50	50	502	100.4