Measuring value of CMNP

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2011 Mechanical Harvesting Field Day

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SWFREC - Immokalee, FL

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Less Tree Damage

Higher grower comfort: more acres MH.
Fewer breakdowns: less costs & higher runtime %

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Late Season Valencia

Extend MH period;
More days/season

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Faster Harvest Speed

More bx/hr;

Note:
need sufficient
trailer allocations.

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Less Trailer debris

Less cost @ juice plant;
More trailer allocation (?)

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Canopy (non)Uniformity

Fruit recovery %

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Lower Cost through Higher Capacity

BX/Season =

BX/HR * HR/Day * Day/Season

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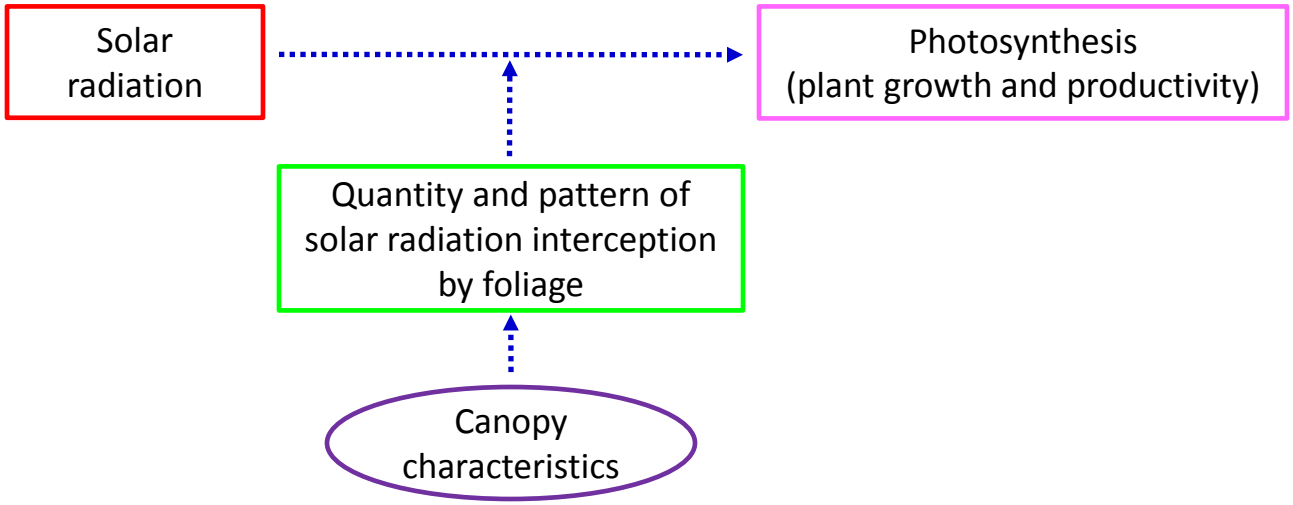
Ranch 1 Rd
Row 24 N
Row 20-N
Row 144 N
Row 140 N
Row 144 S
Row 140 S
Row 20-S
Row 24 - S
© 2011 Google
© 2011 Europa Technologies
©2010 Google
Imagery Date: 12/22/2010
1994
26°20'53.16" N 81°21'43.68" W elev 21 ft
Eye alt 3375 ft

Quantification of Tree Volume Variation

Introduction



Grow rate
Health status
Water consumption
Biomass estimation
Yield prediction
Long-term productivity
Site-specific management
Crop modeling

= f (canopy characteristics, etc.)

Low-cost Image Acquisition Platform

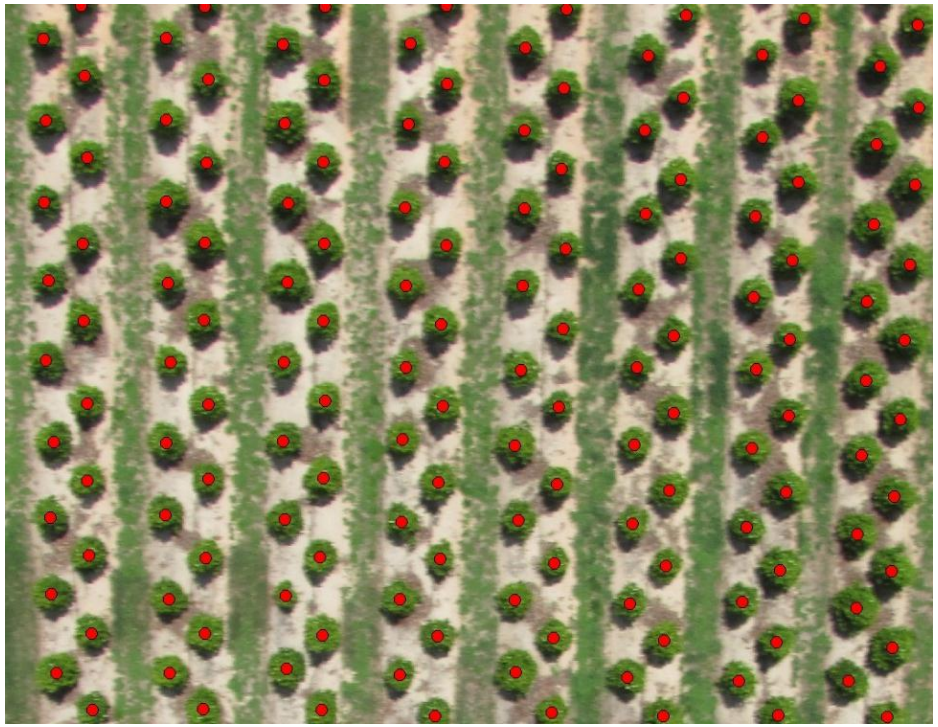
Features:

- Altitude Control
- GPS Position
- Waypoints Navigation
- Payload: 1kg
- Camera:
  - roll and pitch compensated
  - shutter and controls are configured to the operations RC transmitter or to a dedicated camera operator.
- R/C Transmitter 2.400 ~ 2.483 Ghz, 2 - 3 km. range
- LIPO Battery 3300, 5000, 6600 mAh
- Total Weight (without Battery) 1260 grams
- Maximum Altitude 1000 m
- Maximum Speed 8 m/s

Camera

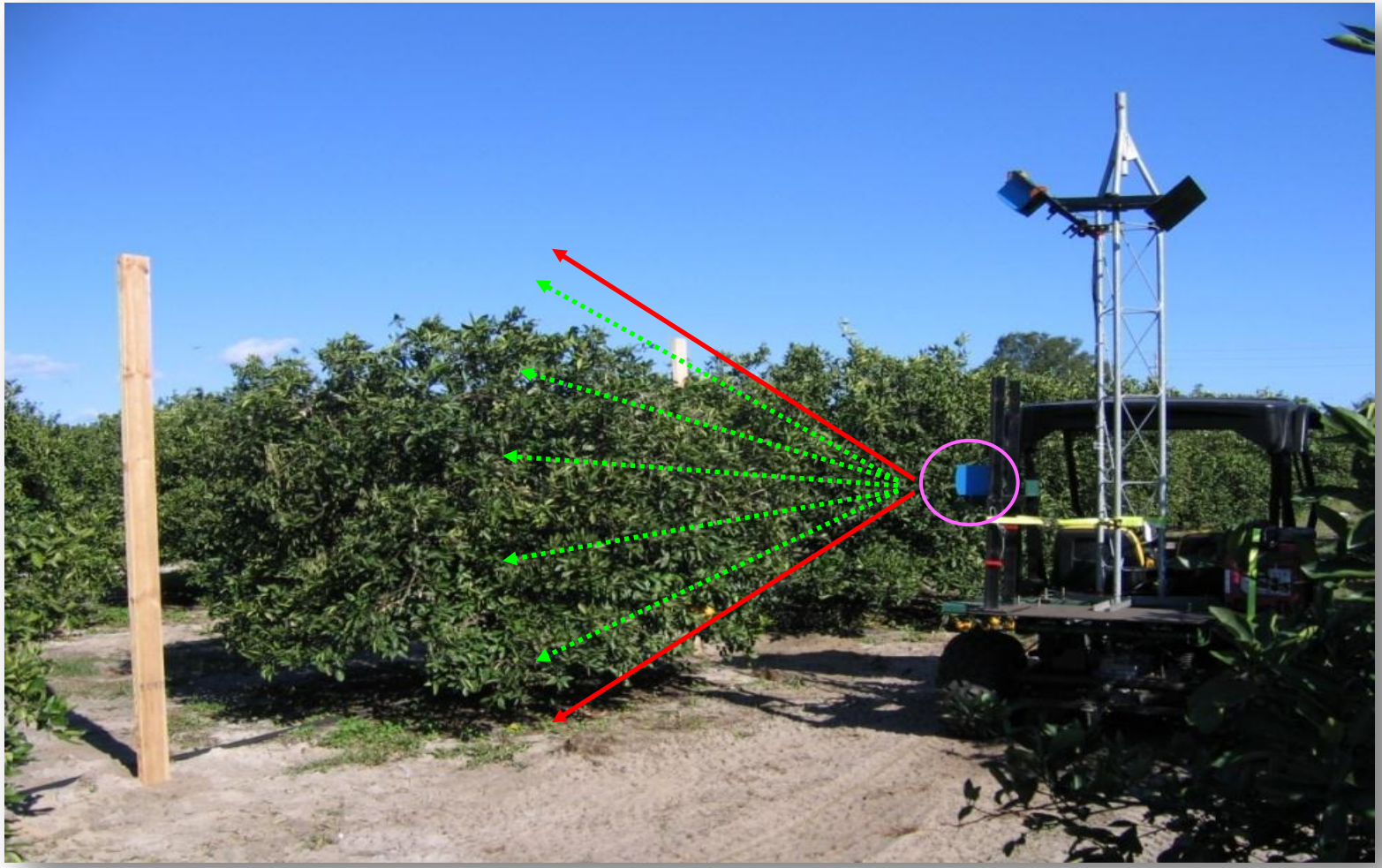

Camera resolution: 3,648 x 2,736 pixels
Ground Size: 82.77 * 61.89 meters
Altitude: 100 meters
Resolution: 2 cm
© 2010 Google
Image U.S. Geological Survey
2009
Goo
Date: Dec 17, 2007
lat 28.107704° lon -81.715369° elev 0 m
Eye alt

Tree Counting Nursery



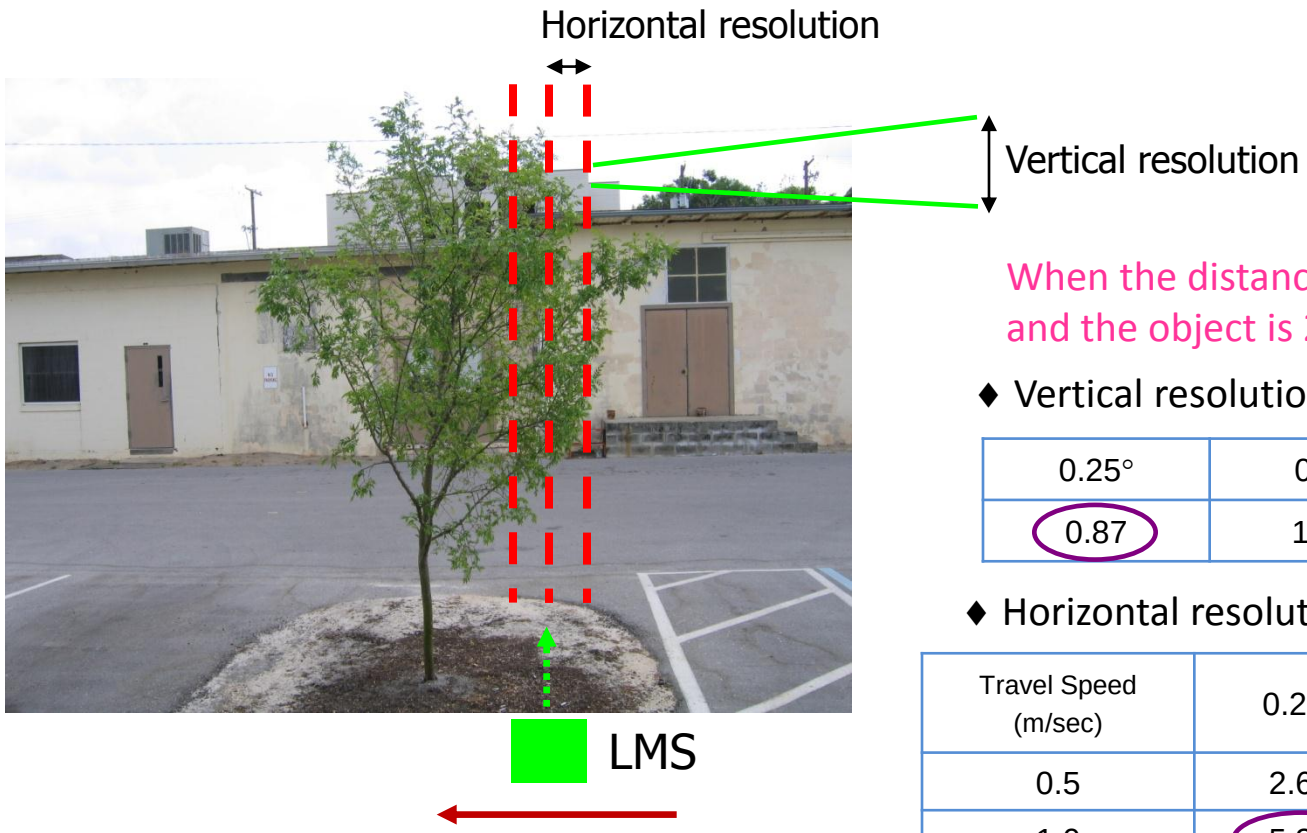
Diameter Estimation

Laser Scanner



Experimental System

- Laser scanner (SICK LMS200)



When the distance between the LMS and the object is 2m,

♦ Vertical resolution (cm)

0.25°	0.5°	1°
0.87	1.75	3.49

♦ Horizontal resolution (cm)

Travel Speed (m/sec)	0.25°	0.5°	1°
0.5	2.65	1.30	0.65
1.0	5.30	2.60	1.30
2.0	10.60	5.20	2.60
3.0	15.90	7.80	3.90

Results

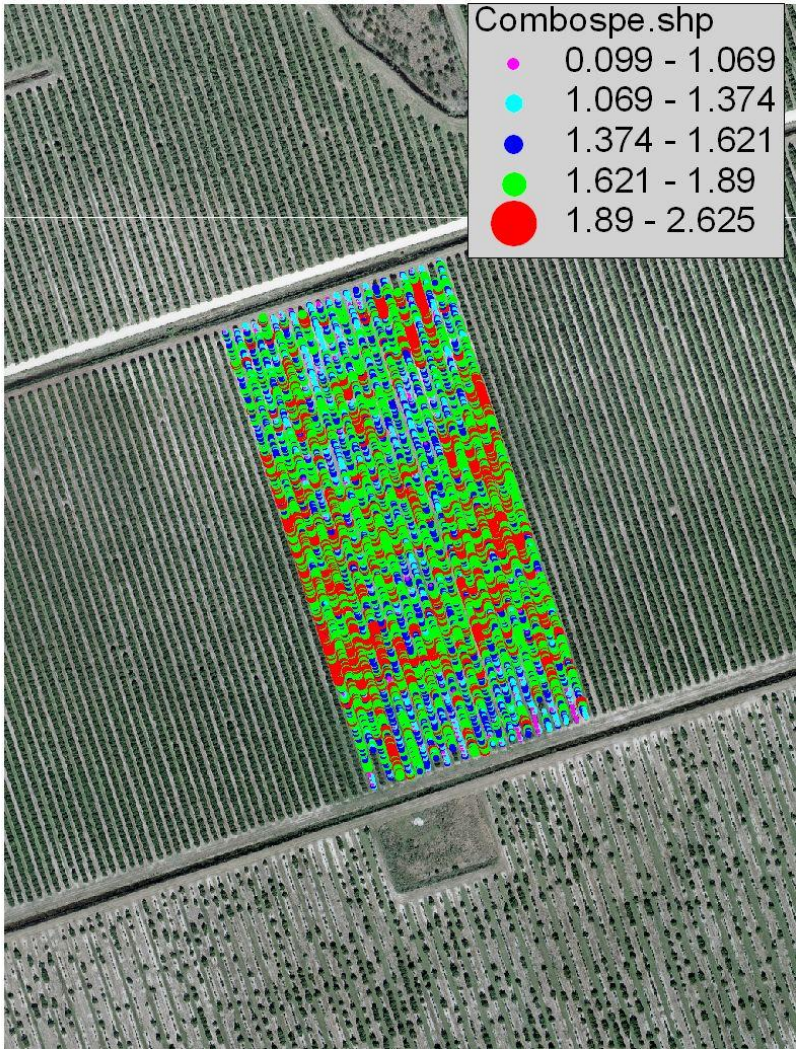
- Relative errors of tree canopy height, width, surface area, and volume measurements
  - Two laser movement speed measurement methods
  - Laser angular resolution: 0.25°, Laser movement speed: 0.63 m/sec

$$relaative\ error\,(\%) = \frac{laser\ meas. - manual\ meas.}{manual\ meas.} \times 100$$

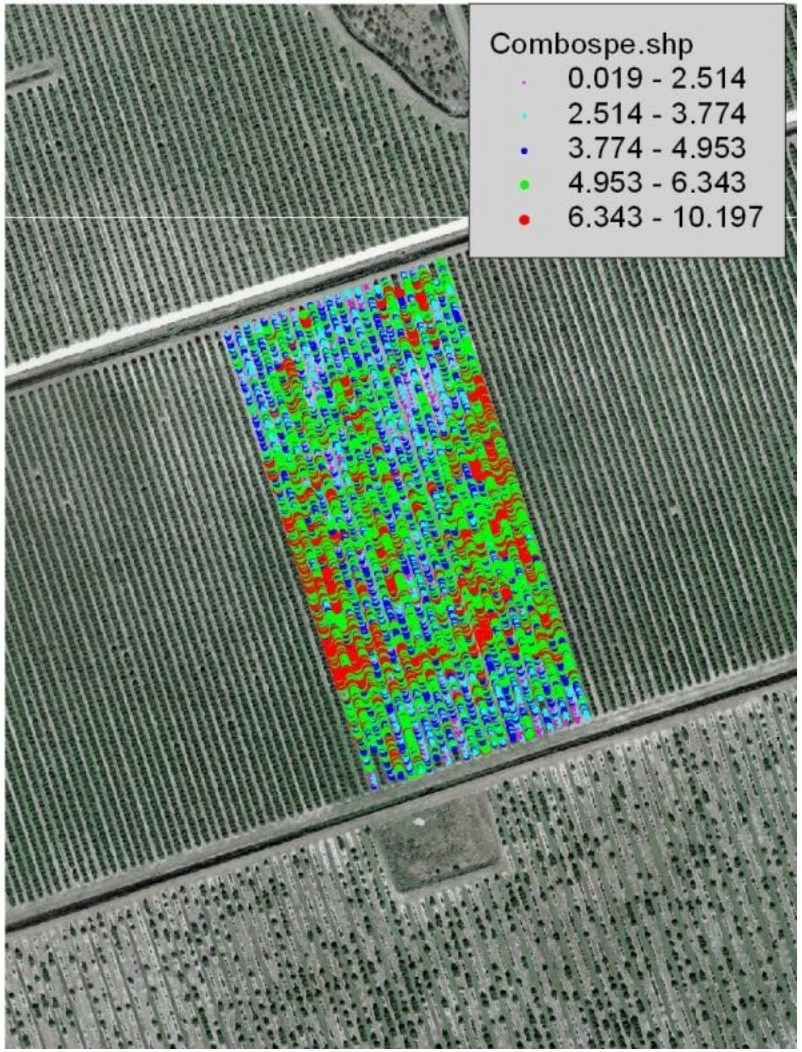
Tree geometric parameter		Laser movement speed measurement method	
		By GPS at 5 Hz	By two-pole method
Height		-0.37	-0.37
Width		5.37	0.01
Surface area	Original data	715.20	699.62
	Processed by convex hull method	0.61	-1.99
	Processed by Savitzky-Golay filter	3.02	0.78
Volume	Original data	-11.93	-13.04
	Processed by convex hull method	7.61	5.96
	Processed by Savitzky-Golay filter	-13.59	-14.70

Results

- Tree height variation



- Tree canopy volume variation



Correlation ?
Canopy uniformity & Fruit recovery %

- 2011 - Late season Valencia trial
  - 4 harvest dates (May 3 – Jun 14)
  - with and without CMNP
- 2012 – EUP acreage
  - with and without CMNP
  - test under various shaker settings
- Data:
  - fruit delivered to trailer
  - fruit on ground (less pre-harvest drop)
  - fruit in tree (post harvest)
  - measure of row's canopy uniformity

  - Will CMNP make a difference?

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Summary Data

(Feb 2011, Pineapples)

	Avg yield	Recovery	Removal	Harvest Speed	Canopy Uniformity
	bx/tree	%	%	mph	holes/100 trees
Average:	**3.1**	**84%**	**90%**	**1.33**	**5**
Min:	**2.3**	**79%**	**87%**	**1.13**	**0**
Max:	**4.2**	**89%**	**93%**	**1.51**	**14**
N: (rows)	20	20	20	20	20

Operators asked to run @ constant speed & shake intensity.

1.3 mph

260 cpm

NO CMNP.

Note: an issue with fruit splitting.

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Preliminary Results

	Correlation Coefficients:
%recovery - %removal:	0.835
%recovery - avg yield:	0.091
%recovery - harvest speed:	0.047
%recovery - hole#:	0.173
%removal - harvest speed:	-0.250
%removal - hole#:	0.138

Not much correlation b/c tree fairly uniform.

Other measures of canopy uniformity (Dr. Ehsani):

1. helicopter flights
2. laser scans

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