Urban Forest Extraction

Use of Remote Sensing Datasets to Quantify Urban Forest Coverage in Mixed Land Use Areas

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Study Area

Morgan Hill, CA

Project Objective

- Collaborate with City of Morgan Hill on using GIS data to identify the tree canopy in the Morgan Hill Region.

- Develop an automated methodology using available data sets and tools.

- Ensure developed methods adhere to professional standards and return valid results.
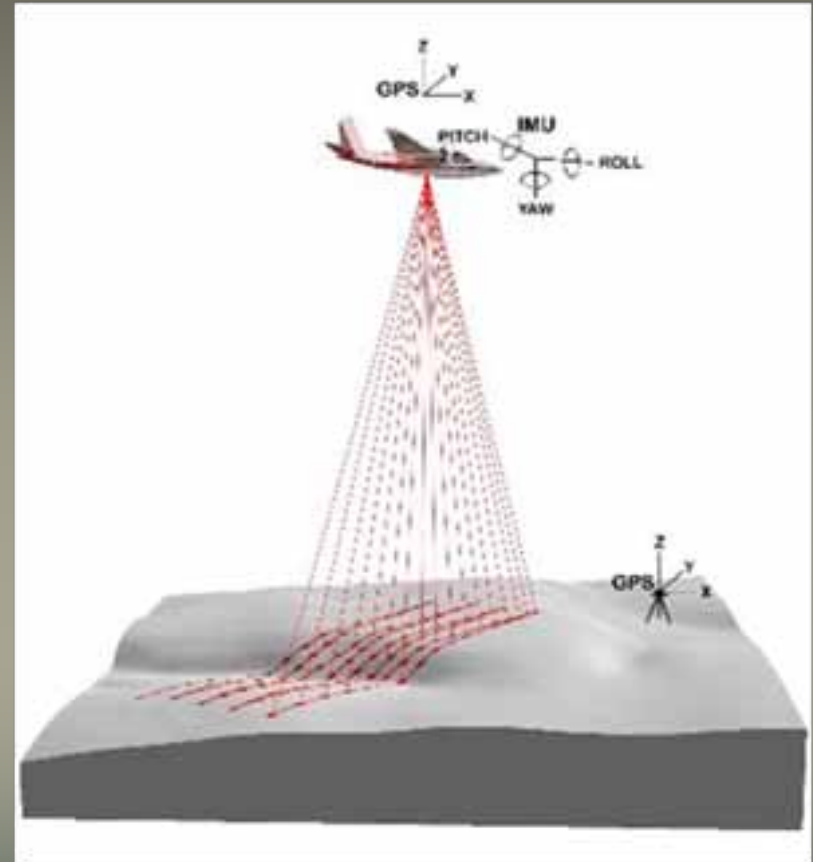
Data Sets & Coverage

2006 LIDAR Grid

2006 Ortho-Photography Grid

LIDAR Definition

- **LIDAR** (*Light Detection and Ranging*) is an optical remote sensing technology that measures properties of scattered light to find range and/or other information of a distant target.
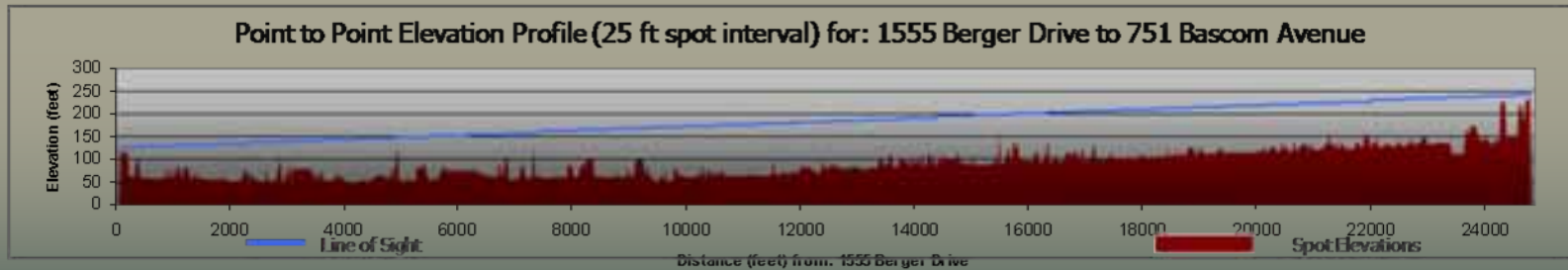
2006 Lidar Data Set – Potential

Building Footprint Extraction

3-D Modeling

Line of Sight Analysis

Point to Point Elevation Profile (25 ft spot interval) for: 1555 Berger Drive to 751 Bascom Avenue

2006 Ortho-Photo Data Set – Potential

Available Tools

Preliminary Results

- Utilizing Lidar data set and Lidar Analyst.

- Excellent point identification.

- Poor forest and extent identification.

- Estimated coverage - area: 160,000 sq. feet (5.7%).

Preliminary Results

- Utilizing Ortho data set and Feature Analyst.

- Excellent forest coverage

- Poor discrimination of shrubs, grasses and trees.

- Estimated coverage - area 424,000 sq. feet (14.7%).

Synthesized Approach

- Exploit the horizontal dimension using Feature Analyst and Ortho-Imagery.

- Exploit the vertical dimension using Lidar Analyst and Lidar data.

- Combine these using Spatial Analyst from ESRI.

Acknowledgements

- Robert Colley – GIS Manager County of Santa Clara, "There must be a way to combine these data sets together to get an accurate result."

- "Integrating LIDAR data and multi-spectral imagery for enhanced classification of rangeland vegetation: A meta analysis", Edward W. Bork, Jason G. Su (2006) University of Alberta, University of British Columbia.

Synthesized Approach - Overview
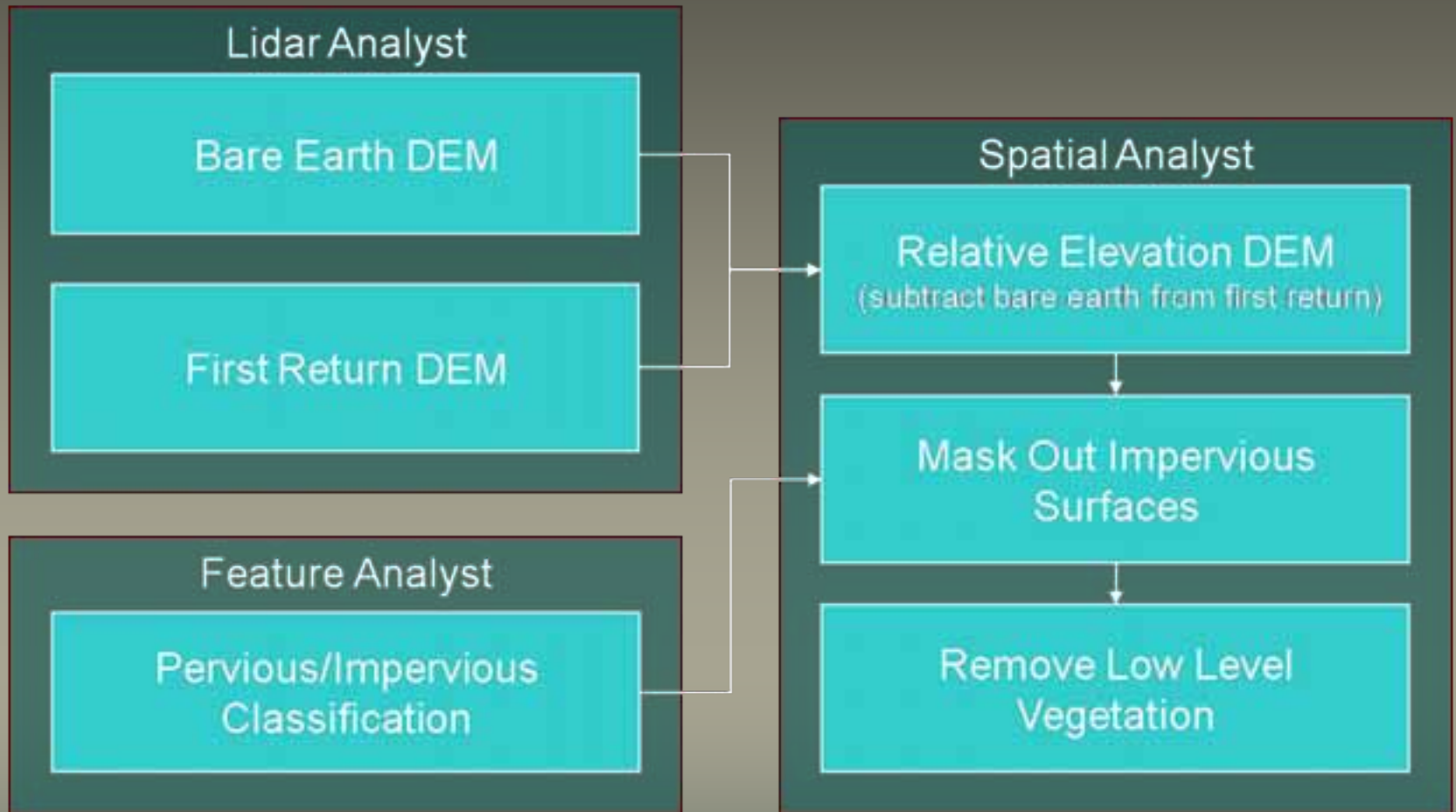
First Return DEM

- Derived from Lidar Analyst.

- Includes first Lidar point elevation value.

- Lidar Tile Statistics:

		Return Number					
		1	2	3	4	5	Total
# of returns per pulse	1	445,661	-	-	-	-	445,661
	2	23,066	23,105	-	-	-	46,192
	3	955	950	944	-	-	2,849
	4	2	2	2	2	-	8
	5	-	-	-	-	-	-
	Total:	469,724	24,058	946	2	-	494,730

Return 1

Return 2   Pulse 1

Bare Earth DEM

- Derived from Lidar Analyst.

- Includes Lidar points classified as Bare Earth.

- Lidar Tile Statistics:

# of returns per pulse	Return Number					
		1	2	3	4	5	Total
1	292,142	"	"	"	"	292,142
2	"	12,591	"	"	"	12,591
3	"	"	637	"	"	637
4	"	"	"	2	"	2
5	"	"	"	"	"	"
Total:	292,142	12,591	637	2	-	305,372

Return 1
Return 2 Pulse 1
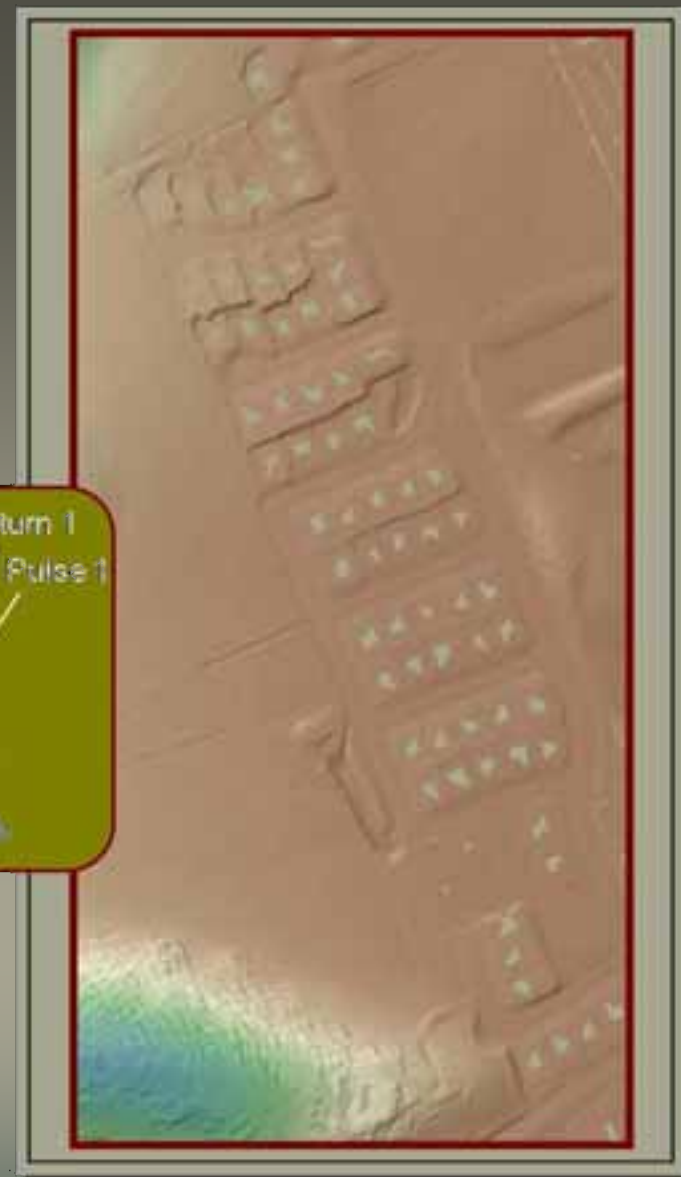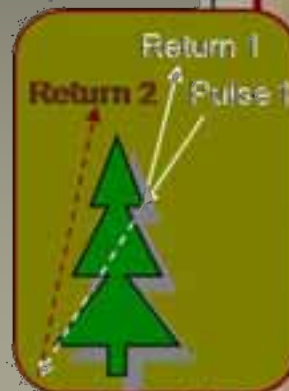
Relative Elevation DEM

- Derived by subtracting Bare Earth DEM from First Return DEM utilizing ESRI Spatial Analyst

- White space indicates zero value and/or no data in Bare Earth DEM.

Classification Training

- Perform a "wall-to-wall" classification on 2006 Ortho Imagery using Feature Analyst.

- Training set identifies pervious (ground/vegetation) and impervious (structures/asphalt).
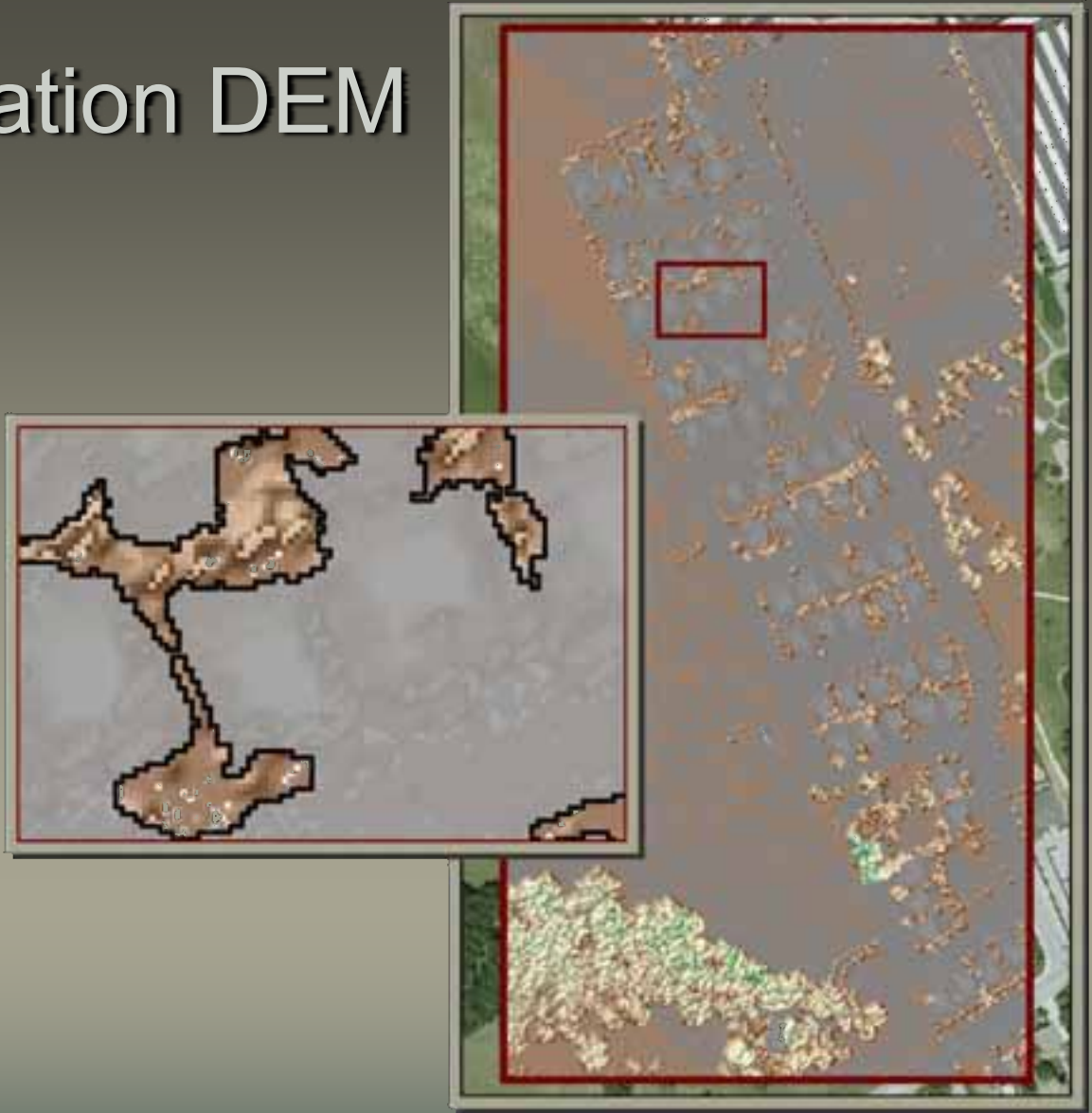
- Shadows are an issue.

Impervious Classification

- Feature Analyst returns ground classification in two classes.

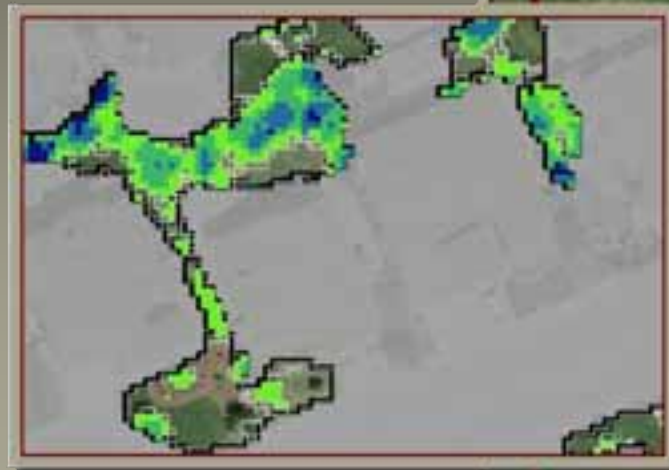- Excellent discrimination, however some imprecision is inevitable.

Pervious Elevation DEM

- Cells that are in the pervious layer are extracted using the raster calculator in ESRI Spatial Analyst.
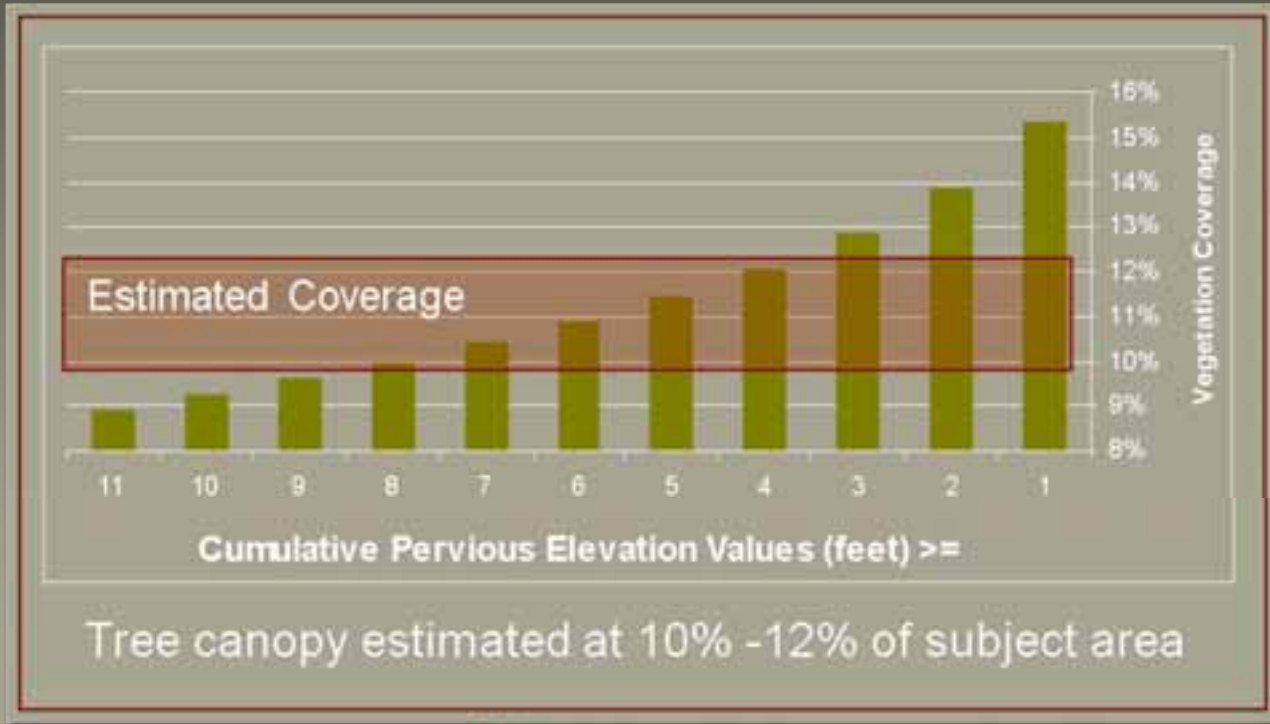
Classify Vegetation

- Raster elevation DEM in the pervious layer converted to feature class.

- Feature class is classified by elevation values.

- Identifies non-ground cover vegetation.

Vegetation Elevation

Color	Range
	-2 - 1
	2 - 4
	5 - 9
	10 - 13
	14 - 76

Estimated Tree Canopy

Tree canopy estimated at 10% -12% of subject area

Summary

- Lidar analysis yields ≈ 6% coverage and works best in urban areas.

- Ortho analysis yields ≈ 15% coverage and works best in rural areas.

- Combined analysis yields ≈ 10-12% coverage and works best in mixed areas.