



VISUAL LEARNING
SYSTEMS

The LIDAR Analyst™ Extension for ArcGIS™

**Automated Feature Extraction Software for
Airborne LIDAR Datasets**

We put the information in GISSM

A Visual Learning Systems, Inc. White Paper

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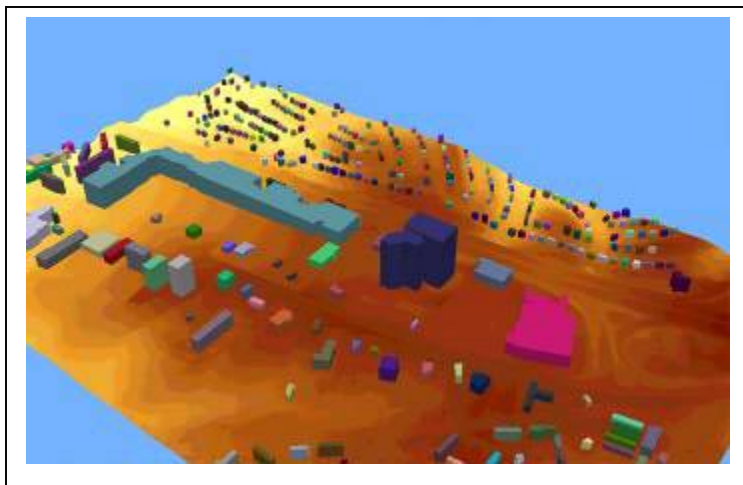
Contents

Introduction.....	1
Product Design.....	2
Product Features:	4
Platforms.....	6

LIDAR Analyst

Introduction

The LIDAR Analyst extension for ArcGIS is a necessary tool for anyone who has LIDAR data. LIDAR Analyst completely automates the extraction of 3D terrain surfaces, buildings, trees, and forest areas from LIDAR. Comprehensive testing of LIDAR Analyst by the U.S. Army Topographic Engineering Center (TEC) shows the accuracy of terrain, buildings, and trees is outstanding for both leaf-off and leaf-on conditions, often generating trees and buildings at a rate of over 1,000 per minute. LIDAR Analyst also automatically extracts attributes of features, such as building height, area, perimeter, roof type, tree crown width, and tree stem diameter.



LIDAR Analyst automatically extracts 3D terrain, buildings, trees, and forest features from airborne LIDAR. The top image shows the raw LIDAR data. The bottom image shows 3D building Shapefiles on top of the Bare earth surface. All of these features are extracted with 100% automation.

LIDAR is an acronym for Light Detection And Ranging that collects very-high resolution elevation information of the earth including natural and cultural features. LIDAR technology provides an accurate, expedient and cost-effective ways to produce detailed Digital Elevation Models (DEMs).

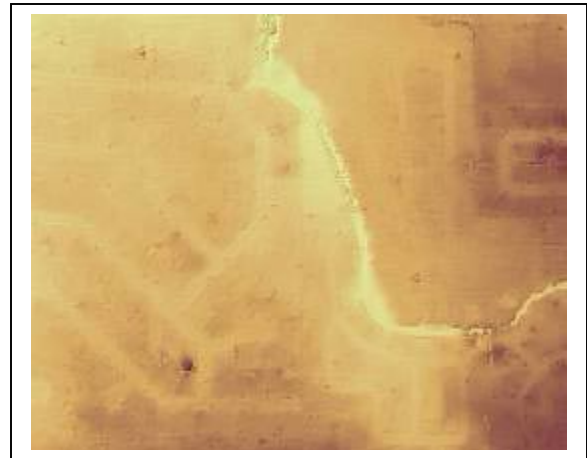
Although LIDAR data sets contain vast amounts of 3D information, terrain and cultural features such as buildings, trees, power lines, and many other visible features must be extracted.

Product Design

LIDAR Analyst provides 100% automation of the workflow for feature extraction of terrain (Bare Earth), buildings, trees, and forest areas from LIDAR datasets.

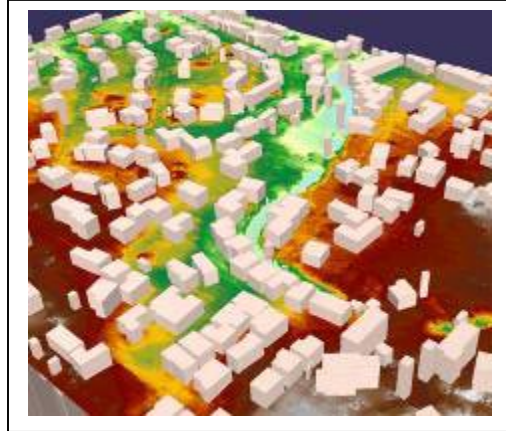
Bare Earth: Bare Earth is the modeling of terrain with all elevated features (typically buildings and trees) removed. Bare earth is critical for effectively modeling and displaying the buildings and tree volumes on an accurate real-world terrain. In order to extract bare earth, edges are detected from the last return elevation data and areas of sharp change in elevation, for example, the edges of buildings and trees, are picked out and removed from the original images.

When extracting bare earth with LIDAR Analyst, you simply choose the final return, and if available, the first return. LIDAR Analyst generates the bare earth model.

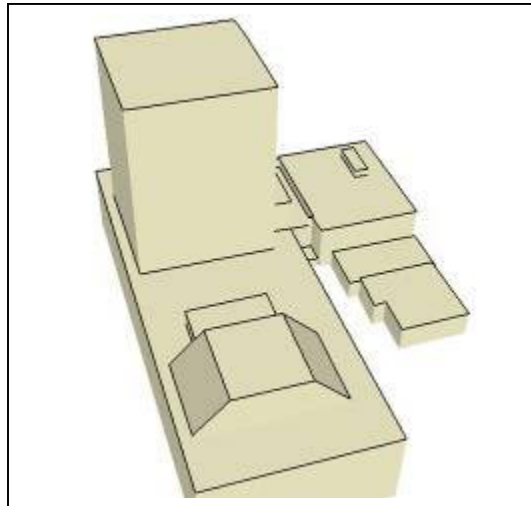
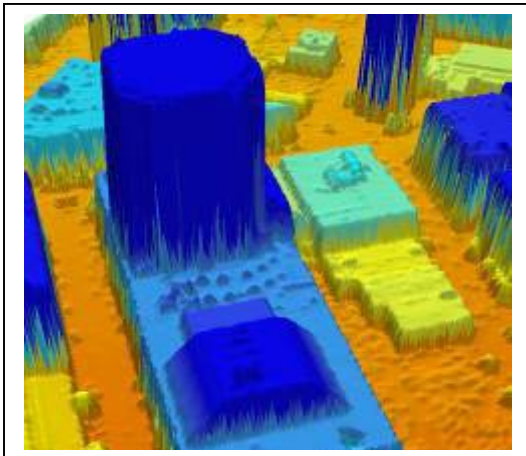


The image on the left shows a hillshaded LIDAR DEM. The image on the right is the Bare Earth surface that is automatically extracted by LIDAR Analyst. Comprehensive testing by the U.S. Army Topographic Engineering Center (TEC) shows the Bare Earth extraction is accurate to within centimeters of the sensor accuracy for both

Building Footprints: LIDAR Analyst automatically extracts 3D building footprints as simple building models from airborne LIDAR data. Building attributes of height, area, perimeter, average height and building roof type (pitched, simple, etc.) are also automatically collected. Production rates for building extraction have exceeded 1,000 buildings per minute for multiple types of land-cover settings including urban and suburban settings. Additional tools that are planned for the LIDAR Analyst included automated collection.

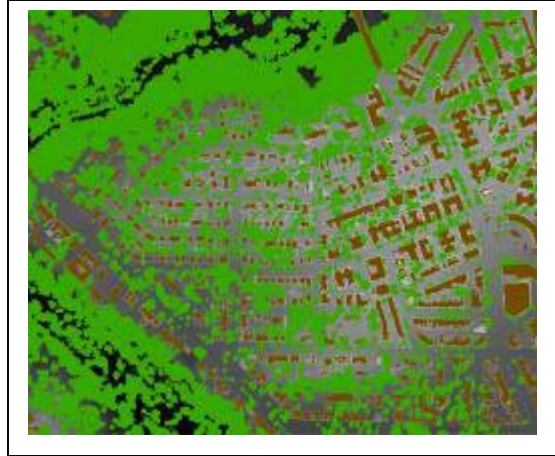
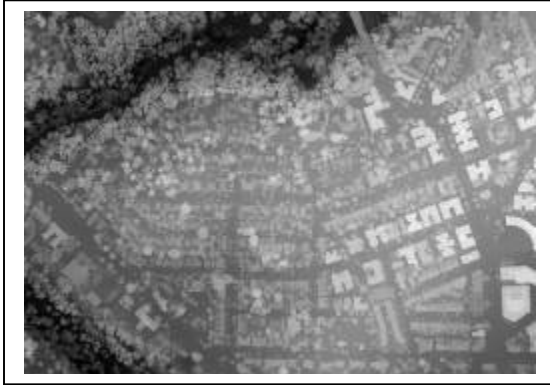


The image on the left shows the extraction of building footprints from the LIDAR data. The image on the right shows the 3D buildings on top of the hill shaded terrain model.



The image on the left is a LIDAR DEM of a complex building. The image on the right shows the extraction of the complex building as a 3D Shapefile. VLS will offer automated complex building capture in the LIDAR Analyst extension for ArcGIS and ERDAS IMAGINE.

Tree Extraction: LIDAR Analyst also provides a 100% automated extraction workflow for trees. Trees are collected as point Shapefiles and forest regions are collected as polygons. Attributes for trees that are automatically collected include tree height, crown width, and stem diameter.



The image on the left is a LIDAR DEM. The image on the right shows the extraction of trees (green) and buildings (brown).

Product Features:

- **Load LIDAR Data**
 - Prompts user for
 - First return
 - Last return
 - Intensity
 - Runs Hillshade and relief tool on each of the above inputs.
- **Hill Shade and Relief Tool**
 - Input is any DEM
 - Set Shadow length (Lighting Altitude)
 - Set Sun angle (Lighting Azimuth)
 - Shading Styles
 - Level of detail
- **Bare Earth Extractor**
 - First return (optional)
 - Last return (required)
 - Automatically clean data before extracting bare-earth
 - Spikes and pits removal
 - Low pass filter smoothing
 - Bare-earth extraction method

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- Method 1 (default)
 - Method 2 (used in case of tall buildings)
 - Mask value
 - **Building Extractor**
 - Last return DEM
 - Bare-earth DEM
 - Minimum building area
 - Minimum building height
 - Maximum slope for building roofs
 - Smoothing tolerance (Bezier smooth)
 - Z-enable using (combo box lists options – min, max, average, actual, none)
 - Square up (enabled by default)
 - Extract as multi-components. (Lego-land buildings)
 - **Attributes**
 - Building ID
 - Roof type – multi-level flat, simple flat, complex, pitched
 - Average height above ground level
 - Min height above ground level
 - Max height above ground level
 - Dev height – range of height
 - Area
 - Perimeter
 - Length
 - Width
 - Orientation angle
 - **Tree and Forest Extractor**
 - First return (optional)
 - Last return (required)
 - Bare-earth (required)
 - Buildings (required)
 - Output type:
 - Tree points or
 - Forest polygons
 - Minimum tree height
 - Average tree diameter
 - Max dist between trees (for forests)
 - Min size of a forest (for forests)
 - **Attributes:**
 - Tree ID
 - Tree Height
 - Crown width of tree
 - Stem diameter
 - **Bare Earth Clean Up Tools**

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- Spikes and Pits Removal
 - Input DEM
 - Percentage of DEM range above which spikes appear
 - Outer radius of search annulus
 - Inner radius of search annulus
 - Show detached spikes and pits as a shape file
 - Bare Earth Modification Tools
 - Create Bare Earth Modification Layer
 - Process Bare Earth Modifications
 - Replace Buildings
 - **Create 3D Shapes Tool**
 - Input shape file
 - Z attribution method - min, max, average, actual
 - DEM file
 - **Square Tool**
 - Input building shape file
 - Smoothing tolerance
 - Digital elevation model
 - Bare-earth
 - **Polygon Reshape Deluxe Editing Tool**
 - **Image Cut Tool**

Platforms

- Windows XP, Windows NT, Windows 2000, Windows 98, & Windows 95