# Geospatial Scripts for LIDAR Processing

TNTmips includes a number of standard features that facilitate processing of LIDAR data. Among these are:

- direct use of LAS point files
- LIDAR Manager allows merging, tiling, reprojecting LAS files, as well as extract by area and/or by class
- Create and use tiled LAS files as single seamless dataset
- Point Profile tool for displaying/selecting LIDAR points
- Automated LIDAR point classification.

These features are documented in several Technical Guides that are listed on the next page.
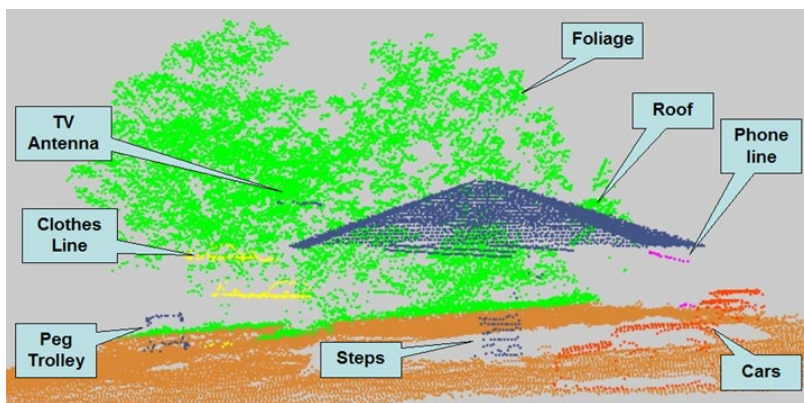
Vertical profile of a portion of a high-density airborne LIDAR point cloud classified interactively using the Point Profile tool.

Terranean Mapping Technologies (now a part of RPS Group Australia) operates a LIDAR system and uses TNTmips in combination with specialized software to process their LIDAR data. They have made available a series of scripts they have developed using the TNT Geospatial Scripting Language (SML) to carry out LIDAR processing in TNTmips. They use these scripts to create, filter, and refine surfaces from LAS files, to classify the LIDAR points, and to extract additional information from the LIDAR point clouds.
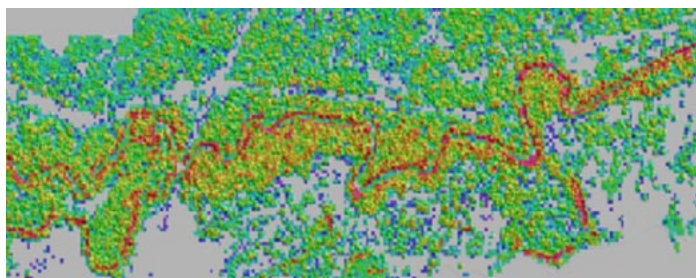

Raster image with colors indicating the percentage of LIDAR returns from the vegetation canopy (a measure of foliage cover). Terranean Mapping derived these values from the LIDAR points classified using the SML scripts described here. Red indicates highest vegetation returns.
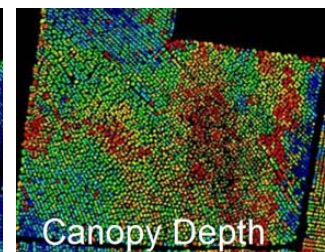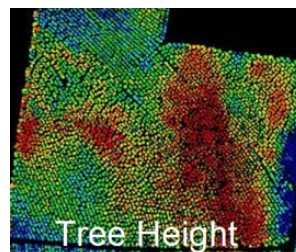
High-Density LIDAR Data

The LIDAR system operated by Terranean and RPS Group is flown at low altitude and low speed, producing a high spatial density of LIDAR points that can include returns from the ground, hard surfaces above ground, and multiple returns from vegetation. This dense data can be readily converted to raster surfaces because the low-altitude LIDAR system typically generates up to 13 pulses per square meter, producing multiple point returns per raster cell for a DEM with 1-meter cell size. Surface rasters are generated from both minimum and maximum LIDAR point elevations. These surfaces are filtered and processed using SML scripts to produce a bare-ground DEM, which is then used to classify the LIDAR points into ground and non-ground categories. (Note that the Lidar Classification process in TNTmips provides ground classification options for more typical sparser point clouds acquired at higher altitude and flying speed.)

LIDAR Point-Cloud Analysis

Terranean Mapping used the classified LIDAR point clouds created by SML processing to perform a number of innovative analyses. They were able to analyze LIDAR data from a pine tree planatation to delineate tree crowns and measure tree height, canopy density and canopy depth. They found LIDAR to be much more effective for measuring small trees than aerial photography. In other projects they were able to map powerlines from LIDAR point data and to thin LIDAR ground points to remove redundant points in flat areas. Some of these applications are illustrated here and in their PDF document entitled LIDAR with TNTmips that is available for download with the scripts (see link on next page).
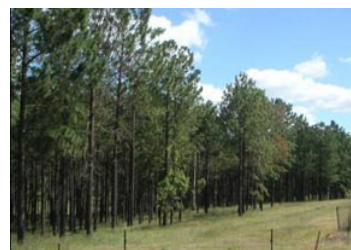
Terranean Mapping used SML-classified LIDAR points to analyze the canopy structure of a pine plantation, deriving measures of tree height, tree crown density, canopy depth, and other characteristics.

(continued)

SML Scripts for LIDAR Processing

The SML scripts described below were specifically developed for processing high-density LIDAR point data, with much of the processing done in the raster domain. They are available for free download at:

http://www.microimages.com/sml/smlsamples-htm/lidar.htm.

LAS_to_Raster.sml: produces raw surfaces from the unclassified LIDAR point data in an LAS file. Minimum Z and Maximum Z surfaces are produced, along with a raster with the count of LIDAR point returns for each cell. The Minimum Z surface is a good starting point for a "bare earth" DEM, as it includes ground returns, buildings, and some vegetation returns where the canopy is too dense to allow penetration to the ground. The Maximum Z surface includes the top of the vegetation canopy plus buildings and bare ground that have no vegetation above them.

Interp.sml: fills gaps (null areas) in the surface raster that correspond to areas of no LIDAR returns (water surfaces, building shadows) and null areas created by the other processing scripts.

Filter_LiDAR_DEM.sml: removes hard man-made objects above ground, such as buildings and cars, while retaining important ground features such as retaining walls and banks. The removed features are replaced by null cells.

EdgeFill.sml: fills in a small number of cells around the edges of gaps using a Focal Median function. This script is used in conjunction with Interp.sml.
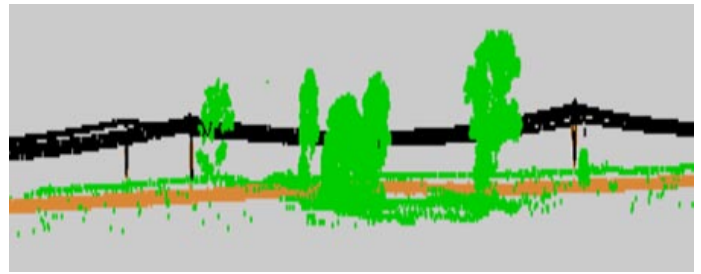
Reinstate.sml: compares the results of the Filter_LiDAR_DEM script with the original Minimum Z surface to identify areas where ground cells have been filtered out along with above ground features. Cells in these areas are reassigned the value from Minimum Z to restore the ground elevation value.

Classify_LAS.sml: uses the final "bare-earth" DEM to classify the LIDAR points in an LAS file into "ground" and "above-ground" categories.

LIDAR Processing Workflow

A PDF file entitled *TNTmips LiDAR to DEM workflow* outlines a typical workflow using the LIDAR scripts and other TNTmips processes. These scripts can be used in conjunction with the Spatial Filter process to produce a bare-earth DEM and classified LIDAR points from high-density LIDAR point data. After this automated processing, the Editor in TNTmips can be used to do final manual editing of the DEM using the relief-shaded DEM as a reference to identify anomalies, and to manually reclassify corresponding points in the LAS point file. The resulting ground points can then be used in the TNTmips Surface Modeling process to interpolate a final bare-earth DEM.

The bare-earth DEM and classified LIDAR points then can be used in other standard spatial analysis processes in TNTmips or in custom analysis scripts to extract information from the point cloud data. The vegetation canopy analysis and powerline classification shown here are examples of the types of analyses that can be performed with these products.

Vertical section through portion of a classified airborne LIDAR point cloud using the Point Profile tool. Black points are returns from powerlines, which can be classified readily after a bare-ground DEM is created using the SML LIDAR scripts. Powerline points are first returns greater than 5 meters above the ground where the minimum non-ground return height for the same DEM cell is at least 3 meters above the ground (eliminating returns from trees).

The pine plantation canopy analysis performed by Terranean Mapping used single-tree measures of canopy characteristics, such as the crown density image shown below, to derive geometric objects that subdivide the area into stands with different ranges of average canopy value, as shown to the right.

Crown Density
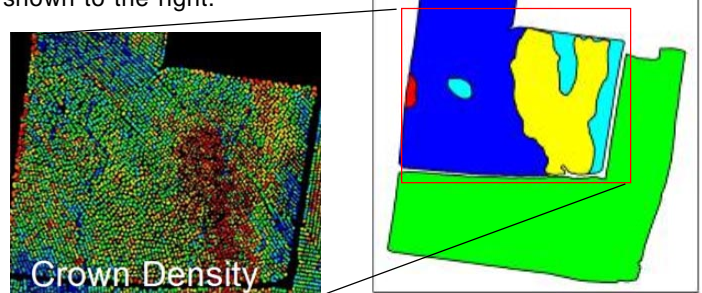
Manage LAS Point Clouds
Merge and/orTile LAS Point Clouds
Use LAS Files as Single Seamless Dataset
Automatically Classify LAS Point Clouds
Classify Ground Points by Terrain Following
Classify Ground Points by Multiscale Curvature
LAS Point Cloud Display Options
Select Points by Class, Return Type, Intensity
Style Points by Class, Elevation, Intensity
View LAS Point Cloud as Surface
Interactive Editing of Point Classes
Point Profile Tool