LAS format and processing
DTMs from tins and local binning

Arrowsmith
LAS files: industry standard format

Storing lidar data

Originally, lidar data was only delivered in ASCII format. With the massive size of lidar data collections, a binary format called LAS was soon adopted to manage and standardize the way in which lidar data was organized and disseminated. Now it is quite common to see lidar data represented in LAS. LAS is a more acceptable file format because LAS files contain more information and, being binary, can be read by the importer more efficiently.

LAS is an industry format created and maintained by the American Society for Photogrammetry and Remote Sensing (ASPRS). LAS is a published standard file format for the interchange of lidar data. It maintains specific information related to lidar data. It is a way for vendors and clients to interchange data and maintain all information specific to that data.

Each LAS file contains metadata of the lidar survey in a header block followed by individual records for each laser pulse recorded. The header portion of each LAS file holds attribute information on the lidar survey itself: data extents, flight date, flight time, number of point records, number of points by return, any applied data offset, and any applied scale factor. The following lidar point attributes are maintained for each laser pulse of a LAS file: x, y, z location information, GPS time stamp, intensity, return number, number of returns, point classification values, scan angle, additional RGB values, scan direction, edge of flight line, user data, point source ID and waveform information.

ArcGIS supports lidar data that is provided in either ASCII or LAS file format.

The attribute information is maintained in ArcGIS for further analysis.

The LAS dataset, mosaic dataset, and terrain dataset all support lidar data in LAS format. Only the LAS dataset and mosaic dataset work directly with LAS files, while the terrain dataset requires that LAS files be imported into the geodatabase using multipoint geometry.

The terrain dataset supports lidar data in both ASCII and LAS formats. For more information on how to use ASCII data to build a terrain dataset, see Importing terrain dataset source measurements.
Example of EarthScope Northern California LiDAR data from Mill Gulch along the San Andreas Fault (NCALM data processed at and downloaded from OpenTopography)
Grids in ArcMap for context
LiDAR Job Metadata

Modify and resubmit this job ↑
LiDAR job report ↑

Download Job Metadata:

metadata-1379543887043302978972.txt

Dataset Information:

Dataset Name: EarthScope Northern California LiDAR Project (NCAL)

Dataset Acknowledgement: This material is based on services provided to the Plate Boundary Observatory by NCALM (http://www.ncalm.org). PBO is operated by UNAVCO for EarthScope (http://www.earthscope.org) and supported by the National Science Foundation (No. EAR-0350028 and EAR-0732947).

Full Dataset Metadata

Horizontal Coordinates: UTM Zone 10 N WGS84 Meters
Vertical Coordinates: Ellipsoid

Data Access Acknowledgement: This material is based on [data, processing] services provided by the OpenTopography Facility with support from the National Science Foundation under NSF Award Numbers 0930731 & 0930643

Job Description:

User  ramon.arrowsmith@asu.edu
Job ID  1379543887043302978972
Title  Mill Gulch Full Feature for VISES
LASTOOLS

LAStools: award-winning software for rapid LiDAR processing

download LAStools HERE

now with GUIs and ArcGIS toolbox

abstract:
We provide an easy-to-use, ultra-light-weight, very efficient C++ programming API called LASLib (with LASzip DLL) that implements reading and writing of LiDAR points from and to the ASPRS LAS format compressed, but otherwise identical twin --- the LAZ format (see below). All source code (GPL) is included.
Install LASTOOLS somewhere like C:
Install LASTOOLS arc toolbar

ArcToolbox

Add Toolbox

Add a toolbox (a tbx file) to this window so you can easily access the tools it contains and create new tools in it.

Add Toolbox

Look in: ArcGIS_toolbox

scripts

LASTools.tbx

Name: LASTools.tbx

Show of type: Toolboxes

Open

ArcToolbox

3D Analyst Tools
Analysis Tools
Cartography Tools
Conversion Tools
Data Interoperability Tools
Data Management Tools
Editing Tools
Geocoding Tools
Geostatistical Analyst Tools

LASTools

blast2dem
las2dem
las2iso
las2las (filter)
las2las (project)
las2las (transform)
las2shp
las2tin
las2txt
lasboundary
lasclassify
lasclip
lascontrol
lasdiff
lasduplicate
lasdiff
lasgrid
lasground
lasheight
lasheight (classify)
lasinfo
lasmerge
lasprecision
lassoc
lasplit
lasthine
lastile
lasview
laszip
shp2las
txt2las

Linear Referencing Tools
las2shp using LASTOOLS toolbar

| input file | C:\Users\Ramon\Desktop\working\VISES\Exercises\MG\MG_FF_points.las |
| shape type | MultiPointZ |
| record size | 1024 |
| output file (optional) | C:\Users\Ramon\Desktop\working\VISES\Exercises\MG\MG_FF_points.shp |
| output directory (optional) | |
| output appendix (optional) | |

Output file (optional):

Specifies the file name of the generated output Shapefile.
Need to define the projection for the shapefile
Need to make a las dataset in Arc
LAS dataset in ArcMap
LAS file in ArcMap
LAS file in ArcScene
Generating DEMs from LIDAR

LIDAR points → triangulating → temporary TIN → resampling → raster DEM → interpolating

Isenburg, et al., 2006
Interpolation Methods

- Inverse Distance Weighting (IDW)
- Natural Neighbors
- Kriging
- Splines
- TIN
  - linear
  - quintic
- …

Isenburg, et al., 2006
DEM Generation via TIN Streaming

- Read points from disk
- Streaming Computation of Delaunay Triangulation
- Immediate Rasterization of Streaming TIN
- Store elevation rasters to temporary files (grouped by rows)
- Output final DEM to disk

Isenburg, et al., 2006
Example Result

- 500,141,313 Points
- 11 GB
  (binary, xyz, doubles)

- 50,394 × 30,500 DEM
- 3 GB
  (binary, BIL, 16 bit, 20 ft)

- on a household laptop with two harddisks
- in 67 minutes
- 64 MB of main memory
- 270 MB temporary disk space

Isenburg, et al., 2006
Strip: “...it's a licensing issue. To get around it (for academic or personal use) you can simply use lasile to make it small enough and then run blast2dem on smaller tiles and then recomposite with GDAL.” —Martin Isenburg
Points2Grid

**General Information:**

**Tool Type:** DEM generation

Points2Grid is a robust and scalable tool for gridding LIDAR point cloud data to generate Digital Elevation Models (DEM). Points2Grid uses a local gridding method to compute grid cell elevation using a neighborhood defined around each cell based on a search radius provided by the user (see image below). Points2Grid offers two processing modes - in-core and out-of-core - to allow it to handle generation of rasters larger than available memory.

**Keywords:** gridding, P2G, point cloud, binning, local gridding, DEM

**Licensing:** BSD license

**Cost:** Free

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**Download URL:** http://sourceforge.net/projects/otforge/files/points2grid/1.0.1/

**Project URL:** http://www.opentopography.org/index.php/resources/otforge/points2grid

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**Technical Information:**

**OS:** Mac, Unix, Linux, Other

**Code Type:** Libraries/Source code

**Language:** C++

**Dependencies:** curl (tested to work with version 7.20.0 of libcurl) and libblas (tested to work with version 1.2.1 of libblas)
An Efficient Implementation of a Local Binning Algorithm for Digital Elevation Model Generation of LiDAR/ALSM Dataset (Kim, et al., 2006)
Need comma delimited file for P2G
ASCII to Raster

Input ASCII raster file:
C:\Users\Ramon\Desktop\working\VISSER\Exercises\MG\MG_FIX_points11_1.txt.clw.asc

Output raster:
C:\Users\Ramon\Desktop\working\VISSER\Exercises\MG\MG_FIX_points11_1.txt.clw2.img

Output data type (optional):
- FLOAT

Output data type (optional)
The data type of the output raster dataset:

- INTEGER—An integer raster dataset will be created.
- FLOAT—A floating-point raster dataset will be created.
1 m local binning dem
1 m radius shot density
1 m radius shot density
Ground returns only (TIN)
Ground returns only (1 m radius IDW)
Points over bare earth surface