2025.7.28 GRSS Summer School

Lidar360

- Download Link: https://www.lidar360.com/LiDAR360
- CD key: AU66UNUXUIZ6RLEX

Lidar Processing

- Main Packages
    1. laspy
    2. GDAL
    3. numpy
    4. scipy
    5. matplotlib
    6. pandas
- Auxiliary installation packages
    1. pip
    2. setuptools

python packages Installation

Propose using Anaconda to manage python packages.

Anaconda https://www.anaconda.com/products/individual

Installation (In Anaconda Prompt):

```
conda install -c conda-forge numpy
conda install -c conda-forge pandas
conda install -c conda-forge scipy
conda install -c conda-forge matplotlib
#laspy
conda install -c conda-forge laspy
#open3d
conda install -c open3d-admin open3d
#or
pip install open3d
#scikit-image
conda install -c conda-forge scikit-image
#gdal
conda install -c conda-forge gdal
conda install scikit-learn
conda install joblib
conda install math
```

Test

No error message indicates a successful installation.

```
#python test
python -c "from laspy.file import File"
python -c "from mpl_toolkits.mplot3d import Axes3D"
python -c "from osgeo import gdal"
python -c "import math"
python -c "import joblib"
python -c "from osgeo import osr"
python -c "from scipy import ndimage"
python -c "from scipy import spatial"
python -c "from scipy.ndimage.filters import gaussian_filter"
python -c "from skimage.feature import peak_local_max"
python -c "from skimage.segmentation import watershed"
python -c "import laspy"
python -c "import matplotlib"
```

```
python -c "import numpy as np"
python -c "import open3d as o3d"
python -c "import pandas as pd"
```

Las File

In May 2003, American Society of Photogrammetry and Remote Sensing (ASPRS) released LiDAR Data Exchange Format Standard(LDEFS) version 1.0 to standardize the format of airborne LiDAR data.

The LAS binary format is an open data format designed to store three-dimensional coordinate data generated by laser scanning and has now been adopted by most companies.

LAS 数据结构 1.0 1.1 1.2	
Public Header Block	
Variable Length Records	
Point Data Records	

LAS 数据结构 1.3 1.4	
Public Header Block	
Variable Length Records	
Point Data Records	
Extended Variable Length Record	

Las Record

Public Header Block

Public Header Block records the essential descriptive information of the LAS file.

Item	Format	Size	Required	Size	location	Struct
File Signature (“LASF”)	char[4]	4 bytes	*	4	0	s
File Source ID	unsigned short	2 bytes	*	2	4	H
Global Encoding	unsigned short	2 bytes	*	2	6	H
Project ID - GUID data 1	unsigned long	4 bytes		4	8	L
Project ID - GUID data 2	unsigned short	2 byte		2	12	H
Project ID - GUID data 3	unsigned short	2 byte		2	14	H
Project ID - GUID data 4	unsigned char[8]	8 bytes		8	16	B
Version Major	unsigned char	1 byte	*	1	24	B
Version Minor	unsigned char	1 byte	*	1	25	B
System Identifier	char[32]	32 bytes	*	32	26	s
Generating Software	char[32]	32 bytes	*	32	58	s
File Creation Day	unsigned	2	*	2	90	H

Item	Format	Size	Required	Size	location	Struct
of Year	short	bytes				
File Creation Year	unsigned short	2 bytes	*	2	92	H
Header Size	unsigned short	2 bytes	*	2	94	H
Offset to point data	unsigned long	4 bytes	*	4	96	L
Number of Variable Length Records	unsigned long	4 bytes	*	4	100	L
Point Data Record Format	unsigned char	1 byte	*	1	104	B
Point Data Record Length	unsigned short	2 bytes	*	2	105	H
Legacy Number of point records	unsigned long	4 bytes	*	4	107	L
Legacy Number of points by return	unsigned long [5]	20 bytes	*	20	111	L
X scale factor	double	8 bytes	*	8	131	d
Y scale factor	double	8 bytes	*	8	139	d
Z scale factor	double	8 bytes	*	8	147	d
X offset	double	8 bytes	*	8	155	d
Y offset	double	8 bytes	*	8	163	d
Z offset	double	8 bytes	*	8	171	d
Max X	double	8 bytes	*	8	179	d

Item	Format	Size	Required	Size	location	Struct
Min X	double	8 bytes	*	8	187	d
Max Y	double	8 bytes	*	8	195	d
Min Y	double	8 bytes	*	8	203	d
Max Z	double	8 bytes	*	8	211	d
Min Z	double	8 bytes	*	8	219	d
Start of Waveform Data Packet Record	Unsigned long long	8 bytes	*	8	227	Q
Start of first Extended Variable Length Record	unsigned long long	8 bytes	*	8	235	Q
Number of Extended Variable Length Records	unsigned long	4 bytes	*	4	243	L
Number of point records	unsigned long long	8 bytes	*	8	247	Q
Number of points by return	unsigned long long [15]	120 bytes	*	120	255	Q

Processing

The Python code has been provided in the corresponding folder and covers the fundamental LiDAR data-processing workflow: **LAS file Reading**, **Denoising**, **Filtering**, **DEM&DSM&CHM Generation**, **Individual Tree**

Segmentation, **Forest Structure Extraction**, and **Reading of H5-format spaceborne waveform files**.