LIDAR_Data_Prep

March 1, 2017

The data provided by the Norwegian life science university comprise 20 lidar flightlines in *.las* format, as well as a list of inventory plot center coordinates and a table of inventory plot statistics. For each measured lidar return, the *.las* files store x,y coordinates (in meters, UTM zone 32N wgs84 projection), height (above geoid, in meters), return number, and scan angle (the angle of the apparatus relative to plane nadir). This script processed the lidar data by converting all height measurements to height-above-ground (canopy height), stratifying the returns into first, last, and ground returns, dividing those into two categories by scan angle, dismissing negative heights as errors, merging the 20 subsets, and clipping the merged files to the plot discs.

In [2]:
```
import os
from subprocess import Popen
```

The following code block writes a batch file to execute LAStools' *lasheight* to normalize each flightline to height above ground. This is an unlicensed tool which will add some noise to the result. All subsequent files are normalized to heights.

In [7]:
```
filename = r"C:\LAStools\LAStools\bin\Normalize.bat"
dataname = r"D:\Users\jkelly\input_specifier.txt"
#os.mkdir(r"D:\Users\jkelly\Heights")

try:
    os.remove(filename)
except OSError:
    pass
with open(dataname, 'r') as datafile:
    with open(filename, 'w') as ofile:
        lasname = datafile.readline()[:-1]
        k=1
        while lasname != "end":
            heightsavename = r"D:\Users\jkelly\Heights\height_" + str(k) +

            line1 = "lasheight -i " + lasname + " -replace_z -utm 32N -o "
            #print(line1)

            lasname = datafile.readline()[:-1]
            k+=1
            ofile.write(line1)
```

```
In [8]: p = Popen(filename, cwd=r"C:\LAStools\LAStools\bin")
```

This block writes a batch file to execute LAStools' *lasground* to extract the ground returns for each flightline. This is an unlicensed tool which will add some noise to the result.

```
In [5]: filename = r"C:\LAStools\LAStools\bin\Grounds.bat"
        dataname = r"D:\Users\jkelly\height_names.txt"


        try:
            os.remove(filename)
        except OSError:
            pass
        with open(dataname, 'r') as datafile:
            with open(filename, 'w') as ofile:
                lasname = datafile.readline()[:-1]
                k=1
                while lasname != "end":
                    groundsavename = r"D:\Users\jkelly\Grounds\ground_" + str(k) +
                    # This one just separates ground (2) and non-ground.
                    line1 = "lasground -i " + lasname + " -utm 32N -o temp.las\n"
                    # This one filters and retains the ground returns.
                    line2 = "las2las -i temp.las -keep_return 2 -utm 32N -o " + gro
                    lasname = datafile.readline()[:-1]
                    k+=1
                    ofile.write(line1)
                    ofile.write(line2)
```

```
In [6]: p = Popen(filename, cwd=r"C:\LAStools\LAStools\bin")
```

This block writes a batch script for LAStools to filter the first and last returns of each flightline having scan angle between -10 and 10 into new *.las* files.

```
In [9]: filename = r"C:\LAStools\LAStools\bin\Angles.bat"
        dataname = r"D:\Users\jkelly\height_names.txt"
        #os.mkdir(r"D:\Users\jkelly\first_LTE10")
        #os.mkdir(r"D:\Users\jkelly\last_LTE10")
        try:
            os.remove(filename)
        except OSError:
            pass
        with open(dataname, 'r') as datafile:
            with open(filename, 'w') as ofile:
                lasname = datafile.readline()[:-1]
                k=1
                while lasname != "end":
                    firstsavename = r"D:\Users\jkelly\first_LTE10\first_LTE10_" + s
                    lastsavename = r"D:\Users\jkelly\last_LTE10\last_LTE10_" + str
```

```
                    line1 = "las2las -i " + lasname + " -first_only -keep_scan_angl
                    line2 = "las2las -i " + lasname + " -last_only -drop_first -kee
                    #print(line1)
                    #print (line2)
                    lasname = datafile.readline()[:-1]
                    k+=1
                    ofile.write(line1)
                    ofile.write(line2)
```

```
In [10]: p = Popen(filename, cwd=r"C:\LAStools\LAStools\bin")
```

The next two blocks do the same for scan angles greater than 10 or less than -10.

```
In [11]: filename = r"C:\LAStools\LAStools\bin\Angles.bat"
         dataname = r"D:\Users\jkelly\height_names.txt"
         #os.mkdir(r"D:\Users\jkelly\first_GT10")
         #os.mkdir(r"D:\Users\jkelly\last_GT10")
         try:
             os.remove(filename)
         except OSError:
             pass
         with open(dataname, 'r') as datafile:
             with open(filename, 'w') as ofile:
                 lasname = datafile.readline()[:-1]
                 k=1
                 while lasname != "end":
                     firstsavename = r"D:\Users\jkelly\first_GT10\first_GT10_" + st
                     lastsavename = r"D:\Users\jkelly\last_GT10\last_GT10_" + str(k
                     line1 = "las2las -i " + lasname + " -first_only -drop_scan_ang
                     line2 = "las2las -i " + lasname + " -last_only -drop_first -dr
                     #print(line1)
                     #print (line2)
                     lasname = datafile.readline()[:-1]
                     k+=1
                     ofile.write(line1)
                     ofile.write(line2)
```

```
In [12]: p = Popen(filename, cwd=r"C:\LAStools\LAStools\bin")
```

The next block writes and executes a batch file for LAStools to filter all first and last returns.

```
In [14]: filename = r"C:\LAStools\LAStools\bin\no_Angles.bat"
         dataname = r"D:\Users\jkelly\height_names.txt"
         #os.mkdir(r"D:\Users\jkelly\first_all")
         #os.mkdir(r"D:\Users\jkelly\last_all")
         try:
```

```
        os.remove(filename)
    except OSError:
        pass
    with open(dataname, 'r') as datafile:
        with open(filename, 'w') as ofile:
            lasname = datafile.readline()[:-1]
            k=1
            while lasname != "end":
                firstsavename = r"D:\Users\jkelly\first_all\first_all_" + str
                lastsavename = r"D:\Users\jkelly\last_all\last_all_" + str(k)
                line1 = "las2las -i " + lasname + " -first_only -drop_z_below
                line2 = "las2las -i " + lasname + " -last_only -drop_first -dr
                #print(line1)
                #print (line2)
                lasname = datafile.readline()[:-1]
                k+=1
                ofile.write(line1)
                ofile.write(line2)
```

```
In [15]: p = Popen(filename, cwd=r"C:\LAStools\LAStools\bin")
```

All single returns were assigned to **First** and dropped from **Last**. All negative heights were dropped as errors.

This next section converts all the individual *.las* files to textfiles grouped in folders.

```
In [4]: for file in os.walk(r"D:\Users\jkelly\first_all"): print(file[2])
```

```
['first_all_1.las', 'first_all_10.las', 'first_all_11.las', 'first_all_12.las', 'fi
```

```
In [37]: filename = r"C:\LAStools\LAStools\bin\textwriter.bat"
         #pathname = r"D:\Users\jkelly\first_all"
         #pathname = r"D:\Users\jkelly\last_all"
         #pathname = r"D:\Users\jkelly\first_LTE10"
         #pathname = r"D:\Users\jkelly\last_LTE10"
         #pathname = r"D:\Users\jkelly\first_GT10"
         #pathname = r"D:\Users\jkelly\last_GT10"
         #pathname = r"D:\Users\jkelly\Grounds"

         #os.mkdir(r"D:\Users\jkelly\CSVs\first_all_csvs")
         #os.mkdir(r"D:\Users\jkelly\CSVs\last_all_csvs")
         #os.mkdir(r"D:\Users\jkelly\CSVs\first_LTE10_csvs")
         #os.mkdir(r"D:\Users\jkelly\CSVs\last_LTE10_csvs")
         #os.mkdir(r"D:\Users\jkelly\CSVs\first_GT10_csvs")
         #os.mkdir(r"D:\Users\jkelly\CSVs\last_GT10_csvs")
         #os.mkdir(r"D:\Users\jkelly\CSVs\ground_all_csvs")
```

```
        try:
            os.remove(filename)
        except OSError:
            pass

        with open(filename, 'w') as ofile:
            k=1
            for file in os.walk(pathname):
                filelist = file[2]
                for name in filelist:
                    lasname = pathname + "\\" + name
                    #savename = r"D:\Users\jkelly\CSVs\first_all_csvs\first_all_"
                    #savename = r"D:\Users\jkelly\CSVs\last_all_csvs\last_all_" +
                    #savename = r"D:\Users\jkelly\CSVs\first_LTE10_csvs\first_LTE1
                    #savename = r"D:\Users\jkelly\CSVs\last_LTE10_csvs\last_LTE10_
                    #savename = r"D:\Users\jkelly\CSVs\first_GT10_csvs\first_GT10_
                    savename = r"D:\Users\jkelly\CSVs\last_GT10_csvs\last_GT10_" +
                    #savename = r"D:\Users\jkelly\CSVs\ground_all_csvs\ground_all_

                    line1 = "las2txt -i " + lasname + " -parse xyza  -o " + savena
                    k+=1
                    ofile.write(line1)
```

```
In [38]: p = Popen(filename, cwd=r"C:\LAStools\LAStools\bin")
```

This next section merges each set of 20 *.las* files into one, and then copies those to textfiles in the same directory.

```
In [48]: filename = r"C:\LAStools\LAStools\bin\merger.bat"
```

```
        try:
            os.remove(filename)
        except OSError:
            pass
        with open(filename, 'w') as ofile:
            for pathname in [r"D:\Users\jkelly\first_all", r"D:\Users\jkelly\last_

                lasname = pathname + "\\*.las"
                savename = pathname + pathname[15:] + "_combined.las"
                line1 = "lasmerge -i " + lasname + " -o " + savename + "\n"
                line2 =  "las2txt -i " + savename + " -parse xyza  -o " + savename
                ofile.write(line1)
                ofile.write(line2)
```

```
In [44]: p = Popen(filename, cwd=r"C:\LAStools\LAStools\bin")
```

This block clips each combined *.las* files to the $400m^2$ inventory plot discs using LAStools' *lasclip*, an unlicensed tool which adds a small amount of noise to the result.

```
In [10]: filename = r"C:\LAStools\LAStools\bin\clipper.bat"
         polyname = r"D:\Users\jkelly\Plots\plot_discs.shp"
         #os.mkdir(r"D:\Users\jkelly\Clips")
         try:
             os.remove(filename)
         except OSError:
             pass

         with open(filename, 'w') as ofile:
             for pathname in [r"D:\Users\jkelly\first_all", r"D:\Users\jkelly\last_
                 lasname = pathname + pathname[15:] + "_combined.las"
                 savename = r"D:\Users\jkelly\Clips" + "\\" + pathname[16:] + "_cli

                 line1 = "lasclip -i " + lasname + " -poly " + polyname + " -o " +
                 ofile.write(line1)



In [11]: p = Popen(filename, cwd=r"C:\LAStools\LAStools\bin")
```

This section converts the clipped *.las* files to shapefiles and textfiles.

```
In [5]: filename = r"C:\LAStools\LAStools\bin\clipconverter.bat"


        try:
            os.remove(filename)
        except OSError:
            pass

        with open(filename, 'w') as ofile:
            for file in os.walk(pathname):
                filelist = file[2]
                for name in filelist:
                    line1 =  "las2txt -i " + pathname + "\\" + name + " -parse xyza
                    #line1 =  "las2shp -i " + pathname + "\\" + name + " -parse xyz
                    ofile.write(line1)
                    #ofile.write(line2)

In [16]: p = Popen(filename, cwd=r"C:\LAStools\LAStools\bin")

In [ ]:
```