FUSION APPENDIX 1: COMPUTING METRICS FOR INDIVIDUAL FOREST STANDS

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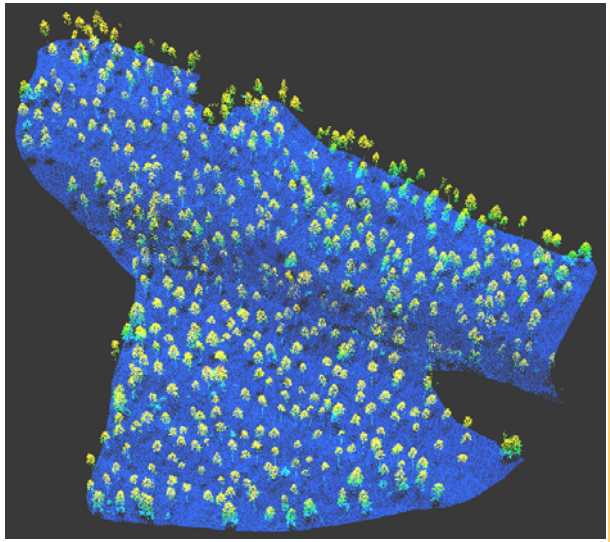

*A thinned Douglas Fir stand displayed in the LDV. The raw LIDAR data was clipped from the original data set using the **PolyClipData** command.*

Introduction

This appendix is designed to familiarize you with techniques that allow you to characterize individual forest stands using FUSION with LIDAR data. The appendix differs from the previous exercises in that it does not provide step by step instructions, but instead a general work flow. There are two parts to the appendix. Part 1 describes the process of clipping a section of raw LIDAR data using the **PolyClipData** command; Part 2 demonstrates the process of extracting forest metrics using the **Gridmetrics** command line executable in FUSION.

Prerequisites

- Successful completion of Exercises 1-12, or proficiency with the Command line executables within FUSION.
- Sample Data downloaded from the FUSION website.

Overview of Major Steps

Part 1—Clipping out raw LIDAR data using the **PolyClipData** command.
Part 2—Extracting forest metrics using the **Gridmetrics** command.

Part 1—Clipping out raw LIDAR data using the PolyClipData command.

In forestry related projects we are usually interested in characterizing certain stands or areas within our project boundary. Polygons created in ArcGIS are a common form of organizing geospatial information into specific areas of interest. The **PolyClipData** command line executable in FUSION allows the user to clip out raw LIDAR data that resides in a polygon (for a more detailed overview on the PolyClipData command please refer to the FUSION manual).

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Below is an example of the **PolyClipData** command to extract a specific portion of the raw LIDAR data for analysis.

polyclipcontrol.bat - Notepad

File Edit Format View Help

```
..\polyclipdata /shape:3,3 C:\lidar\SampleData\UNIT2.SHP C:\lidar\sampledata\control.las C:\lidar\SampleData\lda_4800K_data.lda
```

Fusions Command Line Executable

Switch

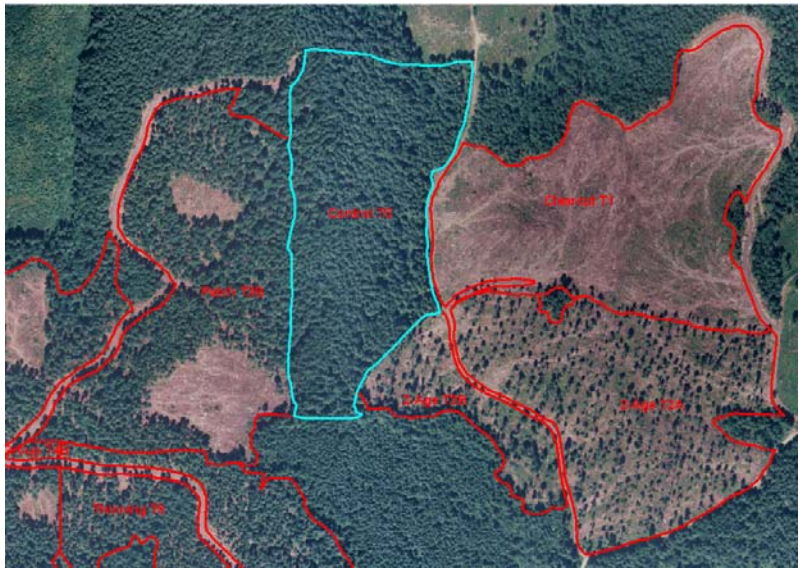
Shapefile containing the polygon used for clipping the LIDAR data

<output file>

<input file>

*The **/shape** switch identifies the specific polygon/polygons used to clip the data. In our case you designate column 3 (UNIT2_column, see note below). Then you identify the unique value in that column for the specific polygon, in our case "3". If you wanted to create a separate LIDAR data file for all polygons by running one line of script you would use the switch as folows:*
*/shape:3, * Each new .las file would be labeled by its value in the UNIT2_ column.*

Note: the /shape switch must be used for the polyclipdata command to work, this is conflicting with the manual!!!!



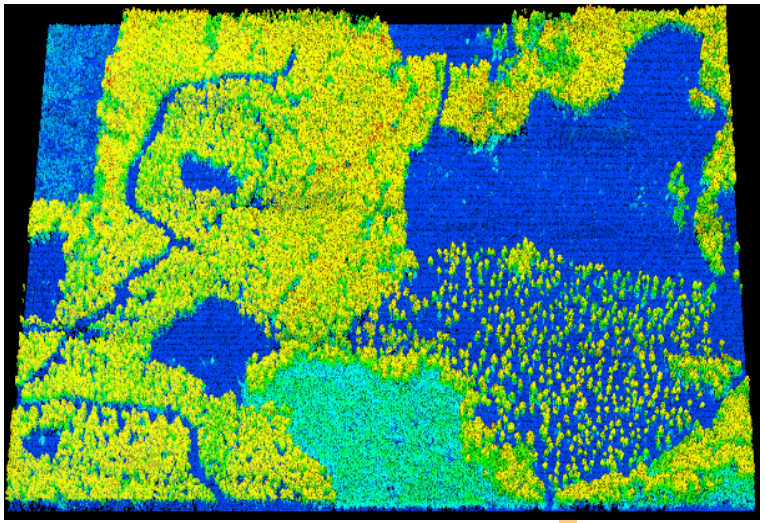
Attributes of UNIT2

	FID	Shape *	AREA	PERIMETER	UNIT2_	UNIT2_ID	ACRES	UNIT_NAME
▶	0	Polygon	1762659.396	7975.825	2	0	40.465	Clearcut T1
	1	Polygon	1376683.988	5501.375	3	0	31.604	Control T6
	2	Polygon	1662869.882	6544.948	4	0	38.174	Patch T3B
	3	Polygon	1464631.098	5876.375	5	0	33.623	Patch T3A
	4	Polygon	1475155.25	6109.849	7	0	33.865	2-Age T2A
	5	Polygon	401562.977	3601.89	8	0	9.219	2-Age T2B
	6	Polygon	1616424.729	7710.323	9	0	37.108	Group T4A
	7	Polygon	23779.383	734.791	10	0	0.546	Group T4B
	8	Polygon	1432803.465	9050.596	11	0	32.893	Thinning T5

Column #'s 0 1 2 3 4 5 6

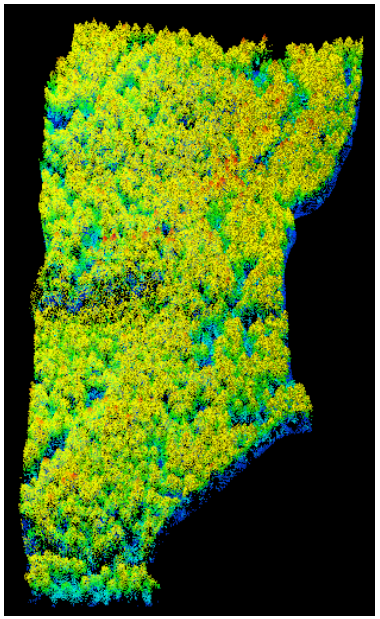
Note: the FID column isn't numbered and the shape column starts at zero.

Results from the PolyClipData script on the previous page.



Input File C:\lidar\SampleData\lda_4800K_data.lda

Run PolyClipData.exe



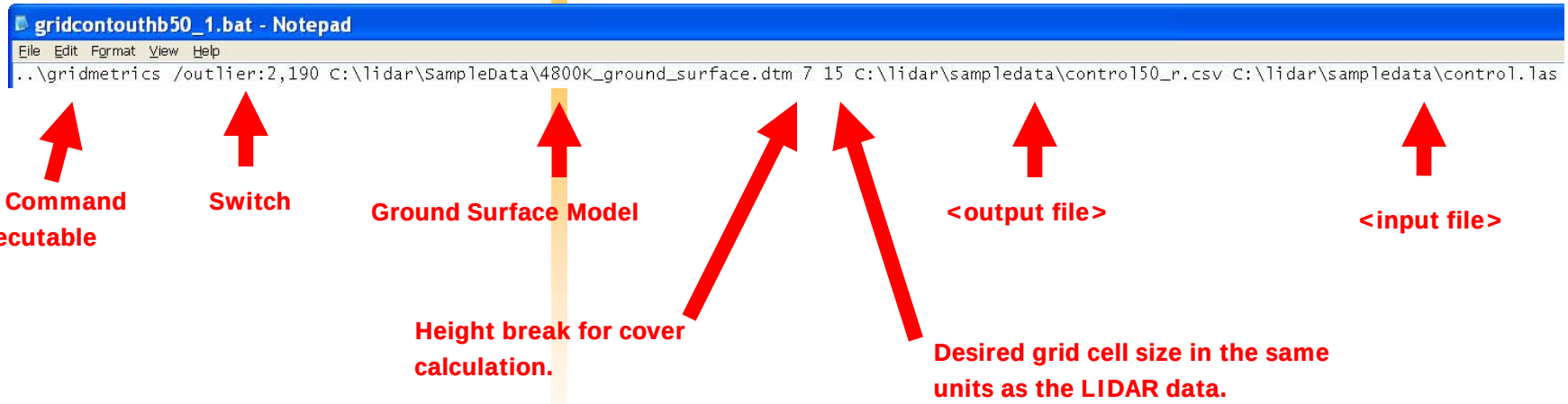
Resulting output file
C:\lidar\SampleData\control.las

Appendix 1 continues on the next page...

Part 2—Extracting forest metrics using the GridMetrics command.

GridMetrics computes a series of descriptive statistics for a LIDAR data set. Output is a raster (grid) represented in database form with each record corresponding to a single grid cell in the output grid. GridMetrics can compute statistics using either elevation or intensity values but not both in the same run. In our example below we will run the GridMetrics command line executable using elevation values from the control.las file (the LIDAR data we clipped from our original data set using the PolyClipData command in Part 1). For a comprehensive description of GridMetrics please refer to the FUSION Manual.

Below is an example of the **GridMetrics** command to compute the descriptive statistics for control.las.



The outlier switch used in the script (/outlier:low,high) will omit points below low and above high in the output statistics. Low and high are interpreted as **heights above ground**.

A small part of the resulting .csv file produced from the GridMetrics script on the previous page.

control7_all_returns_all_metrics_elevation_stats.csv

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T
1	row	col	pt count	density count total	density count above 7.00 units	minimum	maximum	mean	std dev	CV	P05	P10	P25	P50	P75	P90	P95	Density	center X	centerY
2	130	31	4	4	4	99.4622	131.2255	107.9469	15.5302	0.1439	99.5724	99.6825	100.013	100.5499	108.4838	122.1288	126.6772	1	975540	569010
3	128	61	4	4	3	0.5776	130.7838	92.0679	61.6623	0.6697	16.9831	33.3886	82.6051	118.4551	127.9179	129.6375	130.2107	0.75	975990	568980
4	128	65	4	4	1	-0.7318	75.1367	18.7252	37.6127	2.0087	-0.66	-0.5881	-0.3726	0.2479	19.3457	52.8203	63.9785	0.25	976050	568980
5	127	41	4	4	4	77.5067	81.686	79.271	1.7785	0.0224	77.6613	77.816	78.28	78.9457	79.9367	80.9863	81.3361	1	975690	568965
6	127	58	4	4	2	0.9069	111.7396	52.1225	59.5313	1.1421	0.908	0.9091	0.9125	47.9218	99.1317	106.6964	109.218	0.5	975945	568965
7	126	67	4	4	2	-0.5239	122.6547	57.5474	67.2314	1.1683	-0.5046	-0.4854	-0.4277	54.0295	112.0046	118.3947	120.5247	0.5	976080	568950
8	62	1	4	4	4	108.6946	125.1862	117.0774	7.3318	0.0626	109.4401	110.1856	112.422	117.2144	121.8699	123.8597	124.5229	1	975090	567990
9	62	44	4	4	4	18.1373	111.7307	73.9011	39.6269	0.5362	27.5219	36.9065	65.0604	82.8681	91.7088	103.7219	107.7263	1	975735	567990
10	61	1	4	4	4	69.4098	104.775	91.6524	16.3463	0.1784	72.4069	75.404	84.3952	96.2123	103.4695	104.2528	104.5139	1	975090	567975
11	61	51	4	4	0	-0.3263	1.2654	0.6198	0.6967	1.1241	-0.1952	-0.0642	0.329	0.77	1.0608	1.1835	1.2244	0	975840	567975

A brief explanation of the output metrics:

Available metrics are:

count	point counts per cell
densitytotal	total counts per cell used for calculating cover
densityabove	counts per cell for points above heightbreak
densitycell	Density of returns used for calculating cover
min	minimum value for cell
max	maximum value for cell
mean	mean value for cell
stddev	standard deviation of cell values
cv	coefficient of variation for cell
cover	cover estimate for cell
p05	5th percentile value for cell (must be p05, not p5)
p10	10th percentile value for cell
p25	25th percentile value for cell
p50	50th percentile value (median) for cell
p75	75th percentile value for cell
p90	90th percentile value for cell
p95	95th percentile value for cell
iq	75th percentile minus 25th percentile for cell
90m10	90th percentile minus 10th percentile for cell
95m05	95th percentile minus 5th percentile for cell

Appendix 1 continues on the next page...

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A comparison of summary statistics computed using GridMetrics on two LIDAR data sets clipped using the PolyClipData command.

The **Control** summary statistics characterize an area of dense undisturbed Douglas Fir. The **Treatment** summary statistics characterize a Douglas Fir stand after thinning. The photographs below depict the typical density and vertical structure of each stand. Do you think the statistics reflect this? Can you see correlations? The last statistic "Density" represents % vegetation cover above 7 feet. The percentile values (e.g., P05, P10....) indicate the spread of the data histogram. Compare the maximum average values versus the maximum max values for each stand. (All the photos, polygons and raw LIDAR data used in this example can be found in the FUSION Sample Data).

Control Stand

Treatment Stand

Outlier:2, 190, Cover HB 7						
only first returns used for cover	Average		Min		Max	
Statistic	Treatment	Control	Treatment	Control	Treatment	Control
density count total	67.39916963	101.3427029	4	4	262	421
density count above 7.0 units	13.03188019	88.20136573	0	0	194	409
minimum	-0.812853099	5.099292091	-7.4125	-9.1691	88.2922	132.028
maximum	52.24199766	132.9794067	-0.486	0.2295	171.8563	184.8527
mean	14.68121779	88.8889472	-1.6493	-0.5297	119.7797	149.9611
std dev	17.91920083	33.63473662	0.1133	0.1392	67.1459	78.0705
CV	0.89429226	0.485600794	-1484.99	-53.5027	1211.303	14.0447
P05	-0.518614413	26.37832963	-3.4441	-4.4427	88.5978	137.9435
P10	-0.301838138	43.17445839	-2.8135	-3.6947	88.9035	142.7419
P25	1.265556302	73.95453978	-2.3131	-2.7233	124.8263	153.8653
P50	10.69477488	96.32133741	-1.6516	-1.3639	142.2819	160.2511
P75	24.62610098	111.1348962	-1.2772	-0.2959	150.3318	168.7225
P90	36.34331306	120.942726	-0.8413	-0.0026	160.2438	175.2938
P95	42.06736907	125.3747251	-0.643	0.1674	162.4072	180.6385
Density	0.14351855	0.854319454	0	0	1	1

Summary of the GridMetrics output for the LIDAR data within the **Control** T6 and 2-Age t2A (**Treatment**) polygons.

- **Density count total** and **std dev** suggests more vertical structure detected in the control stand (LIDAR pulses that only hit the ground have one return, those that hit different layers of vertical structure can have multiple returns).
- **Density** (% vegetation cover) indicates that the canopy cover is much denser for the **Control** (85%) then the **Treatment** (14%).

This concludes Appendix 1.