

www.terrasolid.com

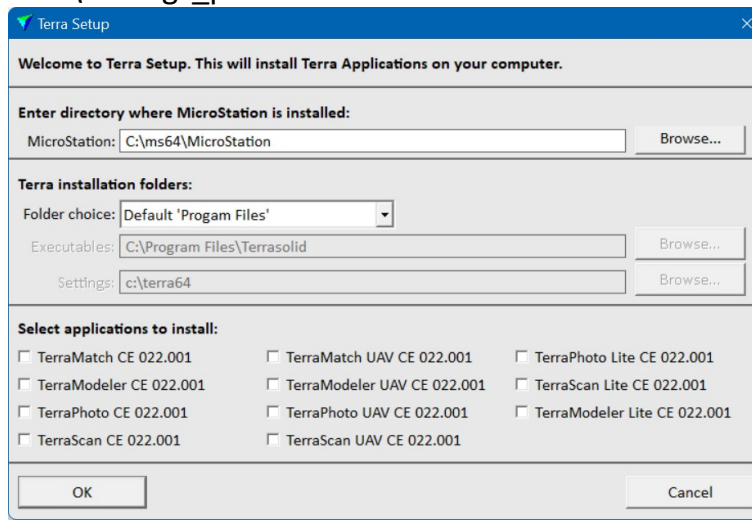
TerraScan New Features

Arttu Soininen 15.03.2022



Setup: Executable Files into C:\Program Files

- Setup **Folder choice** has options:
 - Default c:\terra64 – install all files to c:\terra64
 - Default 'Program Files' – executables into c:\Program Files\Terrasolid, rest into c:\terra64
 - Freely selectable folders – you choose folder for executables and folder for settings files
- When executables are in separate folder, applications find settings files using:
 1. Environment variables if defined
 2. Using c:\Program Files\Terrasolid\settings_path.txt if no environment variables



View / Column Titles

- **Main Window** can display column titles for the list of points
- **View / Column titles** menu item toggles display on or off

tampere000001.fbi - 14 774 653 points

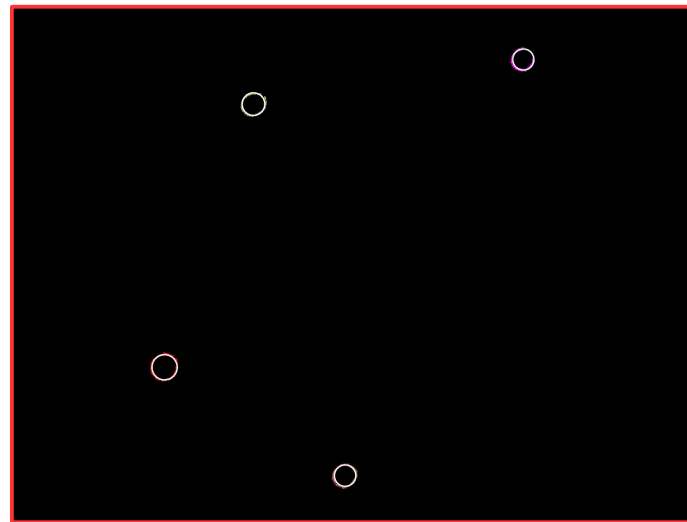
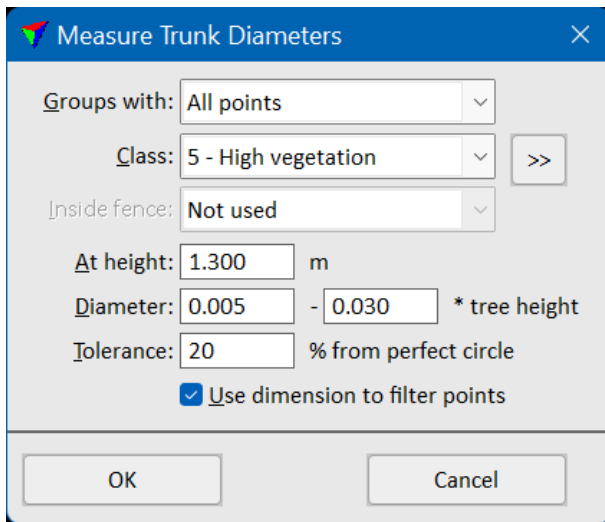
File Output Point View Classify Group Tools Line Wizard

Class	Easting	Northing	Elevation	Intensity	Distance
5	325786.570	6819173.810	+114.830	62	17.901
5	325786.270	6819173.800	+114.450	55	17.526
5	325786.110	6819173.780	+114.810	32	17.890
5	325783.760	6819173.860	+102.060	9	5.097
8	325782.800	6819173.890	+96.900	12	0.000
5	325785.110	6819173.800	+110.610	12	13.639
5	325784.810	6819173.810	+108.990	18	12.005
5	325783.430	6819173.850	+101.520	23	4.577
5	325783.190	6819173.860	+100.260	15	3.334
5	325784.930	6819173.780	+110.860	35	13.881
5	325784.640	6819173.790	+109.290	14	12.306
5	325784.670	6819173.770	+110.680	15	13.696

Show location Modified: D Identify

Measure Trunk Diameters

- **Measure Trunk Diameters** tool finds trunk diameters at given height from ground
- Requires grouping is done and distance values have been computed (height from ground)
- Draws result as circles into the CAD file
- You can check the fitted circles and modify if necessary
- Write group info can use circles on a given level to write trunk diameters



Write Group Info

- Writes a list of groups as a text file
- Good for creating a list of objects such as a list of trees
- **File formats / User group formats** category in **Scan Settings** lets you define your own file format
- Columns can be selected from:
 - Group id
 - Point count
 - Average easting
 - Average northing
 - Average z
 - Ground z at average xy
 - Trunk easting
 - Trunk northing
 - Trunk ground z
 - Trunk diameter
 - Canopy width
 - Biggest distance
 - Smallest distance
 - Length
 - Width
 - Height

Check Footprint Polygons Improvements



- Can check for overlapping polygons – will not apply a shift/rotation which would result in overlapping footprint polygons
- **Save List As** menu command for saving list into a text file

Area	Cover	Angle	Rating	Shift
206	100%	0.06	90%	0.20
206	97%	2.32	73%	0.85
206	100%	2.07	79%	0.20
206	100%	3.39	59%	0.00
205	100%	3.27	76%	0.89
205	100%	0.05	72%	0.00
205	100%	0.50	53%	0.20
205	100%	0.24	57%	0.00
205	100%	0.21	3%	0.20
205	100%	0.09	66%	0.45
204	100%	2.01	52%	0.20
204	100%	0.55	64%	0.00
204	100%	1.20	7%	0.28
204	100%	0.06	78%	0.00
204	99%	1.27	27%	0.45
204	100%	0.24	91%	0.40
204	100%	1.44	41%	0.20
204	100%	1.25	76%	0.20
204	97%	2.19	55%	0.60
204	98%	1.36	63%	0.28

Various Improvements



- **Place Tower String** and **Place Railroad String** tools have **Undo last** button will undo last vertex added
- **Classify Using Brush** displays points being classified dynamically
- Multiple source classes in **Classify / Low points**
- **Draw line boundaries** in **Define Project** renamed **Draw cloud boundaries** – can now draw boundary for whole project point cloud
- **Sort points** keeps active block and neighbouring block points separate – OK to run and save active block points

Read Collection / Import Collection



- **Read collection** menu command has replaced **Read directory**
- **Import collection** menu command has replaced **Import directory**
- These allow collection of multiple files from multiple folders

LAZ 1.4 Support



- TerraScan can read, write and use LAZ 1.4 as project storage format

Additional Attributes in LAS & LAZ



- In addition to standard LAS point records, TerraScan can read and write following extra attributes:
 - Amplitude – 2 bytes
 - Reflectance – 2bytes
 - Pulse width/echo length – 2 bytes
 - Deviation – 2 bytes
 - Reliability/confidence – 1 byte
 - Distance – 4 bytes
 - Group – 4 bytes
 - Normal vector – 4 bytes

LAS/LAZ1.4 Scanner Channel Support



- LAS 1.4 file format has 2 bit field **Scanner Channel** allowing scanner numbers 0-3
- TerraScan primarily reads and writes scanner number into 8 bit **User Data** field (0-255)
- When you read or import LAS 1.4 or LAZ 1.4:
 - Selecting **File – scanner byte** in **Scanner numbers** reads from 8 bit field
 - Selecting **File – scanner channel** reads from 2 bit field
- When writing a file, TerraScan always writes scanner information into **User Data** field and writes last two bits of scanner information into **Scanner Channel** field
- When opening a block, TerraScan always reads scanner information from **User Data** field

Read points - lapinkylantie000003.laz

Cloud type: Airborne lidar
Format: LAZ 1.4
Fit view: 1
Points: 44 666 940

Input projection: 3132 >> 3132 ETRS89 / ETRS-GK25FIN
Active projection: 3132 >> 3132 ETRS89 / ETRS-GK25FIN
Transform: None
Coordinates: E475052 N6676459 --> E475052 N6676459

☐ Only every 10 th point
☒ Only glass 2 - Ground
☐ Inside fence only

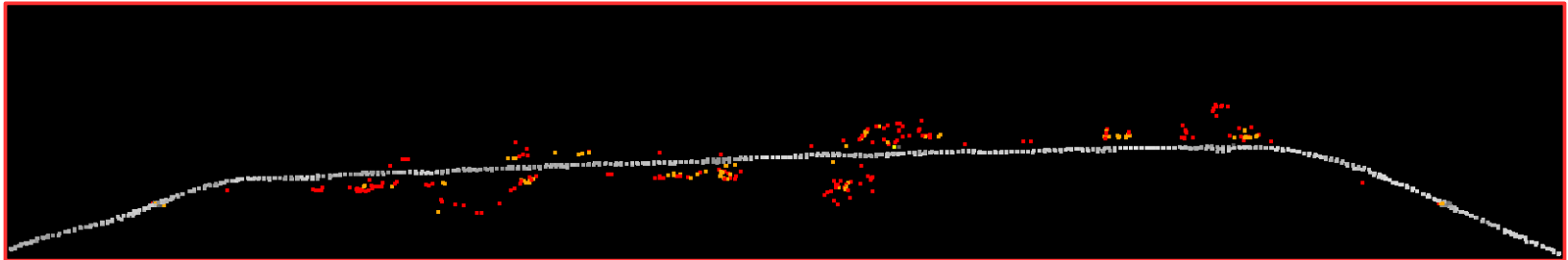
☒ Xyz ☐ Amplitude ☒ Angle ☐ Image number
☒ Line ☐ Group ☐ Normal vector ☐ Reflectance
☒ Echo ☒ Time ☐ Echo length ☐ Deviation
☐ Color ☒ Intensity ☐ Echo normality ☒ Class
☒ Distance ☒ Scanner ☐ Echo position ☐ Reliability

Line numbers: Use from file
Scanner numbers: File -- scanner channel

OK Cancel

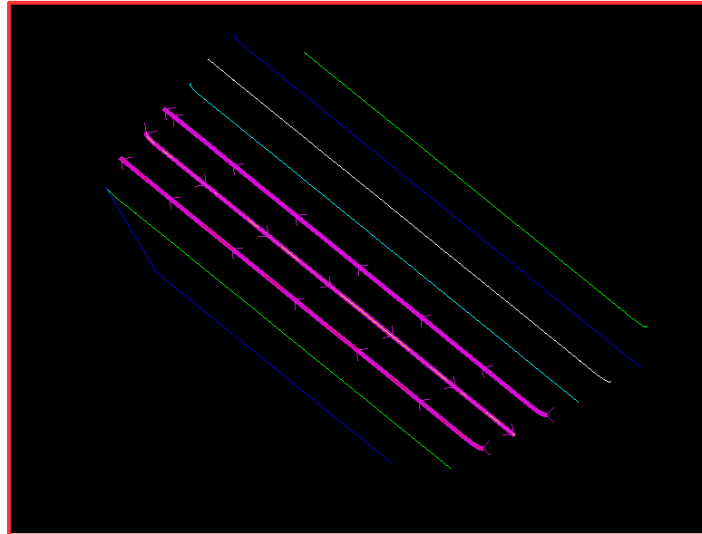
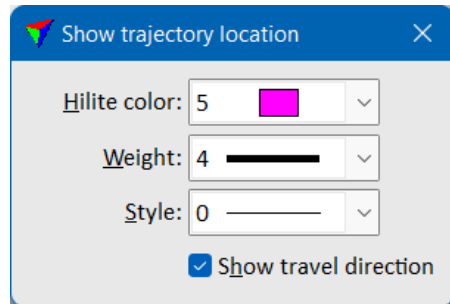
Agisoft Confidence Values

- Software can read **Confidence** values written by Agisoft from LAS or LAZ files
- Confidence tells from how many images the point has been generated from
- TerraScan calls this attribute **Reliability**
- **Classify / By reliability** can classify points based on reliability value
- **Cut low reliability** will classify/remove low reliability points which have better reliability neighbours
- Points can be displayed colored by reliability
- **Classify / Surface points** can use reliability as weight factor
- **Smoothen points** can use reliability as weight factor when smoothing xyz



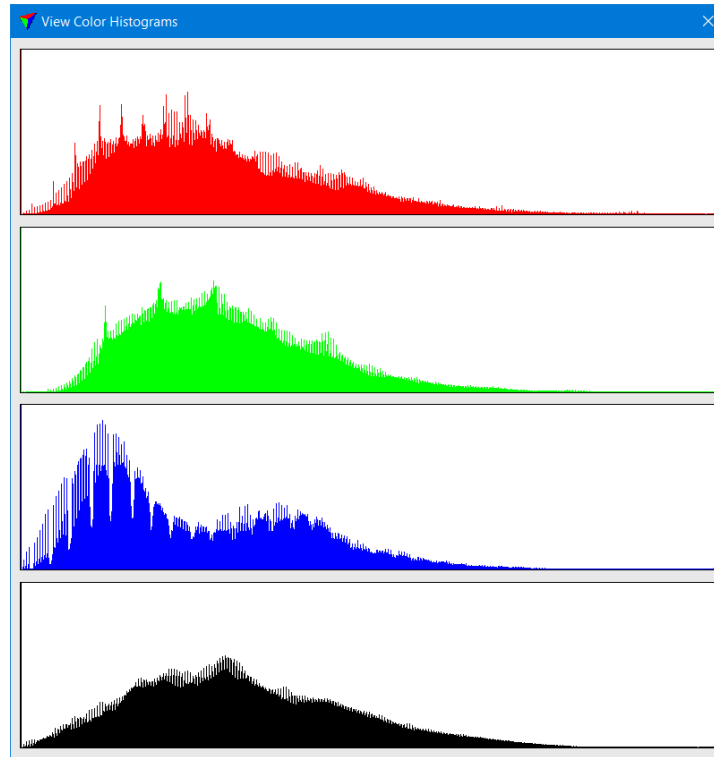
Manage Trajectories Improvements

- Change in trajectory file naming from second to 0.01 second resolution
 - Splitting trajectories to shorter than 1.0 second intervals could produce duplicate file names
- **Show location** lets user select hilite color, weight and style
- **Show location** hilites multiple selected trajectories
- **Support for Ctrl** key in Identify for identifying multiple trajectories



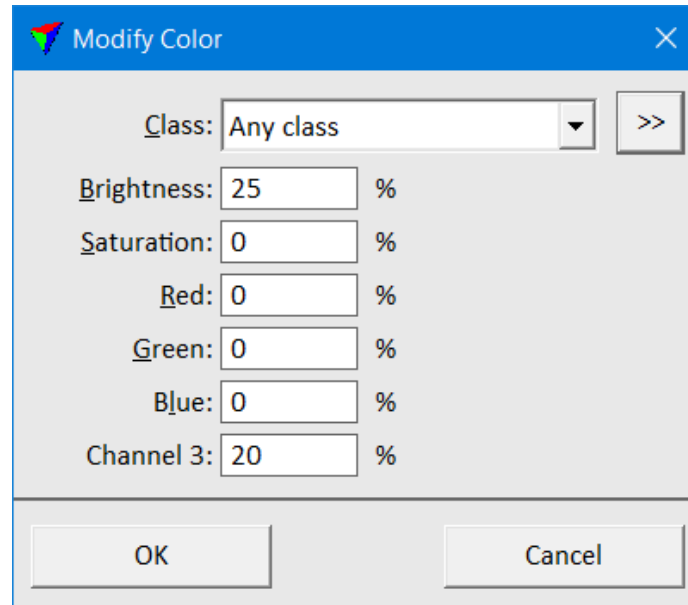
View / Color Histograms

- Menu command for viewing histograms of point color information
- Displays 3-10 channels



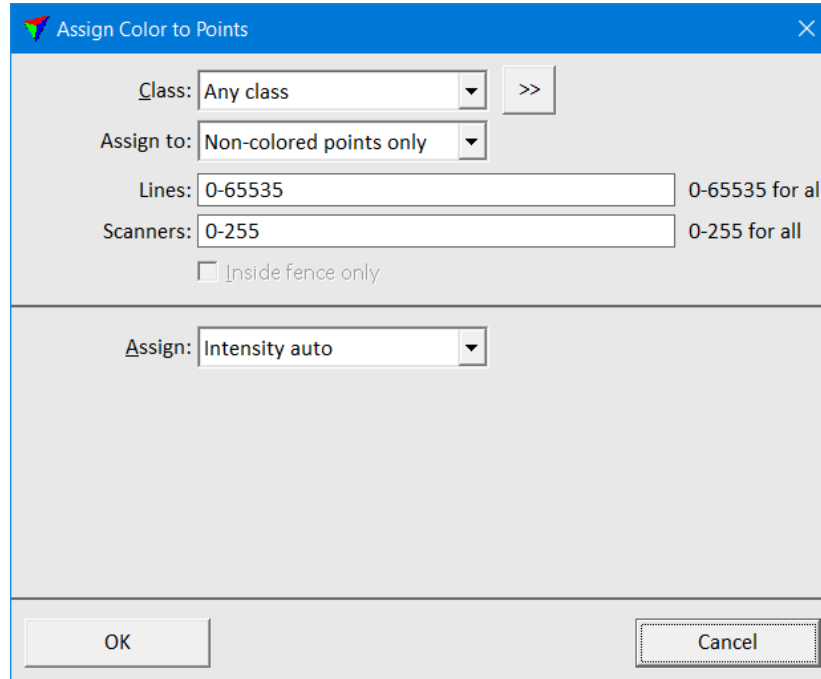
Tools / Modify Color

- Menu command for modifying color values of loaded points
- Preview of result – clicking **Cancel** will restore original color values
- Supports 3-10 channels



Assign Color Improvements

- **Assign to** setting with **Non-colored points only** – this will assign color to completely black points only
- Can assign **Intensity auto** coloring



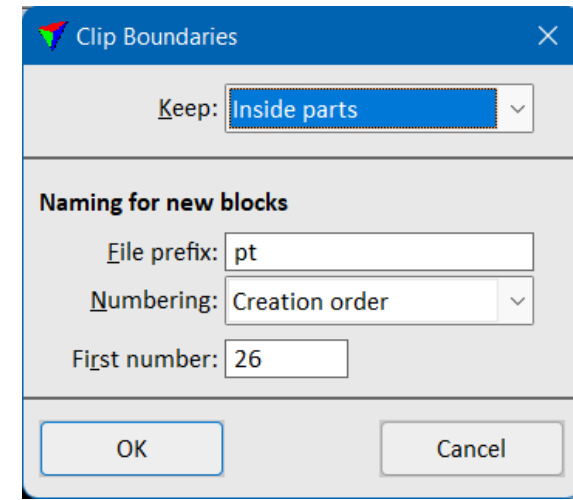
The dialog box titled "Assign Color to Points" has a blue header bar with a close button (X) in the top right corner. The main area is light gray and contains the following controls:

- Class:** A dropdown menu showing "Any class" with a downward arrow, followed by a button with ">>" text.
- Assign to:** A dropdown menu showing "Non-colored points only" with a downward arrow.
- Lines:** A text input field containing "0-65535" with a small "0-65535 for all" label to its right.
- Scanners:** A text input field containing "0-255" with a small "0-255 for all" label to its right.
- ☐ **Inside fence only**
- Assign:** A dropdown menu showing "Intensity auto" with a downward arrow.

At the bottom, there are two buttons: "OK" on the left and "Cancel" on the right, both with dashed borders.

Clip boundaries in Define Project

- Menu command for clipping project boundaries using polygons
- You can create grid block boundaries first and then clip those using selected polygons
- **Merge small blocks** can merge small blocks with larger neighbours based on area
- This can be run before importing points into a project



Clip Boundaries

Keep:

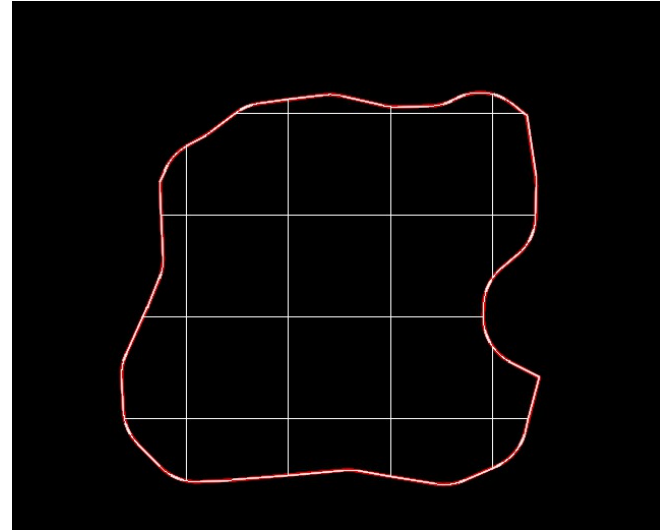
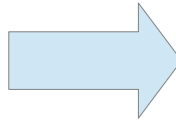
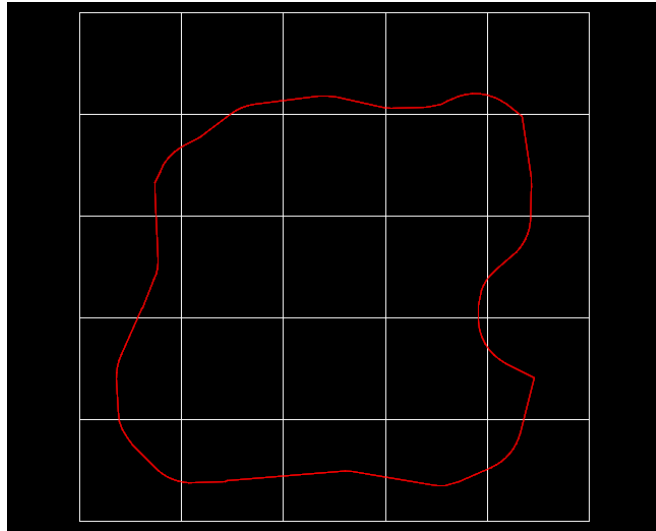
Naming for new blocks

File prefix:

Numbering:

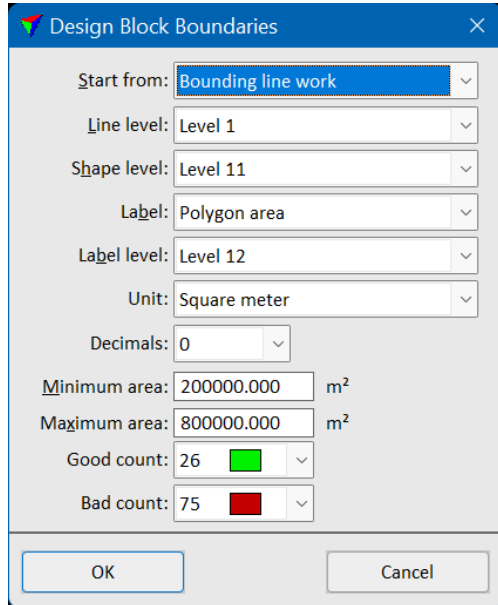
First number:

OK Cancel



Design Block Boundaries & Block Area

- **Design Block Boundaries** can run based on block area instead of point count
- You can design block boundaries without reading every n:th point if point density is fairly uniform



Design Block Boundaries

Start from: Bounding line work

Line level: Level 1

Shape level: Level 11

Label: Polygon area


Label level: Level 12


Unit: Square meter

Decimals: 0

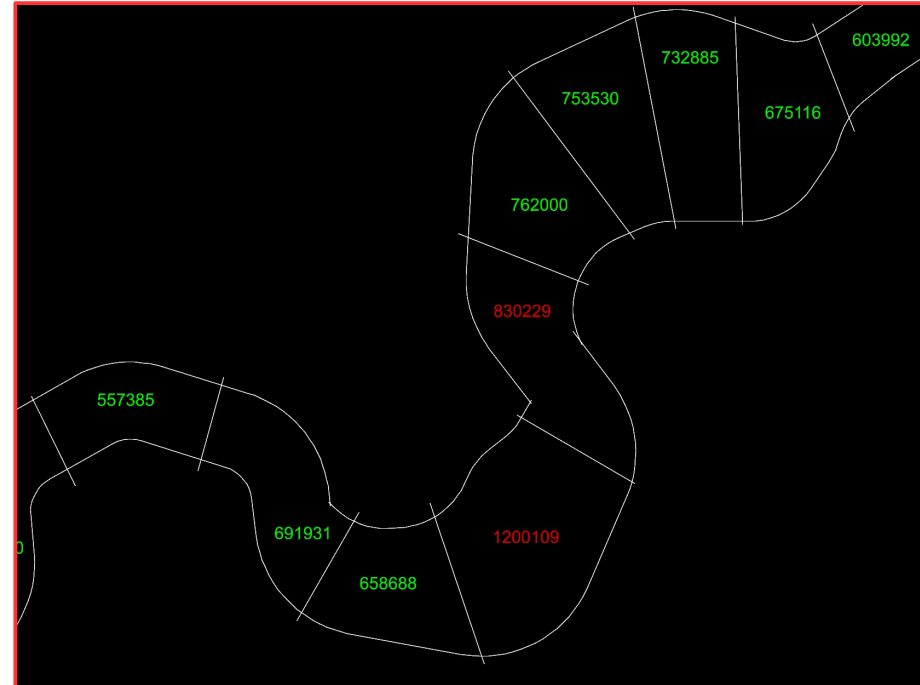
Minimum area: 200000.000 m²

Maximum area: 800000.000 m²

Good count: 26 

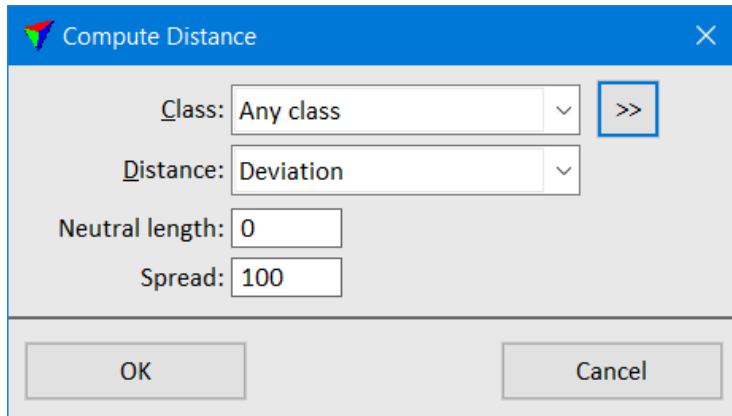
Bad count: 75 

OK Cancel



Compute distance & Deviation

- **Compute distance** can translate **Deviation** values into distance values
- Ground classification can then use distance values derived from deviation as a probability for point being ground

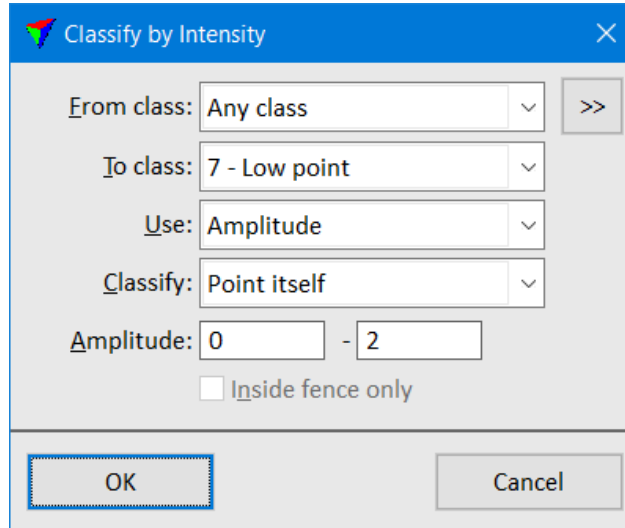


The image shows a software dialog box titled "Compute Distance". It contains the following controls:

- A dropdown menu labeled "Class:" with "Any class" selected.
- A dropdown menu labeled "Distance:" with "Deviation" selected.
- A text input field labeled "Neutral length:" with the value "0".
- A text input field labeled "Spread:" with the value "100".
- A button labeled ">>" to the right of the "Class:" dropdown.
- "OK" and "Cancel" buttons at the bottom.

Classify / By intensity Can Use Amplitude or Reflectance

- **Classify / By intensity** can now classify points based on amplitude, intensity or reflectance values



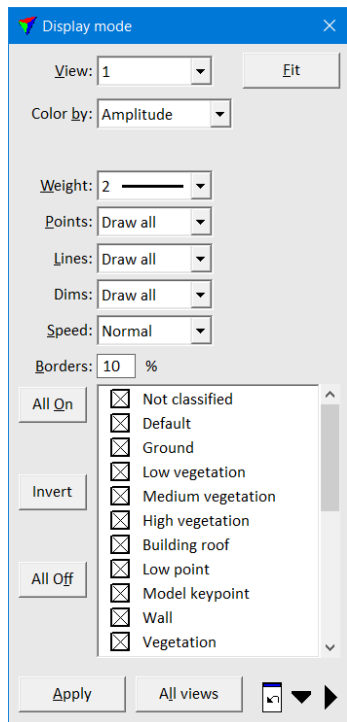
The screenshot shows a software dialog box titled "Classify by Intensity" with a close button (X) in the top right corner. The dialog contains several configuration options:

- From class:** A dropdown menu set to "Any class" with a right-pointing arrow button (>>) to its right.
- To class:** A dropdown menu set to "7 - Low point".
- Use:** A dropdown menu set to "Amplitude".
- Classify:** A dropdown menu set to "Point itself".
- Amplitude:** Two input fields containing the values "0" and "2" separated by a hyphen (-).
- Inside fence only:** An unchecked checkbox.

At the bottom of the dialog are two buttons: "OK" and "Cancel". The "OK" button is highlighted with a blue dashed border.

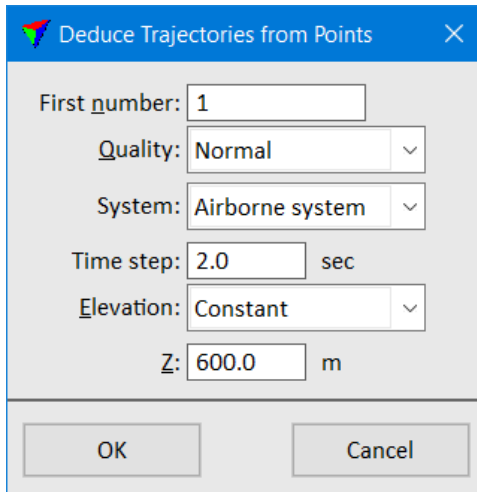
Amplitude Coloring

- **Amplitude** option in **Color by** will display points colored by amplitude
- Color scheme is automatically fitted (similar to **Auto intensity**)



Deduce Trajectories

- **Manage Trajectories** dialog has **Tools / Deduce trajectories** menu command which can create fake trajectory information from time stamped point cloud
- You can use this as last resort if you have laser point cloud with time stamps but no access to trajectory information
- Makes it possible to run tools which require trajectory information
- Runs using loaded points – read every n:th point if you have a large project



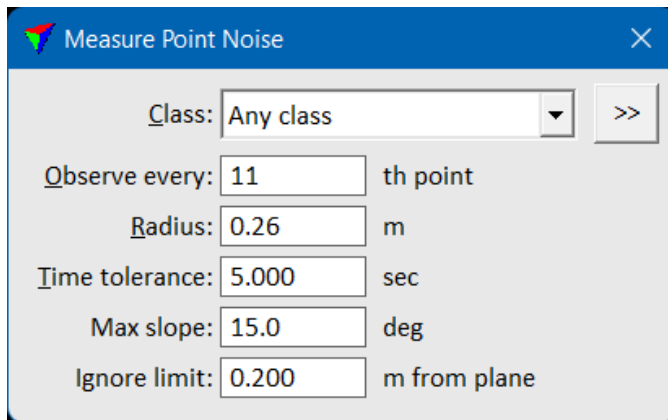
The dialog box titled "Deduce Trajectories from Points" contains the following settings:

First number:	1
Quality:	Normal
System:	Airborne system
Time step:	2.0 sec
Elevation:	Constant
Z:	600.0 m

Buttons: OK, Cancel

Measure Point Noise

- Reports one numerical value describing point-to-point noise level in the point cloud
- Reported value is average difference from a point to a plane fitted to all the points within a given 3D search radius from the point
- OK to run using **Any class**
- Alternatively, you may classify hard surface areas and get a value for clean hard surfaces

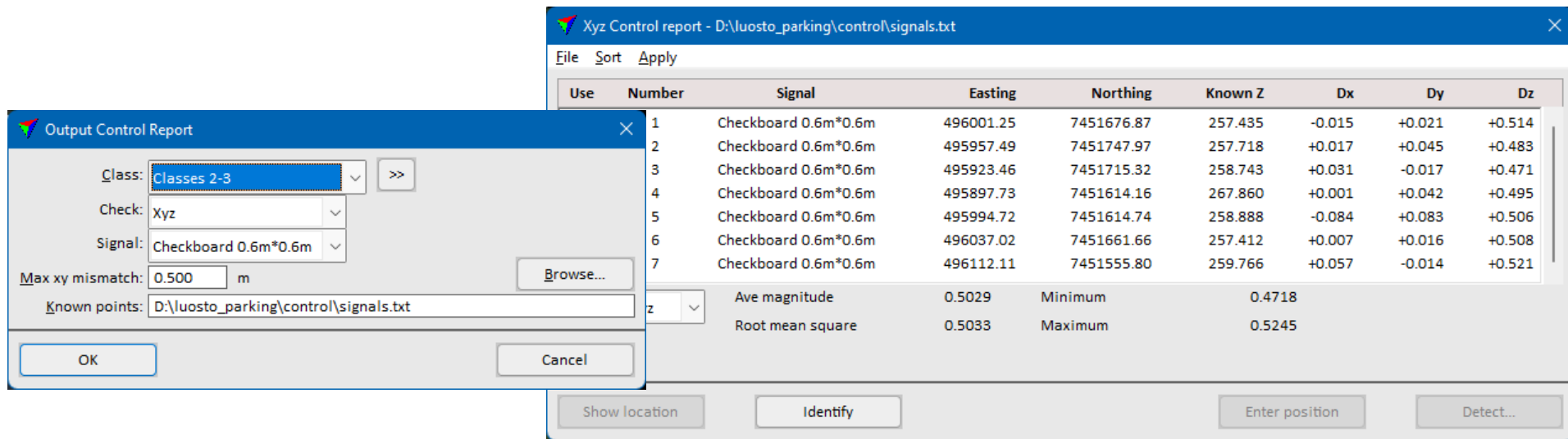


The screenshot shows a software dialog box titled "Measure Point Noise". It contains several input fields and a button:

- Class:** A dropdown menu set to "Any class" with a right-pointing arrow button.
- Observe every:** A text box containing "11" followed by the text "th point".
- Radius:** A text box containing "0.26" followed by the text "m".
- Time tolerance:** A text box containing "5.000" followed by the text "sec".
- Max slope:** A text box containing "15.0" followed by the text "deg".
- Ignore limit:** A text box containing "0.200" followed by the text "m from plane".

Output Control Report & Signal Markers

- **Output Control Report** can find signal markers using laser intensity and report xyz mismatches
- You can define signal markers using **Scan Settings** and **Signal Markers** category
 - If you click **Add** without selected elements, you create a checkboard pattern signal marker definition
 - If you select elements first, you create free shape signal marker definition (largest polygon is dark background, smaller polygon(s) are bright intensity)



The screenshot shows the 'Output Control Report' dialog box in the foreground and the 'XYZ Control report' table in the background.

Output Control Report Dialog:

- Class: Classes 2-3
- Check: XYZ
- Signal: Checkboard 0.6m*0.6m
- Max xy mismatch: 0.500 m
- Known points: D:\luosto_parking\control\signals.txt
- Buttons: OK, Cancel, Browse...

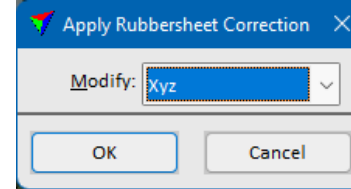
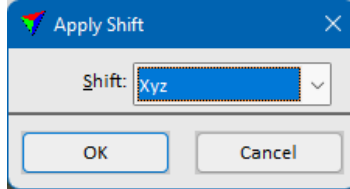
XYZ Control report - D:\luosto_parking\control\signals.txt

Use	Number	Signal	Easting	Northing	Known Z	Dx	Dy	Dz
	1	Checkboard 0.6m*0.6m	496001.25	7451676.87	257.435	-0.015	+0.021	+0.514
	2	Checkboard 0.6m*0.6m	495957.49	7451747.97	257.718	+0.017	+0.045	+0.483
	3	Checkboard 0.6m*0.6m	495923.46	7451715.32	258.743	+0.031	-0.017	+0.471
	4	Checkboard 0.6m*0.6m	495897.73	7451614.16	267.860	+0.001	+0.042	+0.495
	5	Checkboard 0.6m*0.6m	495994.72	7451614.74	258.888	-0.084	+0.083	+0.506
	6	Checkboard 0.6m*0.6m	496037.02	7451661.66	257.412	+0.007	+0.016	+0.508
	7	Checkboard 0.6m*0.6m	496112.11	7451555.80	259.766	+0.057	-0.014	+0.521
		Ave magnitude	0.5029	Minimum	0.4718			
		Root mean square	0.5033	Maximum	0.5245			

Buttons at the bottom: Show location, Identify, Enter position, Detect...

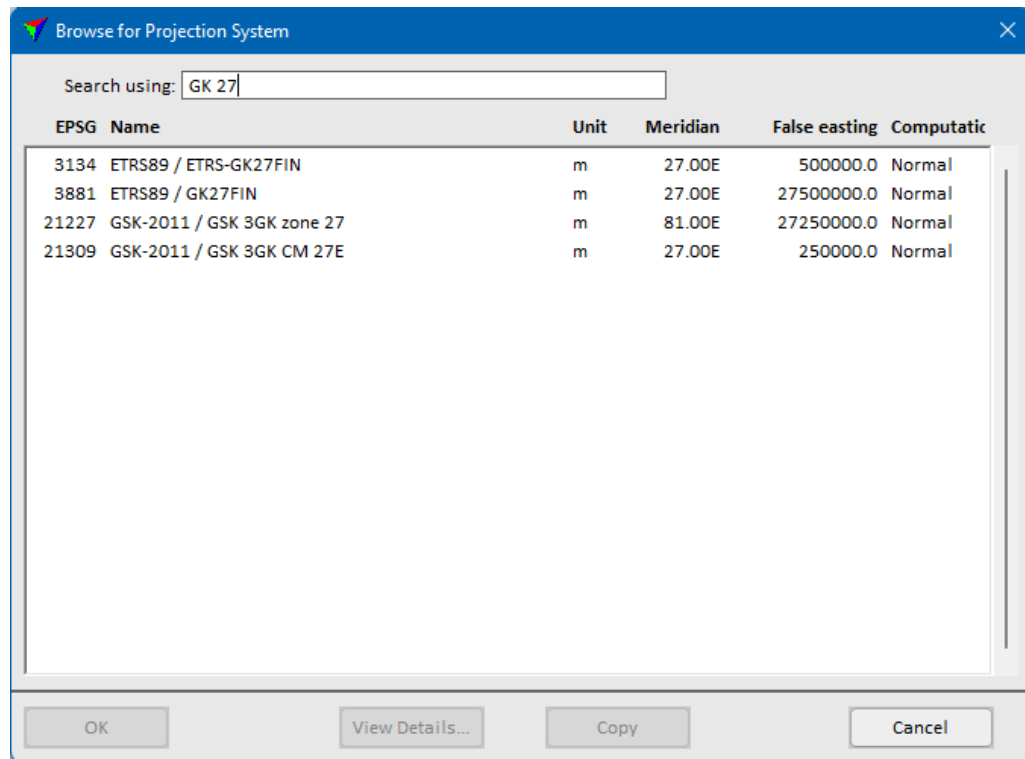
Output Control Report & Apply

- **Apply / Shift** menu command will apply average mismatch **Xyz**, **Xy** or **Z** shift to loaded points
- **Apply / Rubbersheet correction** will apply rubbersheet **Xyz**, **Xy** or **Z** correction to loaded points



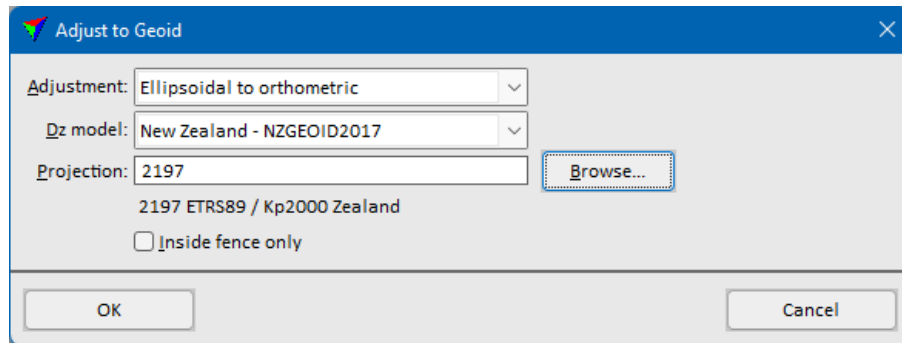
World Coordinate Systems

- TerraScan supports a comprehensive list of world projection systems
- You can add user systems in **Scan Settings**
- It is best to specify active projection system whenever reading or importing points
 - You can enter EPSG code of projection system
 - Alternatively, you can enter some key words from the name
- If projection system is known, TerraScan will write projection system info into LAS, LAZ and FBI files



Adjust to Geoid & Geoid Models

- Can convert between ellipsoidal and orthometric elevation support a number of geoid model sources
- Geoid models come with multiple application installation packages
- Geoid models go into \terra64\geoid folder
- TerraScan for MicroStation CE installation package does not contain geoid models but you can start geoid model download directly from the dialog



The image shows a software dialog box titled "Adjust to Geoid". It contains the following elements:

- Adjustment:** A dropdown menu with "Ellipsoidal to orthometric" selected.
- Dz model:** A dropdown menu with "New Zealand - NZGEOID2017" selected.
- Projection:** A text field containing "2197". To its right is a "Browse..." button.
- Projection details:** Below the text field, it says "2197 ETRS89 / Kp2000 Zealand".
- Checkbox:** An unchecked checkbox labeled "Inside fence only".
- Buttons:** "OK" and "Cancel" buttons at the bottom.

New Drone Project Wizard

- Wizard for importing DJI L1 laser point cloud

New Drone Project

Scanner system: DJI L1

Project name: Luosto ☒ Create default point classes

Laser input: D:\luosto_parking\cloud_-797835e5.las 16.08.2021

Input system: 4326 >> 4326 WGS84 longitude & latitude ☒ Assign color to black points

Input elevations: Ellipsoidal ☒ Sort points for speed

Trajectory input: D:\luosto_parking\DJI_20210816201607_0001_Zenmuse-L1-mission_sbet.out 16.08.2021

Input system: 4326 >> 4326 WGS84 longitude & latitude

Input elevations: Ellipsoidal

Target system: 3134 >> 3134 ETRS89 / ETRS-GK27FIN E26.91 N67.15

Target elevations: Orthometric -> E496058 N7451460

Geoid model: Finland - FIN2005

Storage folder: D:\luosto_parking\

New Drone Project Wizard



- Creates design file if not open already
- Fixes coordinate setup to match incoming points
- Reads laser points into memory applying coordinate transformation
- (Optional) Sort points by xy location for speed
- Classifies all points to class **1 – Default**
- (Optional) Adjusts elevations from ellipsoidal to orthometric
- (Optional) Creates default list of point classes
- Fixes scan direction bit
- Creates folder and reads trajectory solutions applying coordinate transformations
- (Optional) Adjusts trajectory elevations from ellipsoidal to orthometric
- Deduces line numbers for laser points

Process Drone Data Wizard

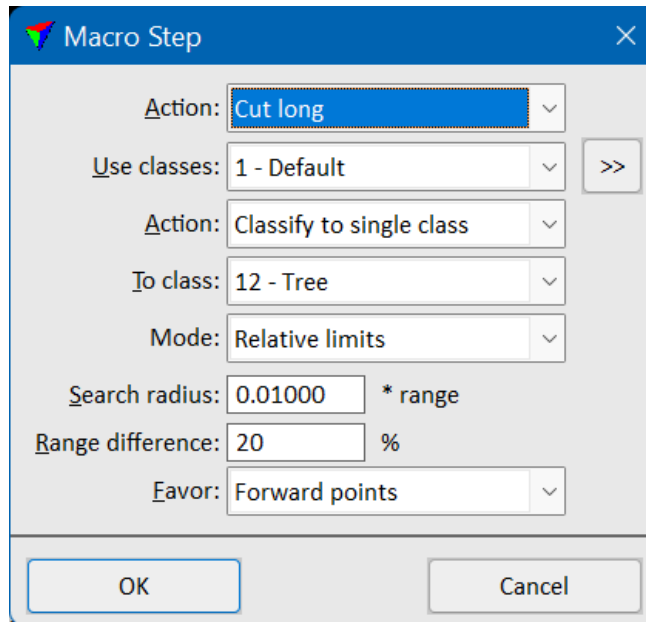
- Helps in running typical processing steps for UAV lidar data
- You can run steps as one batch process
- Or you can run some steps at a time and perform operations with other tools in the software

Process Drone Data

<input checked="" type="checkbox"/> Split trajectory	Settings...
<input checked="" type="checkbox"/> Cut overlap	Settings...
<input checked="" type="checkbox"/> Smoothen and remove noise	Settings...
<input checked="" type="checkbox"/> Thin points to inactive	Settings...
<input checked="" type="checkbox"/> Classify ground	Settings...
<input type="checkbox"/> Check ground	
<input checked="" type="checkbox"/> Classify height from ground	Settings...
<input checked="" type="checkbox"/> Classify above ground features	Settings...
<input checked="" type="checkbox"/> Copy result to inactive points	Settings...
<input checked="" type="checkbox"/> Copy result to noise points	Settings...
OK	Cancel

Cut Long & Relative Limits

- **Cut long** has **Relative limits** mode
- Search radius depends on range from scanner – this takes point density into account



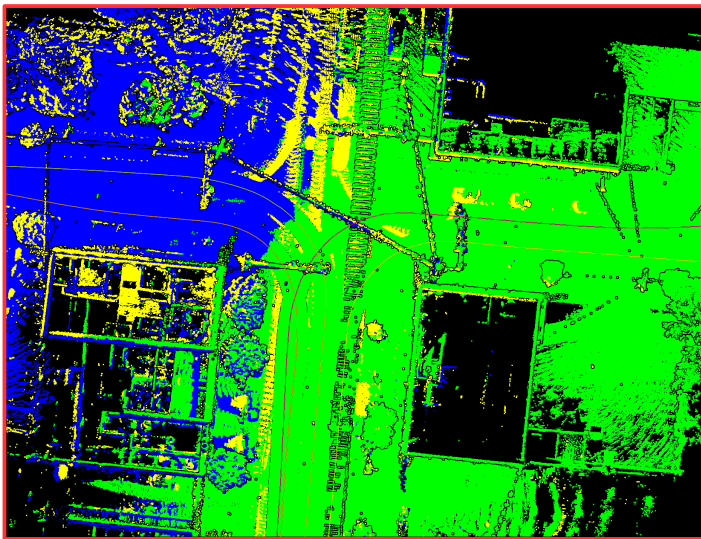
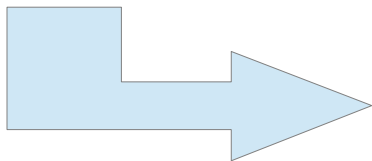
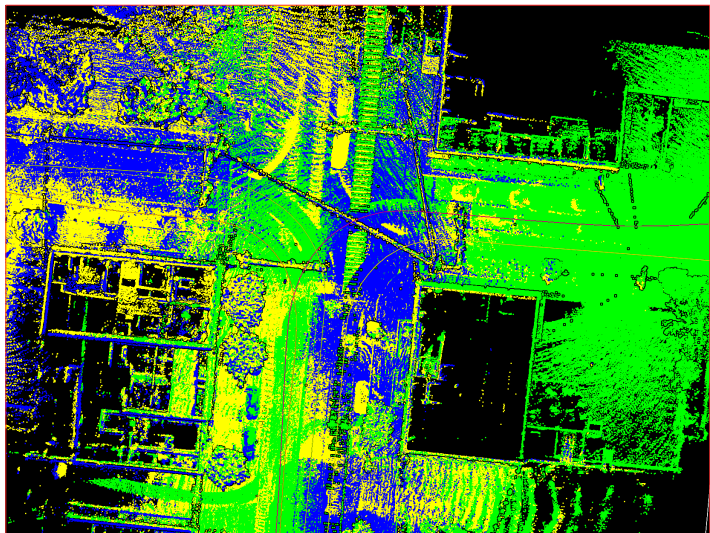
The image shows a 'Macro Step' dialog box with a blue title bar and a close button. It contains several configuration options for a 'Cut long' macro step. The 'Action' is set to 'Cut long'. Below it, 'Use classes' is set to '1 - Default' with a '>>' button. The next 'Action' is 'Classify to single class'. 'To class' is set to '12 - Tree'. The 'Mode' is set to 'Relative limits'. 'Search radius' is 0.01000 with a '* range' multiplier. 'Range difference' is 20 with a '%' multiplier. 'Favor' is set to 'Forward points'. At the bottom are 'OK' and 'Cancel' buttons.

Action:	Cut long	
Use classes:	1 - Default	>>
Action:	Classify to single class	
To class:	12 - Tree	
Mode:	Relative limits	
Search radius:	0.01000	* range
Range difference:	20	%
Favor:	Forward points	

OK Cancel

Cut Overlap & Favor First or Last

- **Cut overlap** by range has options for favoring first or last passes
- Makes it easy to remove duplicate mobile passes in a city



Macro Step

Action: **Cut overlap**

Coverage: **Classes Any**

Action: **Delete**

☐ Cut by quality
Hole size: **10.0** m

☐ Cut single scanner edges
Keep: **0** degree corridor

☐ Cut by offset
Scan lines: **Perpendicular to flight**
Keep: **25** degree corridor

☐ Cut by scan angle
Keep angles <= **10** deg

☒ Cut by range
Use: **3D range - favor first**
Search radius: **0.100** m + **0.0050** * range
Add to range: **8.000** m

☐ Cut by density
Search radius: **0.500** m
Keep classes: **6,22**
Scanner groups:

OK Cancel

Import into Project & Thin by Order

- **Import into project** has **Thin by order** option
- This will automatically thin incoming data before writing into block files
- Reduces data volume before creating new files
- Useful with mobile or static scanner data where data density is very high close to the scanner



Import Points into Project

Format and coordinates

Format: LAZ 1.4

Input projection: 3844 Browse...

3844 Pulkovo 1942(58) / Stereo70

Transform: None

Coordinates: E393279 N683426 --> E393279 N683426

Input times: GPS standard time 316770238

Storing points

Outside blocks: Ignore outside blocks

Block overlap: No overlap

☐ Only every 10 th point

☐ Only class 2 - Ground >>

☒ Thin by order Dxy < 0.010 Dz < 0.010 m

☐ Inside fence only

☐ Delete empty blocks

☐ Merge small blocks Min: 50 Max: 250 million

☒ Autosave project after import

Flightline numbering

Line numbers: Use from file

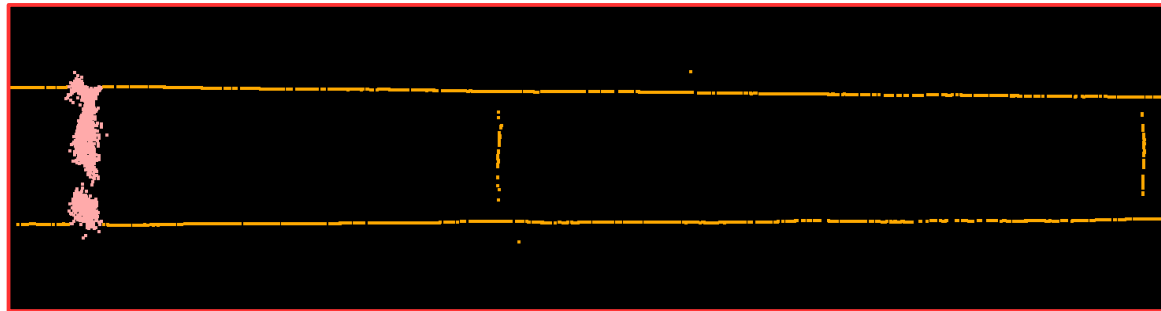
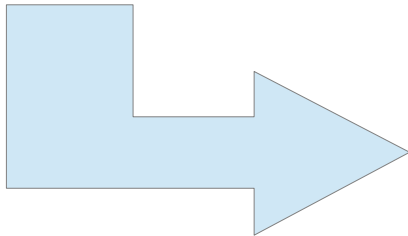
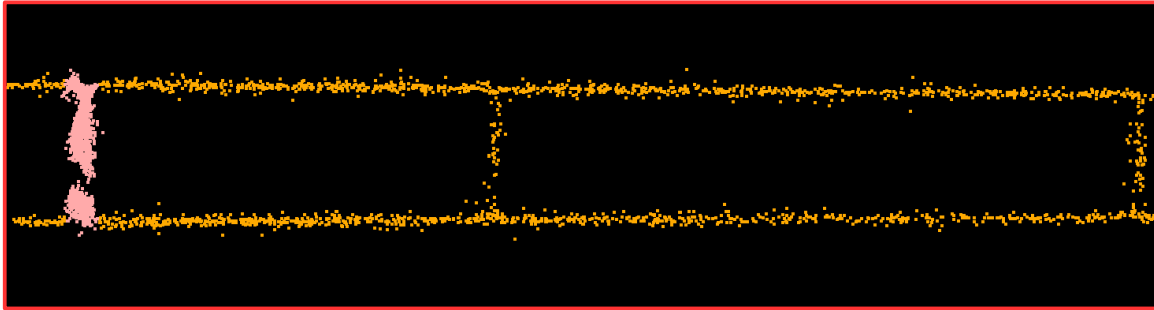
Scanner numbering

Scanner numbers: File -- scanner byte

OK ☐ TerraSlave >> Cancel

Smoothing Wires

- **Smoothen points** tool has option **XYZ – wires** for smoothing linear features
- **Max fix** specifies maximum allowed movement for a point
- Points more than **Max fix** away from locally fitted line stay unmodified



Smoothen Points

Smoother: XYZ - wires

Modify class: 21 - Wire >>

Fixed class: None >>

Radius: 0.400 m

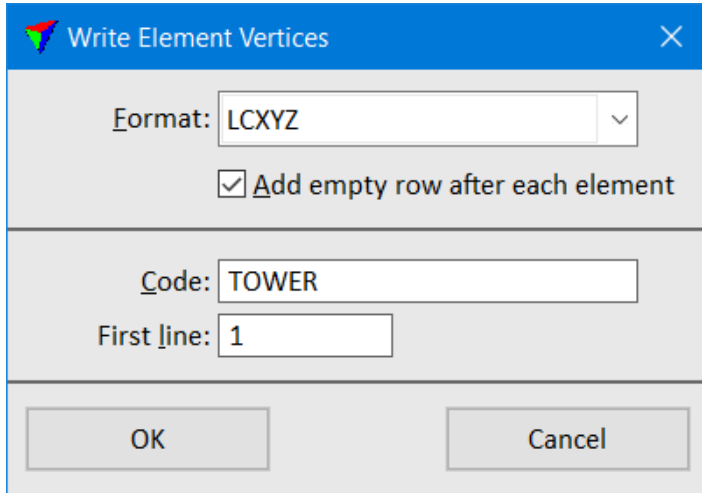
Max fix: 0.200 m

☐ Inside fence only

OK Cancel

Output / Write Element Vertices

- **Output / Write element vertices** writes vertices of selected vector elements to a text file
- Tool supports linear elements, ellipses and cells



The dialog box titled "Write Element Vertices" has a blue header bar with a close button. It contains three main sections: 1. Format: A dropdown menu showing "LCXYZ" with a small arrow icon to its right. Below it is a checkbox labeled "Add empty row after each element" which is checked. 2. Code: A text input field containing the word "TOWER". 3. First line: A text input field containing the number "1". At the bottom are two buttons: "OK" and "Cancel".

```
1 TOWER 395266.280 683871.852 0.000
1 TOWER 395338.908 683989.563 0.000
1 TOWER 395433.017 684034.600 0.000
1 TOWER 395478.026 684118.532 0.000
1 TOWER 395525.080 684190.182 0.000
1 TOWER 395531.218 684196.323 0.000
1 TOWER 395591.571 684245.454 0.000
1 TOWER 395685.680 684309.939 0.000
1 TOWER 395701.024 684318.128 0.000
1 TOWER 395739.895 684340.646 0.000

2 TOWER 395306.174 683837.051 0.000
2 TOWER 395356.298 683939.408 0.000
2 TOWER 395362.435 683944.526 0.000
2 TOWER 395442.223 683997.751 0.000
2 TOWER 395543.493 684153.333 0.000
2 TOWER 395637.602 684239.313 0.000
2 TOWER 395754.216 684281.279 0.000
```