

# New Features in TerraScan

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# MicroStation

- During week starting 23.02.2009 :
  - Release of ver 009.001 of applications for V8
  - Release of ver 009.001 of applications for SE / J
  - This will be the last SE / J updates
- Later releases will be for V8 and XM
- First XM versions will end of March

# Terra License Server & Manager

- During week starting 23.02.2009 :
  - Release of ver 009.xxx Server and Manager
  - Manager will run without administrative rights
- Later improvements to Server & Manager:
  - Ability to run service version of Server
  - Ability to move licenses from one server to another

# LAS 1.1 and LAS 1.2

- TerraScan 008.016 reads and writes LAS 1.1 and 1.2
- Use LAS 1.0, 1.1 or 1.2 as project storage format
- LAS 1.2 improvements:
  - Optional 3 \* 16 bit RGB color values for points
  - Time can be GPS seconds-of-week or standard GPS time
- Limitations in LAS 1.2 support:
  - Does not write coordinate system information
  - No testing done on standard GPS time stamps
  - TerraScan uses 3\*8 bit RGB color values
  - Less significant byte of color value is zero when TerraScan writes out 3\*16 bits into LAS 1.2

# LAS 1.2

## Point record format 3

Item	Format	Size	TerraScan Use
X	long	4 bytes	
Y	long	4 bytes	
Z	long	4 bytes	
Intensity	unsigned short	2 bytes	
Return Number	3 bits (bits 0, 1, 2)	3 bits	
Number of Returns (given pulse)	3 bits (bits 3, 4, 5)	3 bits	
Scan Direction Flag	1 bit (bit 6)	1 bit	
Edge of Flight Line	1 bit (bit 7)	1 bit	
Classification	unsigned char	1 byte	
Scan Angle Rank (-90 to +90) – Left side	unsigned char	1 byte	
User Data	unsigned char	1 byte	Scanner number 0 - 255
Point Source ID	unsigned short	2 bytes	Flightline number 0 - 65535
GPS Time	double	8 bytes	
Red	unsigned short	2 bytes	Red 0 - 255
Green	unsigned short	2 bytes	Green 0 - 255
Blue	unsigned short	2 bytes	Blue 0 - 255

# GPS Seconds of Week

- Trajectories and laser data have been stored using GPS seconds-of-week time stamps
- Time restarts from zero once a week
- Time stamps are not unique
- Flights lasting over GPS roll-over cause some problems in TerraScan
  - Example: start at 602154.78, end 1789.11

# GPS Standard Time

- Started from zero 06.01.1980
- Gives unique time stamps from which one can deduce:
  - Year, month and day
  - Time of day
- No roll-over problems in trajectories
- TerraScan works if trajectories and laser points have the same timing system
- Future versions will be able to convert from seconds-of-week to standard time

# Various improvements

- Ability to **Step** thru a macro
- Macro execution report shows failed steps in red
- *Travel Path* shows station value of section
- **Invert** button in display mode for classes
- **Invert** button in display mode for flightlines
- **Convert geoid model** can convert from French RAF98 model raf98.mnt
- Belgium Lambert 72 / BEREAF 2003 projection
- **By level** option for color, weight and style in V8

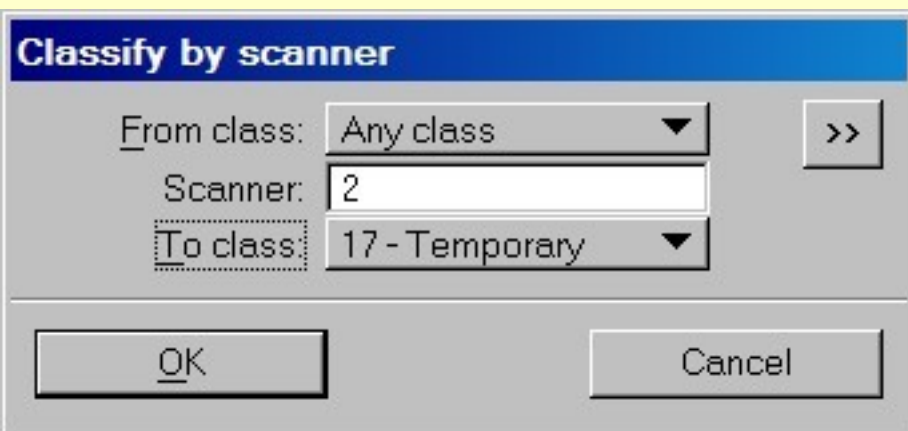


# Various improvements

- Option for choosing slow point by point display method in **Point display** category of *Settings*
- **TIN Model** option for elevation in *Mouse Point Adjustment*
- **Outside block only** option in **Delete by class** macro action
- **Draw into profile** allows selection of multiple classes
- Better logic for filling gaps when exporting lattice models

# Scanner numbers

- Ability to assign scanner numbers during import
- Scanner number stored only in LAS format
  - **File Marker** field = one byte
- **Adjust laser angles** can apply to specific scanner
- Classify / By scanner
- Coloring by scanner



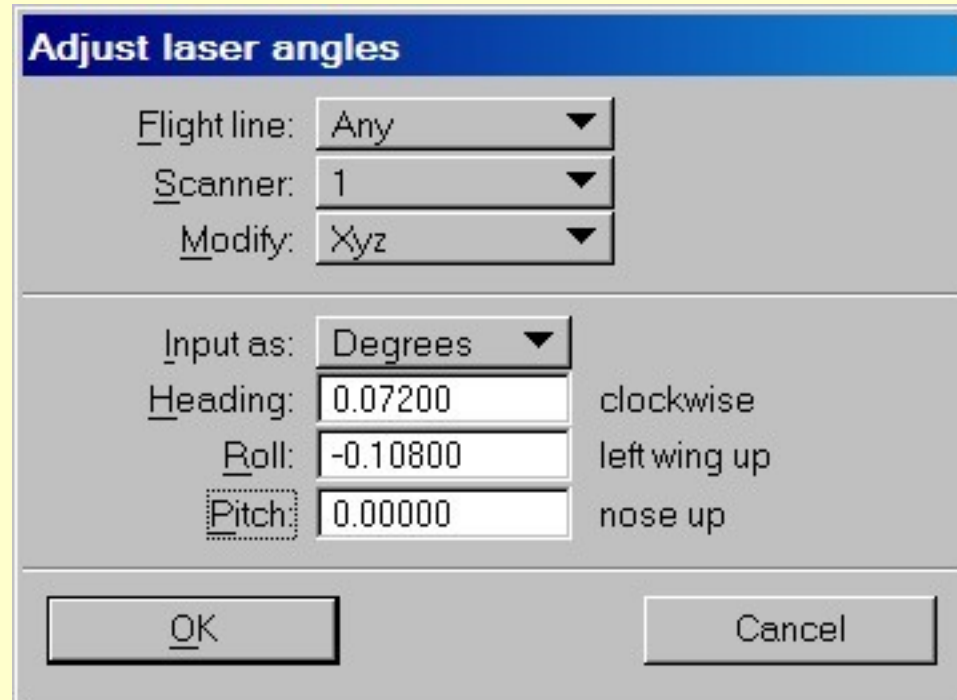
**Classify by scanner**

From class: Any class >>

Scanner: 2

To class: 17 - Temporary

OK Cancel



**Adjust laser angles**

Flight line: Any

Scanner: 1

Modify: Xyz

Input as: Degrees

Heading: 0.07200 clockwise

Roll: -0.10800 left wing up

Pitch: 0.00000 nose up

OK Cancel

# Accuracy for trajectory positions

- Import Applanix smrmsg\_XXXXX.out file or IPAS SOL
  - time stamped uncertainty / RMS values
- Draw trajectory colored by elevation accuracy
- TerraScan stores 4 rms values:
  - X & Y
  - Z
  - Heading
  - Roll & Pitch
- Accuracy for positions affects:
  - **Find Fluctuations** tool
  - All tie line computation

# Density grids

- **Define Project / Export lattice models** can export lattices where value is:
  - Number of laser points
  - Density of laser points

**Export lattice model**

Class: Any class >>

Value: Point density

Export: Selected rectangle(s)

Expand by: 0.000 m

Grid spacing: 1.000 m

Conserve memory

File format: Xyz text

Outside points: Skip

Outside Z: 0.0

File naming: Selected text elements

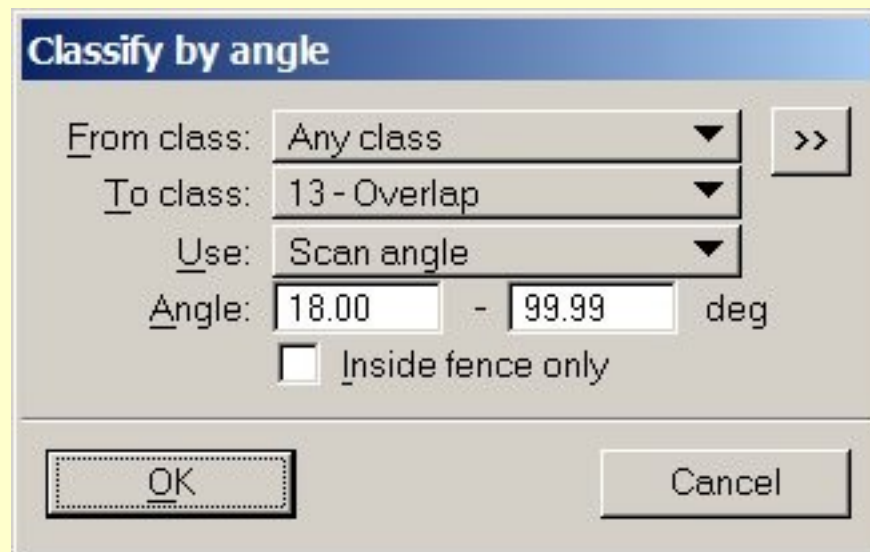
Directory: c:\

Extension: xyz Browse...

OK Cancel

# Classify / By Angle

- Classify points by scan angle or by angle from vertical
- **Scan angle** option:
  - If LAS file, uses scan angle value from file
  - If not LAS file, computes scan angle
  - Angle between -128 .. +127
- Angle from vertical:
  - Angle between 0 – 90



The screenshot shows a dialog box titled "Classify by angle". It contains the following fields and controls:

- From class:** A dropdown menu with "Any class" selected.
- To class:** A dropdown menu with "13 - Overlap" selected.
- Use:** A dropdown menu with "Scan angle" selected.
- Angle:** Two input fields containing "18.00" and "99.99", separated by a hyphen, with the unit "deg" to the right.
- Inside fence only:** An unchecked checkbox.
- Navigation:** A ">>" button to the right of the class dropdowns.
- Buttons:** "OK" and "Cancel" buttons at the bottom.

# Classify / By centerline

- Support multiple source classes
- Option for comparing with:
  - Closest linear element – old logic before 007.013
  - Any linear element – more recent logic

The screenshot shows a dialog box titled "Classify by centerline". It contains several configuration options:

- From class:** A dropdown menu set to "Any class" with a right-pointing arrow button.
- To class:** A dropdown menu set to "6 - Building".
- Compare with:** A dropdown menu set to "Closest line".
- Side:** A dropdown menu set to "On righth side".
- Offset:** Two input fields: the first contains "5.00" and the second contains "999.00", followed by the unit "m".
- By elevation difference:** An unchecked checkbox. Below it, two input fields: the first contains "-1.00" and the second contains "1.00", followed by the unit "m".
- By longitudinal distance from vertex:** An unchecked checkbox. Below it, two input fields: the first contains "0.00" and the second contains "2.00", followed by the unit "m".

At the bottom of the dialog are two buttons: "OK" and "Cancel".

# Extract color from images

- Older versions extracted color from closest raw image in 3d
- Now has option for selecting:
  - Closest in 3d
  - Closest in xy
  - Closest in time

# Macro for stops & turns

- Finds time sequences with no movement or with rapid heading change from trajectories
- Create macro for classification
- Added for mobile data
- Classifying turns useful for airborne data sets

**Macro for stops & turns**

Classify stops  
From class: Any class  
To class: 14 - Stop

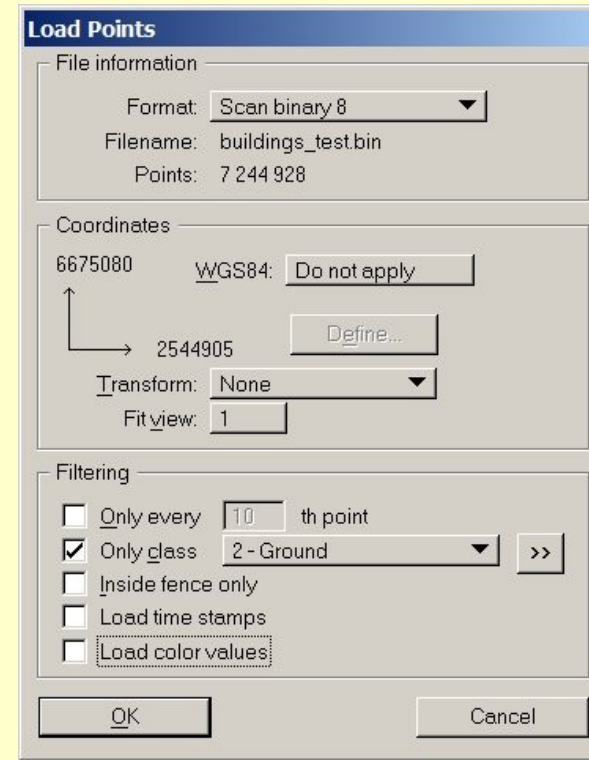
Classify turns  
From class: Any class  
To class: 16 - Turn  
Heading change > 4.0 deg/sec

OK Cancel



# Improved Safety

- **Save points** disabled if you do not read all information from a file with **Read points**
- Disabled if
  - **Load color values** is off and input file had colors
  - **Load time stamps** if off and input file had time
  - **Only class** is on
  - **Inside fence only** is on
  - **Only every** is on



# Copy from Reference

- Copy some point parameters from another state of processing

**Copy from reference**

Apply to: Any class >>

**Reference project**  
Search in: Block with matching name

**Match by**

<input type="checkbox"/> Flightline	<input type="checkbox"/> Intensity
<input checked="" type="checkbox"/> Time stamp	<input type="checkbox"/> Color
<input type="checkbox"/> Scanner number	<input type="checkbox"/> Class
<input checked="" type="checkbox"/> Echo information	<input type="checkbox"/> Xy Within: 0.000 m
<input type="checkbox"/> Scan angle	<input type="checkbox"/> Elevation Within: 0.000 m

**Copy data**

<input type="checkbox"/> Flightline	<input type="checkbox"/> Intensity
<input type="checkbox"/> Time stamp	<input type="checkbox"/> Color
<input type="checkbox"/> Scanner number	<input type="checkbox"/> Class
<input type="checkbox"/> Echo information	<input checked="" type="checkbox"/> Xy
<input type="checkbox"/> Scan angle	<input checked="" type="checkbox"/> Elevation

OK Cancel

# Example Case

- Imported data into \laser1
- Solved HRP and applied to \laser2
- Performed automatic and manual classification
- Realized that HRP correction was wrong but classification is good and has taken a lot effort
- Solution:
  - Define \laser1 as reference project
  - Copy xy and z from \laser1 into \laser2

# Copy from Reference & LAS

- **Time stamp + Echo information** uniquely identify a point if all data from same GPS week
- **Flightline + Time stamp + Echo information** if data spans multiple GPS weeks

**Copy from reference**

Apply to: Any class >>

**Reference project**  
Search in: Block with matching name

**Match by**

<input type="checkbox"/> Flightline	<input type="checkbox"/> Intensity
<input checked="" type="checkbox"/> Time stamp	<input type="checkbox"/> Color
<input type="checkbox"/> Scanner number	<input type="checkbox"/> Class
<input checked="" type="checkbox"/> Echo information	<input type="checkbox"/> Xy Within: 0.000 m
<input type="checkbox"/> Scan angle	<input type="checkbox"/> Elevation Within: 0.000 m

**Copy data**

<input type="checkbox"/> Flightline	<input type="checkbox"/> Intensity
<input type="checkbox"/> Time stamp	<input type="checkbox"/> Color
<input type="checkbox"/> Scanner number	<input type="checkbox"/> Class
<input type="checkbox"/> Echo information	<input checked="" type="checkbox"/> Xy
<input type="checkbox"/> Scan angle	<input checked="" type="checkbox"/> Elevation

OK Cancel

# Copy from Reference & TScan binary

- Time stamps stored as 32 bit integer using 0.0002 second resolution
- 100 000 pulses / second results in 20 pulses having the same time stamp
- **Time stamp + Echo information** not enough to uniquely identify a point
- Use multiple parameters which you know have not changed

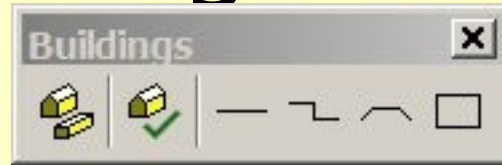
# Echo length coloring

- Echo length is the length of return pulse
- Value relative to typical return pulse length from a hard surface (-32768 ... +32767 mm)
- Can currently extract only from TopEye waveform
- Not currently stored in any format
- Future:
  - Extract from Optech & Riegl waveform files
  - Read from manufacturer's raw files?
  - Store in TerraScan binary and LAS
  - Use in ground classification

# Construct Planar Building

- Can select multiple planes in the list box
  - Delete multiple in one operation
- Separate menu commands for recomputing plane boundaries
- Used to automatically recompute base directions and boundaries whenever user changed the number of planes (delete, merge or add)

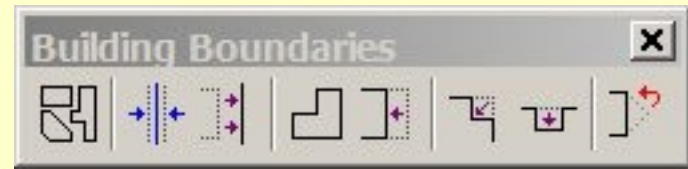
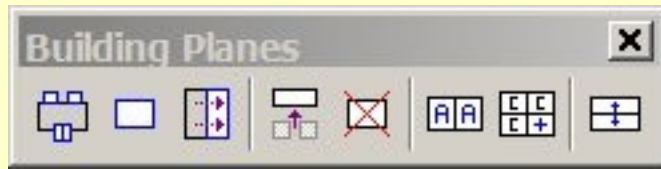
# New Building Vectorization



- For airborne laser data + images
- Three goals:
  - Produce approximate 3D vector models automatically
  - Produce accurate 3D vector models faster than old set of tools
  - Vectorize buildings with non-planar roofs
- Ready for production use in April



# Old Building Vectorization



- Manual tools for working on one building at a time
- Meant for producing accurate vector models
- Appeared in software 2003
- First tested on Helsinki Univ of Technology area
- 2.3 sq km originally took 3 days to vectorize
- With some improvement in tools, the same area took 1.5 days to vectorize in 2004
- One building was not vectorized due to irregular, small details

# Old Building Vectorization

- Creates accurate fully 3D vector models with support from images
- Tools may be unusable if building has no dominating planar surfaces
  - Curved roofs
  - Roofs with excessive small detail
- Does not enforce aerial fill
  - Hard to ensure no gaps between planes
- Hard work
  - User ends up managing planes with complex buildings instead of entering edge lines or corner points

# New Building Vectorization

- Relies on following classification done:
  - Ground
  - Height from ground
  - Buildings
- **Vectorize Buildings** tool produces 3D vector models automatically
  - Can use 2D edge lines/polygons
- **Check Buildings Models** tool lets you review automatic models one at a time against an airborne raw image
  - Tools for placing edge lines