From Drone to CAD

... with Carlson Software

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Objectives

- Understanding of Field Procedures for both Photo and Lidar Drone Projects
- Types of Drones – Review types as well at the all important 'Payload(s)'
- Workflow of producing deliverables from Drones (Photo/Photo-Lidar/Lidar Only)
- Explore the options within Point Cloud Data – Feature Extraction → Into CAD
- Project Setup and Settings to best utilize Field To Finish Projects for both the Field and Office with Carlson Software – Into CAD
- Explore and Learn the Feature Extraction Options within Carlson Software

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Objectives

Yes, learning can be fun....

Let's make that a **Goal of Today**!

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Setting Up…

Field Procedures 101

Targets:
- Easy to See
- Can be 'Home Made'
- Contrast in 'Key'
- Spread Out

- SPC Target/Coordinates vs. Local Coordinate

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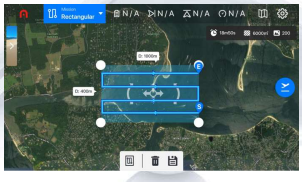
Mission Planning

Mission Planning Options:
- Waypoint
- Rectangular
- Polygon
- Oblique
- Slope



Key Parameters:
- Altitude (AGL or MSL)
- Front and side overlap percentages
- Flight speed
- Camera angle
- Gimbal pitch

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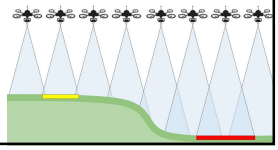
Planning a Rectangular Mission

- **Steps:**
  - Open Autel Explorer and select "Mission."
  - Choose "Rectangular" mission type.
  - Define the area of interest by adjusting the rectangle on the map.
  - Set mission parameters: altitude, overlap, speed, camera angle.
  - Save and name the mission for future use.
- **Tips:**
  - Use 75–85% front overlap and 70–75% side overlap for optimal results.
  - Adjust flight speed to 8–12 km/h to prevent motion blur.
  - Set camera angle to 90° for nadir (downward) images.



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Executing the Mission

Pre-Flight Checklist:
- Ensure batteries are fully charged.
- Verify sufficient storage on the SD card.
- Check GPS signal strength.
- Calibrate compass if prompted.
- Confirm weather conditions are suitable for flight.
- Check RTK

During Flight:
- Monitor live feed for image quality.
- Be prepared to pause or abort the mission if necessary.
- Maintain visual line of sight (VLOS) with the drone.web.carlsonsw.com

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Proper Field Operations for Drone Mapping Missions

Purpose:
- Ensure accurate, repeatable mapping
- Minimize re-flights and processing errors
- Align drone data with survey-grade control

Key Components:
- Mission planning
- Ground Control Points (GCPs)
- Check points
- Proper placement & documentation

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What Are Ground Control Points (GCPs)?

Definition:
- Known surveyed points used to georeferenced drone data

Why GCPs Matter:
- Improve absolute accuracy
- Reduce GNSS drift
- Support engineering-grade deliverables

Survey Requirements:
- RTK/PPK or total station
- Clearly visible
- Stable and undisturbed

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Types of Ground Control Targets

- Painted targets, Spray Painted X with a Mag Nail.
- Fabric or vinyl targets (reusable)
- Plastic or aluminum panels (semi-permanent)
- Natural features (limited use)
- Permanent Painted Lines, Roadways, Parking Lot Lines, Tips of Painted Arrows.

Best Practices:

- High contrast
- Size matched to flight altitude
- Flat and level, Unobstructed Views

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Proper GCP Placement Strategy

Even distribution across site
Place near corners, edges, and interior
Avoid clustering or single-edge layouts

Typical Counts:
<20 acres: 5–7 GCPs
20–100 acres: 8–12 GCPs
Large sites: increase proportionally
Often with RTK drones, Less GCPs are required.

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Check Points vs GCPs

Check Points:

- Surveyed but not used in processing
- Validate horizontal and vertical accuracy

Best Practice:

- 20–30% of total points as check points
- Similar distribution to GCPs

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LiDAR vs Photogrammetry – Field Thought Process

Photogrammetry:
- Image quality and overlap are critical
- GCPs drive absolute accuracy
- Sensitive to lighting, shadows, and surface texture
- Visual clarity is essential

LiDAR:
- Sensor calibration and trajectory accuracy matter most
- Fewer GCPs often required
- Penetrates vegetation

Key Difference:
- Photogrammetry is image-driven
- LiDAR is trajectory-driven

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Drone Platform: Entry-Level vs Heavy-Lift

Entry-Level Photogrammetry Drones:
- DJI Phantom / Mavic series
- Autel EVO II series

Heavy-Lift Industrial Platform:
- Carlson CRD1
- Others within the industry…

These platforms are designed for *very different* missions, workloads, and long-term use.

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Entry-Level Photogrammetry Drones

- Designed for simplicity and speed:
  - Integrated fixed camera
  - Lightweight and portable
  - Quick setup, minimal training
  - Lower upfront cost
- Best for orthomosaics, stockpiles, and small construction sites

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Limitations of Entry-Level Drones

- Camera-only payloads
- Limited flight time with accessories
- No LiDAR or specialty sensors
- Limited upgrade path
- Performance affected by wind and complex environments

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Heavy-Lift Platform

- Designed for professional survey and scalability:

(Hardware Example – Carlson CRD1)

- Modular payload system
- Supports LiDAR, large cameras, specialty sensors
- High power propulsion and long endurance
- Built for repeatable, survey-grade results

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Payload & Capability Comparison

- Entry-Level Drones:
  - Fixed camera
  - Photogrammetry only
  - Limited payload capacity
- Heavy-Lift Drones:
  - Interchangeable payloads
  - Photogrammetry, LiDAR, bathymetry, etc.
  - High payload capacity and flexibility

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Operational & Business Impact

- Entry-Level Platforms:
  - Great starting point
  - Often replaced as needs grow
- Heavy-Lift / Scalable Drone Platform:
  - One platform, many missions
  - Lower long-term cost of ownership
  - Scales with your business

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FCC Drone Action – What You Need to Know

Clarifying facts and impacts for customers and sales teams

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Background Context

- The drone industry has raised concerns about Chinese-made drones for several years.
  - Primary concern: potential transmission of collected data back to China.
  - U.S. agencies required a security audit by a qualifying U.S. authority.
  - The audit deadline passed with no qualifying audit completed.

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What Happening Now

- The FCC has acted following the missed audit deadline
  - The FCC (not the FAA) has restricted new approvals.
  - New makes and models of CCP-associated drones are now blocked from certification.

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What the FCC Covered List DOES NOT Do

- Does NOT ban the use of existing drones.
  - Does NOT ground any current drone fleets.
  - Does NOT affect resale or operation of previously authorized drones.
  - DJI, Autel, and other foreign-made drones already certified remain legal to fly.

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Practical Impact (Forward-Looking)

- No new certifications for additional foreign-made drone models or radio components.
  - Federal authorization would be required for future approvals.
  - Parts availability and long-term platform support may become more limited over time.

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What Is NDAA Compliance?

- NDAA = National Defense Authorization Act.
  - Focuses on secure supply chains and trusted manufacturing.
  - American-made or allied-country components are acceptable.
  - Example: Japanese components = acceptable; North Korean components = not acceptable.

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What This Means for Customers

- If you already own an Autel or DJI, etc.
- You can continue flying legally
  - Previously delivered systems are not affected.
  - There is no immediate operational disruption.

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What This Means for New Purchases

New procurement decisions should prioritize 'NDAA Compliance'

- Consider long-term supply chain stability.
- Evaluate manufacturer support and regulatory risk going forward.

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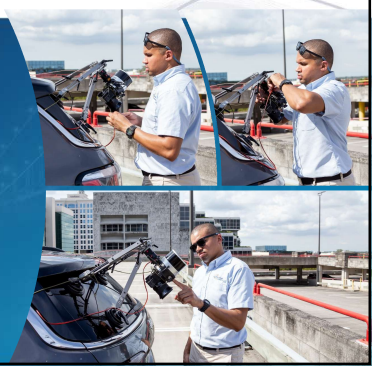
Other Technology…

Mobile Mapping And Handheld LiDAR +SLAM



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Features

- One-Button Operation
- Automatic Antenna Lever Arm Offset Estimation
- One-Click Raw Processing
- Batch Processing
- Advanced Point Cloud Filters
- What You See Is What You Get
- Full Boresight and Calibration Tools

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Mount Antenna

Ensure that the antenna(s) is/are securely and properly mounted on the vehicle in an area with good visibility of the sky.

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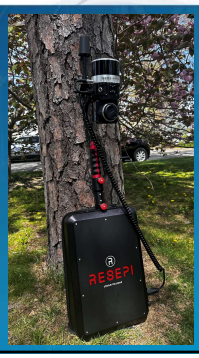
SLAM - Simultaneous Localization and Mapping

- Laser SLAM uses LIDAR sensors to capture 3D point clouds of the environment.
- SLAM is best for use in GPS denied environments



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LiDAR Backpack

- Internal Battery Power
- Handheld
- Can be used with GNSS
- SLAM capable

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Drone Platform: Summary…

Each Drone ‘Type’ has it’s Individual Purpose

Depending on the scope of your job you may need more than one type or style of drone classification

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Now what to do with all of that 'Drone-Data' you've collected…!!!

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Processing the 'Data…'

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Flexibility

Carlson PhotoCapture

Released in April 2018

Cloud-based

Released in July 2021

Standalone

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Key differences

Cloud-based

- No need to use a powerful PC
- Pay only when you need it
- Process and access your data anytime, from any device
- Share your data with stakeholders, partners, or the entire world
- All your data is safely and redundantly backed up

Standalone

- Works without high speed internet
- Permanent license
- Compliance with security regulations
- Unlimited volume: process as many projects as you need

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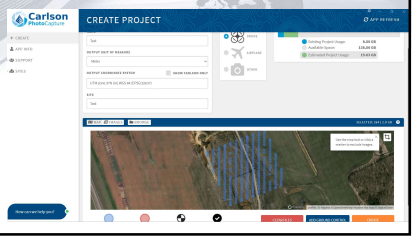
How it works

1

UPLOAD YOUR IMAGERY

Choose your project coordinate system and various other settings. Upload or add your imagery to Carlson Photo Capture



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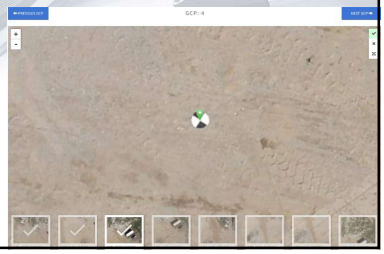
ADJUST GCPs (OPTIONAL)

Use our intuitive ground control adjustment process to deliver high accuracy.

RECENT UPDATE –
GCP AUTO-DETECTION



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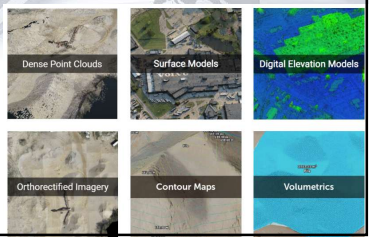
VISUALIZE, ANALYZE, SHARE

Explore finished products. Create new data with Survey Canvas. Export data to other Carlson software products for design, mapping etc.



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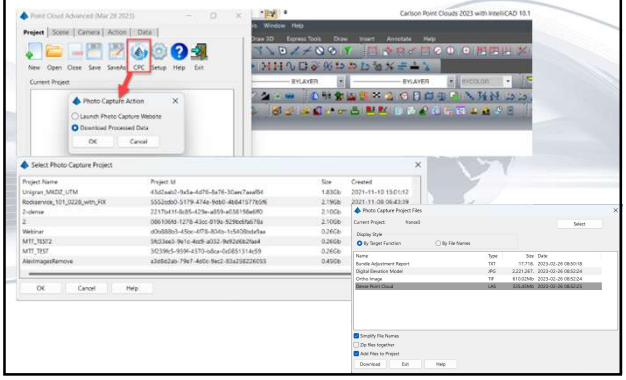
Did you know that CPC is available from Carlson Office?



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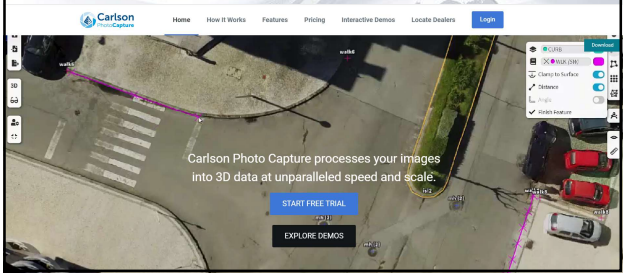

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Drone flight in Krakow

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Time for discussion…

- Still an Emerging Technology
- Find the product that works best for you
- Carlson is not the only option…

But… we'd enjoy having you as a customer ☺

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Getting Started with…
Carlson Point Cloud Advanced

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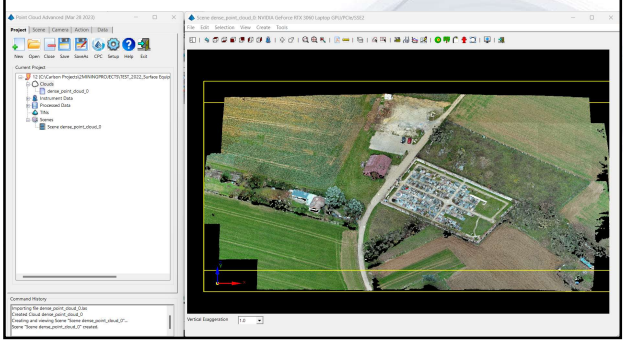
Carlson Point Cloud



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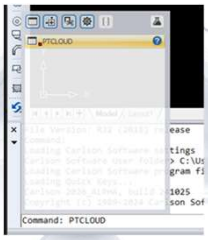
Launching

- Point Clouds Icon
- “PTCLOUD” command



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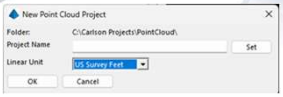
Start a new project

Enter name and linear unit. Defaults to drawing unit



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Project Page

- Upper toolbar
- Project tree
  - Outlines all entities in the project
  - Most data is in "Processed Data" folder
- Command History

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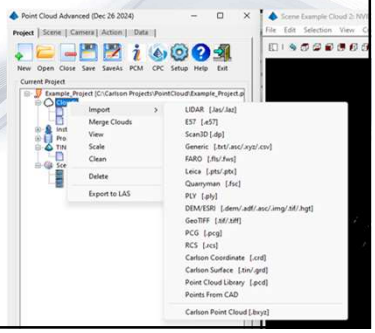
Import a Point Cloud

Clouds must be imported to an internal format "bxyz" before use.

On the project page right-click the Clouds folder and select import. Then select the type of file to import from the available options

LAS/LAZ, E57 and Scan3D are the most common



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Import a Point Cloud

- Import File information: WKT string saved with the file if available
- Set name for imported file
- Select Orthomosaic if available
  - Used with certain actions
- Change projection (optional)
- Set Linear unit
- Resample or Remove duplicates (optional)
  - If point cloud has 500 million+ points "Remove duplicated points" will be on by default

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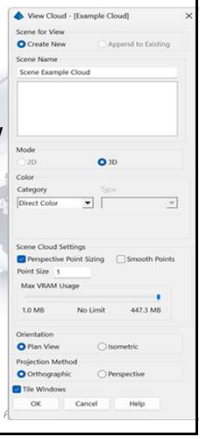
View the Point Cloud

<Cloud to view>->Right-Click->View

Create Scene Dialog

- Select Color Mode
- Set Rendering options
- Set Projection mode



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Scene Page

Requires a scene viewer window open

- Scene Entity tree
- Click on entities in tree for specific controls and settings
  - Hide/Show
  - Color Mode
  - Point Cloud Classifications

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Action Page

Requires a scene viewer window open

- Selection
- Point Cloud Editing and Transformation
- Create entities
- Extract features

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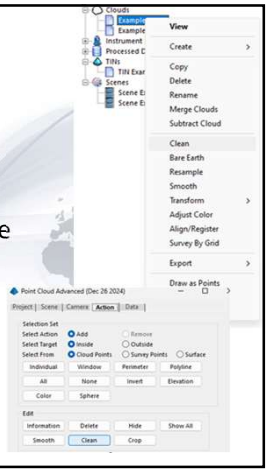
Point Cloud Clean

- Project Tree->Right-click cloud->Clean
- With a scene open with the cloud:

  Action Page-> Edit->Clean



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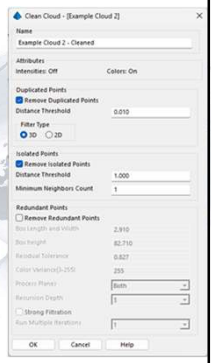
Point Cloud Clean

- Remove Duplicated Points - Results in the point cloud have approximately even spacing of Distance Threshold
- Remove Isolated Points - can remove small clumps of points
- Remove Redundant Points - decimates point cloud for surface model creation (least common).



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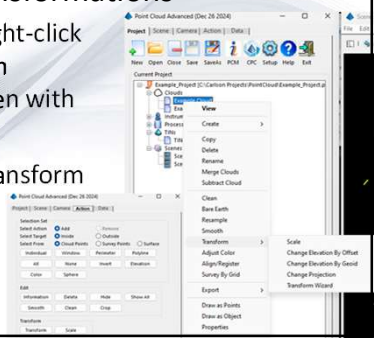
Point Cloud Transformations

- Project Tree->Right-click cloud->Transform
- With a scene open with the cloud:

  Action Page-> Transform



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Point Cloud Transformations

- Scale - Quickly scale between common units such as US Feet and Meters
- Elevate by Geoid or offset - Changes elevation of all points
- Change Projection - Transform from one projection system to another.
  - Must know the current point cloud projection and target projection
- Transformation Wizard offers advanced options for scaling, offset and rotation by matrix.

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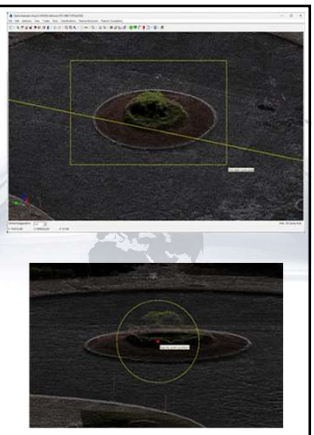
Making a selection

- By perimeter polyline
- By rectangle
- By sphere
- By color



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Selection Actions

- Hide
- Delete
- Create new entity
- Classify - from Scene Page with a cloud selected in the tree
- Use with supported extraction routines
  - Bare Earth
  - Building
  - Contours
  - Paint Lines

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Field to Finish

Carlson Point Cloud Module

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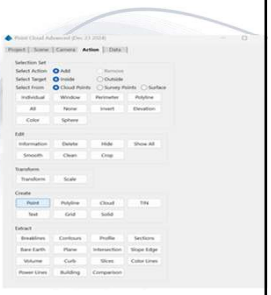
Create Point Panel

Available from Action Page->Create->Point

Allows for placement of Coordinate points with Field to Finish codes



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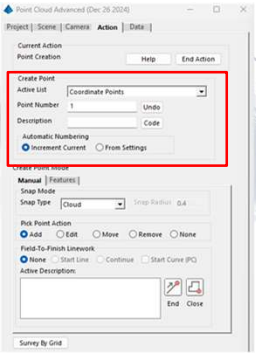
F2F Code Setup

- Set if points will be added to CRD point list (most common), control point list or scan position list
- Designate starting point number
- Set F2F code in description box
- Increment point number or use custom settings



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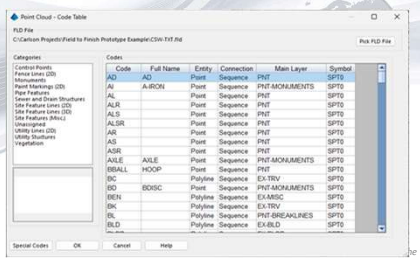
F2F Code Setup

- Code button allows setting a code from FLD file



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Manual Drafting

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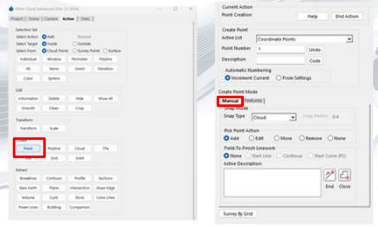
How to access

Action Page->Create->Point->Manual



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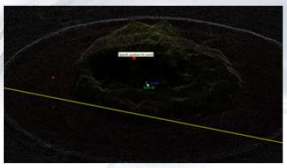
Create Point Entity

- Use Point Entity code
- Select “Add” Pick Point Action
- Click on point in the cloud to place CRD point



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Create Polyline Entity

- Use a Polyline Entity code
- Select “Add” Pick Point Action
- Click on points along feature. A polyline will be drawn as points are picked
- Special codes for Begin and End are added automatically.

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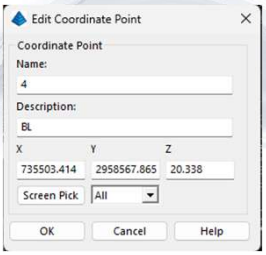
Point Editing

- Select “Edit” pick point action and click on crd point
- Edit parameters as needed
- Screen Pick allows for re-pick of point



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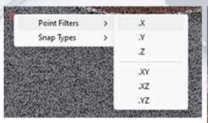
Shortcuts

- E key to end current polyline
- C to close current polyline
- Right-Click
  - Undo
  - Edit
  - Remove
  - Move
- Shift Right-Click
  - Point Filters
  - Snap Types



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Tree and Pole extraction

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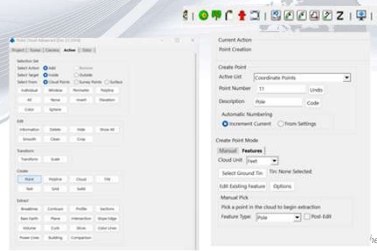
How to access

Action Page->Create->Point->Features or by clicking the Tree or Pole icons in the Scene View Window



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Requirements

Point Cloud must have the Poles, Tree Trunks and Canopies captured well for extraction to work

Tree trunk and canopy captured
Extraction is possible

No tree trunk captured. Cannot extract

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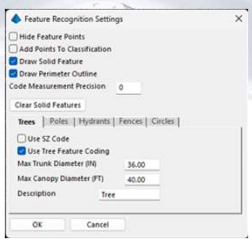
Extraction Options - Options Button

- All Feature options
  - Hide points
  - Add to classification
  - Draw Solid
  - Draw perimeter
- Entity specific parameters
  - Max Diameter properties need to be tuned for best results
  - Set a Description or Code per entity



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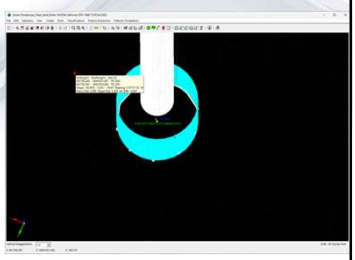
Point Description

Descriptions include

- Feature type
- Height
- Diameter
- Lean
- Tree type



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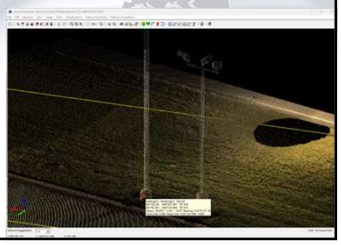
Extract a pole or tree

- Locate a pole or tree with the trunk or base of pole well defined and isolated
- Click on the base of the pole or trunk 6-24 in from the base of the ground
- If extraction fails, read warning in command history and adjust pick position or parameters. Edit extracted feature if necessary.



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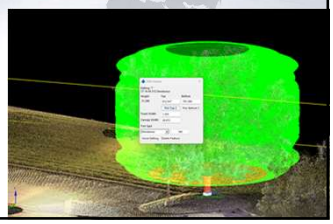
Edit a Feature Point

Press “Edit Existing Feature” and click on feature point

Can adjust

- Bottom/Top positions
- Diameters
- Lean
- Tree Type
- etc



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Feature Extraction

Carlson Point Cloud Module

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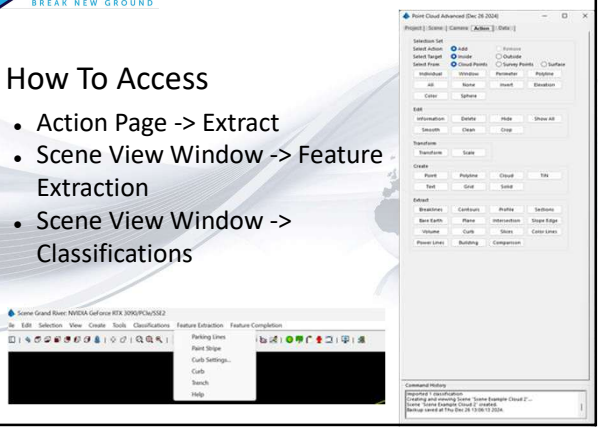
How To Access

- Action Page -> Extract
- Scene View Window -> Feature Extraction
- Scene View Window -> Classifications



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Feature Extraction from the Action Page

- Bare Earth
- Contours
- Volumes
- Power Lines
- Building Outline
- More…

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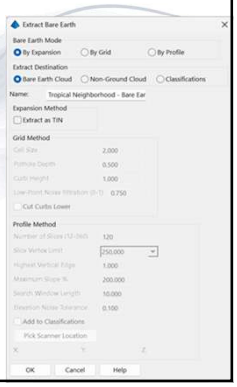
Bare Earth

- By Expansion Method
  - No parameters
  - Can extract direct to TIN
  - Works best for terrain with gradual slopes
  - Cloud Linear Unit must be accurate
- By Grid
  - Use if Expansion gives poor results
  - Set Cell Size to minimum 5x the average point spacing in the point cloud
  - Increase Cell Size if the point cloud has a large area and extraction runs slower than desired.
- By Profile
  - For use with Ground LIDAR scans.
  - Typically not needed over other methods



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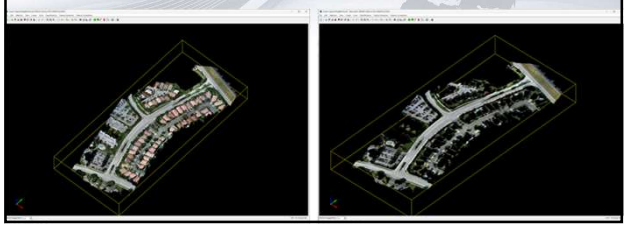
Bare Earth By Expansion Example



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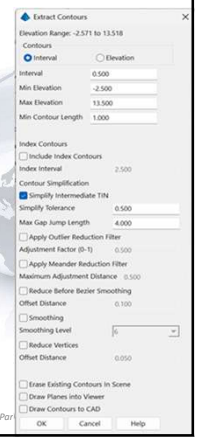
Contours

- Create contours at regular interval or at a specific elevation
- Option to add Index contours
- Uses intermediate TIN which can be simplified as needed



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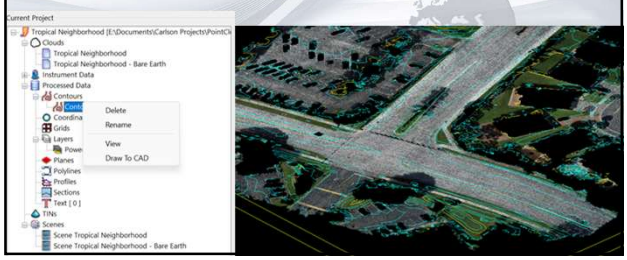
Contours

Contours appear in the project tree where they can be drawn to CAD



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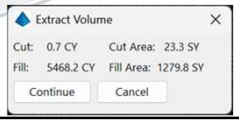
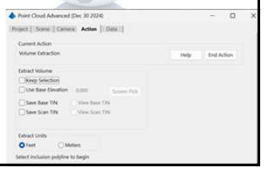
Extract Volumes

- Draw a Polyline using the Create Polyline Panel surrounding the mound
- Set Extract units
- Optionally extract Tins used for calculation
- Screen Pick the Polyline





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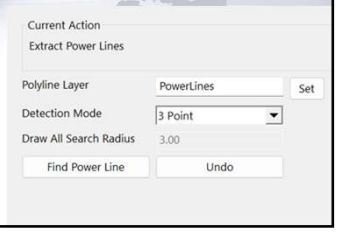
Extract Power Lines

Detection Modes

- 3-Point solves Catenary curve from 3 screen picked points
- 1-Point follows wire points from one screen pick
- 1-Point Draw all works same as above but also looks for nearby parallel powerlines in the search radius



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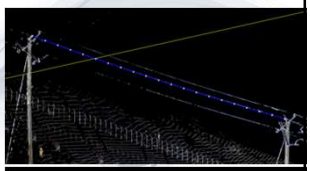
Extract Power Lines

3-point mode is best when the wire is not captured in the point cloud well

1-point require the wire be well captured in the cloud to follow accurately.



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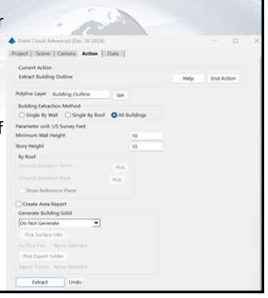
Extract Buildings

- Extracts rough polylines of building footprints, calculates approximate areas and heights
- Recommended to use “Single By Wall” for cloud made with ground lidar. Requires clicking on a wall
- Recommended to use “All Buildings” for other cases.
  - Works with Selection
- Set Minimum Wall Height above height of fences for better results



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Extract Buildings

Extracted outlines are numbered with floor count, height, and rea

Using Extract All Buildings

Using Extract Single By Wall

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Feature Extraction with Cloud and Orthomosaic Image

- Parking Lines / Paint Stripes
- Curbs
- Smart Classifications

These routines utilize Machine Learning techniques to detect features. Send us your datasets to help us improve the detection!

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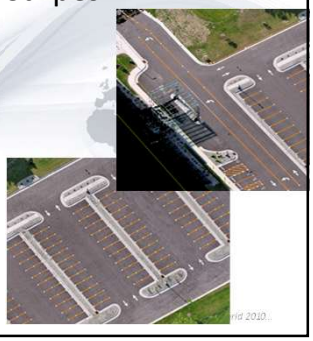
Parking Lines / Paint Stripes

- Paint lines - Extracts all paint lines including road lines
- Parking Lines - Extracts parking lines only as 3-point polylines
- Recommended to use Auto Detection mode which requires orthomosaic image.
- Use Selection Mode if orthomosaic is not available. Requires paint points be selected well



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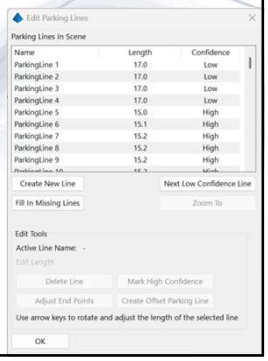
Parking Line Editor

Access from Line Editor button on Parking Line extraction panel

- Create new
- Fill in missing
- Edit existing
- Review low confidence parking lines



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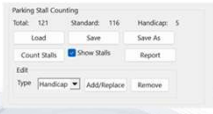
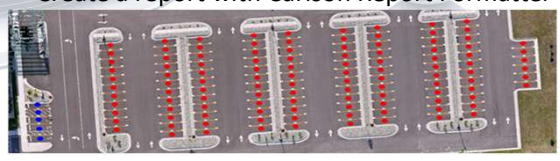
Parking Stall Counting

- Requires polylines from Parking Lines routine
- Counts stalls in between parking lines
- Manually edit spaces as Standard or Handicap
- Visualizes parking stalls with colored markers
- Create a report with Carlson Report Formatter





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Curbs

"Curbs" on the action page is legacy routine

Use Feature Extraction drop down -> Curbs.

Requires Orthomosaic Image

Detects the base of curb line and then offsets the line to create top and back of curb lines

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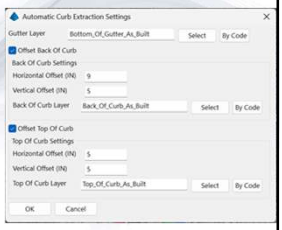
Curb Settings

Access from Feature Extraction drop down menu –

> Curb Settings…

- Set Layer names
- Enable/disable back and top of curb offset polylines
- Set horizontal and vertical offset values



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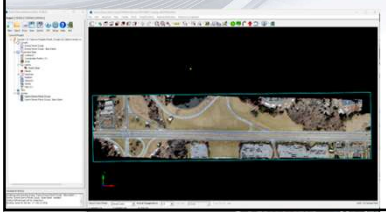
Road Edges

Access from Feature Extraction drop down menu –

> Road Edges…

- Set Layer names
- Send To CAD
- Polylines Category = Road Edge



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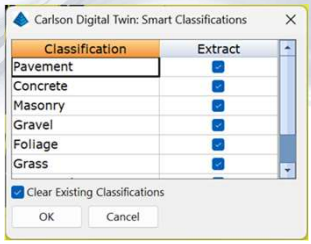
Smart Classifications

Access from Classifications drop down menu -> Smart Classifications from Image

Set Classifications to extract from menu

Sets color more to classification for visualization of results



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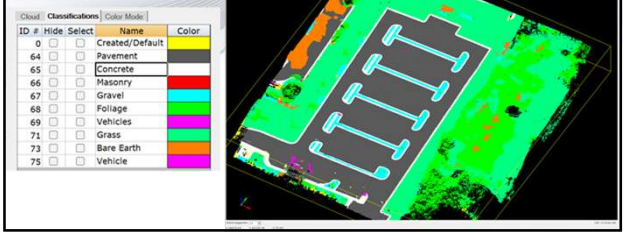
Smart Classifications



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SESSION EVALUATION

2026 SURVEYORS' Conference

HTTPS://WWW.SURVEYMONKEY.COM/R/PSLS2026EVAL

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