



Presented at the FIG Working Week 2023,
28 May - 1 June 2023 in Orlando, Florida, USA

FIG WORKING WEEK 2023

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Protecting
Our World,
Conquering
New Frontiers

Data Quality Considerations that Allow Automated Modeling of UAS Point Clouds

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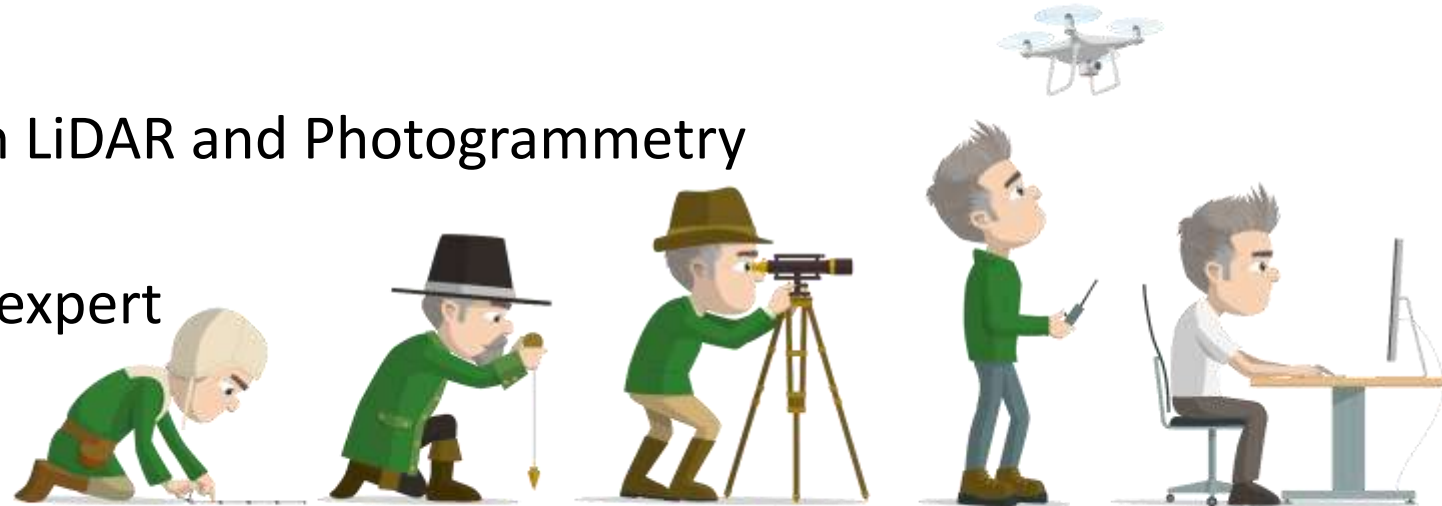


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Making UAS Technology More Efficient

- The main goal is to educate about how UAS point clouds differ and how data quality affects feature extraction efficiency
- There are many applications for UAS but make sure to pick the right tool for the job
- Focus on the data not on the system
- Help clear up any confusion between LiDAR and Photogrammetry based data sets
- We want to make you a data quality expert



About TopoDOT®

30+ Years in LiDAR Industry

15+ Years Development

HQ in Orlando, FL. USA

Offices in UK, Romania, Australia and China

7000+ Users

700+ Customers Worldwide

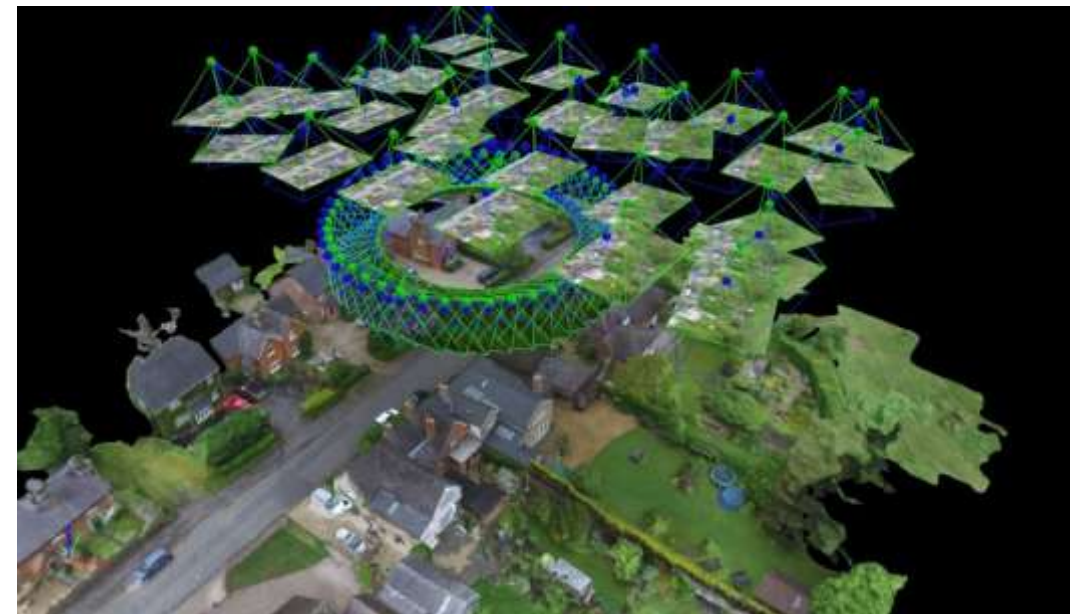
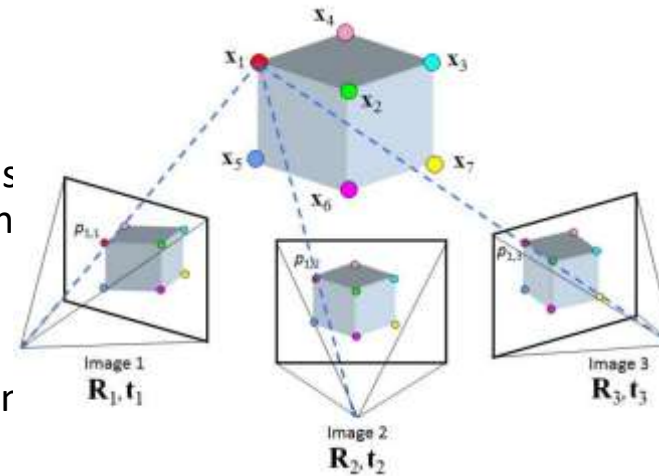


Data Fusion



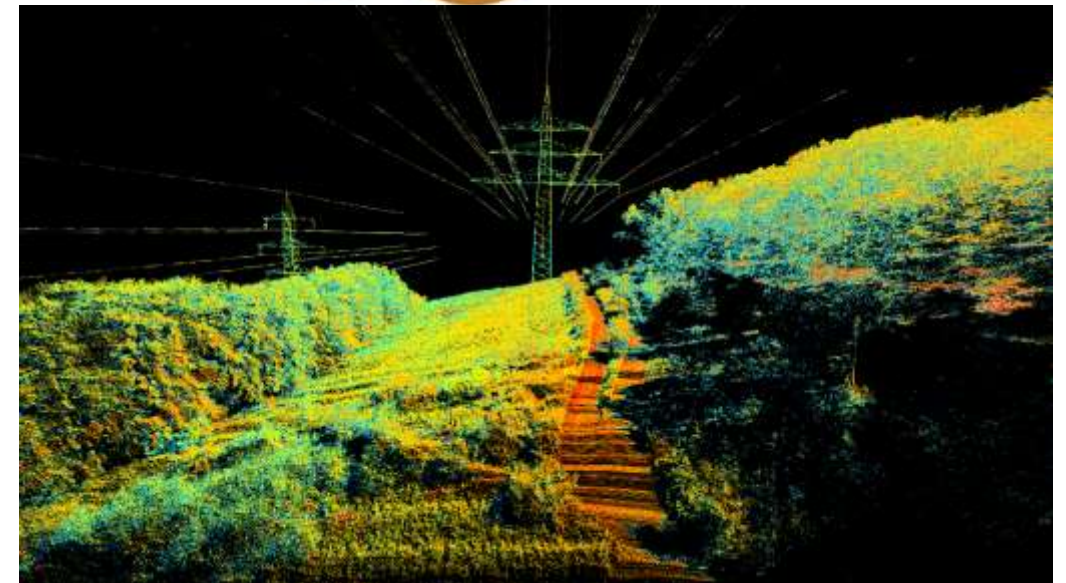
UAS – Photogrammetry

- How does it work?
 - Collect a bunch of high-resolution photos that overlap an area so that a single feature appears in multiple photos but from varying vantage points.
 - Post Process Geo-Referencing
- These type of point clouds are also referred to as Structure from Motion (SfM)
- Additional Equipment – Subsystems (IMU optional), Cameras
- Accuracy?
 - To achieve high accuracy one must pick a higher end professional camera
 - Limited to Pixel Density and/or Size – GSD (Ground Sampling Distance)
- When to pick over LiDAR?
 - Areas free from overhead trees or dense forest canopies
 - Large Structures (ALTA Survey)
 - Accuracy requirements aren't as tight
- Open bare earth, mining, volumetric



UAS – LiDAR

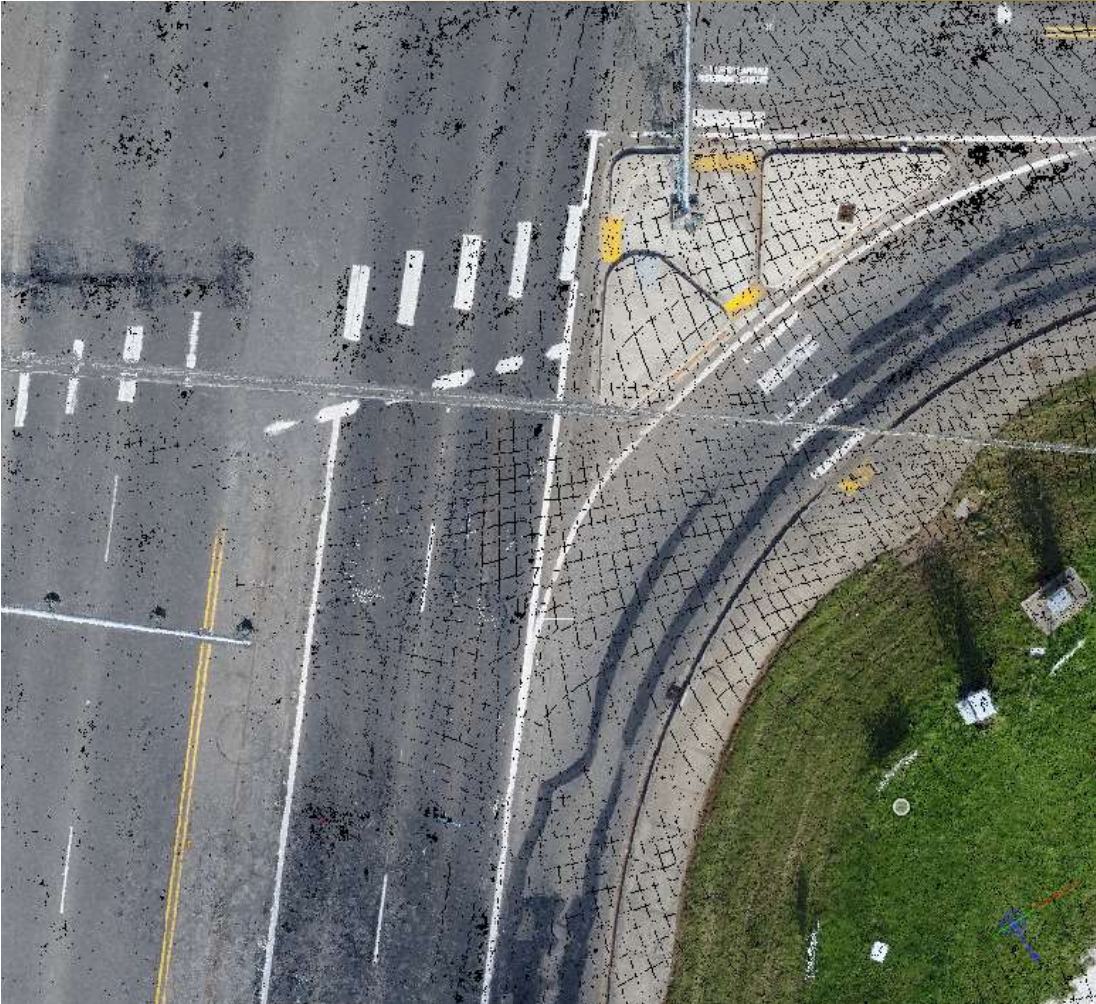
- How does it work?
 - LiDAR stands for ‘Light Detection and Ranging’ that uses pulses of laser light – and time of flight – to determine the surface of objects and/or the ground. These pulses happen quickly and in various directions, forming a sheet/plane of light that is flown over the terrain.
 - Direct Geo-Referencing
- Additional Equipment – Subsystems (GNSS/GPS, INS-IMU), Cameras
- Accuracy?
 - To achieve high accuracy one must pick a higher end professional sensor
 - Limited to Point Density and Calibration of subsystems
- When to pick over Photogrammetry?
 - Areas with dense forest canopy
 - Structures of small diameter: utilities, powerlines
 - Fusing with MLS or TLS
- Powerlines, transportation, data fusion



How to go from this...



LiDAR

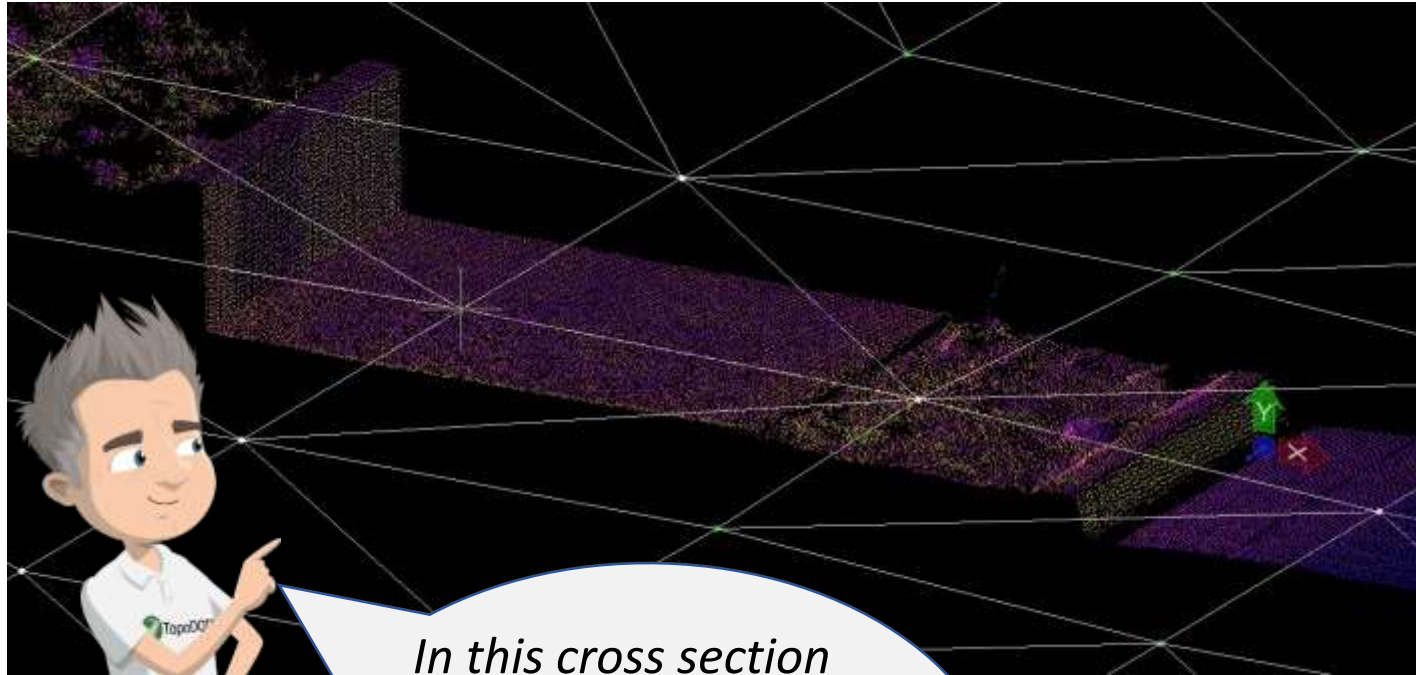


Photo/SFM 10

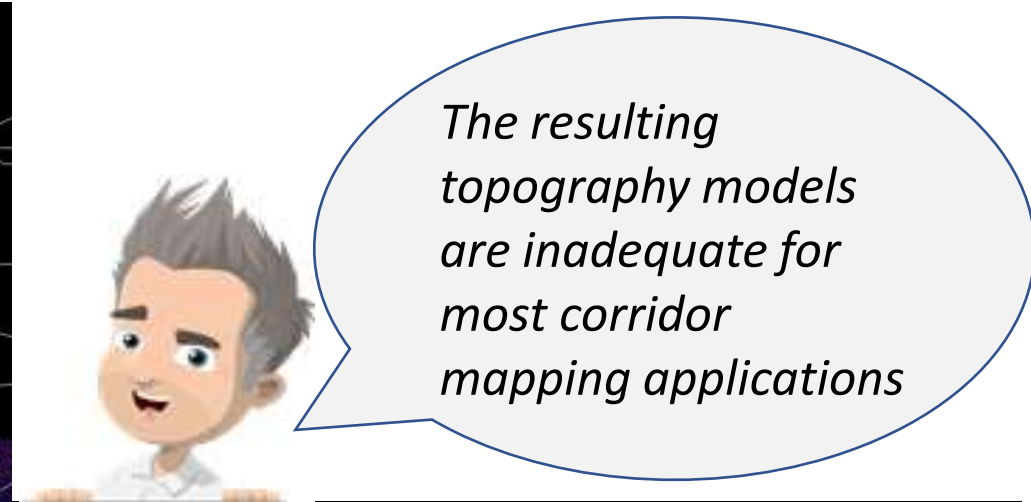
To this...



Automatic DTM Extraction from “Ground” Data Doesn’t Meet Feature Requirements of Engineering Quality CAD Deliverables



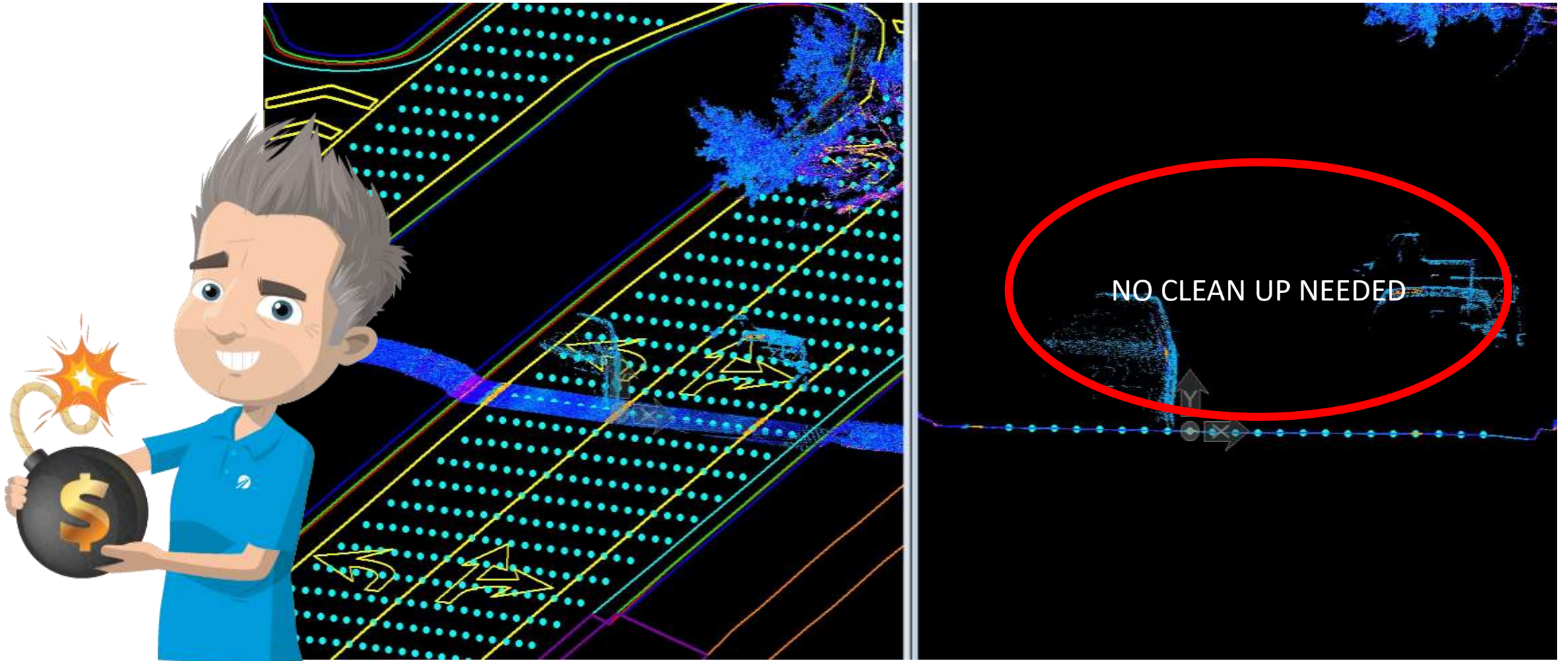
In this cross section of point cloud data for example, legacy software didn't place breaks at the critical features.



The resulting topography models are inadequate for most corridor mapping applications



Key to Unlock Point Cloud Survey Efficiency is: A Signature based Approach to Point Cloud Extraction



Signature Based Feature Extraction



UAV Point Cloud Feature
Extraction under 5 minutes



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Quality Considerations for Feature Extraction Using Signature Based Automated Tools



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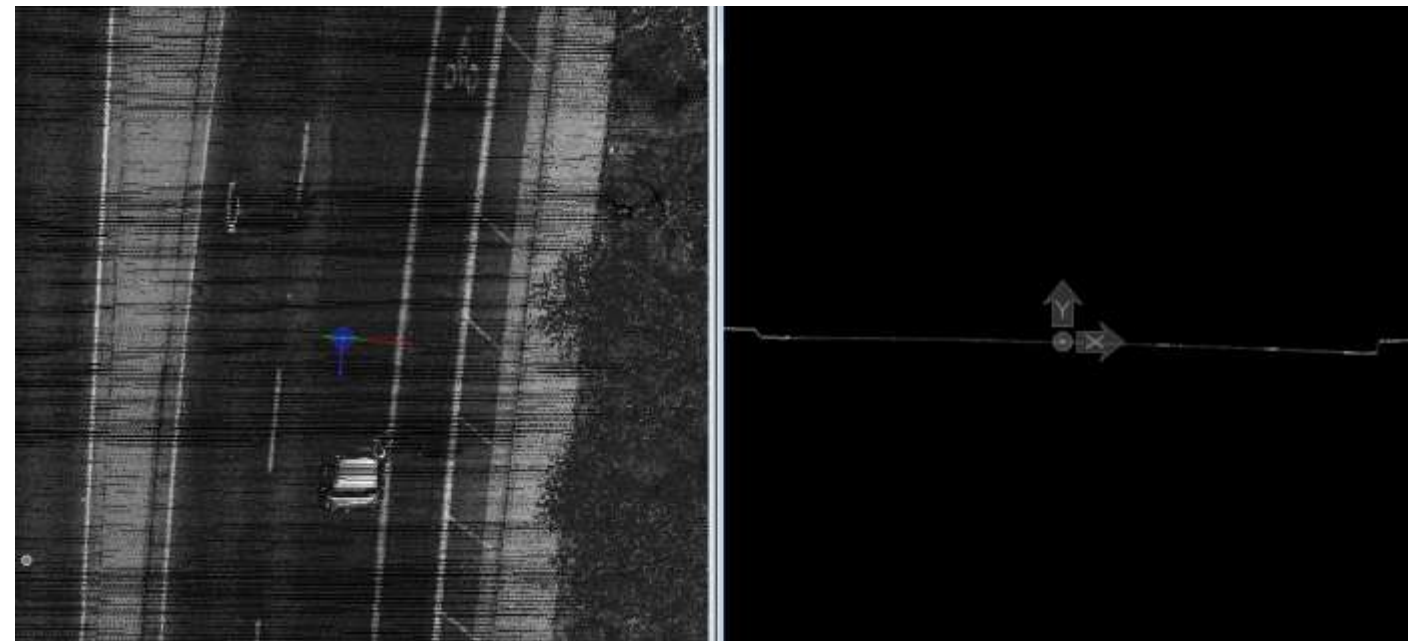


LiDAR

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Surfaces: Road



LiDAR

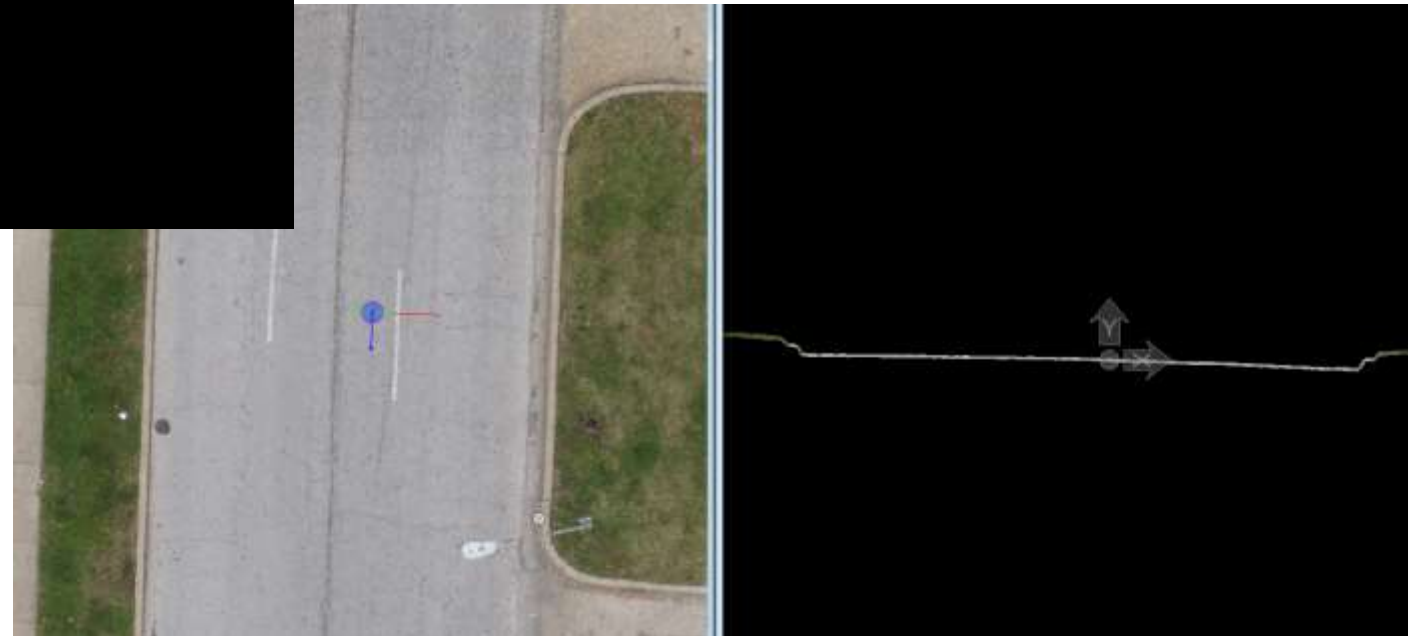
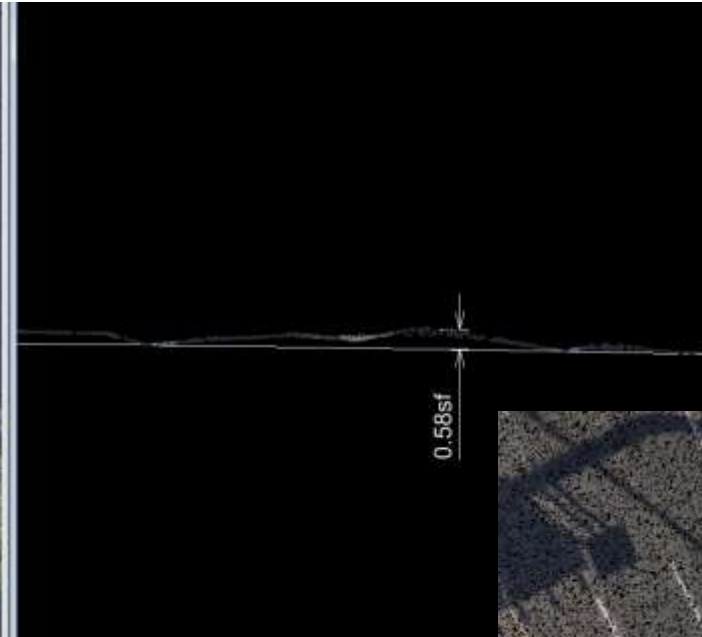
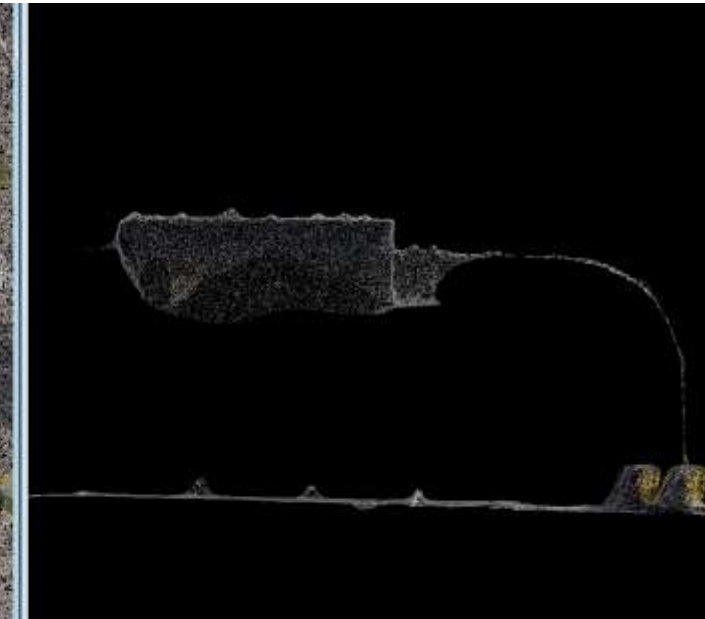


Photo 16

Surfaces: Road – The poor (Anomalies)

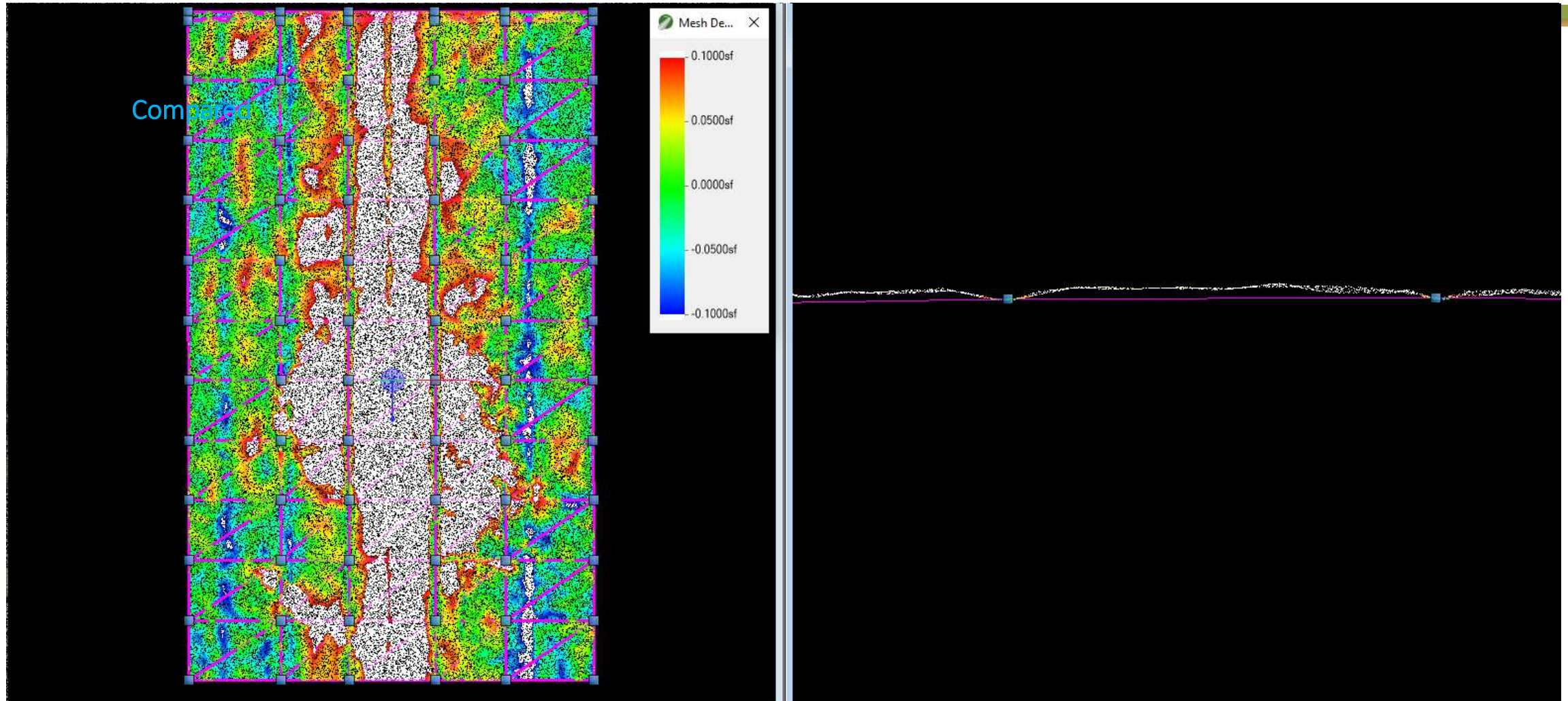


Photo



Photo

UAS Visual – Road – The poor (Anomalies)

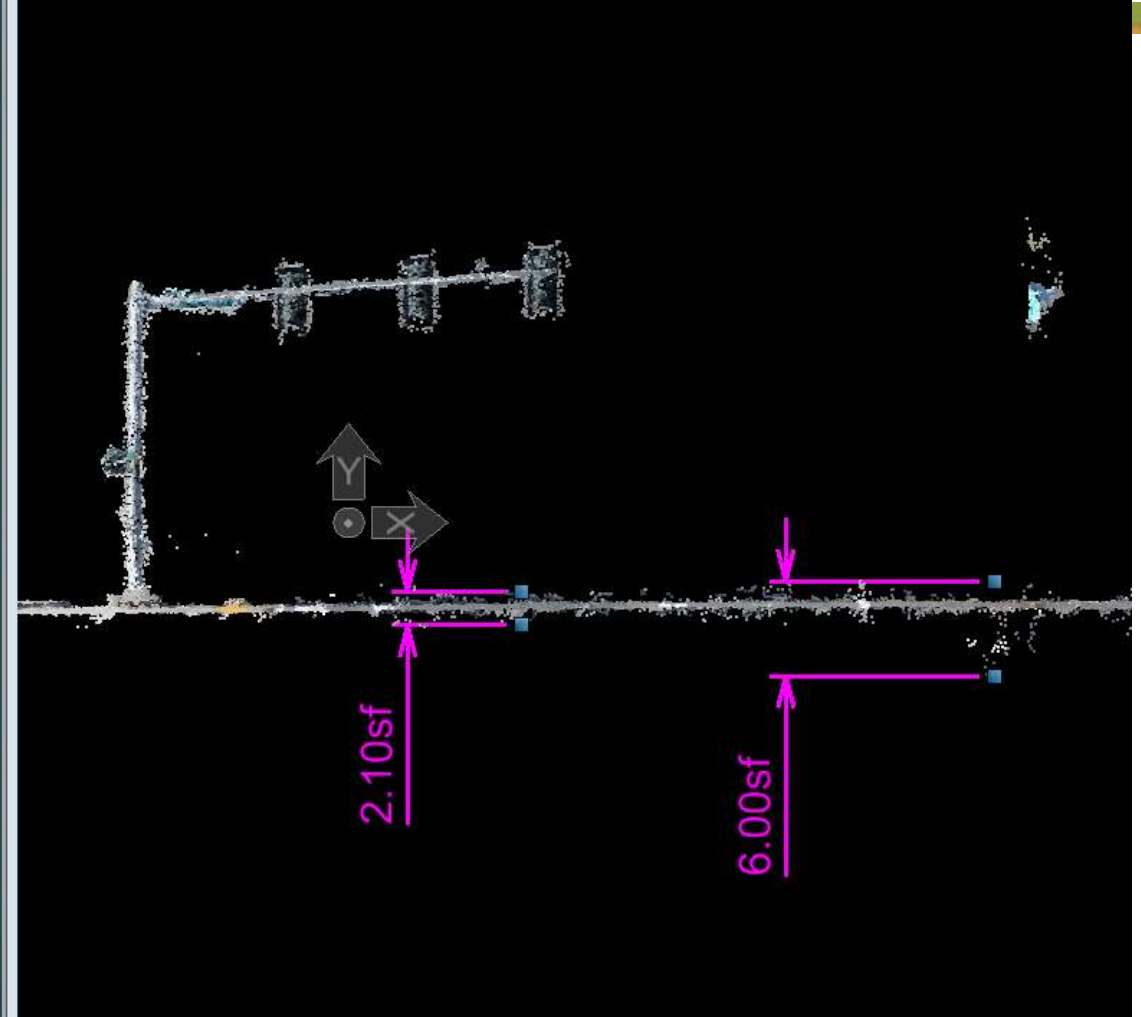


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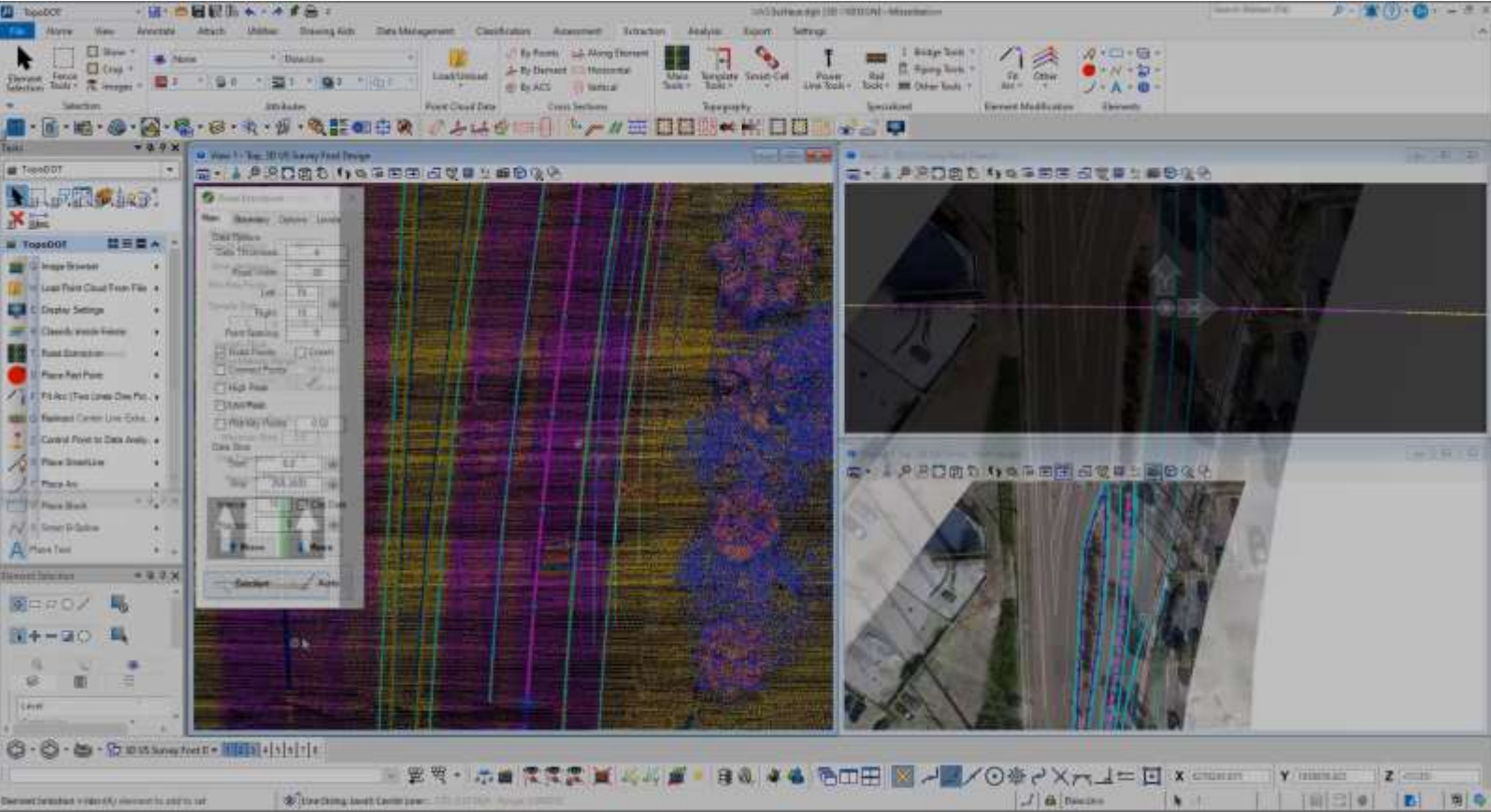
UAS Visual – Road – Noise



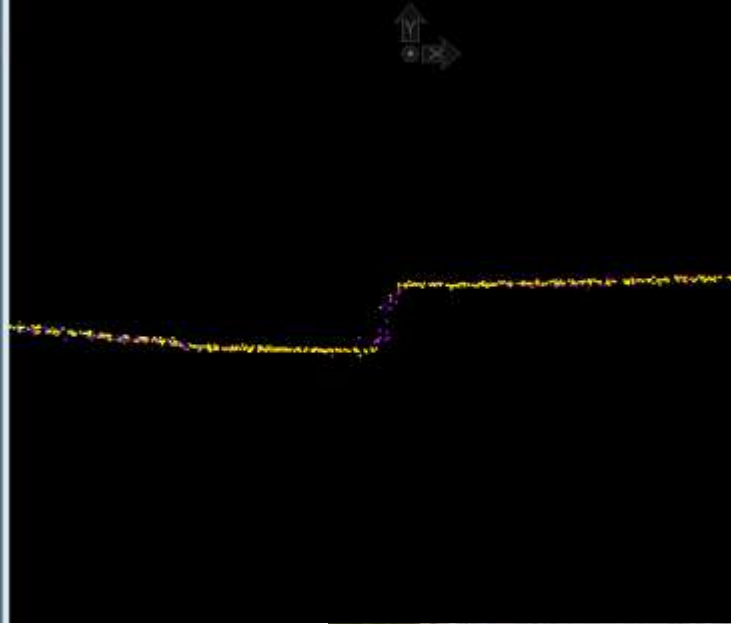
Photo



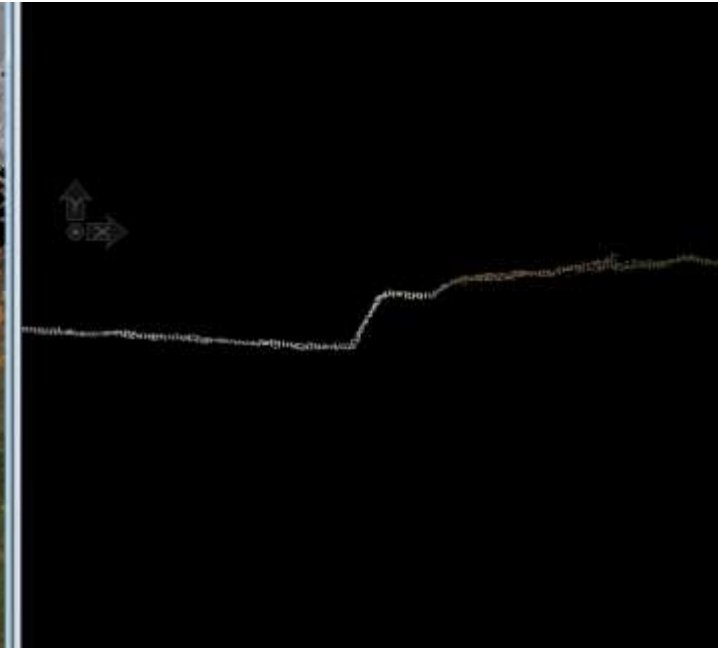
Surface Model



Man Made Structures: Curbing – The Good



LiDAR



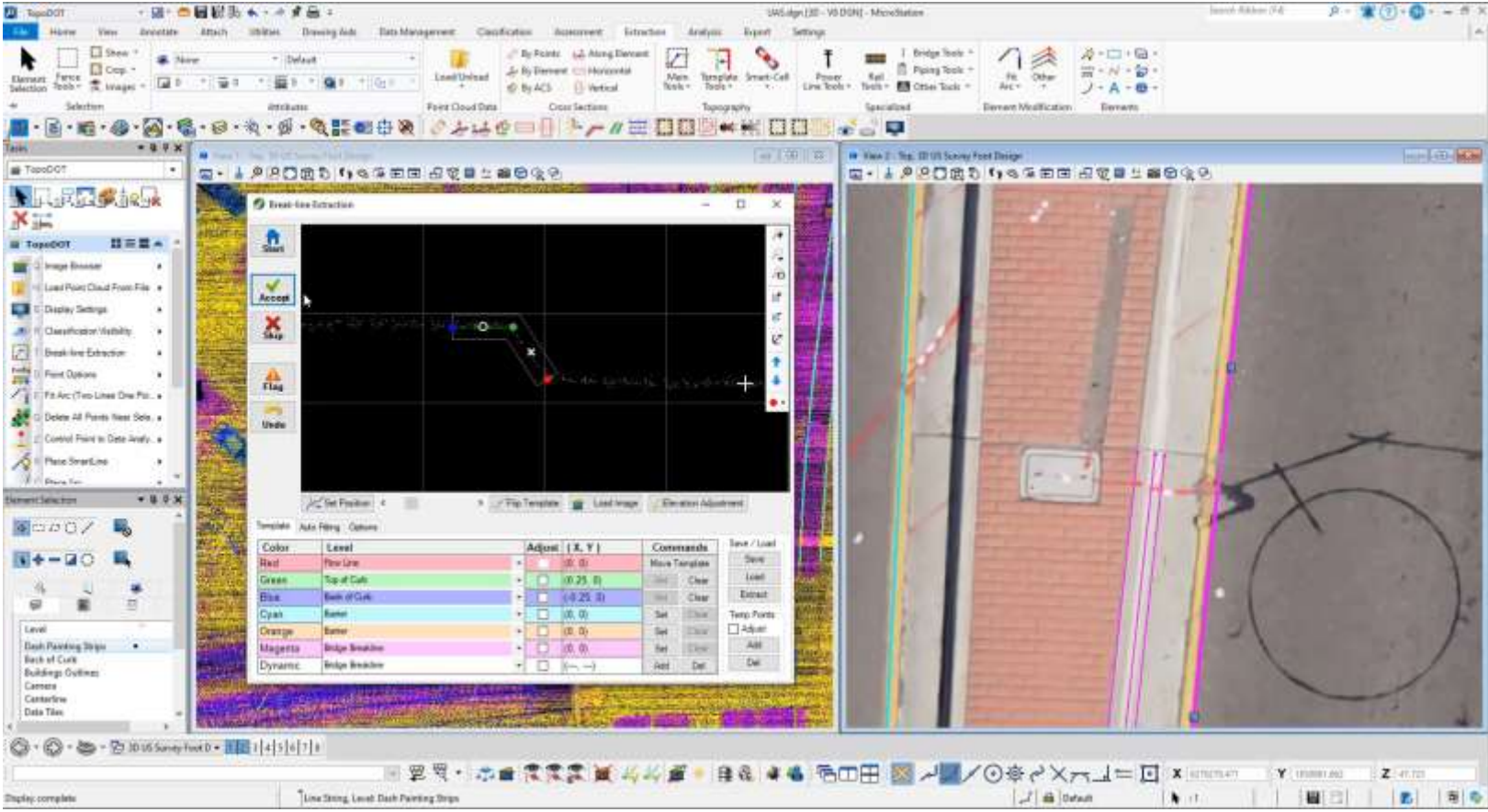
Man Made Structures: Curbing – Poor



LiDAR



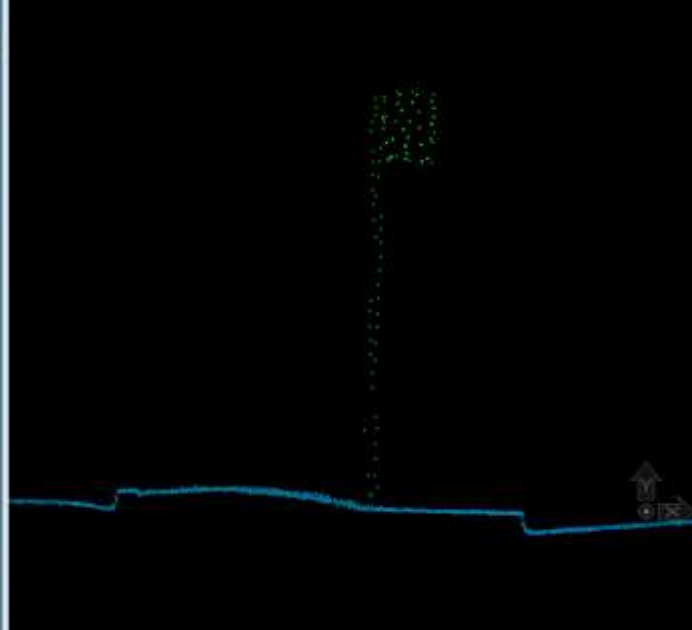
Break Lines



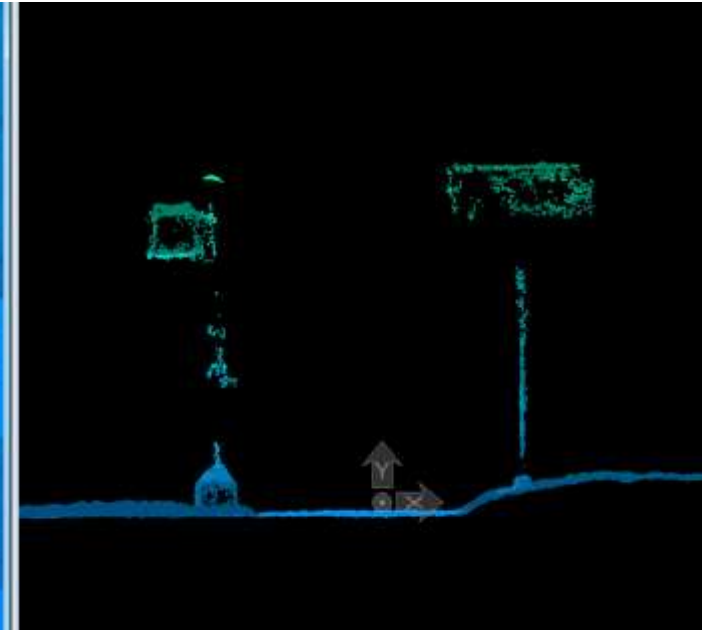
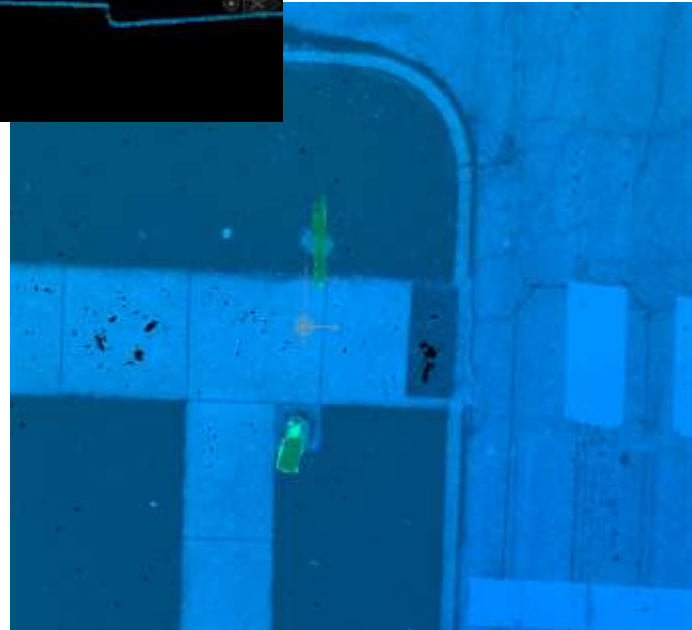
Vertical Assets: Signs/Lights – Good



Photo



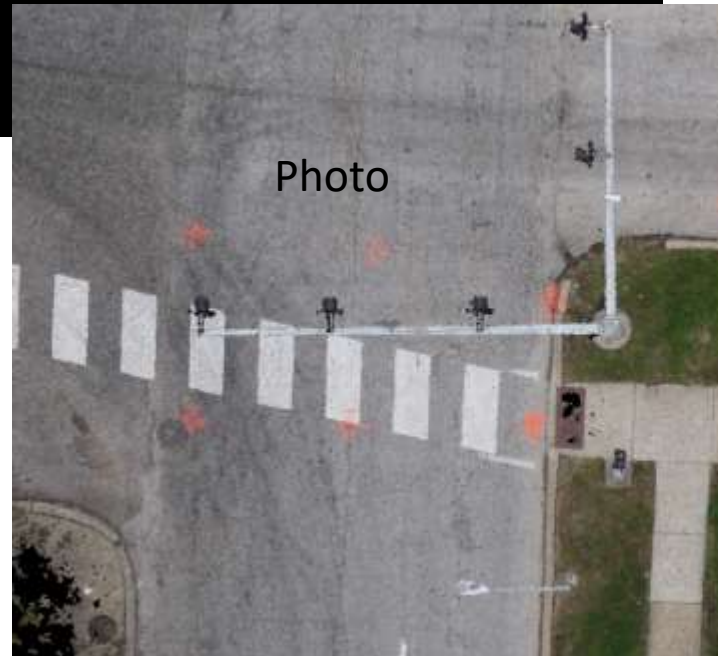
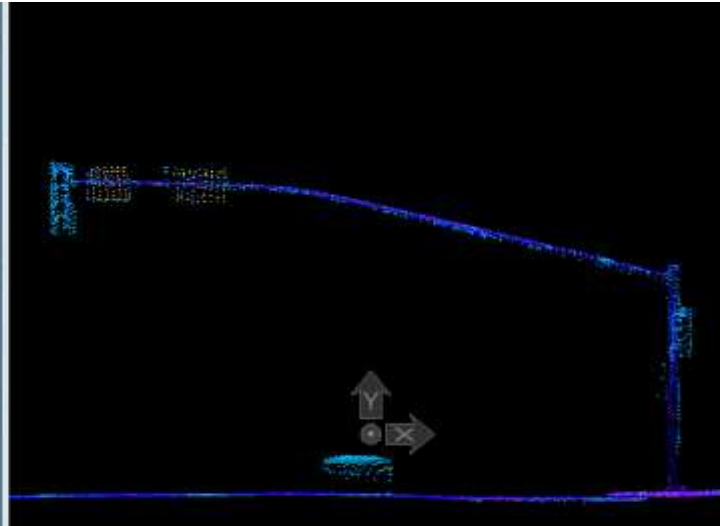
LiDAR



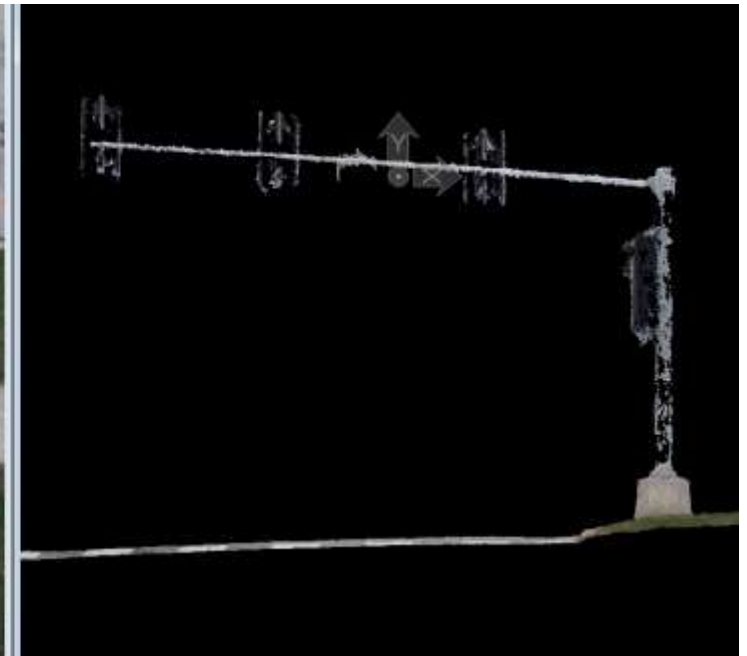
Vertical Assets: Traffic Mast – Good



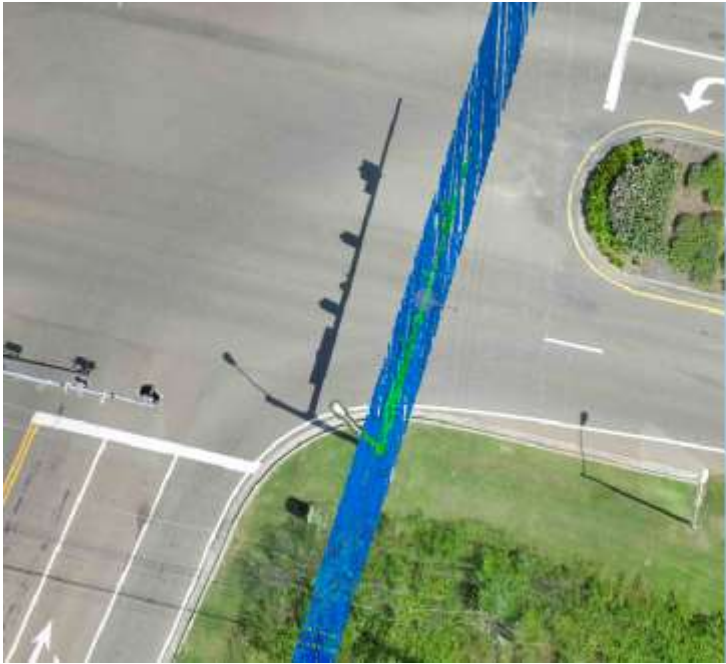
LiDAR



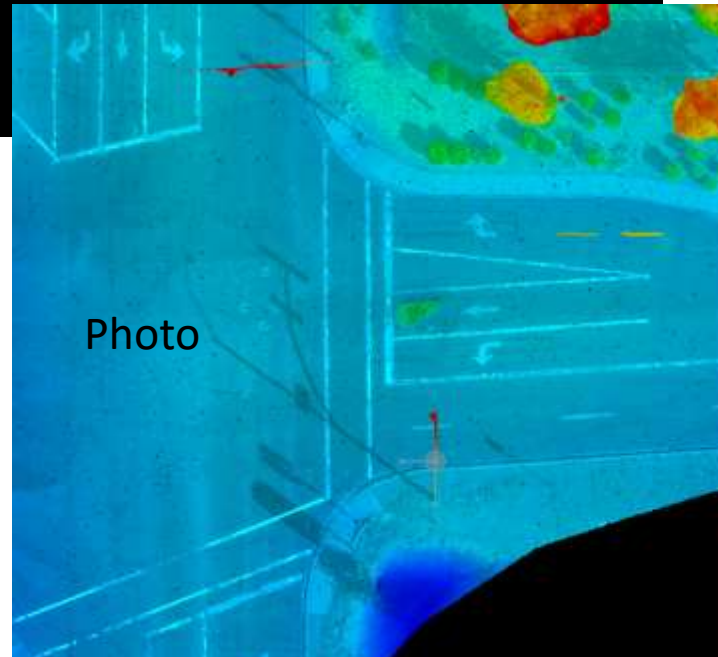
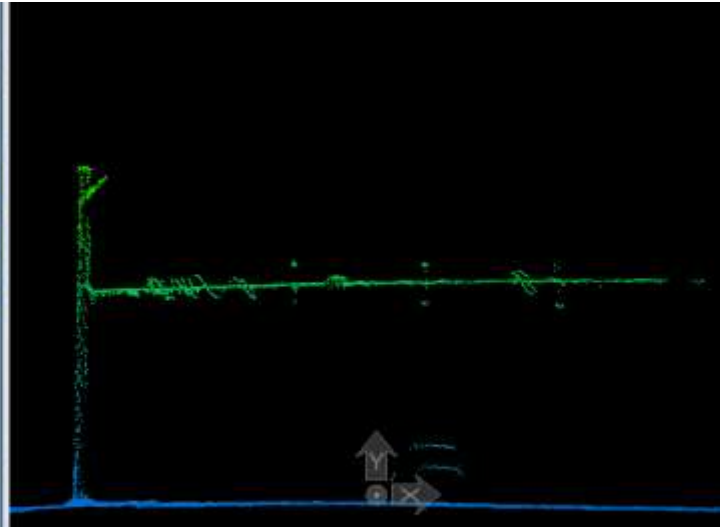
Photo



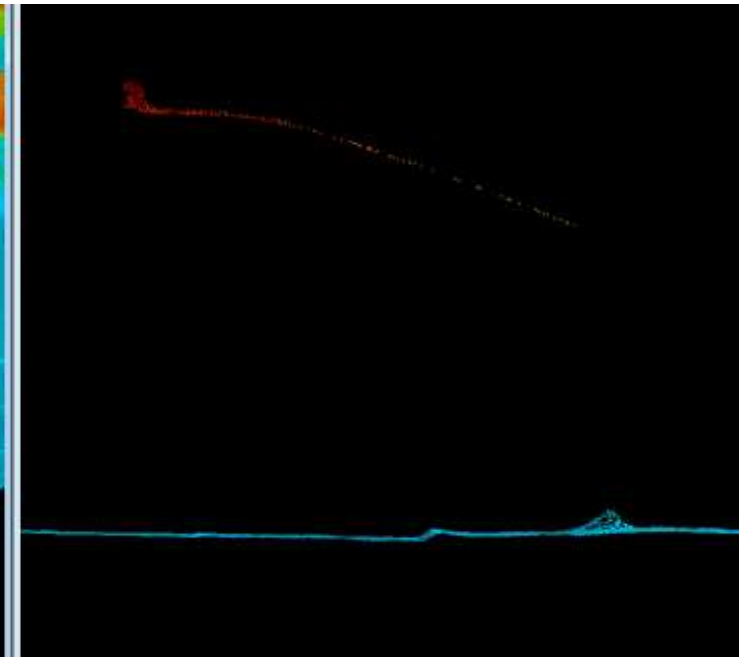
Vertical Assets: Traffic Mast – Poor



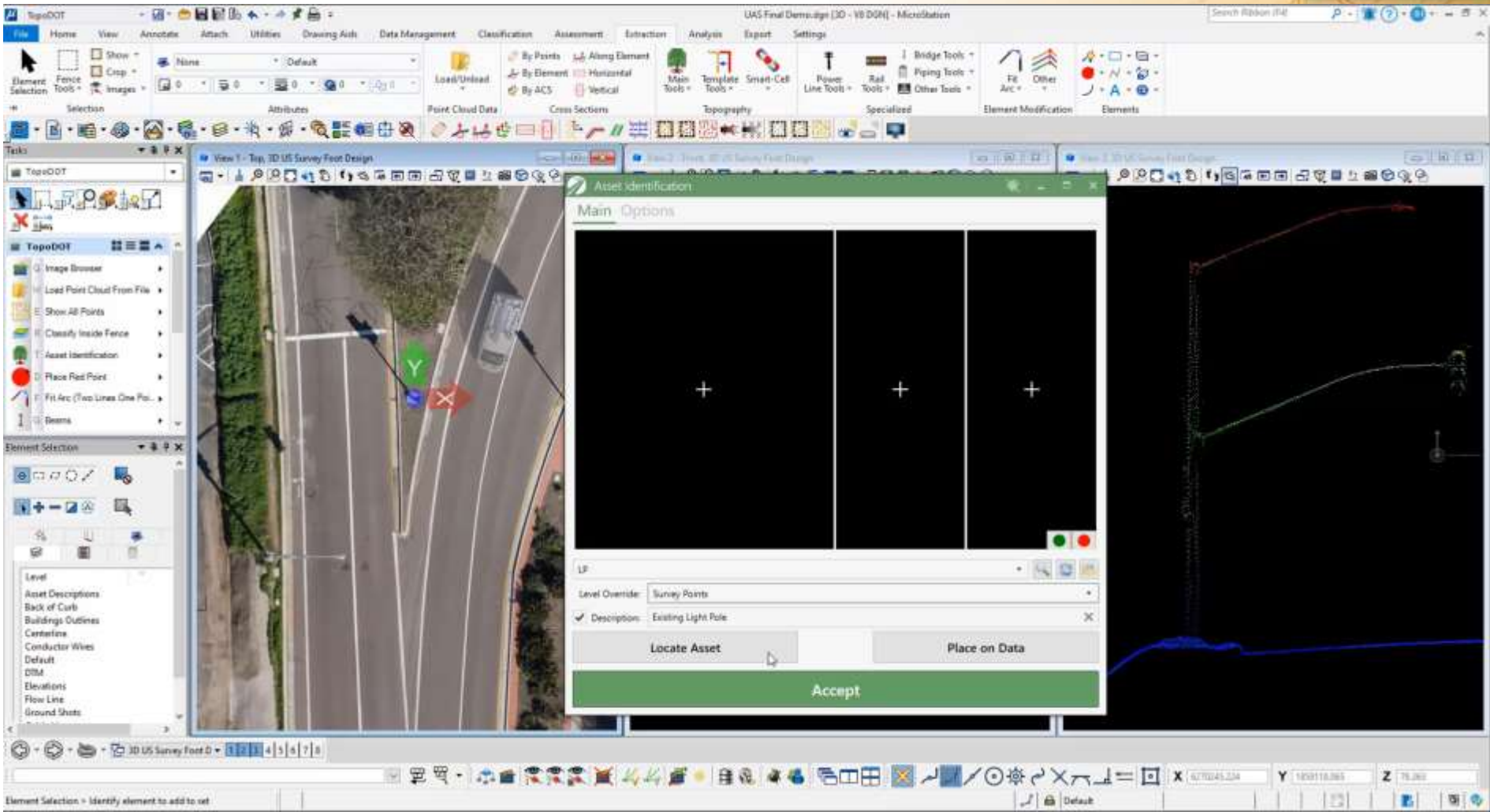
LiDAR



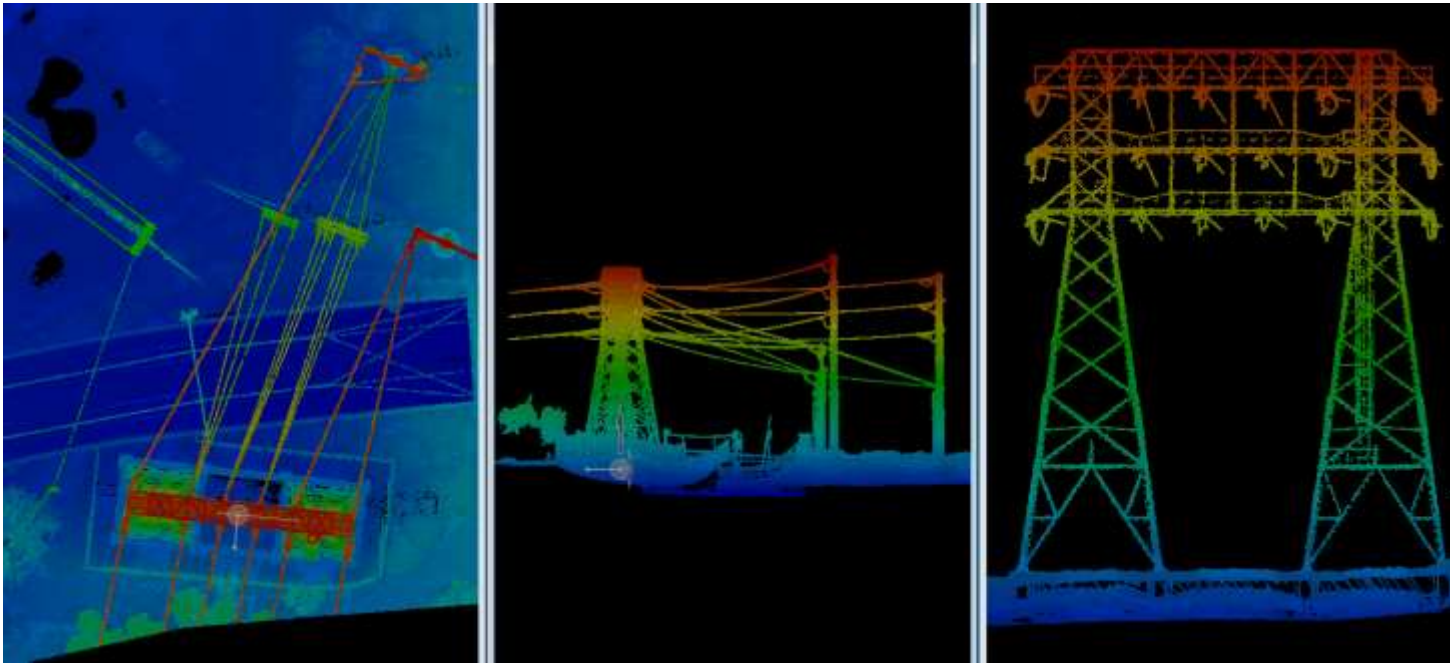
Photo



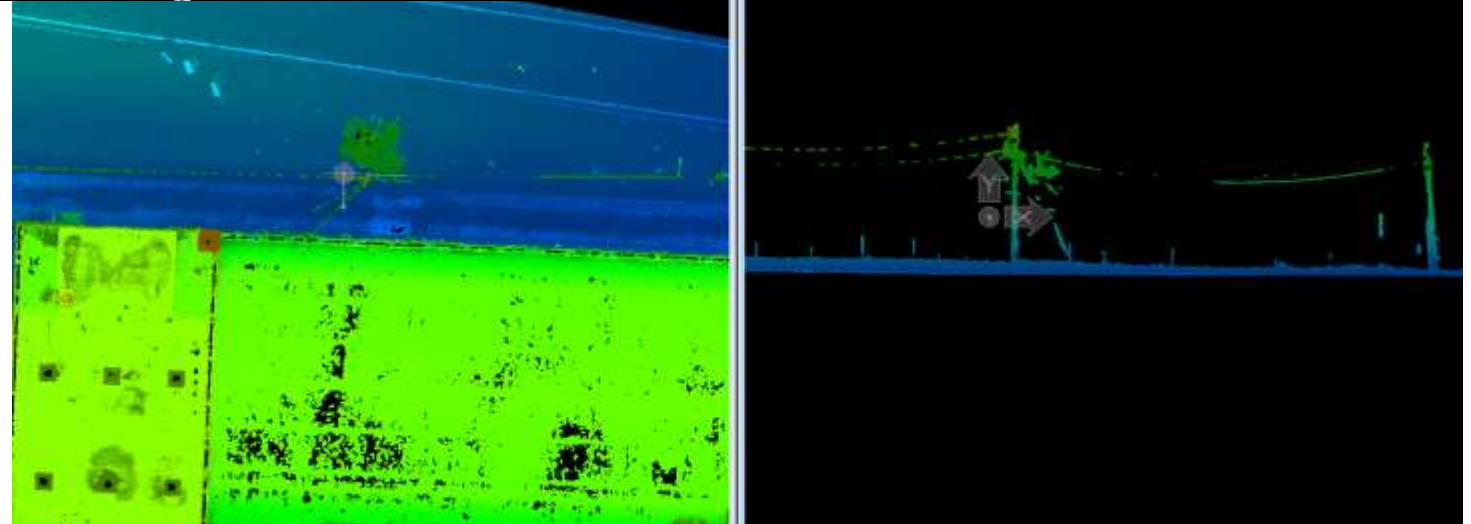
Vertical Assets



Linear Features— Powerlines



LiDAR

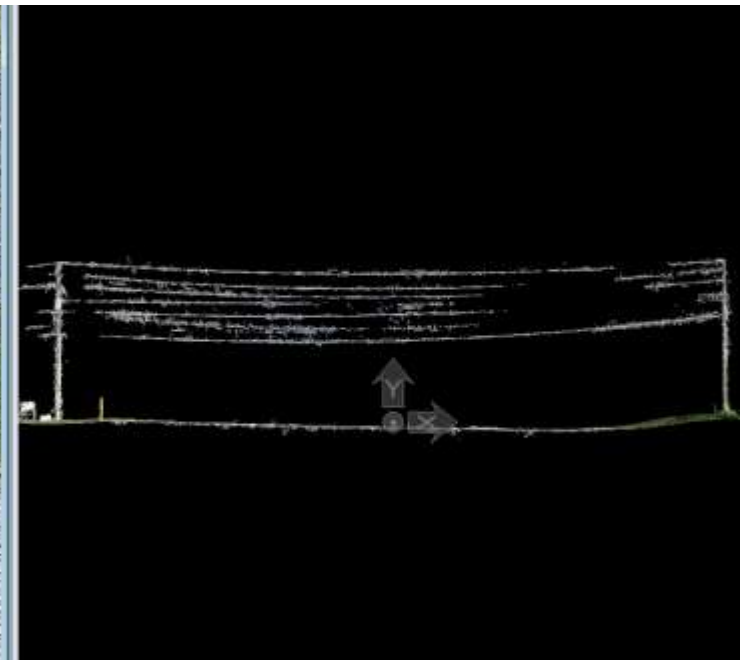
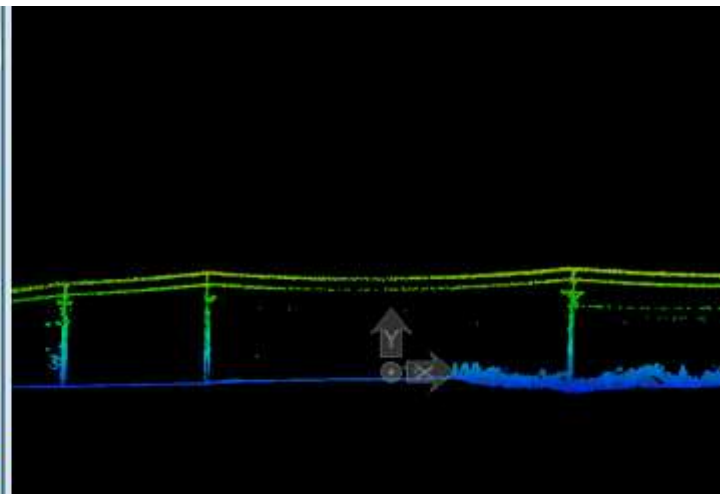


Photo

Linear Features— Powerlines

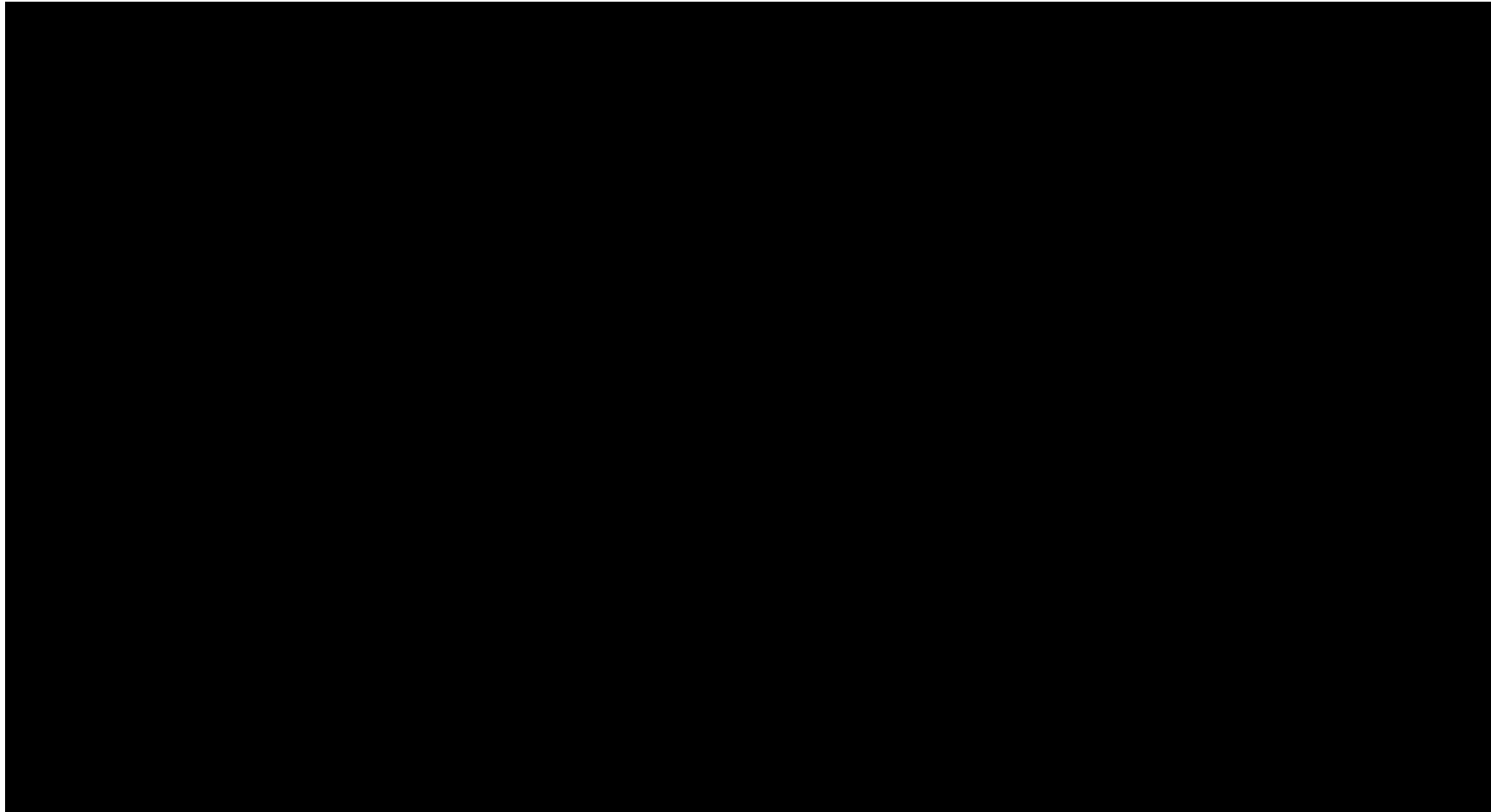


LiDAR

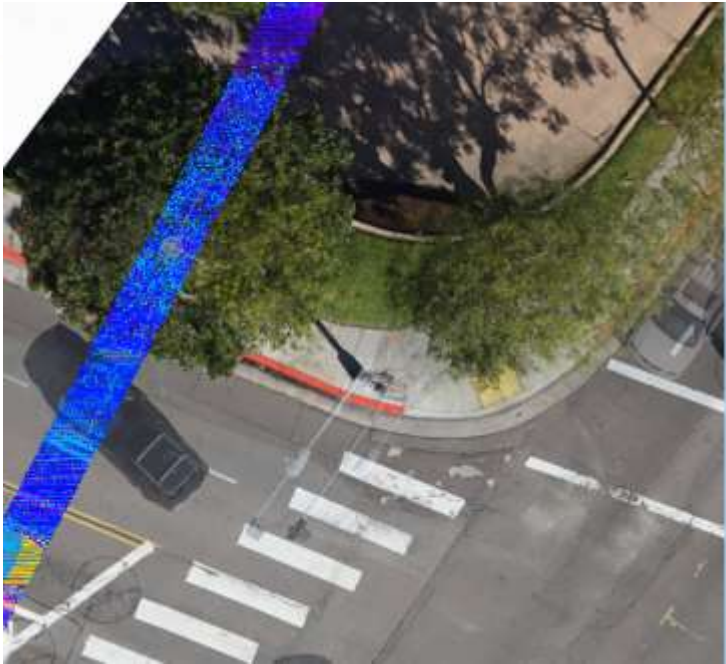


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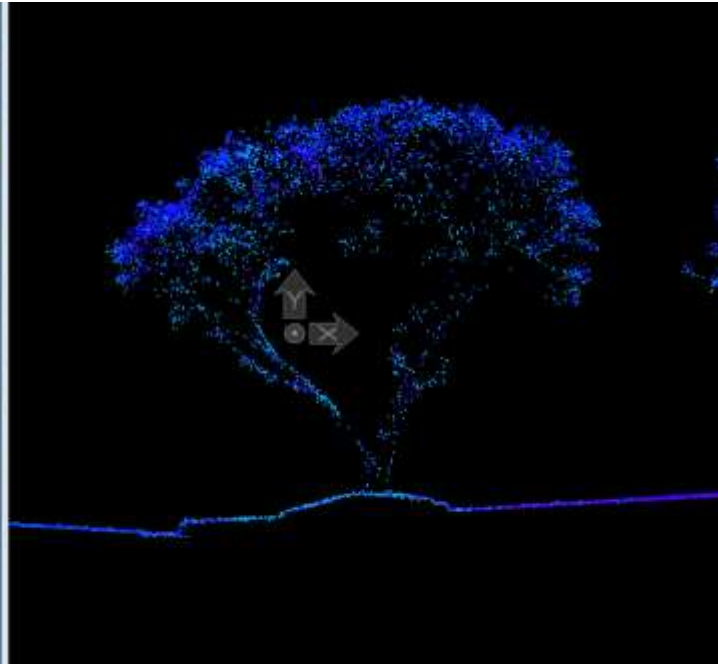
Linear Features



Vegetation



LiDAR



Photo

Vegetation

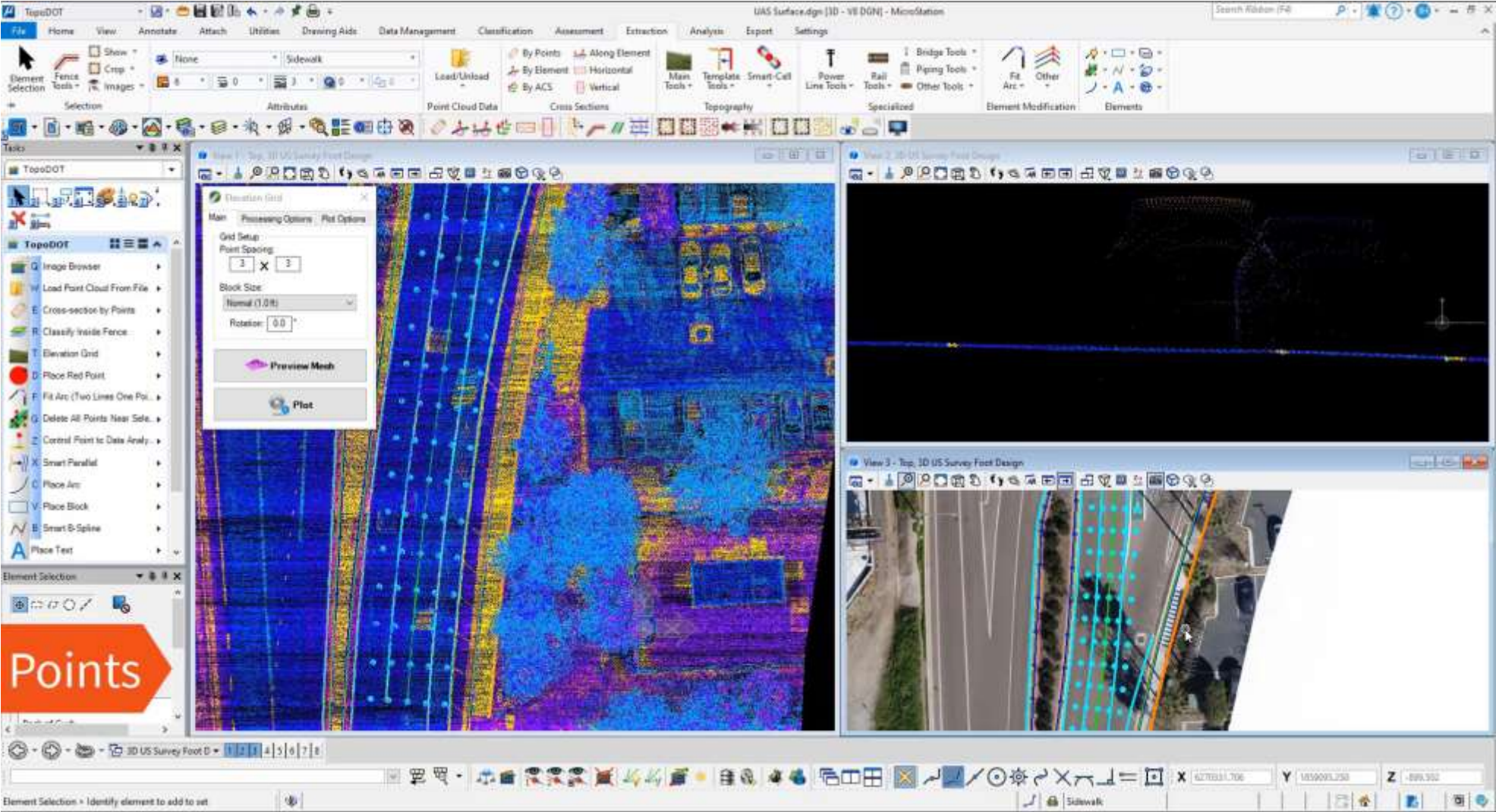


Photo

Photo



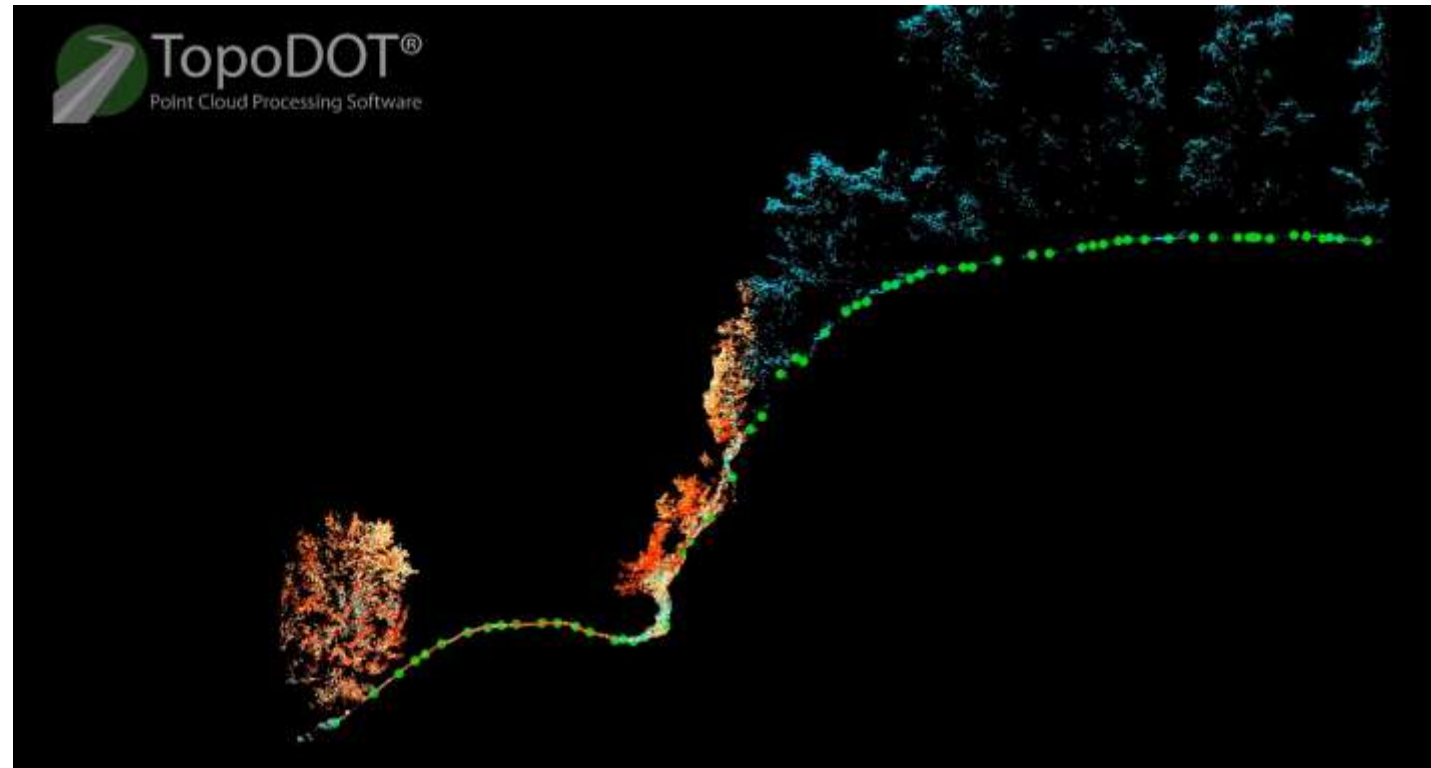
Vegetation



Big Picture

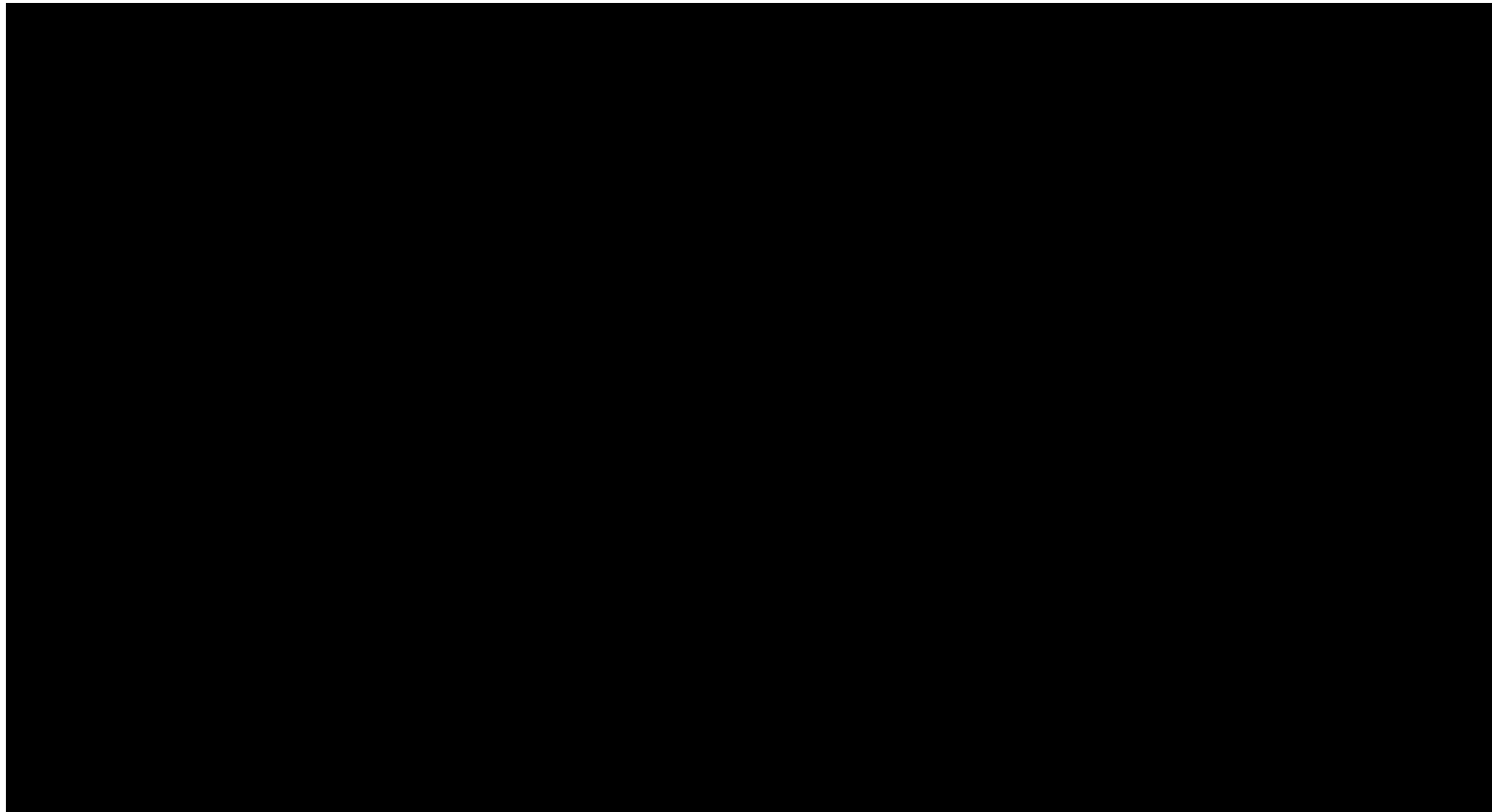
The benefits of advancing survey technology with drones are many:

- Ease of scalability and the ability to work remotely
- Applies to a wide variety of applications and can be geolocated
- Improve productivity, safety and collaboration
- It is a sustainable and accessible technology proving: lower costs, project times and repeat field-trips
- Extract faster than traditional methods

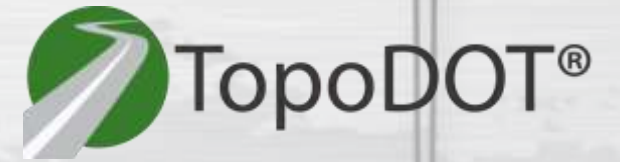


Key to Unlock Productivity

- Feature extraction efficiency depends on data quality
- Lower quality data can make feature extraction inefficient and therefore costly
- Cleaning the data can be time consuming and inefficient. Use signature based approach
- Smoothing data may lose sharpness for man made objects
- If you can see the feature you can extract it



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