

“Another Tool in the Toolbox- Integrating Mobile Laser Scanning into the Mapping & Surveying Workflow”

IHEEP 2009

Bradley E. Adams, P.E.

BHI

Eric Andelin, C.P., GISP.

ADS



Agenda

- Introduction
- Existing Methods
- Mobile LiDAR
- Case Study- Loop 12
- Case Study- DFW Connector Project
- Conclusions



Introduction



Bohannan Huston, Inc.

Civil Engineering ▲ Spatial Data ▲ Advanced Technologies

Founded in 1959



Introduction



Founded 1964

All things geospatial

35 employees

Woman owned, Small Business, HUB Certified

Offices in Tulsa, OK and Austin, TX



Existing Methods

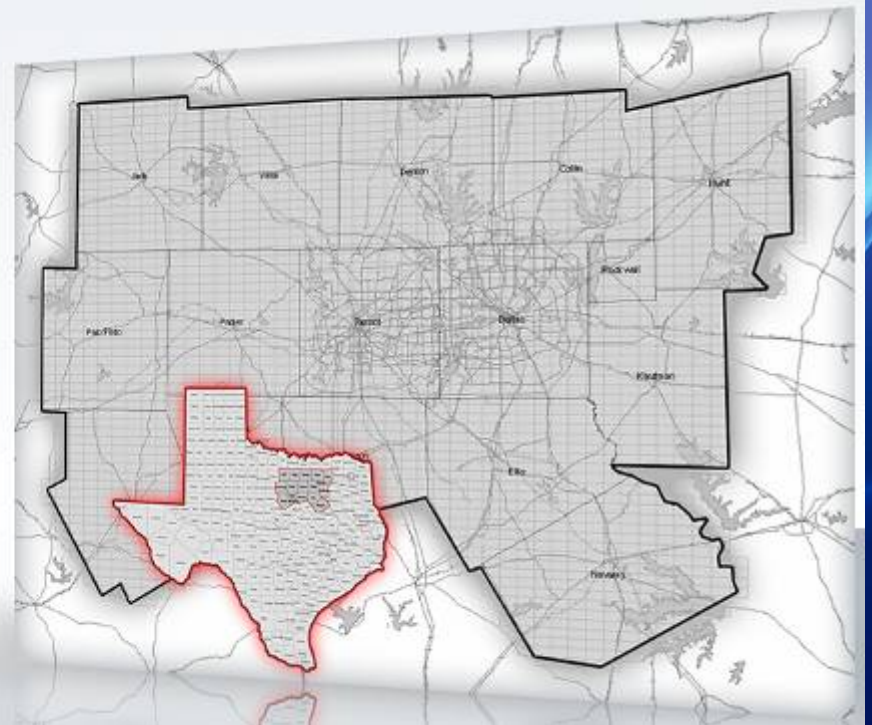
- Traditional Surveying
 - High Accuracy
 - Limited area
 - Very Slow



TxDOT 17 County

13,711

Square miles



TxDOT 17 County



TxDOT 17 County



TxDOT 17 County



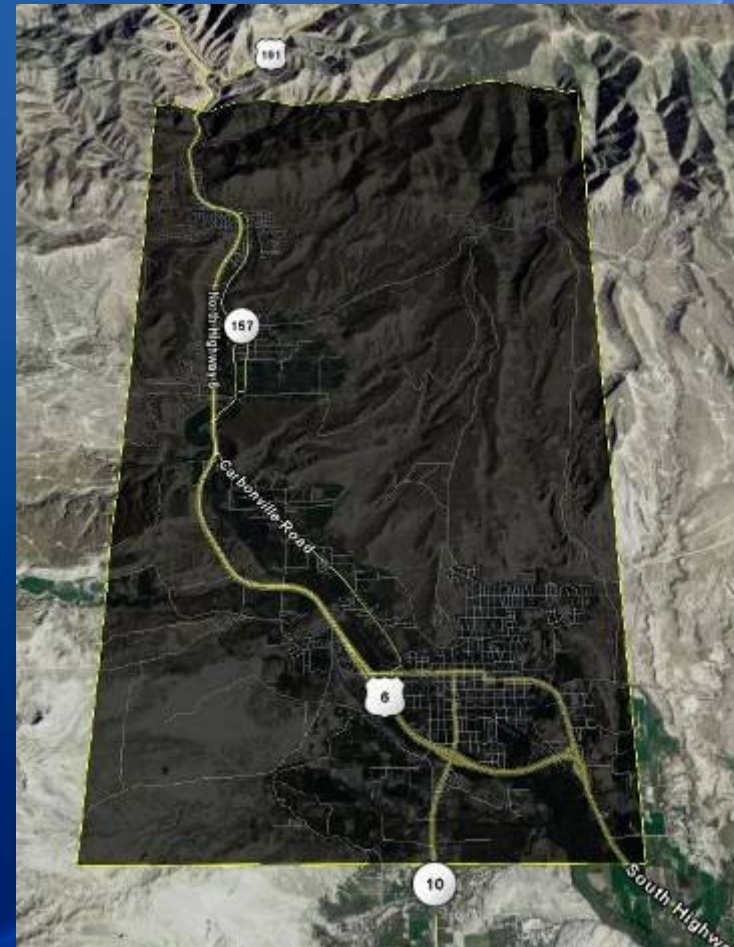
Carbon County, UT

50 square miles

2' contours

6 week turnaround

Low cost



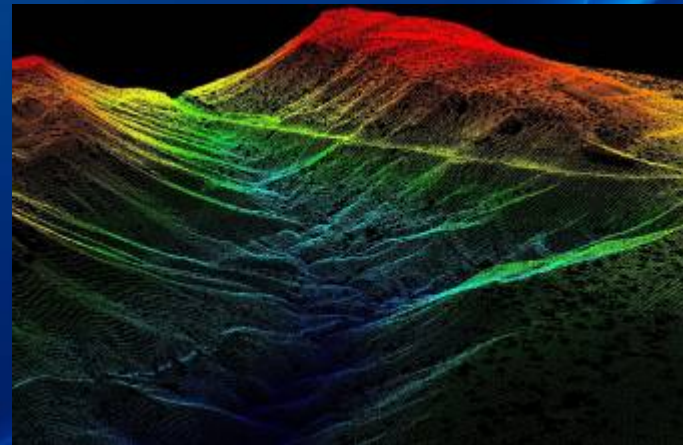
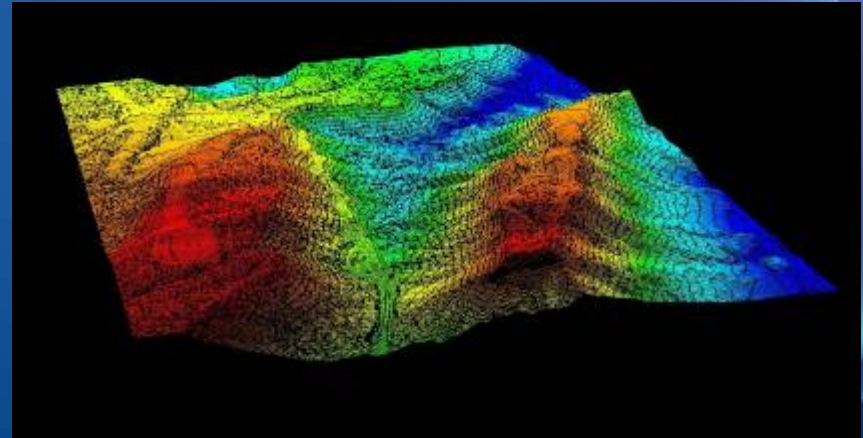
Carbon County, UT

3.5 sq km sample

1,750,000 points

2 pts per sq meter

- Bare earth
- Approximations



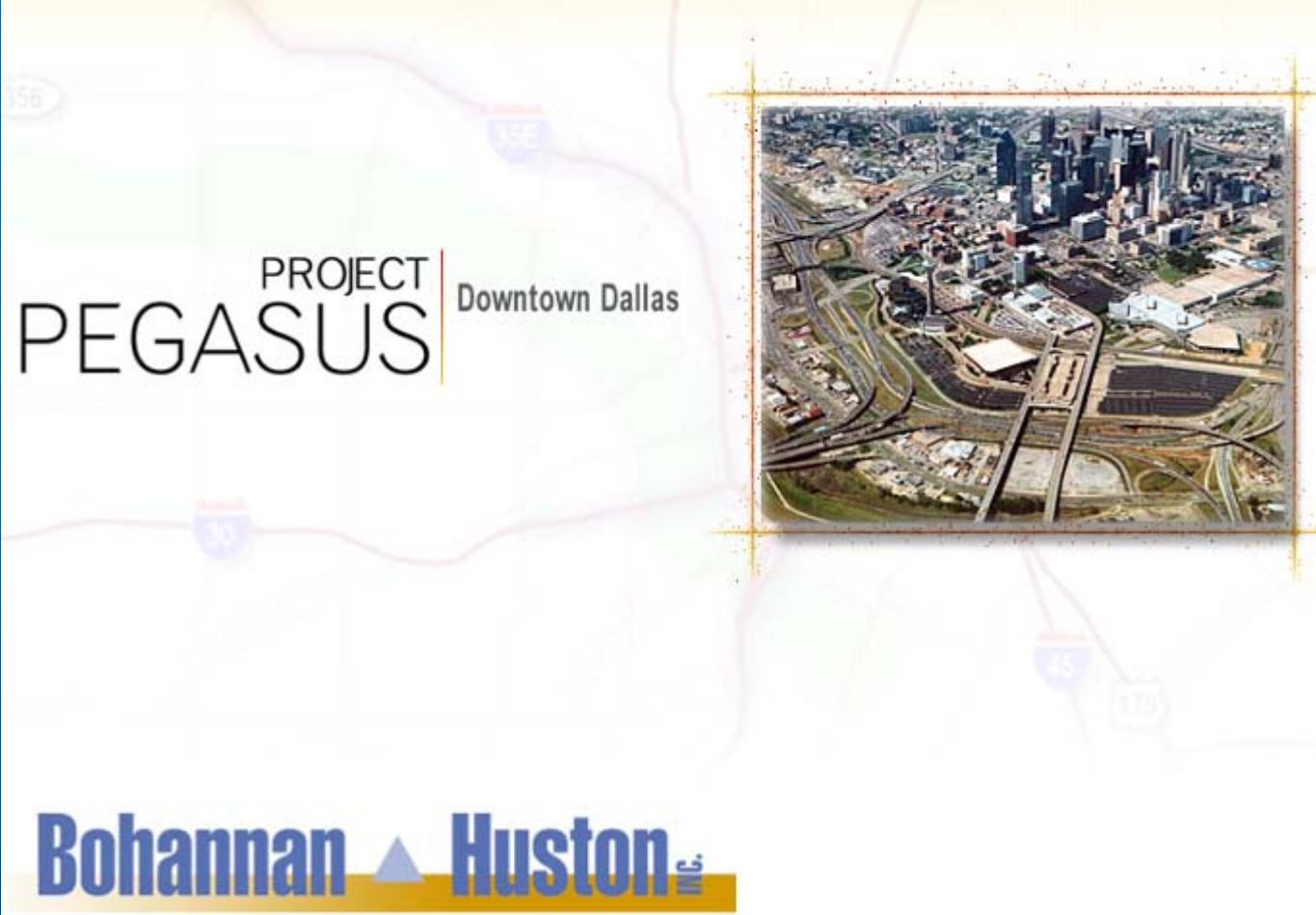
Carbon County, UT

Carbon County, Utah

Aerial LiDAR sample



Terrestrial LiDAR



PROJECT
PEGASUS | Downtown Dallas

Bohannon ▲ Huston INC.

The image shows a map of downtown Dallas with a highlighted area. An inset aerial photograph shows a dense urban area with a complex highway interchange and several tall skyscrapers. The map background includes highway shields for 356, 35E, 53, 45, and 176.



Project Pegasus

Project Area

Downtown Dallas

1. Houston St. Viaduct
2. Jefferson St. Viaduct
3. IH 45/ IH 30 Interchange
4. Woodall Rodgers/ Stemmons Interchange
5. N. Dallas Tollway/ Stemmons Interchange
6. Railroad X-Sections
7. Utility Crossing
8. Building Clearance
9. RR Bridge S. of Lamar
10. RR Bridge S. of Woodall Rodgers



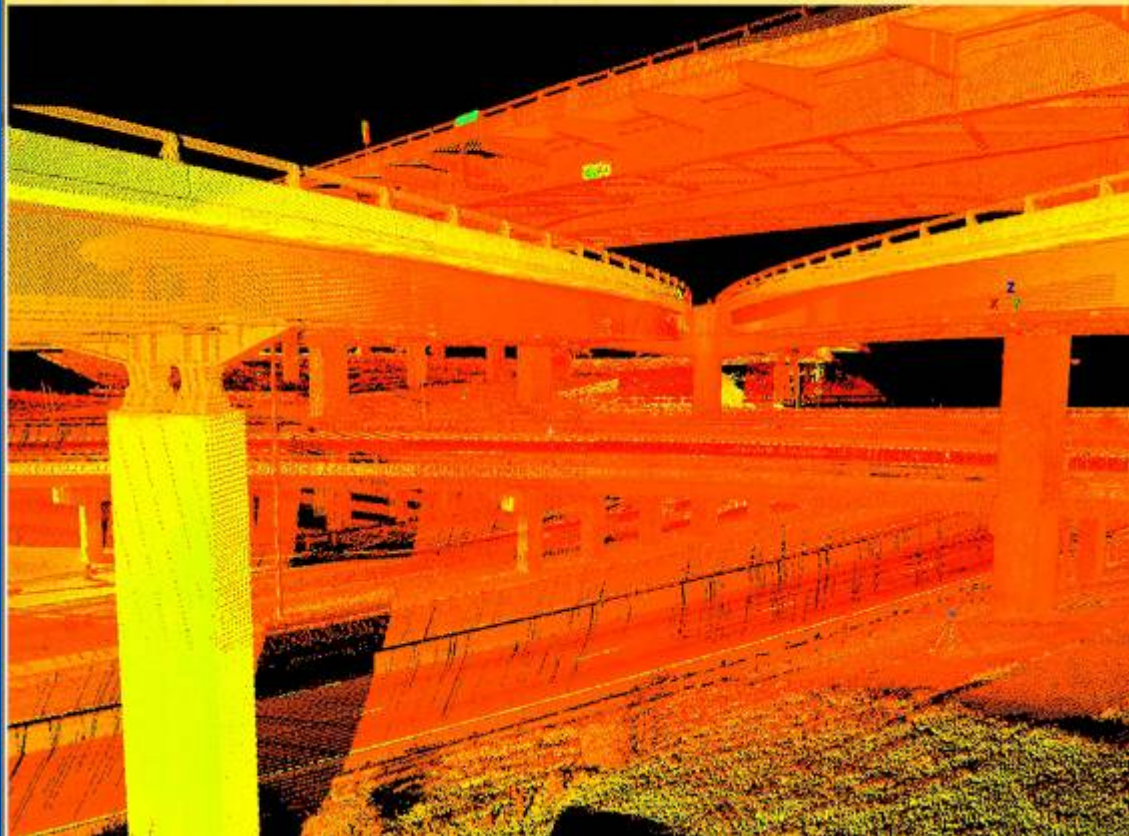
Project Pegasus

IH 45/IH 30 Interchange



Project Pegasus

IH 45/IH 30 Interchange



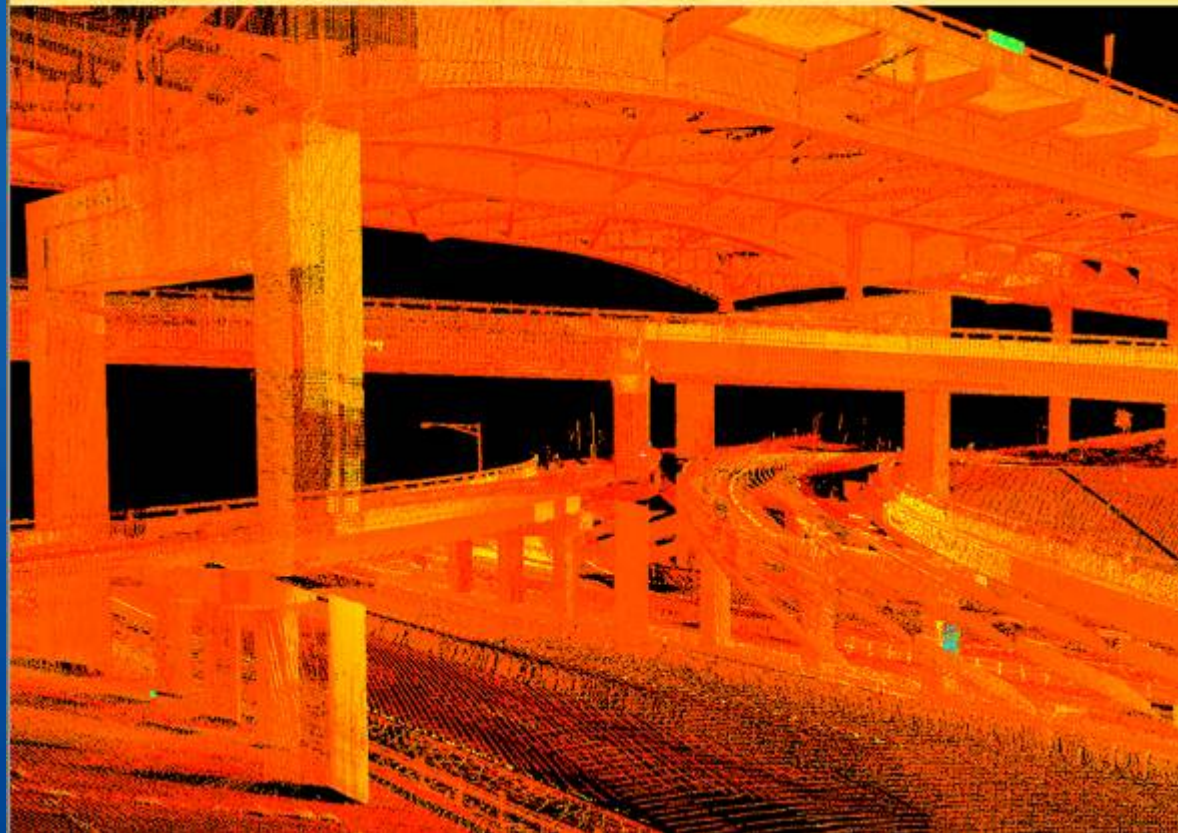
Project Pegasus

IH 45/IH 30 Interchange



Project Pegasus

IH 45/IH 30 Interchange



Project Pegasus

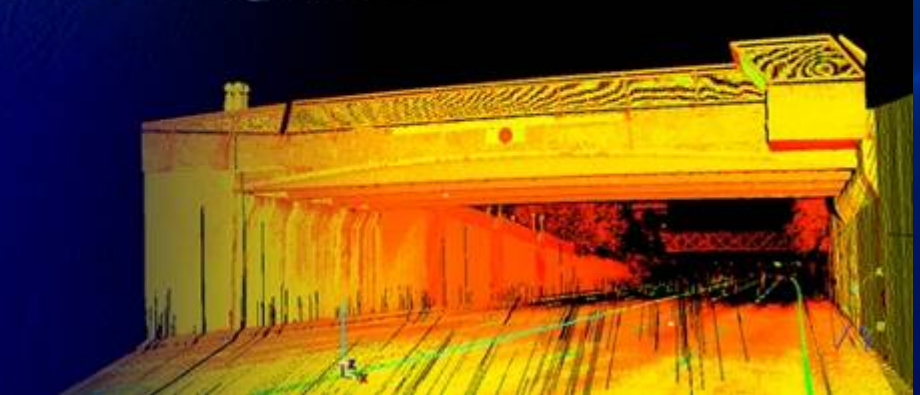
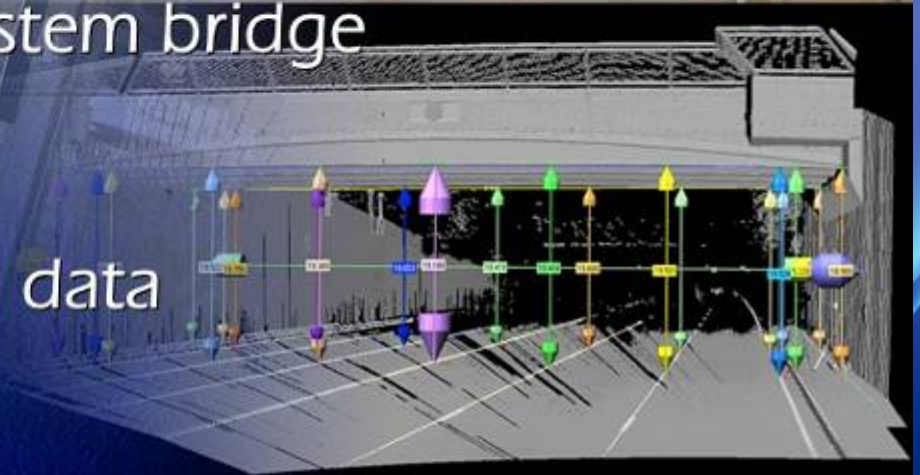
RR Bridge S. of Woodall Rodgers



TXDOT Ft. Worth District Bridge Clearance Project

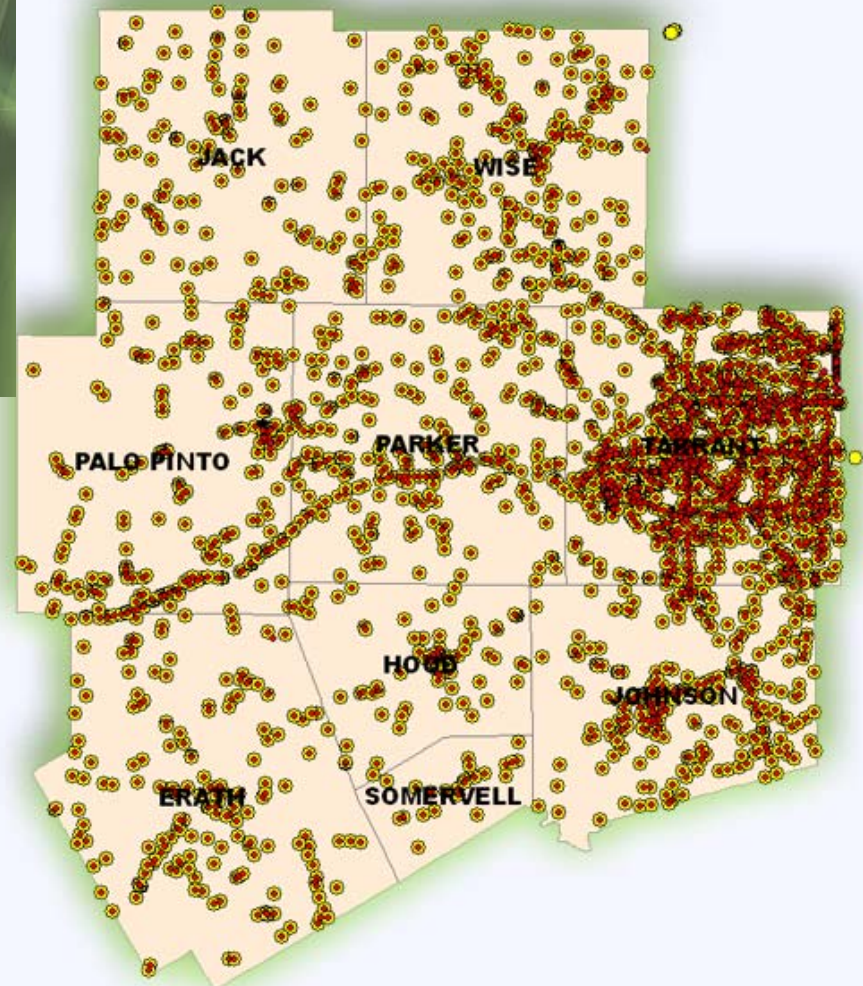
- +/- 1000 on and off system bridge clearances
- aerial photos
- tabular and graphical data
- Geo-database

Deliverables



Ft. Worth Bridge Clearance

Approximately **825**, which constituted roughly **2,200** spans with roadways underneath



Ft. Worth Bridge Clearance



Ft. Worth Bridge Clearance



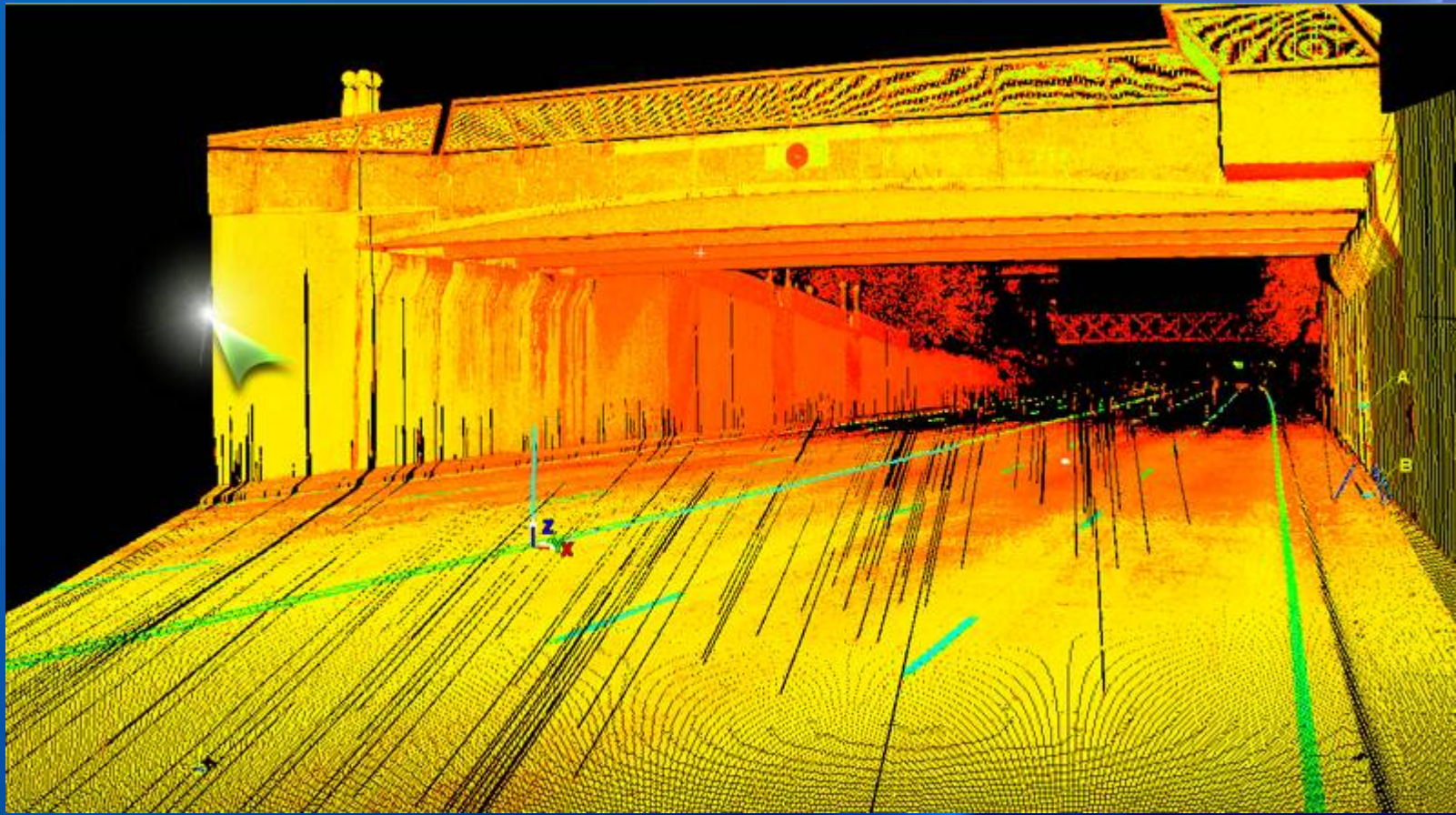
Ft. Worth Bridge Clearance



Ft. Worth Bridge Clearance



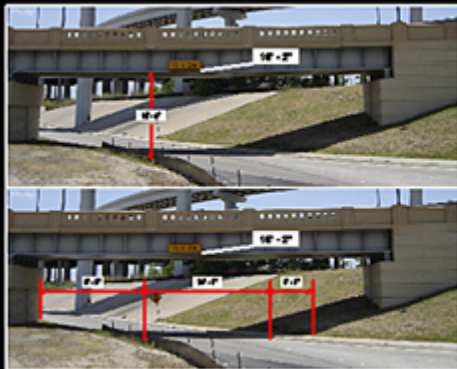
Ft. Worth Bridge Clearance



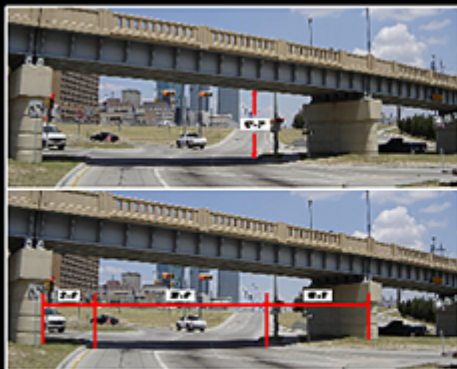
Ft. Worth Bridge Clearance



Ft. Worth Bridge Clearance



TRINITY RAILWAY EXP over SH 180 EB



TRINITY RAILWAY EXP over JONES ST



PLAN

NBI BRIDGE I.D.	02-225-1268-01-258	
FEATURE CARRIED	TRINITY RAILWAY EXP	
FEATURE CROSSED	SH 180 EB	JONES ST
MINIMUM VERTICAL CLEARANCE	10'-0"	17'-0"
MINIMUM LATERAL CLEARANCE	20'-0"	20'-0"
POSTED	10'-0"	Not Posted
HEIGHTS/GEOMETRY SECTION NUMBER	10	
ACQUISITION DATE	6/30/2016	
VERTICAL CLEARANCE		
	SH 180 EB	JONES ST
AA / 646	10'-0" / 10'-0"	17'-0" / 17'-0"
AA	10'-0"	17'-0"
AB	10'-0"	17'-0"
AD	17'-0"	17'-0"
AD	NA	17'-0"
BA / 640	10'-0" / 10'-0"	17'-0" / 17'-0"
BA / 600	10'-0" / 10'-0"	17'-0" / 17'-0"
BA	10'-0"	17'-0"
BB	10'-0"	17'-0"
BC	17'-0"	17'-0"
BB	NA	17'-0"
BD / 600	10'-0" / 10'-0"	17'-0" / 17'-0"
HORIZONTAL CLEARANCE		
LEFT	0'-0"	0'-0"
RIGHT	0'-0"	0'-0"

LOCATION OF MINIMUM VERTICAL CLEARANCE FOR BRIDGE

RECORD 02-225-1268-01-258 IS PART OF INTERCHANGE 01 SH 180 EB



DART Rail Tunnel

GIS SUCCESS STORIES | QUALITY UTILITY LOCATION | HIGH-VISIBILITY SAFETY APPAREL

MARCH 2008

POB

POINT OF BEGINNING

3D VISION

Scanning Tunnels and
NASCAR's First Superspeedway

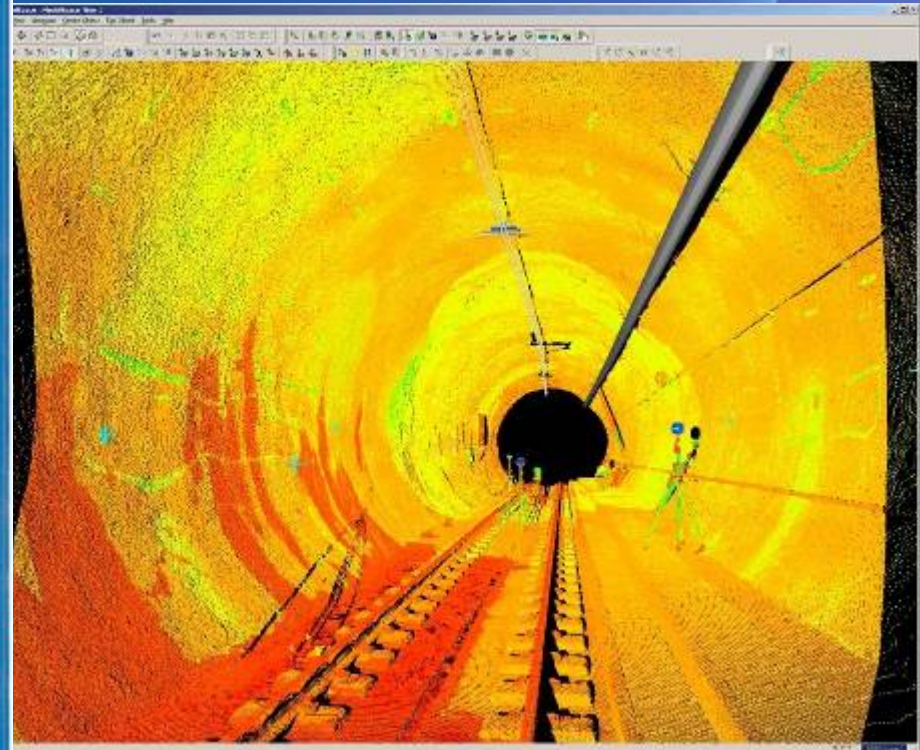
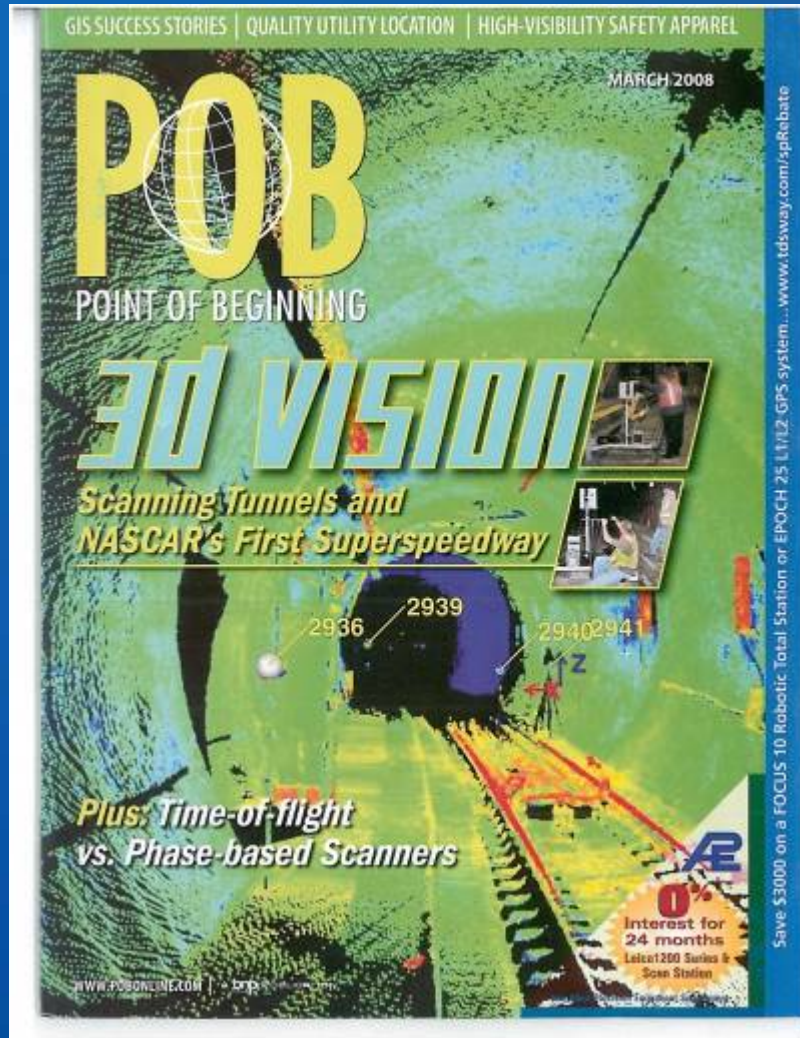
2936 2939 2940 2941

Plus: Time-of-flight
vs. Phase-based Scanners

Save \$3000 on a FOCUS 10 Robotic Total Station or EPOCH 25 LVLZ GPS system...www.tdsurvey.com/splRebate

www.POBLINE.COM | tsp.com

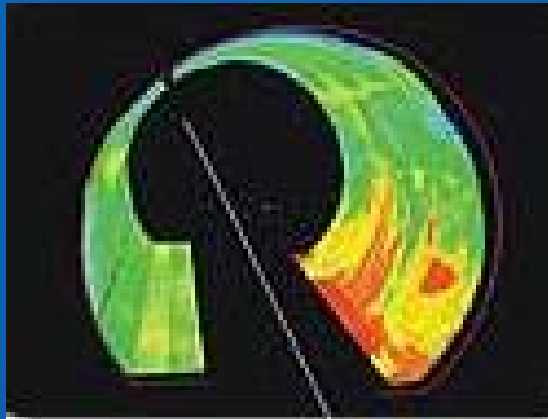
Interest for
24 months
Lease 200 Series &
Scan Station



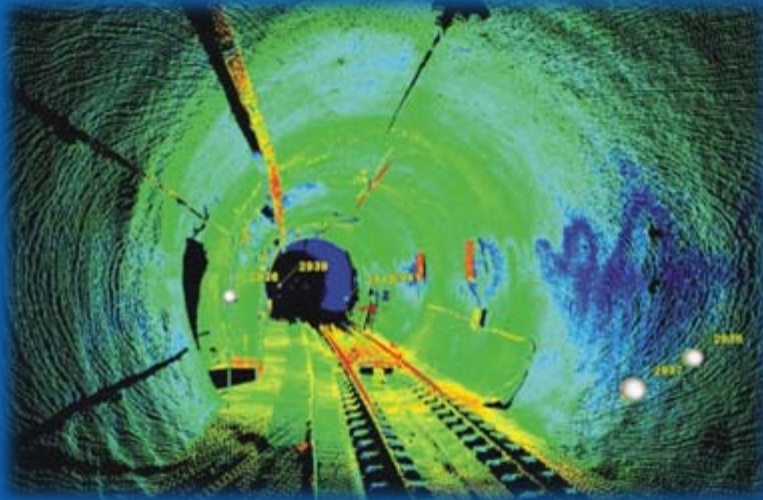
DART Rail Tunnel



DART Rail Tunnel



DART Rail Tunnel



The Dallas Area Rapid Transit (DART) Light Rail Transit system serves Dallas and 12 surrounding cities. BHI was selected to map and create a model of twin 3.5-mile tunnels located below northeast downtown Dallas, especially areas suspected of water seepage. BHI completed the project on time and within budget.

- ▲ **Project size:** Seven miles of tunnel data at a 10,000 points per square meter density
- ▲ **Cost:** \$265,000.00
- ▲ **Completed:** 2006
- ▲ **Challenges:**
 - Completing 346 scans in 23 nights, averaging 15 scans/night
 - Performing detailed surveying of lightless areas during transit system closure (1:00-4:00 am)
 - Delivering data in MicroStation and Geopak formats with 10 degree intervals for cross sections
 - Building custom software for mapping digital terrain data within a tunnel environment



DART Rail Tunnel

DALLAS AREA RAPID TRANSIT TUNNEL SCAN

**Dallas Area Rapid Transit
Tunnel Scan**

DART
1401 Pasifco Ave.
Dallas, Texas 75202

Bohannon & Huston.
270 East 14th Street, Suite 100, Garland, TX 75042

**Dallas Area Rapid Transit
Tunnel Scan**
Dallas, Texas

MAPPS
Bohannon & Huston.
270 East 14th Street, Suite 100, Garland, TX 75042

Geospatial Excellence Awards 2007
Technology Innovation

Bohannon & Huston

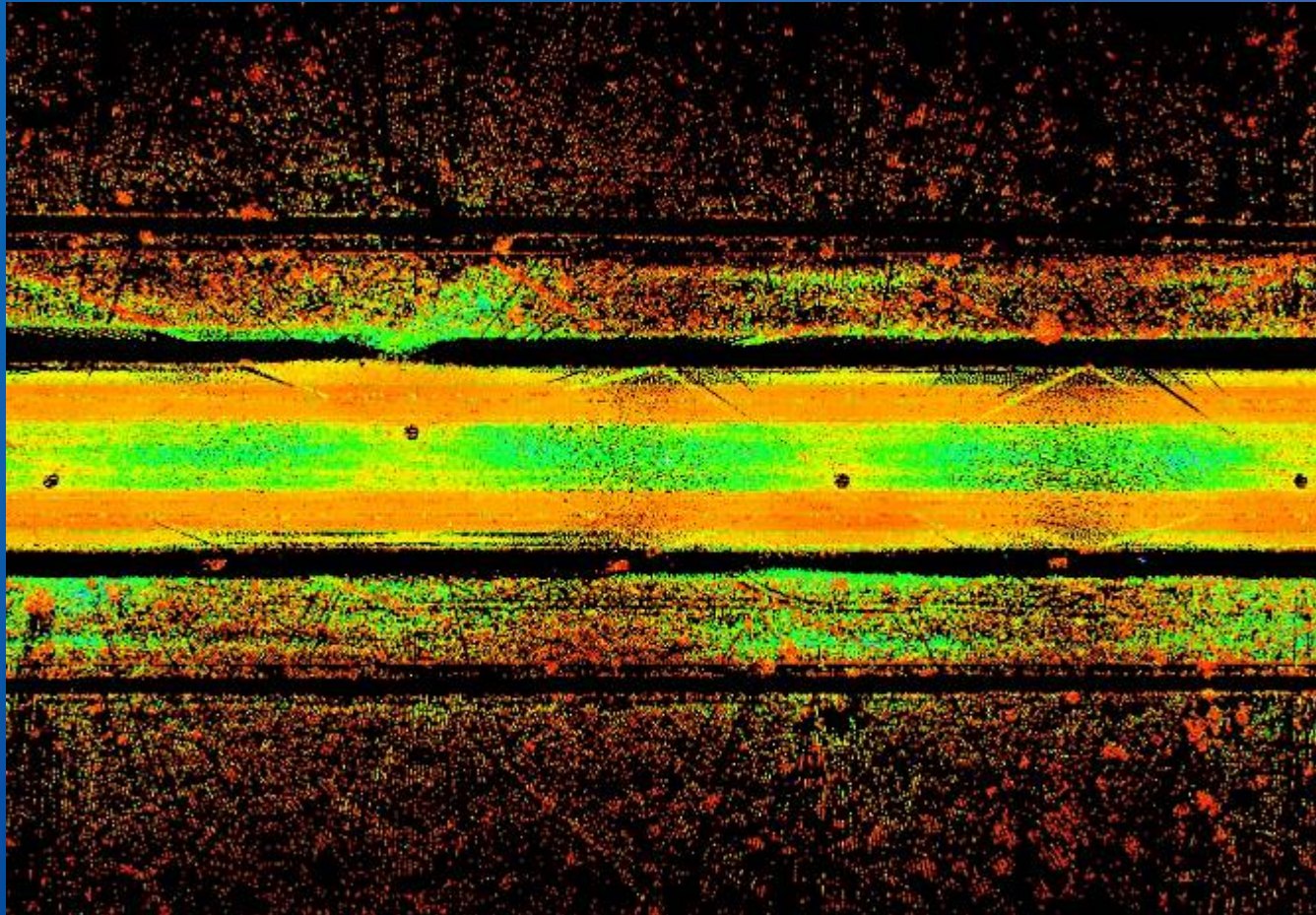
MAPPS AWARD WINNING PROJECT
GEOSPATIAL EXCELLENCE AWARDS 2007 - TECHNOLOGY INNOVATION



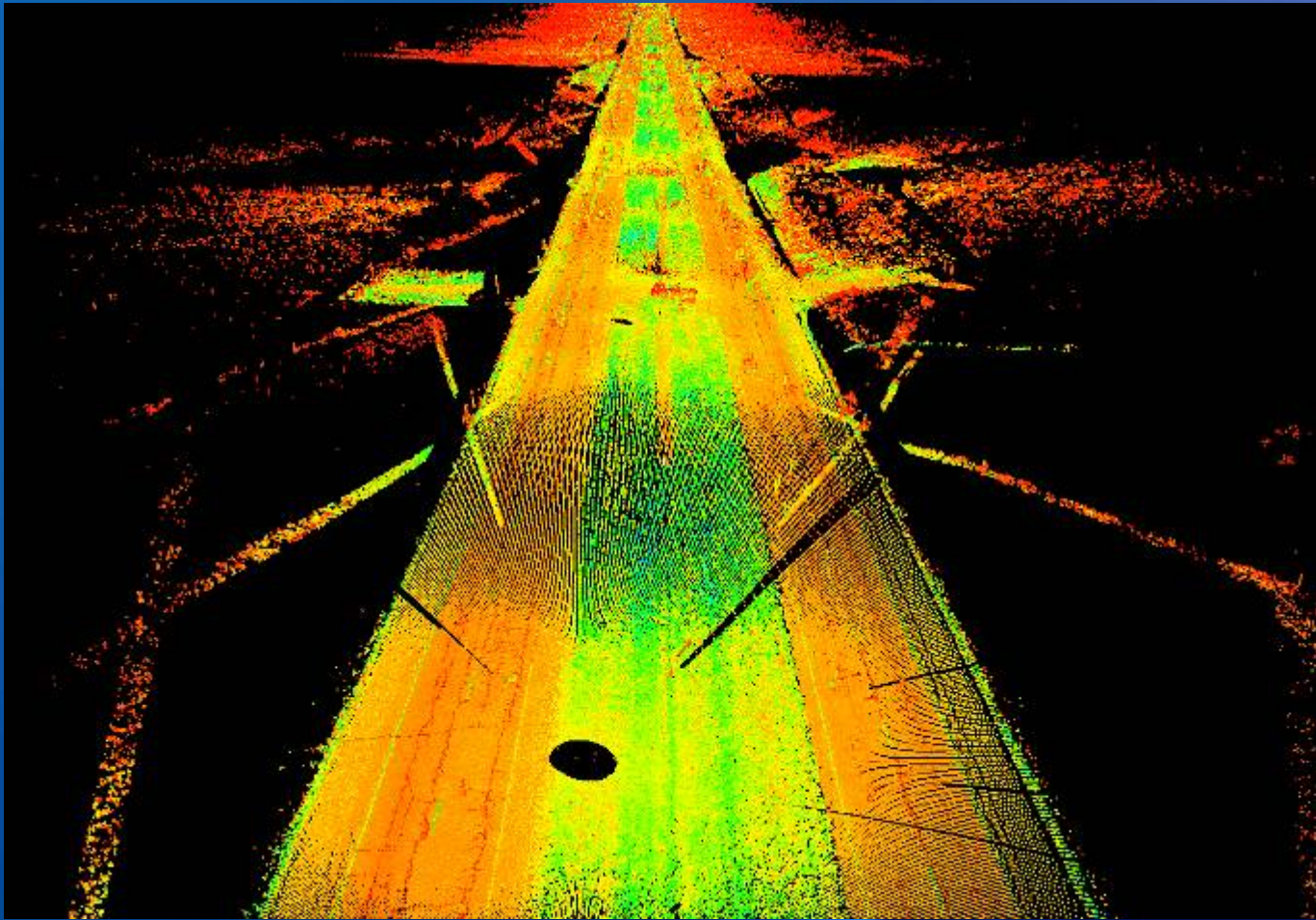
IH 20 in Amarillo



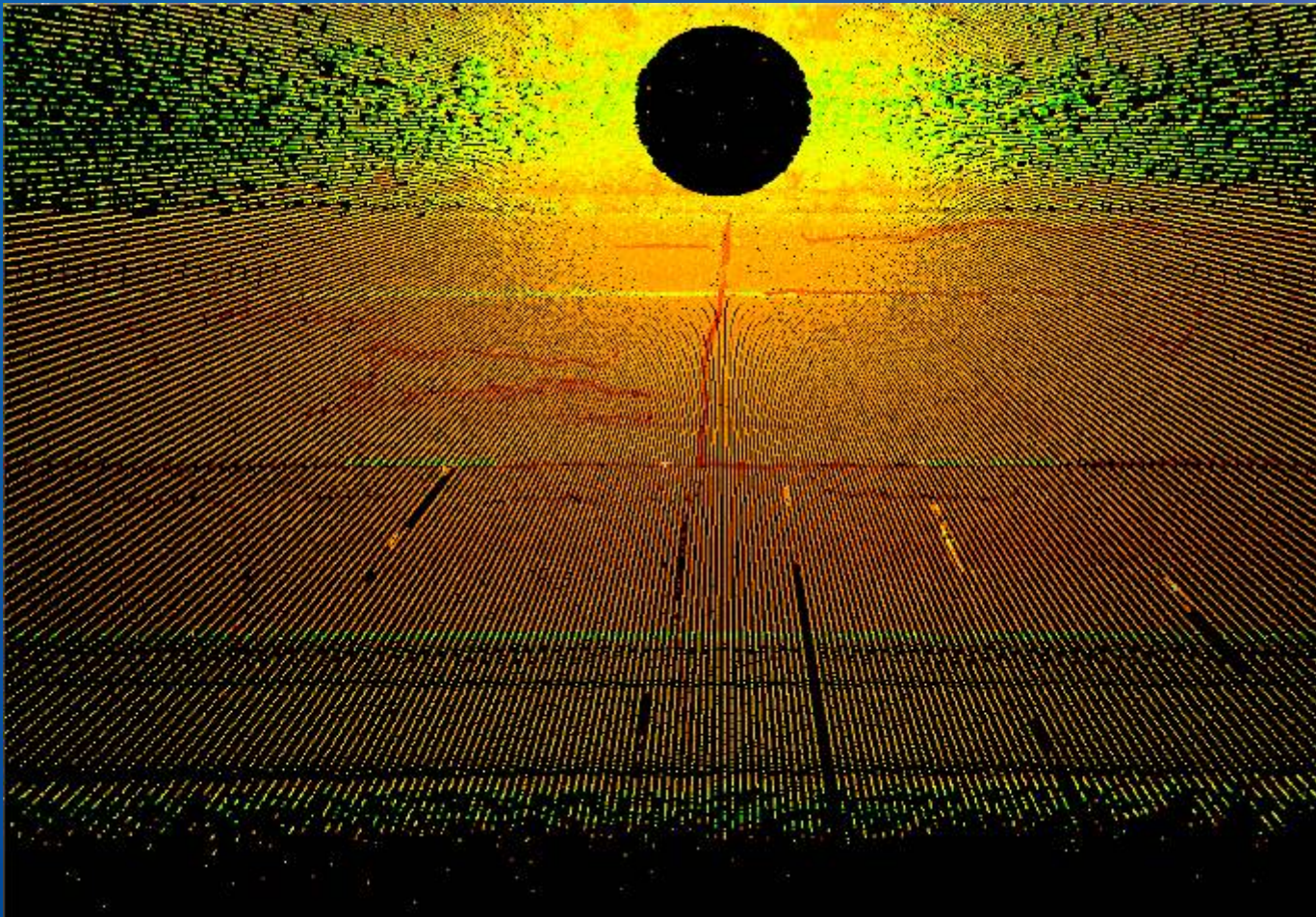
IH 20 in Amarillo



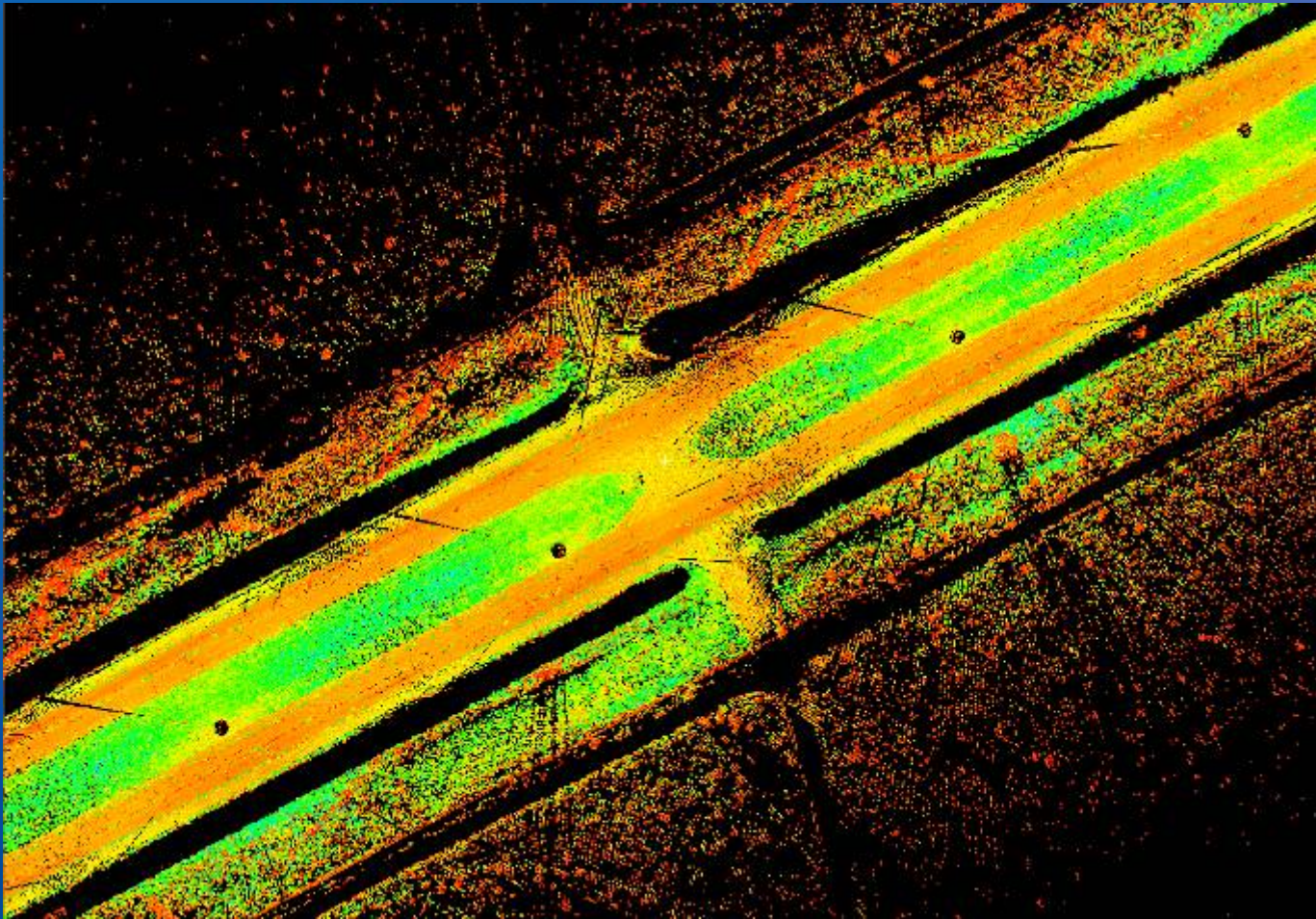
IH 20 in Amarillo



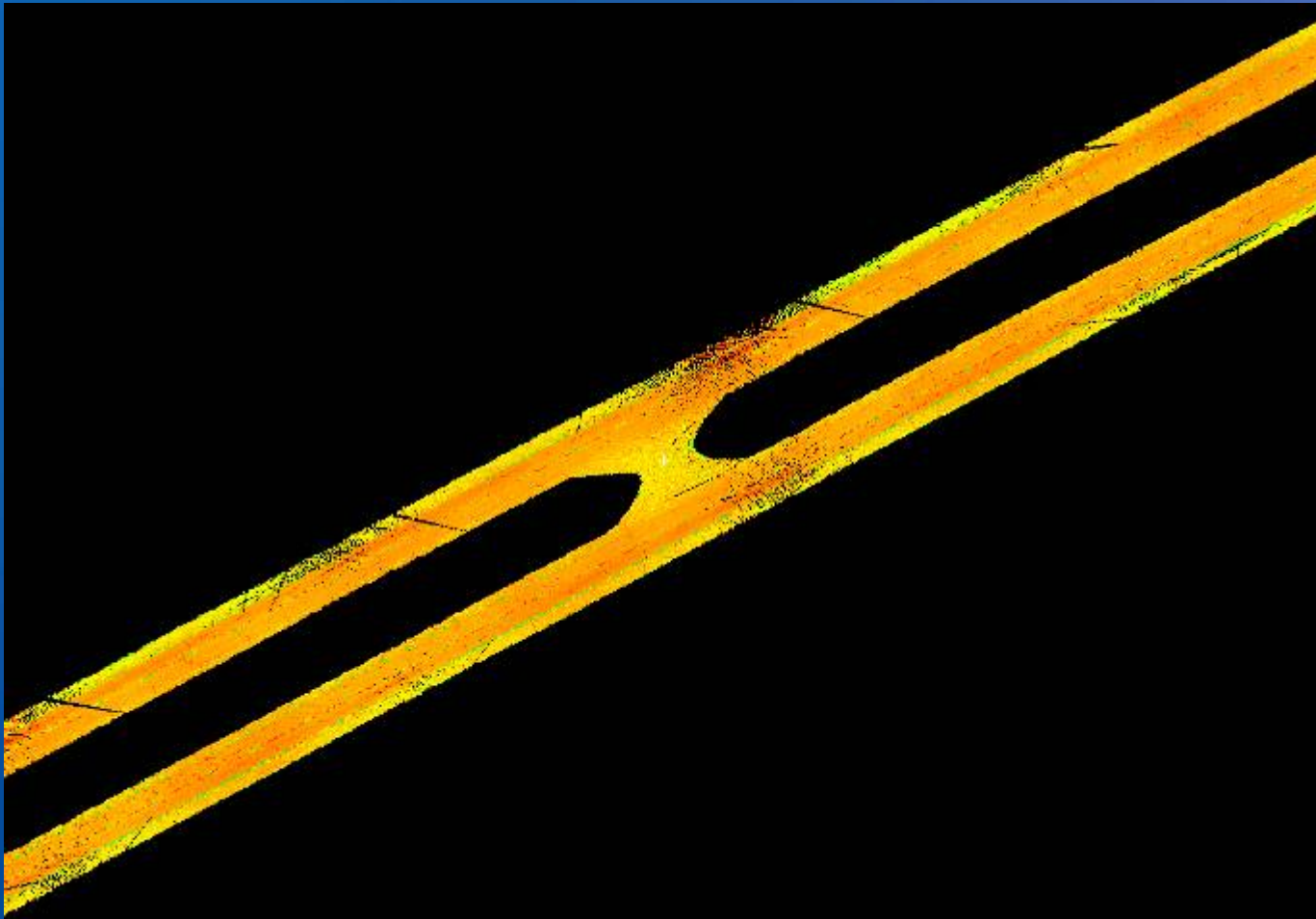
IH 20 in Amarillo



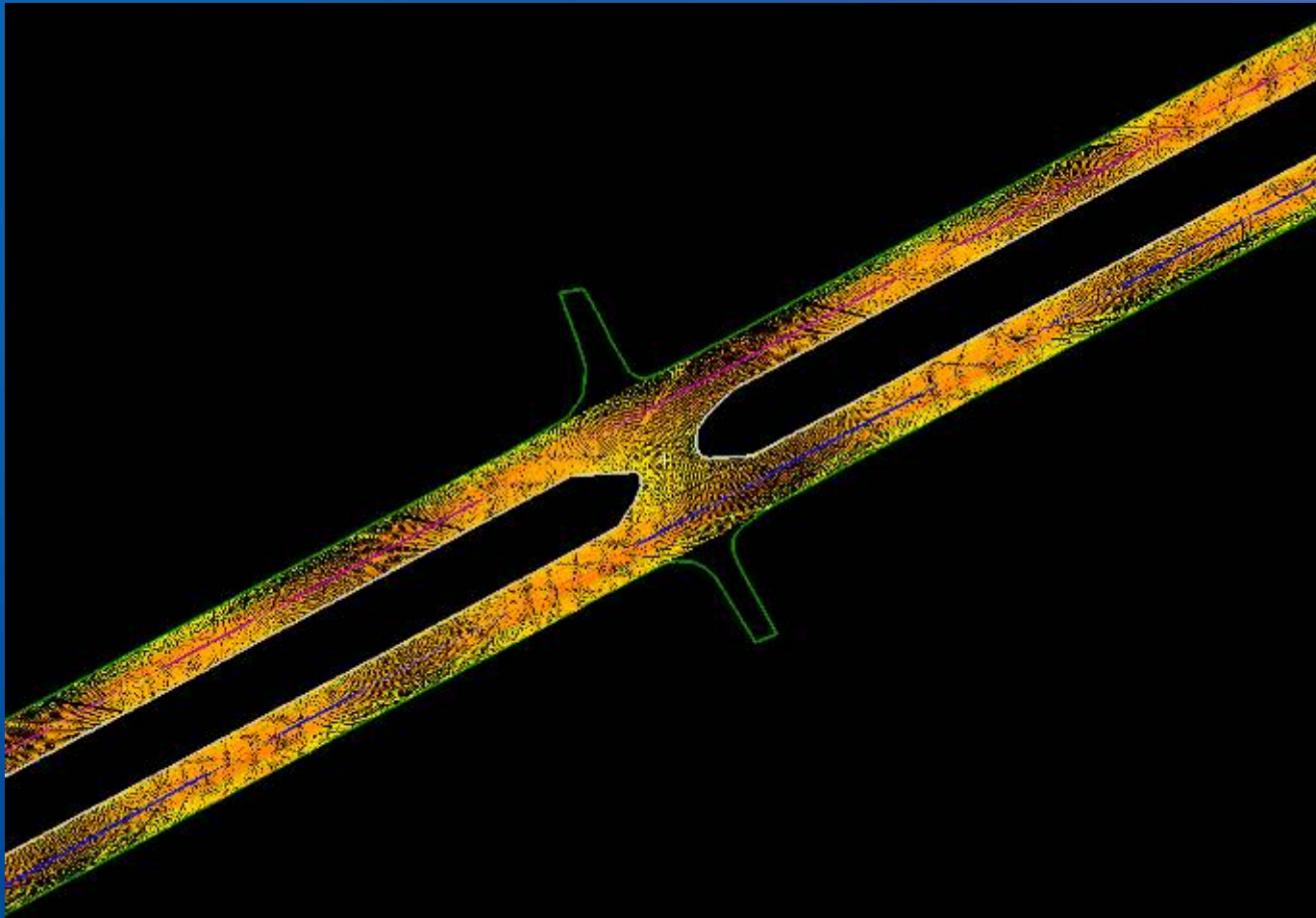
IH 20 in Amarillo



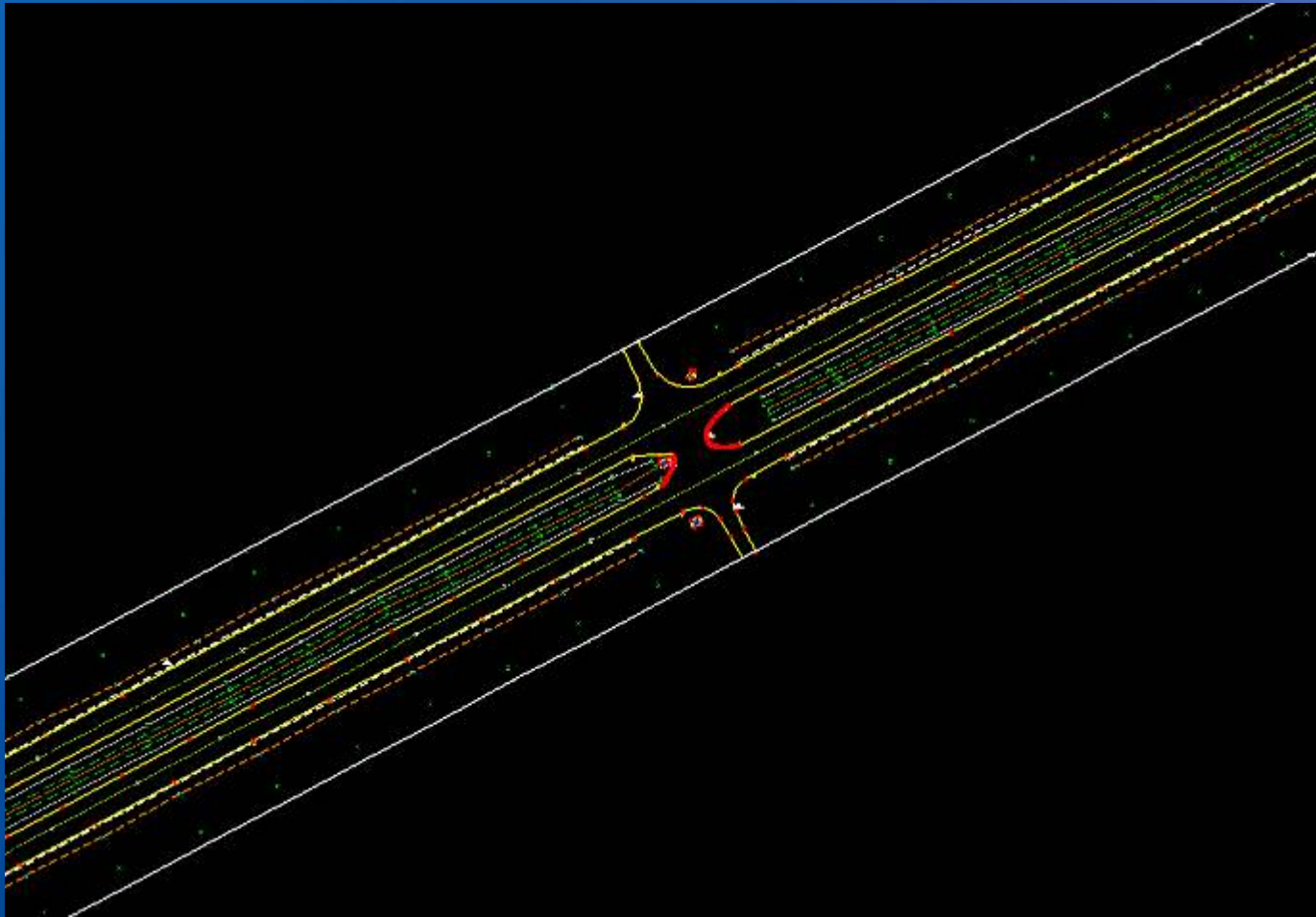
IH 20 in Amarillo



IH 20 in Amarillo



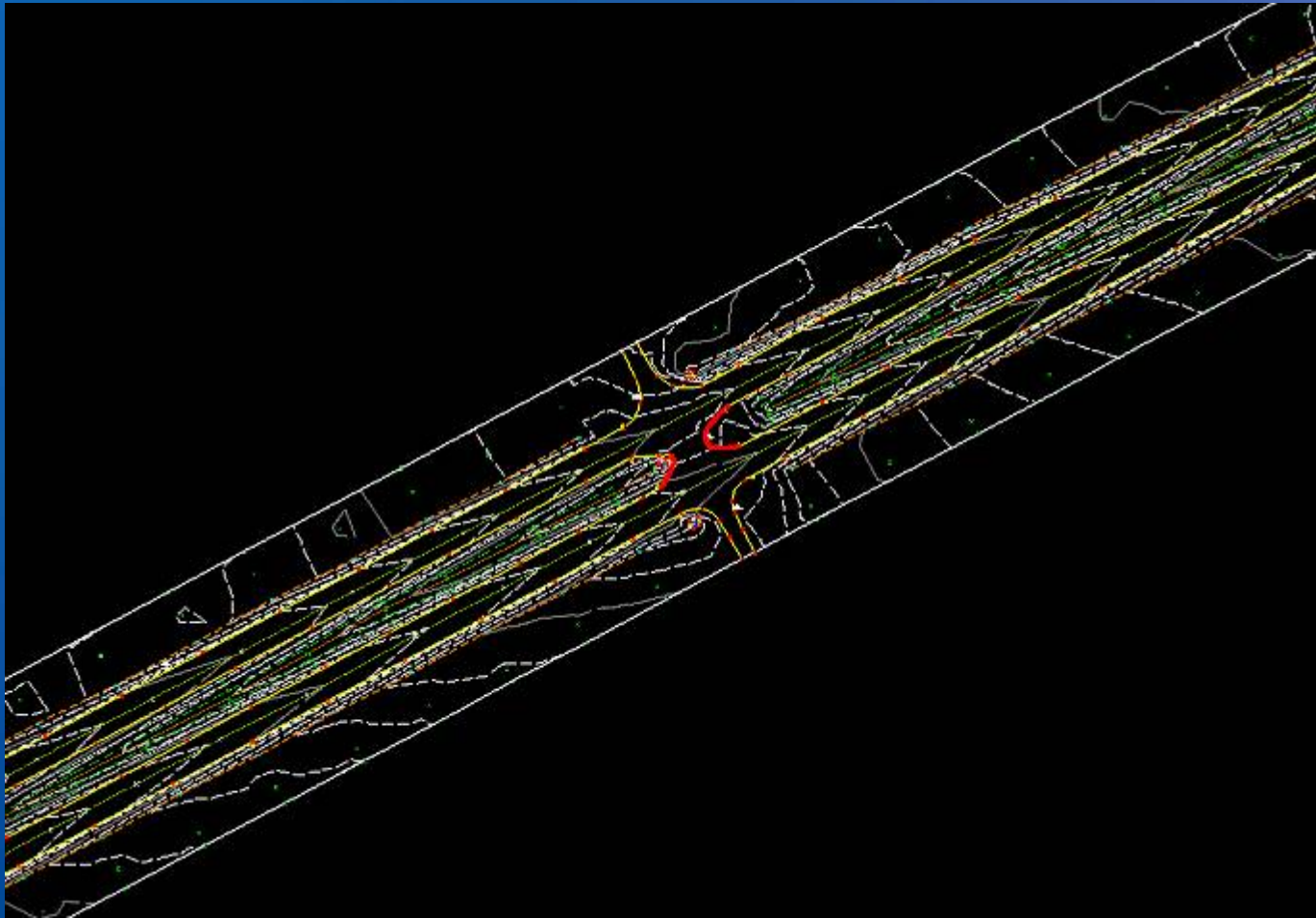
IH 20 in Amarillo



IH 20 in Amarillo



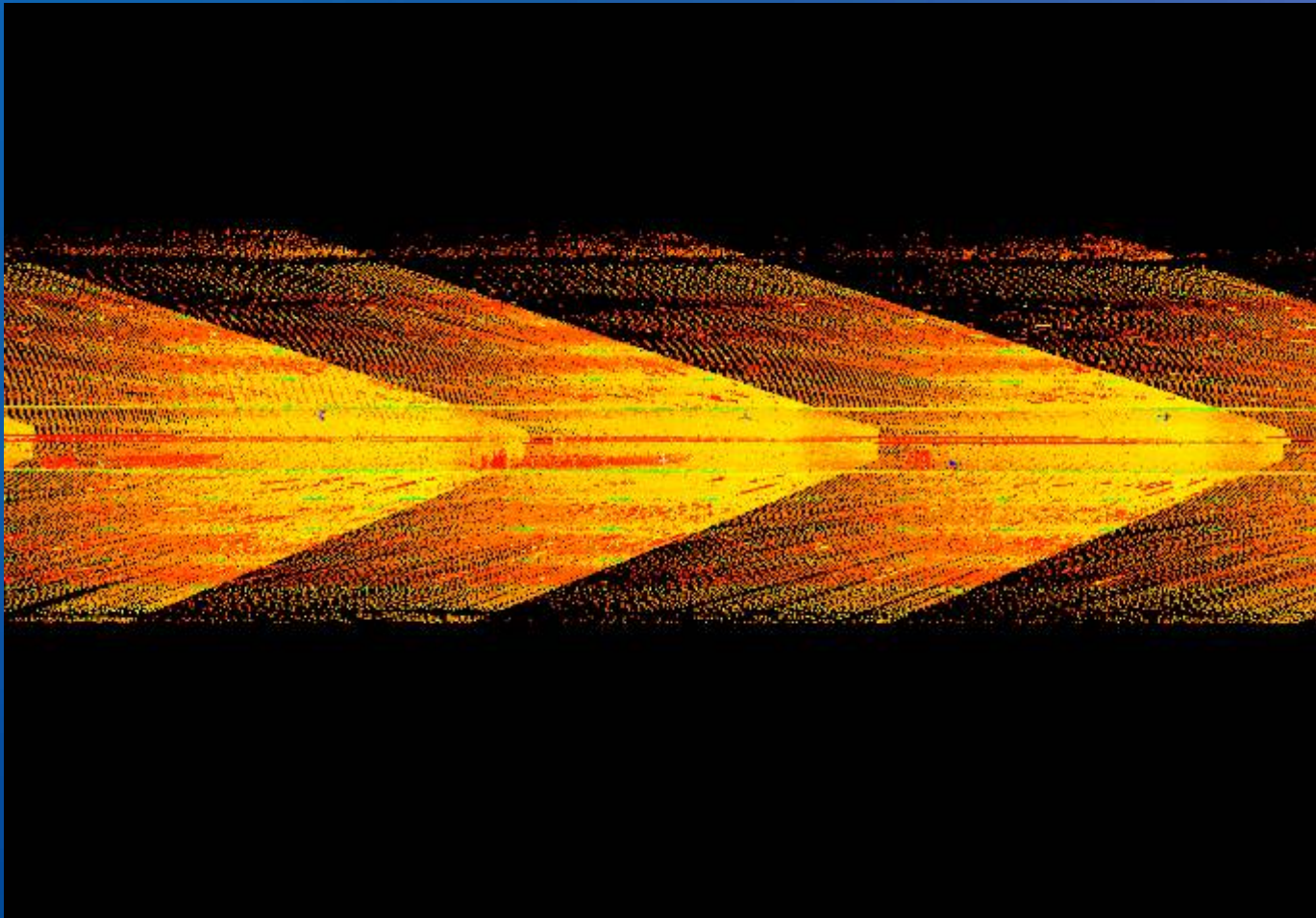
IH 20 in Amarillo



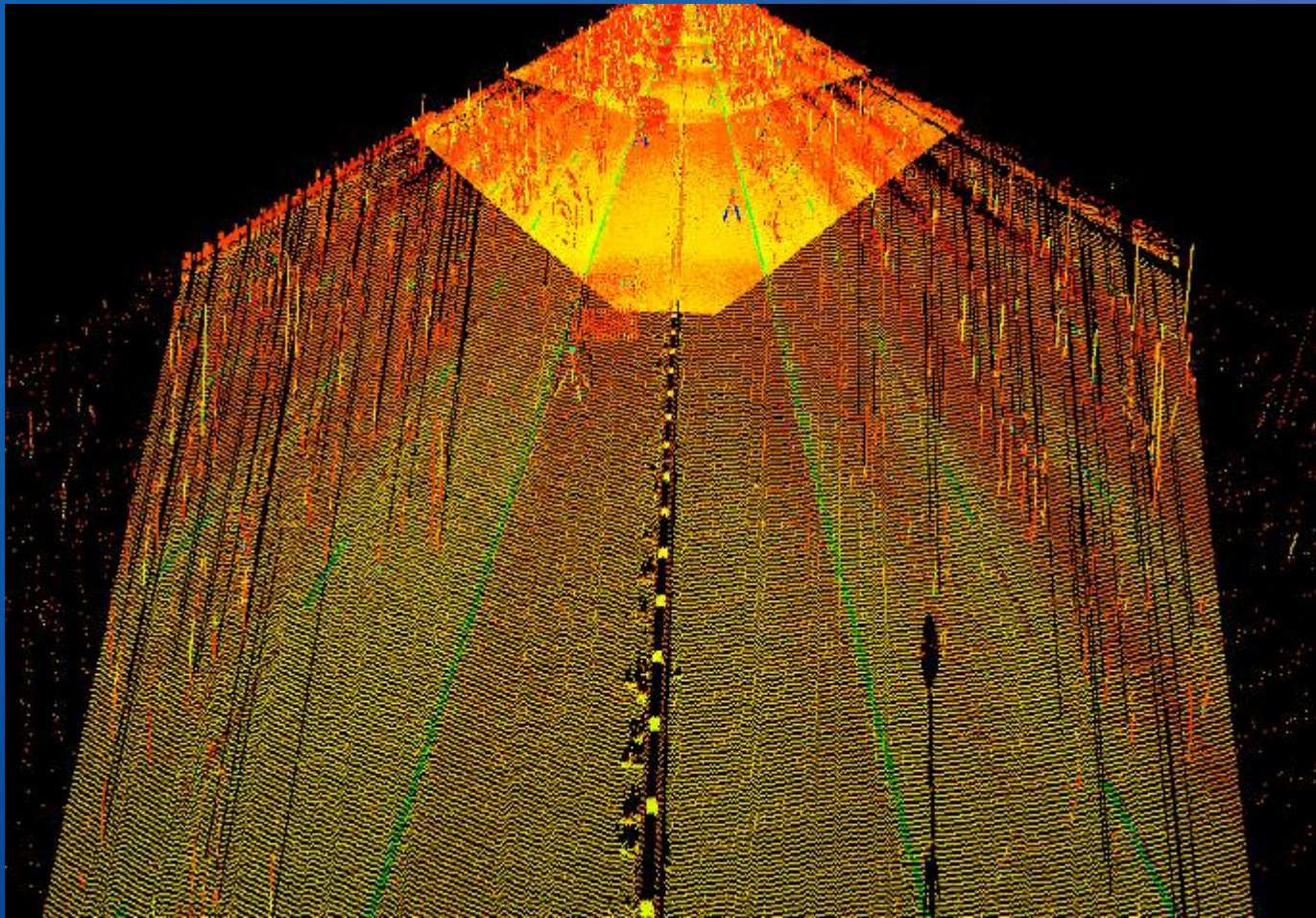
IH 635 Median-Dallas



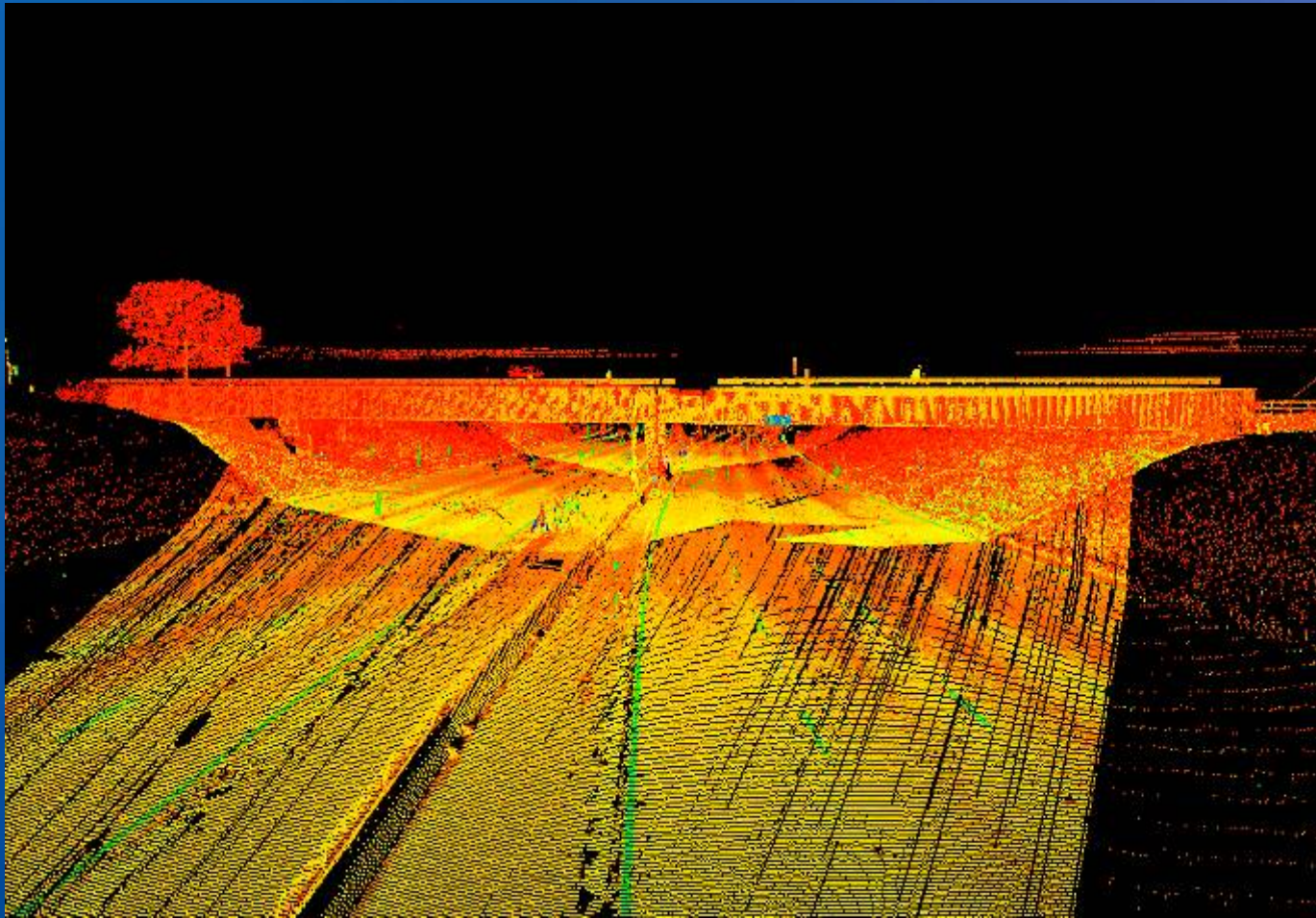
IH 635 Median-Dallas



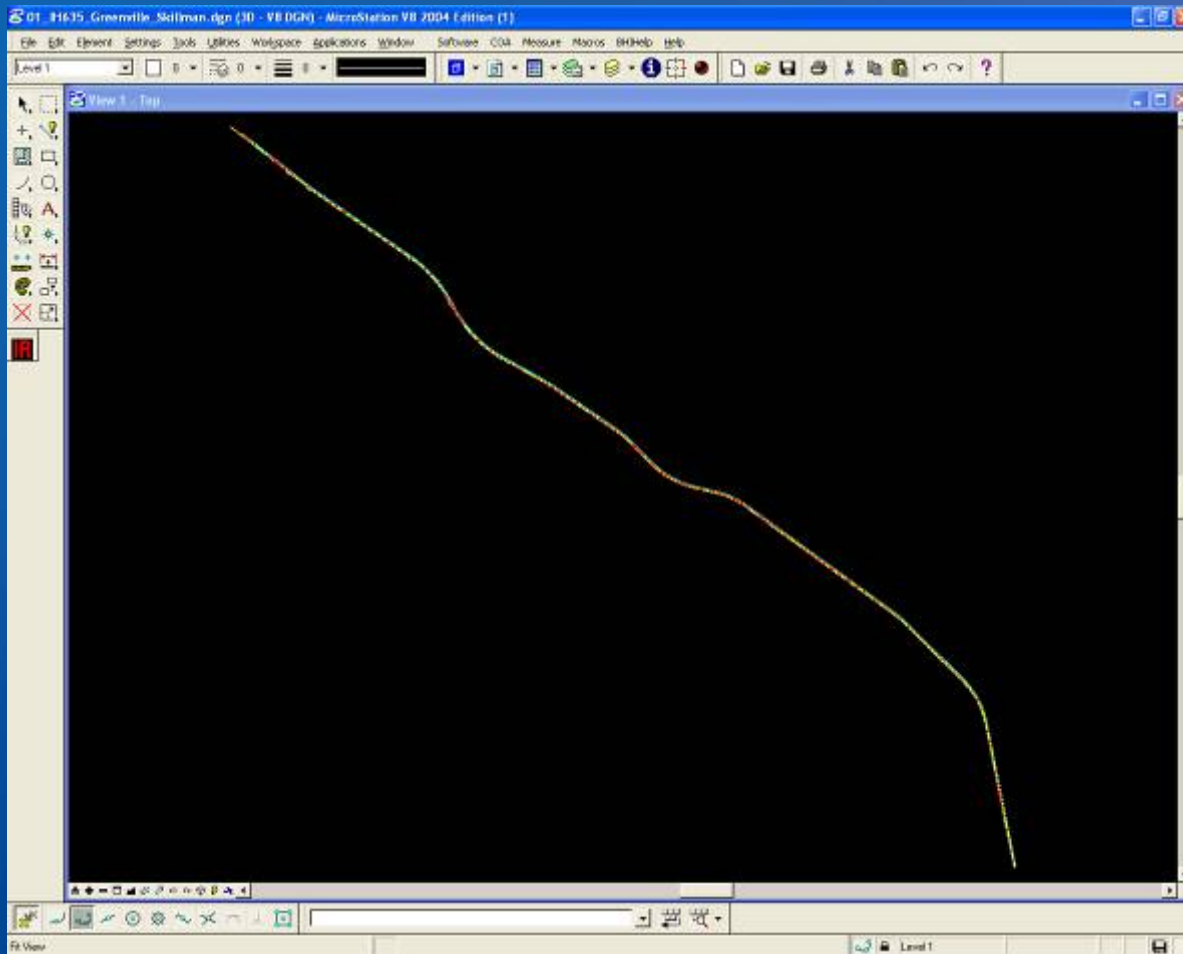
IH 635 Median-Dallas



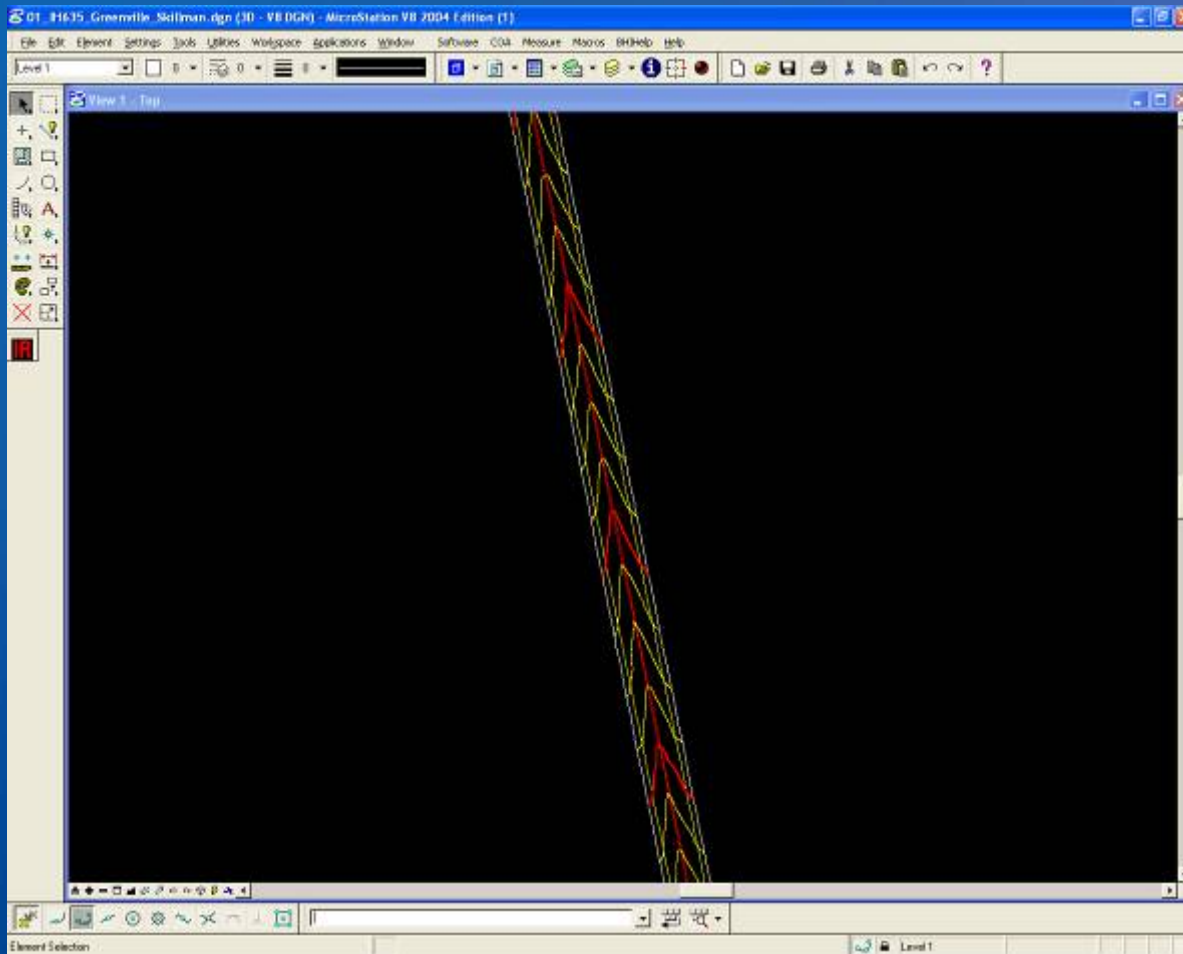
IH 635 Median-Dallas



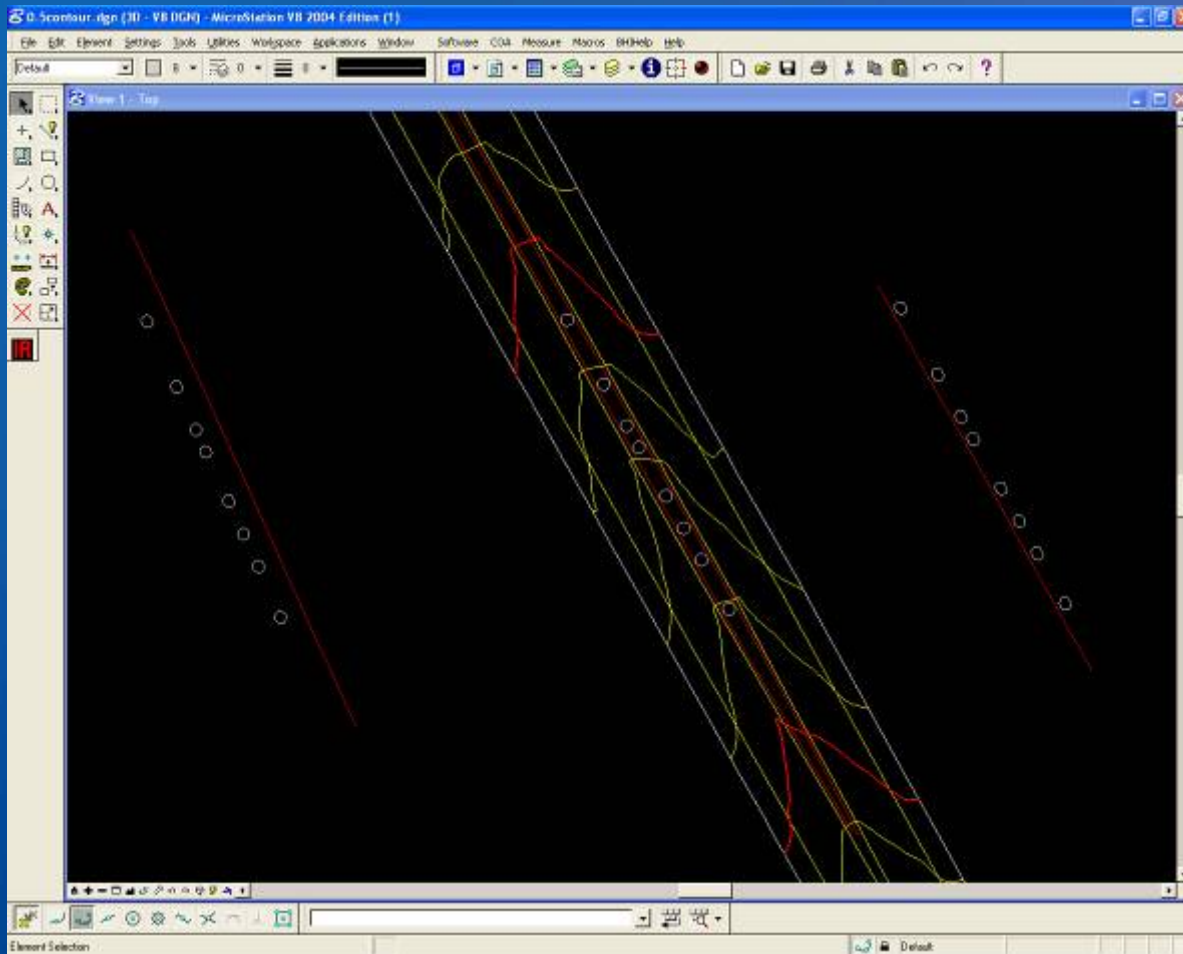
IH 635 Median-Dallas



IH 635 Median-Dallas



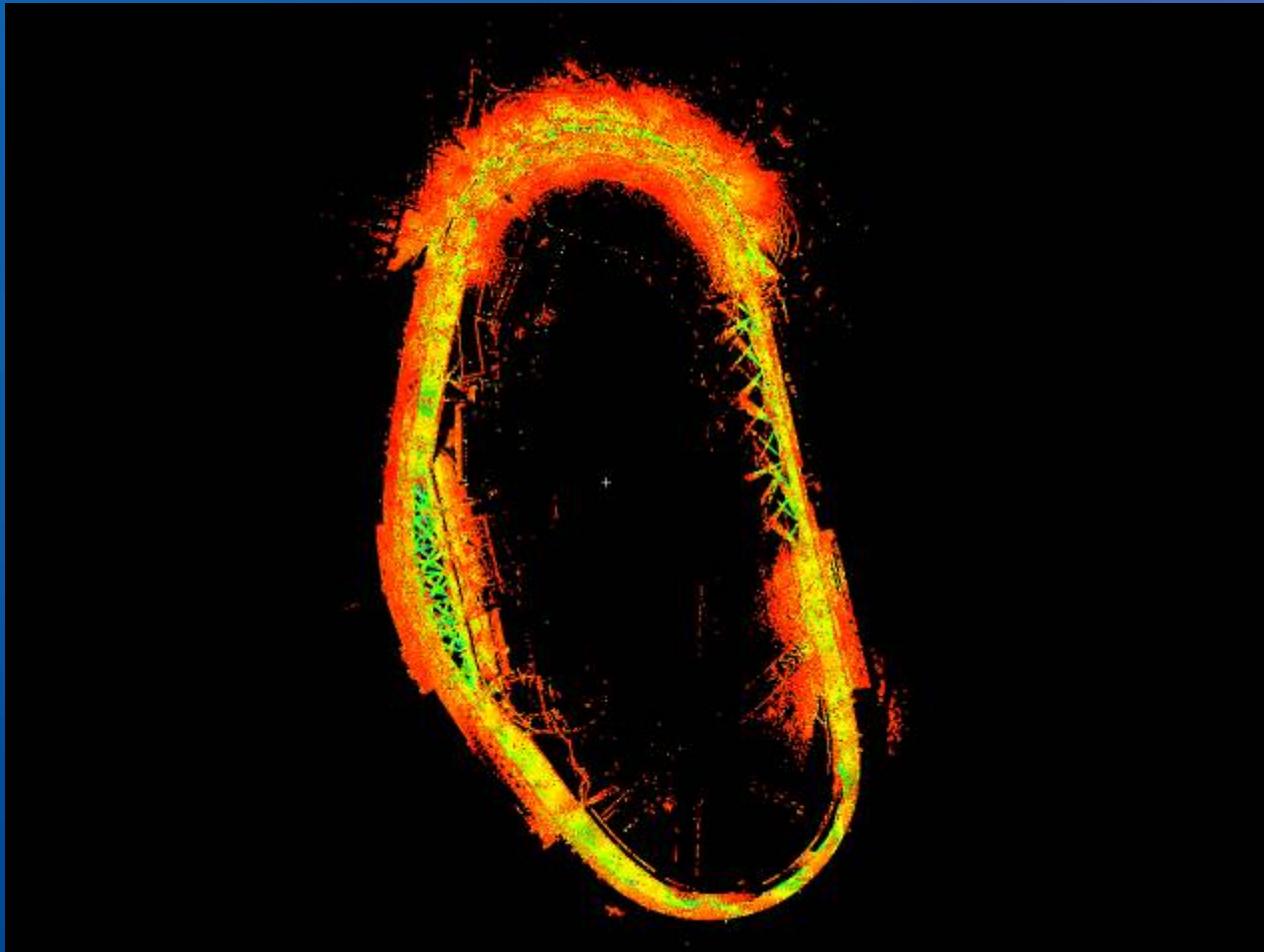
IH 635 Median-Dallas



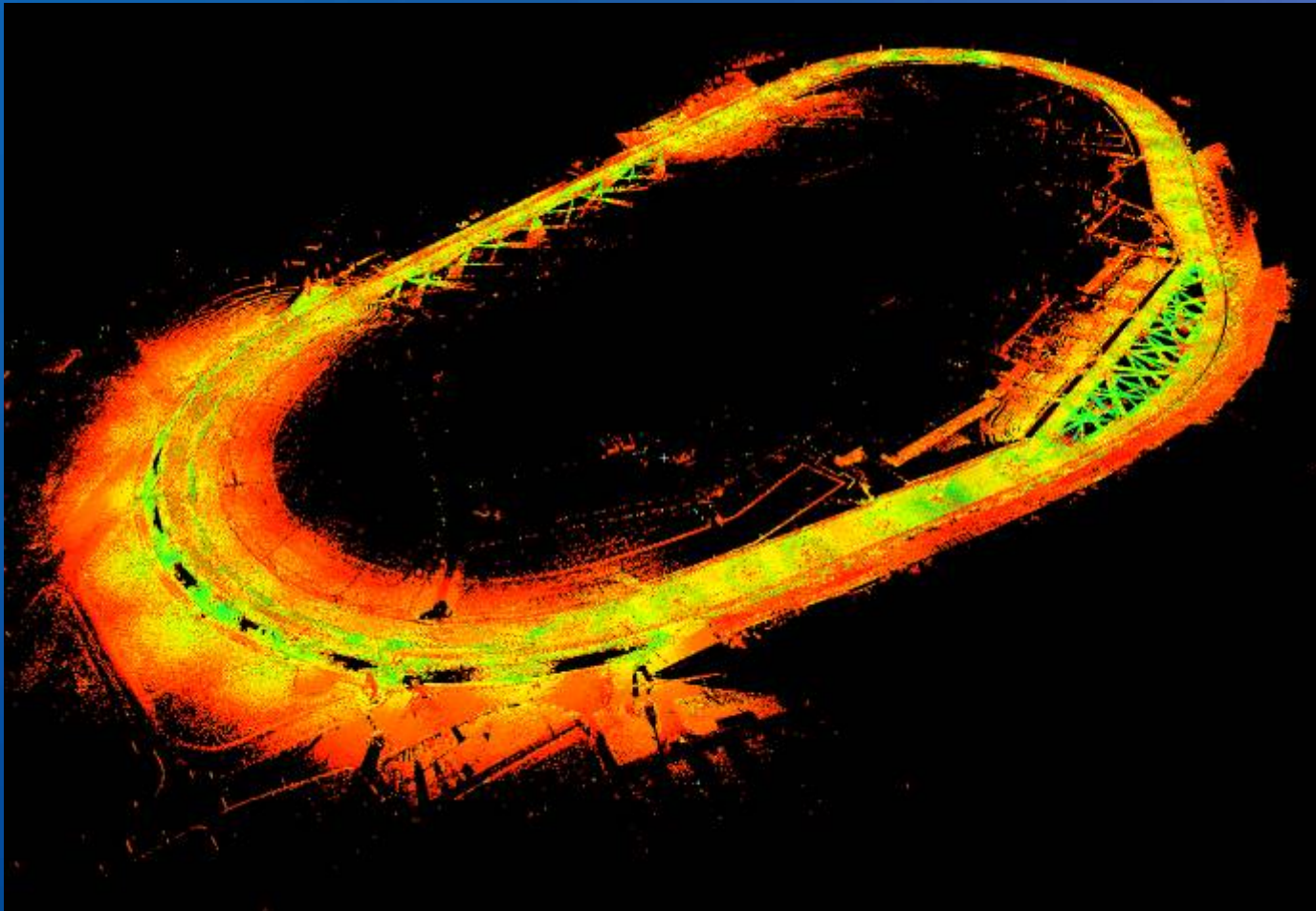
Talladega Super Speedway



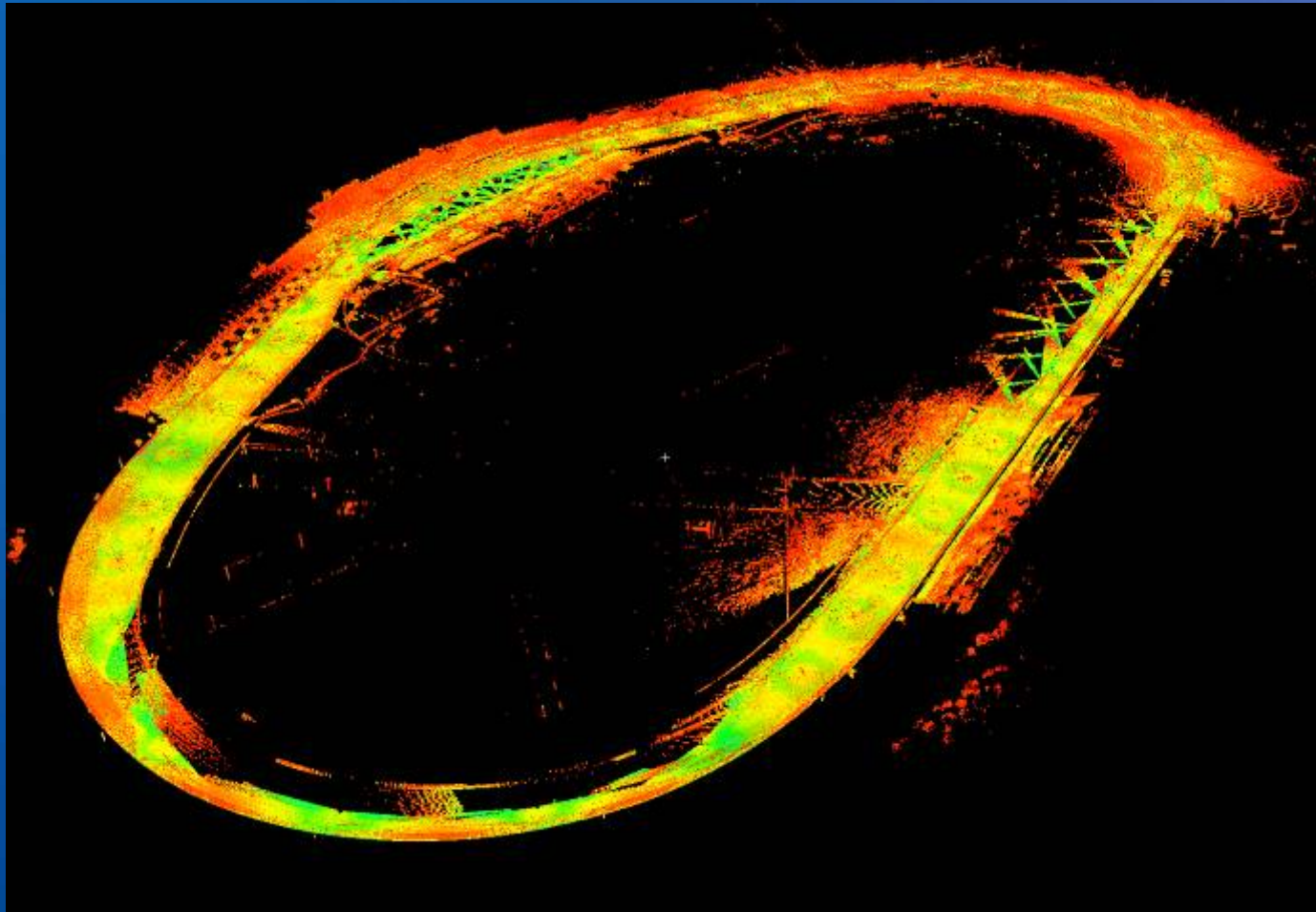
Talladega Super Speedway



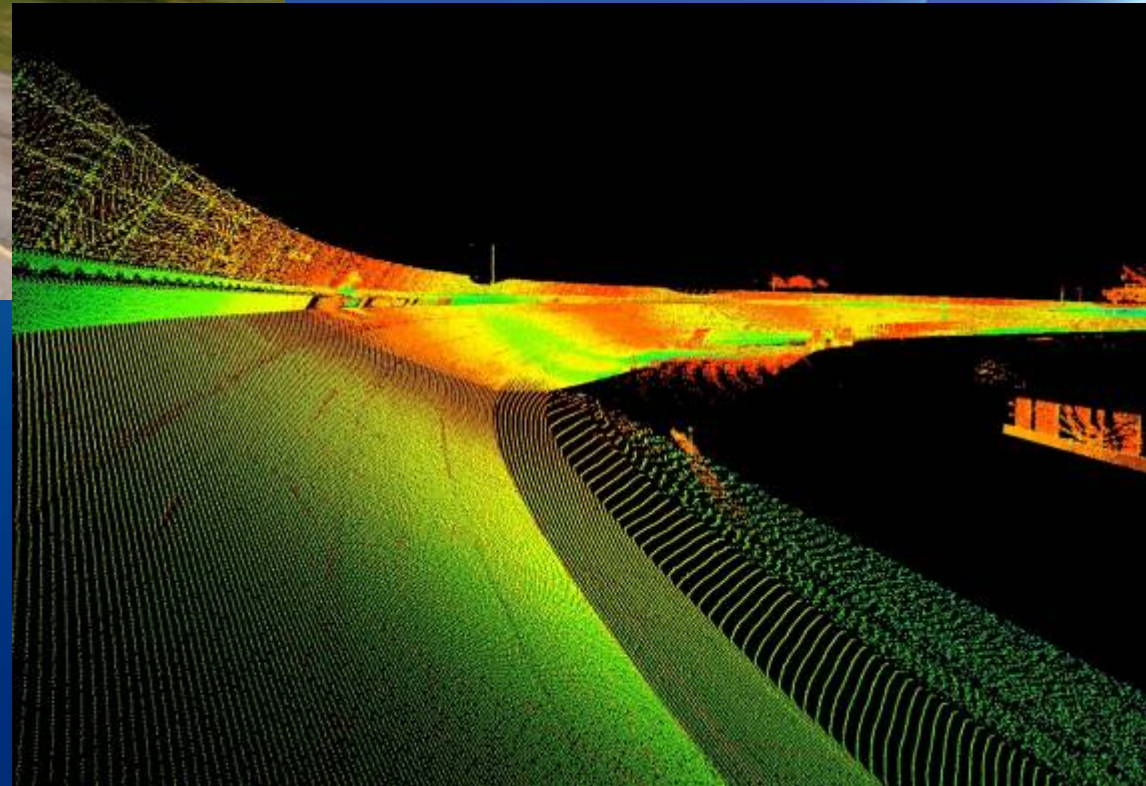
Talladega Super Speedway



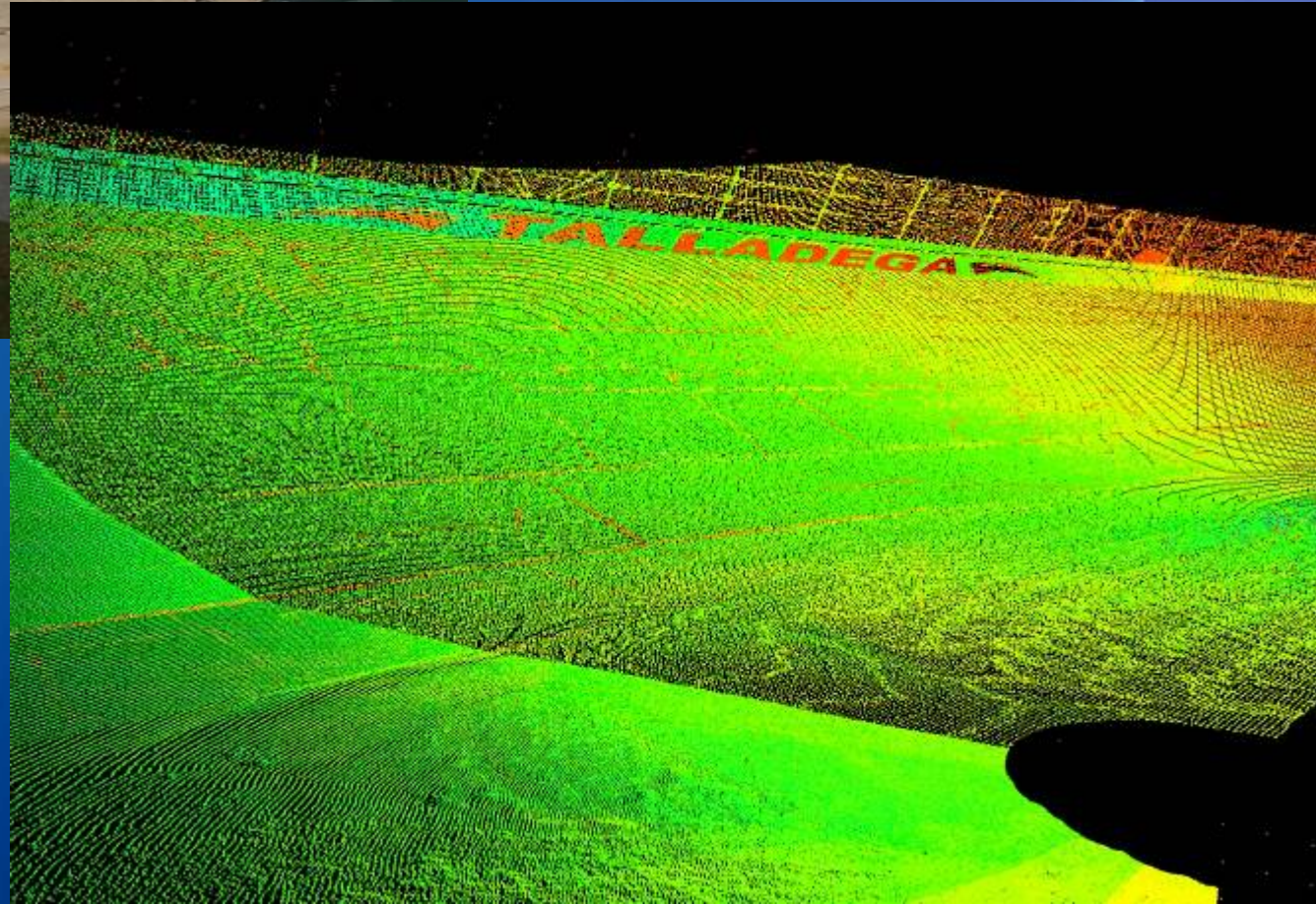
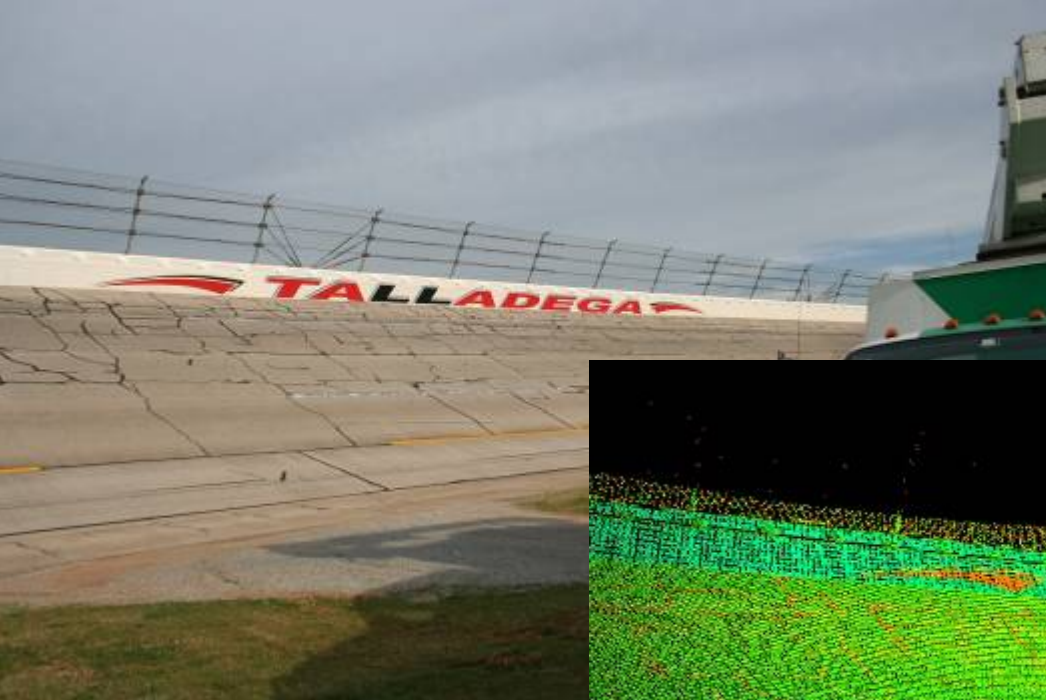
Talladega Super Speedway



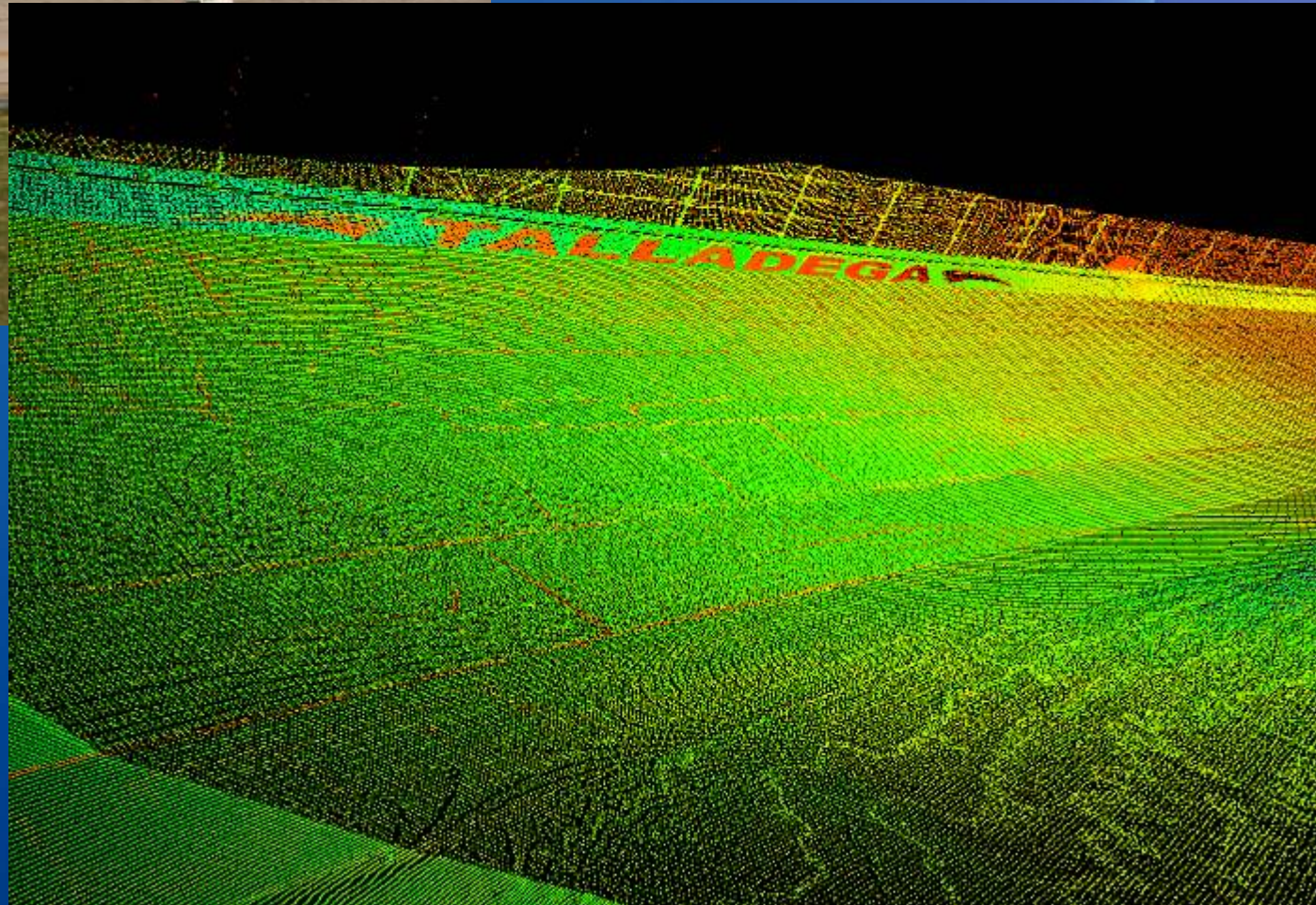
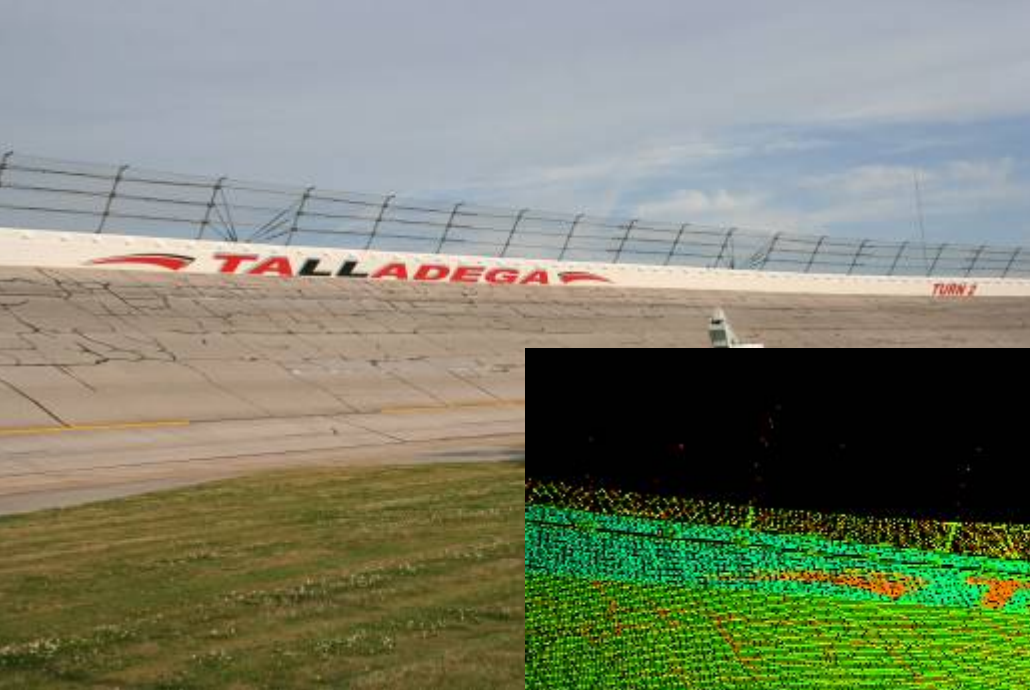
Talladega Super Speedway



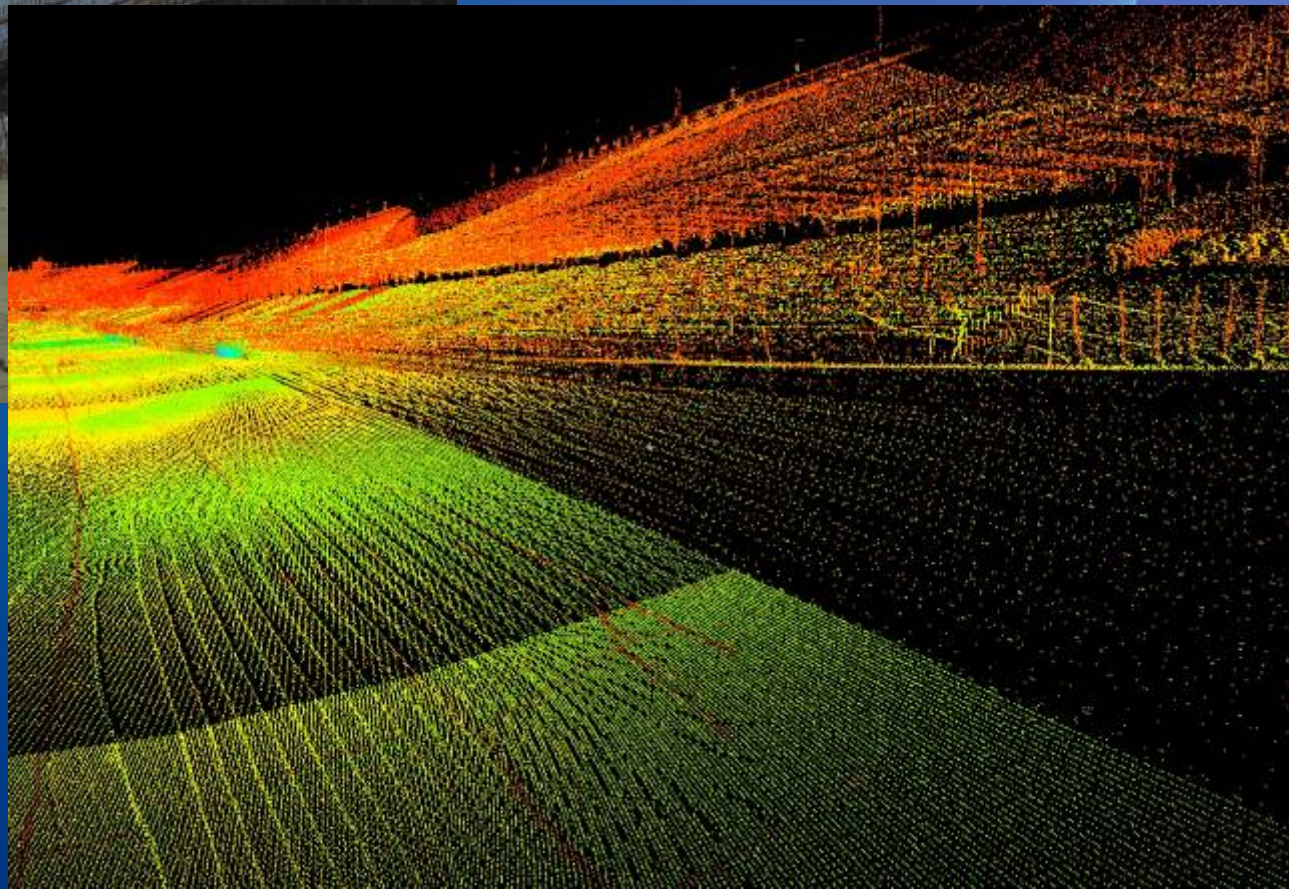
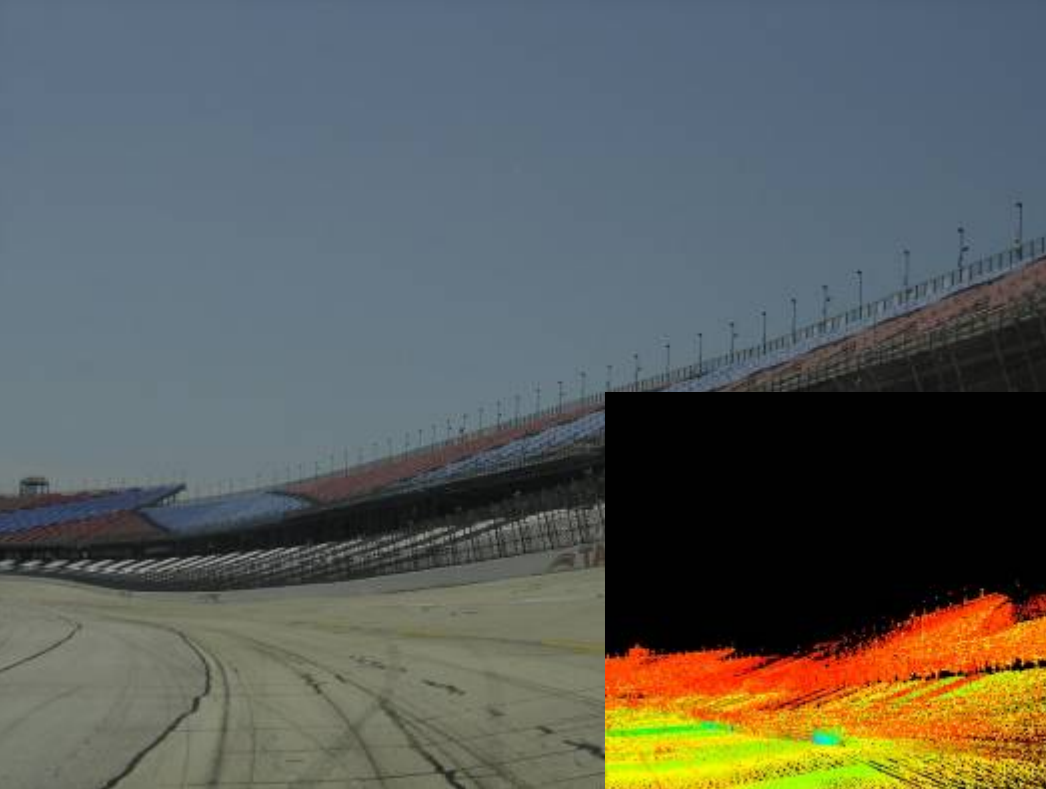
Talladega Super Speedway



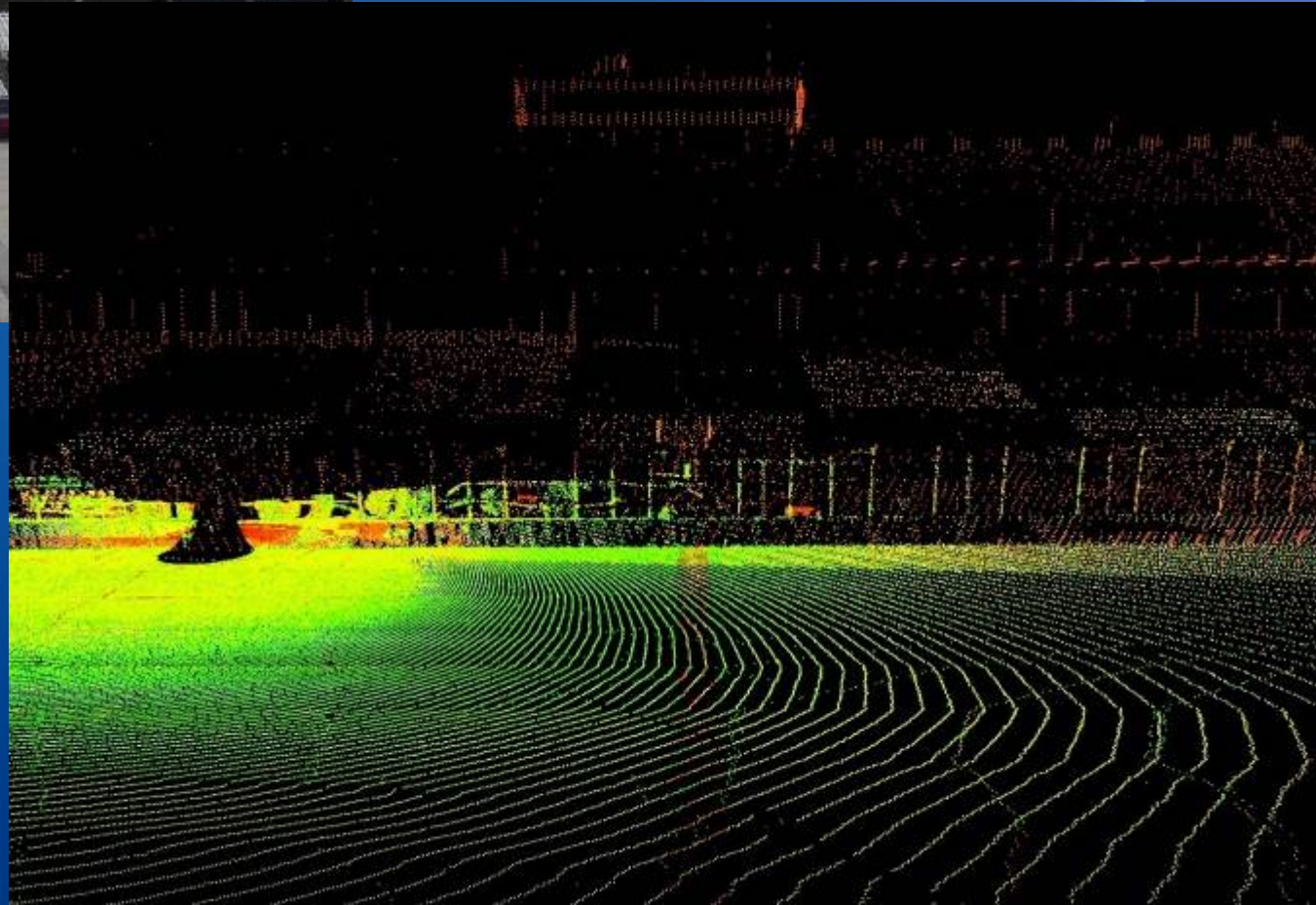
Talladega Super Speedway



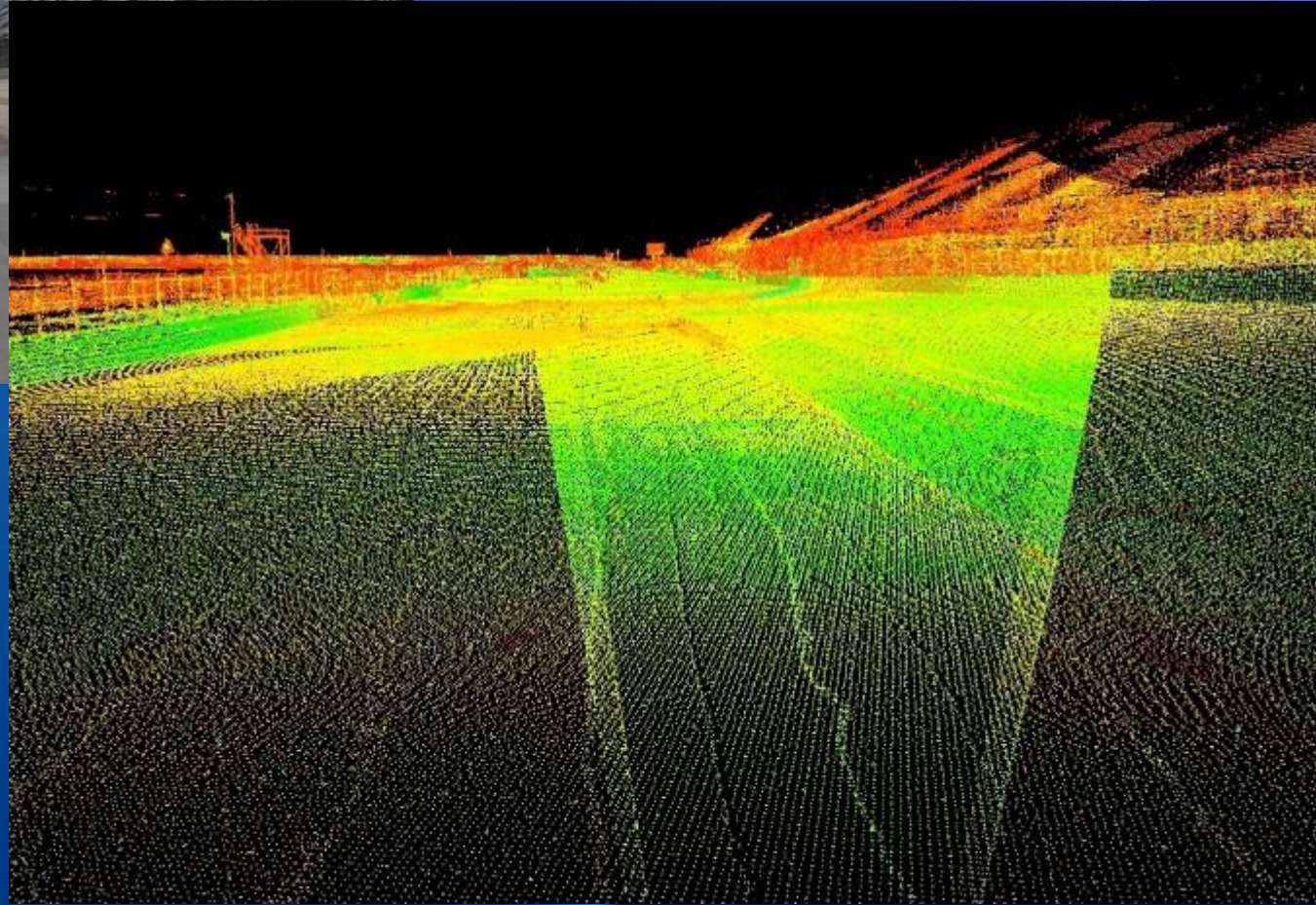
Talladega Super Speedway



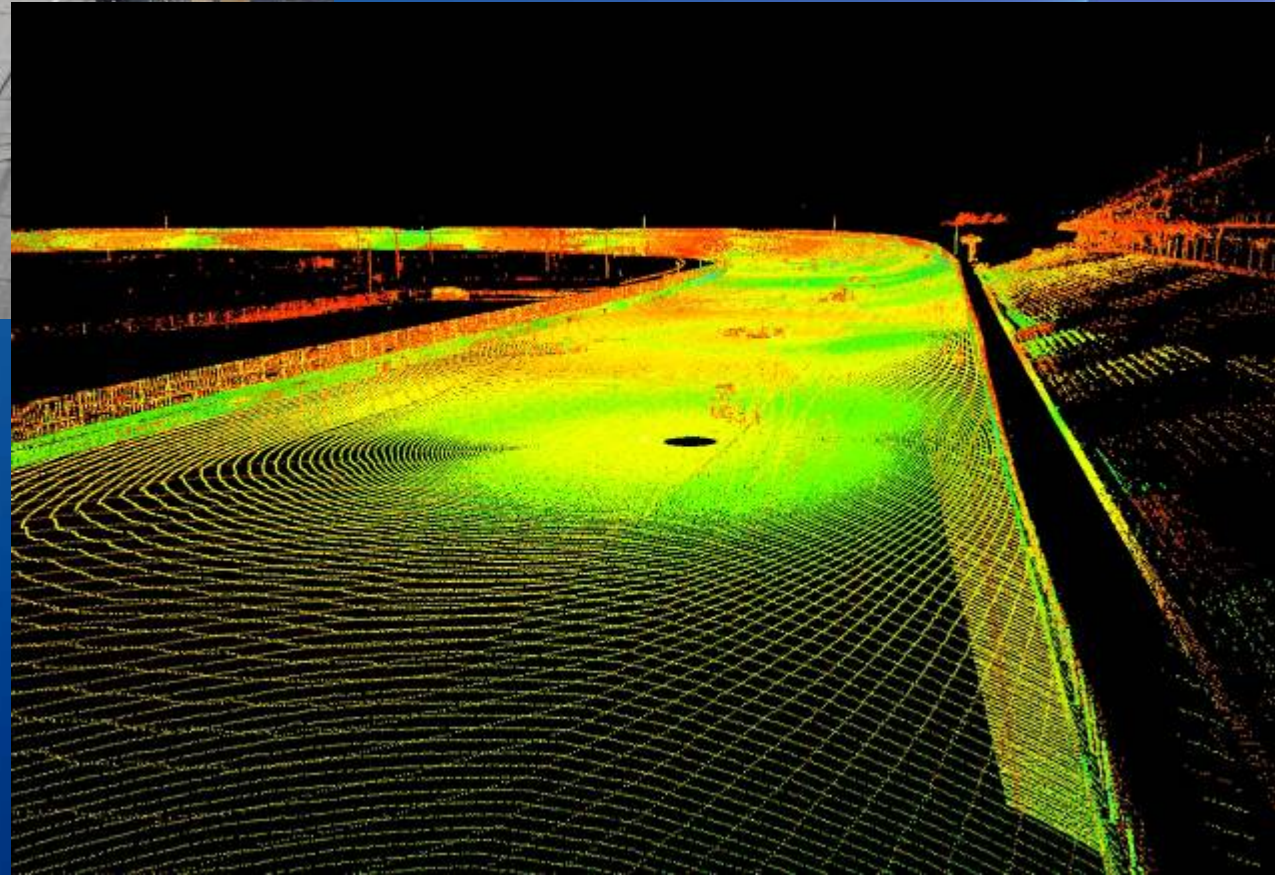
Talladega Super Speedway



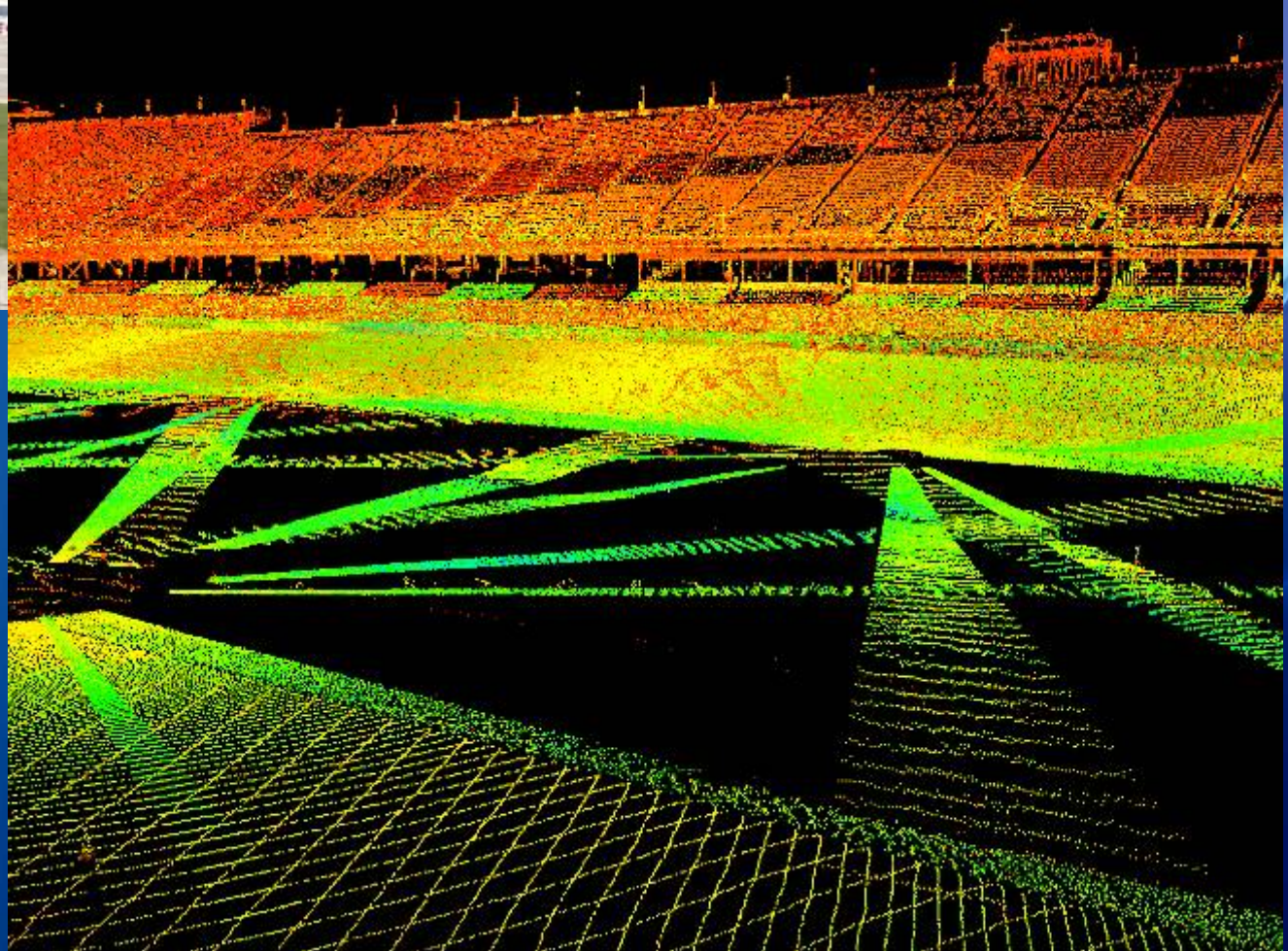
Talladega Super Speedway



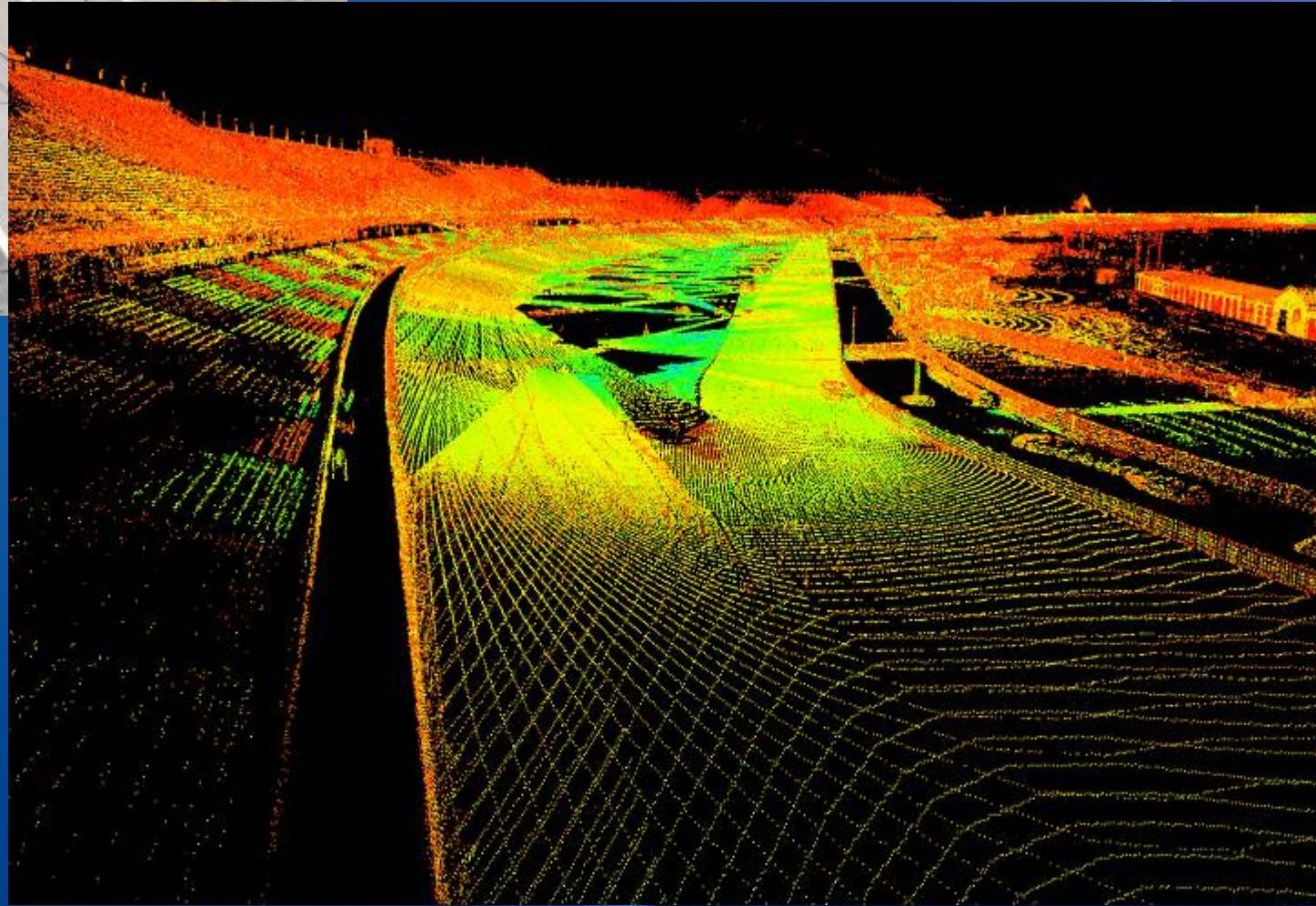
Talladega Super Speedway



Talladega Super Speedway



Talladega Super Speedway



Mobile LiDAR

Mobile LiDAR

- High Accuracy
- Rapid collection
- Safety



Mobile LiDAR

The ADS LYNX Mobile Mapper

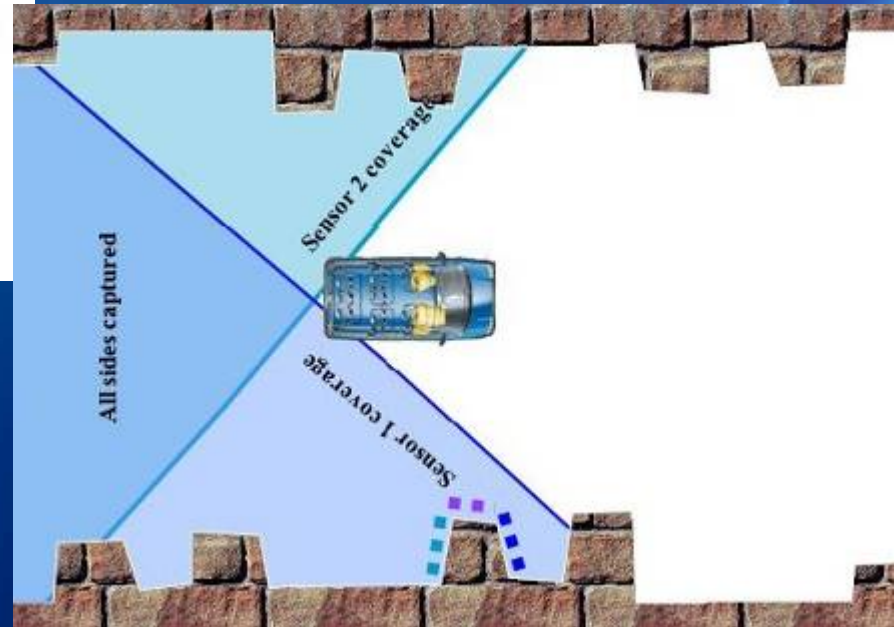
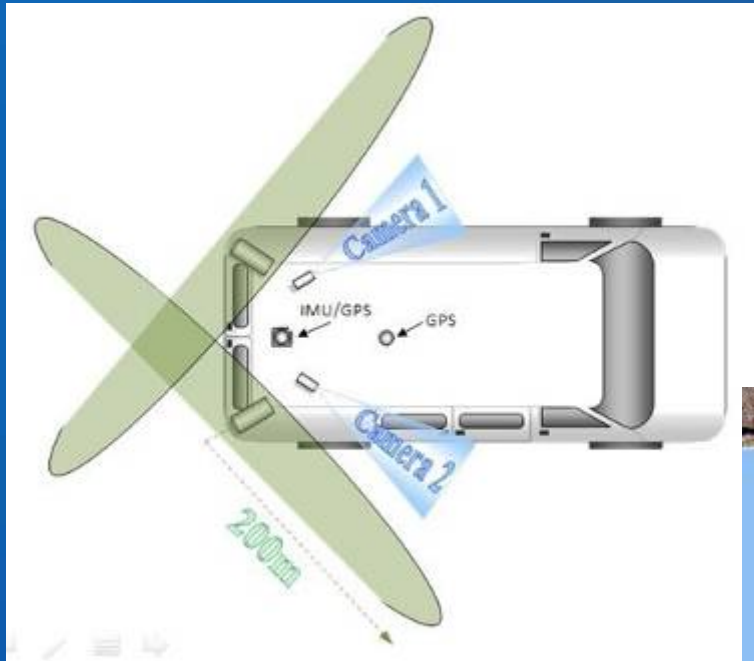


Optech V200 LYNX Specs

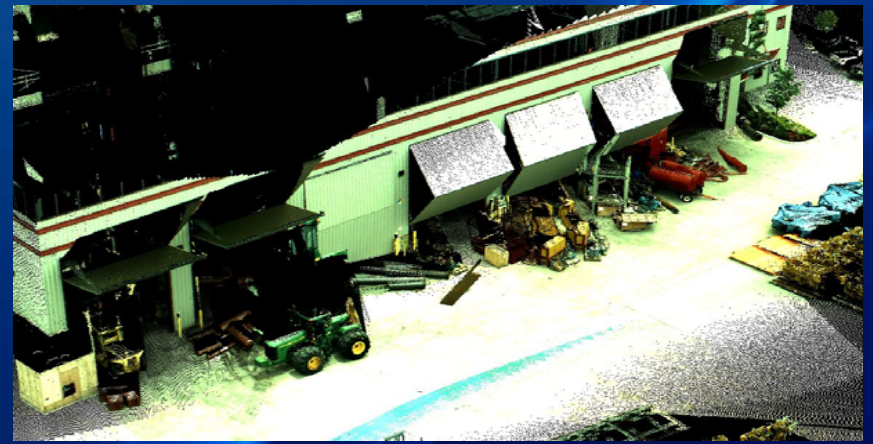
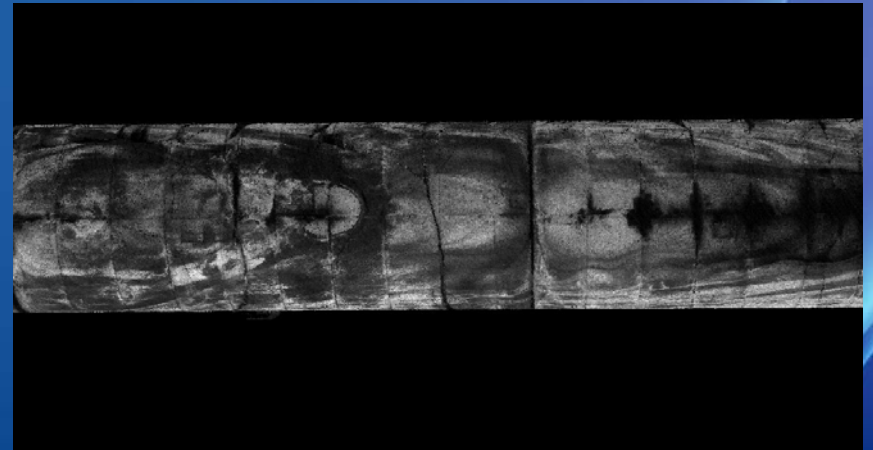
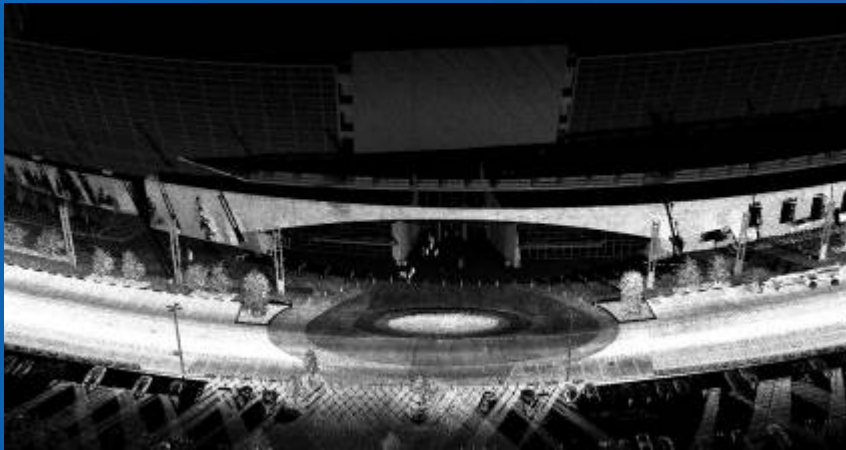
ADS LYNX Mobile Mapper Specifications

System	V200
Parameter	
Number of LiDAR sensors	2
Number of cameras	2 (2 Mpixel)
Maximum range	200 m, 20%
Range precision	± 8 mm, 1σ
Absolute accuracy	± 5 cm (1σ) ^{1,2}
Laser measurement rate	200 kHz programmable
Measurements per laser pulse	Up to 4 simultaneous
Scan frequency	80 to 200 Hz programmable
Scanner field of view	360° without obscurations
Laser classification	IEC/CDRH Class 1 eye safe
¹ Assumes good GPS quality	
² Accuracy may be improved via post processing techniques	

Optech V200 LYNX



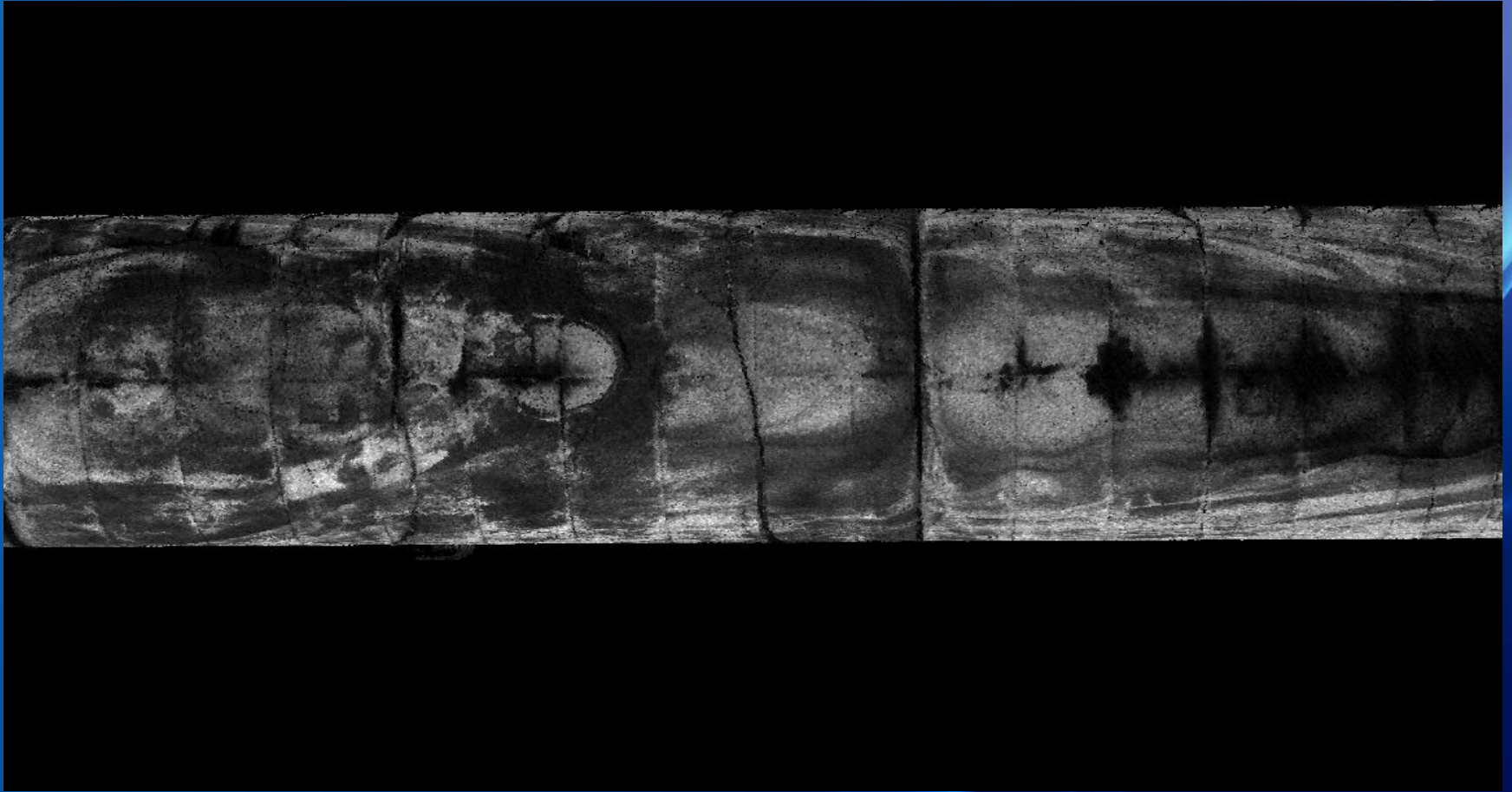
Sample data



Sample data



Sample data



Sample data



Sample data



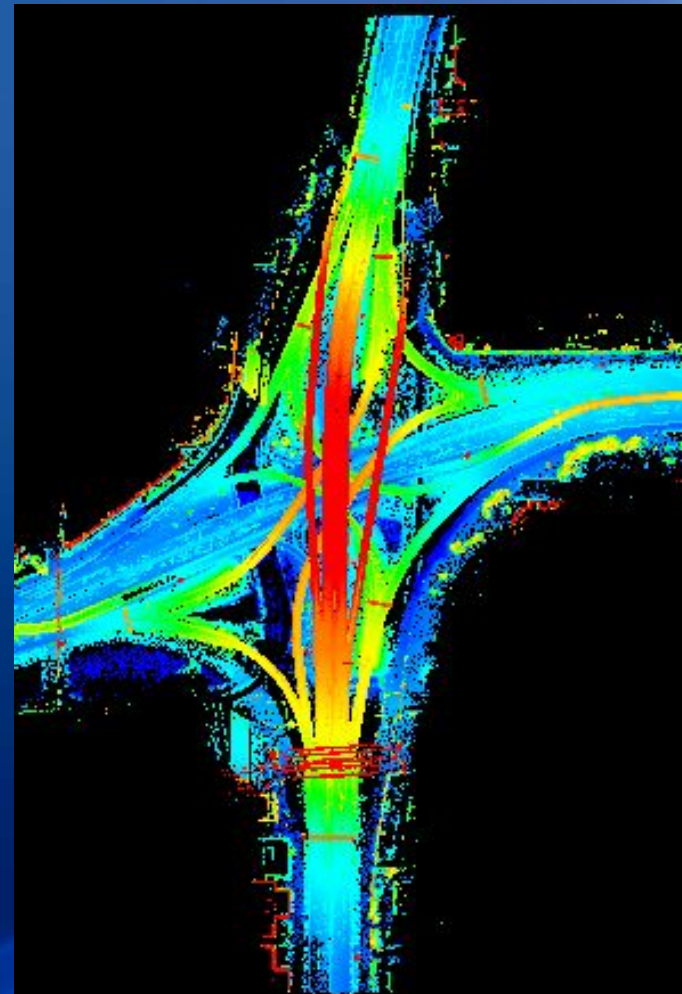
Sample data

ADS LYNX Mobile LiDAR

Cowboys Stadium



I-610 & 59 Houston



I-610 & 59 Houston

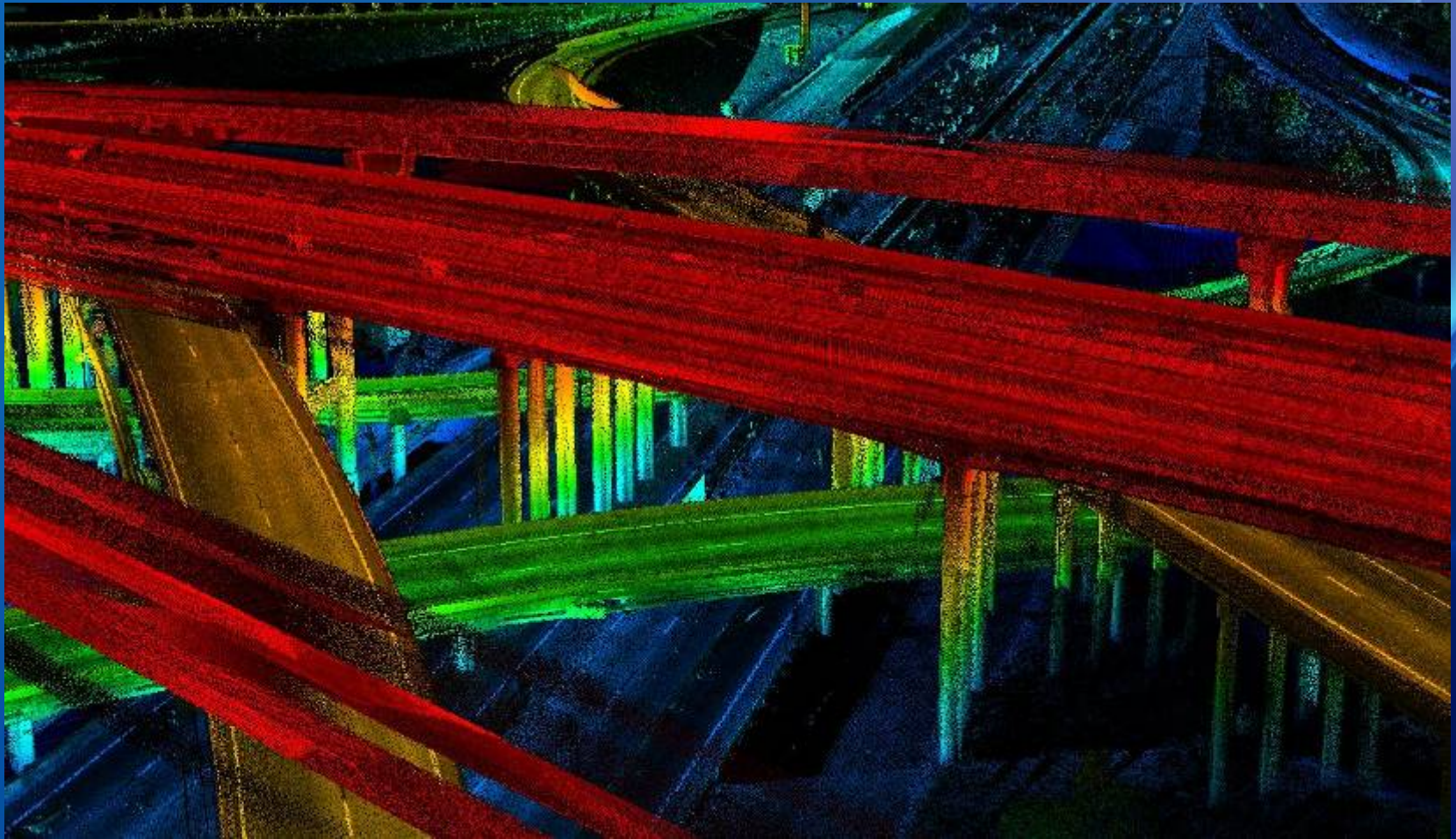
ADS LYNX Mobile LiDAR
I-610 & 59



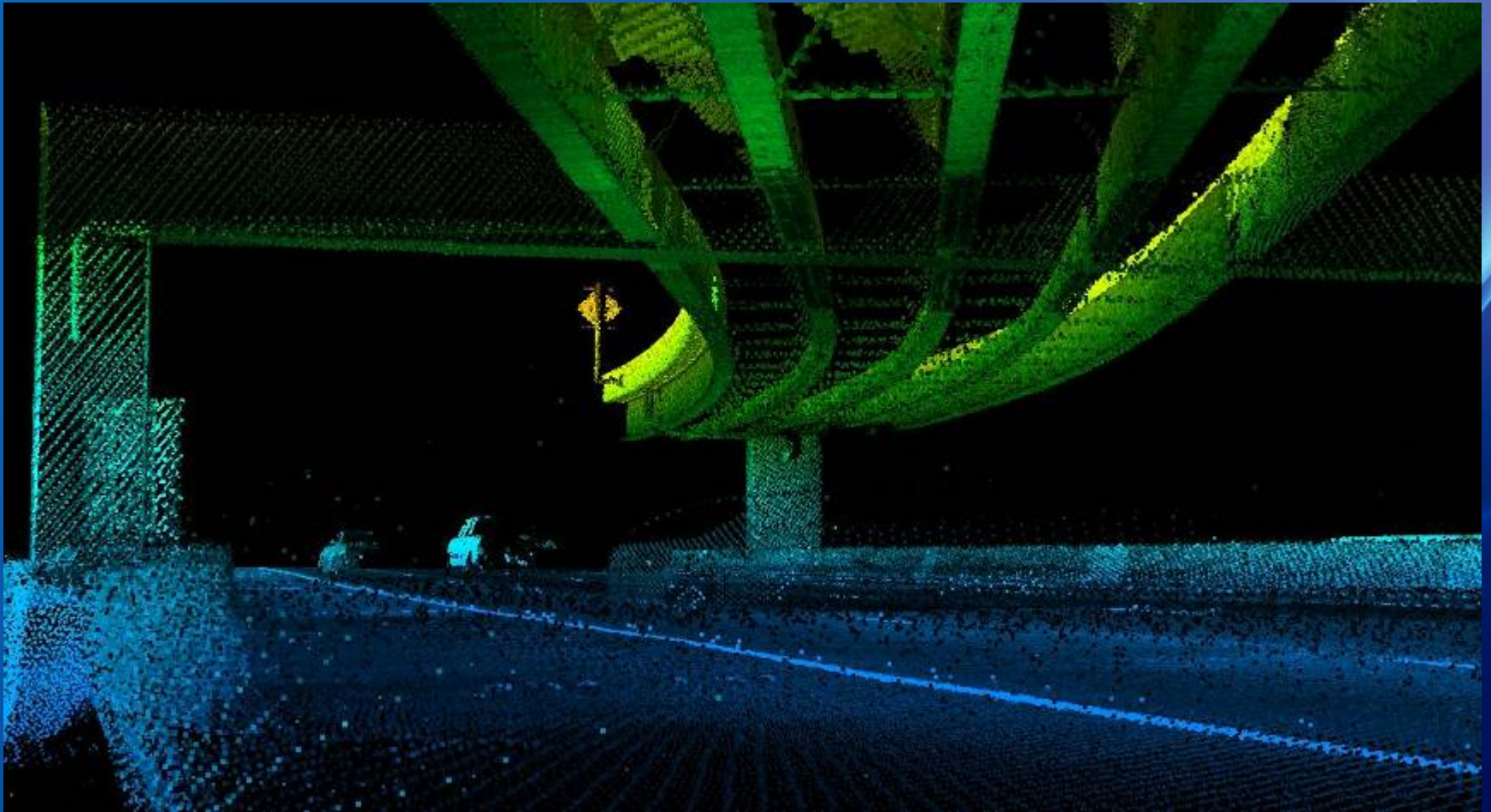
I-610 & 59 Interchange



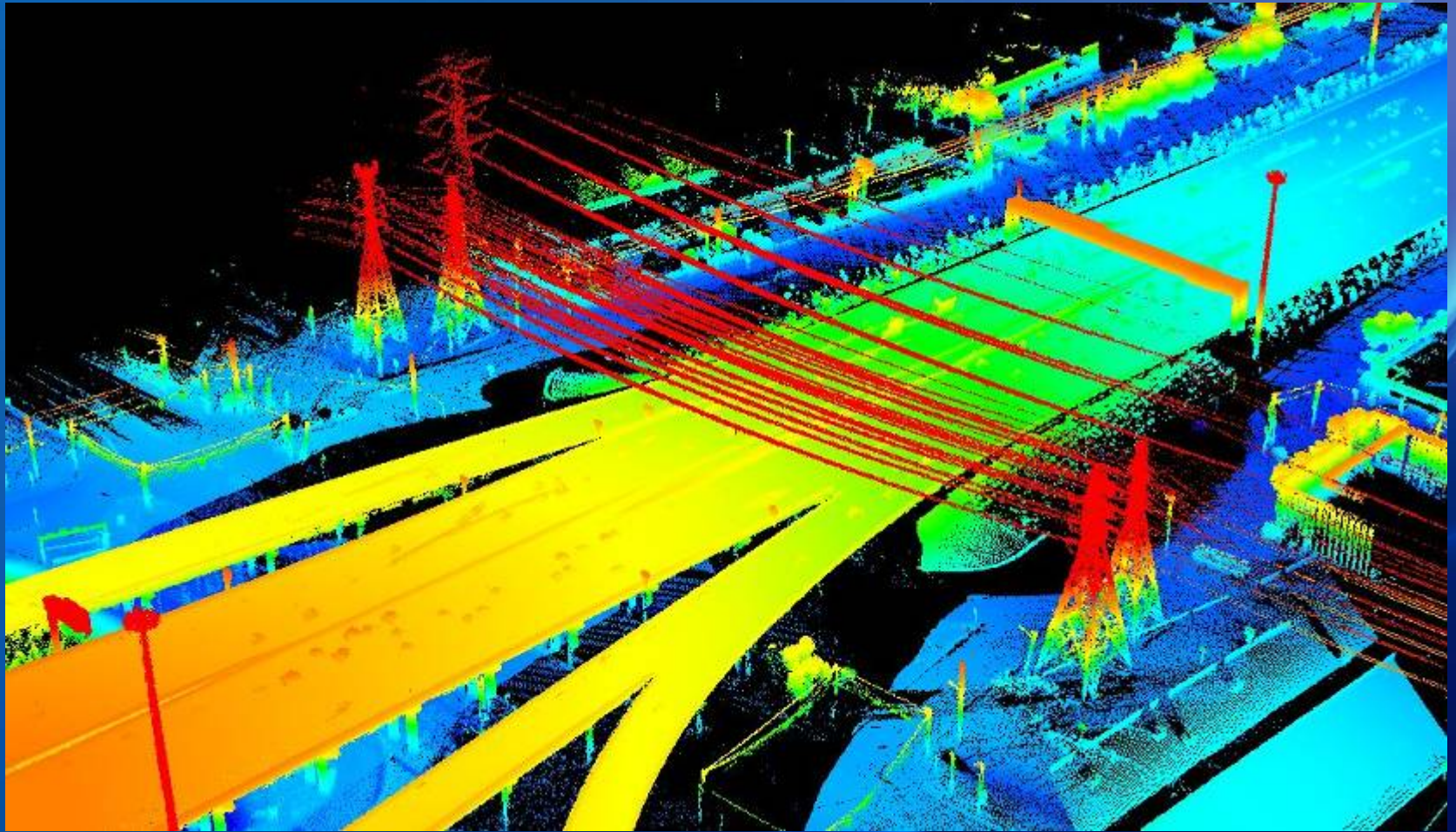
I-610 & 59 Interchange



I-610 & 59 Interchange



I-610 & 59 Interchange



I-610 & 59 Interchange

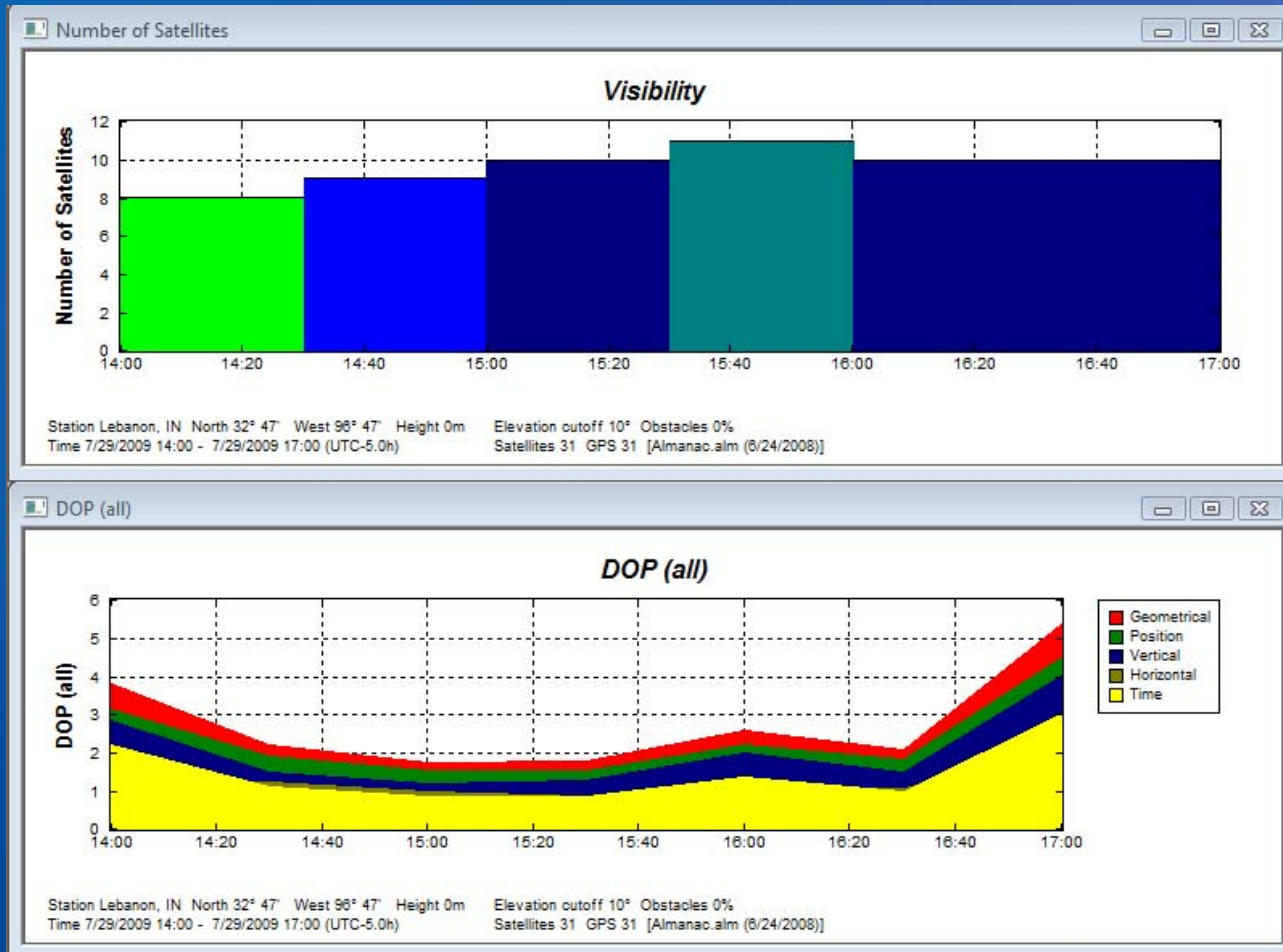


I-65 near Indianapolis

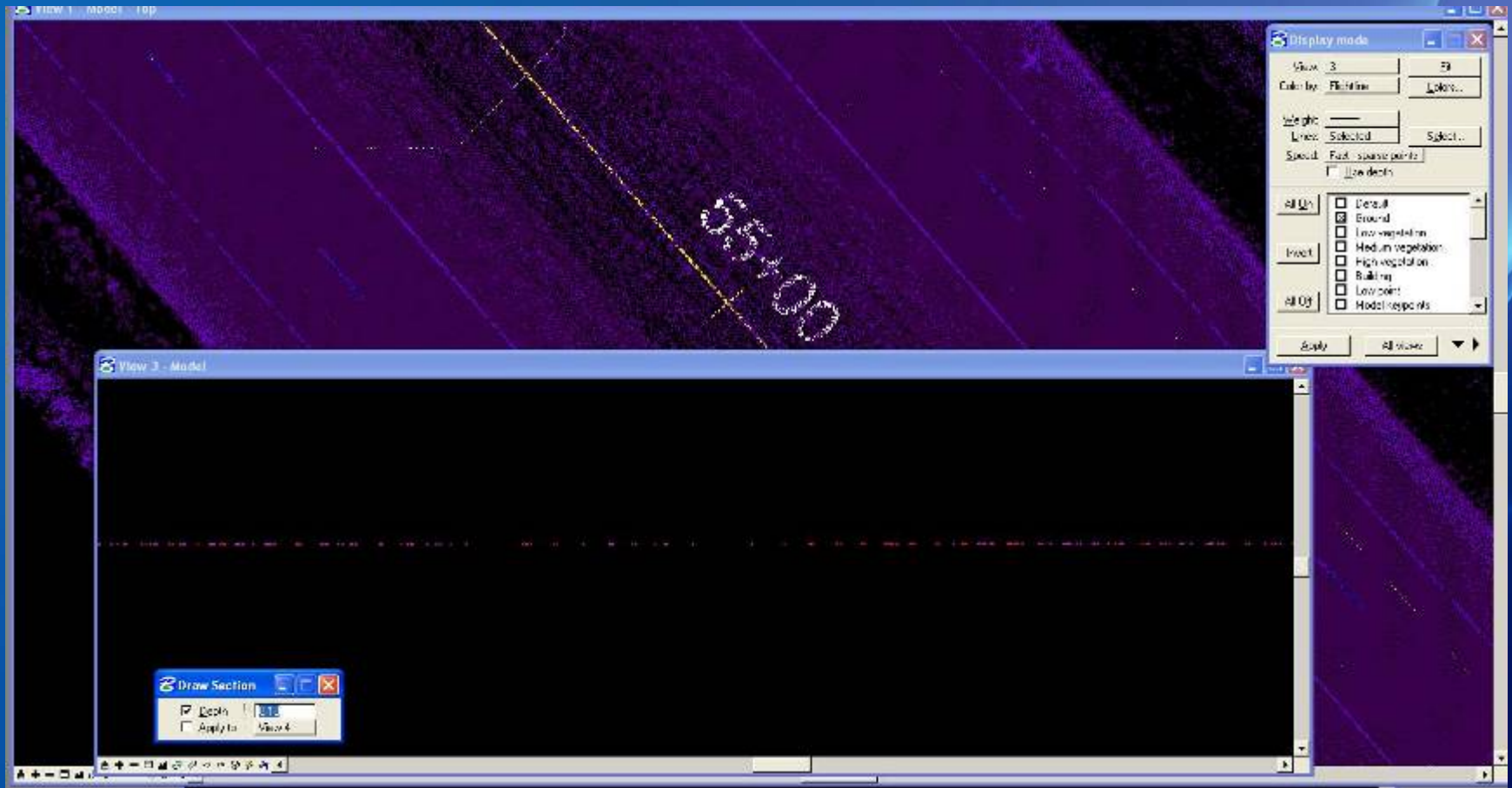
- Mobile
 - 8 miles
 - Divided hwy
 - Two bridges
 - Rapid response
 - 60 control points



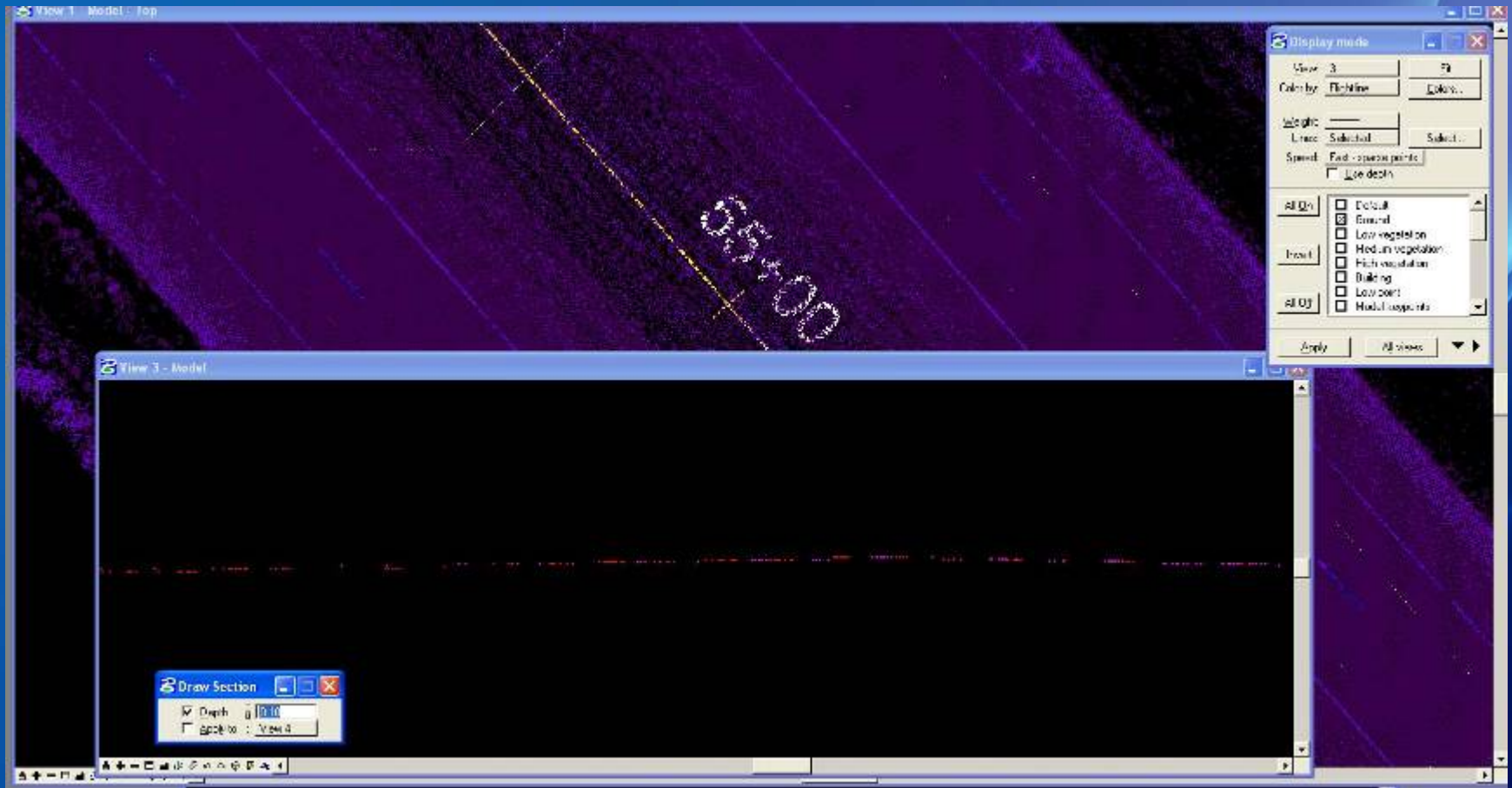
I-65 near Indianapolis



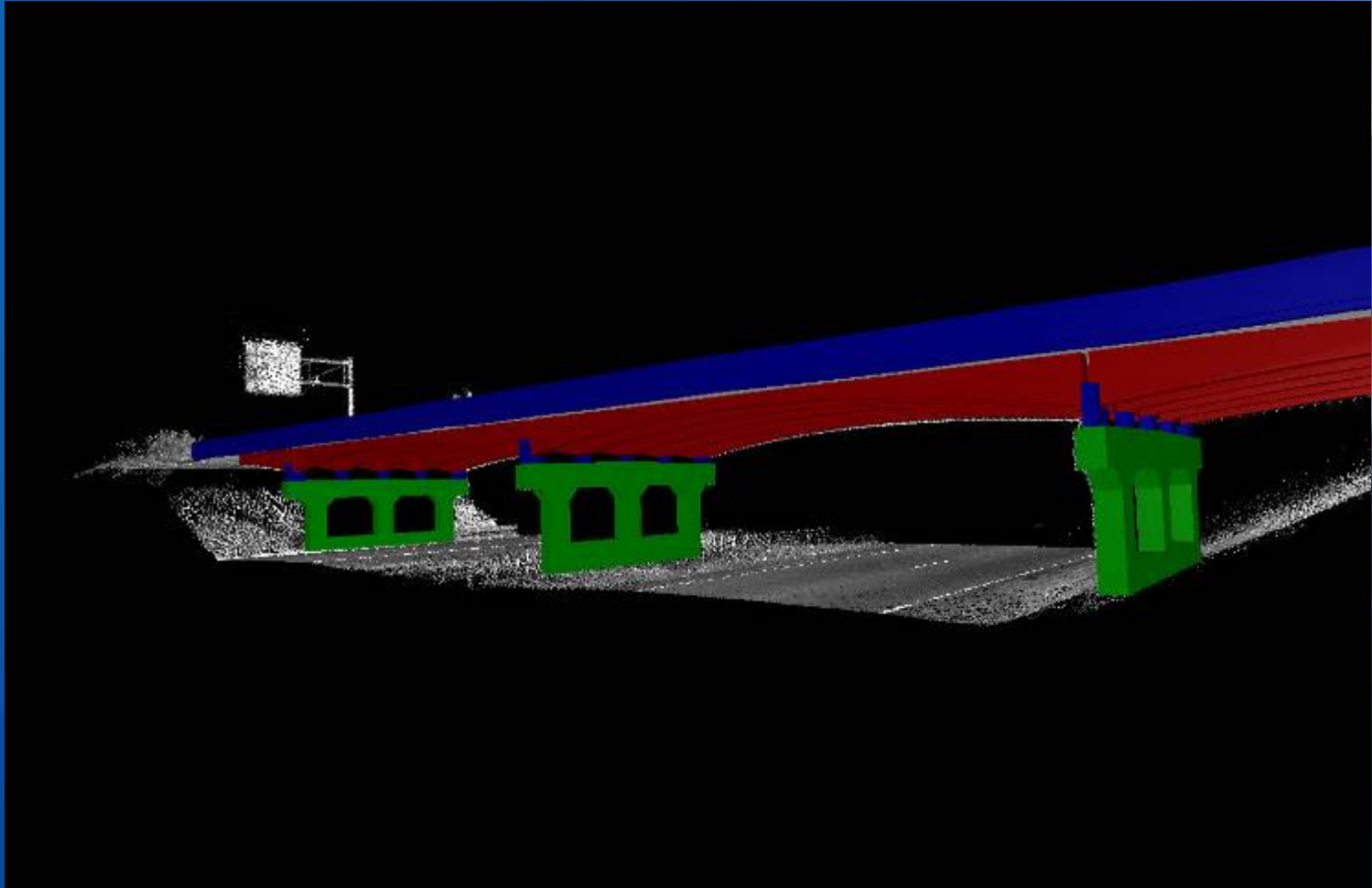
I-65 near Indianapolis



I-65 near Indianapolis



I-65 near Indianapolis



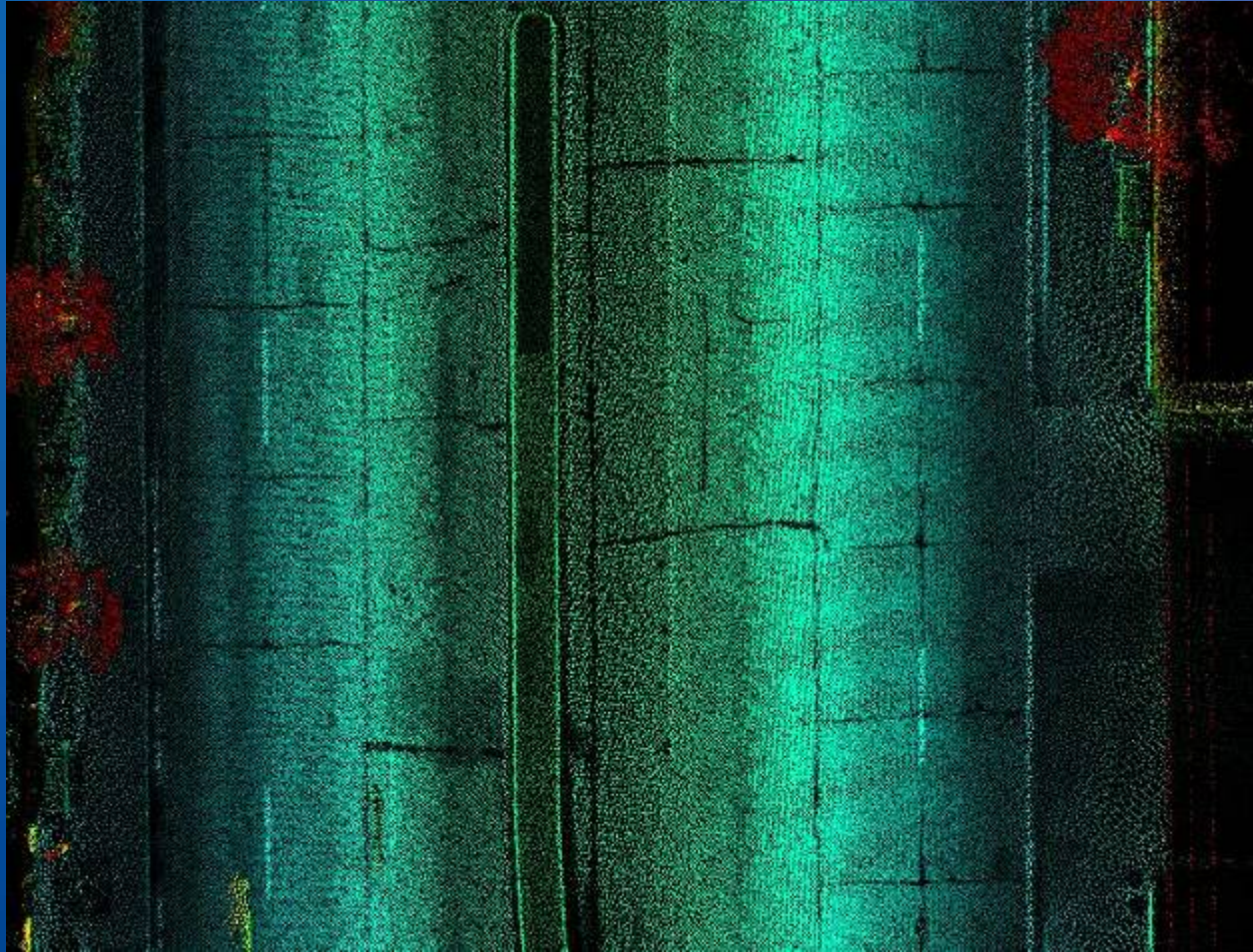
Case Study Loop 12/Buckner Rd

Terrestrial and Mobile

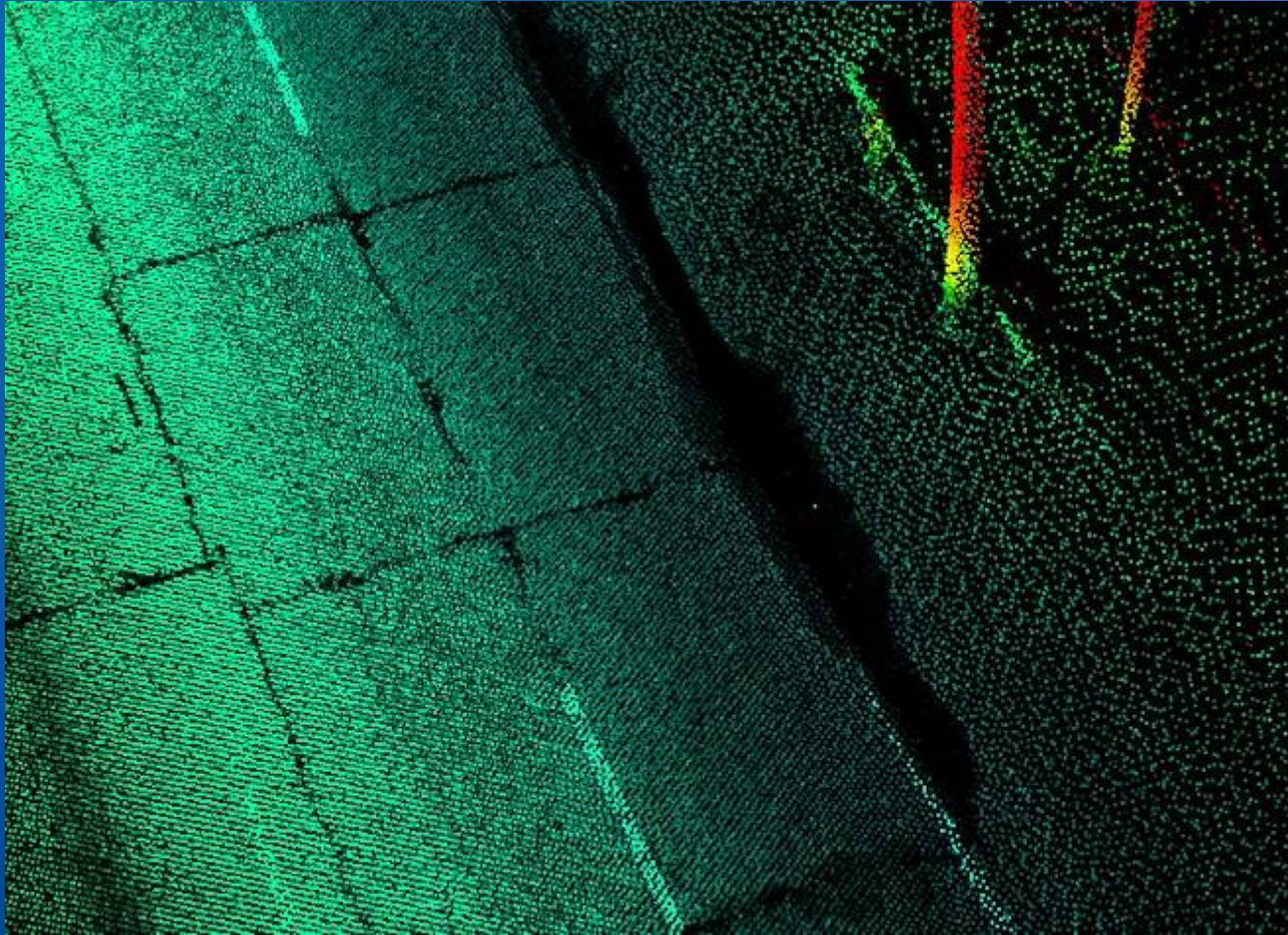
- Comparison area +/- 1 mile
- Mobile 10 PID points



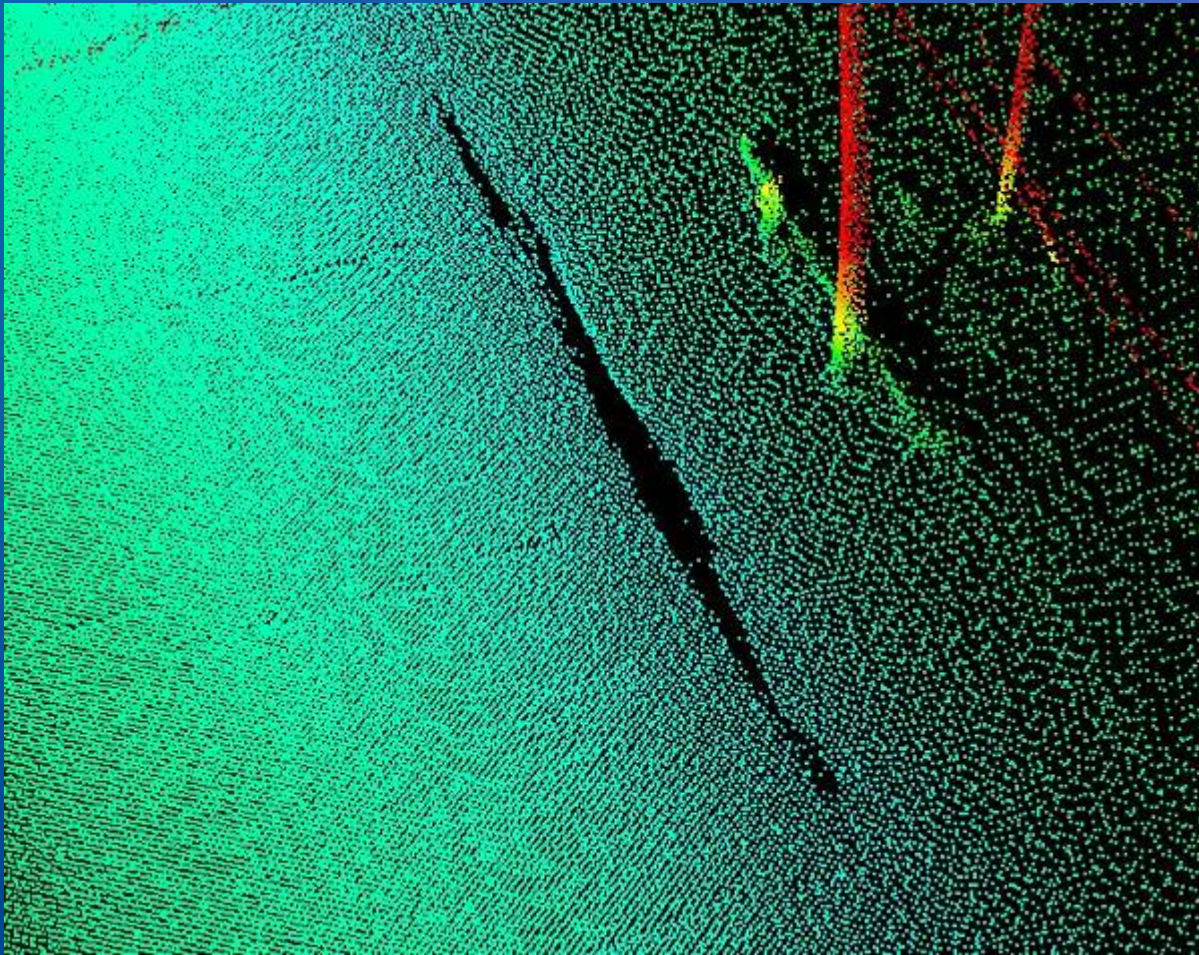
Case Study Loop 12/Buckner Rd



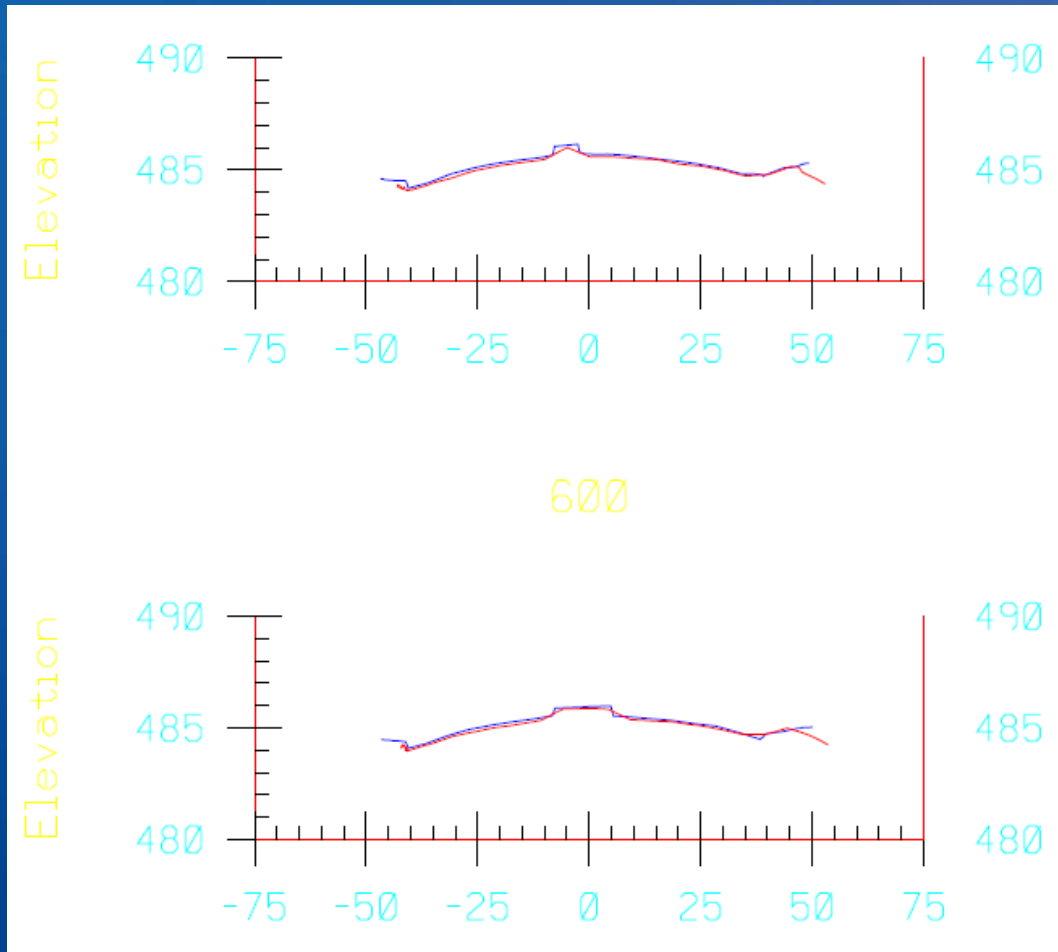
Case Study Loop 12/Buckner Rd



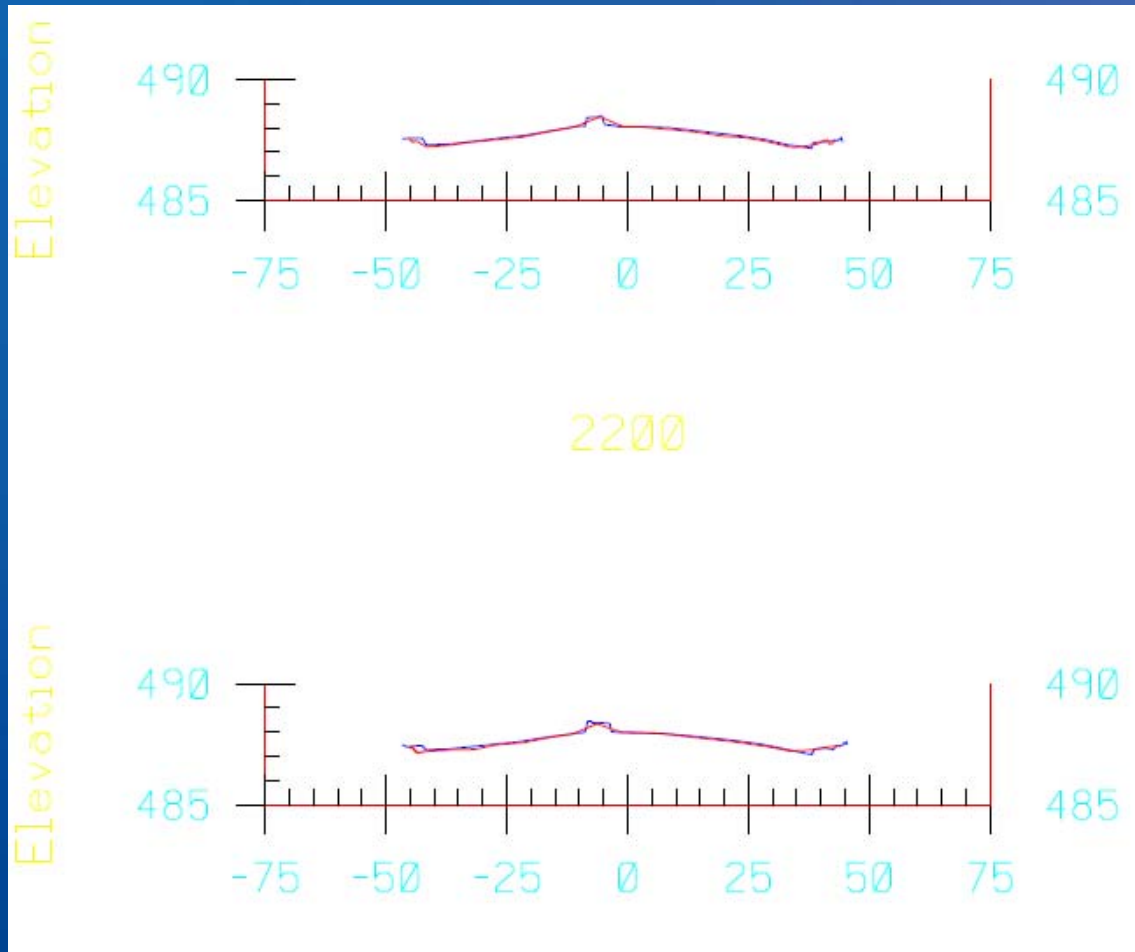
Case Study Loop 12/Buckner Rd



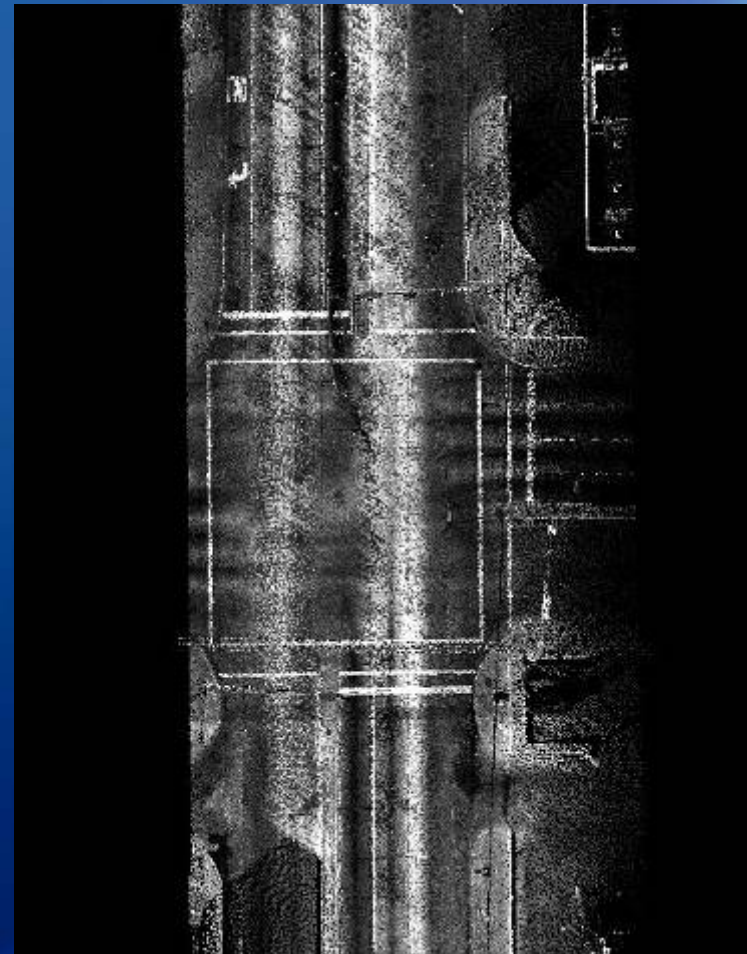
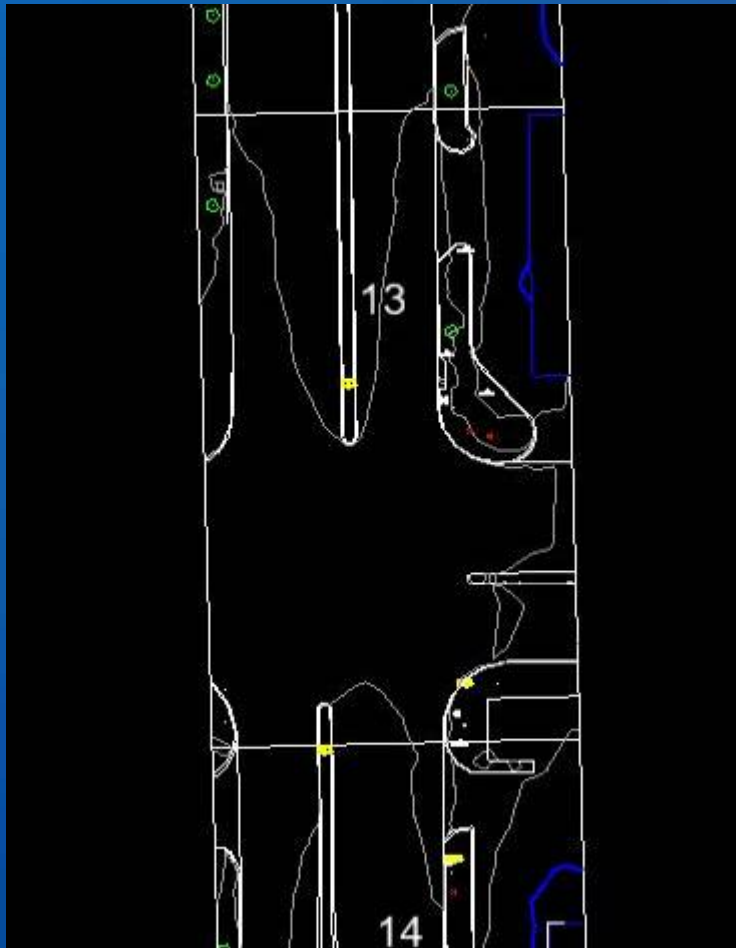
Case Study Loop 12/Buckner Rd



Case Study Loop 12/Buckner Rd



Case Study Loop 12/Buckner Rd



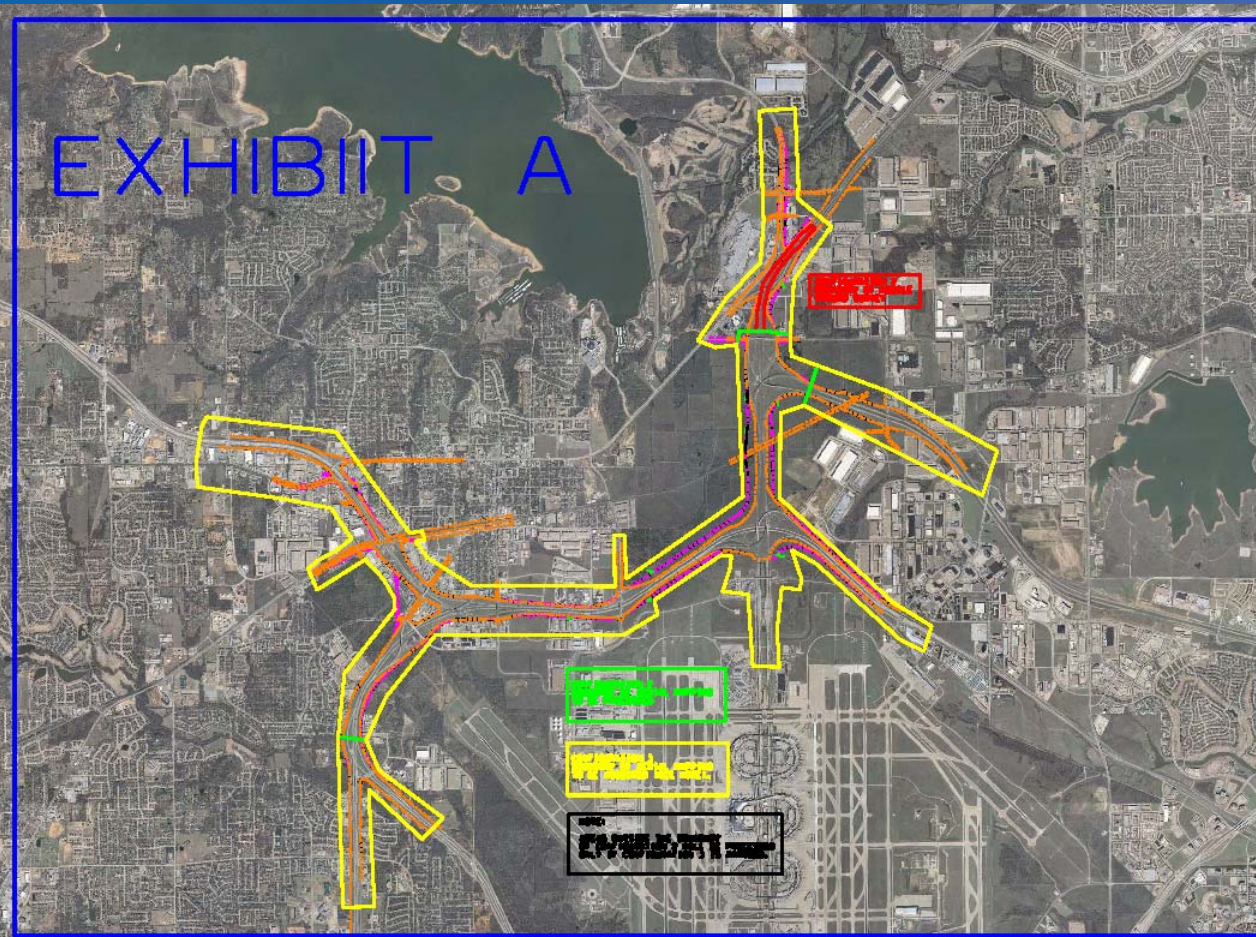
Case Study Loop 12/Buckner Rd

ADS LYNX MOBILE MAPPER

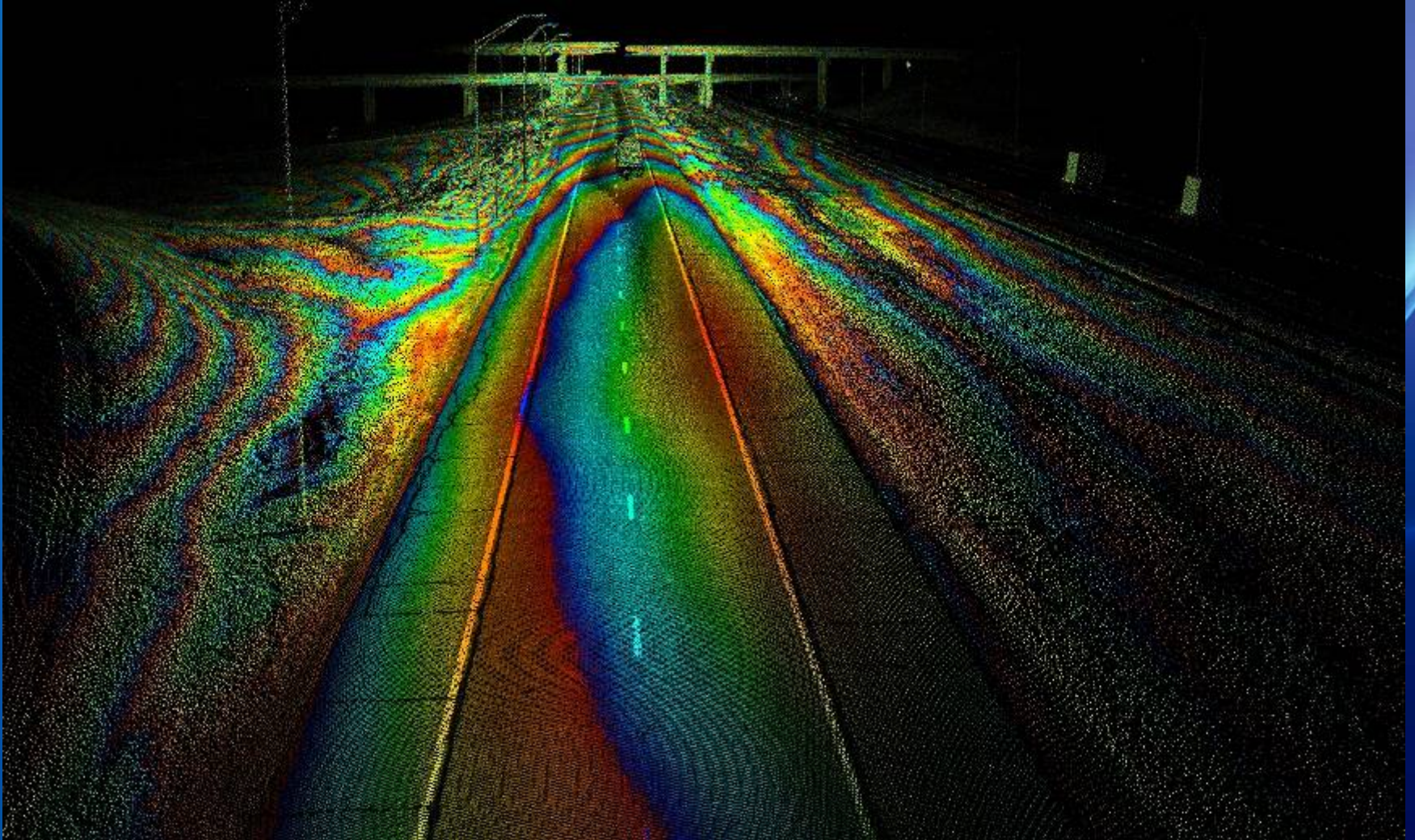
***Loop 12
Mattison Drive Intersection***



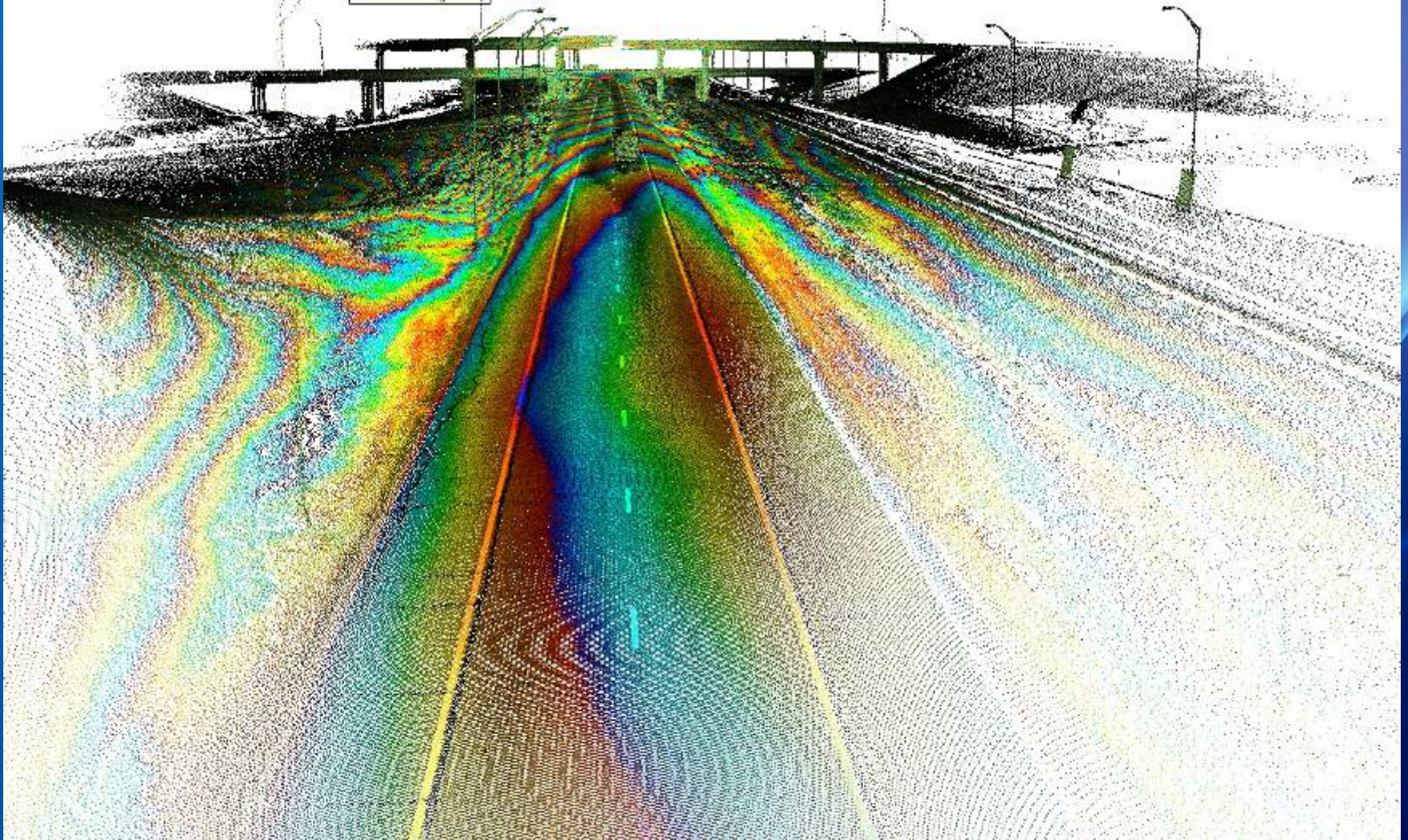
D/FW Connector



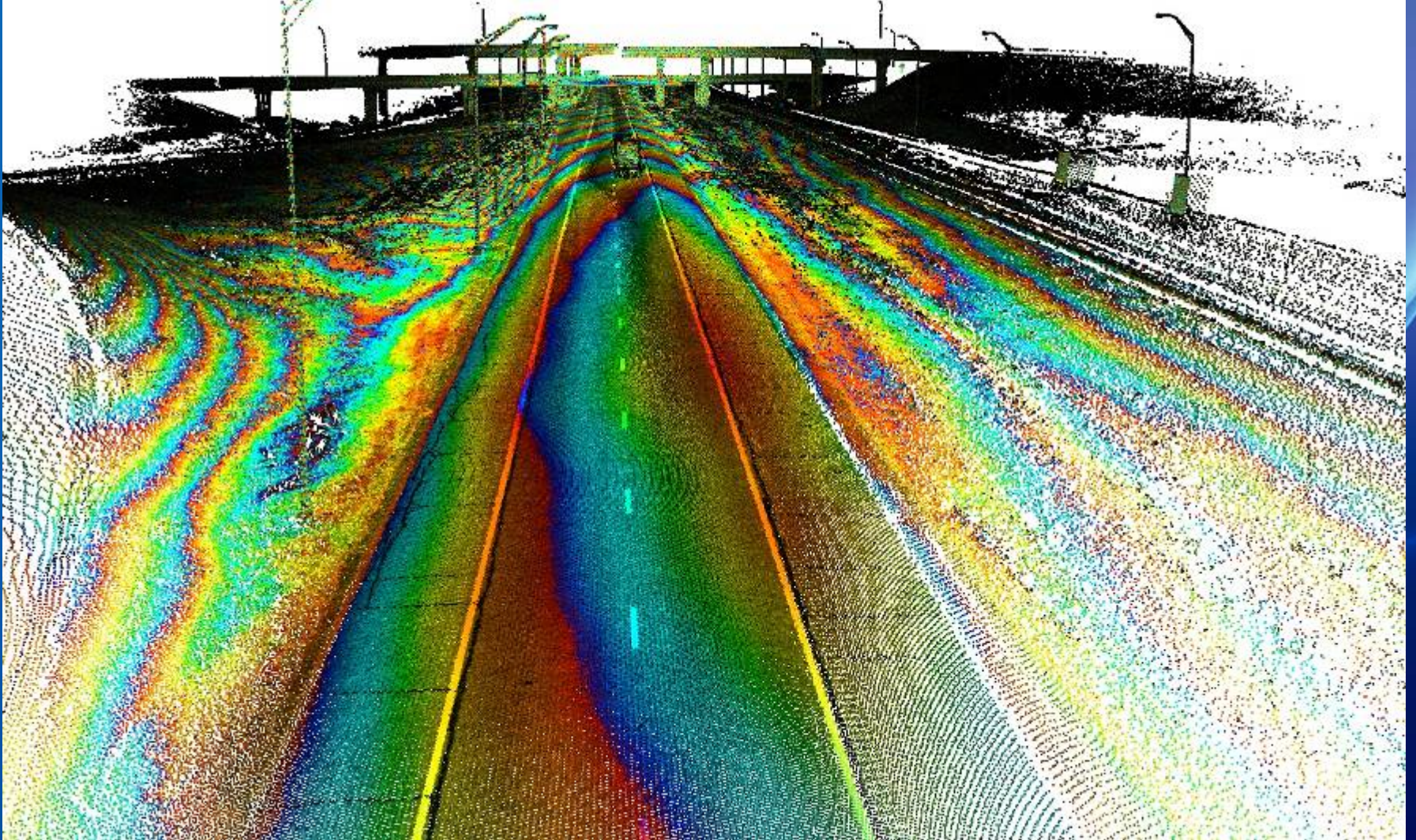
D/FW Connector



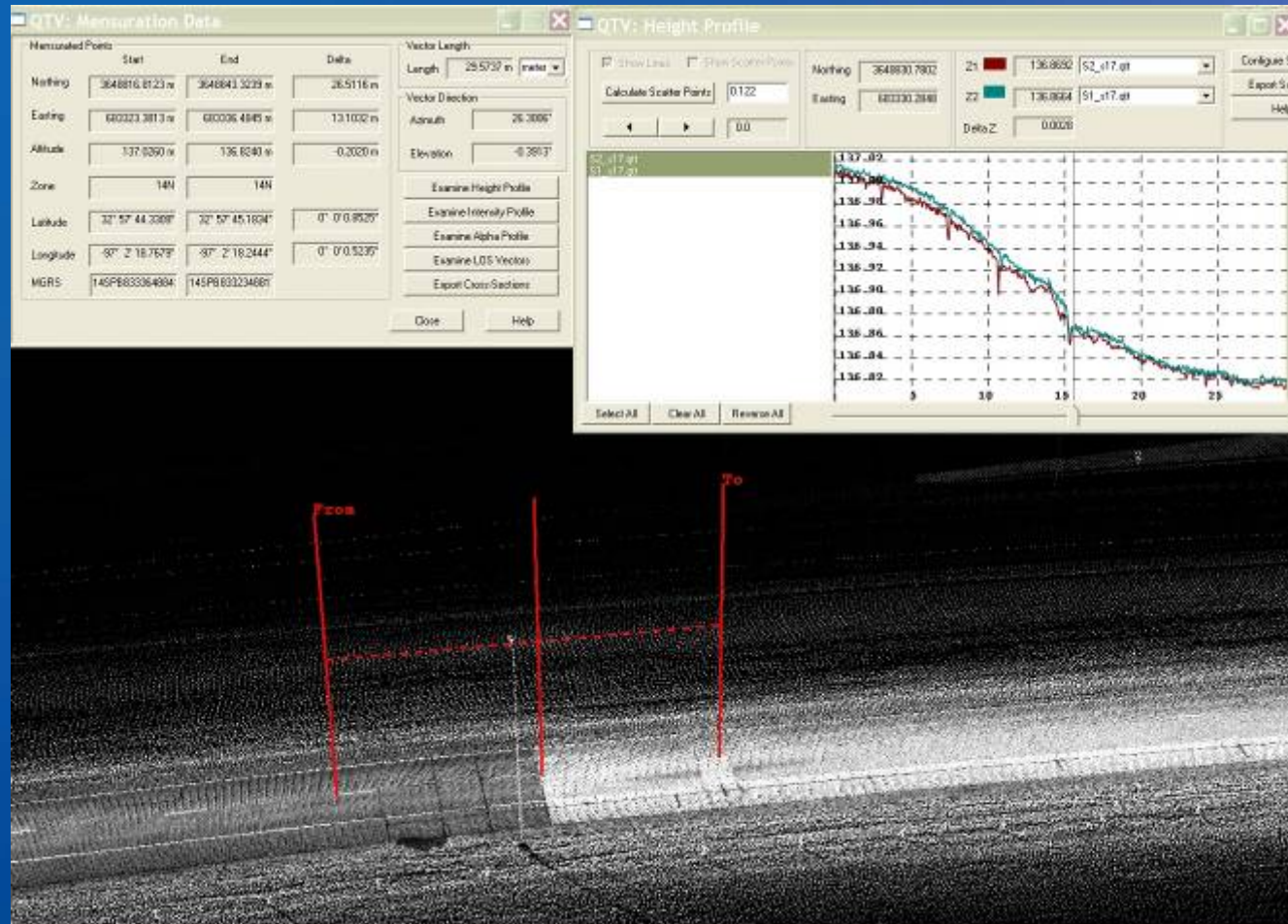
D/FW Connector



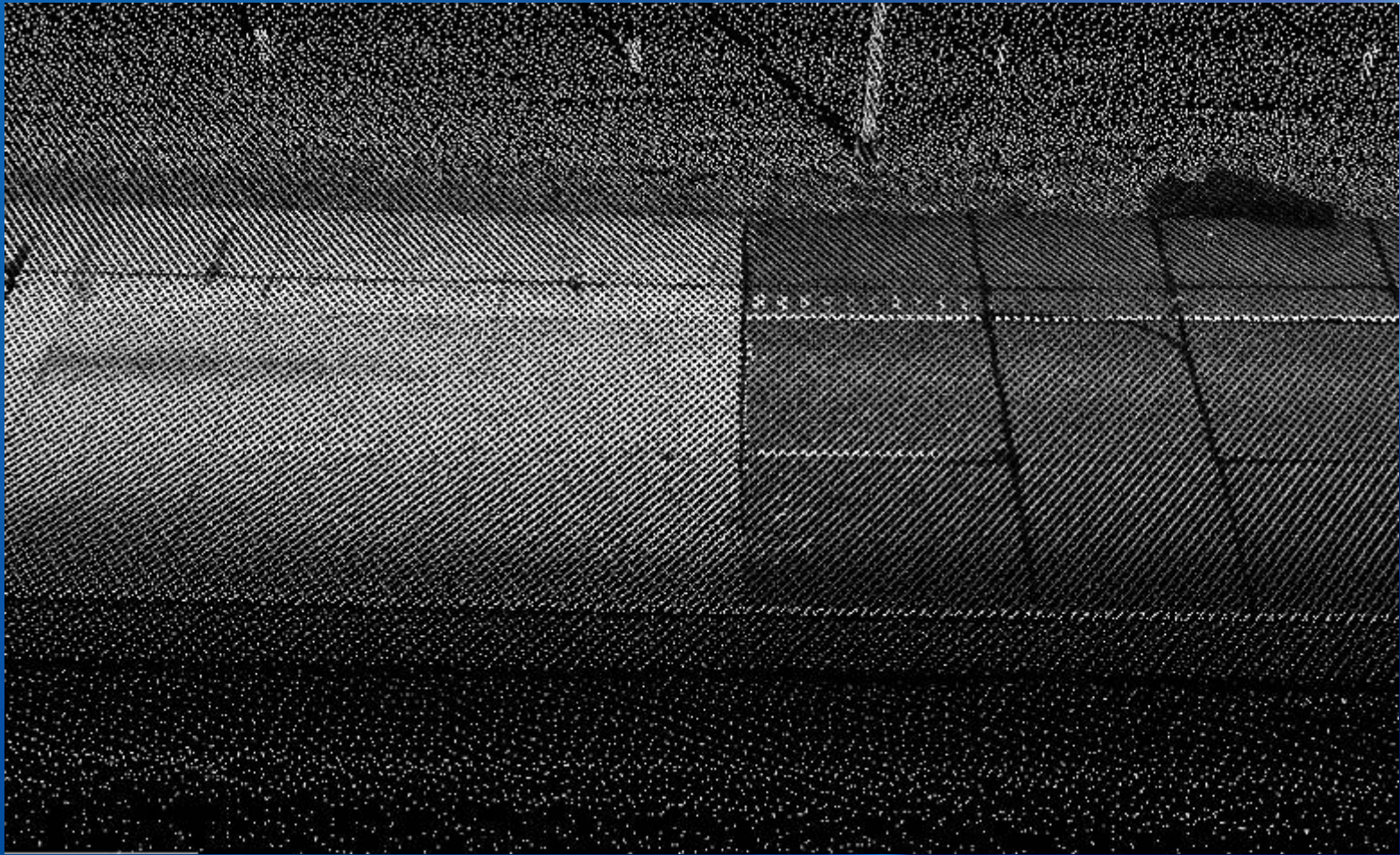
D/FW Connector



D/FW Connector



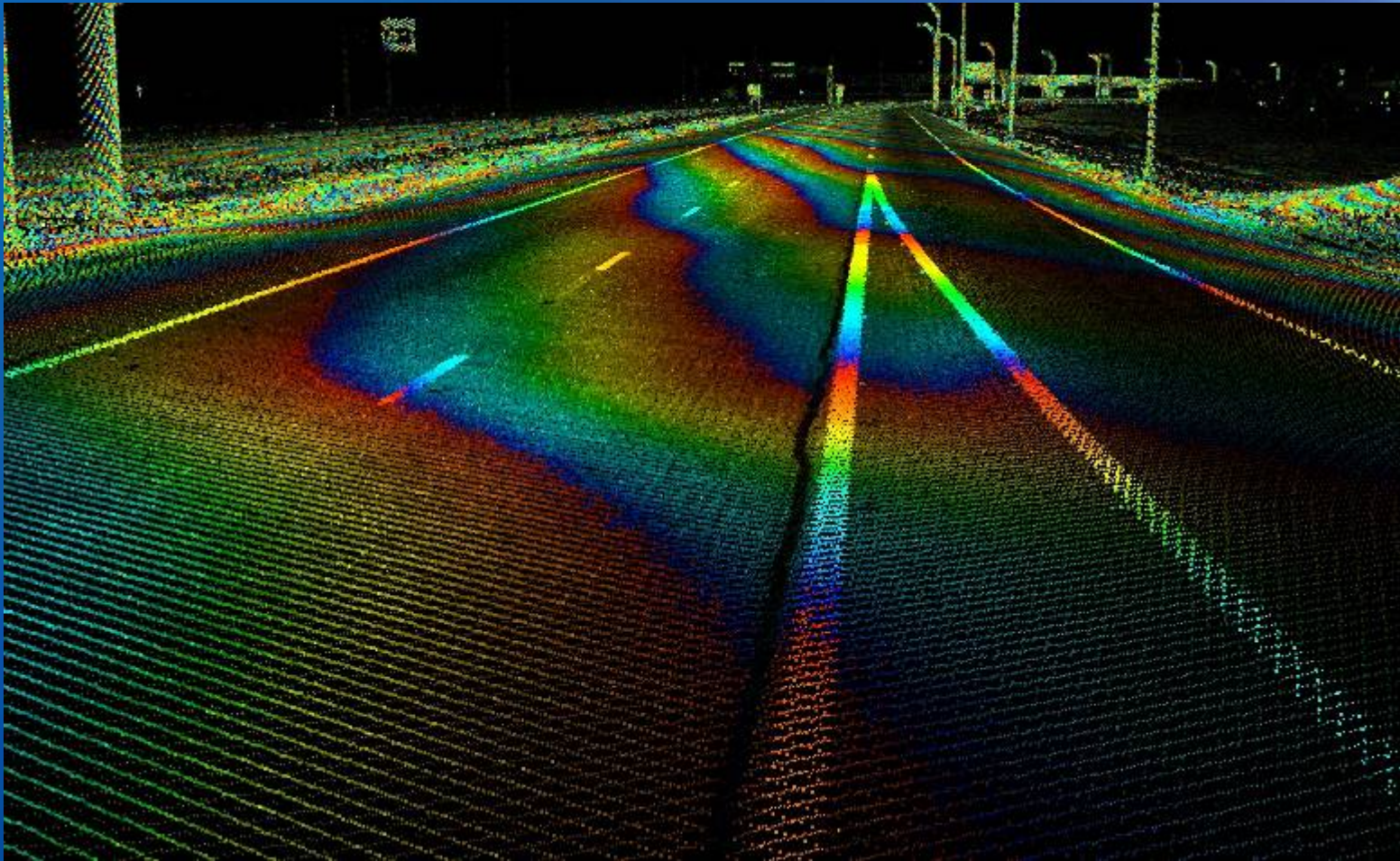
D/FW Connector



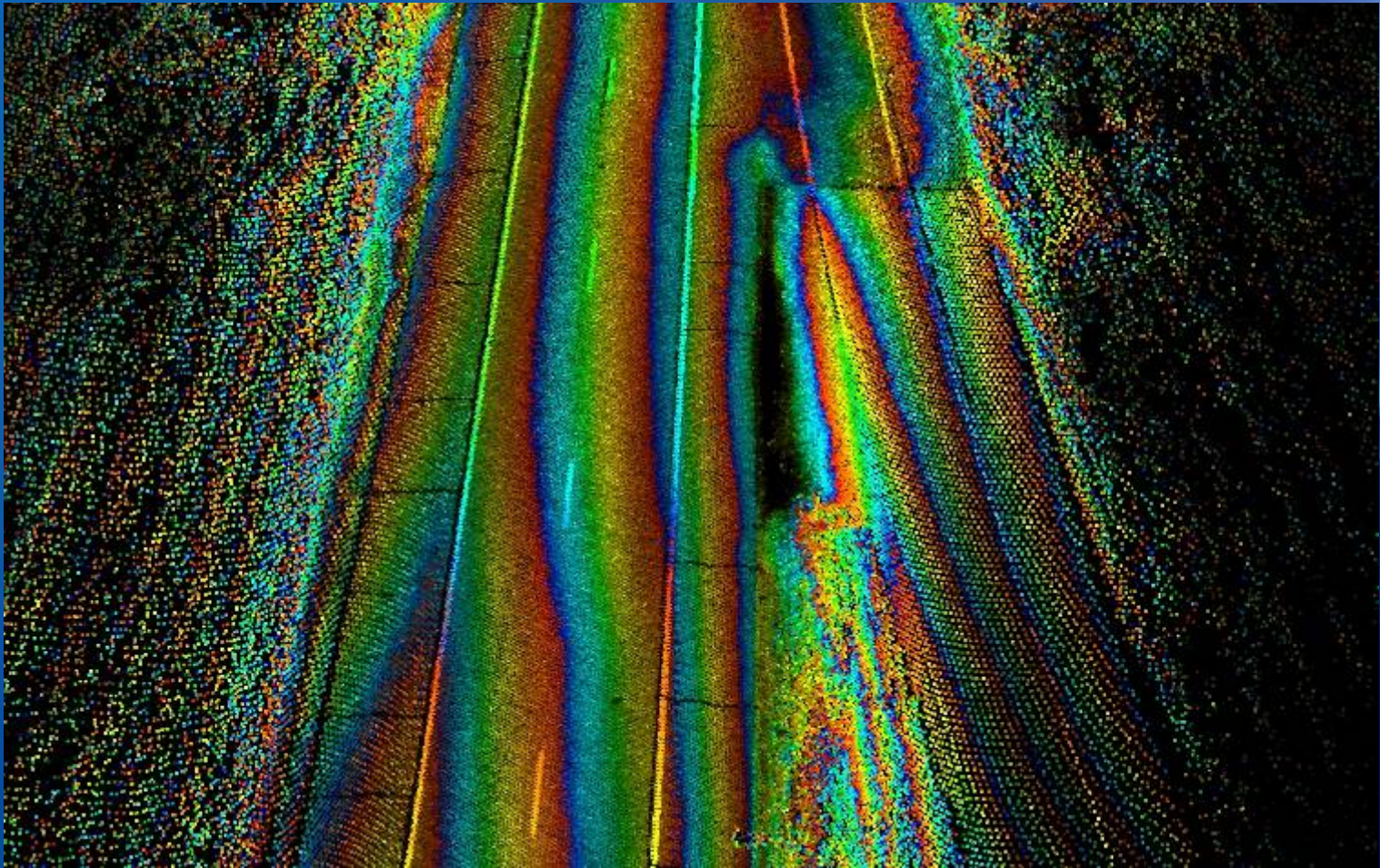
D/FW Connector



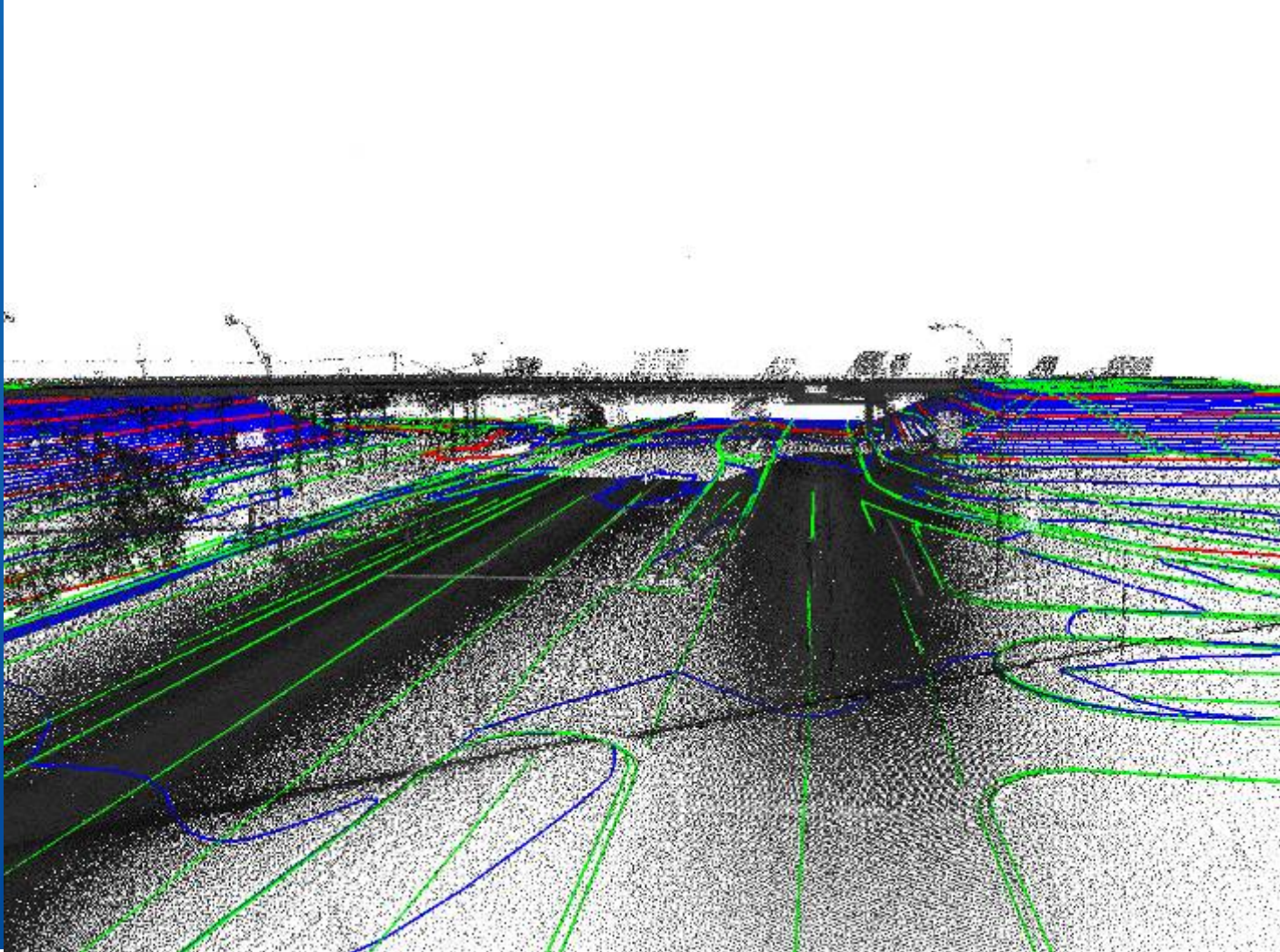
D/FW Connector



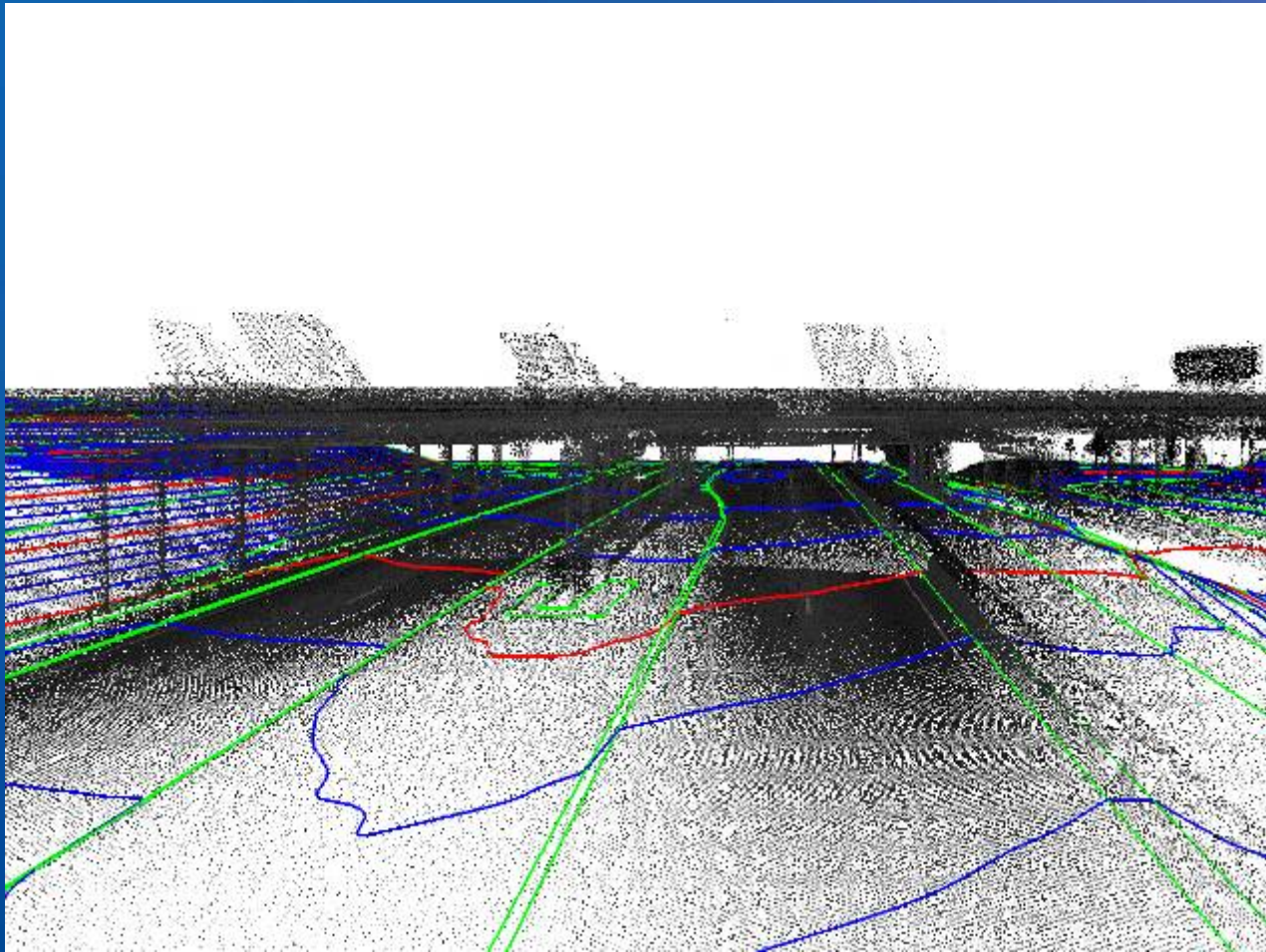
D/FW Connector



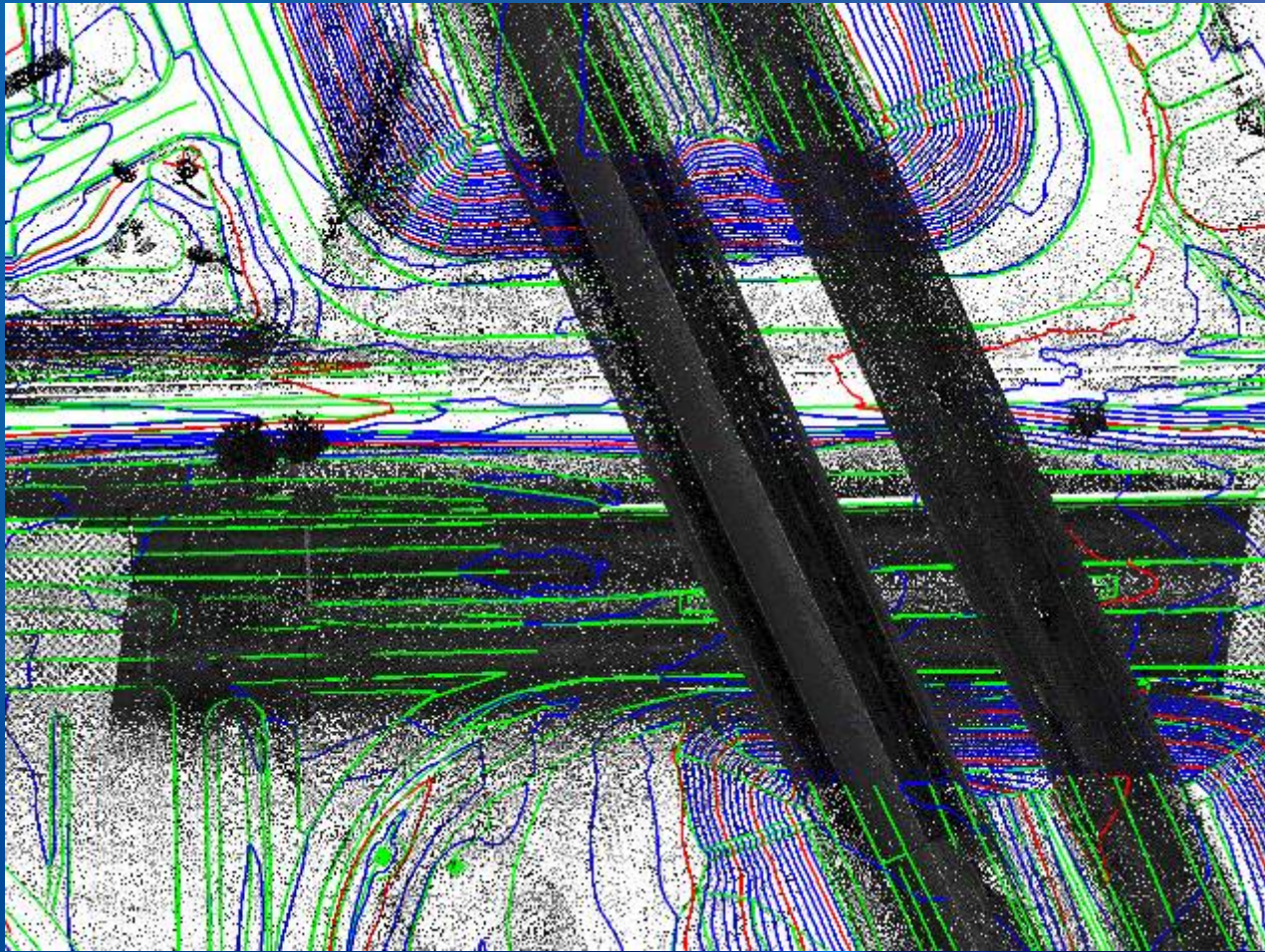
D/FW Connector



D/FW Connector



D/FW Connector



Conclusions

- Mobile LiDAR is a perfect complement to existing methods
- Fits uniquely between Aerial Missions and Terrestrial Acquisition
- Balance between Speed, Accuracy, and Safety

